

**Thailand's National Report on the State of Conservation of
its World Heritage Property Inscribed on the World Heritage List
Dong Phrayayen - Khao Yai Forest Complex (Thailand) (N590)**

This report addresses the issues and concerns raised as per the World Heritage Committee's Decision 37COM7B.15.

1. Wildlife corridors and 4-lane widening constructions on Highway 304

1.1 Rationale for the designs

Highway 304 strategically connects the Northeastern region of Thailand to the Central and Eastern regions and plays a vital role in boosting major economic activities and productivities for the nation. There are two sections of the Highway 304 in the boundary of Dong Phrayayen – Khao Yai Forest Complex where wildlife corridors will be constructed along with the widening construction of the Highway. These steep and curving two-lane sections running along mountainous terrain are very dangerous, especially for the heavy-loaded trucks travelling downhill (vehicles tend to overtake by using the opposite lane). The 4-lane widening will not only improve the overall safety of the Highway sections but will also provide the opportunity to construct ecologically effective wildlife corridors.

Section km. 26+000 to km. 29+500: The wildlife corridor was designed based on an extensive study of wildlife diversity, habitats and travelling activities. This has enabled the mapping of the concentration of wildlife crossing locations in the national parks. The combination of elevated highway and eco-duct design was chosen among five alternative designs taking into account the engineering, economic, and environmental aspects (see **Annex 1-1**). In addition, there will be construction of crossing structures allowing small mammals and amphibians to cross under the highway at various locations.







Section km. 42+000 to km. 57+000: The appropriate wildlife crossing is situated from km. 42+600 to km. 42+930 based on an extensive wildlife study as well. The valley terrain at the wildlife crossing location is best suited for elevated road and wildlife underpass concept (see **Annex 1-2**). The design, aimed to serve both species found to be using the area (i.e. gaur, deer) and anticipated species with rehabilitated ecosystem (i.e. elephant, monkey), includes underpass with sufficient clearance for large animals and an arboreal bridge. There will also be crossing structures for small mammals and amphibians underneath the highway at various locations.

1.2 Timeline

The tentative timeline of the wildlife corridors and 4-lane widening constructions on Highway 304 is presented in the chart below. This planned schedule is for both sections of the Highway. The wildlife corridor construction is included in the engineering design of the widening project. The environmental management plan (EMP) is comprised of myriads of impact mitigation measures, mitigation action plans and monitoring plans covering pre-construction phase,

construction phase and 20 years into operation phase. Specific action plans focusing on wildlife and plant ecology and the effectiveness of the corridor will be implemented at different times specific to the context of each plan and will be discussed in the following section.

The EIA for section km.26+000 to km.29+500 has already passed the first approval step of Expert Committee (2-step approval) on 7 May 2013 and awaits the consideration of the National Environment Board (2nd of the 2-step approval), after which it will then be considered by the Cabinet. As for the EIA of section km. 42+000 to km.57+000, the EIA is at the first approval step of Expert Committee consideration. The Department of Highways is firmly committed to implement the project as soon as possible.

Actions	2014	2015	2016	2017	...
EIA approval					
Budget request and approval					
Procurement					
Construction					
EMP implementation					20 yr
Environmental monitoring					20 yr

1.3 Environmental measures

The environmental impact assessment of the two proposed constructed sections documents the existing conditions, expected impacts from pre-construction, construction, and operation phases, corresponding mitigation measures and monitoring plans. Detailed action plans include time of implementation, responsible agencies, and estimated budgets. With all environmental factors considered in the EIA, only the mitigation action plans targeting at wildlife and plant ecology to ensure long-term safeguard and effectiveness of the wildlife corridors are highlighted here:

Reforestation: For km. 26 to km. 29, the study of the 1-km zone adjacent to the Highway indicated that Thaplan National Park, comparatively to Khao Yai National Park, is less viable for wildlife habitat especially in dry season. Thus, 250-rai (40 ha.) along the Hin Daad Stream, 1-4 km further away from the Highway into Thaplan National Park, will be planted with non-invasive species food-source plants for wildlife of the area (see addendum of **Annex 1-1**). Additionally, 100-rai (16 ha.) decadent forest area in Thaplan National Park will also be reforested to enhance the overall ecosystem. Planting will be completed in the first year of construction by the park authority using the Department of Highways' budget. For the corridor around km.42, relocated plants within the project will be replanted over the corridor as part of the contractor's responsibility and maintained by the park authority.

Artificial salt licks and check dams: Detailed survey of the 1-km radius from the highway indicated animal tracks but water sources and salt licks along and near the planned corridors are absent. To induce movement of wildlife across the corridor, 11 and 9 artificial salt licks will be created in

Thaplan NP and Khao Yai NP, respectively. Also, 9 and 4 check dams will be constructed in Thaplan National Park and Khao Yai National Park, respectively, along the streams with seasonal flow (see addendum of **Annex 1-1**). These artificial salt licks and check dams will be created during the construction phase so that it will be readily in-use in the operation phase. The park authority will be responsible for the maintenance using the Department of Highways' budget.

Fences: To ensure wildlife crossing at the designated locations, cement-based mesh wire fence will be installed along the at-grade portion of the highway between km. 26 and km. 29. Similar fences will also be installed for the corridor around km. 42 stretching from both ends of the elevated highway to guide animals to use the corridor. The mesh wire was chosen among different designs to maximize risk reduction of animal being caught in the fence, and the cement base will deter reptiles and amphibians from crossing, using the highway, and instead cross via the structures. There will also be similar fences stretching from both ends of the km. 26 to km. 29 corridor, each running 5-km long, to limit wildlife movement to the boundary of Khao Yai National Park and Thaplan National Park (see addendum of **Annex 1-1**). The Department of Highways will be responsible for the budget and construction of these fences. The location of the 5-km fences will be decided upon consultation with stakeholders including the Department of National Park, Wildlife and Plant Conservation, park officials, and nearby residents, taking into account of the land use management plan of the forest complex.

1.4 Speed limit enforcement

While the wildlife corridor construction has not yet begun, additional road signs (see addendum of **Annex 1-1**) have been installed by the Department of Highways' Prachinburi District Office to warn drivers that they are entering World Heritage area between km. 26 and km. 29 and to beware of wildlife and refrain from making excessive noise. Moreover, the Department of Highways has installed an Intelligent Traffic System (ITS) for incident management and speed enforcement along km. 40 to km. 47. The ITS comprises microwave radar detection, real-time camera and variable message warning signs, which effectively assist the highway police in managing traffic and enforcing speed limit which helps reduce the cumulative impacts of traffic in the forest complex area.

2. The construction of Huay Samong Dam

During 1989 – 1995, the Cabinet approved the survey, design and construction on Bangpakong Watershed Development including the Huay Samong Dam, a project initiated by His Majesty the King. The said project is deemed necessary for the sustainability of the livelihood of nearby communities and the forest complex area, in terms of water conservation for agriculture and household, floods prevention and forest fire mitigation. The Royal Irrigation Department (RID), under the Ministry of Agricultural and Cooperatives,

finished its studies and submitted its report to the National Environment Board for final consideration in 2009. During 2005 – 2009, there were subsequent reviews of the EIA report, as well as the environmental impact mitigation plan of the Huay Samong Dam.

On 27th October 2009, the Cabinet approved the construction of Huay Samong Project. The project would take 9 years to complete (2010-2018).

The working area of construction is located outside the property but the boundary areas of Thap Lan National Park accounting for 186.4 hectare (ha.) and Pang Sida National Park accounting for 76.8 ha. will be flooded after the completion of the dam. The RID started construction of the dam in April, 2011.

2.1 The Prevention of Impact on the World Heritage Property

The Royal Irrigation Department has worked with all other relevant departments for the conservation of the area during both construction and operation phases of Huay Samong Dam.

● Construction Phase

Several preventive measures, as follows, have been announced against a possible impact on World Heritage area:

- 1) Setting up entrance and exit check-points both at Huay Samong construction site and at the World Heritage area. The check-points are in addition to an existing one at the reservoir area together with the patrol unit of the Thap Lan National Park who continues to patrol the area even after the National Park's revocation and the area has been granted to the Royal Irrigation Department for dam construction.
- 2) The provision of patrolling equipments together with an in-service training of patrol officers to strengthen their performance.
- 3) Setting up a barbed-wire fence showing the border line between the National Park and the area for the new settlement area.
- 4) Relocation of villagers from reservoir area helps to minimize the risk of invasion of the National Park, preventing activities such as collecting forest products, deforestation, and settlement in the World Heritage areas.
- 5) Vocational training for relocated villagers to equip them with occupational skills. Such vocational training will likely help prevent them from invading the forest complex.
- 6) The most important of all aspects is to implant in the mind of the younger generation an awareness of natural resource conservation; and to teach the villagers who are living around the target areas including the construction workers to know about Forestry Laws.

● Operation Phase

Three national park patrol units and one check-point will be established at the reservoir and in the surrounding areas to prevent any invasion through patrolling in the construction area. In addition, the Royal Irrigation

Department will officially proceed with the return of 2,458 ha. of the reservoir area to the Department of National Parks, Wildlife and Plant Conservation as part of the National Park.

2.2 The Promotion and Conservation of Outstanding Universal Value

The Royal Irrigation Department is mobilizing resources with utmost commitment to have Huay Samong Dam successfully completed, with minimal effects on the Outstanding Universal Value (OUV) of Dong Phrayayen - Khao Yai Forest Complex both wildlife and plant species as least as possible.

- The survey of the target area and its vicinity has been conducted for the second year running, on the assumption that the wildlife will be affected from the flood. The survey is focused on the number of species found in the area in order to prepare for migration and provision of new home for the wildlife when the reservoir is completed. However, the welfare of the wildlife will be monitored continuously even after the completion of the reservoir.

- Since the area around the reservoir has been planted with eucalyptus trees, it is therefore necessary to restore the environmental system along the edge of the World Heritage area by planting local trees such as eaglewood, Siamese rosewood, *Hopea odorata*, as well as providing artificial salt lick, building check dams to increase damp and moisture to the area.

- Regarding the release of fish species, the alien fish species will not be released into the reservoir area. The Department of Fisheries has currently undertaken and followed up with an inspection of water environment and fish species. After the completion of Fishery Conservation Centre, breeding of local fish will be conducted and released into local natural water sources for the conservation of local-fish breeding ground in the area.

2.3 Progress of Project Construction

At present, 17.316 % of the dam has been completed with the delay rate of 7.803 % from original plan. According to the plan, dam construction will be completed in July 2016 while irrigation system construction will commence in Fiscal Year 2014 -2017. During Huay Samong dam construction, the Construction Office 7 of the Royal Irrigation Department, the responsible agency for the project construction, has announced and posted information on notice boards at the office and labour camps to inform their construction labours and concerned staff to strictly follow the rules and regulation. Details are as follows:

- Encroachment into the World Heritage property is prohibited, except in the area approved for reservoir construction;

- Forest products and wildlife hunting are prohibited, as well as other activities that can affect or harm wildlife in the World Heritage property;
- Wood cutting, clearance or burning is prohibited in the World Heritage property as specified in the regulations and laws of the National Parks Act B.E. 2504 (1961 A.D.)

These notice boards are posted in visible locations in front of the project. The consultant firms were also encouraged to inform their contractors that workers are strictly not allowed to encroach the national park area for wood cutting and wildlife hunting strictly.

2.4 Summary of Operation in accordance with the Environmental Impact Mitigation Plan (EIMP) in the Fiscal Year 2013

EIMP is set to be undertaken in a 15-year period (Fiscal Year 2012-2029) with the total budget of 516.59 million baht. There are 47 work plans in total which cover construction phase and operation phase. Concerned agencies are mainly the Department of National Parks, Wildlife and Plant Conservation, Thap Lan National Park, Pang Sida National Park, the Office of Conservation Area Zone 1 Administration (Prachinburi), Prachinburi Office of Natural Resources and Environment, the Royal Forest Department, the Royal Irrigation Department and the Office of Natural Resources and Environmental Policy and Planning (ONEP).

The Fiscal Year 2013 was the second year that the Royal Irrigation Department followed up the EIMP. The total budget of 46.42 million baht was allocated to relevant agencies. This includes 13 work plans related to World Heritage as detailed in **Annex 2**.

2.4.1 Work plans for environmental impact in project construction phase:

From a total of 27 work plans undertaken in 2013, thirteen plans were related to the World Heritage properties as follows:

- Work plan for public relations on the Huay Samong Project: activities such as trainings, workshop seminars on “Water Resources Development”, training courses for youth groups to make them better understand irrigation and environmental conservation.;
- Work plan for survey and distribution of compensation for land and property: land compensation and removal costs was 100 % paid while 75 % of the compensated people have already moved out and the rest are preparing to move to their new places;
- Work plan for prevention and reforestation in the surrounding area of reservoir: responsible agencies are the Department of National Parks, Wildlife and Plant Conservation and Prachinburi Office of Natural Resources and Environment. Activities undertaken include

reforestation, watershed ecosystem improvement, wet firebreaks, and trainings on natural resources and environmental conservation and rehabilitation;

- Work plan for wildlife migration and conservation: the Department of National Parks, Wildlife and Plant Conservation has continued surveying four groups of wildlife around the reservoir area in order to prepare an evacuation plan and to accommodate migrated wildlife after water storage commencement;

- Work plan for declaration of reservoir area as national park: the Royal Irrigation Department is appointing a committee for the consideration of returning the reservoir area to the World Heritage properties (Dong Phrayayen – Khao Yai) under control of the Department of National Parks, Wildlife and Plant Conservation. The area of the Huay Samong Project will later be declared as national park;

- Work plan for announcement of conservation area zone: the Royal Irrigation Department and the Royal Forest Department have set up a plan for rehabilitation of forest in the conservation area and propose to the Department of National Parks, Wildlife and Plant Conservation to be protected areas;

- Work plan for the prevention of encroachment on reservoir area and forest rehabilitation in the World Heritage areas in Thap Lan and Pang Sida National Parks: activities that have been undertaken include reforestation, plantation of animal food plants, watershed preservation and rehabilitation activities.;

- Work plan for setting up a new protection patrol unit of Thap Lan and Pang Sida National Parks: the unit is under construction while personnel and equipment are being provided. Patrols have been undertaken to guard the World Heritage properties;

2.4.2 Environmental Monitoring Plans: In parallel with environmental mitigation plans, environmental monitoring plans consisting of 20 plans, of which 3 plans relating to World Heritage property have been carried out as follows:

- Work plan for monitoring the prevention of encroachment in reservoir and forest area, and reforestation: the Royal Forest Department serves as the responsible agency for the area surrounding the Huay Samong Project which is a national reserve forest and agricultural land reform area. Check-points for forest encroachment and wildlife hunting prevention have been set up as well as patrols in the buffer zone of the World Heritage properties and national parks;

- Work plan for monitoring the results of Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans: this plan is being undertaken by the Office of Project Management, the Royal Irrigation Department. Activities under the work plan include monitoring the implementation of each agency according to EIMP, providing suggestions for

improvement of the plan, summarizing monitoring reports of EIMP implementation twice a year and submitting to the Office of Natural Resources and Environmental Policy and Planning and the World Heritage Centre. Other activities include collecting of data and evaluation of results of EIMP, analysis of forecasted impacts and submitting the results to the National Environment Board and the Sub-committee for Environmental Impact Mitigation.

2.5 Summary of operation in accordance with the Environmental Impact Mitigation Plan (EIMP) in the Fiscal Year 2014

Budget allocation of the fiscal year 2014 in an amount of 40 million baht has been approved by the Government to cover the operation in accordance with the EIMP under the Huay Samong Dam Project in Prachinburi Province, totalling 21 work plans, of which 13 of these work plans are related to the World Heritage property. The Royal Irrigation Department has already released the allocation of the fund to the relevant agencies accordingly.

2.6 Conclusion

Since the Royal Irrigation Department commenced the construction of Huay Samong Project in 2011, the department has strictly undertaken all environmental mitigation and monitoring plans with other concerned agencies. As a result, the area surrounding the project in national parks, the World Heritage property and forest conservation area are free from any encroachment. Forest rehabilitation has been intensively implemented by reforestation and check dam construction. Therefore, the Environmental Impact Mitigation Measures and Environmental Impact Monitoring Plans which have been undertaken at present are effective plans that will help highlight the OUV of the Dong Phrayayen – Khao Yai World Heritage property.

3. Land encroachment and law enforcement

The Department of National Parks, Wildlife and Plant Conservation has adopted measures for protection and solving problems on land encroachment upon Dong Phrayayen-KhaoYai Forest Complex as follows:

3.1 Close monitoring of the level of encroachment

The Department of National Parks, Wildlife and Plant Conservation has assigned authorities under the Natural World Heritage office and the National Park Office to monitor land use in Dong Phrayayen-KhaoYai Forest Complex and undertake detailed mapping of the encroachments which is expected to be finished in 2014. However, at this stage, a number of clarifications should be made as follows:

- 1) The monitoring of the change in land use in Dong Phrayayen – Khao Yai Forest Complex is being conducted by interpretation of LANDSAT satellite images of 2003 and 2011.

The results of 2003 revealed that Dong Phrayayen- Khao Yai Forest Complex covered a forest area of 528,729 ha. and 86,771 ha. of non-forest area comprising agricultural land, communities, water supplies and others. In 2011 it was discovered that a total forest area of 539,685 ha. while non-forest area comprising agricultural land, communities, water supplies and others was reduced to 75,815 ha. Based on the results of the analysis, the forest area increased from 85.90 to 87.70 per cent in such period. Moreover, the results of the analysis in each area found that forest area in all sites increased especially in Pangsida and Khao Yai National Parks where forest areas exceed 90 per cent of total area. For Thap Lan National Park, although there exists large communities in the area but the forest area still increased from 76 to 77.20 per cent.

2) The results of the survey found that the problems of illegal land encroachment for private accommodation and resorts construction occurred within the land area specified by the Cabinet Resolution on 30th June 1998 which is within the boundary of the World Heritage property. At the same time, the Department of National Parks, Wildlife and Plant Conservation continues to implement various measures to prevent new land encroachment outside the specified land area in the World Heritage property. Currently, there are 435 land encroachments cases pending court decisions: 313 cases in Wang Nam Khieo District, 10 cases in Serng Sang District and 17 cases in Konburi District in Nakorn Ratchasima province and 95 cases in Na Dee District in Prachinburi province. A total of 361 cases involve land encroachments for private accommodation and resorts construction and the rest involve land encroachments for agricultural purposes.

As regards the World Heritage Committee's recommendation for Thailand to submit a request for boundary modification to exclude encroached areas that do not contribute to the OUV of the World Heritage property as outlined in the *Operational Guidelines*, such a request for boundary modification will be submitted to the World Heritage Centre as soon as the issue of land ownership over these areas is resolved.

3.2 Strengthening enforcement measures

All the protected areas in the Dong Phrayayen – Khao Yai Forest Complex have full-time resident staff, including superintendents and permanent staff for each area. There are 80 ranger stations located in and around the complex. Basic management capacity of these ranger stations is at a level deemed sufficient and adequate by regional and international standards. The protection of natural resources and environment as well as the suppression of illegal are some of the routine work conducted by each ranger station.

The Department of National Parks, Wildlife and Plant Conservation utilizes the Smart Patrol techniques in its patrol practices within all protected areas to strengthen its efficiency to curb illegal activities. Rangers are trained to use technology including GPS as a tool for data collection during their patrol. All information collected in each patrol are examined to determine hot

spots of illegal activities so to ensure that such activities will be eliminated or suppressed effectively. Furthermore, the patrolling on all protected areas in the World Heritage property is conducted in a systematic way, as a network to protect the core area of the property from various threats.

The illegal logging that occurs in the Dong Phrayayen-Khao Yai Forest Complex World Heritage is of Siamese Rosewood (*Dalbergia cochinchinensis*) especially in Thap Lan National Park and Ta Phraya National Park where the highest arrest cases are found. As the illegal logging mostly takes place along the Thai-Cambodian border, the bilateral cooperation is required in order to promote cooperative efforts in monitoring the border areas and sharing information on illegal activities. The international prevention measure along Thai-Cambodian border is to seek political commitment at policy level and cooperation on the ground between the two countries. On 8 May 2013, the Vice Minister for Foreign Affairs led a bilateral meeting with the Cambodian side on "the joint patrol for the prevention of illegal logging along the border" at the Poipet Immigration Office, Banteay Meanchey, the Kingdom of Cambodia. Both parties agreed to establish a Joint National Committee responsible for the prevention of illegal logging of Siamese Rosewood. The Joint Provincial Committee was also established within the framework of the Joint National Committee in order to implement policies and conduct patrolling in areas of responsibility as well as being coordination agency along the border areas.

The Department of National Parks, Wildlife and Plant Conservation has developed specific work plan for the protection of Siamese Rosewood and other natural resources in the area and suppression of illegal logging with budget allocation under related work plan/projects to its implementing agencies. The concerned agencies in the Dong Phrayayen-Khao Yai Forest Complex World Heritage site continue to work with the army, police, administration agencies and local forest protection units. They have also implemented a number of preventive measures in the Dong Phrayayen-Khao Yai Forest Complex World Heritage as follows:

- Integration of task force among concerned agencies namely Royal Forest Department, Royal Thai Army, Border Patrolling Police to take action regularly in the areas;
- Implementation of conservation measures or public awareness programme to local residents;
- Creation of an inventory of Siamese Rosewood in Pang Sida National Park ;
- Installation of notification signs indicating boundary of Ta Phraya National Park in both Thai and Cambodian languages along the Thai-Cambodian border;
- Installation of public relations signs along the boundary of Dong Phrayayen-Khao Yai Forest Complex World Heritage;
- Launch of public relations programmes in communities, schools and radio stations; and

- Arrangement of training courses for enhancing effectiveness in law enforcement for forest rangers in cooperation with the Royal Thai Army, Royal Thai Navy and Royal Thai Police in providing experienced and knowledgeable resource persons for the training course.

4. Working with the local communities in the surrounding area

Several methods are being utilized to work with the local communities in Dong Phrayayen – Khao Yai Forest Complex.

4.1 A “Protected Area Committee - (PAC)” was formed as a consultative body to the superintendent to assist in gaining acceptance from the local communities for the management of the property. In previous occasions, PAC of all protected areas attended the workshop to evaluate the management of Dong Phrayayen – Khao Yai Forest Complex in the revision of the management plan.

4.2 Communication with local communities through public relations campaign is being conducted regularly.

4.3 Learning centres for conservation of natural resources and environment have been established inside the property.

4.4 Educational programmes on knowledge and conservation of natural resources and environment in many schools surrounding the property have been established.

4.5 Programmes on career and income support for surrounding communities have been established.

4.6 Financial assistance from private sectors in the forest plantation for conservation and restoration of natural resources and environment have been provided.

5. Reduction of illegal grazing of livestock

The statistical report revealed that grazing of livestock in World Heritage area has decreased. The number of livestock owners fell from 29 to 10 and number of livestock fell from 673 to 253. All livestock owners are villagers from nearby communities with their own livestock, and do not represent commercial agricultural companies. The procedure to curb illegal grazing comprises the following steps:

5.1 surveying the type and number of livestock;

5.2 disseminating information to the public regarding enforcement of the removal of livestock stables located around the forest area;

5.3 specifying a limited zone for grazing;

5.4 removal of livestock out of the property; and

5.5 taking necessary legal measures as a last resort.

All the above steps and measures have been worked out in collaboration and close consultation with the local communities which led to a continuous reduction of illegal livestock grazing in the property.

6. Extending the property

At present, two plans exist for further expansion of the Dong Phrayayen – Khao Yai Forest Complex.

6.1 Project on adding other protected areas as buffer zones of the World Heritage property in 2017, consisting of:

(1) Khao Pang Ma Non-hunting Area covering 800 ha (expected to be finished in 2015);

(2) Lam Nang Rong Non-hunting Area covering 1,344 ha (expected to be finished in 2015);

(3) Jed Kod – Pong Kon Sao Center of Nature Education and Ecotourism covering 2,776 ha;

(4) Forest plantation (whose concession will expire in 2014) covering 2,400 ha;

(5) Kang Koi Non-hunting Area covering 5,503.36 ha;

(6) Sakaerat Environmental Research Station and the Biosphere Reserve covering 7,808 ha;

(7) Khao Phu Luang Center of Conservative tourism covering 27,200 ha;

(8) Nakorn Nayok Wildlife Conservation Promotion and Development Station covering 763.68 ha; and

(9) Khao E-to Forest Park covering 2,174.88 ha.

These expansion projects will be submitted for approval by The Department of National Parks, Wildlife and Plant Conservation, the National Committee on the Convention for the Protection of the World Cultural and Natural Heritage of Thailand, and the Cabinet respectively. Only when these steps are completed, then the boundary modification request will be officially submitted to the World Heritage Centre in accordance with the relevant procedures as outlined in the *Operational Guidelines*.

6.2 Project on adding nearby areas to the national parks and wildlife sanctuaries to be included in the expanded World Heritage property

This consists of areas that have been classified as being significant and outstanding ecosystems, namely:

(1) The concession-expired forest plantation covering 2,726.56 ha. will be added into Dong Yai Wildlife Sanctuary (expected to be finished in 2015).

(2) The areas of Khun Darn Prakarnchon Dam covering 166.795 . will be added into Khao Yai National Park (expected to be finished in 2015).

(3) The areas of the national reserved forest covering 6,416 ha. will be added into Pang Sida National Park (expected to be finished in 2015).

These proposed areas must be approved by the National Committee on National Parks and the National Committee on Wildlife Reservation and Protection before it will be taken for consideration of the National Committee on the

Convention for the Protection of the World Cultural and Natural Heritage of Thailand, and the Cabinet respectively. Then, the boundary modification will be officially submitted in accordance with the relevant procedures as outlined in the *Operational Guidelines*.

7. Management Plan of Dong Phrayayen – Khao Yai Forest Complex World Heritage Site.

The Department of National Parks, Wildlife and Plant Conservation recently revised the management plan of the Dong Phrayayen – Khao Yai Forest Complex use since 2006 with up-to-date information containing present which has been in threats and challenges. The review of the management plan was conducted in the workshop among the Department of National Parks, Wildlife and Plant Conservation officers, NGOs, stakeholders and local communities. The new version of Dong Phrayayen – Khao Yai Forest Complex management plan will be used for 5 years during 2013 – 2017. Having its outstanding values at the national, regional and global level, this management plan also aims to maintain the outstanding universal value of the property. All concerns from the World Heritage Committee and present threats were taken into account in the preparation of the new management plan which contains the following 6 main aspects:

- 7.1 Boundary Demarcation and Area Management;
- 7.2 Qualitative Management of Natural Resources;
- 7.3 Enhancement of Management Efficiency;
- 7.4 Participation in Management;
- 7.5 Source of education of World Heritage matters;
- 7.6 International Cooperation.

This management plan was already approved by the National World Heritage Committee. Its English version will be submitted to the World Heritage Centre as soon as it becomes available.

8. Zoning of the property

The property has undergone zoning measures for the effectiveness of administration and operation control in accordance with appropriate principles and transparency. The Dong Phrayayen – Khao Yai Forest Complex has been categorized into 6 zones.

8.1 Intensive Use Zone comprises the headquarters and ranger stations as well as accommodation, visitor centre, food centre, Kong Kaew youth camp, Suraswadee youth camp, camping grounds at Pha Kluai Mai and Lam Takong, Protection Station 4 (Klong Pla Kang) of Khao Yai National Park; the areas of headquarter, Protection Station 2 (Lam Plai Mas), Protection Station 13 (Suan Hom), Protection Station 11 (Thai Samakki) of Thap Lan National Park; the areas of headquarter, visitor centre, accommodation, Protection Station 8 (Ra Bo Hoo Kwang/Pra Prong) of Pang Sida National Park;

the areas of headquarter, Protection Station 4 (Klang Dong) of Ta Phraya National Park.

8.2 Outdoor Recreation Zone includes the areas of Heaw Suwat Waterfall, Heaw Narok Waterfall, Heaw Nokkok, Thap Lan Reservoir, Pang Sida Waterfall, Pha Takien Waterfall, Suan Man-Suan Thong Waterfall, Marn Tara Waterfall, Kaew Maka group of waterfalls, Jedi Mountain, viewpoint at km25, Yak Hill, Saladdai forest, viewpoint at Banthat Range, viewpoint of Pha Dang, Lalu, Lalerng Roi Roo Forest Protection Unit at Dong Yai Wildlife Sanctuary, etc.

8.3 Primitive Zone includes the areas of primitive forest covers which are not identified with other groups such as Maka Valley, Huai Yang Watershed Area and Kang Yai Mark which is one of the conserved sites of Thailand.

8.4 Recovery Zone includes the degraded areas in the southern part of Khao Yai National Park, the eastern side of Highway 304 covering the joint area of Pak Thongchai District of Nakorn Ratchasima and Nadi District of Prachinburi, the northern area of Thap Lan National Park in Kornburi District and Serng Sang District of Nakorn Ratchasima, Khao Talai in Pang Sida National Park. This zone is preferable for restoration of natural resources due to the previous land modification.

8.5 Strict Natural Reserve includes the areas of Bung Pai, Klong Ethao, Khao Lhaem, salt licks and savanna in Khao Yai National Park; the middle part of Thap Lan National Park which serves as the important habitat for wild elephants (*Elephas maximus*); the habitat area of guars (*Bos gaurus*) in Ta Phraya National Park and the habitat area of wild elephants in Dong Yai Wildlife Sanctuary.

8.6 Special Use Zone includes the Radar Station at Khao Kiew Summit in Khao Yai National Park, the joint area between Khao Yai National Park and Thap Lan National Park which is allocated for special use such as land reformation for agriculture and forest villages, as well as the Royal Initiative Project in Thap Lan National Park, Chong Klam Bon Reservoir, Ta Krabark Reservoir, Phra Pong Reservoir, Military Camp, Chong Klam Bon Wildlife Breeding Station, the Provincial Electric Authority in Pang Sida National Park, the Border Patrol Police in Ta Phraya National Park as well as the area in Thap Lan National Park which is presently undergoing judicial process to prove land ownership.

However, the mentioned zoning is categorized by each protected areas. Measures for maintaining its core area comprise limitation of access to the core area with no modification of the core area. For instance, by closing road number 3436 which cuts through the core areas of Thap Lan National Park and Pang Sida National Park (connecting transportation from Sa Kaew Province with Nakorn Ratchasima Province) enables the protection of the huge inner area between two national parks. Two national park protection stations (or ranger station) are established in both national parks and work together to strengthen their capacities in the SMART PATROL system in this core area as well as other areas.

9. Sister Park Arrangement

The Department of National Parks, Wildlife and Plant Conservation recently initiated a Sister Park Programme to enhance capacity and experience of Thai national park officers with its partner in exchange of research and management practices of national parks as well as natural resources. With approximately ten targeted national parks, Khao Yai National Park was selected as a pilot site in this programme. On 20 September 2013, the superintendent of Khao Yai National Park signed the Sister Park Arrangement with the superintendent of the Great Smoky Mountains National Park, USA. This arrangement was initiated by the decision of the 35th session of the World Heritage Committee that encouraged the States Parties of Thailand and the United States of America to consider the sister-parks proposal as an opportunity to explore capacity building initiatives in support of management of the Dong Phrayayen – Khao Yai Forest Complex.

10. World Ranger Day Anniversary

In order to honour and pay tributes to the important duties of forest rangers in natural resources and environmental protection at protected area especially in the world heritage sites namely Tung Yai–Huay Kha Khaeng Wildlife Sanctuary and Dongphayayen–Khao Yai Forest Complex , the Department of National Parks, Wildlife and Plant Conservation cooperated with its partners that worked in forest conservation namely IUCN, Freeland foundation and Khao Yai Protected Foundation to hold celebrations to mark the world ranger day anniversary on 21 June 2013 at Pang Sida National Park. The anniversary was presided by the Minister of Natural Resources and Environment to commemorate the 3 rangers who lost their lives and 4 rangers who were injured during their tour of duty to protect the properties. The Department of National Parks, Wildlife and Plant Conservation and relevant partners namely the Forest Protected Volunteer, Khao Yai Protected Foundation, Sueb Nakasatian Foundation, RFD Cooperative and Injured Ranger of the Department of National Parks, Wildlife and Plant Conservation Fund donated an amount of 1,990,000 Baht for 89 rangers nationwide. In addition, the families of those rangers who lost their lives were provided with scholarships for the education of their children.

ANNEX 1
ANNEXES FOR WILDLIFE CORRIDOR
PROJECTS ON HIGHWAY 304

**Supporting document for state of conservation report for
Dong Phrayayen - Khao Yai Forest complex, 2014**

ANNEX 1-1

EXECUTIVE SUMMARY REPORT

ENVIRONMENTAL IMPACT ASSESSMENT

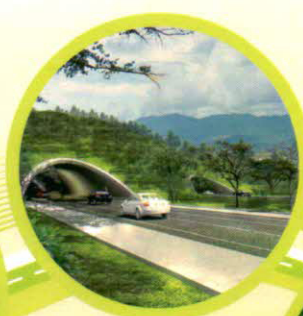
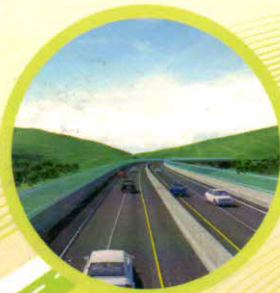
**WILDLIFE CORRIDOR AND ROAD WIDENING
PROJECT ON HIGHWAY NO.304 (SECTION KM.26-29)
KABINBURI DISTRICT – PAKTHONGCHAI DISTRICT**



DEPARTMENT OF HIGHWAYS

ENVIRONMENTAL IMPACT ASSESSMENT

WILDLIFE CORRIDOR AND ROAD WIDENING PROJECT ON HIGHWAY No. 304 (SECTION Km. 26–29) KABINBURI DISTRICT–PAKTHONGCHAI DISTRICT



Prepared by
TEAM Consulting Engineering and Management Co., Ltd.

August 2012

**ENVIRONMENTAL IMPACT ASSESSMENT OF WILDLIFE CORRIDOR AND ROAD WIDENING
PROJECT ON HIGHWAY NO.304 KABINBURI DISTRICT-PAKTHONGCHAI DISTRICT**

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<p style="text-align: center;">ENVIRONMENTAL IMPACT ASSESSMENT OF WILDLIFE CORRIDOR AND ROAD WIDENING PROJECT ON HIGHWAY NO.304 KABINBURI DISTRICT-PAKTHONGCHAI DISTRICT</p>

1. INTRODUCTION

1.1 Importance and Background of the Project

Dong Phrayayen-Khaoyai forest complex has been certified and put in the inventory of the natural world heritage site according to the 29th meeting of The World Heritage Committee in South Africa 2005. This is due to the dominance of the place which is fit in criteria no. 10 as being important habitat and meaningful for rare types of fauna and flora together with the bio-diversity that should be preserved. Its current area is about 3.5 million rai, comprising 5 sites of protected areas. They are Khaoyai National Park, Tublan National Park, Pangsida National Park, Taphraya National Park and Dong Yai Wildlife Sanctuary. The areas cover some parts of Saraburi, Nakhonratchasima, Prachinburi, Sakaeo and Buriram provinces. The eastern part is adjacent to Banteay Chmor, the protected area in Cambodia.

The World Heritage Committee has suggested Thailand to establish the corridor of Khaoyai – Tublan forest complex. This is one of suggestions, being consistent with the expert group of The International Union for Conservation of Nature (IUCN) who identified important issues about the problem of national highway no. 304 which separates Khaoyai – Tublan forest complex. Hence it is necessary to establish the wildlife corridor in order to increase bio-diversity and protect wildlife from car accident.

The highway No.304 is a main network that links the journey and transportation between the northeastern and eastern regions of Thailand. It is a main route to transport goods from the northeastern region to Laem Chabang port and the eastern seaboard. The current traffic situation is rather congested, with high accident occurrence. With well recognition of this problem together with the necessity of expansion the traffic lanes to support traffic volume and economic growth, the Department of Highways has plan to expand the 2 traffic lanes to be 4 traffic lanes phase 2. This followed the cabinet resolution, dated on January 10th, 1995. Later the resolution on June 22nd, 2004 had approved the Department of Highways to expand this highway. This is also in line with the strategy of the provincial cluster of Nakhonratchasima, Chaiyaphum, Buriram and Surin, to develop the integrated highway network.

In order to achieve the objective to maintain valuations of Dong Phrayayen-Khaoyai forest complex to be the treasure of the nation and worldwide, it is necessary to study the linkage of forest complex eco-system. Proper design is required for the crossway to link the wildlife corridor in order to lower the impact on wildlife so that they are able to cross the road between km 26-29. This would be consistent with suggestions of The International Union for Conservation of Nature (IUCN) expert group as mentioned earlier.

The Department of Highways has responsibility for the Detailed Engineering Design on wildlife corridor at the forest complex site of world heritage on the national highway no. 304, Kabinburi - Pakthongchai between km 26-29. So, the department had employed the consultant consortium which comprises TEAM Consulting and Management Co., Ltd, ASDECON Corporation Co., Ltd, Geotechnical & Foundation Engineering Co., Ltd. and Daoreuk Communications Co., Ltd to conduct the study, survey and design the wildlife corridor on the national highway no. 304 together with expansion of the traffic lane. Representatives of Department of National Parks, Wildlife and Plant Conservation, Office of Natural Resources and Environmental Policy and the Planning and National Committee on the Protection of the World Heritage Convention also participated and considered this project.

1.2 Objectives of the Project

The project objective is mainly to link this forest complex, to expand the national highway for the security on transportation and to maintain valuations of Dong Phrayayen-Khao Yai forest complex to be the treasure of the nation and worldwide. The benefit to be generated comprises:

- (1) To maintain the way of life of wildlife, including to conserve bio-diversity of the eco-system in parallel to sustainable development.
- (2) To support an increase of traffic volume in the future, aiming at the convenient and safety of road users who will travel on the highway no. 304.
- (3) To be knowledge base of wildlife corridor or wildlife crossing, and can be applied for the other highways which pass through the protected area.

1.3 Objectives of Environmental Impact Assessment

(1) To assess the environmental impact caused by activities related to the project development on environmental resources and the impacts of the environment on the project. Consideration will be on major issues; i.e. short-term impact or temporary impact during pre-construction and construction periods, long-term impact during operation period or utilization of resources which cannot be rehabilitated to the original condition.

(2) To recommend the preventive, mitigation and monitoring measures for environment, including action plan on environmental impacts management. This will increase the positive impact or project benefits while reduce negative impact to environment around the project. Preventive and mitigation measures related to engineering aspect will be identified in the project detailed design. Managerial environmental mitigation measures will be attached to the construction contract as condition to be implemented by construction contractors. Moreover it will be the guideline for the responsible agencies during operation period.

2. FIVE ALTERNATIVES FOR WILDLIFE CORRIDOR AT THE WORLD HERITAGE FOREST COMPLEX AND NATIONAL HIGHWAY EXPANSION

(1) Alternative 1: Highway Tunnel

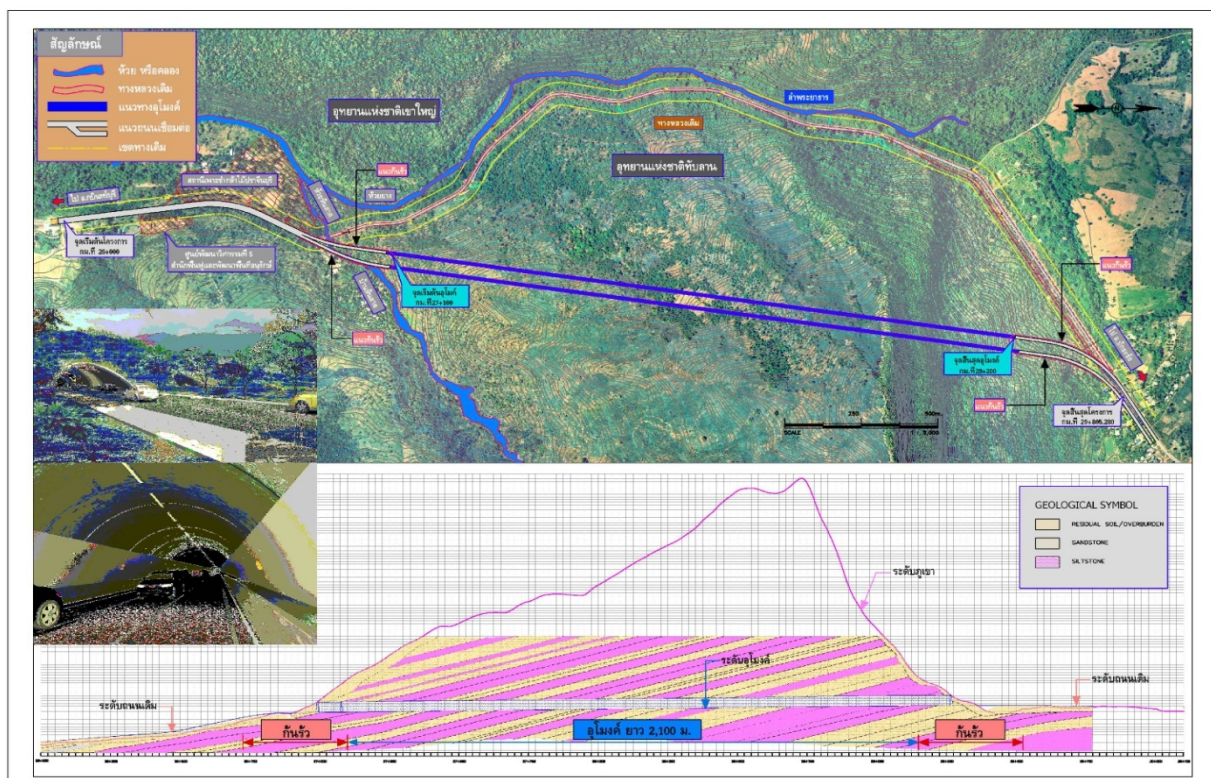


Figure 2-1: Highway Tunnel

(2) Alternative 2: Elevated Highway

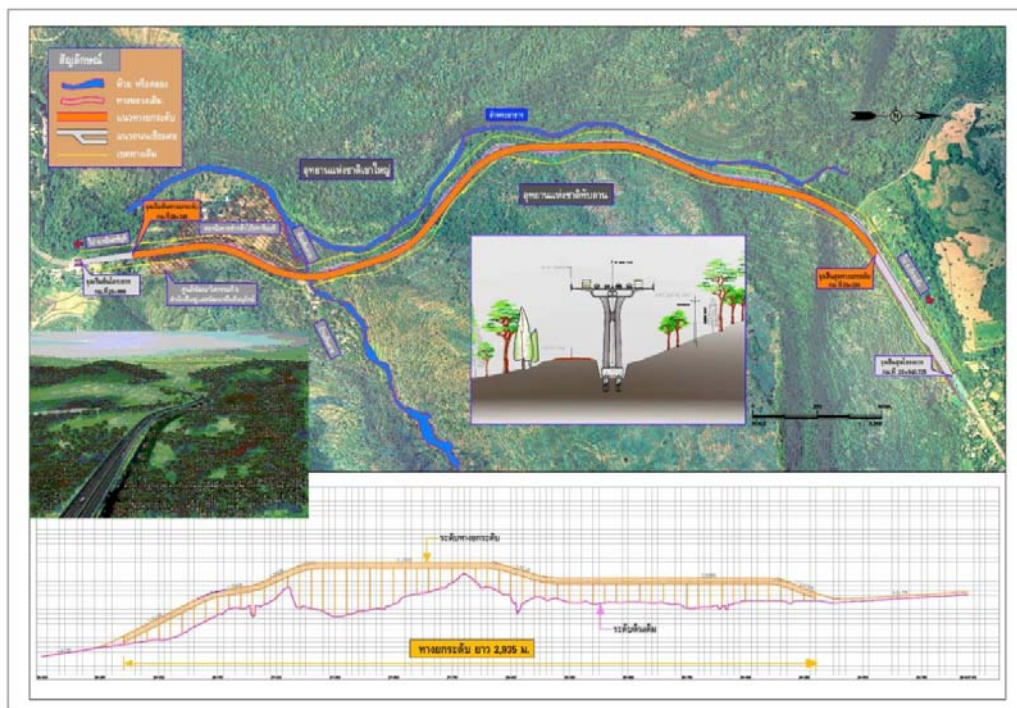


Figure 2-2 : Elevated Highway

(3) Alternative 3: Shallow Tunnel

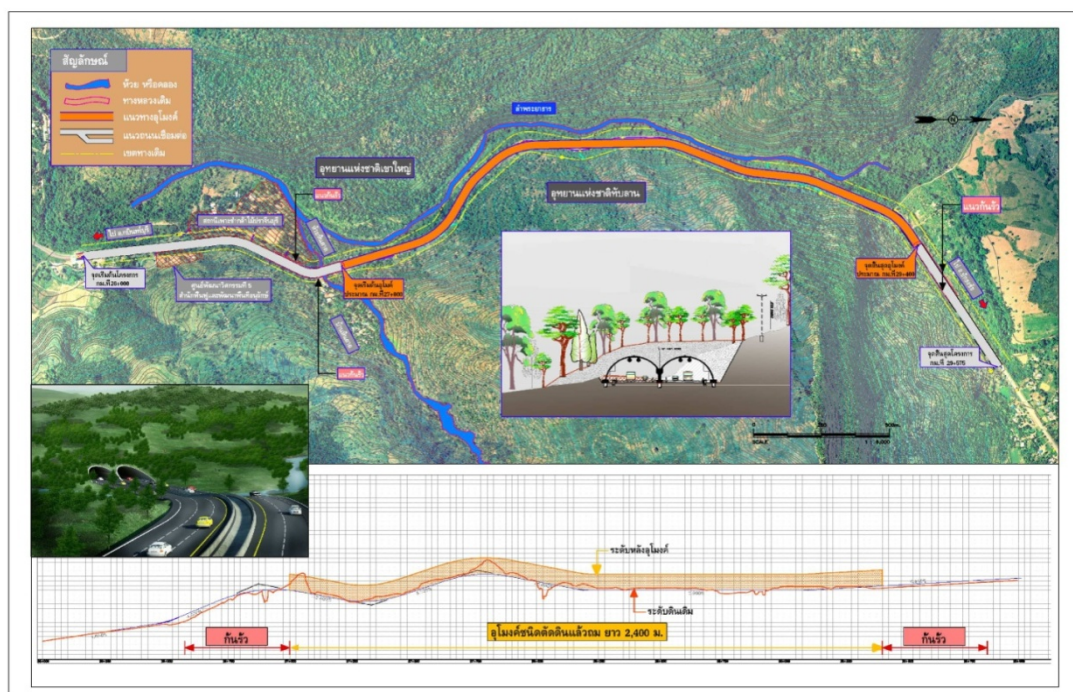


Figure 2-3 : Shallow Tunnel

(4) **Alternative 4: Combined Wildlife Corridor**

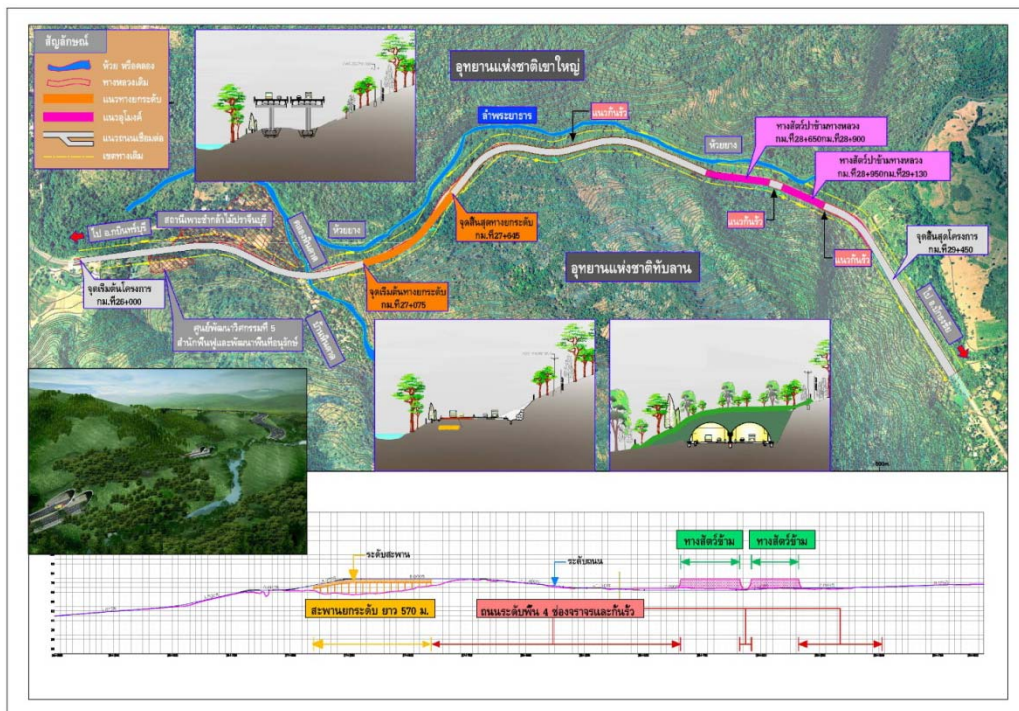


Figure 2-4: Combined Wildlife Corridor

(3) **Alternative 5: Wildlife Crossing/Ecoduct at Specific Sites**

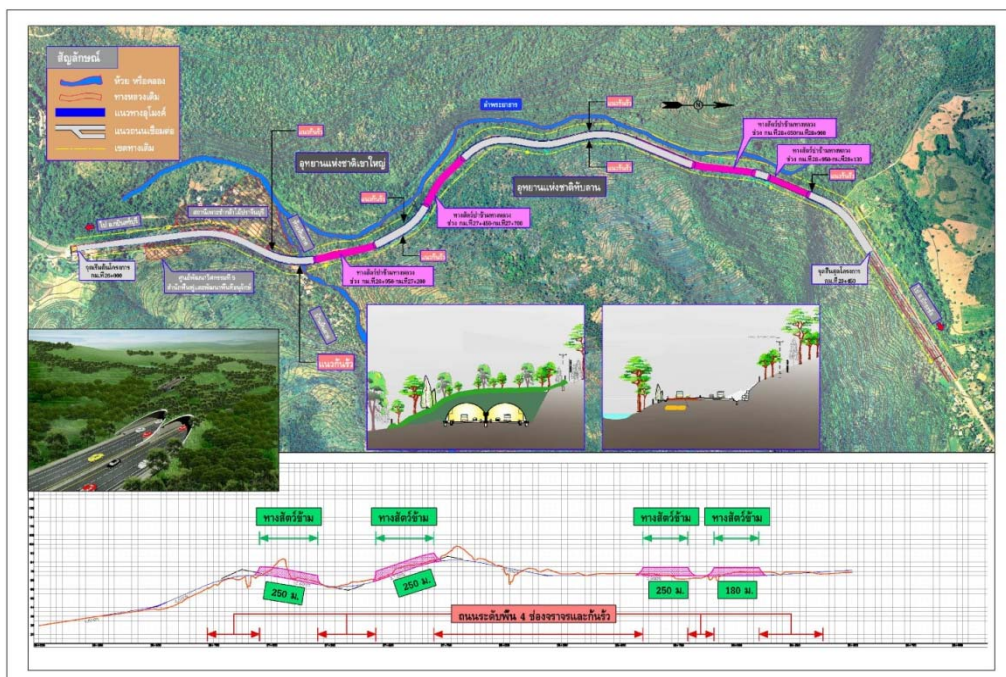








Figure 2-5 : Wildlife Crossing/Ecoduct at Specific Sites

Advantage and disadvantage of each alternative is summarized in **Table 2-1**.

Table 2-1
Summary of Advantages and Disadvantages of Each Alternative of Wildlife Corridor between km.26-29

Alternative Pattern	Engineering, Economic and investment aspect					Safety aspect		Environmental Impact		Measure on Wildlife Corridor			Timing (year)			Alternatives consideration	
	Construction Cost* (million ฿)	Length (km)	Physical Feature	Impact on Traffic during Construction	Maintenance/ Operating Cost	Safety to Car User	Rescue Operation	During Construction	During Operation	Concept	Response to Linkage of Forst Complex	Other Measures	Detailed/Design + Request for Permission (yr)	Construction (yr)	Total (yr)	Advantages	Disadvantages
1. Highway Tunnel 	5,300	3.2 (At-grade road 1.1 Highway Tunnel 2.1)	Excelient	Very low	High	Low	Difficult	High	Low	Wildlife over pass	Excelient	Not necessary (Regular monitoring by Department of National parks wildlife and plant conservation)	1 yr (DD)+2 yr (waive)	3.0	6.0	Fully return forest complex / shorten journey distance / not necessary to have monitoring measures.	Costly / problems of dumping site for soil and rock during mountain excavation / impact on non-air conditioned vehicles such as motorcycle and travelling on foot / risky of crime while difficulty of rescue / require revocation of national park.
2. Elevated Highway 	3,750	3.4 (At grade road 0.46 Elevated Highway 2.94)	Good	Moderate	Low	High	Moderate	Moderate	Low	Wildlife under pass	Very good	Not necessary (Regular monitoring by Department of National parks wildlife and plant conservation)	0.50	2.0	2.5	Fully return forest complex / require some monitoring measures.	There will be visual incompatibility with environment impact on wildlife and geology condition during construction / impact on passers-by who go on foot during operation period / timeframe and construction cost will be high, as varied to an increase of spacing
3. Shallow Tunnel 	3,450	3.4 (At-grade road 1.0 Shallow Tunnel 2.4)	Poor	Highest	High	Low	Difficult	Highest	High	Wildlife over pass	Very good	High (Forest rehabilitation measures and landscaping, will be monitored and evaluated by Department of National Parks, Wildlife and Plant Conservation)	2 yr. (waive)	2.0	4.0	Fully return forest complex / lower cost than highway tunnel.	Require many measures for forest rehabilitation on the top of tunnels/during construction period, there will be land excavation in the large forest area which may require revocation of national park/ impact on non-air conditioned vehicles such as motorcycle and travelling on foot / risky of crime and difficulty of rescue.
4. Combined Wildlife Corridor  	1,300	3.4 (At-grade road 2.4 Elevated highway 0.57 Shallow Tunnels 0.25, 0.18)	Moderate	High	Low	Moderate	Moderate	Moderate	Moderate	Wildlife overpass and underpass the highway. There will be tunnels for small wildlife and raptiles under at-grade road sections.	Good	Moderate (measures of Monitoring, evaluation and surveillance for hunting prevention)	0.50	1.5	2.0	Not costly budget required / pattern is designed in accordance with topography	Impact on passers-by who go on foot, requires other measures; e.g. installation of fence along at-grade road sections or underpass for small wildlife and monitoring.
5. Wildlife Crossing / Ecoduct at specific sites 	1,600	3.4 (At-grade road 2.47 Shallow Tunnels 0.25, 0.25 and 0.18)	Moderate	Low	Low	High	Easy	Low	Low	Wildlife overpass and underpass the highway. There will be tunnels for small wildlife and reptiles under the at-grade road sections	Moderate	High (measures of monitoring, evaluation and surveillance for hunting prevention)	0.50	1.0	1.5	Small budget required, with rapid completion of the project	Necessary to have monitoring measures and incentive for wildlife to get across, including other measures such as installation of fence along at-grade road sections or underpass for small wildlife.

* adjust according to inflation rate and increased minimum labour wage

3. SUITABLE ALTERNATIVE FOR THE PROJECT DEVELOPMENT

According to the comparison among 5 alternative patterns which are based on criteria of engineering, economic-financial, natural resources and environment including social aspects, the most suitable one is alternative 4 which is the combination between elevated highway and wildlife crossing (ecoduct). Reasons are:

(1) Consistency with Results of the Study on Wildlife Ecology

The project had conducted the study of wildlife ecology along both sides of the highway, comprising Khao Yai and Tub Lan National Parks, in the rainy and dry seasons. The results indicated the clue of wildlife, along the entire route where the 2 national parks are situated. In the dry season, it was found that gaur came very close to the highway, within 170 meter distance. The large wildlife such as guar, bear, barking deer, wild deer and mountain goat were in the area, mostly found at km 26+500 -27+300 and 27+900 - 28+900. It is obvious shown that the wildlife in both national parks had come to the highway, but within particular places. Hence it is suitable to choose the pattern of combined wildlife corridor. Furthermore, this pattern can reduce the death of wildlife from car accident on the project route. Steel fencing on the road at the ground level will prevent wildlife coming to the highway.

(2) Consistency with Results of the Study on Forest Ecology

According to results of the project study in the context of forest ecology, the majority of forest complex in Khao Yai National Park is dry evergreen forest and mixed deciduous forest while grass land, secondary forest, forest plantation and mixed deciduous forest are found at Tub Lan National Park at km 27+800 - 29+300. Vegetations found along both sides is low density in comparison to vegetations exist deeper in both national parks. In conclusion, structure of both forests along the highway has significant plant society of dry evergreen forest and mixed deciduous forest. As the connecting parts of both national parks are between km 27+700 - 28+100 and km 28+500 onwards, alternative 4 which is combined wildlife corridor with wildlife crossing at specific places is the most suitable one.

(3) Minimize limitations of Utilization of Road Users

According to the survey and collection of basic data, activities related to utilization on ordinary highway are diverse, including traveling on foot. There are various types of vehicle passing the project area. The journey type is combination between long distance journey and local journey. In case alternative 4 is selected, its structure will be combined wildlife corridor with construction of wildlife crossing at specific places in form of cut and cover tunnels. Landscape at

the top level of tunnel will be consistent with the landscape of these two forest sites. This will encourage wildlife to use the crossings while not affecting to the road users.

(4) Maximum and Effective Utilization from the Advantage of the Project Topography

As alternative 4 is combined wildlife crossing, the engineering design is based on geographic feature and wildlife habitats. Beyond Huay Hindard, the road slightly slopes down from the valley before sloping up again. Hence the design structure is elevated highway or bridge so that the wildlife can cross underneath. Besides, there will be at-grade sections where topographical features allow. As the area is rather plain at the end of the project route, the wildlife crossing is then designed over depressed section of the highway.

(5) Consistency with the Needs of the People in Project Area and Concerned People

Public participation was conducted 5 times in Pracinburi province and Bangkok, during December 2008 – December 2009. This comprises meeting with target groups to provide the project information, project orientation, seminar on open view for learning, meeting for feedback on technical comments, 1st focus group meeting, 2nd focus group meeting to propose criteria for selection of alternatives and the meeting on conclusion of results of the detailed design study. It was found that majority of the people, especially villagers at Huay Hindard (Ban Pachampi community) and representatives of Department of National Parks, Wildlife and Plant Conservation agreed with alternative pattern4; combined wildlife crossing. The reasons are the least impacts on way of life of the people living in the project area and alleviation of problems of car accidents to wildlife due to installation of fence along the road at the ground level to prevent wildlife coming to the highway. Moreover there is a design of passage channel for Reptiles and small wildlife along at-grade sections of the project alignment.

Summary of the Project Description

Project	Wildlife Corridor and road widening on Highway No.304 Kabinburi District-Pakthongchai District
Starting point of the Project	Linking with existing four-lane highway at km 26+000, at national park boundary, in front of Engineering Development Center 5, Office of the Rehabilitation and Development of Protected Areas, Tungpho sub-district, Nadi district, Prachinburi province
Ending point of the Project	Merging with existing four-lane highway at km 29+500, at national park boundary, near Kudtawan village, Bhubhram sub-district, Nadi district, Prachinburi province
Distance	3.5 kilometers
Situation of existing route	The existing route is asphaltic paved, aligning along the mountain shoulder, as a corridor between Khao Yai and Tub Lan National Parks. The western part is situated along Lam Prayatarn stream of Khao Yai National Park. It is 2-lane highway, with 3.5 meter width of each lane. Each road shoulder is 2 meter wide. Total width of road surface is 11 meters. This enables to facilitate more than 8,000 vehicles per day in average. It is classified within standard class 1. The route width is under standard and majority of horizontal curves is under standard. The narrowest radius is 72 meters, at Hindard village. However the slope is within standard.
Existing right-of-way	Existing right-of-way of the project is about 80 meters.
Existing design speed of the highway	Existing design speed is within standard for rolling terrain. Suitable speed for the highest slope of 6% is about 80-110 km/hr. However the design speed for the minimum horizontal radius curve of 210 meters will be about 70-110 km/hr which is slightly lower than the standardization, with the aim to lower impact on the forest complex.
The design pattern of wildlife corridor for world heritage forest complex	Implementation will be on the entyre existing route of the project, with the combined wildlifes corridor pattern. This comprises one part of elevated way that the wildlife can go underneath and two parts of Shallow tunnel that wildlife can cross over, and four parts of at-grade-road.
At-grade-road	<p>The road at ground level to link between the road sections in wildlife corridor and existing 4-lane road. There will be expansion to serve traffic volume in consistency with the standard of the Department of Highways. Width of traffic lane is 3.50 meters while width of inner and outer shoulders is about 1.0-1.5 meter and 2.5-3.0 meter respectively. Total width is not less than 11.0 meter and its total distance is about 2.51 km. Implementation will be in 4 parts as follows:-</p> <ul style="list-style-type: none"> - From starting point of the project to approach of elevated highway at km 26+000 - 27+040, fence will be installed to demarcate the forest boundary with exception on the parts which there are land utilization on road sides. - From approach of elevated highway to Shallow tunnel at km 27+680 - 28+680, the fence will be installed entirely at both sides of the route. This will protect wildlife from road accident. There will be a design for small wildlife underpass as well. - Open space between 2 wildlife crossings between km 28+900 - 28+950, and - From the entry point of wildlife crossing to the end of project route at km 29+130 - 29+450, the fence will be entirely installed at both sides of the route. This will protect wildlife from the danger on road until the end of national park boundary.

Project	Wildlife Corridor and road widening on Highway No.304 Kabinburi District-Pakthongchai District
- Underpass for small wildlife	<ul style="list-style-type: none"> - Design wildlife tunnel along entire at-grade road sections so that small wildlife and amphibians can use. There will be 2 types of tunnels: - Tunnel for amphibians will be constructed with concrete. Its entry will be a square shape of 0.5 x 0.5 meter size, with total distance of 24.6 meters. Tunnel environment will be arranged with proper moisture in order to encourage amphibians to use. - Tunnel for small wildlife will be constructed with concrete. Its entry will be a rectangle shape of 2.1 x 2.6 meter size, with total distance of 24.6 meters. Both sides will be covered by dirt in order to encourage small wildlife to use.
- Pattern of Elevated Highway	<ul style="list-style-type: none"> - Structure of elevated highway will be for wildlife to go underpass at southern part of the project alignment, between km 27+075 – 27+645. Its total distance is 570 meter, with an average height of 8-10 meters while its peak is 13.5 meters from ground level. The elevated highway will start after Huay Hindard, across the valley to join the existing road on the hill which is the highest point of the project road route - The elevated highway will be 12.00 meters wide, with 2 traffic lanes in each direction which can be adjusted to be 3 traffic lanes in each direction in the future. The span between piers of elevated way is 28-30 meters. This width will be sufficient for target groups of wildlife in this area to go through (e.g. barking deer and wild deer). Landscape under elevated way, especially around the piers will be adjusted to be in harmony with surrounding area. - Construction in the project area will be conducted only at foundation and column to support bridge beam. The slab of bridge beam will be made by reinforced concrete which is ready pre-casted. After installation, concrete will be used to fix with the bridge slab. Link slab of the bridge will reduce loud noise and stumbling during driving.
- Shallow Tunnel	<ul style="list-style-type: none"> - The structure of the shallow tunnels for wildlife crossing over the highway at km 28+650 – 28+900 and km 28+950 – 29+130 is about 430 meters long. Its position is near the northern boundary of the national park. The road level will be lowered before construction of tunnel wall and then, the tunnel will be covered with dug earth. Landscape will be arranged to be in harmony with forest complex at both sides. - The tunnel foundation will be 14.30 meters wide and 8.80 meters high to support 2 traffic lanes in each direction. This can be expanded to be 3 traffic lanes in the future. The footpath is 1.80 meter wide. Space above traffic lane will be 2.80 meters, serving for facility system installation such as ventilation fan. - Construction of tunnel structure in the project area will be conducted only at foundation. This will support the tunnel wall which is ready pre-casted in parts. There will be 2 pieces of curve structure. Size and weight of each piece will be small for the convenience in transportation. After installation, concrete will be used to fix the foundation. This will reduce the impact on traffic during construction. There will be sufficient longitudinal ventilation system for exhaust from vehicles.

Project	Wildlife Corridor and road widening on Highway No.304 Kabinburi District-Pakthongchai District
Drainage system	<p>- According to the survey on the project route, there are 8 drainage structures. These comprise 5 round culverts, 2 box culverts and one bridge. Details of improved structure are:</p> <p>Bridge structure at km 26+900 is still in good condition. The traffic surface is above flood level. The design and improvement of the bridge will be removal of the existing structure and construct the new bridge with geometric feature being consistent with at-grade road in accordance with the standard of Department of Highways.</p> <p>As all round culverts along the project route are still in good condition with effective drainage, improvement will be considered on an increase of culverts' length to support the expansion of traffic surface. 2 additional round culverts will be put at km 28+550 and km 28+926.</p> <p>Box culverts are still in good condition with effective drainage, as well as the round culvert. However the design will be on increasing the length of culvert at km 29+140 at both sides of the road, to support the expansion of traffic surface.</p>
Service road for community	<p>- A road will be designed to service the community, at km 26+618.75. The starting point will be on the left side before curving underpass the project route to the right side. The ending point will be at Huay Hindard community (at Ban Pachampi area - km 26+882.938). Its total distance will be 335 meter, functioning as entry-exit, u-turn and access of Huay Hindard community (Ban Pachampi area). The road will be paved, with 3.50 meter width.</p>
Electricity and ventilation system	<p>For convenience and safety on utilization of highway and facilitating the rescue in case of accident, detailed design on facility system has covered:</p> <ul style="list-style-type: none"> - At-grade road: Install single arm and double arms lighting poles and High Pressure Sodium: HPS lamp, with about 30 meter interval. - Elevated Highway: In order to reduce light problem to disturb the wildlife, the design will specify to limit the light at traffic surface only. Flat beam lighting with 70 watt capacity will be installed at bridge rail, with 12-15 meter interval. - Install water & dust proof type of lighting, with 1 x 400 watt capacity inside the Shallow tunnel Light adjustment must be designed at the entry area, with an increase of density to regular level in the tunnel. This aims at safety of drivers. - Ventilation system in the tunnel must be designed with 2 sets of regular and emergency levels. There must be detection system for pollution level in order to command the operating system.
The Project Investment Cost	
- Project construction cost	914,983,806 Baht
- Project maintenance cost	186,077,780 Baht
Environmental management cost	294,307,313 Baht
Total	1,395,368,899 Baht
Construction period of the project	18 month
Discount rate	12%
Project analysis period	20 year

Project	Wildlife Corridor and road widening on Highway No.304 Kabinburi District-Pakthongchai District
The study of Environmental Economic	Economic value of the loss on 32.31 rai of forest resources is equivalent to 5,023,267.40 Baht/year. Evaluation of present value for entire project life (divided into 3 years of pre-construction and construction periods and 20 years of operation period) is equivalent to 163,299,901.10 Baht. Based on 10% discount rate, its value is equivalent to 161,666,911 Baht.
Economic Return	
Net Present Value (NPV)	-19.53 million Baht
Economic Internal Rate of Return (EIRR)	11.73%
Benefit Cost ratio (B/C ratio)	0.98

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1. Physical Environmental Resources 1.1 Topography	<p><i>Pre-construction and construction periods</i></p> <p>Shallow tunnel</p> <p>Construction areas of 2 Shallow tunnels are at high slope, downwards to Phrayatarn stream which is about 20-35 meters from the project area. Hence it is risky to be impacted by the slide of soil layer. When it is in combination with soil leaching during heavy rain, soil sediment will be accumulated in Phrayatarn stream which flows in parallel to the project route. However activities during pre-construction and construction periods are undertaken within a short period and short distance. So it is expected that the impact will be at medium level.</p>	<p><u>Detailed Design</u></p> <p><u>Specific Measures</u></p> <ul style="list-style-type: none"> - The design for construction of Shallow tunnel at km 28+650 - 28+900 and 28+950 - 29+130 has been adjusted to the maximum slope of 4% for entire length of tunnels, the same as the road at ground level. Tunnel structure is designed to be 11.33 meter deep. Covered layer is not higher than 2.5 meters. This will be consistent with the slope level and well-harmonized with forest complex, along both sides of the road. <p><u>General Measures</u></p> <ul style="list-style-type: none"> - Limit cutting woods and clearing/grading area for construction of road embankment and Shallow tunnel, sloping of soil cut and cover will be within construction area and the original right-of-way only. The contractor must install the sign showing clear demarcation of construction area and route zone, along both sides of the road. 	

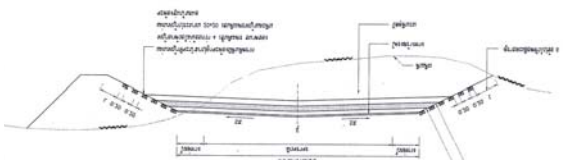
4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.2 Soil resources	<p><i>Pre-construction and construction periods</i></p> <p><u>Impact on soil structure</u></p> <p>Activities which cause general impacts on soil resources are digging and land excavation together with rock explosion, with the amounts of 124,270 cu.m. and 12,860 cu.m. respectively. Hence the amount of 111,370 cu.m. of soil and rock resources with engineering suitability are required for covering on the top of tunnel in order to adjust the area. This implementation cause some changes on soil structure. The impact will be at the moderate level.</p> <p><u>Impact on soil erosion and land slide</u></p> <p>Activities of cutting trees/removal of tree stumps/grading and clearance of vegetations or weeds at boundary the project route must be undertaken during pre-construction period. During construction period, land excavation at some parts of the foot of mountain and covering later will lower the geomorphology stability and may cause land slide at</p>	<p>Protection at back slope of earth cut and rock cut for 2 sites of Shallow tunnels:</p> <ul style="list-style-type: none"> - Specify to adjust the earth cut to be 1:1 while 1:1.5 for earth cut at the level of not deeper than 5 meters. The ratio of back slope adjustment of rock cut is specified as 1:2 for the thickness of soft rock not greater than 5 meters. At area 5 hard rock layer not greater than 15 meters, the ratio of slope adjustment for is specified as 1:4. When the tunnels' construction and cover are nearly completed, cover crops must be planted immediately in order to prevent soil erosion and land slide. - There will be 2 design patterns for 2 types of toll slope i.e.: Adjustment of cover soil to slope level at 1:1 ratio would be for an area at km 28+650 - 28+700 (only left side) and km 28+950 - 29+050 (only left side). Normal soil cover with slope adjustment of 1:2 ratio would be for the area of km 28+650 - 28+700 (only right side), km 28+700 - 28+900 (both sides), km 28+950 - 29+050 (only right side) and km 29+050 - 29+130 (both sides). 	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.2 Soil resources (cont'd)	<p>this area, especially in the rainy season. However implementation will be within short period with short distance, about 190-250 meters each. Then it is expected that impact on soil falling, soil erosion and land slide is at the moderate level.</p> <p>At-grade road</p> <p>Four sites of construction at ground level will be held at the area with soil series found at upland area. The risk of surface soil leaching here is at the moderate to severity level. Hence impact caused by mentioned activities on soil erosion and land slide is at the moderate to high level. The highest probability of soil erosion and land slide caused by implementation during pre-construction and construction periods at both sides of the road is equivalent to 5,546.76 tonnes/ year. This will increase from existing situation (without project of 284.56 tonnes/year) about 1,849.24 %. Loss of soil at the highest severity level (loss rate of about 20 tonnes/year/rai) will be found mostly of the route, equivalent to 63.82 % of total soil loss area,</p>	<p>The tunnel structure type of Geosynthetic Reinforcement is designed for the toll slope area in order to prevent soil erosion. This will be suitable for toll the slope of 6-12 height. The mixture of large pieces of rock (not larger 0.30 meter diameter size) and coarse sand will be used for foundation base which is about 0.5 meter thick, before covering by compacting to be steps. Each step will be 0.50 meter thick. Geosynthetic reinforcement will be strengthened by the use of polymer which has more flexibility. This can tolerate pressure for construction activities.</p> <div> </div> <p>Example of Geosynthetic Reinforcement type structure</p>	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.2 Soil Resources (Cont'd)	This will be followed by soil loss at severity level (loss rate of about 5-15 tonnes/year/rai), equivalent to 19.39 % of total soil loss area and area with soil loss at high severity level (loss rate of about 15-20 tonnes / year / rai), equivalent to 16.79 %% of total soil loss area along the project route.	<p>Geosynthetic structure will be used at each compact soil layer, with the length of 1.50 each before topping up surface area by mixture of soil and fertilizer. This will be topped over by 2.5 x 2.5 size of steel screen. Vetiver grass will be planted at the space of the screen.</p> <p>Vetiver grass is specified to be planted as cover crop at the right of way of 4 sites of the at-grade road; i.e. km 26+000 – 27+040, km 27+680 – 28+680, km 28+900 – 28+950 and km 29+130 – 29+450. Planting will be within strip sodding pattern.</p>  <p>Strip Sodding pattern of vetiver grass, planted as cover crop at 4 sites of right of way on the road at ground level.</p>	

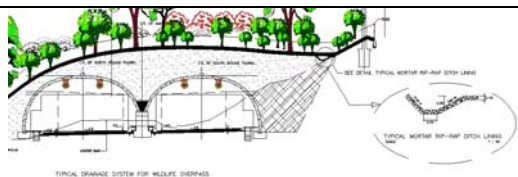
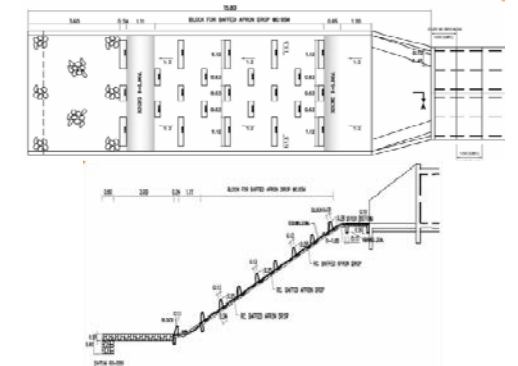
4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.3 Surface water hydrology	<p><i>Pre-construction and construction periods</i></p> <p>Land excavation or rock explosion are essential to conduct at the 2 sites of Shallow tunnel in order to have depth level of tunnel as designed. So there will be probability of falling of soil and rock residues or leaching of soil sediment to Lam Prayatarn stream (Huay Yang). This will decrease width of the stream and obstruct the stream flow. Activities related to improvement / expansion of drainage pipe and expansion of bridge span at Ban Pachampi area (km 26+900) where surface water flows across 1 site of project area at Ban Hindard may need to block waterway temporarily during construction. This will also obstruct the stream flow.</p> <p>Other activities such as construction of elevated highway structure and expansion of traffic lanes of at-grade road would require site preparation for construction of elevated foundation, land excavation, grading, dirt pile from land excavation and land filling including grading and compacting. These will cause huge sediment at this area. In case of rain or</p>	<p><i>Detailed Design</i></p> <ul style="list-style-type: none"> - Impact on surface water hydrology is mostly from soil erosion and land slide, especially at steep slope of road embankment and toll slope of 2 Shallow tunnels In order to prevent this impact, implementation has to follow preventive and mitigation measures for soil resources impact, which is already designed to prevent soil erosion at steep slope of road embankment and toll slope of Shallow tunnels structure. - Specify an improvement of drainage structure along the project route; i.e. an increase of size and number of drainage pipe, to be able to collect the rain water of 50 year return period. There will be a design to increase the length of existing culverts. This comprises increase length of round culvert at 3 sites (km 26+462, km 28+060 and km 28+402), 	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.3 Surface water hydrology (Cont'd)	<p>implementation in the rainy season (between mid May - mid October), there will be leaching, falling or flowing of soil particles to surface water source nearby. Since the water source is not so deep, it may be shallow or the water flow will be obstructed. However these activities will be implemented within short period and from place to place. Hence the impact on surface water hydrology is at the moderate level.</p>	<p>increase number of round culverts at 2 sites (km 28+550 and km 28+926), expansion of box culvert at 1 site (km 29+140) and expansion of bridge span at 1 site (bridge at Huay Hindard, km 26+900). It is expected that drainage structures along the project route would be able to collect overflowed water sufficiently, after improvement.</p> <p>The 2 shallow tunnels (km 28+650 – 28+900 and km 28+950 – 29+130) are designed for installation of drainage system with subdrain type along entire tunnel. Since the soil at the top of tunnel is not so stable, drainage and water collection are required. Due to newly structure of soil and rock, there is not much of friction and adhesion of soil particles. Thus it is essential to have the ditch to collect water from the upper part and drain to lower part. Hence the design of drainage system is specified as mortar rip-rap ditch lining type, with the size of 0.5 x 0.5 meter width and 0.5 meter depth, slope adjustment of 1:1 ratio through baffled structure in order to reduce the strength of water current.</p>	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.3 Surface Water Hydrology (cont'd)		 <p>Structure of Mortar Rip-rap Ditch Lining for slope at 2 sites of Shallow Tunnel</p>  <p>Pattern of Buffled Structure</p> <p>- Expansion of bridge span across Huay Hindard (km 26+900) at Ban Pachampi area is designed with no foundation construction in the water. This aims to prevent obstruction of water flow.</p>	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.3 Surface Water Hydrology (cont'd)		<p><i>Pre-construction and construction periods</i></p> <p><u>Specific Measures</u></p> <ul style="list-style-type: none"> - Prohibit to pile up residues of soil or rock at construction area. They should be placed at specific area, at km 20. Top soil and sub soil must be separated, following the same measures for soil resources. - Construction of bridge at Haüy Hindard (km 26+900) must be completed quickly, and undertaken in the dry season. - In case construction of the bridge across Huay Hindard causes accumulation of soil sediment or residues of construction materials, dredging must be undertaken quickly. - Establish soil protection at the stream bank area of bridge expansion at Ban Huay Hindard, by construction of compacted dike, with the size of 1 meter width, 0.5 meter height at both sides of stream banks. This aims to prevent soil erosion to water sources. Cover crops must be planted at the bank slope immediately after construction completed. - Temporary drainage system must be constructed at the top and inside of 2 sites of shallow tunnels. Water pump must be prepared sufficiently in order to control drainage during raining. 	

**4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND
MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)**

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.3 Surface Water Hydrology (cont'd)		<ul style="list-style-type: none"> - Construct the structure system to prevent soil erosion at sloping area of road embankment and toll slope of Shallow tunnels. following preventive and mitigation measures for soil resources, starting from detailed design onwards. - Construct drainage structure for elevated highway and at 2 sites of shallow tunnel as designed. Construction must be conducted immediately when the project route is nearly completed. - After completion of construction, trees must be planted in order to prevent land slide. Forage crops should be chosen for soil erosion protection, as details shown in landscape design. <p><u>General Measures</u></p> <ul style="list-style-type: none"> - Avoid construction in the rainy season. Construction period should be as short as possible in order to reduce and prevent impact on surface water hydrology and drainage in the area. - Control construction workers, not to throw garbage into the water sources. Construction materials must be collected tidily in order not to obstruct the drainage. - Construction at the area around Huay Hindard waterway must be completed quickly, and being undertaken in the dry season. 	

**4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND
MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)**

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.3 Surface Water Hydrology (cont'd)		<ul style="list-style-type: none"> - Construction activities nearby waterway / canal bank, especially land excavation at canal bank must limit area clearly, only real working area. This aims to protect bank erosion and leaching of top soil to water sources. Meanwhile, the stream bank must be renovated, to be the original condition after completion of construction. - Prohibit to block waterway. If necessary, temporary waterway / drainage channel must be established to drain water out of the area. - Check up pipe condition / drainage channel for entyre project route. In case of blockage or accumulation of soil, sand or obstructed materials, they have to be removed quickly. - Construction of road and diversion bridge must not block the natural drainage, and the drainage condition must be checked at least 24 hrs after raining. - The Department of Highways must inspect and control the contractor to place proper and sufficient drainage system. This aims to prevent inundation at construction and nearby area. - Establish flood protection plan in the construction area, by provision of temporary drainage channel and storage pond, including installation of water pump sufficiently. These will 	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
		be used for control drainage during raining.	
1.3 Surface Water Hydrology (cont'd)		<ul style="list-style-type: none"> - In case of heavy rain or sudden inundation occurs at the construction area, drainage to public waterway must be conducted quickly. Meanwhile there must be no inundation problem at community area or nearby transportation route. - Material or plant residues from dredging, including bored trees must be moved out, not placing in construction area. The contractor has to check drainage channels along the project route. They may be damaged or impacted by soil sediment during construction. The repair and dredging must be done for soil sediment /material residues in order to get drainage flow. 	
	<p>Operation period</p> <p>At the 2 sites of Shallow tunnel, there might be occurrence of soil erosion and land slide of covered soil at the top of tunnels to Lam Prayatharn stream (Huay Yang) which flows in parallel to the project route. This will cause shallowness of waterway and obstruct water flow. In case of not good management towards preventive and mitigation measures for soil erosion and land slide, the impact will be at the moderate level.</p>	<p>Operation period</p> <ul style="list-style-type: none"> - The Department of Highways must maintain culverts to be in good condition, and disposes of garbage and weed residues which might block the culverts every 3 months. The frequency will be 1 more time in the rainy season (May - October). In case sediment and weed is found in the area, removal must be done quickly in order not to block the drainage. 	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.4 Surface Water Quality	<p>Pre-construction and construction period</p> <p>Structure of elevated highway and at-grade road</p> <p>Activities probably cause an impact on surface water quality comprise site preparation for foundation of supporting piers for elevated highways , land excavation, grading, soil piling, land leveling and compacting. These will create large quantity of sediment. In case of raining or implementation in the rainy season, soil sediment will be leached to water sources and cause water turbidity.</p> <p>Shallow Tunnels</p> <p>Activities probably cause an impact on surface water quality comprise land excavation, drilling and rock explosion at the surface area in order to have the depth as designed. In case the soil is piled and transported in the rainy season (between mid May -</p>	<p>Detailed Design</p> <p>Significant impact on surface water quality will be caused by soil erosion and land slide, especially at high slope of road embankment and toll slope of Shallow tunnels. In order to prevent this impact, there must be implementation following preventive and mitigation measures for soil resources which the design is already specified to prevent soil erosion.</p> <p>Installation of permanent sediment trap of Mortar Rip-rap Catch Basin type is designed along the entyre at-grade road in order to collect leaching water, spilled fuel from accident and drained water from drainage structure of round and box culvert types. Its size will be 1 x 1 m, with 0.6 m depth. Four ponds will be installed at km 28+402, km 28+550, km 28+926 and km 29+140.</p> <p>Pre-construction and construction periods</p> <p>Specific Measures</p> <p>Construction on the road at ground level will be undertaken at 4 sites (km 26+000 - 27+040, km 27+680 - 28+680, km 28+900 - 28+950 and km 29+130 - 29+450). In order to improve and expand the traffic lane into 4 lanes, it is necessary to excavate</p>	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.4 Surface Water Quality (cont'd)	mid October), there will be an increase of suspended substances due to falling of soil and rock residues to water sources. This will lower quality of surface water sources to be unsuitable for utilization and living of aquatic organisms. Furthermore this water source is classified as Class 2. Its quality is good. However the project activities are undertaken within short period. So impact on surface water quality is at the moderated level.	land, cut and cover soil along 2 sides of the project route. This may cause leaching of soil sediment to surface water sources nearby. Therefore the contractor must install temporary sediment trap at the right side of the road where there are construction activities, after grading and clearing and before starting any other construction activities. The size of sediment trap should be 2 x 2 m with 1.5 m depth. This pond will enable to dispose about 70% of suspended substances within 5 hour duration (Dr Kriangsak Udomsinrote, B.E. 2539). The contractor will remove this sludge by truck, equipped with liquid containers which enable to prevent leaking during transportation. The disposal must be far from water sources, and agreed by Department of Highways before disposal. The six temporary sedimentation ponds will be constructed at the right side of the project route, at km 26+462 (7 m length), km 28+060 (12 m length), km 28+402 (2 m length), km 28+550 (2 m length), km 28+925 (2 m length) and km 29+140 (8 m length). Permanent sedimentation pond with Mortar Rip-rap Catch Basin type will be installed along the project route, as specified in detailed design. The contractor must install immediately	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.4 Surface Water Quality (cont'd)	<p>Elevated Highway and At-grade road:</p> <p>During operation period, impact on surface water quality will be from the traffic on highway no.304. Various pollutants such as dust from the soil, exhaust gas, spilled fuel, asbestos from wearing out of brake and clutch disc, chromium from brake, spare part and equipments coated with chromium together with heavy metals from tyre worn out can be leached by rainwater into water sources which cross the project route.</p>	<p>when the construction is nearly completed in order to collect leaching water from traffic surface and spilled fuel from accident. Drainage system must be constructed at 2 sites of Shallow tunnels. This will collect leaching water from road surface, as indicated in detailed design. The standard water treatment system will be constructed to control quality of drainage water before discharging outside, aiming to adjust water condition before discharging to natural water sources.</p> <p>Operation period</p> <p>Specific Measures</p> <ul style="list-style-type: none"> - Department of Highways must maintain erosion protection system at right of way, road embankment and toll slope of Shallow tunnels to be always in good condition. In case of damages, reparation must be in action immediately. - Maintain cover crops at the stream bank and area where is potentially eroded from road construction, to be always within protection condition, especially at the two construction sites of Shallow tunnels - Department of Highways must maintain and care for permanent sediment trap of Mortar Rip-rap Catch Basin type along at-grade road, to be always in good and functioning condition. 	


4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.4 Surface Water Quality (cont'd)	<p>Shallow Tunnels</p> <p>Covered soil at the top of tunnel structure may be leached. Then soil sediment might fall into water sources. In case of raining or the conduct of activities in the rainy season, these will cause turbidity in water sources. Besides, wastewater leaching from highway no.304 may contaminate surface water in waterway nearby the project route.</p>	<ul style="list-style-type: none"> - Department of Highways must monitor and care for wastewater treatment system regularly, once a month. - In case of emergency maintenance; i.e. reparation of embankment, its slope, and toll slope of shallow tunnels being damaged by accidents or natural disaster, implementation must be in accordance with preventive and mitigation measures for erosion and land slide during construction strictly. 	
1.5 Air Quality	<p>Pre-construction and construction periods</p> <p>Structure of Elevated Highway and At-grade road</p> <p>It is expected that dust from construction will impact on air quality at the moderate rate, especially at sensitive receptor areas i.e. Engineering Development Center 5, Office of the Rehabilitation and Development of Protected Areas, plant reproductive station and Huay Hindard community (Ban Pachampi area). They are about 20 – 50 meters from the project route. However construction activities relate to the 2 sites of Shallow tunnels are in form of precast and assembly. The majority of work is installation of electric cable system and sound absorbing materials together with detailed work. Pattern of tunnel structure may accumulate air pollution from the said activities. Therefore the operators may be impacted by air pollution such as NO_x, CO, SO₂ and dust. Hence it is</p>	<p>Pre-construction and construction periods</p> <p>Specific Measures</p> <p>Coordinate with concerned agencies in the area in order to conduct public relation regarding construction plan to local people in advance. Especially the communities and sensitive receptor areas nearby the project route such as Engineering Development Center 5, Office of the Rehabilitation and Development of Protected Areas (km 26+270), plant reproductive station (km 26+400), nursery (km 26+540 and km 26+580) and Huay Hindard (Ban Pachampi area – km 26+880).</p> <ul style="list-style-type: none"> - After completion of construction, the contractor must plant trees to trap and decrease dust quantity including any other air pollution. Special care will be at communities and sensitive receptor areas nearby the project route, as mentioned above. Suitable types of tree and planting methodology must be the same as specified in the measures. 	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.5 Air Quality (cont'd)	essential to have air pollution mask and install vacuum together with ventilation system in the tunnels in order to have sufficient ventilation during working. Its ratio should be 5 Air-change/hr. Temperature in the tunnel must be controlled to be suitable for working condition, not exceed 32° Celsius.	<p>- After completion of construction at the 2 sites of Shallow tunnels, the contractor must install ventilation system in the tunnel with not less than 3,240 cu.m./min of airflow together with sensor system to examine air quality automatically. This will control ventilation within default value of not having CO exceeding 30 ppm. (34.2 mg/cu.m.). The position of jet fan is about the middle of tunnel. Eight and six jet fans will be installed at site 1 and site 2 of Shallow tunnels respectively. The jet fans will be controlled by both of manual and automatic systems of the Programmable Logic Controller: PLC. The PLC will receive detection of sensor and control operation of jet fans under both normal and emergency conditions.</p> <p>(1) Normal condition</p> <p>Ventilation direction will be controlled by automatic system, and being consistent mostly with traffic direction. Traffic information will be used as input to fix time interval. The default value will be set in advance. Operation of jet fan will be depending on CO quantity, which will be detected by sensor. In case CO level is higher than the default, 1 set of jet fan will be operated. In case CO is still higher than the default after 5 minutes operation of the first set, one more set of jet fan will be operated. Same examination will be carried out every 5 minutes. In case the CO level is decreased and lower</p>	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.5 Air Quality (cont'd)		<p>than the default, the same amount of jet fan is still maintained, at least 30 minutes. During the daytime or congested traffic duration, ventilation must be at least 25% functioning.</p> <p>(2) Emergency condition</p> <p>When the temperature in the shallow tunnel is higher than the default due to fire in tunnel, Liner Heat Detector Controller will give a signal to the Programmable Logic Controller: PLC to control fully operation of the jet fans. Control of ventilation direction will be within automatic system. It will be consistent with the position which will be ventilated the smoke quickly.</p>  <p>Example of Ventilation System inside 2 Sites of Shallow Tunnel</p> <p>General Measures</p> <ul style="list-style-type: none"> - Control dust by spraying water at the area of land excavation, grading, access road, pile of soil and rock regularly, at least twice a day. - Trucks used to transport construction materials such as soil, sand and rock must be strong structure. Materials must be covered by either tarpaulin or plastic tightly in order to 	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.5 Air Quality (cont'd)		<p>prevent falling or dispersion of dust. Edge of tarpaulin or other cover materials must be at least 30 cm. longer than materials container.</p> <ul style="list-style-type: none"> - Specify area of concrete mixing plant to be far from communities/residential area at least 100 m. or propose to use ready mixed concrete in order to decrease and control dispersion of dust from cement, rock and sand. - Limit speed of trucks, not to exceed 30 km/hr in the project area and not to exceed 60 km/hr in the community area in order to lower dispersion of material residues or dust during transportation. - The contractor has to regularly maintain engines, machinery that use for construction in usable condition. This aims to protect the release of CO and NO₂ smoke, not to exceed the standardization of Pollution Control Department. 	
	<p>Operation period</p> <p>Impact on air quality from an increase of vehicles will be increase of pollutants. The majority are CO, HC, NO_x and particle matter which is smaller than 10 micron.</p> <p>Impact on air quality at the 2 sites of Shallow tunnels</p> <p>Due to a short distance of the tunnel, non-air conditioned vehicles and commuting on foot will be allowed to access tunnel. Non-air conditioned vehicles with the speed of 40 km/hr will spend about 22.5-22.7</p>	<p>Operation period</p> <p>Specific Measures</p> <ul style="list-style-type: none"> - Establish control building for ventilation system with safety protective equipments in case of emergency for the 2 sites of Shallow tunnels. <p>General Measures</p> <ul style="list-style-type: none"> - Traffic must be managed to be a good flow in order to lower pollutants from vehicles. - Department of Highways must coordinate with the highway police to detect vehicles which generate high pollution (black smoke). 	



4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.5 Air Quality (cont'd)	seconds. So, there will be low impact from air quality during this timeframe. With 3-3.6 minutes spending on foot, the impact from air quality in the tunnel will be at moderate level.	- Department of Highways will maintain trees to be in good growth. In case dead trees are found, replanting must be done.	
1.6 Noise	<p>Pre-construction and construction periods</p> <p>Impact will be considered based on fully operation of all machinery, about 15 meter distance and 8 working hours. The calculation will be varied to the distance of affected persons along 2 sides of the project route and sensitive receptor areas. Used equation is with reference to Roadway Construction Noise Model User's Guide; 2006 (FHWA). Findings showed that noise level from construction activities within 20 – 500 meter distance of the project route was in the range of 55.6 – 83.6decibel (A). Although construction activities are undertaken during daytime and one place at the time with mostly in forestry area, area nearby such as Bhubhram community is highly impacted sometimes.</p> <p>Assessment of noise disturbance at Bhubhram community area (about 250 meters from the project route) revealed that its level was 14.2 decibels (A) which is higher than standardization of noise disturbance level which is equivalent to 10 decibels (A). Thus noise disturbance to sensitive receptor area of Bhubhram community is at the high level.</p>	<p>Detailed Design</p> <p>Results of the study showed that there are significant factors to generate noise level along the project route. This is because current situation of the highway is crooked with high slope. So, the vehicles have to accelerate at hilly and mountainous area. Aiming to lower this impact, the project has designed to adjust the slope of the route. Hence the Longitude Profile Grade is set not over 10% in order to prevent or lower noise impact from vehicles' acceleration.</p> <p>Pre-construction and construction period</p> <ul style="list-style-type: none"> - The contractor has to install speed limit sign, not over 60 km/hr. - The contractor has to avoid transportation of construction materials or activities generated loud noise in the nighttime. - Activities generated abnormal loud noise must be operated after 8 hrs and stop before 18.00 hrs. This aims to prevent impact on nearby people. <p>(1) Control activities related to explosion, especially construction at 2 sites of Shallow tunnels where rock explosion is necessary for foundation base. Special type of explosive agent with low noise level should be used in order to lower noise and vibration impact to Bhubhram community area.</p>	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.6 Noise (Cont'd)	As the noise level of rock explosion for construction at the 2 sites of Shallow tunnels is at 72 decibels (A), its impact on sensitive receptor area of Bhubhram community is at the high level.	<p>(2) The contractor must inform affected persons such as villagers who are living at Bhubhram community area (about 250 meters from the project route) before rock explosion, by coordination with Bhubhram TAO 7 days in advance.</p> <p>(3) Limit timeframe and area of each rock explosion, by not operation at many areas in the same time. This will limit continuation of loud noise.</p> <p>(4) The contractor must provide sufficient protection and be confident that rock explosion is accurate. Nevertheless, the project engineer has specified rock explosion by Chemical Expanding Agents method.</p> <p>- Install 2 types of noise and light barrier at elevated structure (km 27+075 – 27+645). Details are:</p> <p>(1) Install Laminated Safety Glass (Reflective Type) of noise barrier which will maximize noise reflection. This will enable to lower down noise level, not less than 25 dB (A). The barrier will be 2 meters high, and installed at 3 sites of km.27+075 – 27+190 (both left and right sides), km 27+190 – 27+400 (only left side) and km 27+400 – 27+640 (both left and right sides)</p>	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.6 Noise (Cont'd)		 <p>Pattern of Laminated Safety Glass (Reflective Type) of Noise Barrier which will be used for Elevated Highway of the Project</p> <p>(2) Install light barrier of Metal Panel (Absorb Type) with 2 meters height and 210 meters length, at km 27+190 – 27+400. Installation will be at the right side, where the elevated structure is curved to the mountain. This will protect light reflection from the project route and vehicles at nighttime which will impact on wildlife's living.</p>  <p>Pattern of Flat Beam Lighting System for Elevated Structure</p>	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.6 Noise (Cont'd)		<p>- The contractor has to plant trees along steel fence along 4 sections of at-grade road expansion, with regular maintenance. The trees must be native type. Trees planting together with construction of concrete wall will lower the noise impact on wildlife. The concrete wall will be 2.5 meter height and 2,410 meter length of each side, or equivalent to 4,820 meters length of 2 sides.</p> <p style="text-align: center;">Installation of Concrete Wall in Combination with Planting Trees to Lower Noise and Light Impact along at-grade road sections</p>	
	<p>Operation period Shallow Tunnel</p> <p>- Noise assessment at Shallow tunnels is based on traffic quantity in the future (2011-2057) in combination with the highest existing noise level of 58.3 dB(A) which is about 5 meter far and 100% reflection from smooth concrete wall. Findings showed that when operation starts in 2011, noise</p>	<p>Operation period Specific Measures</p> <p>- The Department of Highways must specify of not using horn in the tunnel together with installing sign of no horn because it well impact on passers-by on no air-condition vehicles.</p> <p>- For elevated highway at km 27+075 – 27+645, the Department of Highways must examine traffic surface and</p>	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
1.6 Noise (Cont'd)	<p>level from driving through the tunnel would be at 89.34 dB(A). This is higher than standardization of 70 dB(A). Total noise level will depend on an increase of traffic. As it is forecasted that an amount of vehicles in 2057 would be about 59,000 PCU /day, the noise level in the tunnel would be 81.3 dB(A).</p> <p>- In case of driving through the tunnel by non-air condition vehicles, the people will be directly affected by noise. Riding on motorcycle with average speed of 40 km/hr, time spent in the tunnel will be 22.5-22.7 seconds. Going by foot with the speed of 5 km/hr, time spent will be 3-3.6 minutes. When these results are compared with the standardization of acceptable noise level from each working day, it is within the standard in relation to affected time. Hence noise impact on passers-by in the tunnel will be at the moderate level.</p>	noise barrier, including maintenance regularly.	
2. Biological Environmental Resources			
2.1 Aquatic ecology	<p>Pre-construction and construction periods</p> <p>Activities such as site preparation for foundation base, land excavation, grading, soil piling, leveling and compacting may generate large amount of soil sediment. In case of raining or conducting activities in the rainy season, sediments will be leached and dispersed into the water sources. Then the water will</p>	<p>Pre-construction and construction periods</p> <p>Apply the same measures as surface water quality aspect.</p>	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.1 Aquatic ecology (cont'd)	be turbid and affect to aquatic organisms. For example, light for photo-synthesis of phytoplankton is decreased. So quantity of phytoplankton is lower accordingly while some types of weeds can grow well without photosynthesis. This will be effect on changes of the food chain in the water sources. Especially <i>Fragilaria capucina</i> type of diatom may be decreased during construction. Temporary blockage of waterway will change situation of flow water to be still water. Then organisms living in still water may be increased.		
	<p>Operation period</p> <p>Elevated Highway and At-Grade road</p> <p>During operation period, impact will be from the traffic on highway no.304. Various pollutants such as dust from the soil, exhaust gas, spilled fuel, asbestos from wearing out of car brake and clutch disc, chromium from car brake, spare part and equipments coated with chromium together with heavy metals from tyre worn out would contaminate water in waterway nearby the project route. This will deteriorate water quality and unsuitable for aquatic organisms. Spilled fuel will lower solubility of oxygen in the water. This will create good growth of some type of blue green algae such as <i>Oscillatoria</i> sp. which can block sunlight. Furthermore respiration system of this algae will lower Oxygen</p>	<p>Operation period</p> <p>Apply the same measures as surface water quality aspect.</p>	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.1 Aquatic ecology (cont'd)	<p>quantity in the water. This will make some algae die and compost in the water by anaerobic type of bacteria. Hence water quality will be deteriorated. This will be effect to all types of aquatic organism and food chain. As water sources in the project area is classified as Class 2 quality which is significant to ecosystem, activities undertaken during operation period would cause an impact at the moderate level.</p> <p>Shallow Tunnels</p> <p>Covered soil on the top of tunnel structure may be leached. Then soil sediment will fall into water sources. In case of raining or the conduct of activities is in the rainy season, these will cause turbidity in water sources. Besides, leaching of wastewater from highway no.304 may contaminate surface water in waterway nearby the project route. This will deteriorate water quality, and affect to aquatic organisms.</p>		
2.2 Forestry ecology	<p>Pre-construction and construction periods</p> <p>Woods cutting during construction will make loss of 32.31 rai of forestry area. This comprises 872 trees, 2,100 saplings and 11,438 seedlings. However the area in Khaoyai – Tablan National Park adjacent to national highway no.304 is not intact forest. According to the study and survey, rare species are not found. The majority are reforestation type. Then, it can be</p>	<p>Pre-construction and construction periods</p> <p>Specific Measures</p> <ul style="list-style-type: none"> - Establish plant nursery and nursing ground for trees that are removed from the project area. - Remove all size of rare plant species while 5-30 cm diameter size of common species will be removed. - Take off the existing road surface and improve landscape under the bridge similarly to the nature, by using native trees. 	<p>Pre-construction and construction periods</p> <p>Methodology</p> <p>1) Monitor on implementation following environmental impact mitigation measures and action plans during pre-construction and construction periods.</p>

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.2 Forestry ecology (cont'd)	concluded that impact on forest resources is at the moderate level.	<p>- When the construction at 2 sites of shallow tunnels is nearly completed, the contractor has to bring the trees that have been removed during pre-construction period to replant at the top of tunnel structure which is used as wildlife overpass and corridor. This will be a kind of landscaping the corridor to be in harmony with Khao Yai - Tablan National Park Complex. The contractor must coordinate with officials of Royal Forestry Department and Department of National Parks, Wildlife and Plant Conservation in order to propose action plan in detail. This will create good understandings and recommendations from concerned officials, including improvement of action plan to be the most effective one.</p> <p>General Measures</p> <p>- Formulate plan of removing trees and cutting woods together with Department of National Parks, Wildlife and Plant Conservation and Forest Industry Organization.</p> <p>- Only necessary construction equipments for cutting woods, hauling woods, forest clearance including construction of transportation route will be brought into the area. Cutting woods will be avoided as much as possible, and official regulations must be strictly followed. Woods have to be marked clearly, with establishment of inventory list. This will be database for examination and protection for illegal logging</p>	<p>2) Monitor on the changes in forestry area, by examining clearance area together with a number of wood cut, including type and number of big trees that would be removed by officials of Royal Forestry Department for nursing. All these will be cross checked with inventory list which was established during the survey.</p> <p>3) Monitor on planting trees along 2 sides of the at-grade road including landscaping at the corridor.</p> <p>Implemented area</p> <p>Monitor along 2 sides of the project route and nearby area, within 500 meter distance from the middle of project route. The distance will be between km 26+000 to km 29+500, situated in Khaoyai-Tablan National Park.</p> <p>Implemented period</p> <p>Monitor will be implemented 2 times a year, during entyre pre-construction</p>

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.2 Forestry ecology (cont'd)		<p>at the nearby area. Cutting woods in the right-of-way situated in the national park has to get permission from Department of National Parks, Wildlife and Plant Conservation. The Department of Highways has to follow rule of regulation enacted by the Department of National Parks, Wildlife and Plant Conservation (2003). This aims to prevent staff and workers to damage forest and other natural resources.</p> <ul style="list-style-type: none"> - Department of Highways must coordinate with Department of National Parks, Wildlife and Plant Conservation, Royal Forestry Department and Forest Industry Organization to examine boundary of cutting woods area and inventory list after completion of cutting woods. This is to prevent cutting woods outside the project area and to identify trees with ecological value. Trees which should be conserved have to be removed to nearby area. - With reference to economic valuations and utilization, the protected woods (detailed as shown in notification of Forestry Act B.E. 2484) have to be removed for caring at the nursery. The non-protected ones will be cut and taken out for proper utilization by the Forest Industry Organization. - Department of Highways must coordinate with concerned agencies that are responsible for forest protection and conservation in the project area; i.e. Prachinburi Provincial Natural Resources and Environmental Office and Khaoyai- Tablan National Parks in order to inspect, protect and conserve forest. 	<p>period (1 year) and construction period (2 years).</p> <p>Responsible agencies</p> <p>Propose in contract condition that the contractor must provide the third party which is officially certified to monitor and report results to authorized government offices. This will be controlled by the project owner – Department of Highways together with Royal Forestry Department and Department of National Parks, Wildlife and Plant Conservation</p>

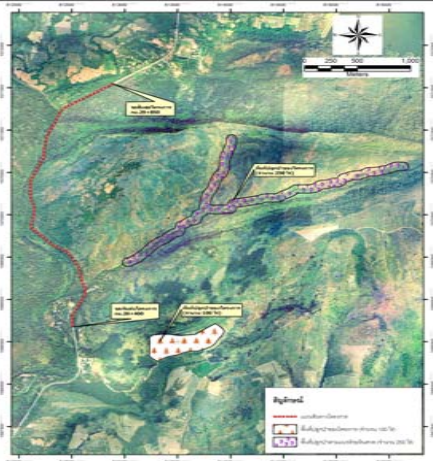
4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.2 Forestry ecology (cont'd)		<ul style="list-style-type: none"> - The contractor must regulate staff and workers. They are not allowed to do illegal wood cutting, forest clearance, collecting forest products, changes of waterway or occupying at the head of water sources. Punishment must be clearly declared. - Prohibit the project staff and workers to do anything which is harmful to natural and forest resources. - In case wildlife are found during cutting woods, clearance, grading or conducting any other activities, the project staff and workers have to let them be away safely. Assistance should be provided in case of safer than letting them be away by themselves or taking them to suitable area or coordinating with officials of Khaoyai – Tablan National Park. Meanwhile, the contractor must strictly regulate of no illegal hunting. This notification has to be declared to concerned persons at all level since construction starts. - No establishment of labour community in the area of Khaoyai and Tablan National Parks in order to avoid impact on forest and wildlife resources. - Use of effective construction equipments which are well-maintained in order to lower noise, dust and smoke from machinery which would impact on trees and natural resources. 	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.2 Forestry ecology (cont'd)		- Beware of unexpected impact such as dumping chemical, fuel or garbage which might be dangerous to forest and wildlife resources. Public relation should be conducted so that the project staff will understand and cooperate.	
	<p>Operation period</p> <p>After completion of construction, the forest complex will be rehabilitated to return to the previous condition, especially at the area under the elevated highway and area on top of shallow tunnels and along the project right-of-way in forest area. Maintenance of reforestation area in Khaoyai – Tablan National Parks will be in form of controlling size and height of trees under elevated way not to be higher than elevated structure together with controlling size and height of tree on top of shallow tunnel to avoid impact from tree roots on tunnel structure. Hence impact on forest resources during operation period is positive.</p>	<p>Operation period</p> <p>Specific measures</p> <ul style="list-style-type: none"> - Control type and size of vegetation in order to lower impact caused by roots to tunnel structure. - Thinning / pruning trees under elevated highway, not to be higher than the height of structure. - Reforestation at directly affected area of 350 rai, at km 26 and 29 with the rate of 25 trees/rai. This will be in Tablan National Park, Bhubhram sub-district, Nadi district, Prachinburi province. Local people should be employed for reforestation. Concerned agencies should be invited to participate as well. 	<p>Operation period</p> <p>Methodology</p> <ol style="list-style-type: none"> 1) Monitor on implementation following preventive and environmental impact mitigation measures and action plan during pre-construction and construction periods. 2) Survey on the changes of forest area and land use along 2 sides of the project route and at the corridor by using aerial photograph together with ground check. 3) Monitor on results of reforestation along 2 sides of the road at ground level, including

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.2 Forestry ecology (cont'd)		 <p>Reforestation area of 350 rai in Tablan National Park, Bhubhram sub-district, Nadi district, Prachinburi province</p>	landscaping of the corridor. This will be in form of examination of the survival rate of trees that have been planted and maintained.

**4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND
MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)**

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.2 Forestry ecology (cont'd)		<p>General measures</p> <p>- In the dry season, there will be burning of weeds in farmlands which always expands to the forest area. Hence there should be inspection and surveillance on forest fire, especially at tunnel area, area under elevated highway and reforestation area.</p>	<p>Implemented area</p> <p>Monitor on 2 sides of the project route and nearby area. This covers area within 500 meters from centerline of project route distance between km 26+000 to 29+50, 2 sites of the corridor above Shallow tunnels and under elevated highway (km 27+040 – 27+680).</p> <p>Implemented period</p> <p>Monitor once a year, with continuation in the first 3 year of operation period. After that monitoring will be carried out every 5 years, at year 8, 13 and 18.</p> <p>Responsible agencies</p> <p>Department of Highways will employ the third party to implement, under inspection and care of Department of National Parks, Wildlife and Plant Conservation together with Royal Forestry Department.</p>


**4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND
MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)**

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.2 Forestry ecology (cont'd)			<p><u>Reforestation in Tablan National Park</u></p> <p><i>Methodology</i></p> <p>1) Monitor on reforestation in Tablan National Park in order to enhance effectiveness of the corridor. This will be in form of examining on planted trees, survival rate, replanting, maintenance, growth rate, maintenance of fire break, including problems and constraints.</p> <p>2) Assess existing situation of the area in order to be used as database for management after reforestation and monitoring plan in Tablan National Park.</p> <p><u>Implemented area</u></p> <p>Reforestation of 350 rai area in Tablan National Park, Bhuhbham sub-district, Nadi district,</p>

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.2 Forestry ecology (cont'd)			<p>Prachinburi province. The area will be divided into 100 rai at deteriorated forest area and 250 rai along the stream.</p> <p><u>Implemented period</u></p> <p>Monitor on reforestation for 5 years, after planting.</p> <p><u>Responsibility agencies</u></p> <p>Being responsible by Department of National Parks, Wildlife and Plant Conservation.</p>
2.3 Wildlife ecology	<p><i>Pre-construction and construction periods</i></p> <p><u>Impact on the loss of food sources and wildlife habitats</u></p> <p>Activities related to wood cutting, forest clearance and grading for alignment of elevated structure and shallow tunnels will cause the loss of wildlife habitat for entire corridor. This covers about 32.31 rai which includes area used for piling soil and rock from land excavation and rock explosion together with construction equipments and materials. Besides, vegetations which are food sources of wildlife are cut and cleared. This lower food quantity while specific area of wildlife is</p>	<p><i>Detailed Design</i></p> <p><u>Specific measures</u></p> <p>- Design underpass tunnel at the 4 sections of at-grade road. This targets for the use of small wildlife and Amphibians. They are:</p> <p>(1) Amphibian tunnel will be constructed with concrete. Its entry is square shape of 0.5 x 0.5 m size and 24.6 m length. There will be 0.05 m diameter holes at the top of tunnel structure, with 0.18 m interval, and covered by steel screen of 0.8 x 0.65 m size. This will help for water drainage and create environment with suitable moisture, aiming to encourage amphibian to use the tunnel.</p>	<p><i>Pre-construction and construction periods</i></p> <p><u>Methodology</u></p> <p>1) Monitor on implementation following action plan together with preventive and mitigation measures for wildlife ecology during pre-construction and construction periods.</p> <p>2) Survey and study the diversity, abundance and status of 4 categories of wildlife; i.e. Mammals,</p>


4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.3 Wildlife ecology (cont'd)	damaged; i.e. hollow for nesting and laying eggs, underground habitat, including resting and refuge place for wildlife ...etc. Apart from these, there may be staff, workers or local people utilize the place for hunting.	 <p>Pattern of Classic Amphibian Tunnel</p>	<p>Reptiles birds and Amphibians. The study will include ecology situation of the area in order to analyse wildlife distribution along the project route and nearby area. This will be compared with existing wildlife ecology, as presented in the Environmental Impact Assessment report of the project in the context of changes of diversity, abundance and distribution of these 4 categories of wildlife.</p> <p>3) Check information about wildlife which have been injured from traffic accident and construction activities. This can be done by asking from contractor, construction workers, local people and ground check together with local authorities; e.g. officials from Khaoyai and Tablan National Parks.</p>

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.3 Wildlife ecology (cont'd)	<p><u>Impact from Noise</u></p> <p>Loud noise from machinery, land excavation, rock explosion and vehicles used to transport construction materials may disturb living, feeding and reproduction activities of wildlife nearby construction area, at 2 levels of:</p> <p><u>Behaviors expression</u></p> <p>Stimulation by the same loud noise will make wildlife loss their hearing because neuro-endocrine system receives the same stimulation (Peterson, 1980). This will interfere signal system of wildlife which results in more being hunted. Furthermore, loud noise also causes disturbance to some other activities; i.e. breeding of wild frog (Odendaal <i>et al.</i>, 1986).</p> <p><u>Internal expression</u></p> <p>Noise enables to stimulate the changes of internal system of wildlife such as digestive system, immune system, reproductive system, nervous system and cardiovascular system (Peterson, 1980; Nayfield & Besch 1981). Noise from construction will cause</p>	<p>(2) Small animal underpass will be constructed with concrete. Its entry is rectangle shape of 2.1 x 2.6 m size, with 24.6 m length. Soil will be covered at 2 sides of tunnel, with the size of 0.6 m width and 0.6 m height. Its strength will be enhanced by putting brick with steel rod of 0.12 mm diameter. Covered soil will create environment in the tunnel to be similar to external environment. This will encourage small animal to use the tunnel.</p> <p>- Distance of 570 m under elevated highway is designed for underpass of medium and large size of wildlife; e.g. gaur, barking deer, wild deer, bear and elephant which are found in the national park, northern side of the project (km 44). Underpass structure will be about 10.7 – 13.5 m high, 30 m wide and 27 m long. Landscaping will be arranged to be harmonized with the forest along 2 sides of the project route.</p>	<p><u>Implemented area</u></p> <p>Monitor along 2 sides of the project route and nearby area, within 500 m distance from the middle of the project route (between km 26+000 to km 29+500).</p>


4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.3 Wildlife ecology (cont'd)	moderate to high impact on reproductive, finding food, living of each wildlife type. However noise from explosion will be at particular place and within short period. Hence the impact will be at the moderate level.	<p>- After completion of tunnel construction, The top of Shallow tunnels will be covered by soil. The thickness will be 5.5 meter. Geosynthetic Reinforcement will be constructed in order to prevent soil erosion and land slide. Mortar Rip-rap Ditch Lining type of drainage system and buffled will be constructed. Landscaping will be undertaken at 2 sides of the project route by planting trees. Artificial salt lick and additional water sources will be constructed around the project route. There will be 9 and 11 sites in Khaoyai and Talan National Parks respectively. This will encourage wildlife to move in the corridor and create fertile ecology system.</p>  <p style="text-align: center;">Area for artificial salt lick construction</p>	<p>Implemented period Monitor twice a year, along entyre pre-construction and construction periods (3 years)</p> <p>Responsible agencies Propose within the contract condition that the contractor must provide the third party which is officially certified to monitor and report results to government offices. This will be controlled by the Department of Highways which is the project owner together with Department of National Parks, Wildlife and Plant Conservation.</p>

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.3 Wildlife ecology (cont'd)		<p><i>Pre-construction and construction periods</i></p> <p><u>Specific measures</u></p> <ul style="list-style-type: none"> - Establishment of artificial salt lick and additional water sources for wildlife will be finished before completion of the project construction, at 11 and 9 sites in Tablan and Khaoyai National Parks respectively. These will be located between km 26 to 29 of Bhuhbham sub-district, Nadi district, Prachinburi province. - Construct fence at 2 sites, at the beginning and the ending of the project route (km 26+425 and km 29+200). Fence at each site will be 5 km long, with 2.5 m height. Its installation will be along 2 sides of the project route. They will be completed during construction period in order to be utilized effectively during operation period. These fences will enforce the wildlife to use the crossway at specific place, aiming at lower accident to wildlife. - When the construction is nearly completed, the contractor must construct sand trap and ponds on top of Shallow tunnels. Sand trap will be 3 x 50 m size, with 0.1 m depth while pond size will be 5 x 20 m and 1.5 m depth. There will be landscape management in area on top of the tunnel structure, which will be used as wildlife overpass. Sand trap 	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.3 Wildlife ecology (cont'd)		<p>will record footprint of wildlife at the corridor. This information will be used to monitor and evaluate effectiveness of the corridor in the future.</p>  <p>Example of sand trap, to be used for monitoring wildlife footprint at the corridor</p> <ul style="list-style-type: none"> - Pond will be used as breeding and living ground of Amphibians which are highly important for food chain of eco-system. This will be incentive for other animals within the same food chain to use the corridor. - At site 1 of Shallow tunnel (km 28+650 – 28+900), four spots of sand trap will be installed. Pond will be constructed at the right side of the project route (2 points at km 28+700 and km 28+800). At site 2 of Shallow tunnel (km 28+950 – 29+130), three spots of sand trap will be installed. One pond will be constructed at the right side of the project route (km 29+075). 	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.3 Wildlife ecology (cont'd)		<p>- At 3 section of the at-grade road (km 27+680 – 28+680, km 28+900 – 28+950 and km 29+130 – 29+450), the contractor must construct steel fence at 2 sides along the project route. The fence will prevent wildlife, from coming to the project route, and protect them from car accident effectively.</p>  <p>Example of fence along the at-grade project route</p> <p>General measures</p> <ul style="list-style-type: none"> - Beware of risk aspects such as noise, light, vibration, including air quality that exceeds standardization. Implementation must follow the measures strictly. - Strictly prohibit the project staff and workers to do anything at the project route or construction area which may damage the forest, wildlife and other natural resources. - Inform the project staff, aiming at understanding and cooperation in terms of avoidance of unexpected impacts such as dumping chemical, fuel or garbage which may be dangerous to forest and wildlife resources. The contractor must provide sufficient trash cans, and disposes of garbage outside the project area every day. 	


4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.3 Wildlife ecology (cont'd)		- Coordinate with concerned agencies which are authorized to protect and conserve forest in the project area; i.e. Prachinburi Provincial Natural Resources and Environment Office and Khaoyai-Tablan National Parks.	
	<p>Operation period</p> <p>After completion of construction, habitat condition of wildlife must be rehabilitated to be the same condition as before, especially area under elevated highway, at the top of Shallow tunnels and along the project route that pass through forest area. After reforestation, the trees under elevated highway must be controlled. The tree height must not be higher than structure of elevated highway while the roots must not disturb tunnel structure. Meanwhile the wildlife will be enabled to utilize the area. However rehabilitation at cut and cover sites takes time. Hence the impact on wildlife is at the moderate level.</p>	<p>Operation period</p> <p>Specific measures</p> <ul style="list-style-type: none"> - Planting trees in order to rehabilitate wildlife habitats at 2 construction sites of Shallow tunnels together with the entry and exit of tunnels. This must be similar condition to natural forest. - Install closed-circuit television to monitor accessibility of wildlife and illegal hunting at the corridor, at both sides of highway no.304, km 26 and 29. - The Department of Highways will be responsible for caring and maintenance of the steel fence which would be installed at all sections of at-grade road. In case of damage or deterioration, repairing must be in action immediately. 	<p>Operation period</p> <p>Methodology</p> <ol style="list-style-type: none"> 1) Monitor on implementation, following preventive and mitigation measures for impact on wildlife eco-system during operation period. 2) Survey and study on abundance of 4 wildlife categories; i.e. Mammals, Reptiles, Birds and Amphibians. The study must cover eco-system of the area in order to analyse wildlife distribution along the project route and nearby area. This will be compared to the existing situation, as presented in the EIA report of the project together with consideration on changes of diversity, abundance level and dispersion of these 4 wildlife categories.

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.3 Wildlife ecology (cont'd)		<p>General measures</p> <ul style="list-style-type: none"> - Establish national park protection unit, including provision of patrols to control illegal hunting. There will be 1 unit at km 29 of highway no.304 while 1 unit of Khaoyai national park (Lam Phrayatharn) was provided by Royal Irrigation Department in 1969. - Specify suitable measures to monitor area utilization of wildlife, including monitor on impact which may occur to wildlife. This aims to formulate mitigation measures and control various impacts on wildlife. - In the project and nearby area, the people always make fire for weed control in their farmlands which always expand. Hence inspection and surveillance must be undertaken, especially at reforestation area. The project therefore designs for 3 sites of observatory towers in the project area. One will be behind Ban Pachampi, Bhubram sub-district, Nadi district. Two of them will be located at km 26 and 29, at the boundary of Tablan and Khaoyai National Parks. They must be completed during construction period, and can be utilized during operation period. - Plant forage crops together with provision of essential facilities for wildlife such as water sources, salt lick ...etc. These will encourage them to use wildlife overpass. 	<p>3) Check information regarding injured wildlife from car accident and construction activities. This will be in form of asking from local people and ground check together with officials from Khaoyai and Tablan National Parks.</p> <p>Implemented area</p> <p>Monitor at 2 sides along the project route and nearby area, within 500 meter distance from the project route (km 26+000 to km 29+500).</p>

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.3 Wildlife ecology (cont'd)		 <p>Example of pond that will be constructed at the project corridor</p>	<p><u>Implemented period</u> Monitor once a year, with continuation in the first 3 year of operation period. After that monitoring will be carried out every 5 years, at year 8, 13 and 18.</p> <p><u>Responsible agencies</u> Department of Highways will employ the third party to implement, under inspection and care of Department of National Parks, Wildlife and Plant Conservation together with Royal Forestry Department.</p> <p><u>Methodology</u> 1) Monitor utilization of wildlife overpass & underpass, from footprint on sand trap. 2) Monitor utilization of small animal underpass and Amphibian tunnel, from camera trap. 3) Monitor utilization of wildlife overpass, by Closed Circuit Television - CCTV.</p>

**4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND
MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)**

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
2.3 Wildlife ecology (cont'd)			<p><u>Implemented area</u> Implement along the entire project route, covering wildlife overpass, 2 sites of Shallow tunnels, wildlife underpass, under elevated highway, small animal underpass and Amphibian tunnel, along 4 parts of at-grade road.</p> <p><u>Implemented period</u> Implement on monthly basis, once a month, for 20 years of project operation. Each time will be 10-15 day continuing, especially in the dynamic season; i.e. migration, hunting, separation from family to live on their own.</p> <p><u>Responsible agencies</u> Department of Highways as the project owner will employ and inspect the third party to monitor on effectiveness of the corridor. Department of National Parks, Wildlife and Plant Conservation as the area owner will cooperate.</p>

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
3. Human Use Values 3.1 Transportation	<p><i>Pre-construction and construction periods</i></p> <p><u>Impact on constraints and route utilization</u></p> <p>Activities which cause impacts are clearing/grading, land cut and fill, bridge extension (km 26+900), construction of layer structure and road surface, including piling of construction materials and the residues generated from clearing /grading. This may encroach traffic surface and cause accident easily. However the impact is valid only during pre-construction and construction periods. Hence its severity is at the moderate level.</p>	<p><i>Procedure of detailed design</i></p> <ul style="list-style-type: none"> - Design 1 route for community service, at km 26+618.75. Starting point will be at the left side, before curving under the project route to the right side and ends at Hindard community (Ban Pachmpi area – km 26+882.938). Its total distance will be 335 meters, functioning as entry/exit of community commuting. The road will be paved, with 3.50 width. There will be 1 underpass for vehicles, with the size of 6 meter width, 3 meter height and about 29 meter length. - Design installation of traffic sign in order to warn the project route users. Type and size of traffic sign has to be within the standard of Department of Highways; i.e. large size and clearly seen. Traffic signs will be installed at 2 sides of right of way of the project route, edge of elevated structure, inside Shallow tunnel, right of way of community service route. They are: <ul style="list-style-type: none"> - 43 points at the at-grade road - 3 points at elevated structure - 1point at Shallow tunnels - 4 points at community service route - Design sufficient light for safety, for all users. This covers at-grade road, elevated highway, Shallow tunnels and community service route. 	<p><u>Implemented area</u></p> <p>Monitor on the project route, at km 26+000 – 29+500 together with transportation route of construction materials such as highway no.33, 304 and 309.</p> <p><u>Operation period</u></p> <p>Monitor 4 times a year, covering 3 years of pre-construction and construction periods.</p> <p><u>Responsible agencies</u></p> <p>Propose as condition in the contract that the contractor must provide the third party which is</p>

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
3.1 Transportation (cont'd)		<ul style="list-style-type: none"> - Design elevated highway (km 27+075 – 27+645) to support low capacity engine of vehicles in relation to the majority of vehicles' types used by the local people. - Climbing lanes should be provided for large truck, including installation tangible Truck Loading Signal at 2 sides of elevated highway. <p><i>Pre-construction and construction periods</i></p> <p><u>Specific area</u></p> <ul style="list-style-type: none"> - Construction at 2 sites of Shallow tunnels has to be carried out with 1 traffic side at the time in order to use the other side as diversion lane. - Install lighting system at all patterns of the project structure immediately, after completion of construction. - Specify construction area along the entire route, especially at the linkage to the highway or rural road, by placing traffic cones, barrier or boundary post with 30 meters interval. In case the construction encroaches traffic surface, the contractor must provide staff to give traffic sign to road users in order to avoid accidents. - In case not good traffic flow is found, the contractor must provide staff to facilitate traffic. - The contractor must keep equipments and machinery at construction area to be in order, to avoid traffic obstruction. 	<p>officially certified to monitor and report results to government offices. This will be controlled by the Department of Highways as the project owner.</p>

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
3.1 Transportation (cont'd)		<p>General measures</p> <ul style="list-style-type: none"> - Planning on the use of route to transport the project equipments, especially on the highway no.304 in order to avoid traffic problem in rush hour. The use of rural road should be avoided, to be the least use in order to prevent the road damage because it is mainly designed for community traffic. - Provide the staff to facilitate the traffic on the project route during construction, especially at the curve, mountainous and construction areas. In case the existing route has to be closed for construction or improvement for traffic lane expansion, the contractor must construct diversion route, crossway and temporary underpass for vehicles. These have to be completed before construction taken place so that the people can commute between 2 sides of the project route during construction period. Sign of diversion route must be installed, and clearly seen. 	
3.2 Flood control and drainage	<p>Pre-construction and construction periods</p> <p>Activities which cause major impacts on drainage along the project route are site preparation, grading in order to construct diversion route for vehicles during construction period. These activities will cause obstruction of water flow. Construction activities related to extension of bridge and drainage channel will block waterway and cause soil erosion at the banks. These will obstruct</p>	<p>Pre-construction and construction periods</p> <p>Apply the same measures as surface water hydrology.</p>	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
3.2 Flood control and drainage (cont'd)	waterway and drainage channel, or make waterway shallow. Furthermore operation of machinery may damage drainage structure. However the impact will be temporary during pre-construction and construction periods only. Hence the impact is classified as moderate level.		
4. Quality of Life Value 4.1 Public health and health/ Occupational health and safety	<p><i>Pre-construction and construction periods</i></p> <ul style="list-style-type: none"> - Dust from soil, smoke from exhaust pipe, noise disturbance and vibration will impact on health. Inhabitants nearby construction area will be exposed by respiration, visual, hearing and sensible. In case of long impact, it is risky to get disease; i.e. respiratory disease, disease of hearing system, including unclear visibility. Factors which generate physical threat comprise soil resources, air quality, noise quality, vibration, safety and accident while mental threat will be from worries, annoying, trouble, tenseness and scare including accident occurrence. - As the construction causes changes of environment and livelihoods of local people around the project 	<p><i>Pre-construction and construction periods</i></p> <p><u>Specific measures</u></p> <ul style="list-style-type: none"> - During construction at 2 sites of Shallow tunnels, temporary ventilation together with the reserve set must be installed, at the rate of 5 air-change/hr. Temperature must be controlled to be suitable for working condition. - During construction at 2 sites of Shallow tunnels, warning system regarding pollutants (especially CO) must be installed in the tunnel. <p><u>General measures</u></p> <p><u>Public health measures</u></p> <ul style="list-style-type: none"> - Provide first aids unit together with ambulance and coordinate with the hospitals and public health centers nearby the construction site in advance in order to get the 	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
4.1 Public health and health/ Occupational health and safety (cont'd)	area, impact on mentality is varied to the severity and duration. The risky groups are construction workers, local people living nearby construction area and passers-by.	service in case of emergency. - Provide training and knowledge on safety in construction area, workers' campsite, including utilization of personal protective equipments.	
4.2 Socio-economic	<p><i>Pre-construction and construction periods</i></p> <p>Since construction area is mostly in the boundary of highway no.304, there is no removal of buildings or disturbance to peoples' land. However the construction may affect to other socio-economic situations; i.e.</p> <p>(1) Inconvenient journey: Due to an increase number of large truck to transport materials / equipments, traffic on the road and nearby network will be obstructed. Then commuting between homes to offices, schools, and religious places will be inconvenient. As nearly every family of local people are working at industrial plants in Kabinburi and commuting by motorcycle and bus nearly every day, they are affected by construction on highway no.304. Since there will be changes in the community and there will be effect on peoples' sensibility, the impact is ranked at the moderate level.</p> <p>(2) Troubling and annoying: Local people who are residing along the sides of highway no.304 will be affected from construction activities. Dust, noise,</p>	<p><i>Pre-construction and construction periods</i></p> <p><u>Specific measures</u></p> <p>Establish the complaint center and coordinate with concerned agencies, starting from pre-construction, construction periods and:</p> <p><u>General measures</u></p> <p>- Conduct public relation and disseminate project information to local administration and people to understand the project correctly. Emphasis will be on construction plan at various sites, along the project route.</p> <p>- Implement following preventive and mitigation measures for various impacts on the trouble, annoying and inconvenient of the people from construction activities.</p> <p>- Consider to employ local people so that there will be income distribution in the community. Local people have to participate in monitoring on impact, during both pre-construction and construction periods. In case of impact occurrence by the project, solutions must be in action quickly.</p>	<p><u>Responsible agencies</u></p> <p>Propose in the contract condition that the contractor must provide the third party which is officially certified to monitor and report results to government offices. This will be controlled by the Department of Highways, as the project owner.</p>

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
4.2 Socio-economic (cont'd)	<p>vibration, exhaust and pollutants will be generated from vehicles and machinery. This will impact on changes of community environment and there will be effect to sensibility and sickness of people in community.</p> <p>(3) Impact on employment: Opportunity of local employment will be increased, especially the non-skilled labour. As the major occupations of local people are agriculture and employee, positive impact will be at the moderate level for the employee group only. Communities nearby workers' campsite will be able to sell more consumption goods, responding to the demand of construction workers. The impact will be at moderate level, within a short period of construction only. However negative impact will be on some shophouse which are obstructed by construction. This affects customers access and safety. Then there will be effect on income and stability of business. This impact assessment is consistent with expression of local people.</p>		

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
4.2 Socio-economic (cont'd)	<p>Operation period</p> <p>(1) In general, impact on transportation is positive. Currently traffic situation at highway no.304 is rather congested with high accidental rate, especially at festival occasion. This makes economic loss, waste of energy, including generated environmental pollution. The project development in combined wildlife corridor pattern will alleviate traffic problem with more safety and convenience in travelling. Hence there is highly positive impact to the region.</p> <p>(2) Impact on quality of life, especially for entrepreneurs who are residing along the highway no.304. Due to an increase volume of traffic, environmental quality is changed; i.e. disturbance of loud noise, vibration and air pollution ...etc. Based on these influences which affect to community senses and sickness, the impact is rated at moderate level. Having consulted with public, they viewed as the project development will generate both positive and negative impacts. The positive one will be on shortening the journey, saving time and expenses, better trading and transportation, boosting up community economy,</p>	<p>Operation period</p> <p>Establish the group of committee to participate in monitoring impact together with environment development, at district and sub-district levels.</p>	

4. SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS, PREVENTIVE AND MITIGATION MEASURES FOR ENVIRONMENT, AND MONITORING MEASURES FOR ENVIRONMENTAL QUALITY (Cont'd)

Components/Environmental Parameters	Major Environmental Impacts	Preventive and Mitigation Measures for Environment	Monitoring Measures for Environmental Quality
4.2 Socio-economic (cont'd)	including development on other aspect such as tourism. However negative impact will be from dust and smoke of vehicles, noise and vibration from traffic ... etc.		
4.3 Visual and Aesthetic Impact	<p>Pre-construction and construction periods</p> <p>Activities which generate visual and aesthetic impacts comprise clearance, grading, cutting woods, digging stump, cut and cover for embankment land excavation and rock explosion at surface area. This will make loss of natural forest and vegetations. Furthermore there will be marks from cut and cover at the mountain. However the impact will be at some parts in construction area, temporary occurrence during pre-construction and construction periods only. The impact is ranked as moderate level.</p>	<p>Pre-construction and construction periods</p> <p>Specific measures</p> <ul style="list-style-type: none"> - Adjust the landscape at the entry / exit of 2 Shallow tunnels to be identity. - Landscape forest area / on the top of the Shallow tunnel to be similar to natural situation. - Install Laminated Safety Glass (Reflective Type) of noise barrier at 2 sides of elevated highway as details specified in preventive and mitigation, measures for impact on noise. - After completion of construction, the contractor must plant trees along 2 sides of the road at ground level. This aims to adjust landscape of concrete wall to harmonize with the nature and enhance the beautiful scenery along project route. These measures will be implemented in parallel to preventive and mitigation measures for impact on air quality and forest ecology. 	

5. SUMMARY OF IMPLEMENTATION ON PUBLIC PARTICIPATION

Implementation on public participation comprises various activities, as shown below:

(1) Information dissemination was conducted by meeting with the Director General of Department of National Park, Wildlife and Plant Conservation, Prachinburi Governor, local leaders and local mass media, during 9-26 December 2008.

(2) Organize forum regarding "Open View for Learning", held on Tuesday 2nd June 2009 at Venus room, Miracle Grand Convention Hotel.

(3) First seminar, held on Tuesday 20th January 2009 at Convention Hall, Dhawarawadee Resort, Srimahapho district, Prachinburi.

(4) First focus group meeting, held on Sunday 29th March 2009.

(5) Second seminar, held on Thursday 5th November 2009 at Sriprachin room, Dhawarawadee Resort, Srimahapho district, Prachinburi.

(6) Second focus group meeting, held on Friday 20th November 2009.

(7) Third seminar, held on Thursday 2nd December 2010 at Sriprachin room, Dhawarawadee Resort, Srimahapho district, Prachinburi.

(8) Third focus group meeting, held on Thursday 24th December 2010.

Conclusion of major issues of questions and suggestions arisen from public consultation implementation

Questions, comments and suggestions	Utilization for the Study
Drainage channel for Reptiles or small animals should be constructed for all types of corridor.	Construction of Amphibian and small animal underpass between the two national parks is a major issue for consideration on detailed design of the project road, with the aim to reduce environmental impact and link of forest complex.
At km 26 – 29, wildlife overpass should be constructed at particular sites while tunnels should be constructed at km 42 – 57.	The consultant takes this issue for consideration on pattern selection. As km 42 – 57 is outside the project area, the consultant will propose this suggestion to Department of Highways.
Solutions to accident problem and traffic between km 42 – 58 should be provided urgently. One site of emergency route and expansion of road shoulders should be done as first priority.	The mentioned area is outside the project boundary. However the consultant will propose this problem to the Department of Highways.
The study, survey and design on corridor of the World Heritage Forest Complex should cover drainage in Lam Phrayatharn in addition because it is only 1 drainage channel in Bhubhram sub-district. Therefore construction must be beware of falling of sediments which will make the stream shallow.	There is the study on Environmental Impact Assessment together with formulation of preventive and mitigation measures for environment, especially the sensitive receptor areas. Therefore the project has prepared measures and action plan.

Questions, comments and suggestions	Utilization for the Study
Alternative Pattern 4-combined wildlife corridors is suitable pattern due to no impact on life style of local people together with lower budget for construction than the other patterns. However the route should be adjusted to be straight alignment instead of curving one. This will help on convenient driving.	The consultant has conducted the study and detailed design for construction of alternative pattern 4 : Combined wildlife corridors.
Propose to add monitor measures for environmental impact by establishment of wildlife protection unit which consists of unit 1 to work at Ban Pachampi area and unit 2 to work at downhill area (km 27+300 – km 27+700) in relation to abundance of wildlife.	The consultant has specified establishment of wildlife protection unit, as monitoring measures for environmental impact.
Propose to add preventive and mitigation measures for environment, by employing local people to participate in caring for wildlife.	The consultant has already specified this issue as mitigation measure for social and environment.
Avoid rock explosion at construction area of underpass tunnel.	The consultant has considered on the use of bomb exploding. However construction of base foundation at the rock layer will be by the use of proper machinery instead of exploding.
<ul style="list-style-type: none"> - In the context of public health, environmental health and safety of the EIA report, a number of total construction workers were not shown. It should be forecasted on a number of in-migrated workers since it is concerned with communication diseases in the area. - How to manage solid waste, wastewater and sewage, including water sources for drinking and consumption. As the project site is located at head of water sources, improper management will affect to environment. 	The study of public health and sanitation impact is a part of the EIA study. Impact assessment together with preventive and mitigation measures for environmental impact is already identified in EIA report. However the workers' campsite is specified to be outside the project area in order to prevent impact on forest ecology and wildlife.
In case the Department of Highways considers on corridor of alternative pattern 4 : combined wildlife corridors, consideration should cover on communication of local people by small vehicles used for agriculture purpose, motorcycle, including going by foot through the tunnel, at km 28+700.00 – 29+400.000.	The consultant has taken this issue for the design of tunnel and elevated highway for utilization of the local people.
Agreed with the alternative pattern 4 of the combined wildlife corridors. However the details must be adjusted as; it should be elevated bridge at site 1 (km 27+400) and there should be U-turn at site 2 (km 28+650 – 28+800), no need to have fence at Ban Pachampi area.	The consultant has conducted the study and detailed design, including construction of alternative pattern 4. Safety related to linkage to the highway at Ban Pachampi areas also has been considered.
Agreed with the alternative pattern 2 – elevated highway with 6 traffic lanes, with diversion route that enable to establish scenic point so that the local people can do trading. Furthermore this pattern would not obstruct waterway, especially in flood season.	The consultant will consider the safety related to scenic point because it is a main route of large truck (about 23%).

Questions, comments and suggestions	Utilization for the Study
Propose to have lenient points from place to place so that the local people can access to collect wild fruits.	The consultant has set the fence boundary in order to reduce impact on the people, including coordinated with Department of National Parks, Wildlife and Plant Conservation to formulate suitable approach.
In case there will be moving of people from the area, it is proposed to provide them the new area. In case of no moving, there should be preventive and mitigation measures for social impact such as trading.	The consultant has already formulated preventive and mitigation measures for social and environmental impacts.
Agreed with tourism promotion in relation to construction of scenic tower at km 28+650 – 28+800 where there is a tunnel. This will be positive effect to the economy of Tungpho and Bhubhram communities.	The consultant has proposed to have tourism center with the function of selling goods and scenic point. Suitable area will be considered.
Alternative pattern 4 contains elevated highway and tunnel which easily generates accidents because its location is on the steep slope.	For the detailed design of project route, the engineer has considered the drivers' safety on the main route, covering road at ground level, elevated highway and tunnel in order to prevent accidents from all types of vehicles.
For alternative pattern 4: combined wildlife corridor there is a proposal to shift wildlife overpass at km 28+650 – km 28+800 to km 29+500 because its location is suitable for wildlife to go across and there is no community settlement.	The consultant has considered to adjust the wildlife overpass, including utilization of additional land because the proposed location is in the boundary of Khaoyai National Park.
Propose to design the alignment of national highway no.304 at Ban Pachampi area to be more straight so that one more u-turn can be constructed in this area.	The consultant has considered the suitability of detailed design at the entry – exit of Ban Pachampi area to be underpass. This will prevent accidents, without adjustment of the alignment. In case of following the proposal, there will be more encroachment into the forest.
Agreed with alternative pattern 4 – combined wildlife corridor which will create the beauty of landscape by having elevated highway and tunnel. However the worries are about impact on wildlife because this pattern is easy for the people to know the clear target for hunting.	The consultant has formulated additional preventive and mitigation measures, by establishment of wildlife and forest protection unit at the risk area of hunting.

ANNEX 1-2

EXECUTIVE SUMMARY REPORT

**FEASIBILITY STUDY FOR ECONOMIC, ENGINEERING
AND ENVIRONMENTAL IMPACT ASSESSMENT
THE FOUR LANES WIDENING PROJECT ON
HIGHWAY ROUTE 304 SECTION A. KABIN BURI –
A. PAK THONG CHAI**



กรมทางหลวง

รายงานสรุปผลการศึกษาลำหรับผู้บริหาร

Executive Summary Report

การศึกษาความเหมาะสม

ทางด้านเศรษฐกิจ วิศวกรรม และผลกระทบสิ่งแวดล้อม

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Executive Summary

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Project Summary

Project Summary

1. Background

This project is the Feasibility Study for Economic, Engineering and Environmental Impact Assessment of the Four Lanes Widening Project on Highway Route No.304 Section A.Kabin Buri - A.Pak Thong Chai, between KM.42+000 and KM.57+000. It is the gap section of the four lane widening highway project of the route No.304 due to this section is located between Khao Yai National Park and Thap Lan National Park, which are registered to be the National World Heritage Sites. Then, the studies for the general requirements of the National World Heritage Sites and Environmental Impact Assessment (EIA) are required.

The consultants selected the typical cross section for the four lanes widening of the project to be constructed within the boundary of the right of way that the Department of Highway has the right according to decree for the right property of land, B.E.2510, 80 metres wide along the route. There are two sections for widening the existing road. The first section between KM.42+000 and KM.48+600 which distance is about 6.60 kilometres is the mountainous terrain that high accident occurred. Then, the typical cross section is separate profile grade. The second section between KM.48+600 and KM.57+000 which distance is about 8.40 kilometres, is the rolling terrain. The typical cross section widens to the right for raised median.

Due to the study of the wildlife expert in the first section of the project, there are several kinds of animal wonder from time to time between Khao Yai National Park and Thap Lan National Park, so the wildlife corridor (animal trail) is required.

2. Socio-Economic Study

- Population Study

The study area are covered 6 provinces; Nakhon Ratchasima, Prachin Buri, Rayong, Chachoengsao, Chon Buri and Sa Kaeo. The forecastings of the population in the study area are 6,094,102 in B.E.2551 and will be 6,777,281 in B.E.2577.

- Economic Study

The forecasting of Economic growth rates and the values of GPP in the study area are growth 3.8% in B.E.2551 and increasing to 4.9% in B.E.2577. Therefore, the economic growth rate in the study area is not quite high but it would be more constant and sustainable in the future.

3. Traffic and Transportation Study

During the study in B.E.2552, Traffic volume on highway Route 304 are 11,855 PCU/Day. According to the result from the traffic model on the project section are summarized as follow.

Traffic forecasting on the project section

Unit: PCU/Day

Year B.E.	Without project	With project	Difference (Percent)
2558	18,900	18,944	0.23
2562	21,386	21,434	0.22
2567	24,474	24,528	0.22
2572	27,582	27,640	0.21
2577	30,671	30,735	0.21

Traffic volumes on the project section will increase every year. Comparison between having and not having this project, the differences of traffic volume on the project section is minimal. However, if this project will constructed, the benefits to road users would be increased on safety and level of service that it might be the main objective to the project section.

4. Typical Cross Sections

According to the project study, there are separated in 2 typical cross sections. The first section between KM.42+000 to KM.48+600 will improve the existing road in the northbound, beside on the southbound will separate grade and median. Furthermore, to be reduced the accident by reviewing on gradient in each location and section. The second section between KM.48+600 to KM.57+000 will improve on the existing road in the northbound and widens the southbound on the rightside of existing road and construct new raised median. The two bridges which 330 metres long eachside between KM.42+600 to KM.42+930, which will cross the valley for the wildlife corridor (animal trail). The community areas nearly the end of the project would ulimated designs of the typical cross section.

5. Project Cost

The total cost estimation is about 951,563,360 Baht. This cost is including with an engineering service cost (Detailed Design and Supervision) about 45,312,540 Baht and construction cost about 906,250,820 Baht. The operation costs comprised of routine maintenance cost about 1.80 million Baht/year and periodic maintenance costs are seal coat 3 year/time for about 12.04 million Baht and overlay 7 year/time for about 73.74 million Baht. The environmental costs are comprised environmental

monitoring cost on construction phase about 2.14 million Baht and environmental monitoring cost on operation phase about 5.55 million Baht.

6. Environmental Impact

Environmental Factors	Recommendation for mitigate the environmental impact
•The alignment pass through the two national parks that were registered as the National World Heritage Sites	• Provide wildlife corridor for animal trial between two national parks without disturbing from the traffic.
•Forest resource	• Ask permission from the responsible authority before road construction begins.
•The clearing before construction causes the erosion especially on the steep terrain.	• Provide ditch lining and plant cover crop along back slope and toe slope
•Noise causes from the traffic	• Control speed limit and provide noise barrier.
•The construction activities may disturb wildlife resources in the cases of residential areas and food supplies.	• Improve the finished terrain within right of way to be the same as natural forest.
•Transportation impacts	• Construct the new roadway to service the traffic and then improve the existing roadway. • Be careful about the scouting of local roads.
•Accidents and safety	• Improve the gradient of the road with sufficient sight distance, construct emergency escaped ramp at long steep gradient and construct climbing lanes for heavy truck.
•Road user, U-Turn and Black Spot	• Construct U-Turn at safety sites.

7. Public Participation

During Public Participation stage, there are three main seminars and two sub-seminars. The target groups are communities along sides of the highway project and its vicinity, government and non-

government organization and local spirit leaders of the communities. The main recommendation subjects in each seminar are about road safety and wildlife corridor issues.

8. Project Analysis

The project analysis is effective for investment and expected to opening for traffic in B.E.2558.

- Net Present Value (NPV) 344.79 million Baht
- Economic Internal Rate of Return (EIRR) 17.92 %
- Benefit/Cost Ratio (B/C) 1.57
- First Year Rate of Return (FYRR) 17.19 %

Project Plan and Budget

Description	Year				Total (Baht)
	1	2	3	4	
1. Survey and Detailed Design	15,859,390				15,859,390
2. Supervision Works		5,890,630	11,781,260	11,781,260	29,453,150
3. Construction Works		181,250,164	362,500,328	362,500,328	906,250,820
Total	15,859,390	187,140,794	374,281,588	374,281,588	951,563,360

Chapter 1

Introduction

Chapter 1

Introduction

1.1 Background and Objective of the Project

The Highway Route 304 Section A. Kabin Buri – A. Pak Thong Chai was constructed as temporary road in B.E.2498. In B.E.2508, there was improved to asphaltic concrete road by Supreme Commander Office which supported by the US army. Presently, this section have total distance about 110 kilometers and it is a part of the four lanes highway expansion project phase II, and a part of highway network No.7 that connected between Eastern and Northeastern region of Thailand. This highway section have promoted on trading, tourism and investment on the agricultural and industrial of Thailand into indo-china region and worldwide markets.

Highway Route 304 Section A. Kabin Buri – A. Pak Thong Chai have almost widened to four lanes, except from KM.42+000 to KM.57+000. A part of this route section are located in the important environmental sensitive areas, the Khao Yai National Park, the Thap Lan National Park and terrestrial watershed of level 1 and 2 areas. Thus, the Environmental Impact Assessment (EIA) report must be prepared and submitted to the National Environment Board for consideration, with its comments and recommendations further submitted the cabinet for approval prior the project implementation.

The feasibility study for economic, engineering and envioronmental impact assessment on the four lanes widening project on Highway Route 304 Section A. Kabin Buri – A. Pak Thong Chai, between KM.42+000 and KM.57+000 which total distance about 15 kilometers. The objectives of this project are summarized as follows:

- (1) To study, summarize and analyze on the alignment, methodology and construction method that feasible for investment and minimize environmental impact
- (2) To study, summarize and analyze on the traffic condition and simulate in the future
- (3) To conduct the preliminary design and estimate construction cost
- (4) To study, summarize and analyze the road user costs
- (5) To study, summarize and analyze the social aspect
- (6) To study, summarize and analyze on the environmental including impact assessment related to the project
- (7) To examine on Environmental Management Plan
- (8) To analyze on feasible investment by using economic index

- (9) To examine on the feasibility study report and Environmental Impact Assessment (EIA) of the project, these will be used for the approval process of the unit concerns prior the project implementation

1.2 Project Location and Route Alignment

The location and route alignment of the project, Highway Route 304 Section A. Kabin Buri – A. Pak Thong Chai between KM.42+000 and KM.57+000 which total distance about 15 kilometers. (Figure 1.2-1 Project Location and Figure 1.2-2 Project Route Alignment). This highway is starting from KM.0+000 at the Kabin Buri intersection and ending at KM.109+754 at Pak Thong Chai intersection (crossing with Route 24). This alignment located in the area of Prachin Buri and Nakorn Ratchasima provinces and divided areas at KM.55+362.

The Project route alignment is starting from KM.42+000 in Tumbol Bu Pram, Amphoe Na Dee, Prachin Buri Province and ending at KM.57+000 in Tumbol Wang Nam Kieo, Amphoe Wang Nam Kieo, Nakorn Ratchasima Province. Mostly, the area are two highway traffic lanes, the surface is asphaltic concrete pavement with 7.00 meter traffic lane and 1.50 meter in each shoulder lanes. The right of way is about 40.00 meter in each side. The highway in this section is quite good condition on maintenance works and between KM.44+000 and KM.55+000 is located in terrain area. It is quite low standard due to high gradient, and surrounding alongside are valley and mountainous areas. On the left side is the Khao Yai National Park area and on the right side is the Thap Lan National Park area. There are some trespass housing and agricultural works on along the area. The critical point which high accident occurred is located between KM.44+200 and KM.44+800. The highest point on this route at KM.55+125, that is 612.855 meter above mean sea level. The highway authorization area divided at KM.55+362 between Prachin Buri Highway District and Nakhon Ratchasima Highway District 3. Currently, there are four lane widened from KM.55+362 to KM.57+000 and community area along at nearly ending area.



Figure 1.2-1 Project Location

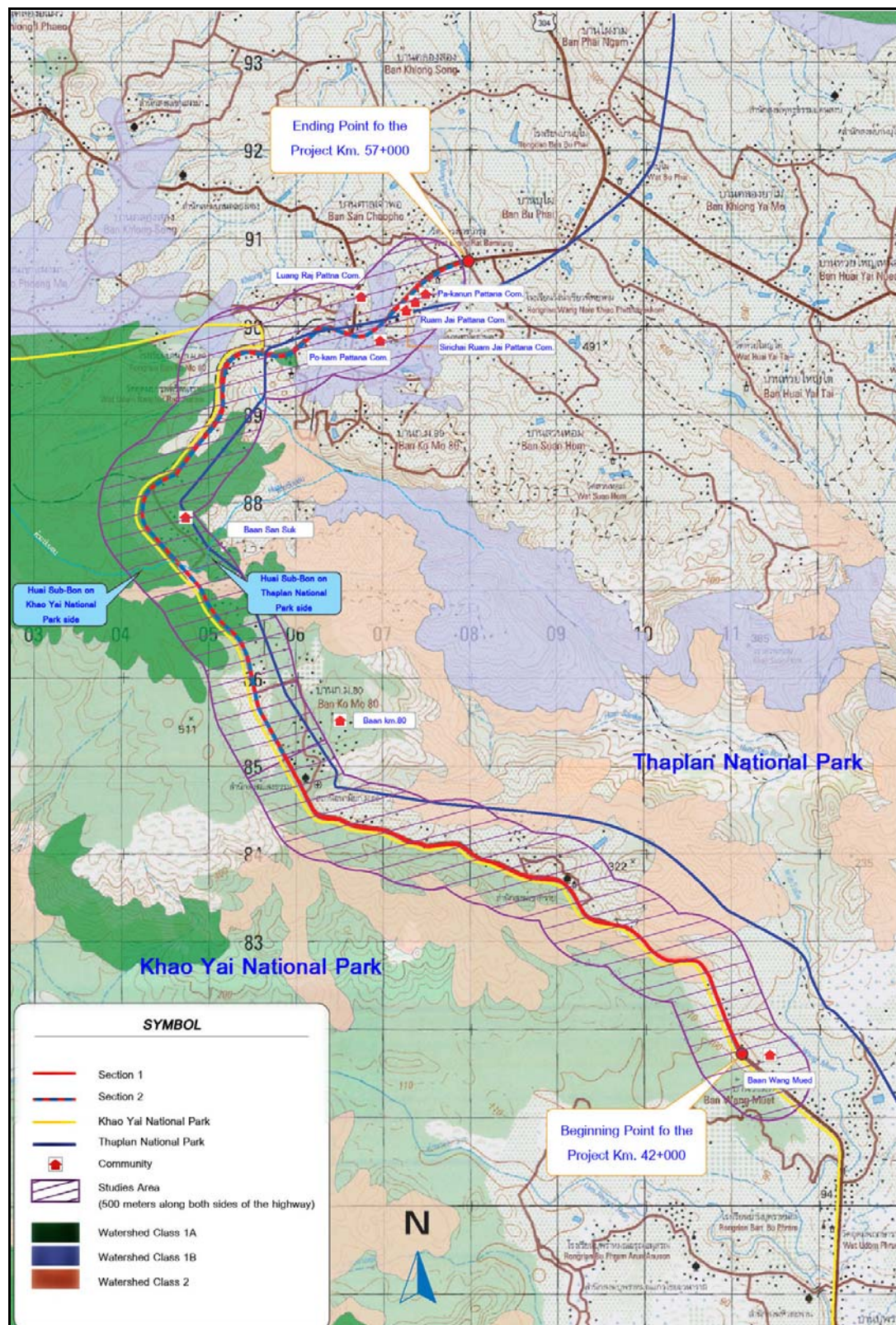


Figure 1.2-2 Project Route Alignment

Chapter 2

Socio-Economic Study

Chapter 2

Socio - Economic Study

2.1 Socio – Economic Conditions in Study Area

The socio-economic study covers the information collection and analysis of the national, regional and provincial levels in the study area. The study area is included, Nakhon Ratchasima, Prachin Buri, Chachoengsao, Sa Kaeo, Chon Buri and Rayong.

2.1.1 Gross Domestic Product (GDP) and Gross Regional Product (GRP)

The studying on Gross Domestic Product (GDP) were 4.24 million million baht in B.E.2550 and average growth rate of GRP in Eastern region and North-Eastern region were about 8.29 percent per year and 5.09 percent per year, respectively.

2.1.2 Gross Provincial Product (GPP)

Refer to the information data in B.E.2550, Gross Provincial Product (GPP) sum of six provinces in the study area were about 717,283 million baht or 16.9 percent of GDP.

2.1.3 Population

In B.E.2550, Thailand had population about 63 million peoples. There were about 21.3 million and 4.4 million in the North-Eastern and Eastern region respectively. The population growth rate during B.E.2547 - 2550 was about 0.56 percent per year.

2.1.4 Average Income per Capita

In B.E.2550, the income per capita is about 67,333 baht per person per year. There was increased from B.E.2544 with growth rate about 5.33 percent per year. Beside, consideration in regional of study area, North-Eastern and Eastern were about 19,789 and 153,149 baht per person per year. The growth rates of average income per capita were 7.48 percent per year for Eastern region and 5.18 percent per year for North-Eastern region, respectively.

2.1.5 Employment

In B.E.2550, Thailand's workforce had about 36.8 million employments. There were 11.8 million in North-Eastern and 2.6 million in Eastern region, respectively. Beside, the growth rate of the

national's employment during B.E. 2544 - 2550 were about 1.82 percent and in regional were 1.82 percent and 3.16 percent in the North-Eastern and Eastern region, respectively.

2.1.6 Tourism

The provincial in the study area have potential for tourism, which quite high due to many attraction places such as waterfalls, mountains, forests and tourism history culture that attractive to the visitors. According to the Tourism Authority of Thailand's statistics of visitors in the study area in B.E. 2550, Chon Buri and Nakhon Ratchasima provinces were highly visitors, which about 7.24 and 5.43 million respectively, the average growth rate of visitors quite high, especially in Nakhon Ratchasima, the average growth rate was about 17.76 percent per year.

2.1.7 Industrial Estate

The provincial in the study area has several industrial estates, especicially in Rayong province. The nearest industrial estate to the project area is the Industrial Estate 304, where located in Amphor Sri Maha Bho, Prachin Buri province nearby the beginning of the project.

2.1.8 Land Uses

The study of land use, are required to determine the currently land used and after the project will be done. The Department of Land Development concluded that the provincial in the study area has approximately area about 28.57 million rai or 45,717 square kilometers, that representing 8.91 percent of the area of Thailand.

The study area is comprised agricultural land about 19.5 million rai or 31,153 square kilometers or 68.14 percent of the total study area. Beside, the foresting land 5.3 million rai or 8,457 square kilometers or 18.50 percent of the total study area, the communities and buildings area are roughly 2 million rai or 3,159 square kilometers and 6.91 percent of the total study area.

2.1.9 Vehicle Registration

In B.E. 2551, the official registration vehicles were about 2,923,384 units, with registered under the public unit about 125,705 units and mostly registered on personel unit. Mostly of personnel unit was motorcycle about 2,019,391 units and personnel truck about 544,705 units.

2.1.10 Health, Education and Religion

In B.E. 2551, the education in study area were about 2,816 schools 37,696 teachers 32,855 classrooms and 780,286 students. There were 84 government and 30 private hospitals, 925 public health centers and 1,532 clinics. Most people were Buddhism with about 3,430 tamples in the study area.

2.2 Changing Analytical and Forecasting on Socio - Economic Study

Forecasting on socio-economic study in the future is a crucial step for the feasibility study of the project, because of population and household income are affecting to transportation demand in the future. The forecasting on economic and social information for the purpose of the database that will used to forecast the amount of travel that occur in the project area. The estimates of population and the economic growth rate in the future. The consultant has considered by using data from the expectations made by the government. The reason that the selected data from the government would follow the framework of the national development, the result would more consistent and updated before forecasting.

2.2.1 Population Forecasting

The population study is related to life and human impact in social, cultural, political and general economic. The analysis of potential changes in population structure will rely on a database of population birthplace, death information and migration. These assumptions will use for predicting population basis. The forecasting population from report of the Office of National Economic and Social Development and updated estimates using data of population corrected from the population by province, Registration Division, Department of Province Administration, which is B.E. 2551 as base year and then analyze the population trends, to obtain estimates of the rate of change. In summary, the populations in the study area are 6,094,102 in B.E.2551 and 6,777,281 in B.E.2577.

2.2.2 Economic Forecasting

The Economic is forecasting by the rate of change in economic conditions, and the values of GPP. The forecasting of the growth rate of GPP are 3.8 percent in B.E.2551 and 4.9 percent in B.E.2577.

2.3 Conclusion on Socio - Economic Study

Although the currently study on the economic growth rate is not much high enough as expected but it would be continued stability with potential growing in the future. However, to be consideration on the development plan, that would be promoted the growth rate of economy and society in the study area. The expected result of variations in economic and social, these will using in the study of traffic and transportation in order to analyze demand of travel and transport in the future and project analysis.

Chapter 3

Traffic and Transportation Study

Chapter 3

Traffic and Transportation Study

3.1 Objective

A study of traffic and transportation on Highway Route 304 Section A. Kabin Buri – A. Pak Thong Chai, and vicinity highway network that effects to the project (as shown in Figure 3.1-1), it was to forecast traffic volume on the highway network. The results were further used in highway design accordings to highway engineering standards, by specifying highway geometric, evaluating traffic on highway as a result of four-lanes highway widening project.

3.2 Traffic and Transportation Data Surveys

Traffic and transportation surveys were conducted in the study area. The data was then used for an analysis of present traffic condition and used as a basic data for traffic model development. The model will be used to forecast traffic in the future.

The traffic and transportation data surveys included:

- Mid Block Traffic Count 3 locations
- Turning Movement Count 3 locations
- Origin - Destination Survey 4 locations
- Traffic Speed Survey

3.3 Traffic Analysis Results

In case of the widening of Highway Route No. 304 between KM.42+000 and KM.57+000, the traffic analysis will be forecasted to years B.E. 2558, 2562, 2567, 2572 and 2577. The construction is expected to be finished and opened to traffic in B.E. 2558.

According to the results from the model, the traffic volume on the project section (PCU/day) will increase from 2.25 to 4.94 percent per year as shown in Table 3.3-1. When comparing between with and without project, cases the differences of traffic volumes on the project section are minimal. However, if this project is constructed, the benefits to road users will include increased of road safety and level of service.

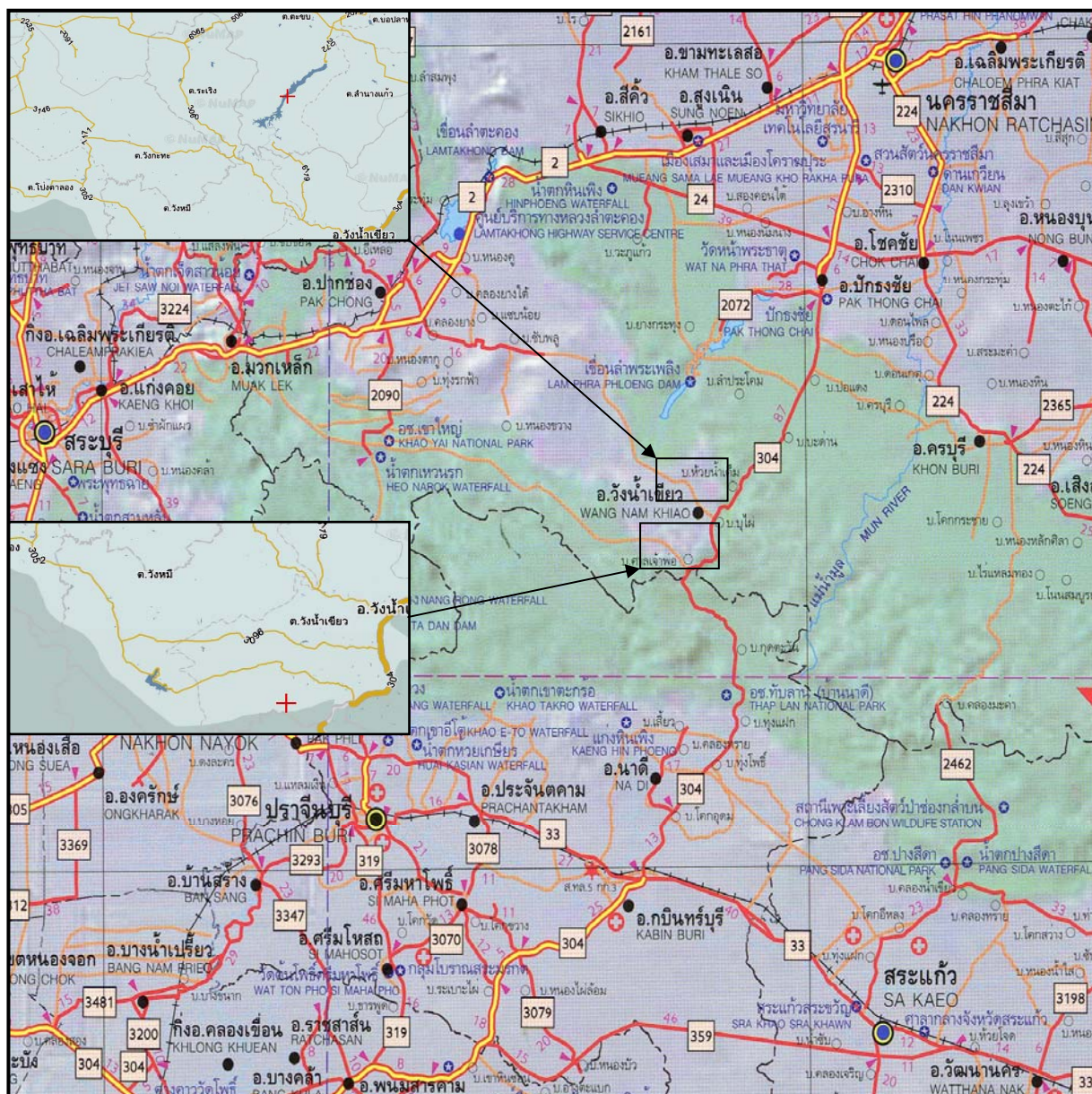


Figure 3.1-1 Highway Network in the Study Area

Table 3.3-1 Total Traffic Volume (PCU/day) during B.E.2558 and 2577

Year B.E.	Total Traffic Volume (PCU / day)	Annual Growth Rate (percent)
2558	37,382	4.82
2562	42,294	3.40
2567	48,419	2.90
2572	54,559	2.54
2577	60,684	2.25

Table 3.3-2 Traffic Volume on the Project Section (PCU/day) during B.E.2558 and 2577

Year B.E.	Without Project	With Project	Difference (Percent)
2558	18,900	18,944	0.23
2562	21,386	21,434	0.22
2567	24,474	24,528	0.22
2572	27,582	27,640	0.21
2577	30,671	30,735	0.21

Regarding to the efficiencies of the highway network as shown in Table 3.3-3, the average speed of highway network will increase from 3.09 to 4.54 kolometer per hour during B.E. 2552 and 2577, respectively. For the with highway project case, not only the number of lanes will increase but also the safety for road users will increase.

Table 3.3-3 Efficiencies of Highway Network in the Future (Unit: per day)

Year B.E	VKT (PCU-km)			VHT (PCU-hr)			Average Speed of the Network (km / hr)		
	Without Project	With Project	Difference	Without Project	With Project	Difference	Without Project	With Project	Difference
2552	1,837,412	1,838,372	960	29,584	28,196	-1,388	62.11	65.20	3.09
2558	2,355,243	2,356,381	1,138	38,016	36,176	-1,840	61.95	65.14	3.19
2562	2,657,539	2,658,781	1,242	43,002	40,848	-2,153	61.80	65.09	3.29
2567	3,032,630	3,034,001	1,371	49,311	46,665	-2,645	61.50	65.02	3.52
2572	3,409,558	3,411,059	1,500	55,893	52,550	-3,343	61.00	64.91	3.91
2577	3,784,204	3,785,834	1,630	62,843	58,464	-4,379	60.22	64.76	4.54

According to the Highway Capacity Manual 2000 (HCM 2000), for a case of two lanes the level of highway, service by using a percent time spent following other vehicles and average travel speed. For more than two lanes highway, is classified the level of service is classified by traffic density. Therefore, the analysis of level of services in cases of with and without project is performed by using different approaches.

In the case of without project, the level of service is “E” and will change to “F” in the B.E. 2562. Therefore, to maintain the level of service “D”, the widening project needs to be started immediately. In the case of with project, the level of service will change from “C” to “D” in B.E. 2562 and still at “D” to B.E. 2577.

Table 3.3-4 Level of Service during Peak Hours, with and without Project Cases

Year B.E.	Level of Service	
	Without Project	With Project
2552	E	C
2558	E	C
2562	F	D
2567	F	D
2572	F	D
2577	F	D

Chapter 4

Route Alternative Study

Chapter 4

Route Alternative Study

4.1 Preliminary Route Selection

Since project route is located between Khao Yai National Park and Thap Lan National Park, the road alignment cannot be considered out of the existing right of way and it is located in the different terrain area. Therefore, the project route shall divide into two section areas:

- **The First Section:** between KM.42+000 and KM.48+600, there are two alternatives selection in the mountainous terrain.
 - 1) Typical Cross Section I: widen to the right side with concrete barrier median
 - 2) Typical Cross Section II: separated roadway profile grades
- **The Second Section:** between KM.48+600 and KM.57+000, there are three alternatives selection in the rolling terrain.
 - 1) Typical Cross Section I: widen to the right side with raised median
 - 2) Typical Cross Section II: widen to the right side with concrete barrier median
 - 3) Typical Cross Section III: widen to the right side with depressed median

4.2 Principles for Selecting Typical Cross Section

There are considerations in three technical categories:

1.	Engineering and Traffic	35	scores
2.	Socio-Economic	25	scores
3.	Environmental Impact	40	scores
	Total	100	scores

4.3 Conclusion of Route Selection

Considered each category, and then the conclusions in each section are concluded as follows.

- **The First Section:** between KM.42+000 and KM.48+600: the “Typical Cross Section II” selected, that is separate roadway profile grades as shown in Table 4.3-1.
- **The Second Section:** between KM.48+600 and KM.57+000: the “Typical Cross Section I” selected, that is widening to the right side with raised median as shown in Table 4.3-2.

Table 4.3-1 Consideration Results of the First Section: between KM.42+000 and KM.48+600

No.	Category of Evaluation	Score	Scores for the first section (KM. 42+000 to KM .48+600)	
			Typical Cross Section I	Typical Cross Section II
1	<u>Engineering and Traffic</u>	35.00	18.16	28.60
	1.1 Geometry			
	1.1.1 Vertical curves	4.00	2.68	2.80
	1.1.2 Gradation	4.00	1.81	1.94
	1.1.3 Sight distance	4.00	2.95	3.02
	1.2 Technical of Construction			
	1.2.1 Difficulty	7.00	4.20	7.00
	1.2.2 Drainage	6.00	3.60	6.00
	1.3 Traffic factors			
	1.3.1 Traffic flow	4.00	1.72	1.85
	1.3.2 Traffic management	6.00	1.20	6.00
2	<u>Socio-Economic</u>	25.00	21.00	21.70
	2.1 Cost of construction	15.00	15.00	11.70
	2.2 Maintenance cost	10.00	6.00	10.00
3	<u>Environmental Impacts</u>	40.00	15.80	24.20
	3.1 Landscape	9.00	5.40	7.20
	3.2 Soil	8.00	4.20	4.60
	3.3 Noise and Vibration	8.00	1.60	4.80
	3.4 Wildlife	8.00	3.20	4.80
	3.5 Forest	7.00	1.40	2.80
Total		100.00	54.96	74.50

Table 4.3-2 Consideration Results of the Second Section: between KM.48+600 and KM.57+000

No.	Category of Evaluation	Score	Scores for the second section (KM. 48+600 to Km.57+000)		
			Typical Cross Section I	Typical Cross Section II	Typical Cross Section III
1	<u>Engineering and Traffic</u>	35.00	32.98	22.97	22.98
	1.1 Geometry				
	1.1.1 Vertical curves	4.00	3.63	3.63	3.63
	1.1.2 Gradation	4.00	3.37	3.36	3.37
	1.1.3 Sight distance	4.00	3.57	3.57	3.57
	1.2 Technical of Construction				
	1.2.1 Difficulty	7.00	7.00	4.20	4.20
	1.2.2 Drainage	6.00	6.00	3.60	1.20
	1.3 Traffic factor				
	1.3.1 Traffic flow	4.00	3.41	3.41	3.41
	1.3.2 Traffic management	6.00	6.00	1.20	3.60
2	<u>Socio-Economic</u>	25.00	23.95	21.00	14.40
	2.1 Cost of construction	15.00	13.95	15.00	8.40
	2.2 Maintenance cost	10.00	10.00	6.00	6.00
3	<u>Environmental Impact</u>	40.00	32.00	32.00	16.00
	3.1 Landscape	10.00	8.00	8.00	4.00
	3.2 Soil	9.00	9.00	9.00	3.60
	3.3 Forrest	9.00	5.40	5.40	3.60
	3.4 Socio-economic	12.00	9.60	9.60	4.80
รวม		100.00	88.93	75.97	53.38

4.4 Wildlife Corridor Study

Due to the construction road will be located between the two National Parks, the animal trail (wildlife corridor) is required. The animal can wander from time to time between two National Parks without any disturbing from the project road.

4.4.1 Type of Wildlife Corridor

According to the study resulted, the suitable location for wildlife corridor would be located between KM.42+000 and KM.44+000. Two types of wildlife corridor were considered for selection.

- **Alternative I: Bridge Crossing between KM.41+900 and KM.42+600 and Box Culvert at KM.42+750**

Raise the bridge over the valley between KM.41+900 to KM.42+600 and improve the terrain under the bridge to be suitable for animal trespassing. Construct noise barriers and fencing along left and right side of the highway between KM.41+500 to KM.42+000 and KM.42+600 to KM.43+000.

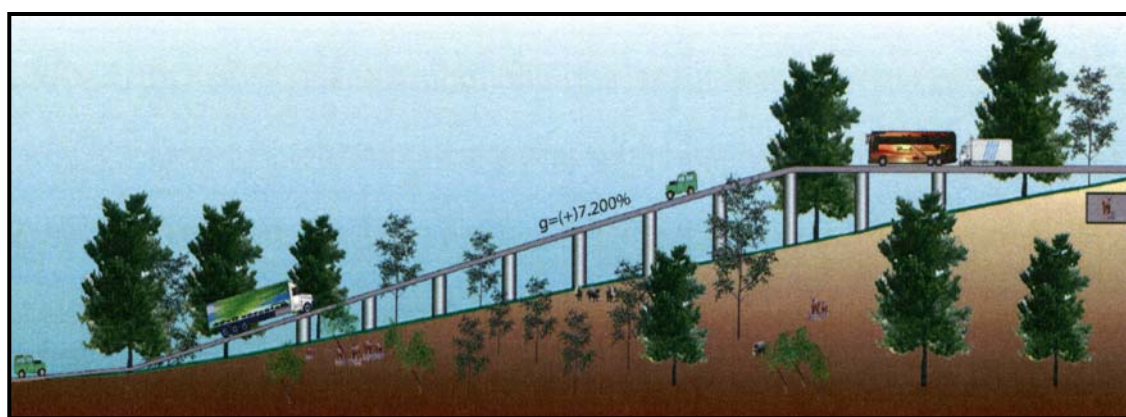
On the existing road, construct box culvert with size 2 - (3.60x3.60) meter and fencing at KM.42+750 for animals passing under the highway as shown in Figure 4.4-1.

- **Alternative II: Bridges Crossing the valley between KM.42+600 and KM.42+930**

Construct the bridge between KM.42+600 to KM.42+930 both northbound and southbound. Improve underneath the bridges to be suitable for animal trespassing. The heights of the bridge are approximately 7 meters. Construct noise barriers and fences along left and right side of the highway between KM.41 +800 to KM.42+600 and KM.42 +930 to KM.43+080, as shown in Figure 4.4-2.

4.4.2 Principle for Selecting Wildlife Corridor

Three technical categories are considered; appropriate in Engineering, Economic and Environmental Impact. Result of considerations shows in Table 4.4-1 to Table 4.4-3. **The Wildlife Corridor “Alternative II” is more suitable than “Alternative I” in all aspect factors.**



**Figure 4.4-1 Alternative I: Bridge Crossing between KM.41+900 and KM.42+600
and Box Culvert at KM.42+750**



Figure 4.4-2 Alternative II: Bridge Crossing the Valley between KM.42+600 and KM.42+930

Table 4.4-1 Result of Engineering Consideration

Consideration case	Identification		Appropriateness	
	Alternative I	Alternative II	Alternative I	Alternative II
Gradation	7.14 %	3.80 %	Not good	Good
Topography	Overhead bridge	Bridge crossing the valley	Moderate	Not good

Table 4.4-2 Result of Economic Consideration

Consideration case	Identification		Appropriateness	
	Alternative I	Alternative II	Alternative I	Alternative II
Construction Cost (million baht)	170.810	136.943	Not good	Good

Table 4.4-3 Result of Environmental Impact Consideration

Consideration case	Identification		Appropriateness	
	Alternative I	Alternative II	Alternative I	Alternative II
1. Physiographic	KM.42+375 to KM.42+625: Thap Lan National Park area is at the foothills and high steep	KM.42+600 to KM.42+930 both sides of the area are valley and low steep	Moderate	Good
2. Area of ecosystem with type and distribution of animals	The ecology of Khao Yai National Park is mixed deciduous and dry evergreen forest, Thap Lan National Park is planning forest with mixed deciduous and dry evergreen forest.	Same as Alternative I	Good	Good
3. Wildlife behavior	All wildlife uses this animal trail with no limit.	All wildlife from nearest areas is the same type. All animal can uses animal trail with more comfortable.	Good	Better
4. Disturbance from human behavior	The disturbance from human is less than the other area.	Same as Alternative I	Moderate	Moderate

Chapter 5

Engineering Study

Chapter 5

Engineering Study

5.1 Route Survey

Basically information for preliminary design of the route alignment based on topographic map 1:50,000 (Location 5337-I / L7018) B.E.2542 from the army map 1:4,000 B.E.2549 from GISTDA existing construction drawing B.E.2539 and the highway's property record list. These information will further use for the route selection and preliminary design.

5.2 Geology and Material Investigation

5.2.1 Geology

General geology of the project section between KM.42+000 and KM.57+000 is the Phu Kradung formation, which a part of Khorat group in Jurassic period.

5.2.2 Soil Investigation

Subgrade soils are classified into two sections by terrain.

- **The First Section:** between KM.42+500 and KM.49+500, it is mountainous terrain. Subgrade soil is sand with clay, CBR values are 8.7 to 30.7%, classified in A-2-7, A-2-6, A-6 and A-1-B groups.
- **The Second Section:** between KM.49+500 and KM.56+500, it is rolling terrain. Subgrade soil is sandy clay, CBR values are 3.3 to 7.8%, classified in A-7-6 and A-6 groups.

5.2.3 Boring Log

There are two locations for the future bridge location.

- **The First Boring Log:** at KM.42+500 on the right side (BH1) Subgrade is sand with clay and gravel, 4 meters depth from natural ground level and SPT-N values are between 15 and 50 counts per 6 inches. Bedrock is sandstone and siltstone, from 5 to 6 meters depth from natural ground level and Rock Quality Designation (RQD) is from 0 to 35%.
- **The Second Boring Log:** at KM.51+050 on the right (BH2). The first layer of subgrade is sandy clay and silty clay, 8.50 meters depth from natural ground level, SPT-N values are between 6 and 12 counts/foot. The second layer of subgrade is silty sand, from 8.50 to 10.40 meters depth from natural ground level. Bedrock is granodiorite with joint dips between 30 and 60 degrees and Rock Quality Designation (RQD) is from 0 to 100%.

5.3 Preliminary Design

Preliminary design for the widening project is designed to corresponding to the DOH standard with environmental impact consideration.

5.3.1 Climbing Lane

There are three sites of climbing lane provided, between KM.43+200 and KM.44+000, between KM.44+600 and KM.45+700 and between KM.46+000 and KM.47+450.

5.3.2 Emergency Escape Ramp

There are two emergency escape ramps provided at KM.44+800 and KM.46+050.

5.3.3 Typical Cross Section

From the results of route selection in Chapter 4, typical cross sections are designed as follow.

- **The First Section:** between KM.42+000 and KM.48+600, it is mountainous terrain. Typical cross section is separated roadway grade, northbound use existing road and southbound is new separated grade with median 6.00 meter wide and U-Turn provided in community area and safety locations, typical cross section shown in Figure 5.3-1 and Figure 5.3-2.
- **The Second Section:** between KM.48+600 and KM.57+000, it is rolling terrain. Typical cross section is separated roadway direction with raised median and U-Turn provided in community area and safety locations, typical cross section shown in Figure 5.3-3.

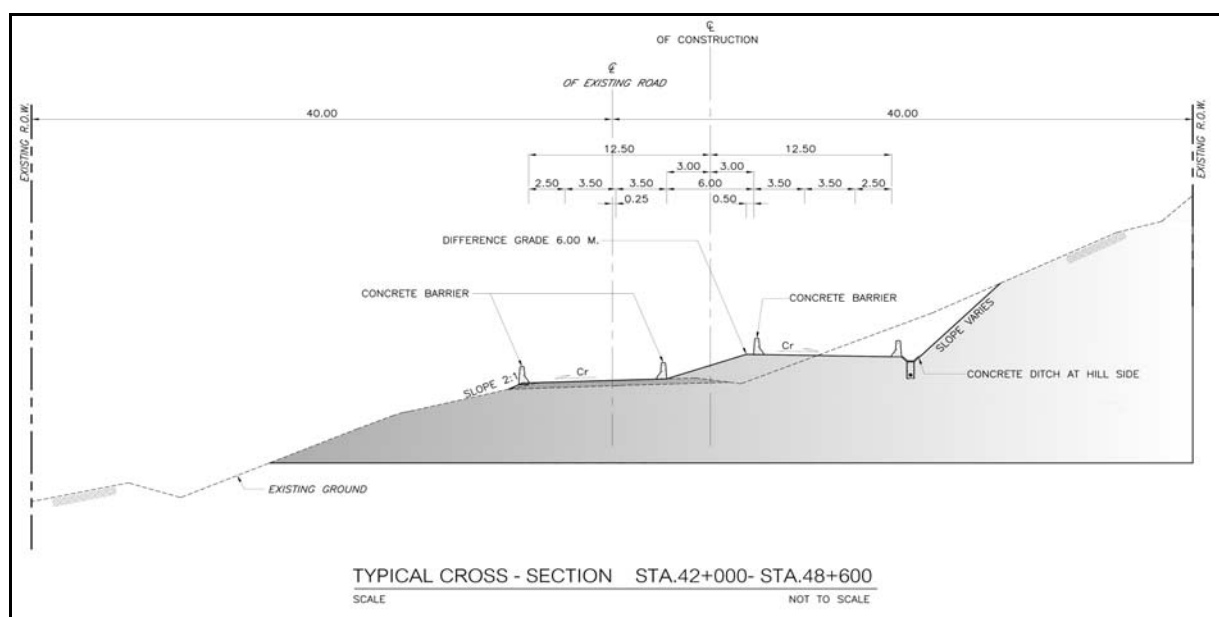
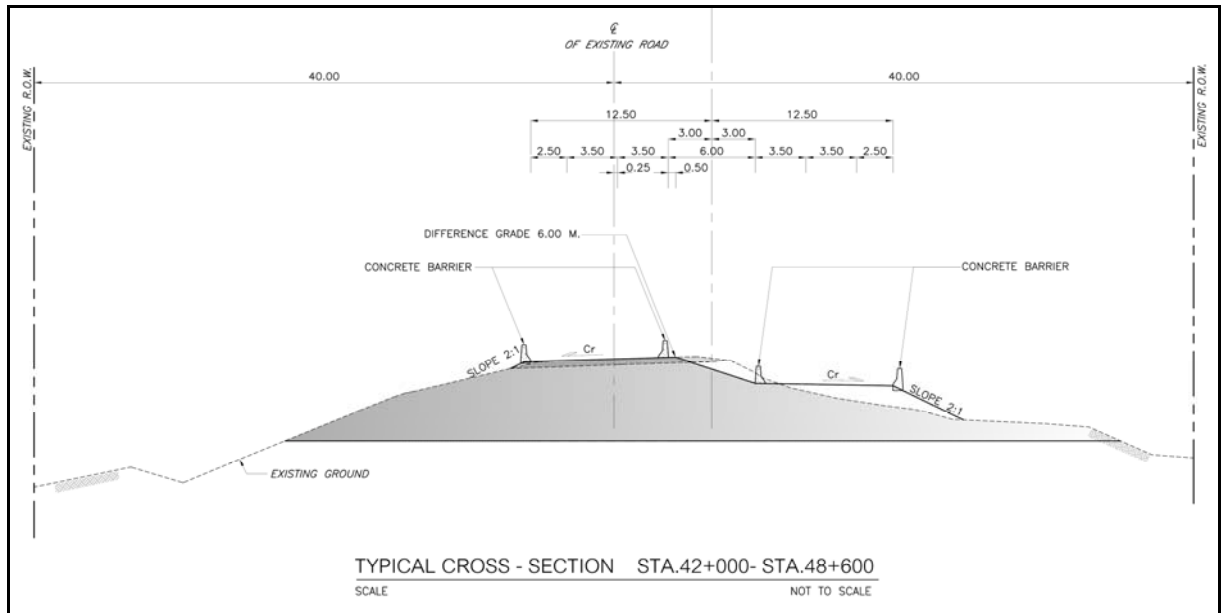
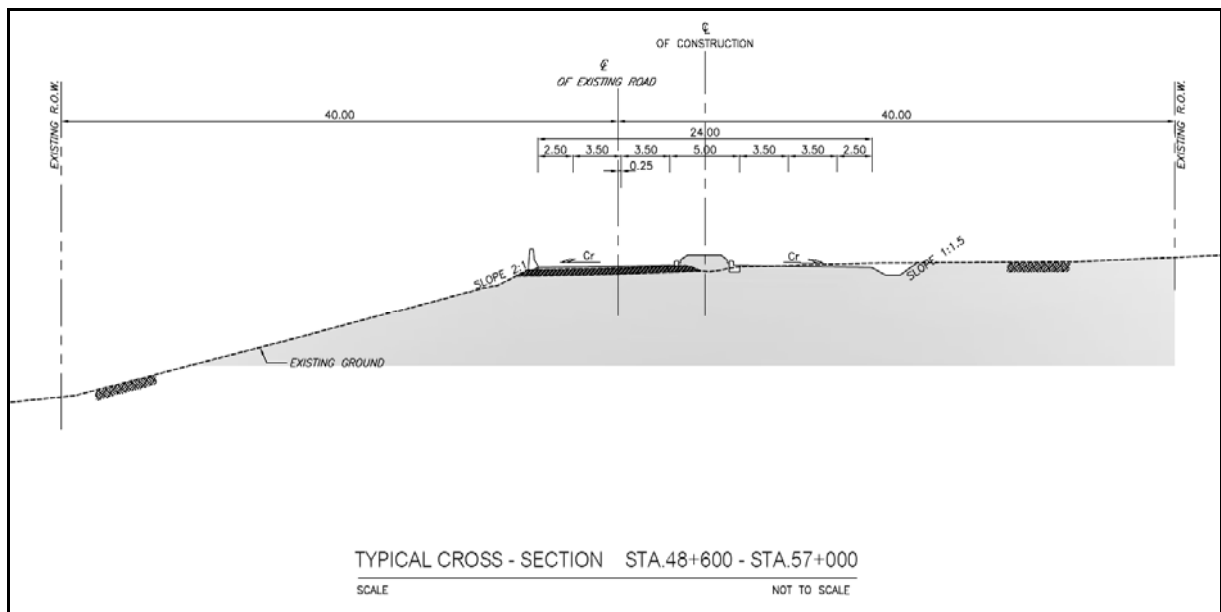


Figure 5.3-1 Typical Cross Section for the First Section: Separated Grade

(New roadway is higher than existing roadway)



**Figure 5.3-2 Typical Cross Section for the First Section: Separated Grade
(Existing roadway is higher than new roadway)**



**Figure 5.3-3 Typical Cross Section for the Second Section: Separated Roadway Direction with
Raised Median**

5.3.4 Pavement Structure

This section will use flexible pavement type, which would more suitable than rigid pavement type. Analytical design is the designed method, designed life is 20 years and percent of heavy truck is 30.12%.

- **The First Section:** between KM.42+000 and KM.48+600, designed CBR subgrade is 9 % and pavement structure 0.50 meter thick.
- **The Second Section:** between KM.48+600 and KM.57+000, designed CBR subgrade is 4 % and pavement structure 1.00 meter thick.

The result of the existing pavement test by falling weight deflectometer method, the existing road shall be improved by milling the existing pavement off 0.05 meter and levelling the pavement with crushed rock and then used cold mix recycling method 0.30 meter depth and overlaid two layers by asphaltic concrete 0.10 meter thickness.

5.3.5 Drainage

Concrete pipe culverts shall be replaced all existing steel pipe culverts with the same numbers, diameter and locations. There are two bridges in road project shall be constructed.

- **The First Location** at KM.42+765, it is the bridge for the wildlife corridor bridge with size of $2-(3 \times 10.00 + 13 \times 20.00 + 4 \times 10.00) = 2 \times 330$ meters.
- **The Second Location** at KM.51+025, it is the bridge over water reservoir outbound bridge with size of $(1 \times 10.00) + (2 \times 20.00) + (1 \times 10.00) = 60.00$ meters.

5.3.6 Pedestrian bridge

There are two pedestrian bridges shall be constructed in the community area and school, that would be provided at KM.54+550 and KM.55+900.

5.3.7 Typical Cross Section at Community Area

Typical cross section at community area between KM.55+200 and KM.56+800 are shown in Figure 5.3-4

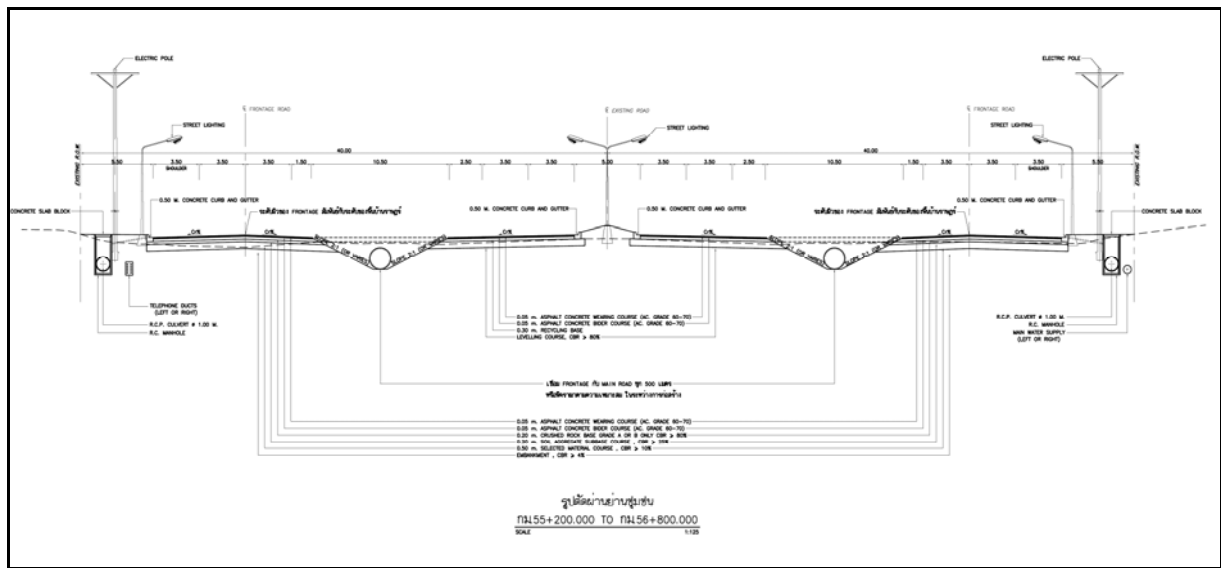


Figure 5.3-4 Typical Cross Section at Community Area between KM.55+200 and KM.56+800

5.3.8 Cost Estimation

The cost estimation is calculated according to the Comptroller General's Department, Ministry of Finance standard. This cost is determined based on operating cost, profit and taxes. The estimation is based on the diesel price rate of 22.90 baht/liter, which is estimated in B.E.2552 price. In addition to the engineering service cost that comprised of survey/detailed design and supervision costs and the project is located in the sensitive area and connected to the Khao Yai and Thap Lan National Parks, the engineering service is, therefore used as 5% of the construction cost.

According to the project is surrounded by the National Park areas, the estimation are considered in the material and transportation cost under the specified area and working in the mountainous terrain location. Therefore, the estimation prices of material and transportation costs are higher than usual.

The cost estimation is 951,563,360 Baht included 10% contingency cost and 5% of engineering service cost.

• Construction Cost	823,864,382	Baht
• Contingency Cost 10%	82,386,438	Baht
• Total Cost of Construction	906,250,820	Baht
• Engineering Service 5%	45,312,540	Baht
• Total Cost	951,563,360	Baht

5.3.9 Operation Costs

According to the flexible pavement type, the operation costs are calculated base on Bureau of Highway Maintenance Management's information, concluded as follows.

- Routine Maintenance costs for four lanes is 120,000 Baht/Kilometer/Year and total of 1,800,000 Baht/year
- Periodic Maintenance costs are two cases,
 - Seal Coat 3 year/time @ 40 Baht/m² and total of 12,040,000 Baht/time
 - Overlay 7 year/time @ 245 Baht/ m² and total of 73,745,000 Baht/time

Chapter 6

Environmental Study

Chapter 6

Environmental Study

6.1 Introduction

A part of this route section are located in the important environmental sensitive areas, the Khao Yai National Park, the Thap Lan National Park and terrestrial watershed of level 1 and 2 areas. The highway section runs through the classified areas of watershed between KM.42+500 and KM.43+700, KM.43+850 and KM.43+950. The route runs through watershed area level 2 for the distance of 1,300 meters between KM.49+900 and KM.50+700, KM.51+050 and KM.52+650, KM.54+350 and KM.54+550. The route runs through watershed area level 1A for 2,600 meters between KM.54+800 and KM.54+900, KM.55+150 and KM.55+250, KM.55+400 and KM.55+900, and through watershed area level 1B for 700 meters. It deems necessary to conduct Environmental Impact Assessment (EIA) to propose to the National Environment Board (NEB) for consideration and propose to the Cabinet to get approval before the project implementation.

6.2 Environmental Study

This step of work is to study and analyze the environmental issues which indicated by the Initial Environmental Examination (IEE). The analytical of 37 factors under the 4 environmental issues were considered significant. Subsequently a screening process, there were 15 environmental factors need detailed environmental study, which are physiographic, soil resources, surface water, air and climates, noises, vibrations, forest resources, wildlife resources, aquatic ecosystem, transportation, socio-economics, public health, occupational health and safety, accidents and safety and road users.

The results of study on project impacts on the environmental factors showed both negative and positive impacts at different levels according to each environmental factor from low to moderate impacts. The levels of environmental impacts cause by project development can be summarized as shown in Table 6.2-1

Table 6.2-1 Summary of the Environmental Study

Environmental Factors	Section 1 (KM.42+000 to KM.48+600)	Section 2 (KM.48+600 to KM.57+000)
1. Physiography	- The route runs through watershed areas class 2 from KM. 42+500 to KM. 43+700 and KM. 43+850 to KM. 43+950 with total distance of 1,300 meters. There are deep cuts and high fills throughout this section causing change of topography with moderate negative impacts.	- The project route from KM. 49+900 to 50+ 700, during this section from KM. 51+050 to 50+650 and from KM. 54+350 to 54+500 the area is classified as watershed class 1 A for 2,600 meters and from KM. 54+800 to 54+900, KM 55+150 to 55+250 and KM. 55+400 to 55+900 the area is classified as watershed class 1 B with the distance of 700 meters. These sections are sensitive to soil erosion, but the topography of section 2 is undulating, with few cut and fill works, it will cause low negative impacts.
2. Soil Resources	- Between KM. 42+000 to KM. 48+600 the route lies on mountain slopes with severe soil erosion. During surface opening process with cut and fell works soil erosion may be accelerated causing moderate negative impacts.	- This section areas are rather flat and little undulating. Soil erosion may be low, and with less cut and fill works the impacts are considered to be at low level.
3. Surface Water	- No evidence of water source during the study period, so there will be no impact.	- There is one water way runs through this section, it is Huai Sub Bon (KM.51+000), where on the Khao Yai National Park side it is water source for wildlife, and on Thaplan National Park side, it is the main source of tap water for the community. The development activities, i.e. piling post works, soil works on the rim of the water body may cause water turbidity which can be classified as moderate impacts. Other pollutants, i.e. organic substance, oils and grease and other chemicals from worker shelters and maintenance shops may cause impact at low level because they are designed to construct far away from Huai Sub Bon. But during the operation phase there may be some sediments wash down in surface water and some oils and grease from passer by vehicles at a minimum impact because the road surface cover with asphalt and the road sides have slope protection. With the highway standard and safety, the accident for grease and oils leakage to pollute the water body should be less.

Table 6.2-1 Summary of the Environmental Study (Cont.)

Environmental Factors	Section 1 (KM.42+000 to KM.48+600)	Section 2 (KM.48+600 to KM.57+000)
4. Air and Climates	<ul style="list-style-type: none"> - The air and climatic quality measurements at Saeng Tam Monastery showed that total solid particles (TSP), particle materials smaller than 10 micron (PM-10), nitrogen (NO₂), carbon monoxide (CO), and total hydrocarbon gas (THC) showed less values than standard criteria. The estimated solid particles and air pollutants during the construction and operation phases are not exceed the standard values except the PM-10 will be higher than standard for the 5 m. distance from the highway. But there is no exception along the highway sides, so the impacts are low. 	<ul style="list-style-type: none"> - The air and climatic quality measurements at Sarn-Chao-Por School indicated that total solid particles (TSP), the particle materials smaller than 10 micron (PM-10), nitrogen dioxide (NO₂) carbon monoxide (CO) and total hydro carbon (THC) are lower than standard criteria. From the estimation of dust particles and air pollutants during the operation phase showed that the particle materials, smaller than 10 micron (PM-10) during B.E. 2567-2577 (A.D. 2024-2034) will be higher than standard criteria for the 5 m. distance from the highway sides, so the estimated impacted community may be Pho cum pattana community (KM. 55+500), Pa Ka Nun Pattana community (KM.56+300) and Luang Raj Bum Roong Monastery (KM. 56+500). The impacts may be at moderate negative level.
5. Noises	<ul style="list-style-type: none"> - From the measurement of average noise level in one hour (Leq 1 hr), maximum noise level (Lmax) at Baan KM. 80 monastery station, the noise levels are below standard criteria, while the estimated noise levels from the construction activities showed that the noise level for leq 24 hour will be higher than 70 decibel A, which is higher than standard criteria The affected areas include Khao Sai Monastery (KM. 45+500), Saeng Tam Monastery (KM. 48+000), but the impacts will last for un continuously short period. So it is expected that the impact will be at low level. - The operation phase in B.E. 2577 (AD. 2034) is forecasted to have highest numbers of vehicles. The areas with leq. 24 hour higher than 70 decibel A which is beyond standard criteria at Khao Sai and Saeng Tam Monasteries 	<ul style="list-style-type: none"> - From the measurement of average noise level in one hour (Leq. 1 hr) and maximum noise level (Lmax) at Baan KM. 80 monastery showed that they are below standard criteria, while the prediction of noise level during construction activities showed noise level at Leq. 24 hr is higher than 70 decibel A which is higher than standard criteria for the following areas, i.e. Pho Cum Pattana community (KM. 55+500), Pha Ka Nun Pattana community (KM. 56+300) and Luang Raj Ban Roong Monastery (KM. 56+500). But the impacts will be at short and uncontinuous period. So it is estimated that the impact is at low negative level. - The operation phase in B.E. 2577 (2034) is predicted to have highest traffic the areas with noise level for Leq 24 hour higher than 70 decibel A which is higher than standard criteria be Pho Cum Pattana community (KM. 55+500), Pha Ka Nun Pattana community (KM. 56+300), Udom Ban Pot Rattanaarm Monastery

Table 6.2-1 Summary of the Environmental Study (Cont.)

Environmental Factors	Section 1 (KM.42+000 to KM.48+600)	Section 2 (KM.48+600 to KM.57+000)
5. Noises (Cont.)	are predicted for the day may vary so the negative impact from noise pollution is at moderate level.	(KM. 54+300), Luang Raj Bam Prong Monastery (KM. 56+500) and Sarn Chao Por School (KM. 55+800). But the estimation is based on the worst case by using the highest traffic per hour of the day, but in reality the situation may be different from hour to hour, so the impacts during the operation phase may be at moderate negative level.
6. Vibrations	- The vibrations measurement at Saerg Tam Monastery station showed that the result comparing with the vibrations effect on human proposed by Department of the Navy Naval Facilities Engineering Command, Design Manual 7.3 (NAVFAC DM-7.3) indicated that the vibrations effect on human is almost none and when comparing the highest vibrations with standard values DIN 4150 to constructed structures proposed by Germany, there is no damage on old-age structures. The prediction of vibrations during construction and operation phases revealed that there would be no damage on general constructed structures or any monastery in the vicinity of the development project areas.	- The results of vibrations measurement at Baan KM.80 School station comparing with the standard values proposed by NAVFAC DM-7.3 indicated that the vibrations is almost none by human feelings. When comparing highest vibrations value with standard criteria on constructed structures as DIN 4150 of Germany the results cannot damage old-age structures. The prediction of vibrations during construction and operation phases may cause low impacts on Sarn-Chao-Por Municipal area, Baan KM.80 School, and Baan-Sarn Chao-Por School as a nuisance.
7. Forest Resources	- The roadsides on Khao Yai National Park cover mostly by Dry Evergreen Forest with scatter Mixed Deciduous Forest. The forests conditions are mostly good. On the Thaplan National Park side remaining forests are between KM. 42+00 and KM. 44+000 in rather poor conditions. From KM. 42+000 – 43+000 it is under forest plantation with mixture of Deciduous trees and Rattans. From KM. 43+000 to 44+000 the Dry Evergreen Forest is scattering on mountain slopes.	- On Khao Yai National Park side the forest is Dry Evergreen Forest and scattered Mixed Deciduous Forest with rather good conditions. From KM.55 onwards the areas are under agriculture and community

Table 6.2-1 Summary of the Environmental Study (Cont.)

Environmental Factors	Section 1 (KM.42+000 to KM.48+600)	Section 2 (KM.48+600 to KM.57+000)
7. Forest Resources (Cont.)	<ul style="list-style-type: none"> - The forest tree species to be harvested of ball out on the Thaplan National Park side for the 12 m. from roadside and 15 KM. long are 57 species, 396 trees, with 94 Pradu (<i>Pterocarpus macrocarpus</i>) the most, follow by 35 Ting Ton (<i>Albizia procera</i>), and 32 trees of <i>Alstonia scholaris</i> and Larn (<i>Corypha lecomtei</i>) each. - The total economic values of the 6.16 cubic meter of affected tree species, are about 11,200 Baht, the volume increment of these trees will be 0.12 m³/year, valued 224 Baht/year. The estimation of future timber values at year 20th , will be 7,406.77 Baht, while net present values are 2,791.53 Baht. It is estimated that the impacts on timber quantities and values are at low negative level. - The forest survey results found 22 species, 236 trees of common reserved species, with no special reserved species, according to the national gazette B.E. 2530. There is only 1 reserved forest product, i.e. Larn <i>Corypha lecomtei</i> leaf which need to get permission from the Royal Forest Department for harvesting and transport. So the impact is at low level. - During the operation phase it is expected that there would be no more forest deforestation, because the development project is only traffic lane expansion, no new highway through the forest area. 	
8. Wildlife	<ul style="list-style-type: none"> - Between KM.42 to KM.43 the survey found barking deer, wild boar, bear, and mongoose on both national parks about 200 m. to 2,200 m. from highway route No.304. The development activities may divide the forest areas and interfere wildlifes as negative moderate impacts. - The development activities may interfere wildlife habitats and food sources, but wildlife can escape into deeper forest areas, so the impact will be at low negative level. - During construction phase, the loud noises from vehicle engines may interfere to the life styles of wildlife, but the impacts are considered to be at low negative level. - During the operation phase the wildlife can move forth and back through the corridor under the elevated bridge (KM.42+600 – KM.42+930). The impact is then considered to be at high positive level. 	<ul style="list-style-type: none"> - Between KM.49 to KM.53, The common wild pigs were found only on Khao Yai National Park side at the distance 600-1800 meters from highway 304. This section of the highway on both sides is not suitable for wildlife crossing, so the project development will cause no impact on wildlifes.

Table 6.2-1 Summary of the Environmental Study (Cont.)

Environmental Factors	Section 1 (KM.42+000 to KM.48+600)	Section 2 (KM.48+600 to KM.57+000)
9. Aquatic Ecosystem	<ul style="list-style-type: none"> - No evidence of water source during the study period, so there will be no impact. 	<ul style="list-style-type: none"> - The plankton found is simple to general water body i.e. <i>Peridinium</i> sp. is dominant on both Khao Yai National Park and Thaplan National Park areas. Some plankton Species indicate low to medium water quality in the form of dissolved food nutrients as mesotrophic to meso-eutrophic status such as <i>Oscillatoria</i> sp. and some species as <i>Dynobryon sertularia</i> which found in low temperature reservoir on Khao Yai N.P. side. The project development activities may cause water turbidity affecting the plankton photosynthesis and decrease dissolved oxygen which influence to aquatic ecosystem. The concrete works during bridge construction may effect on pH of water resulting plankton life cycle and reservoir fauna. This impact is considered to be at low negative level. The sewage drainage from workers camps and maintenance shops may cause low organic, grease and chemical pollution at low level, because they are designed to establish far away from Huai Sub Bon. - During operation phase there may be some sediments and oil leakages from tress passing vehicles into Huai Sub Bon (KM.51+000), with little chance, so it may be low impact, because the road surface is asphaltic and road sides had slope protection. When the road had good standard and safety, the accident to cause oil leakage to pollute the reservoir will be at a minimum.
10. Transportation	<ul style="list-style-type: none"> - The main connecting roads in the project areas consist of Highway route No.33, no.304, local highways Nakhon Ratchasima No.3052, and 3060. The local roads in the villages and communities are on sites, i.e. the connecting road to Baan KM. 80. During the construction phase the traffic may increase from the project vehicles but the traffic convenience is not differ from the present situations. 	<ul style="list-style-type: none"> - The main connecting roads in the study areas are highway route No.33, 304, local highway route No. Nakhon Ratchasima 3052 and 3060. The transportation of the villages and communities are on sites, i.e. Baan Saen Suk connecting Luang Raj Pattana community, and Pho Cum Pattana community. The Project development may increase the number of vehicles but the traffic facilities are not different from present

Table 6.2-1 Summary of the Environmental Study (Cont.)

Environmental Factors	Section 1 (KM.42+000 to KM.48+600)	Section 2 (KM.48+600 to KM.57+000)
10. Transportation (Cont.)	<p>It is estimated that the impacts will be at low negative level. The transportation of construction materials may damage the road surface at some extent, so the impact will be at moderate negative level.</p> <ul style="list-style-type: none"> - After the highway opens for public use, the traffic will be more convenience causing high positive impacts, but road crossings may not be convenient because the highway expanded to 4 lanes, with middle obstruction, so the impact may be at low negative level. 	<p>conditions, so the impact will be at low negative level. The transportation of construction materials may cause same damage to the road surface but considered as moderate negative impacts.</p> <ul style="list-style-type: none"> - During the operation phase the traffic will be more convenient, the impacts are considered as high positive level. The road crossings will be not easy as before because the highway expanded to 4 lanes with middle obstruction, so the impact is considered as low negative.
11. Socio-economics	<ul style="list-style-type: none"> - There is no household to be removed from the highway right of way, but there will be some effects from the development activities, i.e. nuisance, stress from life safety and properties from the workers; i.e. at Baan Saen Suk but at low level. - During the operation phase there may be nuisance from air pollution, noises, and vibrations from tress passing vehicles. The impacts are considered as low negative level. But anyhow, after the project completion, the communication between communities and regions will be more convenience. The local tourism activities will have more safety, so the impacts will be at moderate positive level. 	<ul style="list-style-type: none"> - There are some households interfered from the road expansion, some of them need moving out or resettle. At KM. 54, 40 houses or shop shelters must be moved out, 30 of them are shop shelters. The development activities may nuisance peoples in the communities at Sarn Chao Por Municipal, Baan KM. 80 School, Sarn Chao Por School and insecurity on their lifes and properties from project workers but at the low impact level. The cash flow and job opportunities for the communities will have low positive impact. - During the operation phase nuisances may arise from air pollution, noises and vibrations from tress passing vehicles, but considered as moderate negative impacts. After the project completion the communication between communities and regions will be more convenient. Business and tourism will be promoted with more safety. The impacts are considered as moderate positive level.

Table 6.2-1 Summary of the Environmental Study (Cont.)

Environmental Factors	Section 1 (KM.42+000 to KM.48+600)	Section 2 (KM.48+600 to KM.57+000)
12. Public Health	<ul style="list-style-type: none"> - From the report – patience by disease group (21 disease groups) of Nadee Hospital, A. Nadee, Prachinburi Province Situated near the project areas, the data between B.E. 2549-2551 showed that respiratory system disease is most found followed by digestive system and mouth diseases. The third rank was blood circulation system disease. But in 2549 the digestive system and mouth diseases were highest, followed by respiratory system and blood circulation system diseases the project development activities may have impacts on public health from dust, noises on project workers and peoples in the vicinity of construction areas at a moderate negative level. - During the operation phase the health impact from dust and noises will be at moderate level, on peoples in the vicinity of the highway especially to those sensitive to health infection; i.e. allergic to dust or temperature change such as young children and elderly peoples. When the project finished the highway will facilitate the patients to access to medical centers faster. So the impacts will be at moderate positive level. 	
13. Occupational health and Safety	<ul style="list-style-type: none"> - During the construction phase the workers' health may have some impacts from dust and noises which are under their working conditions, but it is considered as moderate negative impact. The workers may face with some accidents at work and some illness from some improper sanitation management at workers camps. These impacts are considered as low negative impacts, because the chances to get accident is very low due mostly to work characteristics, i.e. road construction is on the ground, no risk from high falling, and even though some activities will use machinery; i.e. post piling machine which may be employed at some period, the chance that workers will associate is rare, so the accidental impact is at low negative level. The problems of workers camp sanitation diseases, i.e. diseases derived from foods and drinks i.e. diarrhea and toxic foods, the effects will not least long and may recover in short period, so the impacts are considered at low negative level. 	
14. Accident and Safety	<ul style="list-style-type: none"> - The first section of the highway had many curves of low standard, some parts are on lopes, both sides are valleys and mountains. The risk spots vulnerable to accident are at KM. 44+200 and KM. 44+800 where accidents frequently happened. On section 2 the routes are rolling to rather flat with no dangerous curve. The accident statistics on highway 304 for KM. 42 to KM. 54 from B.E. 2547 to 2551 were 21, 20, 37 and 16 times respectively. During the construction phase there may be some traffic obstruction that may affect road users, so the impact is considered as moderate negative level. During the operation phase the impact will be high positive level, because the highway is constructed to the standard and all risk spots are improved. 	

Table 6.2-1 Summary of the Environmental Study (Cont.)

Environmental Factors	Section 1 (KM.42+000 to KM.48+600)	Section 2 (KM.48+600 to KM.57+000)
15. Road Users	<p>- From the survey of traffic density at the mid block of the project, there are highest number of modified pick-up to personal seating cars for 24.10 percent, follow by personal 7 seats sedan at 18.62% small trucks 17.24% motor cycle 12.36%; trailers and semi-trailors, more than 7 seats vehicles, medium trucks, medium and big buses 8.10%, 6.64%, 4.94% 3.94%, 2.10% and 1.97% respectively The project development may have some effects on those vehicles' drivers from road obstruction, traffic, because the project construction activities may aggress into some parts of traffic lanes, but the impacts are considered as low negative level. Some parts of the road surface may be damaged by construction activities causing more expenditures on gas/gasoline, but considered as low negative impacts. Anyhow, after project completion, the road users will be more convenience. The advantages to road users from improved highway will be at high positive level. There would be some inconvenience for road crossing of vehicles as before, so the impacts may be at low negative level.</p>	

6.3 Summary of Protection Plan and Environmental Mitigation Measures

The protection plan and environmental impacts mitigation measures for the four lanes widening on Highway Route 304 Section A. Kabin Buri - A. Pak Thong Chai consist of 12 work plans as summarized in Table 6.3-1

6.4 Summary of Environmental Quality Enhancement Plan

The Environmental Quality Enhancement Plan for the four lanes widening on Highway Route 304 Section A. Kabin Buri - A. Pak Thong Chai consist of 2 work plans as summarized in Table 6.4-1

6.5 Summary of Monitoring Plan

The environmental quality monitoring and evaluation plan for the four lanes widening on Highway Route 304 Section A. Kabin Buri - A. Pak Thong Chai from the construction phase to operation phase consist of 13 work plans as summarized in Table 6.5-1

Table 6.3-1 Environmental Mitigation Plan

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
1. Soil erosion Protection and Sediments Control	Along the project route especially when cut through slopes and mountain and surface water source; Huai Sub Bon (KM. 51+000)	Continuously throughout project implementation period	<ol style="list-style-type: none"> 1) Limit the tree cutting and surface opening to the minimum only on implemented areas (not more than 500 m. each time) 2) Surface opening, cut and fill soil works before entering rainy season. 3) Construction works over Huai Sub Bon (KM. 51+000) should finish within dry season. 4) Establish temporary culverts and sediment trap pond near Huai Sub Bon area and frequently observe and eradicate sediments. 5) Soils stock pile and construction materials collection away from slopes and water sources and culverts at least 50 meters. 6) Planting plant cover on slopes throughout the route including slope areas near Huai Sub Bon Bridge. 7) Establish slope protection structures on high slope areas. 	Project Contractor under supervision of Department of Highways	30,428,070 Baht included in the project cost
2. Air Pollution Control Plan	Along the project route especially near communities, school, government offices and monasteries	Operate continuously throughout project implementation period	<ol style="list-style-type: none"> 1) The contractor must spray water on the construction areas at least 3 times per day. 2) Spray water on stock pile soils and sand construction materials or provision of covers. 3) Control truck drivers to drive construction materials trucks less than 40 km./hr. when running through residential communities. 4) Completely cover all construction materials on the truck. 5) Wash all vehicles and their wheels and all construction machines before leaving the construction sites. 6) Concrete mixing area should be away from residential areas at least 100 meters or use ready mixed concrete. 	Contractor under supervision of dept of Highways	Inclusive in Project cost

Table 6.3-1 Environmental Mitigation Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
2. Air Pollution Control Plan (Cont.)			7) Inspect all construction machines engines in good working condition. Stop the engines when they does not work. 8) Tree planting at least 2 rows along the road sides in a zig-zag arrangement, In front of Baan Sarn Chao Par School and Sarn Chao Par Municipal.		
3. Noises and vibrations Control Plan	Along the project route especially near communities, schools, government offices and Monasteries.	Operate continuously throughout the construction phase.	1) Any construction activities that cause noises and vibrations should be confined to 8:00 – 18:00 o'clock and avoid using loud noise machines at the same time. 2) Choose the low noise machines or reduce the noise to be under 90 dB(A) or use noise reduction pad in piling post hitting or use the drill posts instead of hitting posts.	Contractor under supervision of dept of Highways	Inclusive in Project cost
4. Oils and Grease Pollution Control	Maintenance Shops, oil tank store, trucks and machines washing areas, Asphalt mixing areas, including all vehicles and construction equipments.	Continuously throughout the project implementation period.	1) All the sites with pollutants sources should be at least 100 m. away from water ways or drainage systems. 2) All the risk areas to oil leakage and other pollutants; i.e. maintenance ground, cleaning areas, oils stock yards, asphalt mixtures should have pollutants protection measures. 3) Frequently inspect oils and grease trapping unit and collect in Collection tanks for further eradication hygienically. 4) Provision of used oil containers in the workshops to be properly eradicated. 5) Don't throw away all spoil oils into water sources and don't wash any equipment and engines in the natural water sources. 6) Maintain and repair all equipments and project vehicles in good conditions to avoid oil leakage.	Contractor under supervision of Dept. of Highways	Budget for oils and grease control from polluting water sources is 5,000 Baht which include in project cost.

Table 6.3-1 Environmental Mitigation Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
5. Wastes and Sewages to Pollute water sources plan	Workers Camps and Project Offices	Continuously throughout the project implementation period	<ol style="list-style-type: none"> 1) Construction of workers camps 100 m. away from water body, especially Huai Sub Bon. 2) Provision of sewage treatment unit to collect sewage from workers camps. 3) Provision of grease and oil trapping pond near the kitchen and Cleaning areas before discharge to septic tanks. Do not direct discharge into water body. 4) Provision of solid wastes containers throughout the construction sites and workers camps, to collect wastes for proper treatment. 	Contractor under supervision of Dept. of Highways	The budget for waste and sewage protection water sources is 110,000 Baht which include in the project cost
6. Tree Transplanting Plan	Ball out trees from both sides of project route and planted on the corridor area at KM. 42+600 –KM. 42+930	Ball the marked trees during the pre-construction phase and planting during the construction phase	<ol style="list-style-type: none"> 1) Ball the selected trees carefully. 2) Move to refreshing sites. 3) Replanting on the corridor areas. 	Contractor under supervision of Dept. of Highways	1,200,000 Baht inclusive in project cost
7. Transportation Impacts Lessen Plan	Throughout the project route	Continuously during construction phase	<ol style="list-style-type: none"> 1) The contractor must establish sign and notice boards and effective light system to visualize the project construct sites, day and night. 2) Collect all construction materials in appropriate places, not disturb traffic lanes. 3) Avoid obstruction way-in and out to community roads or village roads. 4) Control project drivers to strictly follow traffic rules. 5) In case of road damage by project activities, repairing measures should be promptly conducted to be in good conditions. 	Contractor under supervision of dept. of Highways	Inclusive in Project Cost

Table 6.3-1 Environmental Mitigation Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
8. Traffic and Accident from Traffic Prevention Plan	Along the project route	Continuously throughout the project implementation period	<ol style="list-style-type: none"> 1) Establish public relations boards at the beginning and ending of the project. 2) Provision of warning board, standard lighting to clearly visualize the construction areas day and night, at least 200 m. before entering construction sites. 3) Traffic management during construction phase, construct on Thaplan N.P. side first, then move the traffic lane to the finished side, after that go back to improve the old route. 	Contractor under supervision of Dept. of Highways	Inclusive in Project Cost
9. Occupational health and Safety Plan	Construction areas along project route	Continuously throughout the project implementation period	<ol style="list-style-type: none"> 1) Assign contractor to strictly follow Ministerial Regulations on Safety and Sanitation Management and Working Environment of Office B.E. 2549 2) Provision of first aid care units at the construction sites, including primary health care officials. 	Contractor under supervision of Dept. of Highways	The budget for sanitation and safety control is 30,000 Baht which include in Project Cost.
10. Living Environment and Workers Camps Sanitation Plan	Workers Camps Areas	Continuously Throughout the project implementation period	<ol style="list-style-type: none"> 1) Provision of living space for at least 9 sq-m/person. The workers camps and project office should be at least 100 m. away from water sources. 2) Provision of enough drinking and consumptive water to meet the workers' demands. 3) Provision of toilet 1 unit per 15 workers and establish sewage workers camps and project office. 4) Provision of solid waste receptors with covers enough for the existing solid waste. Assign responsible worker to transfer solid waste to Sarn Chao Par Municipal receptors. 5) Manage the living area environment for better air movement and facilities and away from solid waste receptor at least 50 m. 	Contractor under supervision of Dept. of Highways	Inclusive in Project Cost

Table 6.3-1 Environmental Mitigation Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
10. Living Environment and Workers Camps Sanitation Plan. (Cont.)			6) Improve kitchen area cleanness to meet sanitation standard, do not leave any garbage in kitchen vicinity. 7) After project completion the contractor should abandon the workers camps together with moving out all construction materials from the site and clean up the areas as much as possible.		
11. Public Relations and Public Participation plan	1) Provision of big public relations boards at the beginning and ending point, of project. 2) Community areas and markets of stakeholders.	1) Continuously throughout the construction period	1) Provision of big public relations boards before starting the project at the beginning point and end point of the project. 2) Provision of 1,000 public relations pamphlets to distribute to local communities, roadside traders and general publics before starting the project. 3) Before starting the project at least 30 days, the contractor must in form the road side traders to move out of the highway right of way. 4) Provision of 5 provincial levels complaint centers at Prachinburi Highway Branch Office, Nakhon Ratchasima Highway Maintenance Unit 3, Bu Phram Local community office Wang Nam Kieo Local Community office and Sarn Chao Par Municipal office. Summarize attitudes. Thoughts and suggestions from different complain and submit to Department of Highways for consideration and further implementation.	Contractor under supervision of Dept. of Highways	Budget for Public Relation and people participation is 67,500 Baht which include in project Cost.

Table 6.3-1 Environmental Mitigation Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
12. Project Highway Accident/Emergency Remedy plan	Along the project highway development route	1) Construction Phase Throughout the construction period	1) The contractor establishes notice boards showing telephone numbers for accident or emergency enquiry every 2 kms. Along the road sides for up and down slopes section. 2) The accident founder must stop vehicle engine and turn on emergency lights and request assistance from concerned organizations.	- Prachinburi Highways Sub station. - Highway Police - Wang Nam Kieo Police Station. - Wang Khon Daeng Police Station. - Wang Nam Kieo Hospital. - Bu Phram Or.Bor.Tor. - Sarn Chao Por Municipal. - Wang Nam Kieo Or.Bor.Tor. - Local Surveillance.	1) Construction Phase - Inclusive in Project Cost. - Inclusive in concerned organizations' budget.

Table 6.3-1 Environmental Mitigation Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
12. Project Highway Accident/ Emergency Remedy plan. (Cont.)		2) Operation Phase Throughout the Project Implementation period.	1) The accident founders must stop their car engines, turn on emergency lights and request for assistance from concerned organizations.		2) Operation Phase. - Inclusive in concerned organizations' budget.

Table 6.4-1 The Environmental Quality Enhancement Plan

Plan	Operation area	Duration	Methods/procedures	Responsible unit	Budget
1. Wildlife Corridor	Km. 42+600 to KM. 42+930	1) Construction Phase	1) Construction Phase (1) Design to be elevated highway, upper part for vehicles, lower part for wildlife passage in a 2 parallels roads with 2 vehicle lanes and 1 motorcycle lane and pedestrian walk way each. The underneath of the beam is 7 m. high (2) Construction of 2 m. high wildlife control fence 40-100 m. deep into the forest at 2 points. The first fence starts at Km. 41+800- Km. 42+600 and the second one from Km 42+930 to KM 43+080. The noise protection wall starts from Km 42+000 to KM 43+080 (3) Improve the forest along the corridor by leveling the ground on both sides of the highway to enable wildlife movement and reforest with animal food species including making 2 artificial salt leek spots	The Contractor under the supervision of Department of Highways.	Inclusive in the project cost
		2) Operation Phase	2) Operation Phase (1) Maintenance of forest condition and artificial salt leek spots. (2) Maintenance of soil erosion protection structures.	Department of National Park, wildlife and plant conservation Department of Highways.	

Table 6.4-1 The Environmental Quality Enhancement Plan. (Cont.)

Plan	Operation area	Duration	Methods/procedures	Responsible unit	Budget
2. Landscape Management	Km. 55+750 to KM. 56+750	1) Construction Phase	1) Construction Phase Tree planting immediately after finish construction work (1) On the middle of the highway (raised median): Planting of golden <i>Ficus benjamina</i> for 1 km at 0.5 m. between tree, total number about 16,800 trees. (2) On road sides : along road sides at Baan km. 80 school, Saan Chao Por School and Saan Chao Por Municipal areas planting <i>Polyalthia longifolia</i> (Asoke India) on alternate rows (2 rows) at 2-3 m. spacing. For the distance about 1,150 m. the total number of trees are 2,150 trees.	The Contractor under supervision of Department of Highways	Inclusive in the project cost
		2) Operation Phase	2) Operation Phase (1) Maintenance of planted trees in good condition (2) Maintenance of concrete structure for soil erosion control	Department of Highways	

Table 6.5-1 Environmental Monitoring Plan

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
1. Physiographic Monitoring Plan	Highway slopes, cuts and fills works along the route throughout the project	1) Construction Phase - Monitor at least 2 times per year, in the rainy season, in May and September 2) Operation Phase - Monitor at least 2 times per year, in rainy season in May and September	1) Construction Phase - Monitor the soil erosion of the highway bunds, cut and fill work throughout the project route. - Monitor the contractor to strictly follow the protection and impacts improvement measures for soil resources and environment. 2) Operation and Maintenance Phase - Monitor the plant covers and planted trees throughout the project route - Monitor the soil erosion situations or the slope protection structures for the road bunds, cut and fill works.	The Dept. of Highways prepare the budget to hire third party for monitor.	Inclusive in the soil erosion monitoring budget.
2. Soil Erosion Monitoring Plan	All the slopes, cuts and fills areas throughout the project route.	1) Construction Phase - Monitor at least 2 times per year during rainy season, in May and September.	1) Construction Phase - Monitor soil erosion conditions of the highway bunds, cuts and fills areas throughout the project route. - Monitor the drainage conditions and sediment ponds near Huai Sub-Bon to be in good conditions all the time.	The Dept. of Highways prepare the budget to hire third party for monitor.	1) Construction Phase - Monitoring budget is 10,000 Baht/time. Total is 20,000 Baht/year

Table 6.5-1 Environmental Monitoring Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
2. Soil Erosion Monitoring Plan (Cont.)		2) Operation Phase - Monitor at least 2 times per year during rainy season in May and September. - Monitor for 5 years continuously, and 3 more times every 5 years, in year 10, 15 and 20.	2) Operation and Maintenance Phase - Monitor the plant covers and planted trees along the project route including trees planted on highway division bunds. - Monitor the soil erosion situations or the road bunds, cut and fills slopes.		2) Operation Phase - Monitoring budget is 10,000 Baht/time. The total budget is 20,000 Baht/year
3. Surface Water Quality Monitoring Plan	Water body which the route runs through there is only 1 source Huai Sub-Bon (KM.51+000)	1) Construction Phase - Monitor 2 times/ year during rainy and dry seasons.	During the construction and operation phases, collect water samples from 2 stations; i.e. left hand side and right hand side of the highway to analyse for 12 factors as follows: - Water temperature - pH - Conductivity - Turbidity - Suspended solids - Total solids - Oils and grease - Dissolved oxygen - B.O.D. - Nitrate Nitrogen - Total Coliform Bacteria - Total Fecal Coliform Bacteria	Dept. of Highways prepare budget to hire third party to monitor.	1) Construction Phase - 10,000 Baht/time/ stations monitor at 2 stations 2 times/ year, the total budget will be 40,000 Baht/year

Table 6.5-1 Environmental Monitoring Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
3. Surface Water Quality Monitoring Plan (Cont.)		2) Operation Phase - Monitor 2 times/year continuously for the first 5 years, after that monitor 3 times every 5 years, in year 10, 15 and 20			2) Operation Phase - 10,000 Baht/time/station monitor at 2 stations 2 times per year. Total budget is 40,000 Baht/year
4. Air Quality Monitoring Plan	1) Construction and operation phase monitor at 2 stations at Saeng Tam Monastery (KM.48+000) and Sarn Chao Por School (KM.55+800)	1) Construction Phase Monitor 2 times per year throughout construction period, starting from the beginning of construction 2) Operation Phase Monitor 2 times per year continuously in the first 5 years, and 3 times after that every 5 years in year 10, 15 and 20	1) Construction Phase: A) Indicators for monitoring - Total solid particles (TSP) - Solid particle materials smaller than 10 micron (PM-10) B) Frequency - Measurements conduct for 3 consecutive days, covering work days and holidays. 2) Operation Phase A) Indicators for monitoring - Total solid particles (TSP) - Solid particle materials smaller than 10 micron (PM-10) - Nitrogen dioxide (NO2)	Dept. of Highways prepare budget to hire third party to monitor.	1) Construction Phase - 30,000 Baht/station/time for 2 stations 2 times/year. total budget is 120,000 Baht/year 2) Operation Phase 30,000 Baht/station per time for 2 stations 2 times/year.

Table 6.5-1 Environmental Monitoring Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
4. Air Quality Monitoring Plan (Cont.)			<ul style="list-style-type: none"> - Carbon monoxide (CO) B) Frequency - Measurements conduct for 3 consecutive days covering work days and holidays. 		Total budget is 120,000 Baht/year
5. Noises Monitoring Plan	1) Construction Phase Monitor at 2 stations - Saeng Tam Monastery (KM.48+000) - Sam Chao Por School (KM.55+800) 2) Operation Phase Monitor at 3 stations - Saeng Tam Monastery (KM.48+000) - Sam Chao Por School (KM.55+800) - House No.8, Moo 5, Baan Wang Mued, T. Buphram, A. Nadee, Prachinburi Province (KM.42+000)	1) Construction Phase - Monitor 2 times/year throughout the construction period. 2) Operation Phase - Monitor 2 times/year continuously in the first 5 years and 3 times after that every 5 years in year 10, 15, and 20.	1) Construction and operation Phases A) Indicators for monitoring - average noise level by hour (Leq 1 hr) - average noise level for 24 hours (Leq 24 hr) - Maximum noise level (Lmax) - Noise level L90 - Day and Night noise levels (L _{dn}) B) Frequency - Measurements conduct for 3 consecutive days, covering work days and holidays.	Dept. of Highways prepare budget to hire third party to monitor	1) Construction Phase - 50,000 Baht/ station per time for 2 stations 2 times per year totally 20,000 Baht/ year 2) Operation Phase - 50,000 Baht/ station per year for 3 stations 2 times per year totally 30,000 Baht/year for the first 5 years

Table 6.5-1 Environmental Monitoring Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
6. Vibrations Monitoring Plan	There are 2 stations for measurement at Saeng Tam Monastery (KM.48+000) and Sam Chao por School (KM.55+800)	<p>1) Construction Phase</p> <ul style="list-style-type: none"> - Monitor 2 times/year throughout the construction period, starting from the beginning of the project. <p>2) Operation Phase</p> <ul style="list-style-type: none"> - Monitor 2 times/year for the first 5 years. - Monitor 1 time/year every 5 years, in year 10, 15 and 20. 	<p>1) Construction and Operation Phases</p> <p>A) Indicators for monitoring</p> <ul style="list-style-type: none"> - Peak particle velocity and direction of peak velocity - Frequency - Duration of peak velocity <p>B) Frequency</p> <ul style="list-style-type: none"> - Measurements conduct for 3 consecutive days, covering work days and holidays. 	Dept. of Highways prepare budget to hire third party to monitor	<p>1) Construction Phase</p> <ul style="list-style-type: none"> - 15,000 Baht/ station/time for 2 stations 2 times/year totally 60,000 Baht/year <p>2) Operation Phase</p> <ul style="list-style-type: none"> - 15,000 Baht/ station/ time for 2 stations, 2times/year for the first 5 years totally 60,000 Baht/year. - 15,000 Baht/ station/time 2 station every 5 year in year 10, 15 and 20 30,000 Baht/year

Table 6.5-1 Environmental Monitoring Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
7. Forest Resources Monitoring Plan	Areas along project route and the vicinity for the radius 500 m. on both sides of the route.	1) Construction Phase - Monitor 1 time/year continuously during the construction period. 2) Operation Phase - Monitor 1 time/year for a consecutive 5 years, after that monitor 3 times every 5 years, in year 10, 15 and 20.	1) Construction and Operation Phases - Survey the tree species, number, density, frequency, dominancy, important ecological index and species diversity, including natural regeneration status and compare with the previous survey. 2) Operation Phase - Monitor the survival of planted trees in the wildlife corridor, road sides and road dividing bunds.	Dept. of Highways prepare budget to hire third party to monitor in cooperation with Dept. of National Park, Wildlife and Plant Conservation.	1) Construction Phase - 80,000 Baht/ time/year 2) Operation Phase 80,000 Baht/ time/ year
8. Wildlife Resources Monitoring Plan	The forest areas along the project route in 500 m. radius from the highway on both national parks and the corridor.	1) Construction phase Conduct wildlife survey along the route 2 times per year, throughout the construction period.	1) Construction and Operation Phases - Survey and monitor for species diversity and abundance of 4 groups of wildlives, i.e. Amphibian, Reptiles, Birds, and Mammals. Monitor should be made for ecosystem conditions, species distribution along the project route and their vicinity. Statistics of animals accident during construction period should be recorded.	Dept. of Highways prepare budget to hire third party to monitor in cooperation with Dept. of National Park, Wildlife and Plant Conservation.	1) Construction Phase - 100,000 Baht/ time 2 imes/ year 200,000 Baht.

Table 6.5-1 Environmental Monitoring Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
8. Wildlife Resources Monitoring Plan (Cont.)		2) Operation Phase Wildlife survey along the project route and the corridor area at KM. 42+600 – KM. 42+930 for a consecutive 5 years and monitor 2 times/year, after that monitor 3 times every 5 year, in year 10, 15 and 20 but conduct 2 times/year.	2) Operation Phase - Conduct general monitoring of the forest conditions. - Monitor the movement of wildlifes through the corridor to find the utilization of corridor. Study on species diversity and abundance of the 4 groups of wildlifes, i.e. Amphibian, Reptiles, Birds, and mammals.		2) Operation Phase - 100,000 Baht/time 2 time/year 200,000 Baht/year
9. Aquatic Ecosystem Monitoring Plan	One area at Huai Sub-Bon (KM. 51+000) as in the water sampling station	Monitor 2 times/year during rainy and dry seasons for the first 5 years continuously, after that monitor again 3 times for every 5 years in year 10, 15 and 20.	The monitoring indicators consist of 3 indicators, 1. Phyto plankton using Plankton Net. 2. Zoo plankton using Plankton Net. 3. Reservoir Bed Fauna (Benthos) using Ekman Dredge. Analyze for species, number of species and diversity index.	Dept. of Highways prepare budget to hire third party to monitor.	1) Construction Phase - 4,000 Baht/ time/station for 2 stations, 2 times/year totally 16,000 Baht/year 2) Operation Phase - 4,000 Baht/time, for 2 stations, 2 year totally 16,000 Baht/year

Table 6.5-1 Environmental Monitoring Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
10. Transportation/Accident and Safety/Road Users Monitoring Plan	Collect traffic data at 2 stations : - 1) Highway 304 at KM. 40+000, (Baan Bu Phram) 2) Highway 304 at KM. 60+000 (In front of A. Wang Nam Kieo Highway Police Station)	1) Construction Phase Monitor 2 times/year covering work days and holidays throughout the construction period for 2 years. 2) Operation Phase : Monitor 2 times/year covering work days and holidays throughout the project implementation period consecutively for the first 5 years. After that monitor 3 times for every 5 years in year 10, 15 and 20.	1) Construction Phase - Collect data of traffics on Highway 304 for the project section. - Collect accident data on the project highway section ; i.e. place time and cause - Inspect damages on project highway and construction materials transport roads twice a year, throughout the construction phase. 2) Operation Phase - Collect data on traffics on highway 304 for the project areas. - Collect accident data on the project highway. - Inspect the project highway damages twice as year, throughout the operation period.	Dept. of Highways prepare budget to hire third party to monitor.	1) Construction Phase - 5,000 Baht/time for 2 stations, 2 times/year totally 20,000 Baht/year 2) Operation Phase - 5,000 Baht/time for times 2 stations, 2 times/year totally 20,000 Baht/year
11. Socio-economics Monitoring Plan	1) Community along the route in T. Bu Phram, A. Nadee, Prachinburi province consist of :	1) Construction Phase Once a year, throughout the construction period.	Sampling representative population from households along project route/communities in the vicinity of the highway about 300 samples, to analyze for the designated variables :	Dept. of Highways prepare budget to hire third party to monitor.	1) Construction Phase - 120,000 Baht per time, once a year

Table 6.5-1 Environmental Monitoring Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
11.Socio-economics Monitoring Plan. (Cont.)	- Baan wang Mued (Moo 5) - Baan KM. 80 (Moo 4) - Baan Saen Suk (Moo 9) 2) Community along the route at T. Wang Nam Kieo, A. Wang Nam Kieo, Nakhon Ratchasima Province consist of : - Pho Cum Pattana Comm. - Ruam Jai Pattana Comm. - Sieichai Ruam Jai Pattana. - Luang Raj Pattana Comm. - Pha Ka Nun Pattana Comm.	2) Operation Phase 1 time/year, for the first 5 years, after that monitor 3 more times every 5 years, in year 10, 15 and 20.	1) Construction Phase : - General socio-economic situations, informations acceptance about the project impacts during construction. Attitudes towards the project, problems from the project and suggestions. 2) Operation Phase : - General socio-economic situations, informations acceptance about the project, impacts during operation, attitudes towards the project, problems from the project and suggestions.		Totally 120,000 Baht/year 2) Operation Phase - 120,000 Baht/time once a year. Totally 120,000 Baht/year

Table 6.5-1 Environmental Monitoring Plan (Cont.)

Plan	Operation Areas	Timing	Methodologies	Responsible Unit	Budget
12. Public Health Monitoring Plan	Same as socio-economics Monitoring Plan	1) Construction phase once a year, throughout construction period. 2) Operation Phase Monitor during the opening year, after that monitor in year 5, 10 and 20.	1) Construction Phase - Monitor to follow-up the impacts from the project on public health for the following variables, i.e. health problem affected by the project, monitor together with socio-economic monitoring from at least 300 samples. - Monitor the practice of contractor on mitigation measures for environmental impacts.	Dept. of Highways prepare budget to hire third party to monitor.	Inclusive in the budget for socio-economic monitoring plan.
13. Occupational health and Safety Plan	Operation areas where risk may happen on public health and working accidents i.e. maintenance shops, molding shops/concrete mixture machines and workers' camps. etc.	1) Construction Phase - Monitor 2 times/year 2) Operation Phase - Monitor 2 times/year	- Monitor personal emergency protection gears at works and environmental hygiene of the workers' camps including disease outbreaks, and accidents at work.	Dept. of Highways hire third party to monitor.	1) Construction Phase 10,000 Baht/year. Totally 20,000 Baht/year 2) Operation Phase - same as in construction phase.

Chapter 7

Public Participation

Chapter 7

Public Participation

7.1 Introduction

Public participation were undertaken in accordance to the Constitution of the Kingdom of Thailand B.E. 2550 (2007), which states that the government must adhere to the public participation policy by carrying out activities throughout the study period of the project, to build understanding of local people and give them opportunities to express comment and opinions towards the project such that the project can be implemented suitably and in accordance with needs of local people.

7.2 Objectives

- 1) To disseminate project information to public and concerned organizations from the beginning of project development
- 2) To listen to suggestions and opinions of concerned parties for further consideration by different stages of the studies and development for better benefits and lesser environmental impacts
- 3) To provide communication channels between general publics and project authorities

7.3 Target Areas

The target areas for the public participation activities are along sides of the highway between KM.42+000 and 57+000 and its vicinity of Tambon Buphram, Amphur Nadee, Prachinburi Province and Tambon Wang Nam Kieo and San Chao Por municipal, Amphur Wang Nam Kieo, Nakhon Rachasima province.

7.4 Target Groups

The project analyzed and screened the target groups which may have effects from project development activities as shown in Table 7.4-1

Table 7.4-1 Analysis and Screening of Target Groups

No.	Target Groups	Roles/Activities	Importance
1	Affected groups - Communities along the highway - Businesses along the highway - Government organizations/education institutes/temples near by the highway.	- Direct affected peoples i.e. from land resettlements, negative environmental impacts temporary and permanent during the project development.	If these groups supported the project will receive high public support in mobilizing the project, but if protest it will be an obstacle and may cause to stop or delay the project development.
2	Concerned government organizations. - at Provincial level - at District level	The government organizations responsible for administration, services and coordination with peoples on sites and have important roles in suggesting and transferring of thoughts and government policies to the peoples.	If concerned government organizations have good coordination among themselves and peoples on sites, the project development will be smoothly carried on.
3	Government enterprises i.e. regional water works, electricity, telecommunication company and T.O.T.	The enterprises who give public utilities services and maintenances on sites.	They are important organizations affecting the implementation of project activities. Attention on their cooperation should receive good communication at different stages of project development to lessen impacts on the concerned peoples.
4	Community leaders - villages chairman (Kamnan) - village headmen - community chair person	The highly recognized leaders in the communities have important roles in coordination and correspondent with local peoples.	If they have good attitudes on the project, it will help to carry out. If they are on the protest side or against the project it would hinder the chance to meet with local peoples or protest the project development.
5	Private Enterprises - Chamber of commerce - The Federation of Thai Industries Nakhonratchasima Chapter - Nakhon Rachasima Tourist Industry Association - Prachin Buri Tourist Industry Forum	These organizations have important roles on businesses, trades and investments of the provinces and influence on the peoples, where those organizations located.	These organizations have important roles on business development in the provinces and have broad networks, If they support the project, the success will be reached. But if they protest, the failure and obstacle will happen.

Table 7.4-1 Analysis and Screening of Target Groups (Cont.)

No	Target Groups	Roles/Activities	Importance
6	Non-government organizations on Environments/Natural Resources conservation.	Now-a-days, the public recognized their roles and activities to promote or protest the development projects which may have effects on natural resources and the environment.	The organizations have wide range of networks and have influences on social attitudes. If they disagreed with any development project it will cause project obstruction and affect project development.
7	Local Politician Group <ul style="list-style-type: none"> - The Mayor of Saan Chao Por - Members of the house of representatives on sites - President of Tambon Administrative Organization - Members of the Local community Boards - Members of the Municipal Boards 	They are peoples representatives with high leadership and can influence peoples in their respective areas.	If they favour the project development, the local peoples may support the project. But if they protest the project may be obstructed and time consumed to remedy the situations.
8	Local Media Groups <ul style="list-style-type: none"> - Local radio/Television stations - Local newspapers 	These groups may help to disseminate project information to public at large on both positive or negative manners.	If the mass media positively understand the project development, it will enable public understanding of the project. If they misunderstood project concept, negative impacts on public relations will rapidly disseminate to public at large and may obstruct project development.

7.5 Project Procedure

The plans of procedure on public participation and public relations of the Four Lanes Widening Project on Highway Route 304, Section A. Kabin Buri to A. Pak Thong Chai consists of 7 major plans, they are:

- 1) Project Public Relations Plan
- 2) The plan to meet and receive attitudes from community leaders and local officials on project sites
- 3) Project Orientation Plan (the first seminar)
- 4) Small Groups Meetings Plan to consider alternative selection (the first small groups meetings)
- 5) The meeting to present alternative selection and appropriate selection (the second seminar)
- 6) The small groups meetings to consider mitigation measures on social and environments (the second small group meeting)
- 7) The project summary conference (the third seminar)

The details are as shown in Table 7.5-1

Table 7.5-1 Public Relations Work Plans

No.	Work Plan/People Participation Activities	B.E. 2551 (2008)		B.E. 2552 (2009)												B.E.2553 (2010)							
		NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
1.	PUBLIC RELATIONS OF PROJECT			---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	<ul style="list-style-type: none"> ● DOCUMENT PREPARATION <ul style="list-style-type: none"> - meeting informations - Public Relations Pamphlet - Power Point Presentation - Public Relations Boards - Videos 			●						●												●	
	<ul style="list-style-type: none"> ● Public Relations Pamphlet Dissemination 			●						●												●	
	<ul style="list-style-type: none"> ● Public Relations Through Local Media 		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	<ul style="list-style-type: none"> ● Website Preparation and Informations dissemination through website 		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2.	Community Meetings and Receiving Attitudes from boarders and officials on sites			●																			
3.	Project Orientation (First Seminar)				●																		
4.	Small Groups Meetings to select Appropriate Formats (1st small group meeting)							●															
5.	Presentation of Alternative Formats and Appropriate Format Selection(SecondSeminars)										●												
6.	Small Groups Meeting to consider Mitigation Measures on Social and Environments (2nd small group meeting)																●						
7.	Project Summary Conference (Third Seminar)																						●

7.6 Results of Public Relations Activities

The public relations activities received good cooperation from all target groups, i.e. provincial, Amphur, local government's administrators, including concerned organizations and general publics to participate in seminars and meetings.

The results of main issues are as shown in Table 7.6-1

Table 7.6-1 The Results of Public Participation Questions and Suggestions

Questions / Comments / Suggestions	Answers / Accept for further study
<u>Engineering and Designs</u>	
1. There was not enough lighting that may cause to previous accidents.	1. There will proposed lighting between KM. 42+000 to KM.48+000 at U-turn and community area.
2. Warning signs should be provided between KM. 42 to KM. 57 to warn road users of long descending slope as well as to prevent accidents as many heavy trucks are using this highway.	2. Throughout this section there are warning signs and reflection boards to suggest drivers to use low gears and the warning signs were moved from side road to overhead signs to avoid crashing.
3. Warning signs along roadside are crashed by car accident.	3. The crashing happen because the roadside is narrow. The roadside from KM. 42-46 will be expand to avoid crashing and truck safety.
4. The descend road with heavy traffic on asphalt surface may easily damaged, it is recommend to use concrete surface.	4. The consultant suggests that asphaltic surface is more safely than concrete surface and should be more maintain in good condition.
5. There should be arranged parking area to promote tourism and may reduced accident.	5. The project plans to be constructed parking area and check point at Baan Wang Mee and Pra Ngam.
6. Is it possible to construct a u-turn in the community area such as establishing fiber barrier for using in case of emergency or during holidays and festival celebrations.	6. At this stage, the project has not design for that, but if it is really need, request should go to Prachinburi Highway Region for further consideration.

Questions / Comments / Suggestions	Answers / Accept for further study
<u>Environmental Issues</u>	
1. The design of wildlife corridor to pass underneath will more convenient for the animals, thus increase environmental potential of the project.	1. The consultant has design elevated road for wildlife corridor.
2. As this highway route passes through the World Heritage, environmental aspects should be of great concern.	2. The consultant has paid more attention on this matter and design for wildlife corridor to meet the world heritage conceptual considered.
<u>Other Issues</u>	
1. The possibility for this highway development will budgeting in which fiscal year? And how long will it take to finish the project? It is envisage that, it should be hurry up because it will reduced accident and enhance promote trading and investment in the region.	1. The environmental impacts assessment report will submit to the office of Natural Resource and Environment Policy and Planning for approval and send to the National Environment Board for Board approval before submit to the Cabinet for final approval. So it is estimated that the process will take around 5 years before construction period.

Suggestions / Other Comments

- Pedestrian bridge or walking trail should be established
- Safety measures should be paid more attention
- Traffic system should promote traveling facility
- Lighting along highway on necessary areas should be considered
- Highway route should be connected directly to the community roads
- There should arranged signing or entering to the community area
- The U-turn should be more appropriate, location
- Road side water drainage should be highly considered
- Mitigation measures for environment should be established, i.e. dust pollution
- Spirit houses should not be moved
- Construction should be accelerated
- Road side traders should be appropriate management
- Job/Work Promotion for the community along roadsides
- Public telephone should be established

Chapter 8

Project Analysis

Chapter 8

Project Analysis

Project analysis is a crucial part of the Feasibility Study for Economic, Engineering and Environmental Impact, that can be use for the economic rate of return evaluation. The project cost evaluation and the economic rate of return for the project will brought into consideration of the project implementation.

8.1 Project Costs

The investment costs of the project are shows in details in the table 8.1-1

Table 8.1-1 Project Costs (Economical Value)

Item	Cost (Baht)
Detailed Design Cost	15,859,390
Building Reimbursement	None*
Land Acquisition Cost	None*
Construction Cost	906,250,820
Supervision Cost	29,453,150
Routine Maintenance Cost	1,800,000
Periodic Maintenance Cost (3-Year)	12,040,000
Periodic Maintenance Cost (7-Year)	73,745,000
Environmental Monitoring Cost	7,706,000

Note * Considered in the Right of Way

8.2 Project Benefits

The project benefits mostly include direct and indirect benefit. However, the direct benefit estimated in the monetary term is mainly beneficial considered in the study.

The direct benefits of this project are vehicle operating cost saving (VOC Saving), value of time saving (VOT Saving) and accident cost saving (ACC Saving), as shown in the table 8.2-1.

Table 8.2-1 Project Benefits (Economical Value)

(Unit : Baht)

Case	Project Benefit	2558	2563	2568	2573	2577
Without Project	Vehicle Operating Cost	6,645,155,464	7,715,439,382	8,786,896,716	9,872,405,816	10,748,007,490
	Value of Time	1,163,340,993	1,495,184,731	1,888,143,928	2,358,742,716	2,800,983,105
	Accidental Cost	82,226,193	95,396,426	108,504,065	121,647,090	132,110,516
With Project	Vehicle Operating Cost	6,572,106,697	7,626,280,729	8,676,401,328	9,731,300,265	10,572,730,640
	Value of Time	1,106,876,919	1,419,125,722	1,784,277,666	2,212,552,310	2,605,796,795
	Accidental Cost	67,647,717	78,481,382	89,263,578	100,074,867	108,681,969
Saving	VOC Saving	73,048,767	89,158,653	110,495,388	141,105,551	175,276,850
	VOT Saving	56,464,074	76,059,009	103,866,262	146,190,406	195,186,310
	ACC Saving	14,578,476	16,915,044	19,240,487	21,572,223	23,428,547
Total Benefit		144,091,317	182,132,706	233,602,137	308,868,180	393,891,707

8.3 Project Economic Evaluation

The economic evaluations of the project are considered by analyzing and comparing between the cost of the project and the benefit, including the road network improvement during the analysis period. This evaluation process will be indicators, which are:

- 1) Net Present Value should be positive
- 2) Economic Internal Rate of Return should be greater than 12 percent
- 3) First Year Rate of Return should be greater than 12 percent
- 4) Benefit Cost Ratio should be greater than 1.0

8.4 Project Economic Analysis (Base Case)

The assumptions of project analysis are salvage value of project construction will decreased by 50% from the beginning, the road will opened for public in B.E.2558 and project analysis period is 20 years. The economics prices of the project investment are summaries as follows:

- Detailed Design Cost 14.59 Million Baht
- Construction and Supervision Cost 824.60 Million Baht

- Maintenance and Environment Cost 209.13 Million Baht
- Net Present Value (NPV) 344.79 Million Baht
- Economic Internal Rate of Return (EIRR) 17.92 %
- Benefit Cost Ratio (B/C) 1.57
- First Year Rate of Return 17.19 %

8.5 Sensitivity Analysis

In addition to the Rate of Return for the Project Economics (Base Case), it shall perform the sensitivity analysis of the project. The results are summaries in Table 8.5-1

Table 8.5-1 Sensitivity Analysis of the Project

Index	Discount Rate = 12%			
	NPV	EIRR %	B/C	FYRR%
1) Base Case	344,792,707	17.92%	1.57	17.19%
2) Cost +10%	283,767,487	16.53%	1.42	17.17%
3) Cost +20%	222,742,268	15.33%	1.30	17.14%
4) Benefit -10%	249,288,216	16.39%	1.41	15.45%
5) Benefit -20%	153,783,726	14.78%	1.25	13.70%
6) Cost +20% and Benefit -20%	31,733,287	12.50%	1.04	13.64%

Based on the sensitivity analysis shown on the Table 8.5-1, the project would be beneficially to execute since the analysis significantly indicates sufficiency in the Net Present Value, Benefit-Cost Ratio, Economic Internal Rate of Return and the First Year Rate of Return for changing cases of cost or benefit and extreme case.

8.6 Project Plan and Budget**Table 8.6-1 Project Plan and Budget**

Description	Year				Total (Baht)
	1	2	3	4	
1. Survey and Detailed Design	15,859,390				15,859,390
2. Supervision Works		5,890,630	11,781,260	11,781,260	29,453,150
3. Construction Works		181,250,164	362,500,328	362,500,328	906,250,820
รวม	15,859,390	187,140,794	374,281,588	374,281,588	951,563,360

ANNEX 1-3

**SUPPLEMENT DETAILS FOR STATUS
REPORT OF WILDLIFE CORRIDOR ON
HIGHWAY 304**

THE DEPARTMENT OF HIGHWAYS

Annex 1-3 to State of Conservation Report of Dong Phayayen – Khao Yai Forest Complex – 2014

Supplement details for status report of Wildlife corridor on Highway 304.

The Department of Highways

Contents:

1. Summary of environmental impact assessment of project alternatives
2. Impacts on OUV
3. Environmental Management Plans
4. Wildlife and plant ecosystem management programs
5. Timeline of implementation
6. Implemented actions on traffic control and monitoring

1. Summary of environmental impact assessment of project alternatives

Environmental factors	Project alternatives				
	Alt. 1: Highway tunnel	Alt. 2: Elevated highway	Alt. 3: Shallow tunnel	Alt. 4: Combined wildlife corridor	Alt. 5: Ecoduct at specific sites
1. Physical environment					
1.1 Topography Pre-construction and construction periods	<p>Construction requires alteration of topography especially around the entrance and exit of the tunnels. With the geologic feature of rock layers, special drilling or blasting will be necessary; consequently construction may impact the integrity of topography in the tunnels.</p> <p>Impact level on topography is high.</p>	<p>Construction of elevated highway does not alter existing topography as there will be only bored pile installations at intervals along the alignment.</p>	<p>Construction activities include cut-and-cover at the toe of mountain slopes, which may compromise stability of topography and may cause landslide. Impact level on topography is high.</p>	<p>Along the elevated portion, topography is not changed. For the portion of at-grade 4-lane widening construction, construction may somewhat alter topography. As for the cut-and-cover short tunnel portions, topography may be altered causing risk of landslide, impact level on topography is low.</p>	<p>For the cut-and-cover tunnel portions, topography may be altered causing risk of landslide, impact can be considered as medium level. As for at-grade 4-lane widening, construction requires cutting some slope area for embankment hence altering topography. However, topography along the alignment is mostly flat. Therefore, impact level on topography is low.</p>
Operation period	<p>Alteration of existing topography, especially around tunnel mouths and inside the tunnels, may affect topography at medium level.</p>	<p>No activity is affecting topography.</p>	<p>Along the earth covered tunnels, some part may have steep slope, especially the area adjacent to Phrayatam stream, where topographic stability may be low and causing land slide. The impact can be considered as medium level.</p>	<p>Along the elevated portion, no activities are expected to change topography.</p> <p>At-grade widening will have some part that cuts into existing slopes, while cut-and-cover tunnels will require earth covering the built tunnel. These areas will have lower topographic stability and may lead to landslide, impact land on topography is low.</p>	<p>At-grade widening will have some part that cuts into existing slopes, while cut-and-cover tunnels will require earth covering the built tunnel. These areas will have lower topographic stability and may lead to landslide.</p> <p>Impact level on topography is medium.</p>
1.2 Geology and seismic activity Pre-construction and construction periods	<p>Construction requires boring into mountain. With the geologic feature of rock layers at multiple locations, special drilling and boring or blasting will be needed. This may impact topographic stability, however, no active faults are found in the area of study and the area is in seismic risk zone 0.</p> <p>No impact is anticipated.</p>	<p>No active faults are found in the area of study and the area is in seismic risk zone 0.</p> <p>No impact is anticipated on the elevated highway.</p>	<p>Cut-and-cover tunnel construction is done by laying down structures at ground level and then covering by earth carved out from some part of the mountain. Tunnels are roughly 10-meter high and the area situates in seismic risk zone with earthquake magnitude less than III Mercalli – therefore no impact is expected.</p>	<p>The sections with elevated highway and cut-and-cover tunnels situate in area with no seismic risk, therefore no impact is expected on the elevated highway. At-grade construction portions also locate in zero seismic-risk zone, so no impact in expected.</p>	<p>Cut-and-cover tunnels are roughly 10-meter high and the area situates in seismic risk zone with earthquake magnitude less than III Mercalli – therefore impact is expected to be low.</p> <p>For at-grade widening, construction will require some altering of the area with mountain slope cutting in some area. However, no impact is expected since the area has no seismic risk.</p>
Operation period	<p>Study area has no seismic risk. No impact is expected.</p>	<p>No impact is anticipated on the elevated highway.</p>	<p>The area situates in seismic risk zone with earthquake magnitude less than III Mercalli – therefore no impact is expected.</p>	<p>With no seismic risk, traffic operation on elevated highway will have no impact from earthquake. Similarly for at-grade and tunnel traffic operation.</p> <p>No impact is expected.</p>	<p>No impact is expected.</p>

1. Summary of environmental impact assessment of project alternatives (Cont'd)

Environmental factors	Project alternatives				
	Alt. 1: Highway tunnel	Alt. 2: Elevated highway	Alt. 3: Shallow tunnel	Alt. 4: Combined wildlife corridor	Alt. 5: Ecoduct at specific sites
1.3 Soil resource Pre-construction and construction periods	Drilling and boring into mountain will entail large amount of excavated soil. Transported of this soil may lead to falling or depositing in Hindard creek and Phrayatam stream. Impact may arise at the soil disposal site thus proper receiving site is required. Soil transportation will occur in numerous trips. Impact is estimated to be high level.	Main activities include building structure foundation/ bored pile and earth work. Construction may lead to soil being washed down to stream in case of site nearing any stream. Impact is expected to be low.	Large area of mountain slope toe will be cut for the construction of cut-and-cover tunnel. Soil erosion and sliding may occur above the cut area. Clearing and grubbing, traffic diversion provision, rock/weathering rock cutting may lead to erosion especially in rainy season. Impact is estimated to be high.	Impact is estimated to be low for the elevated and also at-grade widening portions. Cut-and-cover tunnel may reduce topographic stability leading to soil slide. With only some portion of construction being tunnels, impact is expected to be low.	The ecoduct construction of cut-and-cover type may lower the topographic stability. Impact is expected to be medium. At-grade construction involves modifying the area and some slope cutting which may cause soil slide; impact is estimated to be low.
Operation period	Soil stability may be vulnerable at tunnel mouths; soil may be washed down into stream. Impact is expected to be low.	No activities that lead to any impact.	Finished cut-and-cover tunnel, having soil on top, may have relatively lower soil stability and risk soil sliding. Impact is estimated to be high.	For the elevated portion, no activity impacts soil resource. For the tunnel portion, soil on top of the tunnels may risk sliding. However, with only 350+150 meter length, impact is estimated at medium level.	With some slope cutting for lane widening and soil cover on the ecoduct, topographic stability may be relatively low with some erosion risk; Impact level is medium.
1.4 Meteorology and air quality 1.4.1 Meteorology	No impact is anticipated for meteorology or local weather in and around the area.	No impact is anticipated for meteorology or local weather in and around the area.	No impact is anticipated for meteorology or local weather in and around the area.	No impact is anticipated for meteorology or local weather in and around the area.	No impact is anticipated for meteorology or local weather in and around the area.
1.4.2 Air quality Pre-construction and construction periods	Dust and exhaust from machines used in earthwork around the tunnel ends will impact air quality outside the tunnels at medium impact level. Activities inside the tunnel impact the outside air quality only at low level because construction is in contained environment. However, air quality inside tunnels will be impacted by air pollutants such as NO _x , CO, SO ₂ , and dust; impact level is high.	Nearby communities may experience air quality impact at low to medium levels because construction involves soil surface disturbance at intervals for bored piling. Windblown dust can impact communities in the beginning and the ending part of the alignment.	Dispersion of dust from ground disturbance and machine exhaust may impact nearby area at medium level because construction site is far from communities with dense vegetated area in between the project and communities. Construction workers may experience NO _x , CO, SO ₂ and dust, thus high level of impact is expected.	With leveling of the area in preparation for elevated highway and shallow tunnel, dust dispersion and exhaust can impact nearby area at medium level because construction site is far from communities with dense forest in between. Construction workers may experience NO _x , CO, SO ₂ and dust, high level of impact is expected.	With dust dispersion and exhaust, impact to nearby area is estimated to be low to medium since construction site is far from community. But workers in construction area and inside tunnels may experience air pollutants like NO _x , CO, SO ₂ , and dust.
Operation period	For at-grade traffic, impact on air quality is low. For traffic from the tunnels, air quality impact on nearby area is estimated to be low because pollutants are formed inside the tunnels and the area is surrounded by forests.	Low impact is expected for both elevated and at-grade portions.	Air pollutant from tunnel traffic to nearby areas is expected to be low because pollutants occur inside the tunnels. In case of personnel entering the tunnels for maintenance, impact may arise for health.	Impact is low for the elevated highway section. Cut-and-cover tunnel sections will experience impact similarly to Alternative 3.	At-grade widening part may have low impact. For the tunnel portion, impact is similar to Alternative 3.
1.5 Noise, light, and vibration 1.5.1 Noise Pre-construction and construction periods	Construction noise is generated from machines and devices involved in drilling,	Bhubhram community may experience high noise level of 72.2 dB(A), with disturbance noise	Bhubhram community located approx. 250 meters from the ending of the project may receive high	Bhubhram community located approx. 250 meters from the ending of the project may receive high	Bhubhram community located approx. 250 meters from the ending of the project may

1. Summary of environmental impact assessment of project alternatives (Cont'd)

Environmental factors	Project alternatives				
	Alt. 1: Highway tunnel	Alt. 2: Elevated highway	Alt. 3: Shallow tunnel	Alt. 4: Combined wildlife corridor	Alt. 5: Ecoduct at specific sites
	leveling, and transporting of material Bhubhram community located approx. 250 meters from the ending of the project alignment may experience noise of 72.2 dB(A). As for noise impact on wildlife, 77-135 dB(A) or more will impact mammals and birds, therefore significant impact is anticipated within 20-meter radius from the project ROW.	level of 25.5 dB(A)	impact where traffic is near the community with noise level of 72.2 dB(A) and disturbance noise level of 25.5 dB(A)	impact where traffic is near the community with noise level of 72.2 dB(A) and disturbance noise level of 25.5 dB(A)	receive high impact where traffic is near the community with noise level of 72.2 dB(A) and disturbance noise level of 25.5 dB(A)
Operation period	Traffic noise impact on nearby area is low.	Noise impact is medium level because of more convenient traffic.	For the beginning and ending portion of 1.60-km distance with at-grade 4-lane widening, noise impact is medium level. For tunnels, noise from traffic has low impact on nearby areas.	Medium noise impact	Noise impact is medium level because of more convenient traffic.
1.5.2 Light					
Pre-construction and construction periods	Construction activities limited to daytime, thus low impact.	Construction activities limited to daytime, thus low impact.	Construction activities limited to daytime, thus low impact.	Construction activities limited to daytime, thus no impact is anticipated on wildlife.	Construction activities limited to daytime, thus no impact is anticipated on wildlife.
Operation period	Impacts of tunnel lighting and vehicle headlights remain in the tunnels, thus low impact.	Light impact from road lightings and vehicle headlights on the elevated highway will be mitigated by noise/light barrier; lights are installed at level lower than the light barrier. Low impact is expected.	Low impact because light will be in the tunnels.	Roadside lights and vehicle headlights will be mitigated by 3-4 meter high noise barrier. For elevated highway, light will be installed lower than the noise barrier to contain light dispersion. Low light impact for tunnel portion since light is only in the tunnels.	For at-grade portion, light impacts will be lowered by installing light below the noise barrier height – light impact estimated to be low to medium level. Low light impact for tunnel portion since light is only in the tunnels.
1.5.3 Vibration					
Pre-construction and construction periods	Vibration impact, especially for Huay Hindard community, caused by machinery, significantly from large bulldozers, from highway construction. As for impacts on wildlife, preliminary findings from researches suggest that vibration from such machines does not significantly impact animal reproductive systems.	Cause of vibration is most pronounced from Pile Drive machine (Sonic). Such vibration however does not damage buildings or structures. Vibration from these machines does not lead to significant impact.	Vibration impact, especially for Huay Hindard community, caused by machinery, significantly from large bulldozers, from highway construction. As for impacts on wildlife, preliminary findings from researches suggest that vibration from such machines does not significantly impact animal reproductive systems.	Vibration impact, especially for Huay Hindard community, caused by machinery, significantly from large bulldozers, from highway construction. As for impacts on wildlife, preliminary findings from researches suggest that vibration from such machines does not significantly impact animal reproductive systems.	Vibration impact, especially for Huay Hindard community, caused by machinery, significantly from large bulldozers, from highway construction. As for impacts on wildlife, preliminary findings from researches suggest that vibration from such machines does not significantly impact animal reproductive systems.
Operation period	Vibration is estimated to be 0.01-0.04 mm/second, which is an unrecognizable level.	Vibration is estimated to be 0.01-0.04 mm/second, which is an unrecognizable level.	Vibration is estimated to be 0.01-0.04 mm/second, which is an unrecognizable level.	Vibration is estimated to be 0.01-0.04 mm/second, which is an unrecognizable level.	Vibration is estimated to be 0.01-0.04 mm/second, which is an unrecognizable level.
1.6 Surface water hydrology					
Pre-construction and construction periods	Construction of tunnels, including the at-grade widening linking in and out of the tunnels,	Construction along the alignment does not involve construction in the stream. Construction	Cut-and-cover tunnel construction can potentially cause soil spilling into stream blocking flows and	Construction of elevated highway results in low impact.	Construction is similar to Alternaitve 3; but impact is lowered because the ecoduct are only

1. Summary of environmental impact assessment of project alternatives (Cont'd)

Environmental factors	Project alternatives				
	Alt. 1: Highway tunnel	Alt. 2: Elevated highway	Alt. 3: Shallow tunnel	Alt. 4: Combined wildlife corridor	Alt. 5: Ecoduct at specific sites
	does not involve construction in water stream. Building of temporary road for site access may require land alteration and could affect drainage area to some degree.	is restricted in the existing ROW and involves bored piling. No activity that is directly impacting local hydrology.	altering water hydrology. Level of impact is estimated to be medium.	Construction of cut-and-cover tunnels has impact level of medium.	designed at specific places unlike cut-and-cover tunnel.
Operation period	No activities that impact surface water hydrology or obstructing flows.	Problems that may arise from blocked flow is considered low.	Impact level is low; rainwater is collected in the system and drained to retention tank periodically before rejoining the public drainage system.	Impact level is low; rainwater is collected in the system and drained to retention tank periodically before rejoining the public drainage system.	Impact level is low; rainwater is collected in the system and drained to retention tank periodically before rejoining the public drainage system.
1.7 Surface water quality					
Pre-construction and construction periods	Tunnel drilling/boring and moving of excavated material may cause higher suspended solids in stream. Impact level is expected to be low.	Increased suspended solids may be caused by preparation of foundation construction, ground opening, surface alteration, stockpiling of soil from cutting and filling, leveling, and compacting. Impact level is estimated at low.	Rock and soil spillage into stream during stockpiling and transporting may increase suspended solids. Impact level is medium.	Pre-construction (area preparation for foundation construction, preparation for cut-and-cover tunnel construction) and construction (stockpiling, transporting) can increase chance of spillage into stream hence higher suspended solids. Impact level is medium.	Stockpiling and transporting of soil increase likelihood of soil spilling into stream; impact level is medium.
Operation period	No impact to surface water quality.	Contamination to surface water from rainwater runoff washing pollutants on road surface. Impact level is low.	Soil covering the tunnels may risk erosion and sliding into stream. Impact level is medium.	Contamination to surface water from rainwater runoff washing pollutants on road surface. As for tunnel portion, top soil may experience erosion into stream. Impact level is medium.	Contamination to surface water from rainwater runoff washing pollutants on road surface. Soil covering the tunnels may risk erosion and sliding into stream, especially in heavy rain. Impact level is medium.
2. Biological environmental resources					
2.1 Aquatic ecology					
Pre-construction and construction periods	Tunnel drilling/boring and moving of excavated material may cause higher suspended solids in stream. Impact level is expected to be low.	Increased suspended solids may be caused by preparation of foundation construction, ground opening, surface alteration, stockpiling of soil from cutting and filling, leveling, and compacting. Impact level is estimated at low.	Backfilling from west side to east side will affect Huay Yang stream as it situates below the slope hence the risk of receiving eroded soil. Stream may experience turbidity and long-term accumulating of sediments. Impact level is medium.	Construction of elevated part may increase chance of erosion which increases turbidity in stream. Construction of cut-and-cover tunnel from the east to the west may impact Huay Yang which is closest to the alignment. Impact level is medium.	Huay Yang, being parallel to the alignment and adjacent for some portions, especially between km.28+400 and km.29+500, may experience turbidity and increased sedimentation. Impact level is medium.
Operation period	There should be no impact.	Runoff from elevated road can carry pollutants or oil which can pollute stream. Impact level is low.	Huay Yang, being parallel to the alignment and adjacent for some portions, will receive runoff and accidental leakage. Impact level is estimated at medium.	Huay Yang, being parallel to the alignment and adjacent for some portions, will receive runoff and accidental leakage. Impact level is estimated at medium.	Huay Yang, being parallel to the alignment and adjacent for some portions, will receive runoff and accidental leakage. Impact level is estimated at medium.
2.2 Wildlife ecology					
Pre-construction and construction periods	Possible clearing of plants in the area near tunnel mouths and at-grade road widening with the new ROW of 40 meters on each side (total area approx. 24.98 rai). Impact level estimated to be low because most wildlife in the mentioned area are birds.	Clearing work and construction of temporary road in area of approx. 5.63 rai may impact wildlife at medium level as the disturbance is limited in narrow strip along the project alignment.	Loss of vegetation along the alignment for cut-and-cover tunnel construction totally about 45.27 rai. The cut-and-cover tunnels will require a long time to rehabilitate the vegetation that is the wildlife habitat. Impact level is expected to be high.	Clearing work and construction of temporary road cover about 32.31 rai. Impact level is anticipated to be medium.	Clearing work and construction of temporary road cover about 38.11 rai. Impact level is anticipated to be medium.

1. Summary of environmental impact assessment of project alternatives (Cont'd)

Environmental factors	Project alternatives				
	Alt. 1: Highway tunnel	Alt. 2: Elevated highway	Alt. 3: Shallow tunnel	Alt. 4: Combined wildlife corridor	Alt. 5: Ecoduct at specific sites
Operation period	Impact to wildlife is very low down to none.	Impact level is low.	Vegetation above the constructed tunnel may take a long time to recover thus impact is estimated at medium level.	Vegetation above the constructed tunnel may take a long time to recover thus impact is estimated at medium level.	Wildlife habitat will need rehabilitation. There will need to be installation of fence to control wildlife crossing at designated area. Disturbance to wildlife during operation phase should be low.
2.3 Forest ecology Pre-construction and construction periods	Construction of tunnels does not affect forest loss because tunnels go underneath the mountain. Only some part of forest will be cleared in the area of tunnel mouths and at-grade widening, totally about 24.98 rai. Impact is estimated at low level.	Loss of forest along the strip area of elevated highway alignment sums to about 5.63 rai area. The loss can be categorized as 165 trees, 340 saplings, and 701 seedlings. Most trees loss are small-size with no significant economic values. Impact is estimated at low level.	Loss of forest along the cut-and-cover tunnel alignment cover approx. 45.27 rai, including 1325 trees, 2732 saplings, and 5639 seedlings. Impact is estimated at high level.	Loss of forest along the cut-and-cover tunnel alignment cover approx. 32.31 rai; impact is medium level.	Expected loss of forest approx. 38.11 rai. Impact level is high.
Operation period	No impact.	No more activities disturbing forest, thus no impact.	No more activities disturbing forest, thus no impact.	No more activities disturbing forest, thus no impact.	No more activities disturbing forest, thus no impact.
3. Human use values					
3.1 Transportation Pre-construction and construction periods	Increased traffic due to heightened activity of transporting construction materials, area preparation, and tunnel drilling/boring will result in lower level of service. However, as the construction activities mostly locate outside the normal commute route of the area, impact level is expected to be medium.	As the construction of elevated highway utilizes the existing highway area, traffic during the approx. 2-year construction period will be medium.	Increased traffic due to transportation of construction materials in and out of the construction area will lower the level of service. Construction of tunnels will mostly fall on existing road and construction is expected to take 2 years. Impact is expected to be high.	Construction will be using the existing road area for the most part. Construction of elevated road will require installation of foundation near the existing road and only obstruct traffic slightly. Construction of tunnels and at-grade widening will take place on existing road and expected to create impact level of moderate.	With increased traffic due to transportation of construction materials in and out of the area and tunnel structure on the existing road, construction is split into sections of 200-300 meters each. The impact level is medium. At-grade widening will utilize mostly the existing alignment. Impact level should be moderate.
Operation period	Highway tunnels limits access of non-air conditioned vehicles (i.e. motorcycle, agricultural vehicles). In case of severe accidents inside tunnels, rescue operation can be difficult as there are only limited access ways. Impact on traffic can be high.	Traffic on the elevated road will require more drive power due to slopes. As local commute runs on low-power vehicles, impact to local transportation is medium level.	The limitation of highway tunnels is that vehicles without air condition (i.e. motorcycle, agricultural vehicles) are not allowed to access. In case of severe accidents inside tunnels, rescue operation can be difficult as there are only limited access ways. Impact on traffic can be high.	No restriction of vehicle accessing the tunnels as it spans short distances, e.g. 350 meters and 180 meters. As for elevated road, although no vehicle restriction, driving may be less convenient with higher slopes. Impact on traffic can be moderate.	No restriction of vehicles through the project as the alignment comprises at-grade road and some short tunnels.
3.2 Land use Pre-construction and construction periods	Land use impact occurs in area surrounding the tunnels ends including shops around km. 26+900 near Huay Hindard and around tunnel end at km. 29+750. Impact is expected to be low.	No direct impact to nearby land use. Temporary impact due to temporary diversion road. Impact is expected to be moderate.	Impact to nearby land use due to areas being used for stockpiling of soil and construction material and temporary diversion road during construction. Impact is expected to be moderate.	Impact to nearby land use due to areas being used for stockpiling of soil and construction material and temporary diversion road during construction. Impact is expected to be moderate.	Impact to nearby land use due to areas being used for stockpiling of soil and construction material and temporary diversion road during construction. Impact is expected to be moderate.
Operation period	No impact	No activities that further impact land use	No activities that further impact land use	No activities that further impact land use	No activities that further impact land use

1. Summary of environmental impact assessment of project alternatives (Cont'd)

Environmental factors	Project alternatives				
	Alt. 1: Highway tunnel	Alt. 2: Elevated highway	Alt. 3: Shallow tunnel	Alt. 4: Combined wildlife corridor	Alt. 5: Ecoduct at specific sites
4. Quality of life					
4.1 Socio-economic Pre-construction and construction periods	There will be relocation of three buildings (1 house and 2 commercial buildings), worries, and impact on income and travelling of community members along Highway 304. Noise and vibration impact from blasting and drilling/boring of tunnels, inconvenience of traveling, and introduction of workers from outside the area may lead to increased crime and dispute with locals. Positive impacts include more income to local labors.	Impact on commute of the locals as most require daily commute to work in factories in Kabinburi district. Construction activities may also disturb the locals daily lives.	Negative impacts include inconvenience in travelling and disturbance from construction activities. Positive impacts include more income and more commercial activities in the local communities.	Negative impacts include inconvenience in travelling and disturbance from construction activities. Positive impacts include more income and more commercial activities in the local communities.	Negative impacts include inconvenience in travelling and disturbance from construction activities. Positive impacts include more income and more commercial activities in the local communities.
Operation period	On a local level, there may be change of travel behavior from Highway 304. Communities may experience more air pollution, noise, and vibration from increase traffic.	On a local level, there may be change of travel behavior from Highway 304. Communities may experience more air pollution, noise, and vibration from increase traffic.	On a local level, there may be change of travel behavior from Highway 304. Communities may experience more air pollution, noise, and vibration from increase traffic.	On a local level, there may be change of travel behavior from Highway 304. Communities may experience more air pollution, noise, and vibration from increase traffic.	On a local level, there may be change of travel behavior from Highway 304. Communities may experience more air pollution, noise, and vibration from increase traffic.
4.2 Tourism Pre-construction and construction periods	Impacts on tourism by construction obstructing access to tourist attraction, such as access to Wang Namkaeo District.	Impacts on tourism by construction obstructing access to tourist attraction, such as access to Wang Namkaeo District.	Impacts on tourism by construction obstructing access to tourist attraction, such as access to Wang Namkaeo District.	Impacts on tourism by construction obstructing access to tourist attraction, such as access to Wang Namkaeo District.	Impacts on tourism by construction obstructing access to tourist attraction, such as access to Wang Namkaeo District.
Operation period	Positive impact on road user	Positive impact on road user	Positive impact on road user	Positive impact on road user	Positive impact on road user
4.3 Archeology Pre-construction and construction periods	No impact is estimated from construction activities.	No impact is estimated from construction activities.	No impact is estimated from construction activities.	No impact is estimated from construction activities.	No impact is estimated from construction activities.
Operation period	No impact	No impact	No impact	No impact	No impact
4.4 Visual and aesthetic Pre-construction and construction periods	Visual impact localized at tunnel ends area.	Temporary impact limited to short period and will cease after construction finishes.	Temporary impact limited to short period and will cease after construction finishes.	Temporary impact limited to short period and will cease after construction finishes.	Temporary impact limited to short period and will cease after construction finishes.
Operation period	Low impact	Low impact	Low impact	Low impact	Low impact

2. Impacts on OUV

The impacts on the Outstanding Universal Value (OUV) of the property can be summarized as follows:

1) Impacts on forest ecology

Pre-construction and construction periods

Woods cutting during construction will result in loss of 96.12 rai (15.4 ha) of forest area. This comprises 219 trees, 9,660 saplings and 10,223 seedlings. However the area in Khao Yai – Thaplan National Park adjacent to Highway 304 is not intact forest. According to the study and survey, rare species are not found. The majority are reforestation type. Then, it can be concluded that impact on forest resources is at moderate level.

Operation period

After completion of construction, the forest complex will be rehabilitated to return to the undisturbed condition, especially at the area under the elevated highway and area on top of shallow tunnels and along the project right-of-way in forest area. Maintenance of reforestation area in Khao Yai – Thaplan National Parks will be in form of controlling size and height of trees under elevated way not to be higher than elevated structure together with controlling size and height of tree on top of shallow tunnel to avoid impact from tree roots on tunnel structure. Hence impact on forest resources during operation period is positive.

2) Wildlife ecology

Pre-construction and construction periods

a) Impact on the loss of food sources and wildlife habitats

Activities related to wood cutting, forest clearance and grading for alignment of elevated structure and shallow tunnels will cause the loss of wildlife habitat for entire corridor. This covers about 96.12 rai (15.4 ha) which includes area used for piling soil and rock from land excavation and rock explosion together with construction equipments and materials. Besides, vegetations which are food sources of wildlife are cut and cleared. This lower food quantity while specific area of wildlife is damaged; i.e. hollow for nesting and laying eggs, underground habitat, including resting and refuge place for wildlife. Apart from these, there may be staff, workers or local people utilize the place for hunting.

b) Impact from noise

Loud noise from machinery, land excavation, rock explosion and vehicles used to transport construction materials may disturb living, feeding and reproduction activities of wildlife nearby construction area, at 2 levels:

Behaviors expression: stimulation by repetitive loud noise will make wildlife loss their hearing because neuro-endocrine system receives the same stimulation (Peterson, 1980). This will interfere signal system of wildlife which results in more being hunted. Furthermore, loud noise also causes disturbance to some other activities; i.e. breeding of wild frog (Odendaal *et al.*, 1986).

Internal expression: noise enables to stimulate the changes of internal system of wildlife such as digestive system, immune system, reproductive system, nervous system and cardiovascular system (Peterson, 1980; Nayfield & Besch 1981). Noise from construction will cause moderate to high impact on reproductive, finding food, living of each wildlife type. However noise from explosion will be at particular place and within short period. Hence the impact will be at the moderate level.

Operation period

After completion of construction, habitat condition of wildlife must be rehabilitated to be the same condition as before, especially area under elevated highway, at the top of Shallow tunnels and along the project route that pass through forest area. After reforestation, the trees under elevated highway must be controlled. The tree height must not be higher than structure of elevated highway while the roots must not disturb tunnel structure. Meanwhile the wildlife will be enabled to utilize the area. However rehabilitation at cut and cover sites takes time. Hence the impact on wildlife is at moderate level.

3. Environmental Management Plans (EMP)

Mitigation measures and monitoring programs have been proposed to alleviate all expected environmental impacts due to the project development. Detailed EMP for the implementation of the proposed mitigation measures have been prepared comprising 20 action plans as follows:

- 1) Action Plan for mitigating impact on Topography.
- 2) Action Plan for mitigating impact on Soil.
- 3) Action Plan for mitigating impact on Surface Water Hydrology, flood control and drainage.

- 4) Action Plan for Surface Water Quality and Aquatic Ecology.
- 5) Action Plan for Air Quality Impact Mitigation.
- 6) Action Plan for mitigation of Noise Impact.
- 7) Action Plan for mitigation of Vibration Impact.
- 8) Action Plan for Mitigation of Impact on Forest Ecology.
- 9) Action Plan for Tree Transplanting.
- 10) Action Plan for Mitigating Impact on Wildlife Ecology.
- 11) Action Plan for construction of animal guide fences to direct wildlife toward crossing structures
- 12) Action plan to mitigate impacts on Transportation and to avoid accidents.
- 13) Action plan to mitigate impacts on land use.
- 14) Action plan to mitigate impacts on Infrastructure.
- 15) Action plan to mitigate impacts on Public Health, Occupational Health and Safety.
- 16) Action plan for Socio-economic Impact Mitigation.
- 17) Action plan for Response on Complaints.
- 18) Action plan to Mitigate Visual and Aesthetic Impacts.
- 19) Action plan for Landscape Management to enhance Aesthetic Values.
- 20) Action plan for Rescue and emergency traffic management.

And 14 action plans for environmental monitoring have been prepared:

- 1} Action plan for Erosion and Land Slide Monitoring
- 2} Action plan for Surface Water Quality Monitoring
- 3} Action plan for Aquatic Ecology Monitoring
- 4} Action plan for Noise Impact Monitoring
- 5} Action plan for Air Quality Monitoring
- 6} Action plan for Vibration Impact Monitoring
- 7} Action plan for Monitoring Impact on Forest Ecology
- 8} Action plan for Monitoring Reforestation in Thap Land National Park
- 9} Action plan for Monitoring Impact on Wildlife Ecology
- 10} Action plan for Monitoring Efficiency of Wildlife Corridor
- 11} Action plan for Monitoring Impact on Transportation

- 12} Action plan for Monitoring on Flood Control, Drainage and Surface Water Monitoring
- 13} Action plan for Monitoring Impact on Public Health, Occupational Health and Safety
- 14} Action plan for Monitoring Impact on Socio-economic Impacts

The proposed EMP, covering pre-construction, construction, and operation periods, is estimated to be 294 million THB (value at 2008 (time of EIA study)) covering 20-year into operation. Note that this excludes the budget that would be included in construction costs and those allocated under annual maintenance.

4. Wildlife and plant ecosystem management programs

To highlight action plans that directly address the wildlife and plant ecology, the EIA report dedicates a chapter for ecosystem management plan for ease of reference and implementation. The following provides brief detail of the plans targeting wildlife and plant ecology and rationales behind them. These programs will enhance effectiveness and ensure long-term safeguard of the constructed wildlife corridors.

4.1 Reforestation and planting of food plants program

(1) Background

Surveys in the area of planned wildlife corridor during the EIA study indicated tracks of various mammals, i.e. Sambar deer (*Rusa unicolor*), wild boar (*Sus scrofa*), bear (*Ursus malayanus*), Gaur (*Bos gaurus*). However, the steep mountainous terrain with mixed area of natural forest and fields provides relatively little food source. Therefore, to facilitate movement of wildlife in the future, food plants should be planted in the area of the constructed wildlife corridor along with reforestation program.

(2) Objectives

- 1. Rehabilitate the forest to mitigate impacts from plants being destroyed or relocated due to clearance for construction work
- 2. Increase food source for animals
- 3. Mitigate conflicts arising from wildlife entering agricultural area for food
- 4. Fostering participation from different stakeholders in conservation
- 5. Enhance and promote participation of local communities in the project
- 6. Job creation and income distribution to nearby communities

(3) Project area

Area of 350 rai (56 ha) in Thaplan NP between km. 26 and km. 29 of Highway 304, comprising 250-rai (40 ha.) along the Hin Daad Stream located 1-4 km further away from the highway into Thaplan NP and 100-rai (16 ha.) decadent forest area. Figure A-1 shows the areas of reforestation.

(4) Steps of action

1. Select flora native to the area, e.g. *Azelia xylocarpa*, *Sindora siamensis*, *Plerocarpus Indicus*, *Cananga odorata*
2. Select flora suitable as food source of animals, e.g. bamboo, banana, Indian gooseberry, Jambolan plum
3. Plant trees to scatter over designated area with approx. 25 trees/rai
4. Hire local residents to be part of the work force in planting activities
5. Invite different stakeholders to involve in reforestation program

(5) Timeframe

To finish in the first year of construction phase and maintain throughout the operation period

(6) Responsible agencies

Khao Yai NP and Thaplan NP under Department of National Parks, Wildlife, and Plant Conservation (DNP)

(7) Budget

Allocation by Department of Highways and transferred to DNP for implementation

First year planting and maintenance cost is estimated at 2,981 baht per rai and maintenance and replanting (30% replanting) cost of 1,665 baht per rai thereafter. Total cost of planting for 350 rai is 1,043,350 baht and cost of maintenance is 582,750 baht.

(8) Evaluation

Plant survival rate of saplings used in the planting program

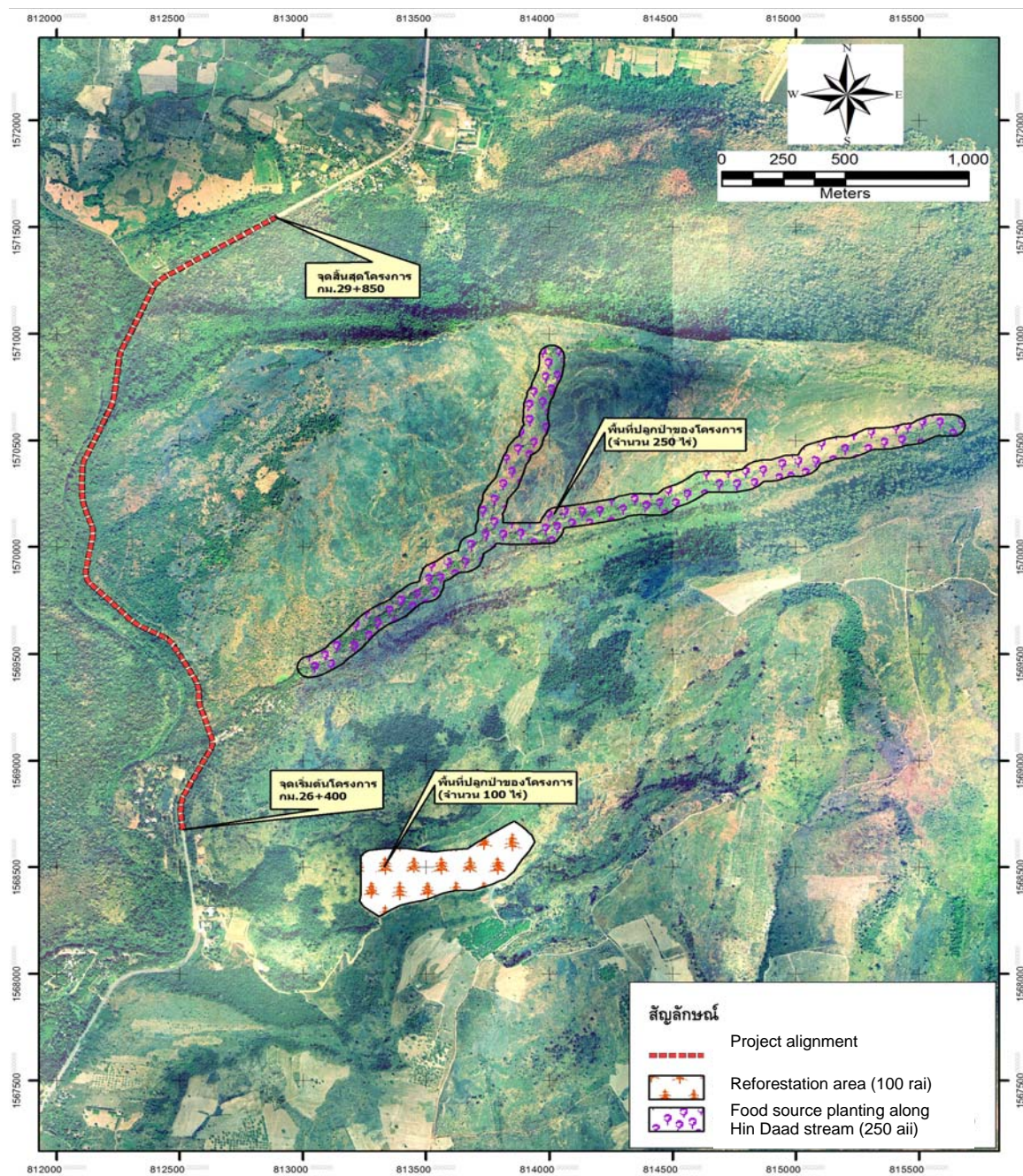


Figure A-1 : Location of reforestation areas.

4.2 Salt lick creation program

(1) Background

Surveys in the area of planned wildlife corridor during the EIA study indicated tracks of various mammals, i.e. Sambar deer (*Rusa unicolor*), wild boar (*Sus scrofa*), bear (*Ursus malayanus*), Gaur (*Bos gaurus*). However, the steep mountainous terrain with mixed area of natural forest and fields has only small number of mineral licks. Therefore, to induce movement of wildlife in the future, artificial salt licks should be created in the area of the constructed wildlife corridor.

(2) Objectives

1. Increase salt licks providing mineral supplement for wildlife
2. Induce movement of wildlife to come to use the wildlife corridor
3. Enhance ecosystem of the area

(3) Project area

11 locations in the Thaplan NP in the area along km. 26 to km. 29 of Highway 304 and 9 locations in Khao Yai NP in the area along km. 26 to km. 29 of Highway 304. These are the primary locations targeting as first priority while there are potentially more locations to make additional licks. Figure A-2 shows the primary locations on the project area map. Figure A-3 presents an example of the designated location.

(4) Steps of action

1. Survey designated locations for salt lick creation
2. Assess the suitability of the locations in term of safety from human threats
3. Choose the appropriate type and method to create salt lick to meet mineral supplement demands of wildlife in the area

(5) Timeframe

To finish in the first year of construction phase so that these salt licks are ready by the operation period

(6) Responsible agencies

Khao Yai NP and Thaplan NP under Department of National Parks, Wildlife, and Plant Conservation (DNP)

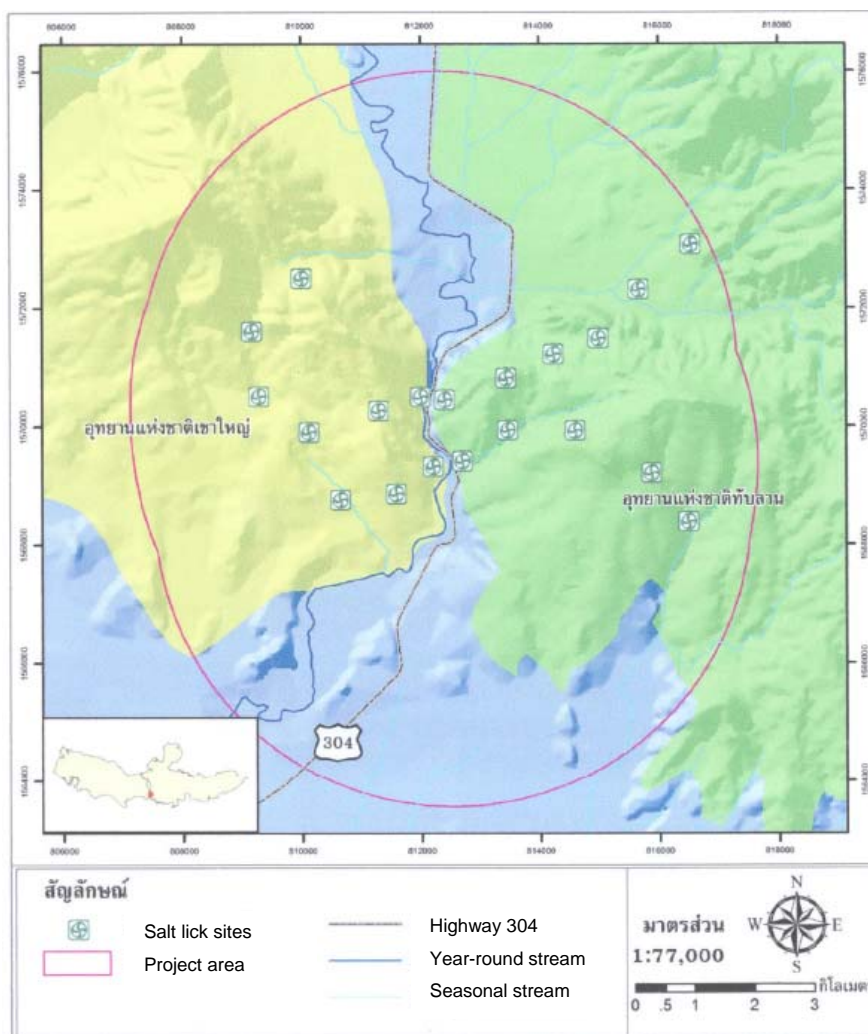


Figure A-2 Planned locations for salt lick creation



Figure A-3 Photograph of salt lick creation location

(7) Budget

Estimated budget for 98 salt licks, each cost 5,000 Baht, totaling to 490,000 Baht allocated by Department of Highways and transferred to DNP for implementation.

(8) Evaluation

Studying animal tracks to assess how much wildlife utilize the created salt licks.

4.3 Check dams creation program

(1) Background

The study found that Khao Yai NP has streams that flow year round. Whereas, in Thaplan NP, streams flow into Huay Hin Dad (Hin Dad stream) which has relatively small amount of water during the dry season. With little rainfall and communities drawing water from natural streams, water is scarce in these streams in the dry season. Water scarcity pressures wildlife to seek water sources in agriculture and community areas. To ease this situation, there should be check dams built upstream in the national parks to sustain water in the dry season and mitigate animal movement out of the national parks.

(2) Objectives

1. Increase water sources to meet demands of wildlife
2. Ease the problem of wild animal entering communities for water and ending up being killed or injured
3. Enhance ecosystem of the area
4. Create natural wildfire barrier which helps lessen wildfire problem
5. Sustain water to be available year round

(3) Project area (Figure A-4 and Figure A-5)

1. In Thaplan NP, 9 sites are proposed for building check dams
2. In Khao Yai NP, 4 sites are proposed for building check dams

(4) Steps of action

1. Survey the proposed locations for building temporary check dams
2. Locate precise check dam construction site
3. Select appropriate check dam type suitable with the specific location. The alternatives are simple pen-like type, simple mixed bamboo type, and simple mixed sack type as shown in Figure A-6.
4. Involve local communities through informing to promote water conservation and efficient use of water

(5) Timeframe

To finish in the first year of construction phase and maintain throughout the operation period

(6) Responsible agencies

Khao Yai NP and Thaplan NP under Department of National Parks, Wildlife, and Plant Conservation (DNP)

(7) Budget

Estimated budget for 67 check dams, each costs 5,000 Baht., totaling to 335,000 Baht to be allocated by The Department of Highways and transferred to DNP for implementation

(8) Evaluation

Available water source throughout the year

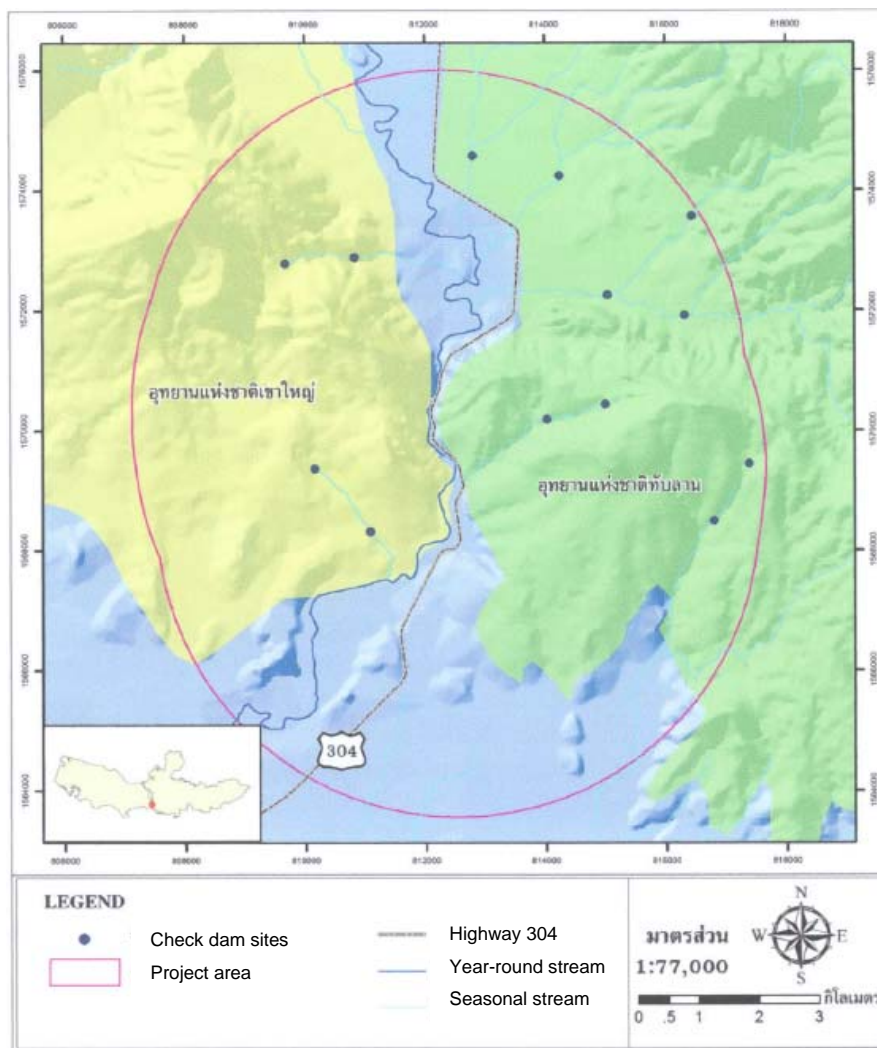


Figure A-4 Proposed check dam locations



Figure A-5 Photograph of proposed check dam location



a. Simple pen-like check dam



b. Simple mixed bamboo check dam



c. Simple mixed sack check dam

Figure A-6 Alternative check dam types

4.4 Park conservation units

(1) Background

With the proposed wildlife corridor locating near existing communities, this could become risk for future prevention of poaching activities. Therefore, park conservation units should be set up to monitor the wildlife corridor.

(2) Objectives

1. Protect the forest area after the construction of wildlife corridor is completed
2. Support active operation in monitoring, information seeking, and swift patrolling to suppress poaching activities
3. Facilitate tourist and safety control operation for traffic in the area
4. Build coalition from various stakeholders in conservation
5. Promote local communities involvement in the program

(3) Project area (Figure A-7)

1. Behind Ton Lan Restaurant around km.29 on Highway 304 in Thaplan NP
2. At Khao Yai NP conservation unit (Phraya Than stream) around km.26

(4) Steps of action

1. Survey the locations proposed for the units
2. Make site plan for construction
3. Proceed with procurement and construction
4. Involve local communities in the process to foster understanding of the program

(5) Timeframe

Finish within the construction phase and to be ready for use in the operation period

(6) Responsible agencies

Khao Yai NP and Thaplan NP under Department of National Parks, Wildlife, and Plant Conservation (DNP)

(7) Budget

The Department of Highways budget transferred to DNP for implementation

(8) Evaluation

1. Lowered encroaching and poaching activities in the wildlife corridor area
2. Increased movement of wildlife to utilize the wildlife corridor
3. Tourists and locals benefits from information provided by the park conservation units

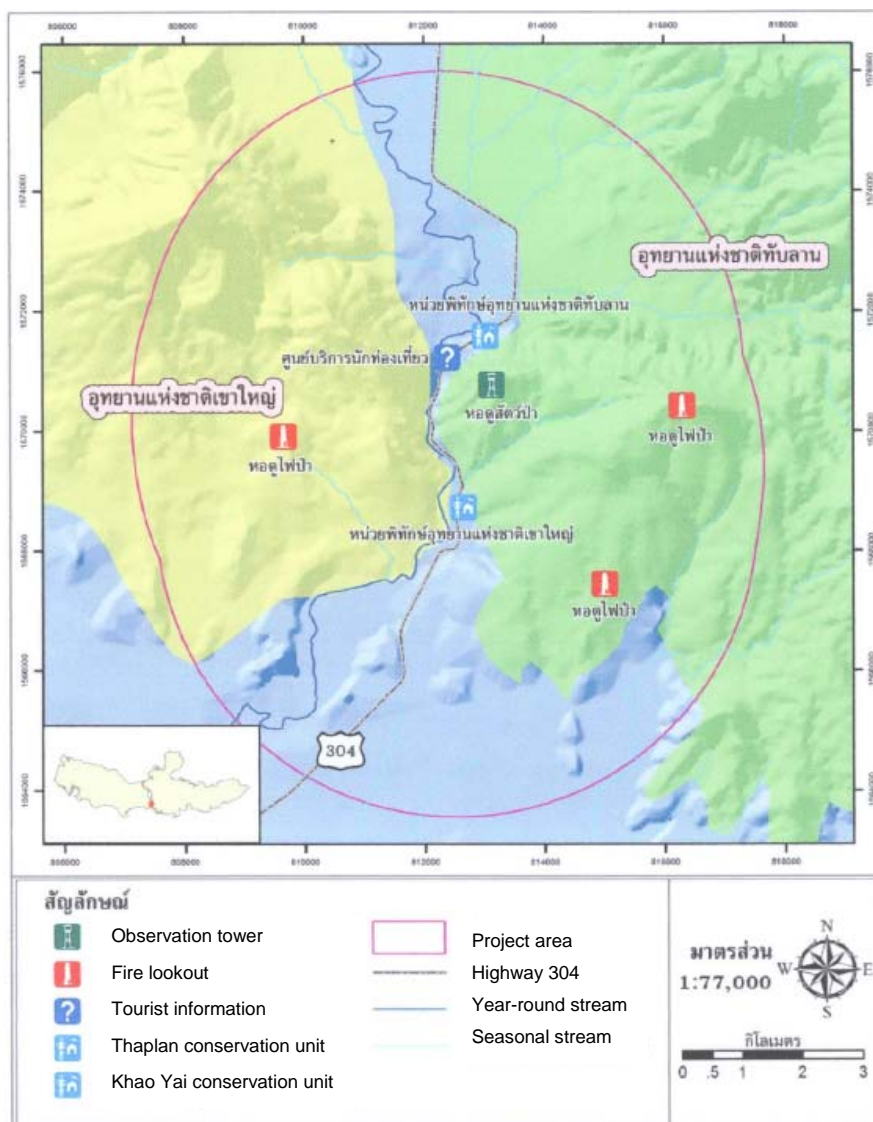


Figure A-7 Locations of park conservation units, wildlife observation, fire lookout, and tourist information center



Figure A-8 Photograph of the location for Thaplan NP conservation unit

4.5 Wildlife observation tower and tourist information center

(1) Background

The increased wildlife activities in the wildlife corridor area will be source of information for academics and researchers in the field of conservation and will be of interest to tourists and general public. Therefore, to facilitate future activities and reduce potential impacts of increase tourists disturbing wildlife habitat by inappropriate activities in the NP, wildlife observation tower should be constructed along with a new tourist information center. This will allow tourist to enjoy the experience while curbing disturbance to wildlife by limiting human access. The observation tower will also aid monitoring of wildlife coming to use the corridor. The tourist information center will help facilitate these increase activities.

(2) Objectives

1. Provide observation tower to monitor wildlife utilization of the corridor and information center
2. Provide observation facility for researchers and tourists and center for resource and information
3. Support ecotourism activity
4. Foster participation from various stakeholders in conservation
5. Promote local communities involvement in the program
6. Job creation and income distribution for local communities

(3) Project area

The observation tower is proposed to be in the field behind Pa Champee house, Buphram subdistrict, Nadi district, Prachinburi (**Figure A-7** and **Figure A-9**). The information center is proposed to be constructed on a 500-rai plot adjacent to Khao Yai NP around km. 29; the location was formerly utilized by some locals but has been left unused. **Figure A-7** shows the location of the proposed site.

(4) Steps of action

1. Observe the proposed location
2. Acquire the land for tourist information center and pay compensation
3. Make site plan and finalize details for construction
4. Proceed with procurement and construction
5. Involve local communities in the process to foster understanding of the program

(5) Timeframe

Finish within the construction phase and to be ready for use in the operation period

(6) Responsible agencies

Khao Yai NP and Thaplan NP under Department of National Parks, Wildlife, and Plant Conservation (DNP)

(7) Budget

The Department of Highways budget transferred to DNP for implementation

(8) Evaluation

Assessing number of visitors to the observation tower and the information center.



Figure A-9 Photograph of the location for wildlife observation tower

4.6 Fire lookout tower program

(1) Background

Every year, the project area in both Thaplan NP and Khao Yai NP is affected from fire started from agricultural burning in nearby agricultural area. To ensure protection of trees planted in the reforestation and planting of food plants program from wildfire, there should be fire lookout tower to effectively monitor fire incidents and deploy swift actions.

(2) Objectives

1. Provide fire lookout tower for the area
2. Provide alert of fire incident and timely control against the fire

3. Promote local communities involvement in the program
4. Create job and distribute income to local communities

(3) Project area (Figure A-7, Figure A-10 and Figure A-11)

1. Field behind Pa Champee house, Buphram subdistrict, Nadi district, Prachinburi
2. At the border of local community and Khao Yai NP around km. 26 and around km. 29, each with one lookout tower
3. At the border of local community and Thaplan NP around km. 26 and around km. 29, each with one lookout tower

(4) Steps of action

1. Assess the proposed locations
2. Make site plan and relevant designs
3. Proceed with procurement and construction
4. Involve local communities in the process to foster understanding of the program

(5) Timeframe

To finish in the construction phase to be ready for use in the operation period

(6) Responsible agencies

Khao Yai NP and Thaplan NP under Department of National Parks, Wildlife, and Plant Conservation (DNP)

(7) Budget

The Department of Highways budget transferred to DNP for implementation

(8) Evaluation

Reduction of fire incident and reduction of fire-affected area



Figure A-10 Photograph of the location for fire lookout tower in Khao Yai NP



Figure A-11 Photograph of the location for fire lookout tower in Thaplan NP

4.7 Animal guide fence program

(1) Background

With the proposed construction of wildlife corridor that provides free movement of animals separated from vehicular traffic on the highway, there must be animal guide fence to protect animals from entering onto the highway as well as preventing them from entering agricultural areas that can lead to damage of agricultural products and harm to the animals. Animal guide fence can also help curbing encroachment and poaching activities.

(2) Objectives

1. Prevent animals from crossing at areas not designated for crossing
2. Mitigate problems of wild animal entering agricultural area
3. Mitigate further forest encroachment
4. Limit access of poaching activities

(3) Project area

To provide clear description of the proposed fence, we can categorize by the functions of the fence, 1) to prevent wildlife crossing onto the at-grade portion of Highway 304, and 2) to prevent wildlife from entering nearby communities and agricultural areas. For the first function, there will be fence constructed throughout the at-grade portion of the Highway 304 between km. 26 and km. 29. For the section function, there will be four fences, each stretching about 5 km. along the boundary of the Khao Yai NP and along the boundary of Thaplan NP. Figure A-12 shows the proposed alignment of the fences.

(4) Steps of action

1. Consult with DNP and the communities throughout the process of animal guide fence construction that will border the park and the communities areas
2. Survey the proposed location for fence construction
3. Design the fence to be suitable with the area as well as the animal types. Note that the type and design of wire fence can pose risk of being caught in the fence and lead to injury and death. Thus, careful consideration will be taken in consultation with experts and review of literatures (i.e. www.wildlifeextra.com/go/news/deer-fence834.html)
4. Involve local communities in the process to foster understanding of the program

(5) Timeframe

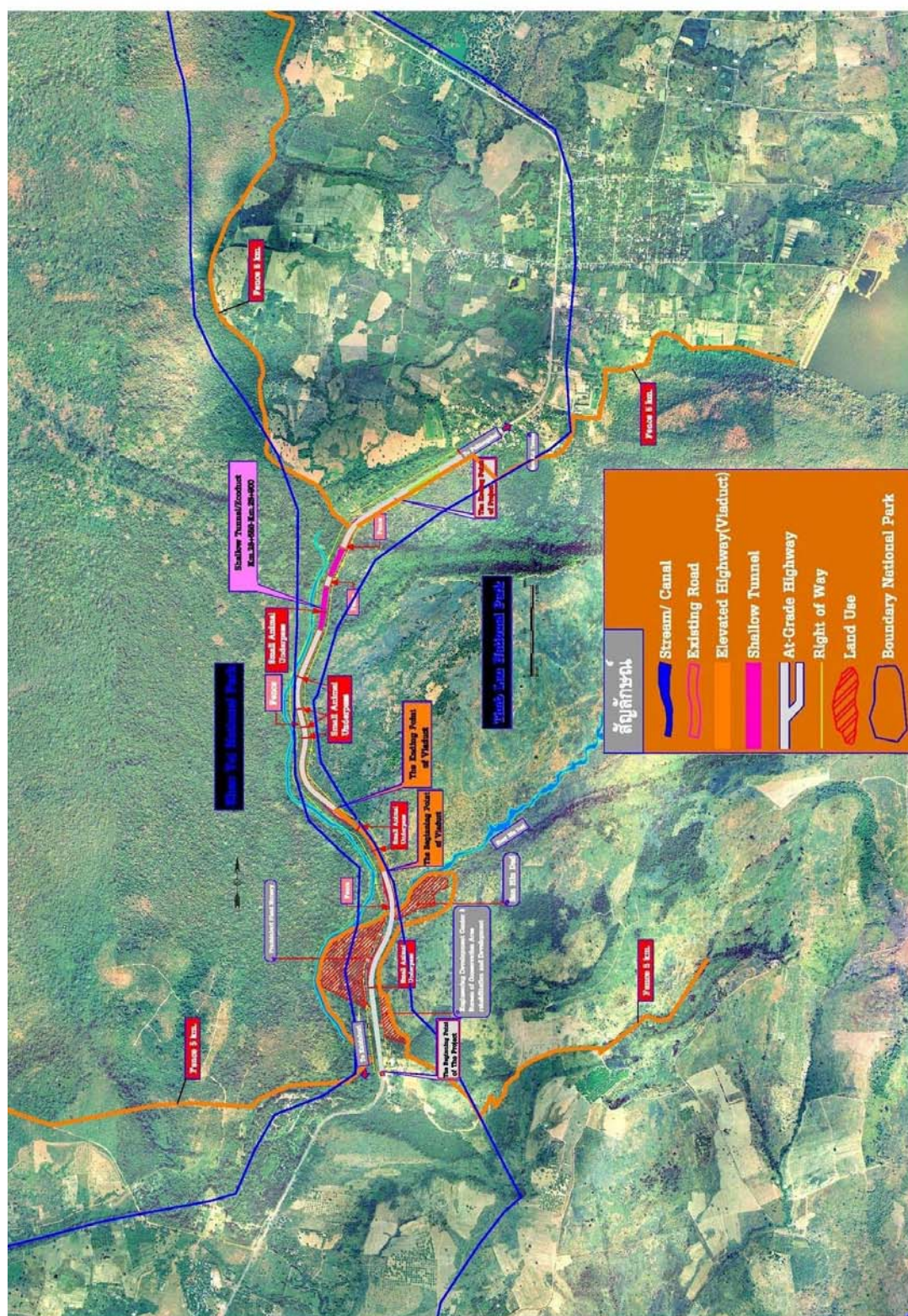
To finish in the construction phase to be ready in the operation period

(6) Responsible agencies

Khao Yai NP and Thaplan NP under Department of National Parks, Wildlife, and Plant Conservation (DNP)

(7) Budget

The Department of Highways budget transferred to DNP for implementation



(8) Evaluation

1. Lower incidents of animals being hit by traffic
2. Reduce problem of encroaching and poaching
3. Increase number of wild animals cross and utilize the designated wildlife corridor

4.8 Closed-circuit camera installation program

(1) Background

With the anticipated wildlife utilizing constructed wildlife corridor, closed-circuit cameras should be installed to effectively monitor their activities as well as to prevent poaching activities.

(2) Objectives

1. Monitor wildlife utilizing the corridor
2. Reduce poaching around the wildlife corridor area
3. Source of information for researchers, park personnels, as well as the public interested in learning wildlife behaviors

(3) Project area

In the wildlife corridor area between km. 26 and km. 29 of Highway 304

(4) Steps of action

1. Survey the locations appropriate for installation of closed-circuit cameras that can observe wild animals activities
2. Installation of the closed-circuit cameras
3. Record wildlife activities as well as poaching incidents

(5) Timeframe

To finish in the construction phase and to be ready for use in the operation period

(6) Responsible agencies

Khao Yai NP and Thaplan NP under DNP

(7) Budget

The Department of Highways budget transferred to DNP for implementation







(8) Evaluation

1. Increase number and species of wild animals cross and utilize the designated wildlife corridor
2. Reduced poaching incidents along the wildlife corridor

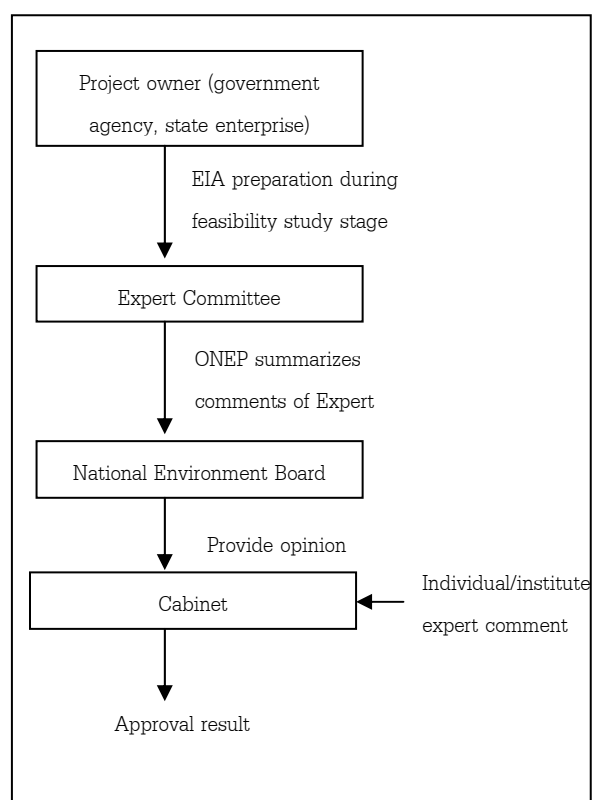
5. Timeline of implementation

The tentative timeline of the wildlife corridors and 4-lane widening constructions on Highway 304 is presented in the **Table A-1** below. The wildlife corridor construction is included in the engineering design of the widening project. The environmental management plan (EMP) comprises myriads of impact mitigation measures, mitigation action plans and monitoring plans covering pre-construction phase, construction phase and 20 years into operation phase.

Table A-1 Timeline of implementation

Actions	2014	2015	2016	2017	...
EIA approval					
Budget request and approval					
Procurement					
Construction					
EMP implementation					20 yr
Environmental monitoring					20 yr

For the latest status of the EIA for section km.26+000 to km.29+500, it passed the approval of Expert Committee (1st of the 2-step approval as shown in the **Figure A-12**) on 7 May 2013, whereas the EIA for section km. 42+000 to km.57+000 is approved by the Expert Committee on 28 January 2014. Both EIA reports currently await the consideration of the National Environment Board (2nd of the 2-step approval), after which it will then be considered by the Cabinet.



Source: Office of Natural Resources and Environment Policy and Planning (ONEP), 2009

Figure A-12 Environmental impact assessment report approval steps for state projects

6. Implemented actions on traffic control and monitoring

To mitigate impacts from traffic to the surrounding forests, new traffic signs have been installed to warn driver of possible animal crossings, to refrain from excessive noise, and to notify that they are entering the World Heritage area and to reduce speed, as shown consecutively in Figure A-12. The same set of three signs have been installed on the northbound direction around km. 26 and the southbound direction around km. 29. This is considered to be immediate mitigation action before the wildlife corridor is constructed.

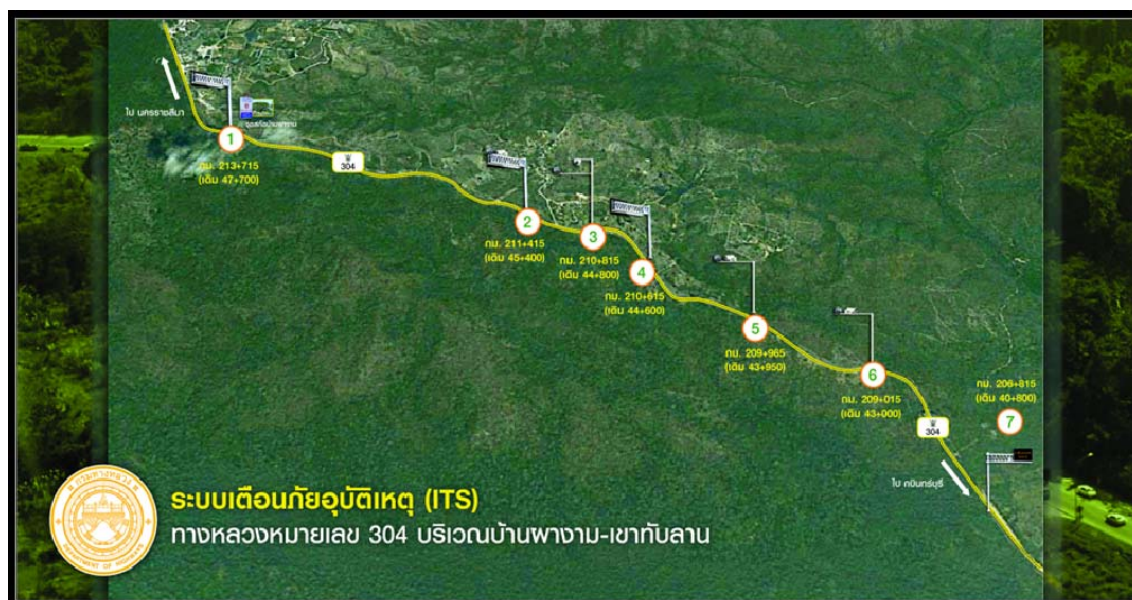


Figure A-13 Traffic signs installed at km. 26 and km. 29 on Highway 304

The World Heritage forest also benefits from traffic control measure that has been recently implemented on Highway 304 around km. 40 – 47. The intelligent traffic system (ITS) has been designed and implemented by the Bureau of Highway Safety, Department of Highways for speed control, incident monitoring, and warning for drivers of any accidents ahead. Given the steep and winding nature of the Highway 304 in that area, this system can reduce accidents and consequently reduce impacts of traffic to the surround forests.

Figure A-14 a. provides overview of the ITS system for Highway 304 km. 40 – 47, which comprises of variable message sign board for southbound traffic at the km. 47 (at which the terrain starts to go downhill) in **Figure A-14 b.**, speed detection and display in **Figure A-14 c.** and variable message signs displaying specific warning in case of accidents on the highway in **Figure A-14 d.** There is also the component of closed-circuit camera monitoring the emergency stop ramp for heavy trucks coming downhill (not shown) so that assistance can be deployed swiftly. The system is automatically monitored and signals will be sent to the traffic

control station at km.47 to the police office on duty as well as monitored at the Department of Highways head office.



a. ITS overview



b. Variable message sign at km. 47+700

Figure A-14 Intelligent traffic system on Highway 304



c. Speed detection and speed display at km. 45+400

(Note: The warning sign displays “Your speed is 65 km./hr.”)



d. Variable message sign at km. 44+600

(Note: The warning sign displays “Beware Dangerous curve”)



Figure A-14 Intelligent traffic sytem on Highway 304 (continued)

STATUS REPORT

1. Wildlife corridors and 4-lane widening constructions on Highway 304

1.1 Rationale for the designs

Highway 304 strategically connects the Northeastern region of Thailand to the Central and Eastern regions and plays vital role in industrial activities. There are two sections of the Highway 304 in the boundary of Dong Phrayayen – Khao Yai Forest Complex where wildlife corridors will be constructed along with widening construction. These steep and curving two-lane sections running along mountainous terrain are very dangerous especially for heavy-loaded trucks traveling downhill and for overtaking vehicles using the opposite-direction lane. The 4-lane widening not only will improve safety of these highway sections but also provide the opportunity to construct ecologically effective wildlife corridors.







Section km. 26+000 to km. 29+500: The wildlife corridor was designed based on extensive study of wildlife diversity, habitats, and traveling activities, resulting in wildlife crossing locations which are optimum for behaviors of the wildlife observed in the national parks. The combination of elevated highway and ecoduct design was chosen among five alternative designs taking into account engineering, economic, and environmental aspects, including impacts on OUV (see Table 2-1 of **Annex 1-1** for alternative summary and **Annex 1-3** for environmental impact assessment). In addition, there will be construction of crossing structures allowing amphibians and small mammals to cross under the highway at various locations.

Section km. 42+000 to km. 57+000: The appropriate wildlife crossing situates from km. 42+600 to km. 42+930 based on extensive wildlife study. The valley terrain at the wildlife crossing location is best suited for elevated road and wildlife underpass concept (see **Annex 1-2**). The design, aimed to serve both species found to use the area (i.e. gaur, Sambar deer) and anticipated species with rehabilitated ecosystem (i.e. elephant, monkey), includes underpass with sufficient clearance for large animals and an arboreal bridge. There will also be crossing structures for amphibians and for small mammals underneath the highway at various locations.

1.2 Timeline

The tentative timeline of the wildlife corridors and 4-lane widening constructions on Highway 304 is presented in the chart below. This planned schedule is for both sections of the highway. The wildlife corridor construction is included in the engineering design of the widening project. The environmental management plan (EMP) comprises myriads of impact mitigation measures, mitigation action plans and monitoring plans covering pre-construction phase, construction phase and 20 years into operation phase. Specific action plans focusing on wildlife and plant ecology and the effectiveness of the corridor will be implemented at different times specific to the context of each plan and will be discussed in the follow section.

For the latest status of the EIA for section km.26+000 to km.29+500, it passed the approval of Expert Committee (1st of the 2-step approval) on 7 May 2013, whereas the EIA for section km. 42+000 to km.57+000 is approved by the Expert Committee on 28 January 2014. Both EIA reports currently await the consideration of the National Environment Board (2nd of the 2-step approval), after which it will then be considered by the Cabinet (see detail of approval process in **Annex 1-3**). The Department of Highways is firmly committed to implement the project as soon as possible.

Actions	2014	2015	2016	2017	...
EIA approval					
Budget request and approval					
Procurement					
Construction					
EMP implementation					20 yr
Environmental monitoring					20 yr

1.3 Environmental measures

The environmental impact assessment studies of the two sections of construction document the existing conditions, expected impacts from pre-construction, construction, and operation phases, and corresponding mitigation measures and monitoring plans. Detailed action plans include time of implementation, responsible agencies, and estimated budgets. With all environmental factors considered in the EIA, only the mitigation action plans targeting at wildlife and plant ecology to ensure long-term safeguard and effectiveness of the wildlife corridors are highlighted here:

Reforestation: For km. 26 to km. 29, the study in 1-km zone adjacent to the highway indicated that Thaplan NP, comparatively to Khao Yai NP, is less viable for wildlife habitat especially in dry season. Thus, 250-rai (40 ha.) along the Hin Daad Stream, 1-4 km further away from the highway into Thaplan NP, will be planted with non-invasive species food-source plants for wildlife of the area (see **Annex 1-3**). Additionally, 100-rai (16 ha.) decadent forest area in Thaplan NP will also be reforested to enhance the overall ecosystem. Planting will be completed in the first year of construction by the park authority using the Department of Highways' budget. For the corridor around km.42, relocated plants within the project will be replanted over the corridor as part of the contractor's responsibility and maintained by park authority.

Artificial salt licks and check dams: Detailed survey of 1-km radius from the highway indicated animal tracks but lack of water sources and salt licks along and near the planned corridors. To induce movement of wildlife across the corridor, 11 and 9 artificial salt licks will be created in Thaplan NP and Khao Yai NP, respectively. Also, 9 and 4 check dams will be constructed in Thaplan NP and Khao Yai NP, respectively, along the streams with seasonal flow (see **Annex 1-3**). These artificial salt licks and check dams will be created during the construction phase so that it will be readily in-use in the operation phase. The park authority will be responsible for maintenance using the Department of Highways' budget.

Fences: To ensure wildlife crossing at the designated locations, cement-based mesh wire fence will be installed along the at-grade portion of the highway between km.26 and km.29. Similar fences will also be installed for the corridor around km .42 stretching from both ends of the elevated highway to guide animals to use the corridor. The mesh wire design was chosen based on literatures to reduce risk of animal death from being caught in the fence and the cement base will deter reptiles and amphibians from crossing onto the highway to cross via the structures. There will also be similar fences stretching from both ends of the km.26 to km.29 corridor, each runs 5-km long, to limit wildlife movement to the boundary of Khao Yai NP and Thaplan NP (see **Annex 1-3**). The Department of Highways will be responsible for budget and construction of these fences. The location of the 5-km fences will be decided upon consultation with stakeholders including the DNP, park officials, and nearby residents, taking into account the forest complex land use management plan.

1.4 Speed limit enforcement

While the wildlife corridor construction has not started, additional road signs (see **Annex 1-3**) have been installed by The Department of Highways' Prachinburi District Office to warn drivers that they are entering World Heritage area between km. 26 and km. 29 and to beware of wildlife and refrain from excessive noise. Moreover, The Department of Highways has installed an Intelligent Traffic System (ITS) for incident management and speed enforcement along km. 40 to km. 47. The ITS, comprising microwave radar detection, real-time camera, and variable message warning signs, assists highway police in managing traffic and enforcing speed limit effectively which helps reduce the cumulative impacts of traffic to the forest.

Apart from speed enforcement measures done by The Department of Highways, The Department of National Parks and Wildlife Conservation has implemented measures to control speed of vehicles traveling within the forest complex area, including:

1. Setting up check points and patrol units to enforce speed limit
2. Setting up traffic calming points (i.e. deflecting gate)
3. Controlling traffic during nighttime
4. Using information board and warning signs



Progress of Implementation

Huay Samong Project, Prachin Buri Province



According to Environmental Mitigation Plans and
Environmental Monitoring Plans,
In Relations to the World Heritage Properties
Under Fiscal Year 2012 - 2013

By

Office of Project Management

Royal Irrigation Department

December 2013



Preface

On 27 October 2009, the cabinet approved the Royal Irrigation Department under the Ministry of Agricultural and Cooperatives to precede the construction of Hauy Samong Reservoir Project initiated by His Majesty the King, Prachin Buri Province. The reservoir with 295.00 million cubic meters storage capacity and irrigation system covering 17,808 ha (111,300 rai) are to be constructed in 9 year construction period (2010-2018) and the concerned agencies shall undertake Environmental Mitigation Plans and Environmental Monitoring Plans (EIMP) for 15 years (from fiscal year 2012 – 2026). Budget for EIMP is 516 million baht, 316 million baht of which is the budget for taking care of world heritage property. The Royal Irrigation Department (RID) is responsible for monthly monitor of implementation of 47 work plans of EIMP, 27 of which are for environmental mitigation and 20 of which are for environmental monitoring. During 2012 -2013, 13 work plans have been undertaken.

Therefore, to follows resolutions of the World Heritage Commission in their session 35th, 36th and 37th, the Royal Irrigation Department, as the agency responsible for project construction and EIMP implementation monitoring, has prepared this report to submit to the World Heritage Commission to explain our strict implementation of EIMP in cooperation with other concerned agencies and in comply with concerned procedures and regulations. The report includes the project background form its EIA report consideration by concerned agencies; namely, the Office of Natural Resources and Environmental Policy and Planning (ONEP), Expert Committee for reviewing EIA report, Sub-committee on World Heritage Treaty, and the Cabinet and the following stage for preparation of EIMP which has been approved by concerned agencies and complied with impacts specified in EIA report. The report also includes results of EIMP implementation and progress of present construction works.

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CHAPTER 1

Chapter 1

Introduction

1.1 Project Background

His Majesty King Bhumibhol Adulyadej talked about Huay Samong Project in Prachin Buri Province for six tiems and the first time on January 22, 1978. He requested the Royal irrigation Department (RID) to consider and set a plan for an irrigation project – a reservoir – in Huay Phra Prong and Huay Samong River Basins where branch streams of the Prachin River exist and gave his initiative the Director General of RID for consideration. The last time, on April 30, 2001, he talked to the Office of the Royal Development Projects Boards privately at Klai Kangwon Palace, Hua Hin District, Prachuap Khirikhan Province, a passage of his talk was: “the foothill plain development project in Prachin Buri and Sa Kaeo Provinces pursuant to His Majesty’s initiatives such as the reservoir projects of Phra Prong, Huay Saton, Tha Krabark, would be splendid. These reservoir would yield more water and the gained consequences would belong to the areas which will be developed afterward.....”.



Figure 1.1 Map of Phra Prong and Huay Samong River Basin (Source : Royal Irrigation Department, 2011)

Later, the Cabinet had a resolution on September 19, 1989 that it agreed on water resources development in the Upper Pakong River Basin, as well as its perennial streams, whereas Huay Samong Project was one of the potential projects. The RID eventually employed a consulting engineering company to carry out the feasibility study on environmental impacts of the Huay Samong Project. Once the study was completed in May 1995, the RID then submitted the EIA report to the Office of Environmental Policy and Planning – later the Office of Natural Resources and Environmental Policy and Planning (ONEP) – for consideration.

The ONEP considered the report and replied to the RID that the Huay Samong Reservoir Project is the project the Cabinet already approved the RID of the Ministry of Agriculture and Cooperatives to study, design and construct, so we would like to suggest you that you should better revise in the report so as to apparently specify measures and operation plan relevant to prevention rehabilitation of environmental impacts caused by the Huay Samong Reservoir Project. The RID therefore revised the said report and resented to the ONEP on November 12, 2003.

On May 13, 2005, the National Park Board had a resolution approving in principle to withdraw some part of the Pang Sida National Park and Thap Lan National Park for the construction of the Huay Samong Reservoir Project in their Meeting No. 3/2548.

On July 14, 2005, the Khao Yai National Park, Pang Sida National Park, Thap Lan National Park and Dong Yai Wildlife Sanctuary were declared the world heritage.

RID, ONEP, and the Department of National Parks, Wildlife and Plant Conservation (DNP) had an unanimous opinion that the project should be restudied on environmental impact assessment under the new conditions of the world heritage declaration and by adding environmental impact study in relevant to areas under world heritage. The report was completed in November 2007.

On 5 August 2009, the National Committee on the Convention for the Protection of the World Cultural and Natural Heritage of Thailand agreed in its meeting No.2/2552 (2009) with the Huay Samong Project to be implemented near to world heritage properties, but the Royal Irrigation Department shall follow all related criteria and monitor and report the area conditions at intervals to prevent any affect to those world heritage properties.

On 20 August 2009, Expert Review Committee considered report of environmental impact assessment on water resource development and agreed with the report in the meeting No. 5/2552 (2009).

On 26 August 2009, The National Environment Board agreed in their meeting No. 4/2552 (2009) with the environmental impact assessment of the Huay Samong, Pachin Buri Province.

On 27 October 2009, the cabinet approved the Royal Irrigation Department under the Ministry of Agricultural and Cooperatives to proceed the construction of Huay Samong Project initiated by His Majesty the King, Prachin Buri Province with 9 year construction period (2010-2018).

On 6 May 2011, the World Heritage Commission Session 35, France had an agreement on their concern of Dong Phrayayen – Khao Yai, with the implementation of Huay Samong Project is one of their concern activities and requested that all construction work of the project be halted until the World Heritage Committee had opportunity to review the EIA and invite expert teams from the World Heritage Center to evaluate potential in undertaking land encroachment protection line.

On 29 February 2012, expert team from UNESCO and IUCN surveyed the project area.

During 24 June – 6 July 2012 the World Heritage Commission Session 36, Russia requested the State party to undertake all suggestions together with the World Heritage Center in operation year 2012 to June 2014 by considering extending the property in order to include areas that better represent its Outstanding Universal Value, based on mapping of encroachment recommended above, and considering current levels of encroachment, realistic boundaries for enforcement, and impacts and mitigation from construction of the Huay Samong Reservoir, and reporting of progress of successful missions implemented by following the suggestions in 2012 to World Heritage Center in 1 February 2013.

During 17-21 June 2013, the World Heritage Commission Session 37, Cambodia reported of their concern on world heritage encroachment, alien species of fish that may spread after water storage, and clearness of environmental impact mitigation plan. They agreed to invite representatives from IUCN to monitor work progress in Thailand and Thailand was requested to report status and progress in 1 February 2014.

1.2 Objectives of Project Development

Main objectives in water resources development of the Huay Samong Reservoir Project are to serve water demands:

- 1) To irrigate agricultural areas of 111,300 rai in Na Di and Kabin Buri districts and upper area of the Bang Pakong River in Prachin Buri Province.
- 2) To abate flood in Prachin Buri and Bang Pakong River Basins
- 3) To provide raw water for public consumption and waterworks authorities.
- 4) To maintain ecosystem by pushing intruding seawater and wastewater out of Prachin Buri and Bang Pakong Rivers.
- 5) To prepare ecological tourist attractions.
- 6) To provide freshwater fish propagation resources and protein supplementary food resources for local people.
- 7) To enhance industrial development in Eastern Seaboard and adjacent areas.
- 8) To interlink all water resources projects in Bang Pakong River Basin.

1.3 Project Description

Project Location

The Huay Samong Reservoir Project has the headwork site located at Bang Kaeng Yao of Kaeng Din So Sub-district, Na Di District in Prachin Buri Province and covers 111,300 rai area.

Project Features

(1) Meteoro-hydrological condition

- Catchment area upstream of headwork 443.00 sg.km.
- Length of stream from headwater to headwork 39.46 km.
- Average annual inflow to reservoir 319.67 millioncu.cm/yr(EHIA 2554)

(2) Zone Type Earth Dam

- Dam crest level + 53.000 m.MSL
- Dam crest width 9.00 m.
- Dam crest length 3,967.51 m.
- Earth crest height from water area 32.75 m.
- Minimum storage level +32.200 m.MSL
- Retention storage level +48.000 m.MSL
- Capacity at minimum storage level 19.50 million cu.cm/yr
- Capacity at normal storage level 295.00 million cu.cm/yr
- Water surface area at minimum storage level 3,750 rai
- Water surface area at normal storage level 16,250 rai

(3) Saddle dam 2 places

(4) Irrigation System

- Length of left irrigation canal 186 km.
For irrigating 94,800 rai in Kaeng Dinso Sub-district, Na Di District, Ban Na Sub-district, Bo Thong Sub-district, Muagn Kao Sub-district, and Kabin Buri Municipality, Kabin Buri District.
- Length of right irrigation canal 34 km.
For irrigating 16,500 rai in Kaeng Dinso Sub-district, Na Di District.

(5) Project investment cost

- Construction cost 8,300 million baht
 - Fiscal Year 2010 with budget provided from Office of the Royal Development Projects Board 73.543 million baht
 - Fiscal Year 2011- 2018 with regular budget.

(6) Implementation period 9 years (2010 - 2018)

1.4 Project Benefits

1. To provide water resource for and extend irrigation area at 111,300 rai in the wet season and 45,000 rai in the dry season in Na Di and Kabin Buri districts, Prachin Buri Province.
2. To abate flood in Prachin Buri River Basin and its tributaries in Na Di and Kabin Buri districts, Prachin Buri Province.
3. To provide raw water for public consumption and waterworks authorities.
4. To maintain ecosystem by pushing intruding seawater and wastewater of Prachin Buri and Bang Pakong Rivers.
5. Reservoir will serve as buffer zone or forest encroachment prevention zone for Thap Lan and Pang Sida National Park as well as increasing moisture content in the forest so that forest fire break is lessened. Stored water can be used for forest fire extinguishment.

1.5 Area Use Permission

- 1) Agricultural Land Reform (ALR) area of 10,919 rai
Agricultural Land Reform Office (ALRO) approved in principle that Royal Irrigation Department (RID) can use the area for construction on 6 November 2009.
- 2) National Reserved Forest Area of 735.2 hectares (4,595 rai)
On 12 January 2011, Minister of National Resources and Environment signed an approval for RID to use national reserved forest area for construction the Huay Samong Project initiated by His Majesty the King in Prachin Buri province.
Director General of Royal Forest Department signed the announcement for Area Definition to government organizations or government agencies for land use in national reserved forest area in P.S. 19 form No.5/2554 (2011) on 24 May 2011 and RID signed to accept on 16 August 2011.
- 3) National Park Area (Pang Sida National Park of 76.8 hectares: (480 rai) and Thap Lan National Park of 186.4 hectares: (1,165 rai) and total is 263.2 hectares: (1,645 Rai)
On 30 September 2010, Minister of National Resources and Environment agreed with National Park Board's meeting No.3/2548 (2005) that held on 13 May 2005.
The Cabinet agreed in principle with the withdrawal the National Park on 20 April 2011, Next step, the Department of National Parks, Wildlife and Plant Conservation will prepare royal decree draft and submit to the Cabinet.

1.6 Project Progress

1.5.1 Other Construction Works

1) In 2010, 73,543 million baht budget was supported from Office of the Royal Development Projects Boards for preparing preliminary works such as construction of the office buildings and temporary houses, project roads, roads, electrical system and water supply system, and the expansion of the high voltage.



2) In 2011, the preparation of preliminary work, including helipad, and fencing.



3) In 2012, the paved road to the project and within the project was implemented.

1.5.2 Storage Dam and Appurtenant Structures

Commencement Date at 11 July 2011

The progress of work No. 29 on 20 October 2013.

- Implementation Plan 25.119 %
- Overall Progress 17.316 % (Delayed 7.803%)

In fiscal year 2014, there is a plan for the construction of left side irrigation system, under Contract No.1 with 1,200,000 baht budget.

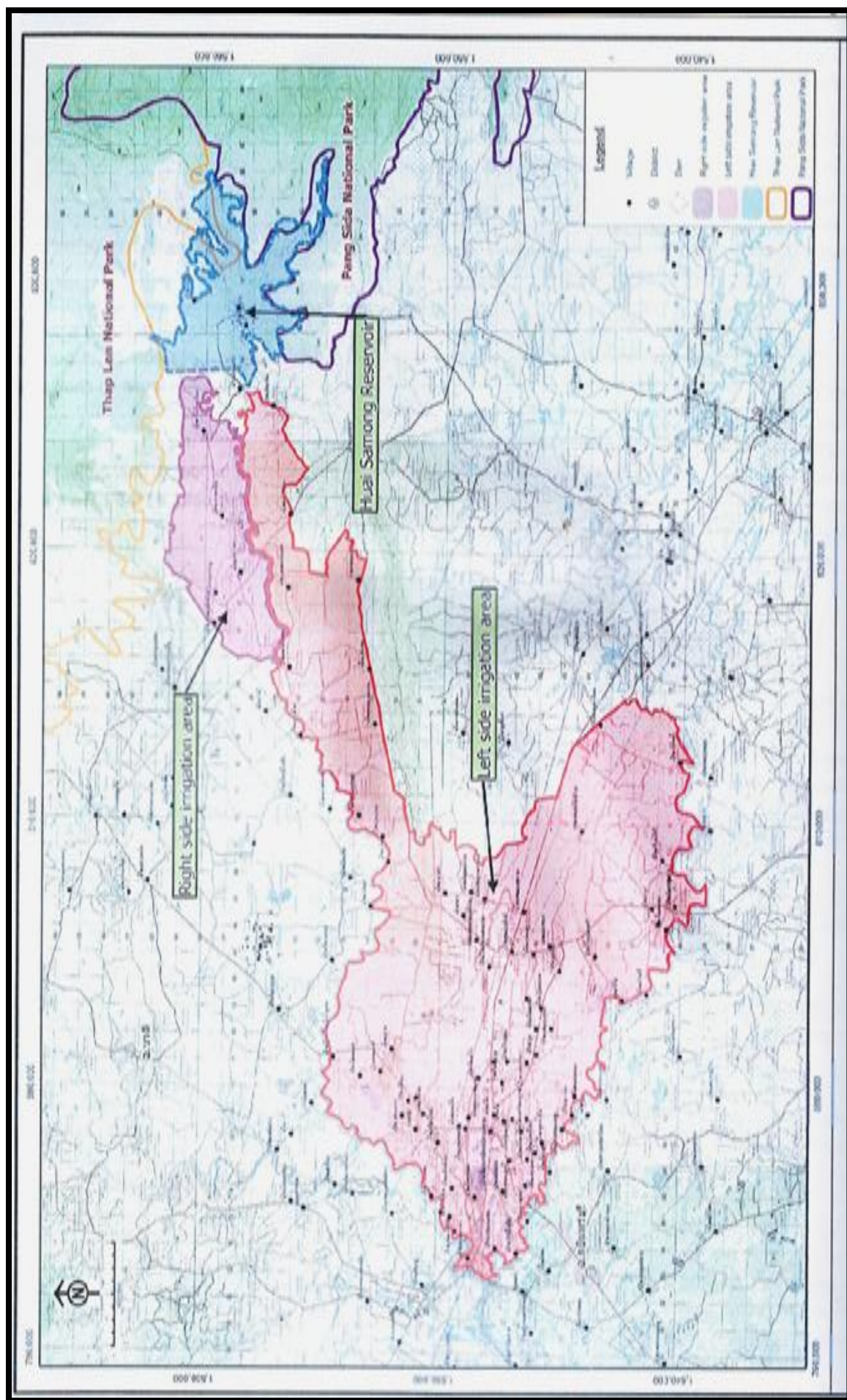


Figure 1.3-1 Location Map of Huay Samong Reservoir Project

(Source : Environmental Impact Assessment Study of The Huay Samong Reservoir Project Prachin Buri Province,2009)

Work Plan	Performance Duration (years)	Pre-construction Period	Project Implementation Duration																		Total (THB million)	Responsible Agency
			Construction Period						Operation Period													
			2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026			
1.Environmental Mitigation Measures Work Plans																						
1.1 Work plans of project construction period																						
1. Plan for public relations on the Huai Samong Reservoir Project	8			2.00	1.37	0.81	0.81	0.81	0.81	0.65										8.11	Royal Irrigation Department and related government agencies	
2. Plan for survey and compensation for land and property*	1.5																			-	Bureau of Land Law, Royal Irrigation Department, Committee on Determinate Compensation and person to be entitled to compensation and person to be entitled to compensation*	
3. Plan for forest clearance and removing from reservoir area*	1																			-	Royal Irrigation Department and; Royal Forest Department of National Parks, Wildlife and Development Bureau*(Clause1.3 and subclause 2 included	
4. Plan for allocating religious place for new community	1			0.50																0.50	Royal Irrigation Department and Kaeng Din So sub-district Administrative Organization	
5. Plan for prevention and control of surface water quality	5																			-	Royal Irrigation Department*	
6. Plan for prevention and control of soil erosion and landslides	8																			-	Royal Irrigation Department and Department of National Parks, Wildlife and Plant Conservation*	
7. Plan for prevention and impact mitigation on aquatic ecology and fisheries	5																			-	Department of Fisheries Research and Development Bureau*(Clause1.3 and subclause 2 included)	
8. Plan for prevention and reforestation in the surrounding area of reservoir	15			37.73	19.60	21.65	13.80	13.80	13.80	9.53	7.76	6.23	6.23	3.68	1.93	0.39	0.39	0.39		-	Thap Lan National Park; Pang Sida National Park; Prachin Buri Provincial Office of Natural Resources and Environment ;and Royal Forest Department	
9. Plan for wildlife migration and conservation	5			1.97	1.40	1.33	1.07	1.07												6.85	Department of National Parks ,Wildlife and Plant Conservation (Wildlife Research Division, Wildlife Conservation Office)	
10. Plan for public health development and safety	3					0.93	0.93	0.93												2.79	Royal Irrigation Department and Prachin Buri Provincial Public Health Office	
10.1 vector-borne diseases monitoring in construction site of the Huai Samong Reservoir Project	2			1.00	1.33															-	Bureau of Vector Borne Disease and The Office of Disease Prevention and Control 3, Chon Buri Province	
11) Plan for transportation improvement	2					10.00	10.00													20.00	Royal Irrigation Department and Department of Rural Roads	
12) Plan for resettlement area allocation*	2																			-	Royal Irrigation Department and Department of Lands*	
13) Plan for archaeology investigation	3			1.00		2.00														4.00	Prachin Buri Finearts Regional Office 5, The Finearts Department	
1.2 Work plans of Project operation period																						
1) Plan for Prevention of soil deterioration in the irrigation area	10				1.03				0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73		7.60	Land Development Department	
2) Plan for development and conservation of aquatic animal resources and fisheries	11						20.66	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93		59.95	Department of Fisheries, Inland Fisheries Research and Development Bureau	
3) Plan for assistance and migration of aquatic animals and fisheries	8				1.88	1.83	1.83	1.58	1.58	1.58	1.58	1.58								-	Department of Fisheries	
4) Plan for water management	10							0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17		1.70	Office of Regional Irrigation 9 and Prachin Buri Irrigation Project (c/o the Royal Irrigation Department) * partial budget for construction and operation	
5) Plan for agricultural development and extension	10							1.67	1.67	1.42	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17		12.95	Prachin Buri Provincial Agricultural Extension Office (c/o the Department of Agricultural Extension)	
6) Plan for occupational promotion and community expansion control in new communities	8			1.00	2.40	2.60	1.20	0.70	0.70	0.70	0.70									10.00	Department of Agricultural Extension; Community Development Department; Royal Irrigation Department; and Prachin Buri Province	
7) Plan for promotion of comprehensive health education for local communities	10							0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60		6.00	Department of Health; Department of Disease Control; and Prachin Buri Provincial Public Health Office	
8) Plan for tourism development and promotion	10							3.63	1.63	1.63	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23		8.50	Royal Irrigation Department; Department of National Parks, Wildlife, and Plant Conservation, and Tourism Authority of Thailand, Office of Tourism Development, Ministry of Tourism and Sports	
1.3 Work plans of world heritage properties impact prevention and resolution																						
1) Plan for prevention of encroachment on reservoir area and forest rehabilitation in the world heritage area																						
1.1 Prevention of encroachment on reservoir area and forest rehabilitation in Thap Lan National Park	13				9.53	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57		-	Thap Lan National Park; Protected Area Regional Office 1 (Prachin Buri); and Department of National Parks, Wildlife and Plant Conservation	
1.2 Prevention of encroachment on reservoir area and forest rehabilitation in Pang Sida National Park	9			3.45	3.50	2.20	2.20	1.95	0.50	0.50	0.05	0.25									Pang Sida National Park; and Department of National Parks, Wildlife and Plant Conservation	
2) Plan for wildlife impact mitigation	6																			-	Department of National Parks, Wildlife and Plant Conservation (Wildlife Research Division, Wildlife Conservation Office) (budget included in clause 1.2 and subclause 5)	
3) Plan for announcement of reservoir area as national park	2																			-	Royal Irrigation Department and Department of National Parks, Wildlife and Plant Conservation	
4) Plan for announcement of conservation area zone	2																			-	Department of National Parks, Wildlife and Plant Conservation	

5) Plan for setting a protection unit of Thap Lan National Park	14			22.09	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08		-	Thap Lan National Park and Department of National Parks, and Department of National Parks, Wildlife and Plant Conservation
6) Plan for setting a protection unit Pang Sida National Park	14			9.92	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08		23.96	Pang Sida National Park and Department of National Parks, and Department of National Parks, Wildlife and Plant Conservation
2. Environmental Impact Monitoring Work Plans																				
2.1 Plan for monitoring on climatic condition and meteorology	3						1.01					0.28					0.28		1.57	Royal Irrigation Department
2.2 Plan for monitoring on surface water quality	3						1.60					0.28					0.28		2.16	Royal Irrigation Department
2.3 Plan for monitoring on surface water quality	14			0.41	0.41	0.41	0.41	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50		6.64	Royal Irrigation Department
2.4 Plan for monitoring on groundwater hydrology and quality	10			1.13	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30						3.83	Royal Irrigation Department
2.5 Plan for monitoring on soil resources and land use	10							0.10	0.32	0.05	0.05	0.32	0.05	0.05	0.32	0.05	0.05		1.36	Land Development Department
2.6 Plan for monitoring on geological condition and dam safety	5																		-	Royal Irrigation Department (Annual budget)
2.7 Plan for monitoring on soil erosion and sedimentation	10																		-	Royal Irrigation Department (Annual budget)
2.8 Plan for monitoring on aquatic ecology and fishery resources	14			0.55	0.55	0.55	0.55	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61		8.30	Department of Fisheries by Inland Fisheries Research and Development Bureau, Prachin Buri Provincial Fishery Office
2.9 Plan for monitoring on prevention of encroachment on reservoir and forest areas, and reforestation	3			2.00	1.00	2.00			2.00										6.00	Forest Plantation Extension, Royal Department, and Forest Resource Management Office 9, Prachin Buri Province
2.10 Plan for monitoring on wildlife impact	6							1.15		0.87		0.87		0.87		0.87	0.27		4.91	Department of National Parks, Wildlife and Plant Conservation (Wildlife Research Division, Wildlife Conservation Office)
2.11 Plan for monitoring on agriculture livestock	10							0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25		2.50	Department of Livestock; Department of Agricultural Extension; and Prachin Buri Provincial Agricultural Office
2.12 Plan for monitoring on irrigation and drainage	10																		-	Royal Irrigation Department (Office of Large Scale Projects)
2.13 Plan for monitoring on flood condition and alleviation	3																		-	Royal Irrigation Department (Office of Large Scale Projects)
2.14 Plan for monitoring on socio-economic conditions	3						0.30					0.30					0.30		0.90	Royal Irrigation Department
2.15 Plan for monitoring on compensation for property and resettlement	5							0.10		0.10		0.10		0.10		0.10			0.50	Prachin Buri Provincial Office; Royal irrigation Department; Department of lands; Cooperative Promotion Department; and Community Development Department
2.16 Plan for monitoring on public health and nutrition	6				0.40		1.15	1.75	1.75	1.75	1.75	1.75							9.90	Department of Heath; Department of Disease Control; and Prachin Buri Provincial Public Health Office
2.17 Plan for monitoring on tourism and recreation	10							0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14		1.40	Royal Irrigation Department; Department of National Park, Wildlife and Plant Conservation; and Tourism Authority of Thailand
2.18 Plan for monitoring on impacts to the world heritage area	15																		-	Royal Irrigation Department ; Department of National Parks, Wildlife and Office of Natural Resources and Environmental Policy and Planning (budget in clauses 2.3,2.8 and 2.10 included)
2.19 Plan for monitoring on prevention and mitigation of environmental impacts	15			1.00	1.00	1.00	1.00	6.00	1.00	1.00	1.00	1.00	1.00	6.00	1.00	1.00	1.00	0.45	24.450	Royal Irrigation Department
2.20 Plan for monitoring on results of environmental impacts mitigation plan	15			1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	-	Office of Natural Resources and Environmental and Planning
Total yearly expenditure		0.00	0.00	86.98	46.42	51.59	62.75	45.67	36.92	30.94		25.52		22.96	15.51	14.67	14.83	2.04		
Grand Total																			516.59	

CHAPTER 2

Chapter 2

Environmental Management in Relation to World Heritage Property

2.1 Environmental Impact Mitigation Measures and Environmental Impact Monitoring Plans

The development of Huay Samong Reservoir Project, Prachin Buri may cause negative impacts on natural resources, environment and people's lives in the project and nearby area. To prevent and mitigate such impacts, environmental impact mitigation plans and environmental impact monitoring plans were set as approved by the cabinet to be exactly undertaken by the Royal Irrigation Department and concern agencies.

1) Environmental Impact Mitigation Plans These plans concern the negatives impacts on environmental resources, especially, the world heritages area, socio-economic and people's lives, which will be affected as reported in the main report. The impacts that have substantial effects have been evaluated both in quality and quantity aspects. The proposed measures on environmental impact mitigation shall be considered an investment cost which is economic, acceptance standard, and practicability to prevent and mitigate those impacts are cost-saving, standardized and practicability. There are all together 47 work plans under the Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans.

There are 15 concerned agencies.

Implementation period is 15 years from 2012 – 2026.

The total budget of THB 516.59772 million.

- 2 work plans for environmental impact at project pre construction stage:

1. Work plan for public relations on the Huay Samong Project initiated by His Majesty the King, Prachin Buri Province

2 Work plan for survey and compensation for land and property

- 11 work plans for environmental impact mitigation at project implementation stage:

1. Work plan for forest clearance and removing from reservoir area

2. Work plan for allocating area for religious place of the new community

3. Work plan for prevention and control of surface water quality

4. Work plan for prevention and control of soil erosion and landslides

5. Work plan for prevention and impact mitigation on aquatic ecology and fisheries

6. Work plan for prevention and reforestation in the surrounding area of reservoir

7. Work plan for wildlife migration and conservation

8. Work plan for public health development and safety

- Vector-borne diseases monitoring in construction site of Huay Samong Project

9. Work plan for transportation route improvement

10. Work plan for resettlement area allocation

11. Work plan for archaeology investigation

- 8 work plans for environmental impact mitigation at project implementation stages:
 1. Work plan for prevention of soil deterioration in the irrigation area
 2. Work plan for development and conservation of aquatic animal resources and fisheries
 3. Work plan for assistance and migration of aquatic animal fisheries
 4. Work plan for water management
 5. Work plan for agricultural development and extension
 6. Work plan for occupational promotion and community expansion control in resettlement area
 7. Work plan for promotion of comprehensive health education for local community
 - 8 . Work plan for tourism development and promotion
- 6 work plans for environmental impact mitigation affecting the world heritage area :
 1. Work plan for prevention of encroachment on reservoir area and forest rehabilitation in the world heritage area
 - a) Measures on prevention of encroachment on reservoir area and forest rehabilitation in Thap Lan National Park
 - b) Measures on prevention of encroachment on reservoir area and forest rehabilitation of Pang Sida National Park
 2. Work plan for wildlife impact mitigation
 3. Work plan for announcement of reservoir area as national park
 4. Work plan for announcement of conservation area zone
 5. Work plan for setting a protection unit of Thap Lan National Park
 6. Work plan for setting a protection unit of Pang Sida National Park

2) Environmental Monitoring Plans: These plans concern monitoring of an efficiency of measures on environmental impact prevention and mitigation, including potentials in developing project in order to be a baseline data for applying to other development projects. There are 20 work plans as follows:

1. Work plan for monitoring on climatic conditions and meteorology
2. Work plan for monitoring on surface water hydrology
3. Work plan for monitoring on surface water quality
4. Work plan for monitoring on groundwater hydrology and quality
5. Work plan for monitoring on soil resources and land use
6. Work plan for monitoring on geological conditions and dam safety
7. Work plan for monitoring on soil erosion and sedimentation
8. Work plan for monitoring on aquatic ecology and fishery resources
9. Work plan for monitoring on prevention of encroachment on reservoir and forest area, and reforestation

10. Work plan for monitoring on wildlife impact
11. Work plan for monitoring on agriculture and livestock
12. Work plan for monitoring on irrigation and drainage
13. Work plan for monitoring on flood conditions and alleviation
14. Work plan for monitoring on socio-economic conditions
15. Work plan for monitoring on compensation for property and resettlement
16. Work plan for monitoring on public health and nutrition
17. Work plan for monitoring on tourism and recreation
18. Work plan for monitoring on impacts to the world heritage area
19. Work plan for monitoring on prevention and mitigation of environmental impacts
20. Work plan for monitoring on results of Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans

2.2 Mechanism Used in Monitoring Implementation EIMP

The Prime Minister as the Chairman of the Office of the Royal Development Projects Boards appointed a special committee for royal development projects coordination as Order 1/2553 dated 7 January 2010 consisting of:

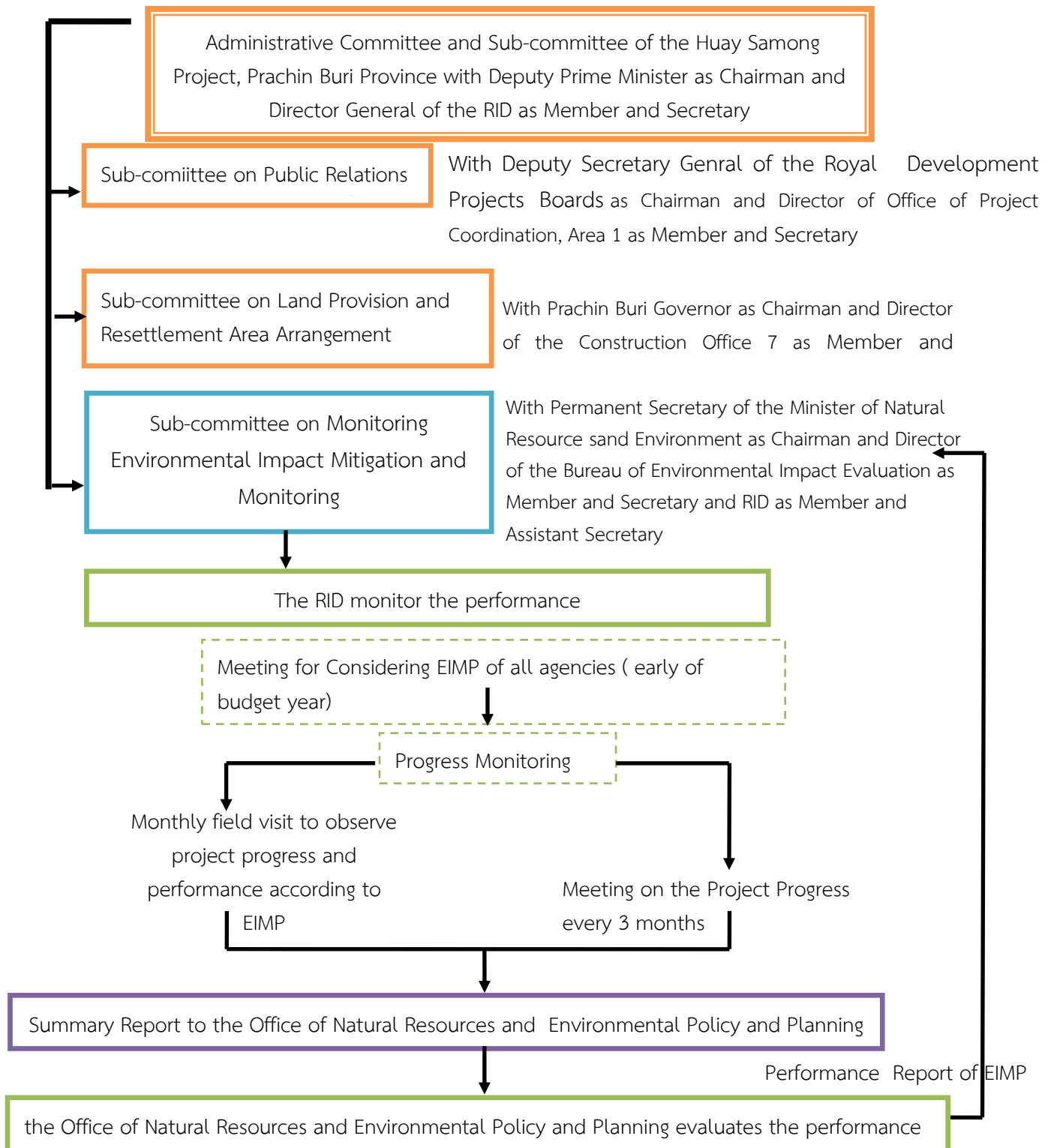


Figure 2.2-1 Flow Chart of Implementation Monitoring (Source: The Royal Irrigation Department, 2013)

2.3 Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans Of Year 2012 – 2013 in parts concerning the World Heritages

In Fiscal Year 2012 -2013, work plans for environmental impact mitigation and environmental impact monitoring in parts concerning the World Heritages are :

1. Work plan for survey and compensation for land and property by the RID and the Committee on Compensation Determination and Persons to be compensated.
2. Work plan for public relations on the Huay Samong Project by the RID
3. Work plan for forest clearance and removing from reservoir area by the RID and, the Royal Forestry Department, the Department of National Parks, Wildlife and Plant Conservation and Forest Industry Organization
4. Work plan for prevention and reforestation in the surrounding area of reservoir By Thap Lan National Park, Pang Sida National Park, Prachin Buri Office of Natural Resources and Environment and the Royal Forestry Department
5. Work plan for wildlife migration and conservation by the Department of National Parks, Wildlife and Plant Conservation
6. Work plan for prevention of encroachment on reservoir area and forest rehabilitation in the world heritage area by Thap Lan National Park, Pang Sida National Park, and the Office of Conservation Area Zone 1 Administration (Prachin Buri)
7. Work plan for announcement of reservoir area as national park by the Royal Irrigation Department and the Department of National Parks, Wildlife and Plant Conservation
8. Work plan for announcement of conservation area zone by the Department of National Parks, Wildlife and Plant Conservation
9. Work plan for setting a protection unit of Thap Lan National Park by the Thap Lan National Park and the Department of National Parks, Wildlife and Plant Conservation
10. Work plan for setting a protection unit of Pang Sida National Park by Pang Sida National Park and the Department of National Parks, Wildlife and Plant Conservation
11. Work plan for prevention of encroachment on reservoir area and forest rehabilitation by the Reforestation Promotion Office and Forest Management Bureau No.9, Prachin Buri Province.
12. Work plan for monitoring on prevention and mitigation of environmental impacts by the Royal Irrigation Department
13. Work plan for monitoring on results of Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans by the Office of Natural Resources and Environmental Policy and Planning

In total, the budget for all work plans concerning world heritage protections of fiscal year 2012 – 2013 is THB 121.37 millions with 10 responsible agencies.

2.4 Results of Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans of Fiscal Year 2012 -2013 in Parts concerning World Heritages

1. Work plan for survey and compensation for land and property

As the reservoir area and the dam site is partly cultivation area, communities and buildings, the survey on land and property shall be done carefully while the compensation shall be equitable so as to minimize the difficulties of people.

Implementation Schedule

2011	2012	2013	2014

Results of Implementation in Year 2012 -2013

The Huay Samong Reservoir Project, Prachin Buri Province, has the land to be compensated at total 2,205 ha (13,780 rai), of which 2,199 ha (13,744 rai) already has been compensated and the remaining 5.6 ha (35 rai) not compensated yet. Total compensation cost THB 13,024,731.

Special compensation will be paid instead of resettlement areas for the following people who have the following right in their lands:

1. Right for habitation 683 families
2. Right for cultivation 930 people

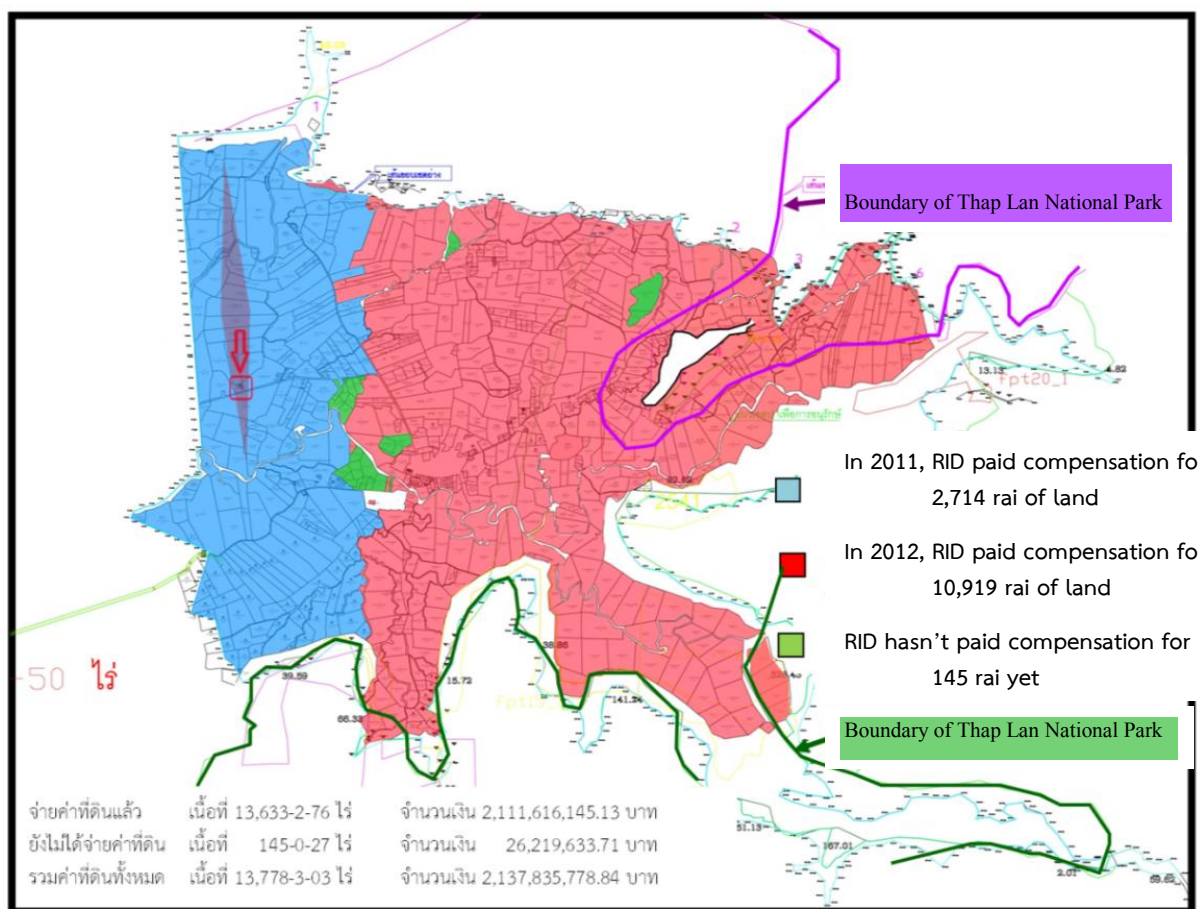


Figure 2.4-1 Map of Surveyed Areas for Compensation of their land and Properties (Source: RID, 2013)

Some of people being paid compensation and removal costs, have their new houses constructed in irrigation area as shown in the following pictures.

Old houses



New Houses



Figure 2.4-2 Those who have already been compensated for their land and property (Source: RID, 2013)

Benefits

After the RID has paid compensation and removal costs to the people residing in the reservoir area where partly is in world heritage property, encroachment in the world heritage area was lessened with better eco-system and people' condition of living. The said cost was used to buy and build new houses and land with higher security.

2. Work Plan for Public Relations of the Huay Samong Reservoir Project

This work plan is for providing people of different target groups with the information on the project objectives, implementation plan/development approaches, expected impacts and benefits, and environmental impact prevention and mitigation measures as well as promoting cooperation and collaboration among concerned agencies for the improvement of the project development.

Responsible Agencies : The Royal Irrigation Department and the Public Relations Committee

Total Budget : 8,110,000 baht

Implementation period : 8 years

Performance during 2012-2013

Construction Year (Year/Million Baht)				Implementation Period (Year/Million Baht)			
2012	2013	2014	2015	2016	2017	2018	2019
2.0	1.37	0.81	0.81	0.81	0.81	0.65	0.65

According to the plan, 3 training courses for young irrigators on the topic “Learning about and study visit to irrigation construction work” and 2 Workshops on the topic “Study visit for Promoting Participatory in Water Management” were held. Public media, publications, souvenirs, photo frames were distributed and public relations was made through communities radio stations.



Top Pictures Young irrigator trainings to promote water management and induce sense of environmental conservation.

Bottom Pictures Workshops on the topic “Study visit for Promoting Participatory in Water Management” for people in the project area to observe models with sustainable water management.

Figure 2.4-3 Activities undertaken according to EIMP (Source: RID, 2013)

Public relations was made through various media e.g. photo frames, notebook, project booklets, pencils, bags and etc.

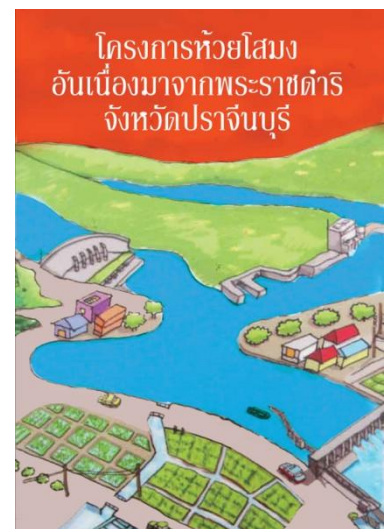
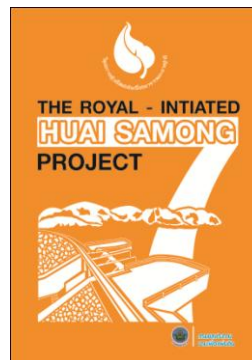


Figure 2.4-3 Public Relations Media (Source: PR Plan of the Construction Office 7, Huay Samong Project, 2013)

Benefits

Target groups of people of this public relations in 2012 -2013 is the people residing in the project area. With the objectives to better their understanding about the project and study visit to successful water user groups, the people will be able to cooperatively and effectively work with the project in water management. Youth also was trained to have more sense of management by providing information through schools in the project area. This plan was proved to be effective and can lessen the people's negative attitude against the project.

3. Work Plan for Forest Clearance and Removing from Reservoir Area

After the project development, the reservoir will cover 2,745 ha (7,159 rai) in which 1,165 rai is in Thap Lan National Park and 480 rai is in Pang Sida National Park, both have been announced natural world heritages (Dong Phrayayen – Khao Yai Forest). Those parts of national park will locate at the tail end of the reservoir but be covered only in some periods when the reservoir is at full storage level. The RID decided not to do forest clearance in that area but will do forest clearance and removing in land used for cultivation e.g. Sor.Por.Kor land type. Trees and weeds must be removed from the cultivation area to prevent their fermentation that can pollute water. Surveys on plantation and removal will be done in 2015 prior to first year storage in 2016 to lessen and prevent impacts in forest cut and wildlife hunting in world heritage sites.

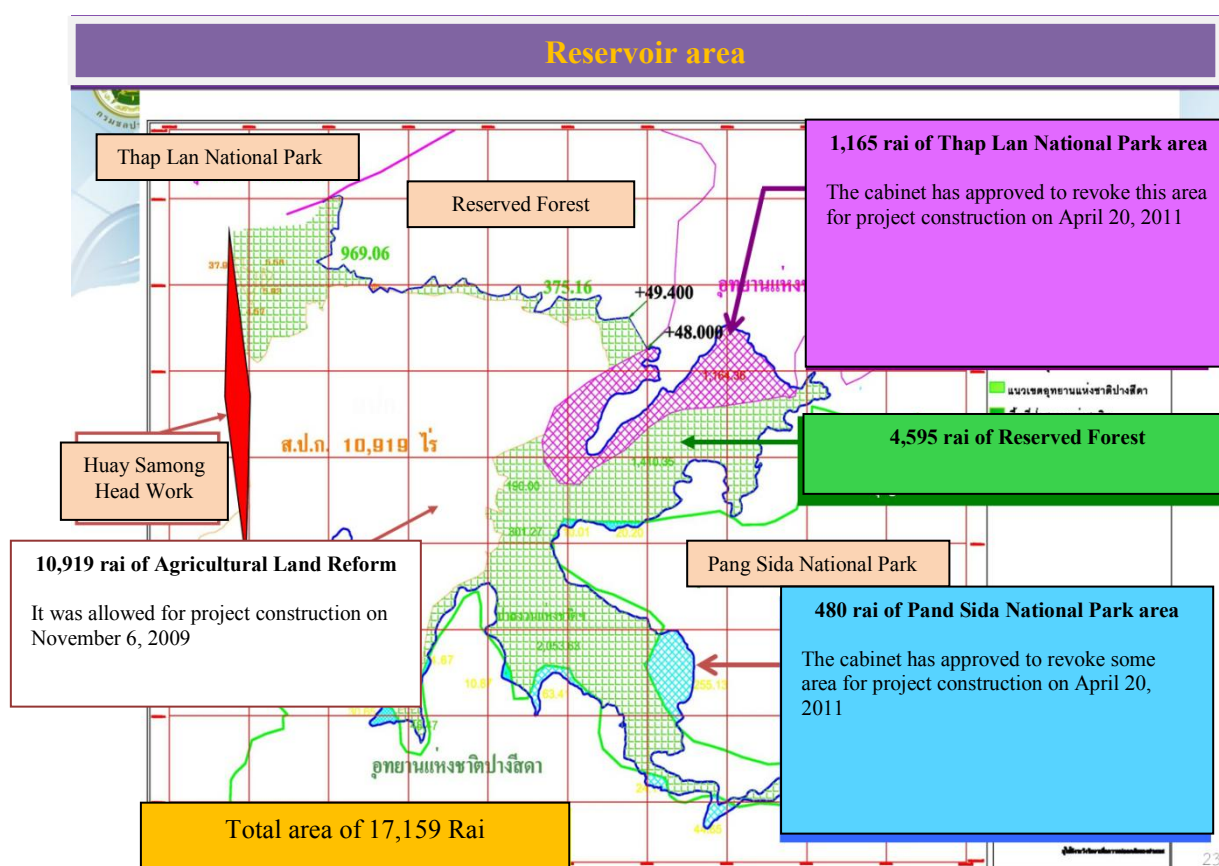


Figure 2.4-5 Map of Forest Clearance and Removing from Reservoir Area (Source: RID, 2012)

4. Work Plan for Prevention and Reforestation in the Surrounding Area of

Reservoir

Under the project development, natural resources and environment surrounding the reservoir will be restored. People and stakeholder will be provided with public relations for better understanding of the project. People will get utmost benefit from the project development. This work plan for prevention and reforestation in the surrounding area of reservoir will help promoting sense of conservation for world heritage sites, minimizing environmental impacts against the world heritage to the lowest level or none as well as rehabilitation of natural resources.

Responsible agencies : the Department of National Parks, Wildlife and Plant Conservation/
the Royal Forestry Department Prachin Buri Office of Natural Resources
and Environment

Implementation (Year/ Million Baht)				Implementation (Year/ Million Baht)										
2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
37.73	19.6	21.65	13.8	13.8	13.8	9.53	7.76	6.23	6.23	3.68	1.93	0.39	0.39	0.39

Total budget : THB 156,910,000

Implementation period : 15 years

Performance during 2012 -2013 : the work plan are divided into 2 plans :

1. Prevention plan
2. Reforestation plan in area surrounding the reservoir for year 2012 at 2,600 rai

And year 2013 at 3,700 rai

Prevention plan

Consists of following activities:

1. Administrative Activities

- 1.1 Public Dissemination to do public relations of the project by
 - Disseminating brochures to pupils, students, people and agencies.
 - Public relations through social network (Facebook)
 - Public relations through radio channel FM 106.25 MHz Sor.Wor.Chro.

Prachin Buri Municipality.

1.2 Trainings on Forest Laws and promoting sense of forest conservation in project labors, staff, communities and youth residing in the project area.

- Reforestation activity to commemorate the 81 year Birthday Anniversary of Her Majesty the Queen.

2. Forest Fire Prevention

There are two activities : 1. Water Provision for Fire Extinguish 2. Preparation of Fire Fighting

Units

3. Preparation of Wet Firebreaks

Wet firebreaks are done by growing wild bananas in lines. Wild bananas lines can break forest fire since they are variety with high water content and easy to propagate. They also can be used as wildlife food.

+ This plan consists the following activities :

1. Rehabilitation of watershed ecosystem
2. Plantation of wild rattan
3. Rehabilitation of watershed forest (general forest)
4. Plantation of fast growing perennial trees for wild animal food
5. Rehabilitation of forest ecosystem by growing local variety trees for wild animal food.
6. Plantation of Eagle wood trees to return them to world heritage forest
7. Plantation of valued trees to replace alien variety trees



Reforestation activity to commemorate the 80 year Birthday Anniversary of Her Majesty the Queen, using 2012 budget on 11 July 2012 at Huay Samong Reservoir Project initiated by H.M. the King, Prachin Buri Province



The above activity was led by Privy Council (His Excellency Mr. *Palakorn* Suwanrath) The Royal Irrigation Department also undertaken reforestation activities together with the Department of National Parks, Wildlife and Plant Conservation

Reforestation activity to commemorate the 80 year Birthday Anniversary of Her Majesty the Queen, using 2012 budget on 11 July 2012 at Huay Samong Reservoir Project initiated by H.M. the King, Prachin Buri Province



Privy Council General Surayud Chulanont chaired the above activity and took part in check dam construction

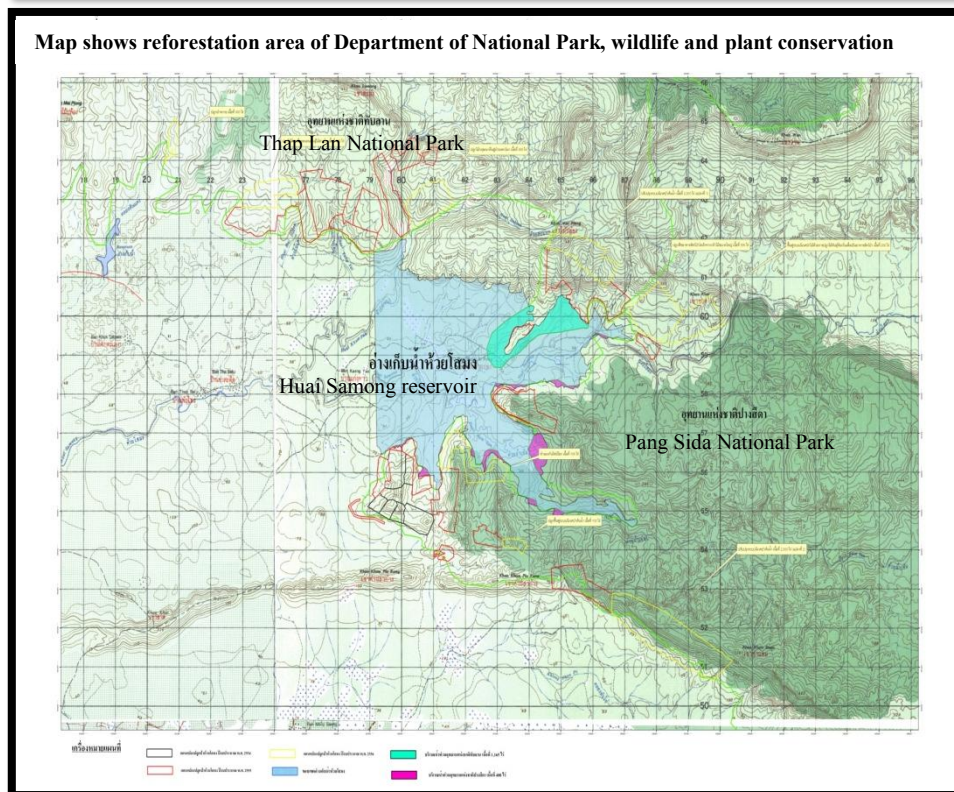
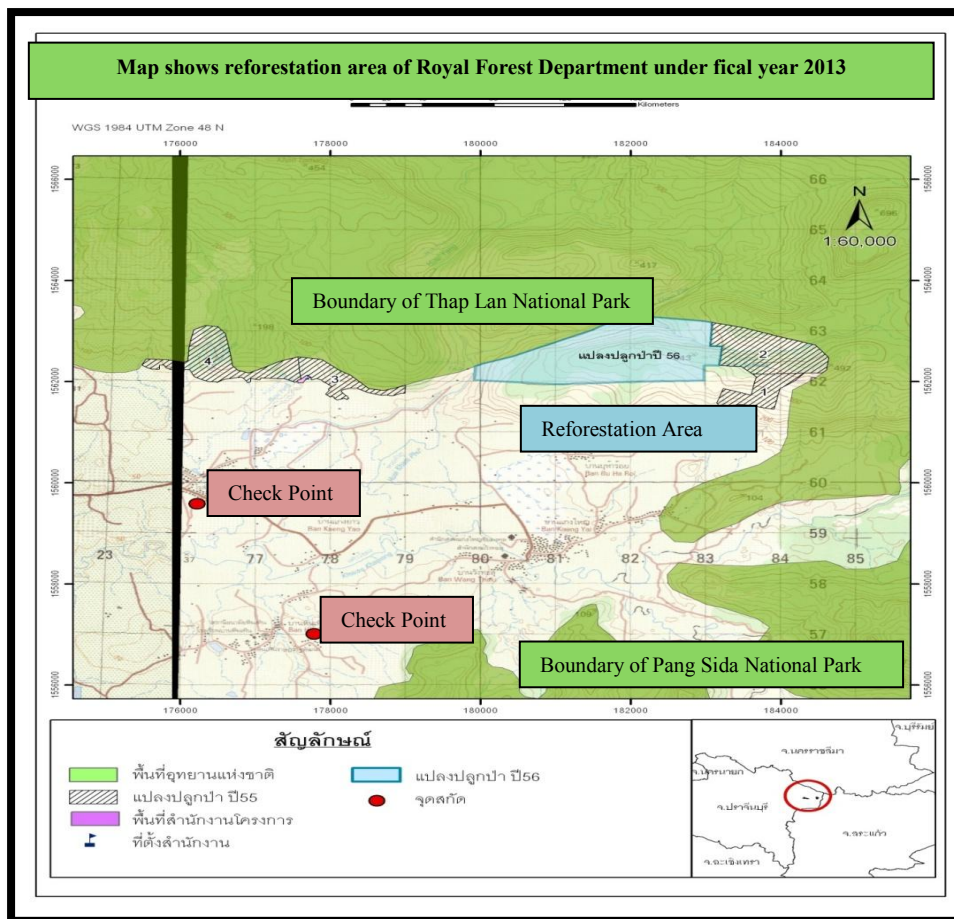


Figure 2.4-6 Map Showing Reforestation Zones under Fiscal Year 2012 -2013 (Source: RID,2013)

5. Plan for Wildlife Migration and Conservation

This work plan is to help, solve, mitigate impacts of the reservoir construction on wildlife. Survey on wildlife was done to cover the whole area since the reservoir area connects with conservation forest which is the habitation and food sources of wildlife. For their safety, wildlife will be migrated to new habitation area safely and with minimum impacts.

Responsible agencies : the Department of National Parks, Wildlife and Plant Conservation

Total budget : 6,852,400 THB

Implementation period : 5 years Objectives 1) to survey on wildlife 2) to survey on new habitation area for migrated wildlife, and 3) to plan the migration of wildlife

<i>Construction (Year/Million Baht)</i>				<i>Implementation (Year/Million Baht)</i>
<i>2012</i>	<i>2013</i>	<i>2014</i>	<i>2015</i>	<i>2016</i>
<i>1.9868</i>	<i>1.3994</i>	<i>1.3294</i>	<i>1.0684</i>	<i>1.0684</i>

Survey Methods

- (1) Big mammals : by installing surveillance camera
- (2) Small mammals: by trap capturing
- (3) Birds : by Point Transect
- (4) Reptiles and Amphibians : by direct count survey of reptiles and amphibians at night at water resources or streams in the Huay Samong Project area

Performance

Plan for Wildlife Migration and Conservation under Fiscal year 2012 was began with survey work in May to August done by the wildlife Research group of the Office of Wildlife Conservation, the Chaichoengsao Wildlife Research Center, Khlong Saeng Forest Wildlife Research Center, Pa Chiang Dao Forest Wildlife Research Center. These agencies cooperatively surveyed on 4 groups of wildlife vertebrate, the result of the surveys are as follows:

Mammals

Big mammals found in the reservoir surrounding area are Malayan sun bears which still use the area north of reservoir in the Thap Lan National park for their living and serows found at steep slope north of the reservoir in the Thap Lan National park. The study reveals that a mammal deemed as "Umbrella Species" like Wild Oxen were found in the Mixed Deciduous Forest near boundary to be flooded in the Thap Lan National park though they are not abundant. However, this reflects that the area still be useful for big mammals as their habitation and food resources as well having potential in supporting and habitat other species of wildlife.

11 species of small mammals found in the projects area are Tupaia belangeri, Indochinese ground squirrel, Gray-Bellied Squirrel, Roof Rat, Noisy Rat, Bandicoot rat, Small Bandicoot Rat, Yellow Rajah Rat and Hill Rat. The most found is Tupaia Belangeri and another abundant in the upper area is Hill Rat found in forest, cultivation field and Eucalyptus plots in the project area.

The surveys reveal that the area northe of reservoir in the Thap Lan National Park and Pang Sida Forest Protection Unit (Kaeng Yai Mak), mammals still are abundant due to their water and food resources and undisturbed condition from human. However, the future change due to project extension may cause impacts to several species of wildlife in the area. There is a need to monitor the living condition of those wildlife for planning of impact mitigation and wildlife migration.

Birds

The surveys reveals that the highest density of bird species found here is Yellow Bellied Sunbird, followed by Spoted Munia and Black-crested Bulbul. Therefore, it can be concluded that the project area is still bird habitation and can accommodate various bird species in spite of the project quite low impacts on birds. However, some species may loss their habitation , for example, those live in the low land area. Therefore, there is still a need to monitors condition of birds so as to plan for impact mitigation on birds like other species of wildlife. Changes in their population must be monitored consecutively as their environment has been changed or turned into reservoir area.

Reptiles and Amphibians

The surveys on Reptiles and Amphibians in water sources, streams and surveying plots in reservoir area reveal that the species found most are species that can adjusted themselves quite well and so habitat in farm lands, namely, Cricket Frogs, Chinese Edible Frogs, Ornate Chorus Frog, Painted Chorus Frog and etc. However, after water storage begins, their habitation may be destroyed. Some species of frogs need flowing stream for laying eggs. Tree frogs e.g. Four-lined Tree Frogs, Dwarf Bush frogs and Nongkhon Bush Frogs need to stay in trees above the ground or live in tree hollows with water for their reproduction. Reptiles like snakes, lizards and skinks lives in forest ground covered with bush or fallen leaves for hiding themselves. These reptiles have restricted area of habitation and cannot move far by themselves. To migrate them to suitable place for their livings according to their eco-system conditions must be don prior to water storage commencement.

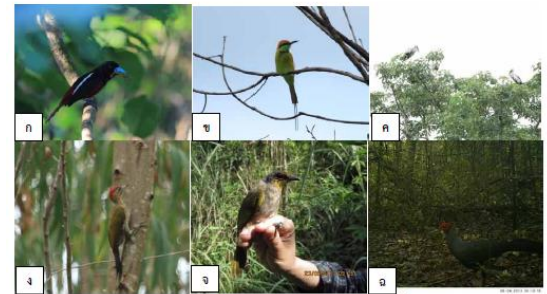


Figure 2.4-7 Surveys on Wildlife as per EIMP (Source: Plan for Wildlife Migration and Conservation, Department of National Parks, Wildlife and Plant Conservation, 2013)

6. Work plan for prevention of encroachment on reservoir area and forest rehabilitation in the world heritage area

The development of Huay Samong Project will cause a loss of national park area in Thap Lan and Pang Sida National Parks and may cause indirect impacts such as illegal cutting, forest encroachment and wildlife hunting, etc. Therefore, after the project development, the RID will return the reservoir area to the Department of National Park, Wildlife and Plant Conservation for prevention of encroachment into reservoir area, rehabilitation of the forest and Huay Samong watershed to its plentiful conditions, and replace the cut forest due to the project implementation with new forest.

The Work plans for prevention of encroachment on reservoir area and forest rehabilitation in the world heritage area are divided into :

6.1) Work plan for prevention of encroachment and reforestation in the Thap Lan National Park

Responsible agencies : Thap Lan National Park / National Park Office

Total Budget : 23,990,140 THB

Implementation period : 13 years

Performance during 2012-2013

Implementation (Year/ Million Baht)			Implementation (Year/ Million Baht)										
2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
9.52494	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57

Thap Lan National Park undertook activities in the work plan for prevention of encroachment and reforestation in the Thap Lan National Park as follows:

1. Wild rattan plantation in 80 ha (500 rai) area by surveys, land measurement, weed eradication and collecting, storing and benchmark making of plantation lines.
2. Plantation of animal food trees in 60.8 ha (380 rai) area by surveys, land measurement, weed eradication and collecting, storing and 76,000 benchmark making of plantation lines .
3. Improvement of watershed ecosystem in 160 ha (1,000 rai) area by by surveys, land measurement, weed eradication and collecting, storing and 25,000 benchmark making of plantation lines.
4. 1 plant nursery of small trees and preparation of nursery material
5. 1 nursery of vetiver grass in which 300,000 stems were produced and nursery material was prepared
6. Preparation for 5 permanent weir construction by site surveys and material preparation. At present, the weirs are under construction.
7. Preparation for 15 semi-permanent weir construction by site surveys and material preparation. At present, the weirs are under construction.

8. Preparation for 60 integrated weir construction by site surveys and material preparation. At present, the weirs are under construction.
9. Setting of 40 km. long firebreak by land surveys and preparation.
10. Setting of 8 km. barb wire fence
11. 1 Training course on staff efficiency increase
12. 1 Youth camp for world heritage conservation hold in a school for inducing sense of conservation and informing them of forest fires problems and it disadvantages
13. 1 Training course for local communities' leaders and member of Sub-district Administrative Organization surrounding the Huay Samong Reservoir
14. 1 Batch of public relations media production
15. 1 Batch of administrative staff training



Figure 2.4-8 Activities on Rehabilitation of Areas surrounding Thap Lan National Park (Source : Work plan for prevention of encroachment on reservoir area and forest rehabilitation in the world heritage area, Department of National Parks Thap Lan, 2013)

6.2) Work plan for prevention of encroachment on reservoir area and forest rehabilitation in the world heritage area in Pang Sida National Park

Responsible agencies : Pang Sida National Park / National Park Office

Total Budget : 15,500,000 THB

Implementation period : 9 years

Activities :

Implementation (Year/ Million Baht)				Implementation (Year/ Million Baht)				
2012	2013	2014	2015	2016	2017	2018	2019	2020
3.45	3.95	2.2	2.2	1.95	0.50	0.50	0.50	0.25

1. Plantation of animal food trees in 8 ha (50 rai) area by seedling of trees e.g. wild banana, Java Plum, Bamboo, Fishtail Palm, etc., nursery, planted in prepared area, taking care and counting those can grow
2. Setting of 10 km. long firebreak
3. Construction of 10 semi-permanent weirs and 50 integrated check dams: 100 % completed
4. Development of communication system by providing mobile VHF/FM radio transmitter and receiver , stationed VHF/FM radio transmitter and receiver , and vehicle VHF/FM radio transmitter and receiver for communication in offices and in field surveys. All items are being delivered and installed.
5. Installment of 2 Solar system Electric Generators. The work is under preparing specifications
6. Preparation of 10 artificial salt lick sites by surveying for proper sites, materials and implementation.
7. 1 Training course on staff efficiency increase to prepare and inform them of the project implementation plan
8. Establishment of mobile PR units and preparation of guidelines on benefits of Huay Samong watershed to be used as PR media and disseminated to people in the affected and benefited area
9. Establishment of mobile PR units to inform people in the affected and benefited area and PR implementation through community radio, posters and publication about forest fire
10. Youth camp for world heritage conservation and training course for local people



Pictures of Activities Undertaken According to the Work Plan

(Source: Work plan for prevention of encroachment on reservoir area and forest rehabilitation in the world heritage area in Pang Sida National Park, 2013)

7. Work plan for announcement of reservoir area as national park

After water storage, the area in Thap Lan National Park and Pang Sida National Park will be flooded at approximately 263 ha (1,643.92 rai or 0.04 % of world heritage sites). Such area was withdrawn from national park prior to project development. However, to preserve its unique value of natural world heritage, as well as promoting sustainable conservation and to enforce laws concerning land protection and management, the Royal Irrigation Department intends to return the area to its former status as National Park.

The Royal Irrigation Department had established a Committee on Criteria Determination and Examination for Returning Conservation Area and the Committee hold a meeting on 9 April 2012 to consider criteria for selection of reservoirs located in the conservation area to be returned to the Department of National Park, Wildlife and Plant Conservation. The Committee decided to give first priority to reservoirs located in Dong Phrayayen- Khao Yai and surveys on such reservoirs were done during 28-29 October 2013. Huay Samong Reservoir Project is one of those projects to returned to the Department of National Park, Wildlife and Plant Conservation.

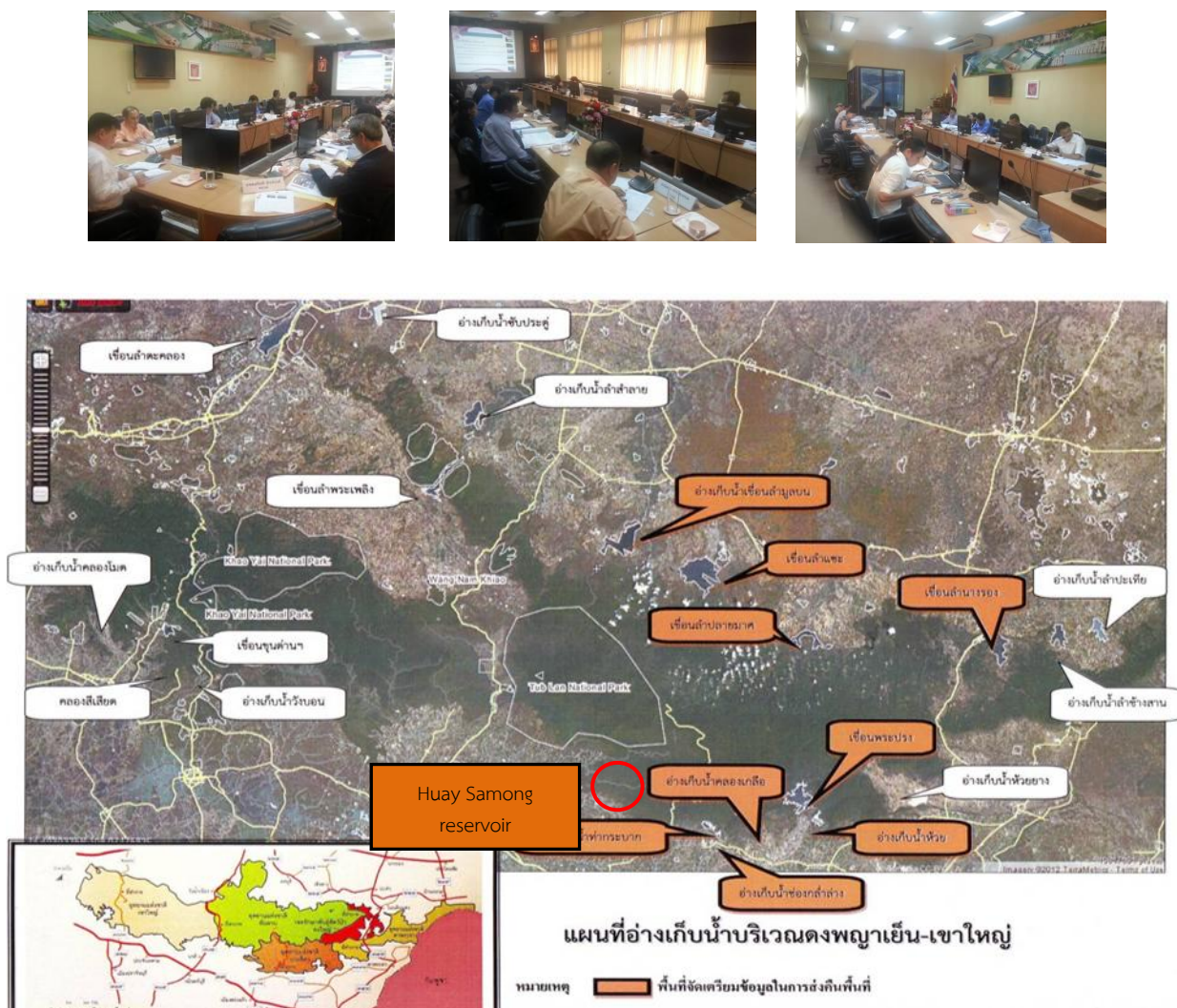
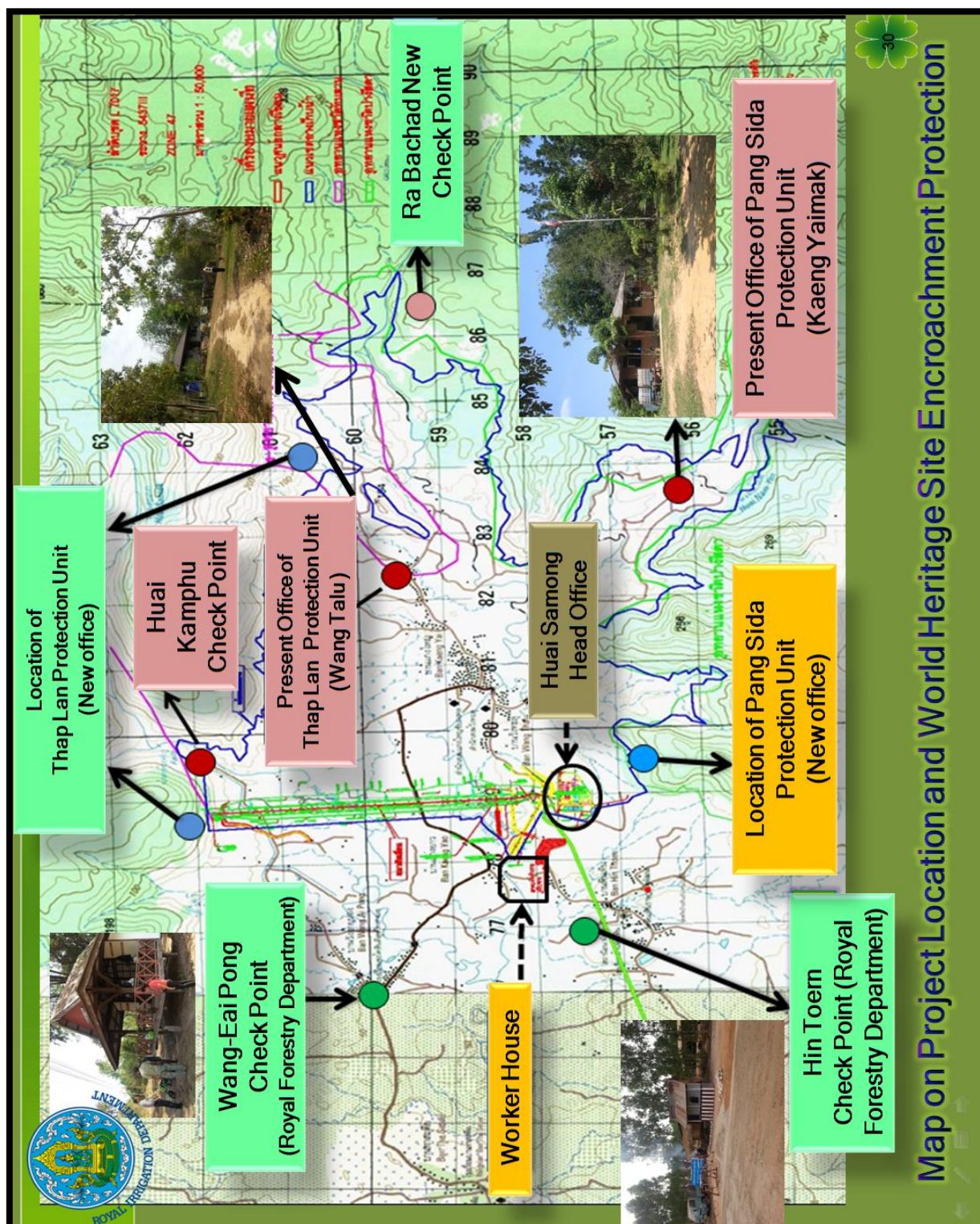


Figure 2.4-10 Map of Reservoirs in Dong Phrayayen – Khao Yai (Source: RID, 2013)



8. Work plan for announcement of conservation area zone

The project development may cause direct impacts as there may be loss of forest ecosystem, wildlife, biological diversity or affect to the area status as the natural world heritage. But those impacts are expected to be at low level because water stored in the Huay Samong Reservoir will flood only the rim of Thap Lan and Pang Sida National Park or at 0.04 % area of the total area of world heritage (3,845,082.53 rai). In fact, this area is currently invaded and deforested by the locals for many activities, for example, eucalyptus, cassava and bamboo shoot plantation. The forest area of 92 ha (574.49 rai) has been proposed by the RID in cooperation with the Royal Forestry Department and the Department of National Park, Wildlife and Plant Conservation to be rehabilitated to plentiful conditions and thus proposed to be announced as conservation area zone according to the regulation for determination of area to be National Park. Such area consists of 2 land plots of total 1,726 ha (10,787 rai)

In fiscal year 2012 and 2013, reforestation was done in the area to be announced as conservation zone by the Royal Forestry Department and Warning signs forbidding encroachment were posted.

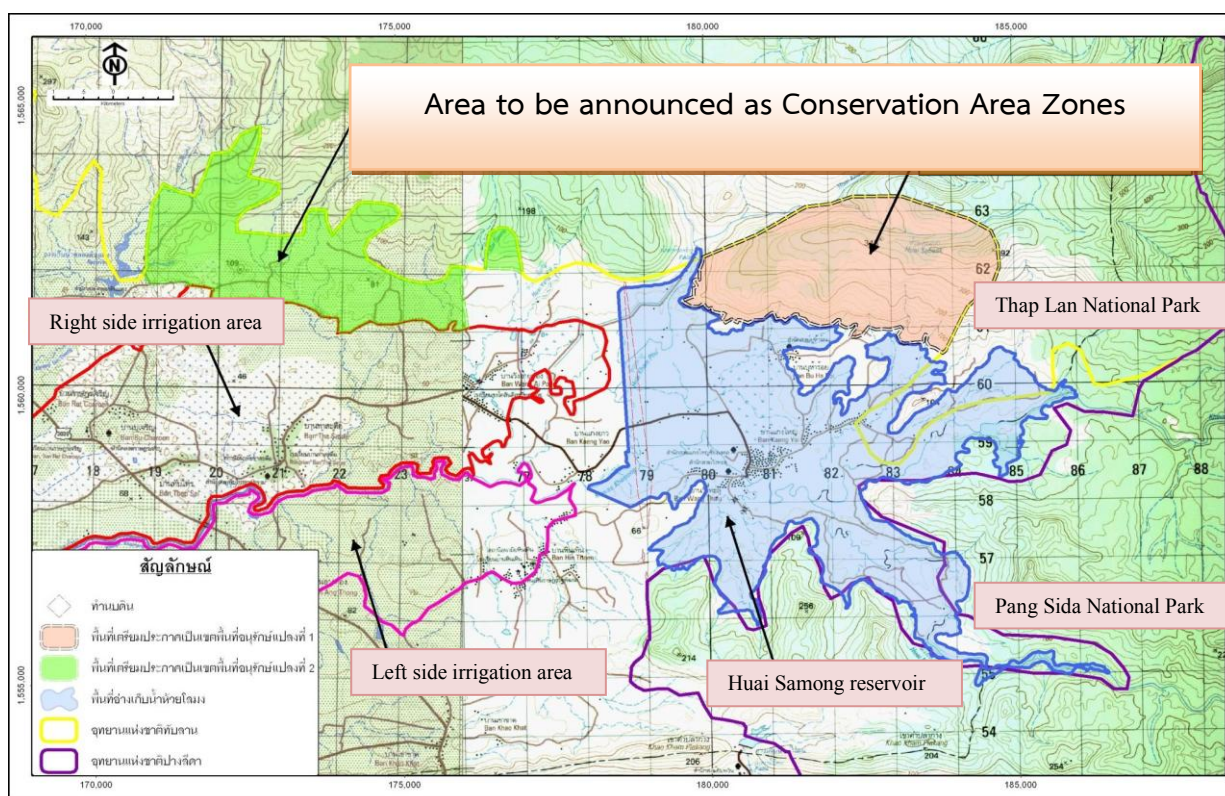


Figure 2.4-12 Area to be announced as Conservation Area Zones (Source : RID, 2013)

9. Work plan for setting a protection unit of Thap Lan National Park

To protect Thap Lan National park as a part of Dong Phrayayen – Kho Yai Forest which was proclaimed as the world natural heritage is the main responsibility of the Thap Lan Protection Units. At present, there are altogether 15 protection units. However, after the project development, Unit No. 06 (Wang Thalu) and one inspection point at Huay Phu Kham will be flooded. Therefore, to enable continue and efficient protection work, 2 new protection units of Thap Lan National Park will be established. At present, the work is under the stage of calling for construction contractors. The Royal Irrigation Department has rendered full support in term of budget, staff and vehicles for the protection surveys for long.

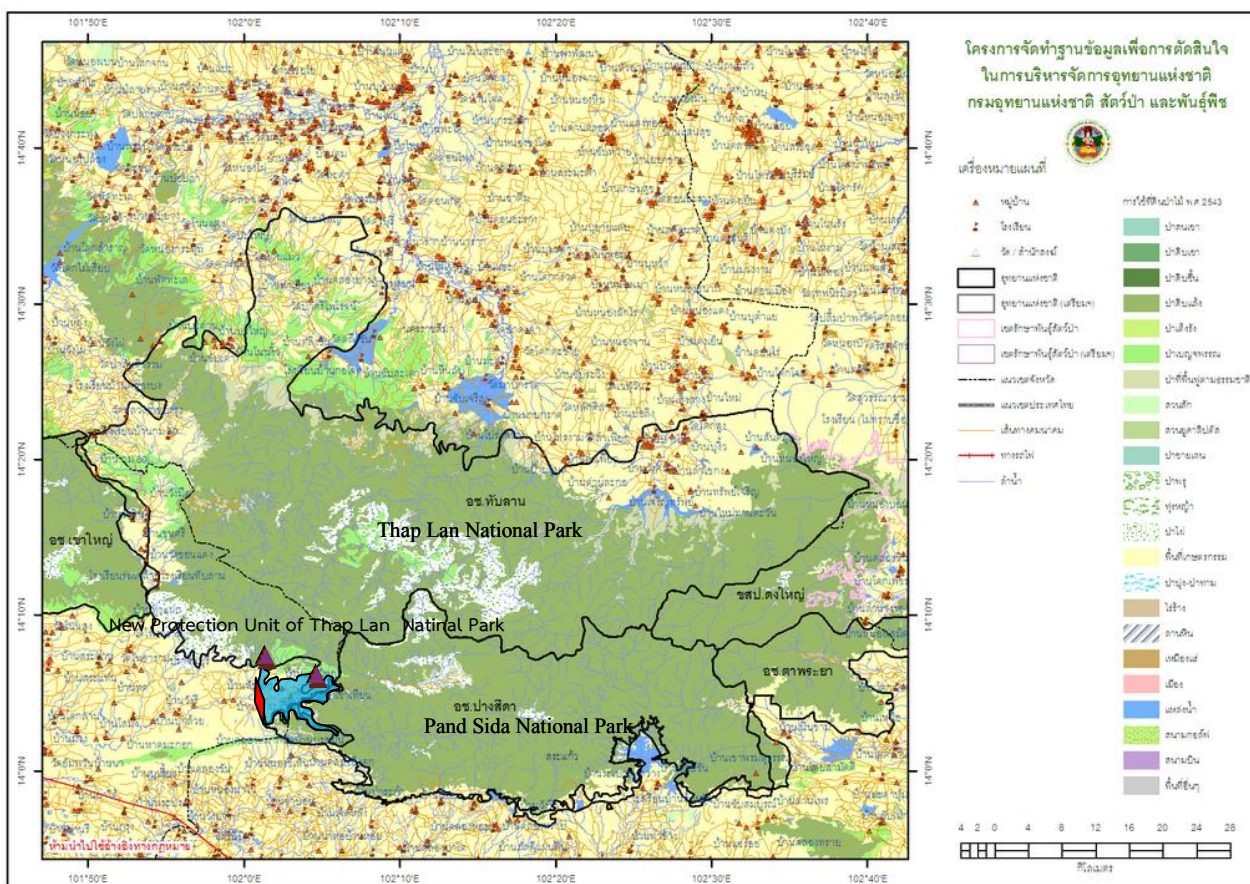


Figure 2.4-13 Work plan for setting a protection unit of Thap Lan National Park
(Source : Department of National Parks, Wildlife and Plant Conservation, 2012)

10. Work plan for setting a protection unit of Pant Sida National Park

To protect Pang Sida National park as a part of Dong Phrayayen – Khao Yai Forest which was proclaimed as the world natural heritage is the main responsibility of the Pang Sida Protection Units. At present, there are altogether 11 protection units. However, after the project development, Unit No. 01 (Kaeng Yai Mak) will be flooded. Therefore, to enable continue and efficient protection work, 1 new protection unit and 1 inspection point of Pang Sida National Park will be established. At present, the work is under construction. In this concern, the Royal Irrigation Department has rendered full support in term of budget, staff and vehicles for the protection surveys for long.

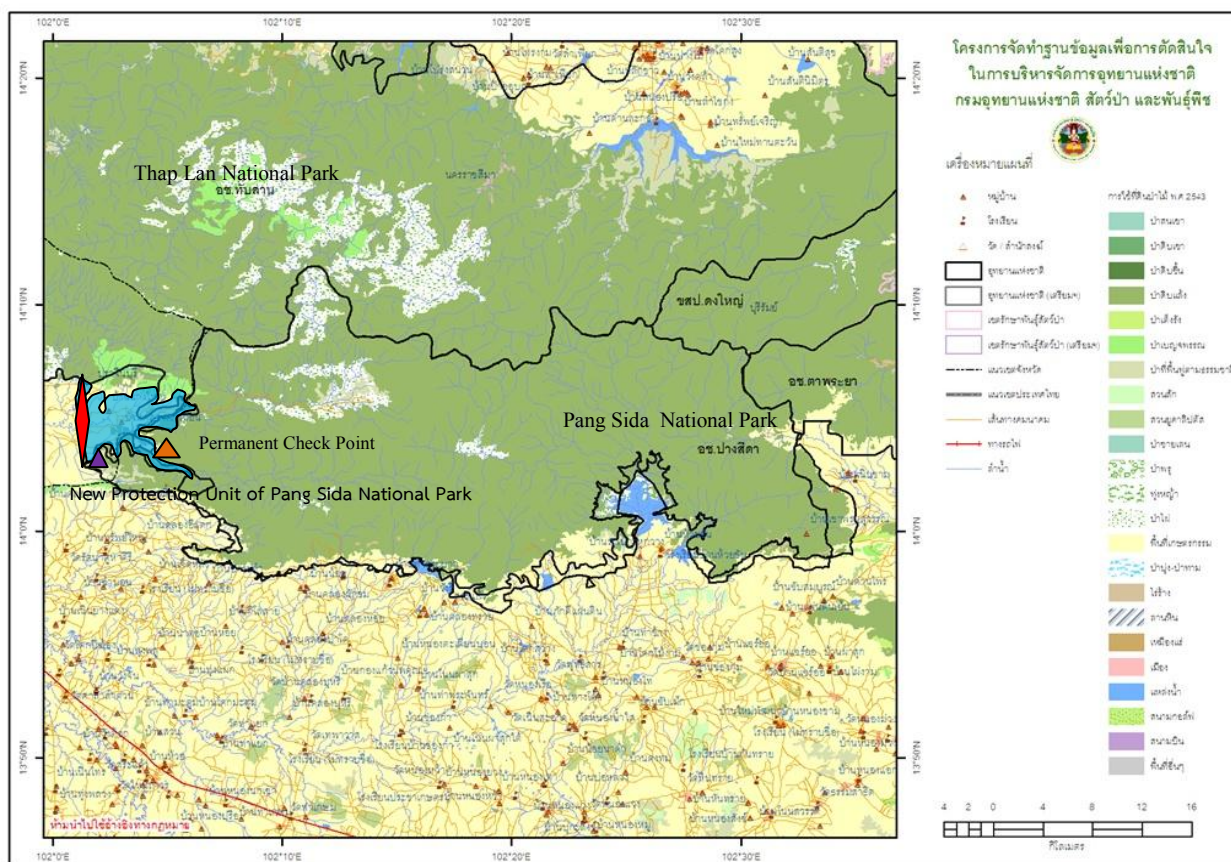


Figure 2.4-14 Work plan for setting a protection unit of Pang Sida National Park
(Source : Department of National Parks, Wildlife and Plant Conservation, 2012)

11. Work plan for prevention of encroachment on reservoir area and forest rehabilitation

The development of Huay Samong Project will cause a loss of forest in national park, Kaeng Din So Forest, Kaeng Yai Forest and Khoa Saton Forest. Therefore, there should be encroachment prevention in the remaining forest and the new replaced forest.

Responsible Agencies : Reforestation Promotion Office, the Royal Forestry Department

Implementation (Year/ Million Baht)			Implementation (Year/ Million Baht)
2012	2013	2014	2015
2.0	1.0	1.5	1.5

Management Bureau No.9, Prachin Buri Province.

Total Budget : 6,000,000 THB

Implementation : 4 years

Activities : Responsible agencies has undertaken the monitoring and prevention measures on encroachment on reservoir area and the encroachment to forest and replaced forest. A forest protection coordination center was set as well as operation teams for forest surveys and inspection points for suppressing and preventing forest encroachment.



Map shows work area of Royal Forest Department, under fiscal year 2012

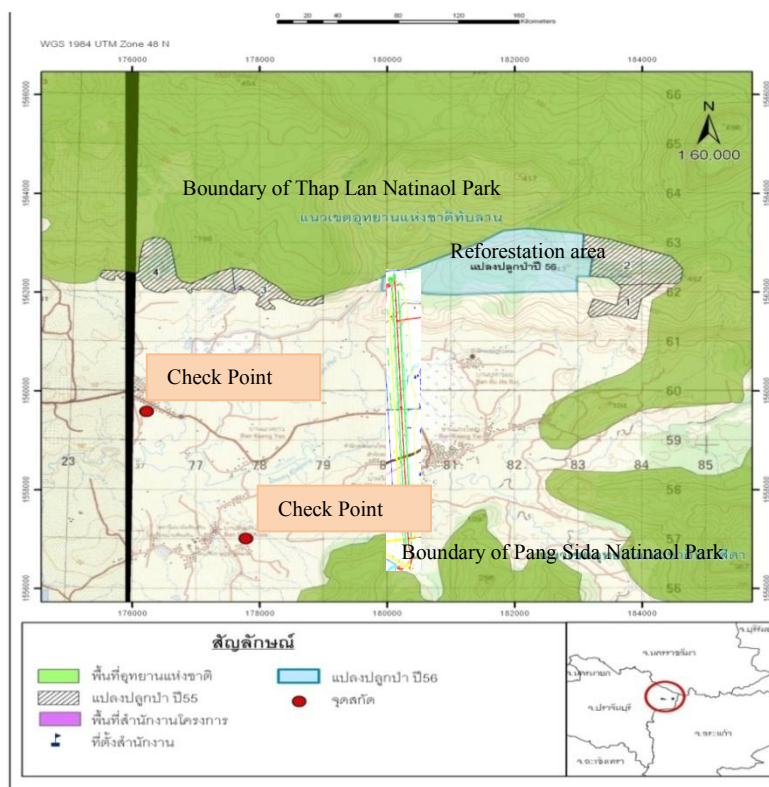


Figure 2.4-15 Work plan for setting a protection unit of Pang Sida National Park
(Source : Royal Fores Department Wildlife and Plant Conservation, 2012)

12. Work plan for monitoring on results of Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans

The Huay Samong Project Development is expected to cause impacts and changes to environment and values in the project site both in time of construction and implementation periods. In order to ensure that the environmental impact is going to be minimized to accepted level, the work plan for monitoring on prevention and mitigation of environmental impacts shall be monitored on its implementation, efficiency of measures to enable the improvement of the mitigation plans to suit the present conditions. Objectives of this plan are as follows:

1) To monitor the implementation of Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans of related agencies

1) To monitor the implementation of measures specified in the EIA report.

Responsible agency : The Royal Irrigation Department

Total Budget : 24,452,000 THB

Implementation period : 15 years

Implementation (Year/ Million Baht)				Implementation (Year/ Million Baht)				
2012	2013	2014	2015	2016	2017-2021	2022	2023-2025	2026
1.0	1.0	1.0	1.0	6.0	1.0	6.0	1.0	1.0

Activities : 1. To monitor the implementation of Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans of related agencies

- On 20 April 2012, a meeting No. 1/2555 was hold on the outcome of the Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans, Huay Samong Project, Prachin Buri Province.

- On Friday 6 July 2012, a meeting No. 2/2555 was hold on the implementation of the Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans.

- On Thrusday 6 September 2012, a meeting No. 3/2555 was hold on the summary of outcome of the Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans.

- On 20 November 2012, Staff of Project Environment Group of the Project Management Office observed the performance at the site field.

- On Thursday 17 January 2013, a meeting No..1/2556 was hold on the implementation of the Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans.

- On Wednesday 24 April 2013,a meeting No. 2/2556 was hold on the progress of the Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans.

- On Wednesday 11 July 2013,a meeting No. 3/2556 was hold on the progress of the Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans.

- On 16 July 2013, RID staff in Environment Group, Office of Project Management, RID monitored work plan on Prevention and Reforestation in the Surrounding Area of Reservoir.

- On 8 August 2013, activities to prevent and reforest in the surrounding area of reservoir area in the Pang Sida National Park and project area was implemented

2. Monitoring reports of the Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans was prepared twice a year to be submitted to the the Office of Natural Resources and Environmental Policy and Planning (ONEP).



Figure 2-16 Site visits to observe the progress of measures specified in EIA reports



Figure 2-17 Monthly field surveys to observe the outcome of EIMP



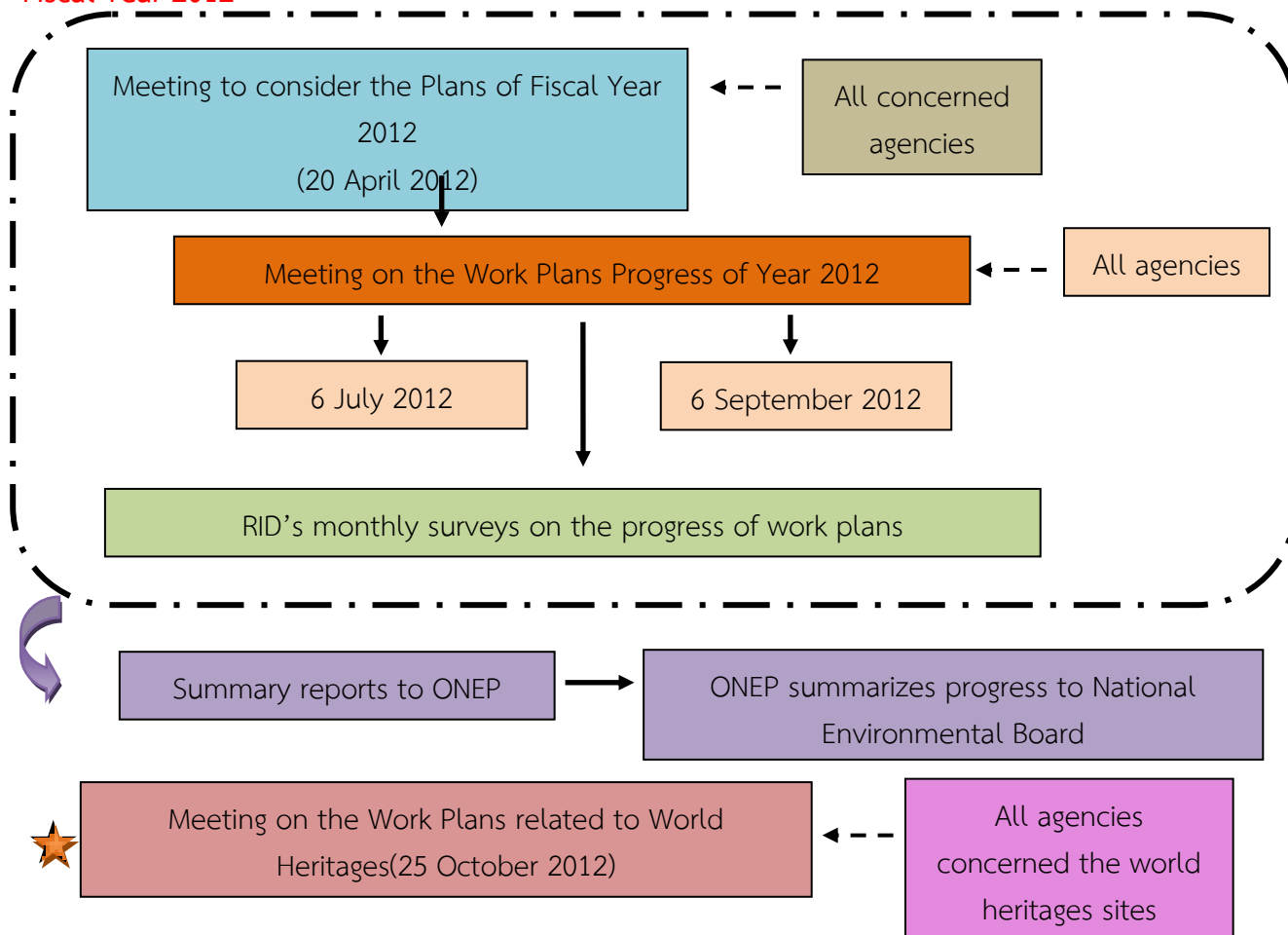
Figure 2 -18 Meetings on progress every three months



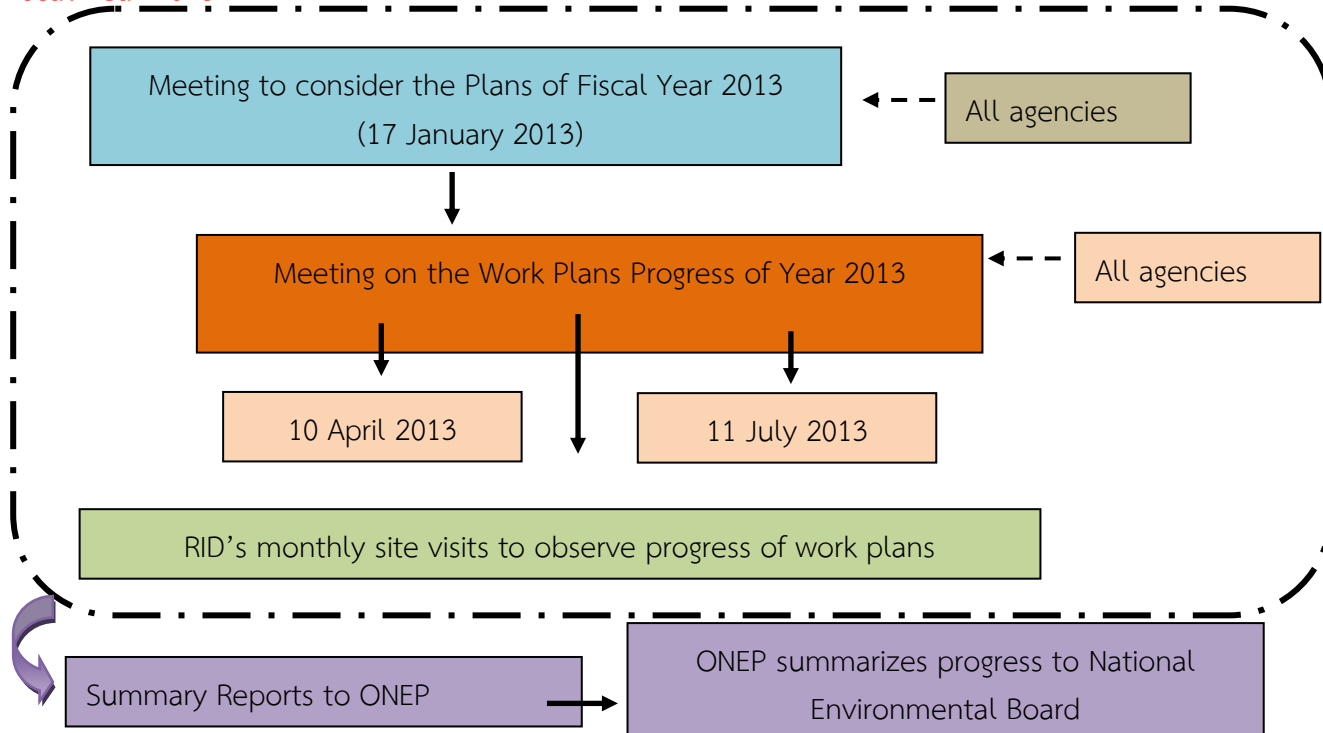
Figure 2.4-18 Reports of the Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans

Flow Chart of Monitoring Procedure on
On the Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans

Fiscal Year 2012



Fiscal Year 2013



13. Work plan for monitoring on results of Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans

To monitor on results, the environmental impact mitigation plans and environmental impact monitoring plans must be monitored strictly according to their pre-construction, construction and operation stages and their impacts toward world heritages sites. 26 work plans on environmental impact mitigation and 20 work plans on environmental impact monitoring then would be adjusted to be in line with actual impacts effectively and achieve the project objectives and implementation plans.

Responsible agency : The Office of Natural Resources and Environmental Policy and Planning

Total budget : 17,549,200 THB (ONEP did not require the budget)

Implementation period : 15 years

Activities : Data collection, evaluation of results of environmental impact mitigation plans and environmental impact monitoring plans and analysis of expected impacts

1. Reduction of impacts on physical resources due to implementation of environmental impact mitigation plans (EIMP)
2. Reduction of impacts on biological resources due to implementation of environmental impact mitigation plans (EIMP)
3. Reduction of impacts on human use due to implementation of environmental impact mitigation plans (EIMP)
4. Reduction of impacts on quality of lives due to implementation of environmental impact mitigation plans (EIMP)

Implementation (Year/ Million Baht)				Implementation (Year/ Million Baht)				
2012	2013	2014	2015	2016	2017	2018	2019	2020-26
1.2	0.4508	1.2	1.2	1.2	1.2	1.2	1.2	1.2



Reports on Evaluation of Results of Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans, Huay Samong Reservoir Project, Prachin Buri Project by the Office of Natural Resources and Environmental Policy and Planning

Figure 2.4-19 The Overview of Comprehensive Implementation of Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans

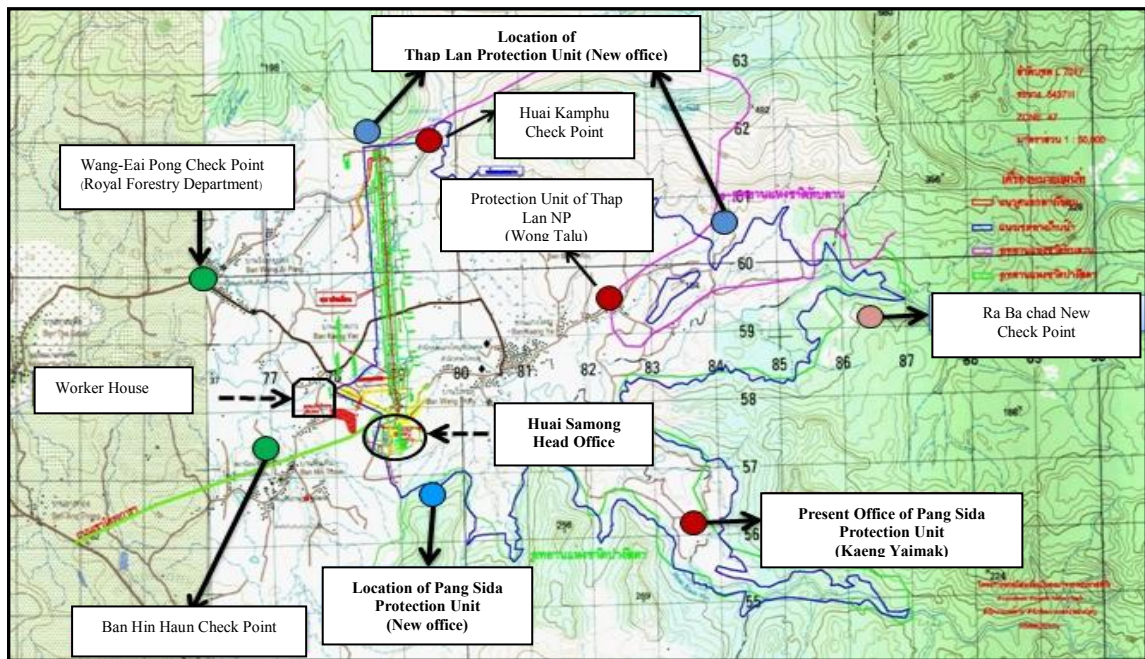


Figure 2.4 -20 Map of World Heritage Site (Dong Phaya Yen – Khao Yai)(Source: RID. 2012)

Summary

Comprehensive Implementation of Environmental Impact Mitigation Plans and Environmental Impact Monitoring Plans among concerned agencies include the **evacuation of people** from the world heritage site Dong Phaya Yen-Khao Yai by paying them with evacuation and compensation fee in equity manner, ***promotion of occupation among affected people***, which can lessen encroachment problems, determination of measures to prevent more encroachment into world heritage properties. There are also the **establishment of National Park Protection Units** in both parks, inspection points of the Royal Forestry Department as well as **setting of guarding petrol with supported vehicles, bots with radio system and manpower** for effective guarding of the area.

To rehabilitate the world heritage properties, the RID together with the Royal Forestry Department and the Department of National Parks, Wildlife and Plant Conservation cooperatively undertook **reforestation surrounding the reservoir area** and in the world heritage sites and project area, **reforestation activities to commemorate His Majesty the King and Queen** to create continuing sense of conservation, activities on **public relations** of the project , the **strict enforcement of laws** as well as the **monitoring and evaluation of EIMP work plans**.

CHAPTER 3

Chapter 3

Explanation of Implementation according to the World Heritage Committee's Resolution

As some parts of the Huay Samong Reservoir Projects are located in Thap Lan and Pang Sida National Parks, which have been proclaimed as the World Natural Heritage Properties (*Dong Phrayayen – Khao Yai*), thus the matter have been raised in the meetings of the World Heritage Committee in its session 35 in 2011, Paris, France; Session 36, 2012, Saint Petersburg in Russia Federation ; and Session 37, 2013, Phnom Penh, Cambodia. The Royal Irrigation Department in cooperation with concerned agencies have undertaken the agreement and concerns of the World Heritage Commission continuously and in comply with environmental mitigation plans.

3.1 Explanation to the World Heritage Commission Session 35 Paris, France on 6 May 2011

1. Concern about reports of escalating threats to the property's Outstanding Universal Value from encroachment, the proposed Huay Samong Dam, cattle grazing, and ineffective management.

Explanation

1.1 The Cabinet of Thailand has approved the study, design and construction of Bang Pakong River Basin Development Project, in which the Huay Samong Project is included on September 19, 1989 prior to the Proclamation of Dong Phrayayen – Khao Yai Forest as a World Heritage Properties.

1.2 Huay Samong Project covers area of 2,745 hectares (17,159 rai) classified into 1,747 ha Sor.Por Gor.4-01 area, 735 ha (4,595 rai) national reserved forest, 264 ha. (1,645 ไร่) national park (186 ha. Thap Lan National Park and 77 ha. Pang Sida National Park) or approximately 0.04% of Dong Phrayayen – Khao Yai, the World Heritage Property, the South western ridge of which the project headwork and reservoir area located. The area is now used as residential and agricultural area while the to-be reservoir area is now used for Eucalyptus growing.

1.3 Realizing the importance of Dong Phrayayen – Khao Yai, Thailand **revised the EIA of Huay Samong Project** after Thap Lan and Pang Sida National Parks have been announced as World Heritage property. **We also revised ecological study especially for the World Heritage Property criteria and additionally set up environmental impact mitigation plan and monitoring plan for it, including the following items:**

1) Plan for Forest Encroachment Prevention around the Reservoir and Reforestation in World Heritage Property

(1.1) Plan for Forest Encroachment Prevention around the Reservoir and Reforestation in Thap Lan World Heritage Property

(1.2) Plan for Forest Encroachment Prevention around the Reservoir and Reforestation in Pang Sida World Heritage Property

2) Wildlife Impact Mitigation Plan

3) Plan for Notification of Reservoir Area as National Park

4) Plan for Notification of Conservation Area

5) Plan for Establishment of New Thap Lan National Park Protection Unit

6) Plan for Establishment of New Pang Sida National Park Protection Unit

The Royal Irrigation Department has set budget of total 99.56 million baht and allocated to the Department of National Parks, Wildlife and Plant Conservation to implement work plans as the implementing agency for all plans for mitigating effects to world heritage property with implementation period 15 years from 2012 – 2026.

2. Urge the State Party to rapidly halt any ongoing encroachment and cattle grazing affecting the property and requests that all construction work on the Huay Samong Dam be halted until the World Heritage Committee has had the opportunity to review a completed Environment Impact Assessment.

Explanation

2.1 Huay Samong Project has been under process concerning Thailand environmental assessment strictly regarding all effects and mitigation measures for WHT carefully with an effective environmental impact prevention and mitigation approaches as follows:

2.1.1 Huay Samong Project has undergone the EIA study for 3 times as follows:

- No.1 Environmental Impact Assessment as specified by the Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (1992), which was completed in 1995.

- No.2 due to the proclamation of Pang Sida National Park as a World Heritage Property, the Royal Irrigation Department, Office of Natural Resources and Environmental Policy and Planning, and the Department of National Parks, Wildlife and Plant Conservation agreed to undertake a new EIA study of the Huay Samong Project including a special study in ecology of world heritage area and additionally set up environmental impact mitigation plan and environment impact monitoring plan for the world heritage property area.

- No.3 Environmental Impact Assessment of Huay Samong Project as specified by the Order of the Minister of Natural Resources and Environment on Criteria, Methods, Regulations and Approaches in EIA report preparation for Projects and Activities that may Cause Severe Effect to Communities in term of Environment, Quality, Natural Resources and Health, including reviewing of measures and formulation of environmental impact mitigation plan and environmental impact monitoring plan, the study was completed in 1968.

2.1.2 Reviewing of EIA report of Huay Samong Project implemented by experts in various fields and agencies concerned namely, Office of Natural Resources and Environmental Policy and Planning, Department of National Parks, Wildlife and Plant Conservation, Royal Forestry Department and other non government organization as follows:

- 1) The National Committee on the Convention for the Protection of the World Cultural and Natural Heritage of Thailand has appointed the Ad hoc subcommittee for the study on Huay Samong Project, comprising the ecological system experts, wildlife experts, representative of Non Government Organization (NGO), Department of National Parks, Wildlife and Plant Conservation, etc., to consider the Environmental Impact

Assessment Report of Huay Samong Project and to survey the project area condition before the resolution of meeting No. 2/2552 on 5 August B.E. 2552 (2009). No objection in implementation on Huay Samong reservoir situated near the World Heritage Property. However, the RID is requested to consider the criteria and the follow up of report on the area condition in intervals in order to protect the impact that may be evaluated as in the list of World Heritage in danger. RID has taken the resolution for the preparation of Environmental impacts, Preventive and Resolution Measures and Environmental Quality Monitoring Plan and then submitted to the Committee of Experts on considering environmental impact assessment report.

2) The Experts Review Committee on considering environmental impact analysis report, including eminent persons of various fields, representatives of Office of National Resources and Environmental Policy and Planning (ONEP), Department of National Parks, Wildlife and Plant Conservation, Royal Forestry Department, representative of Non Government Organization (NGO), has approved on the environmental impact analysis of Huay Samong Project on 20 August B.E. 2552 (2009).

3) National Environmental Board, presided by the Prime Minister, has approved the Environmental Impact report of the Huay Samong Project on 26 August B.E. 2552 (2009); by assigning the Royal Irrigation Department and concerned agencies to determine the reservoir area (except some areas that must be reserved for water management) as the national parks, strictly performing work in conformity with the Environmental Impacts, Preventive and Resolution Measures and Environmental Quality Monitoring Plan, and assigning the RiD to prepare the budget for concerned agencies in work implementation under the specified measures.

2.1.3 The Cabinet has approved the construction of Huay Samong Project on 27 October B.E. 2552 (2009); the construction period lasts 9 years (Fiscal year 2010 – 2018, B.E. 2553 – 256 1). The total budget is 8,300 million baht, including the expenditures under the expenditure under the Environmental Impacts, Preventive and Resolution Measures amounting 516.59 million baht. The RID, Office of National Resources and Environmental Policy and Planning (ONEP) and related agencies were assigned to cooperate in work implementation strictly in conformity with the Environmental Impacts, Preventive and Resolution Measures and Environmental Quality Monitoring Plan.

3. Request the state party to invite the experts from world heritage center to visit project site in order to assess the potential impact of encroachment prevention due to Huay Samong dam construction.

Explanation

The experts from UNESCO and IUCN surveyed Huay Samong project area on 29 February 2012. A meeting was held on 5 March 2012 and chaired by Secretary-General of Natural Resources and Environmental Policy and Planning Office. In the meeting, the Royal Irrigation Department (RID) explained the implementation of Huay Samong project as follows:

1. RID had made both slide show with sound and a document in English to present the project background, impacts from project development and environmental impact prevention and resolution plans with clearly specified time and budget.

2. RID had a committee and a sub-committee for Huay Samong project administration and monitoring.

3. The project's implementation was monitored at intervals throughout its implementation plan.

4. RID had submitted EIA report and EIMP report that had been approved by environmental committee to the experts from UNESCO and IUCN.



Figure 3.1-1 Meetings and Site Surveys with Expert team from UNESCO and IUCN

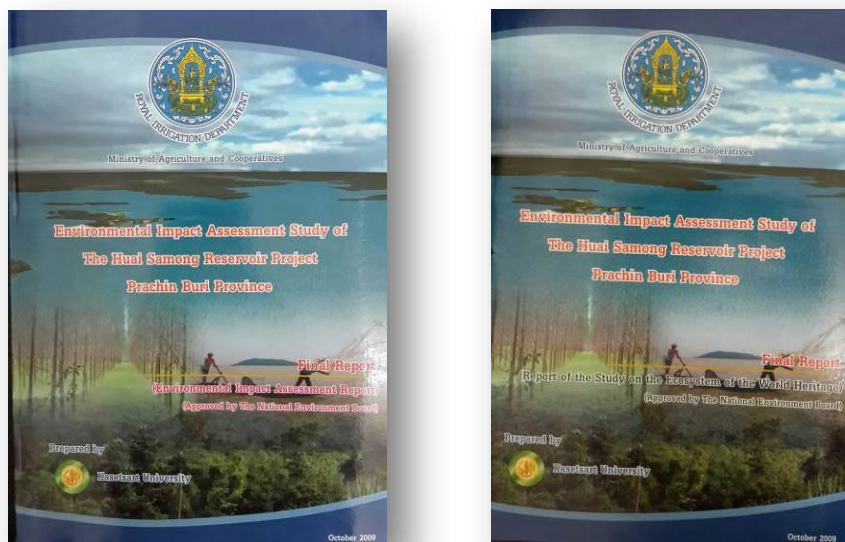


Figure 3.1-2 Explanation Reports to the World Heritage Commission

3.2 Explanation to the World Heritage Commission Session 36, Saint Petersburg, Russia Federation during 28 February – 5 March 2012 2555

1. Also note with concern that construction continues at the Huay Samong dam site, and also requests the State Party to halt construction of the Huay Samong Dam until appropriate resources are committed to ensure mitigation, enforcement and anti-encroachment actions are effectively in place, including enhanced cooperation between management authorities and enforcement actions to prevent further impacts on the property.

Explanation

1.1 Huay Samong project is a large scale project in Bang Pakong River Basin that was initiated by His Majesty the King. The objectives are to supply water for consumption and cultivation of farmers in the dry and wet seasons. Besides, it helps mitigate flood hazard and preserve eco-system of the Prachin Buri river. Suspending of Project Construction will affect public confident in government agencies. Moreover, Prachin Buri province, at present, is suffered from occurring every year that damages property of public, government agencies, private sector and infrastructures such as road, bridge etc. The construction of Huay Samong project can mitigate all problems above.

1.2 The implementation for mitigation, enforcement of actions and prevention of encroachment that may occur from development of Huay Samong Project. Has been implemented strictly and effectively. Besides, there are cooperation from related agencies as follows:

1.2.1 Implementation for prevention of environmental impact and damage, restoration and promotion. Implementation plans that cover both environmental resources and residents in project's area are concrete with specified time frame. Those are 47 action plans for environmental impact mitigation and monitoring to be implemented for 16 years (budget year 2011 -2026).

1.2.2 Environmental Impact Mitigation Plan and Environmental Impact Monitoring Plan of the Huay Samong Project have been considered by relevant authorities several items since the drafting of EIMP report.

1.2.3 Budget planning for the implementation of EIMP plan is implemented. The budget for the restoration of natural resources and protects the environment according to EIMP plan is set at 516.59 million baht for its 16 years implementation (2011-2026) covering the pre, during and post construction periods as follows:

- In Fiscal Year 2011, Royal Irrigation Department was not allocated with the budget for implementation of EIMP plans; therefore, the Office of the Royal Development Project board allocated the necessary budget to support the plan. In addition,

Royal Irrigation Department also used other budget of the department to implement the plan as required.

- In Fiscal Year 2012, Royal Irrigation Department has transferred the budget for 16 implementation plans of EIMP to 11 agencies in total 86.9748 million baht.

- In Fiscal Year 2013, Royal Irrigation Department has allocated with the budget for implementation of EIMP in total 54.85 million baht.

1.2.4 There is a control mechanism for monitoring construction project and the implementation plan of Environmental Impact Prevention and Resolution as follows:

- Administrative Committee and Sub-committee of the Huay Samong Project, Prachin Buri Province with Deputy Prime Minister as Chairman and Director General of the RID as Member and Secretary and Sub-committee on Monitoring Environmental Impact Mitigation and Monitoring with Permanent Secretary of the Minister of Natural Resource and Environment as Chairman and Director of the Bureau of Environmental Impact Evaluation as Member and Secretary and RID as Member and Assistant Secretary.

- Royal irrigation Department has environmental units responsible for control, supervision and monitor construction of the Project to be in accordance with measures specified in the Project EIA report and monitor the works of concerned agencies to be accordance with EIMP throughout the implementation period. There are meeting on the outcome monitoring every three months and measures specified in the EIA have been implemented along with construction work.

- Office of National Resources and Environmental Policy and Planning (ONEP) is responsible for evaluate performance of concerned agencies according to EIMP and gives comments and suggestions.

- RID reports the outcome of implementation of EIMP and submit to กรม Office of National Resources and Environmental Policy and Planning (ONEP) twice a year and the National Environment Board once a year.

2. Require the State Party to undertake all suggestions by cooperating with the World Heritage Center from 2012 to June 2014 and extend the property in order to include areas that better represent its Outstanding Universal Value, based on mapping of encroachments recommended above, and considering current levels of encroachment, realistic boundaries for enforcement, and impacts and mitigation from construction of the Huay Samong Dam.

Explanation

1. Royal Irrigation Department has a policy to implement the Environment Impact Mitigation Plan approved by the Cabinet strictly and throughout the duration specified in the EIMP.

2. Royal Irrigation Department has a policy to return the reservoir area (except the areas necessary for water management by RID) as the national park after finishing Huay Samong Construction Project.

3. Royal Irrigation Department will cooperate with World Heritage Center in conserving the Outstanding Universal Value of the World Heritage Property.

3. To require further the State Party for purposing the world heritage resources conservation at present and reporting of progress of successful missions implementing by following the suggestions in 2012 to World Heritage Center in 1 February 2013.

Explanation

Royal Irrigation Department held a meeting with related agencies namely; Office of Natural Resources and Environmental Policy and Planning, Department of National Parks, Wildlife and Plant Conservation, and Office of the Royal Development Projects Board in 2 October 2012 to consider the Environmental Impact Mitigation Plan approved by the Cabinet. The meeting insisted the approval of the plan and agreed that an explanation report shall be submitted to the World Heritage Committee and Royal Irrigation Department , at present, has submitted such report to the Office of Natural Resources and Environmental Policy and Planning the report in 30 October 2012 to consider for further submit to World Heritage Committee.

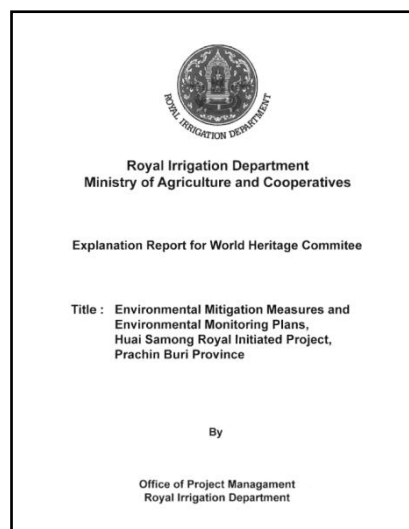


Figure 3.2-1 Meetings for reviewing Environmental Mitigation Plans

3.3 Explanation to the World Heritage Commission Session 37, Phnomphen, Cambodia during 17 – 21 June 2013

The World Heritage Committee agreed in its 37th Session concerning the Huay Samong Project that the State Party should undertake necessary measures for mitigation, thrust and anti-encroachment so as to assure that the construction of the Huay Samong Project will not affect Outstanding Universal Value of the property. The State Party is requested to undertake as follows:

1) the State Party to invite an IUCN Reactive Monitoring Mission to assess progress of the implementation of the IUCN recommendations prior to the 38th Session of the World Heritage Committee for considering whether to in script the Dong Phrayayen – Khao Yai Forest Complex in the list of World Heritage in Danger;

2) To require the State Party for purposing the world heritage resources conservation at present and reporting of progress of successful missions implementing by following the suggestions in 2012 to World Heritage Centre in 1 February 2014 for further use in the 38th Session of the World Heritage Committee.

Explanation

1) The Reactive Monitoring Mission is scheduled to assess progress of the implementation of the IUCN recommendations in January 2014 (B.E 2557). The Royal Irrigation Department and other concerned agencies cooperatively undertake environmental impact mitigation plan and environmental impact monitoring plan strictly, especially in the following 2 concerns:

1.1) Concern about forest encroachment and wildlife hunting

1.1.1 The Royal Irrigation Department hereby confirms that RID and other concerned agencies have cooperatively undertaken Work plan for prevention of encroachment on reservoir area strictly both in the area of Thap Lan and Pang Sida National Parks. The plan not only helps preventing encroachment in the world heritage property but also enhances the area conservation increasingly.

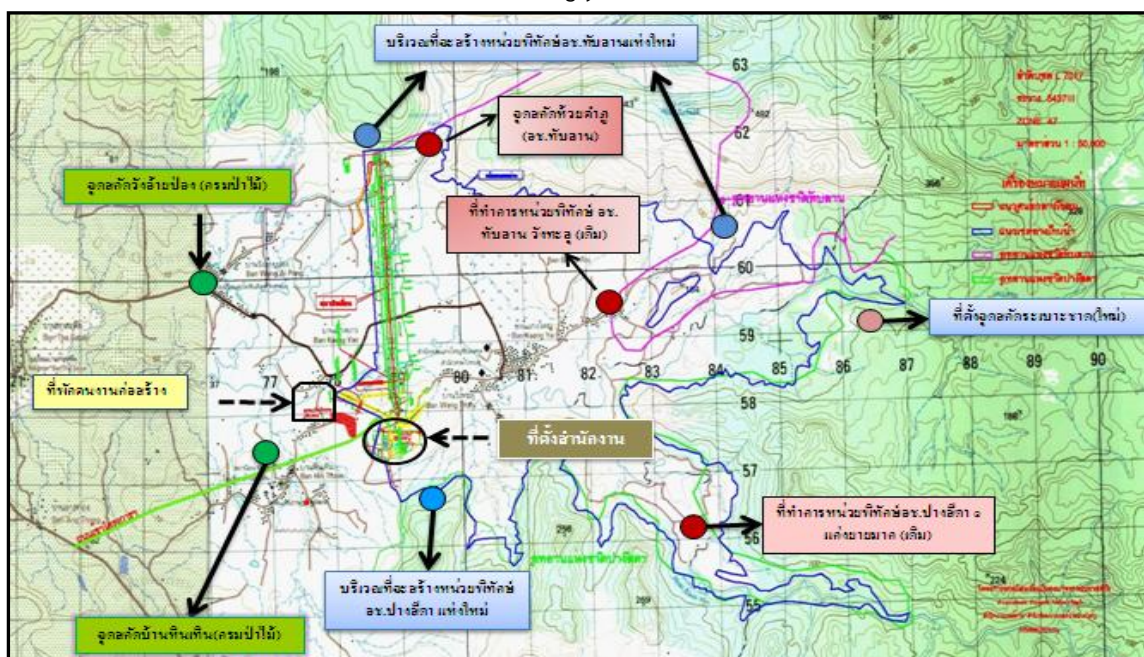


Figure 3.3-1 Map of World Heritage Properties (Dong Phrayayen-Khao Yai) (Source:RID, 2012)

1.1.2 The Royal Irrigation Department has ordered the Construction Office 7 (Huay Samong Project) to prohibit the encroachment to the world heritage property, Dong Phrayayen-Khao Yai Forest Complex to guard the area and prevent impacts to the world heritage area (Thap Lan and Pang Sida National Parks). During Huay Samong Project construction, the Construction Office 7 has informed their construction labors and concerned staff of the following prohibitions:

- (1) Encroachment into the World Heritage Property is prohibited, except in the area approved for reservoir construction
- (2) Forest products and wildlife hunting are prohibited as well as other activities that can affect or harm wildlife in the world heritage property.
- (3) Wood cutting, clearance or burning is prohibited in the world heritage property.
- (4) Regulations and laws specified in the National Parks Act B.E. 2504 (1961 A.D.) must be followed strictly, breaches of them will result in the utmost penalties as specified by laws.

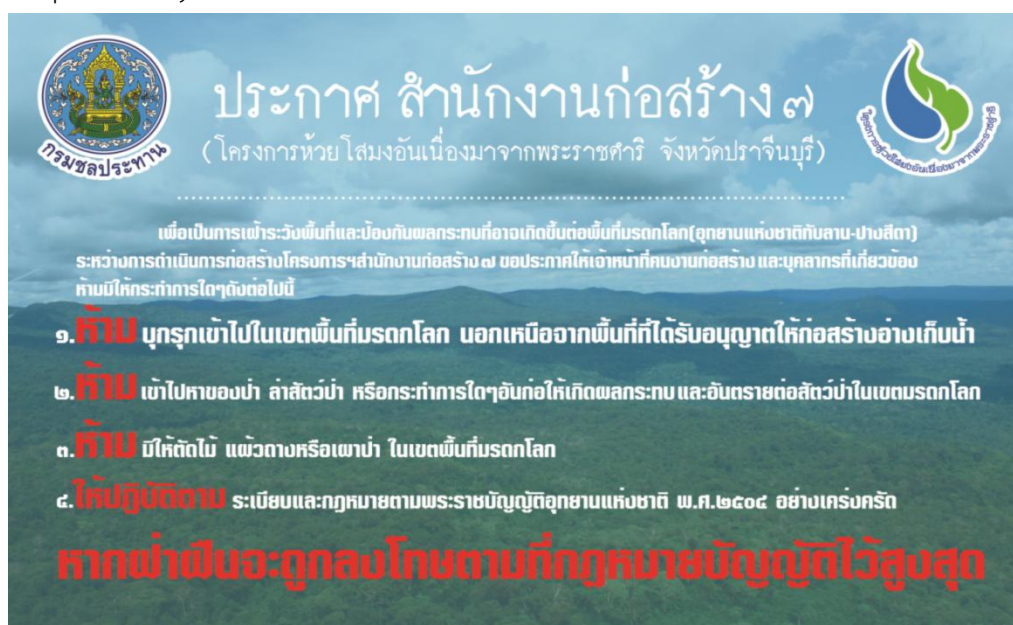


Figure 3.3-2 Encroachment Prohibition Signboards in the World Heritage Property
(Source: the Royal Irrigation Department, 2013)

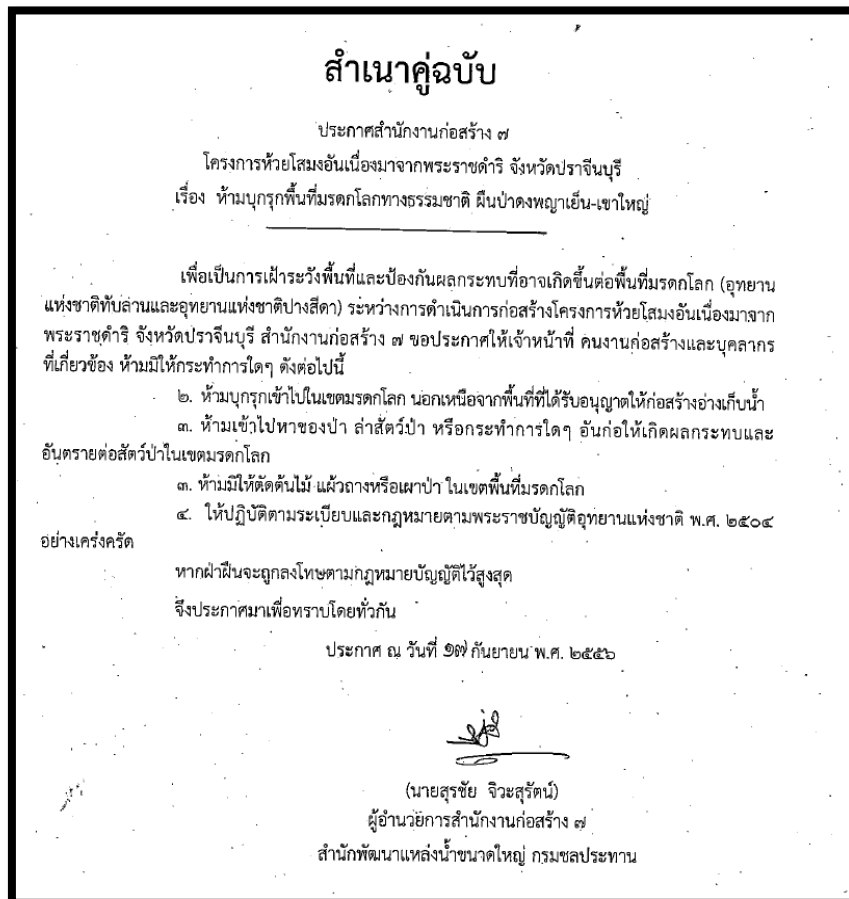


Figure 3.3-3 World Heritage Properties No-Entry Signboard

(Source: the Royal Irrigation Department, 2013)

1.1.3 The RID as an agency responsible for monitoring the implementation of EIMP has regularly followed the progress of each agency as follows:

- To monitor the implementation of each agency according to EIMP by meetings every three months
- To monitor the progress of construction and operation of concerned agencies by monthly site visits and giving recommendations and comments
- To undertake measures specified in EIA

1.1.4 Establishment of National Park Protection Units and Inspection Points At present, guarding points of the Royal Forestry Department are located at two project access roads namely, the Ban Wang Pong Inspection Point and Ban Wang Tern Inspection Point. Both points are still in action while 2 National Park Protection Units are under construction. The Royal Irrigation Department has rendered full support in term of budget, staff and vehicles for the protection surveys..

1.1.5 Establishment of Fishery Resources Conservation Units for inspection of illegal actions. Equipment and legal measures for controlling fishing activities has been provided eg. patrol boats, long-tailed boats with communication radio, etc. Alien fish species are strictly prohibited.

1.1.6 The Royal Irrigation Department has a policy to return the area of National Park withdrawn for reservoir construction back to the Department of National Park, Wildlife and Plant Conservation to be further proclaimed as conservation areas.

1.2 Concern on Alien Species of Fish to be raised in Reservoir Area

The Royal Irrigation Department does not have any policies to promote or support the raising of alien species of fish in the reservoir. There are the work plan for impact mitigation on aquatic ecology and fishery resources, work plan for aquatic ecology and fishery resources development and conservation, work plan for assistance and evacuation of fish and aquatic animals, as the work plan for aquatic ecology and fishery resources to be undertaken by the Fishery Department according to their technical principles.

2) To require the State Party for purposing the world heritage resources conservation at present and reporting of progress of successful missions implementing by following the suggestions in 2012 to World Heritage Centre in 1 February 2014. The Royal Irrigation Department has completed the reports.

APPENDICES

Appendix A

Power Point Presentation of the World Heritage Commission 37's Cambodia,
(During 17-21 June 2013)



Implementation response to the World Heritage Committee's Decision 35, 36 and 37

Huai Samong Reservoir Project Prachin Buri Province

Dr.Somkiat Prajamwong

Director, Office of Project Management
Ministry of Agriculture and Cooperatives

June 17 – 27 ,2013





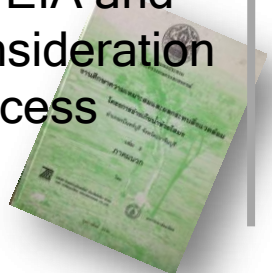
Project Timeline

1995 - 2009

Conducted FS/EIA and consideration process

1995

Conducted FS/EIA and consideration process



May 2005

National Park Committee **revoked** Pang Sida National Park/ Thap Lan park.



July 2005

Pang Sida/ Thap Lan National Park were declared as **World Heritage Site**

2005

Revised EIA (emphasized impact on world heritage)



Aug 2009

World Heritage Committee (Thailand) **has no objection to project** and the National Environment Board **approved EIA**

Oct 2009



Cabinet approved to open the project (2010-2018)

Oct 2010-Aug 2011

Reviewed EIA and EIMP



May 2011

35th World Heritage Committee's Decision @ Paris, France

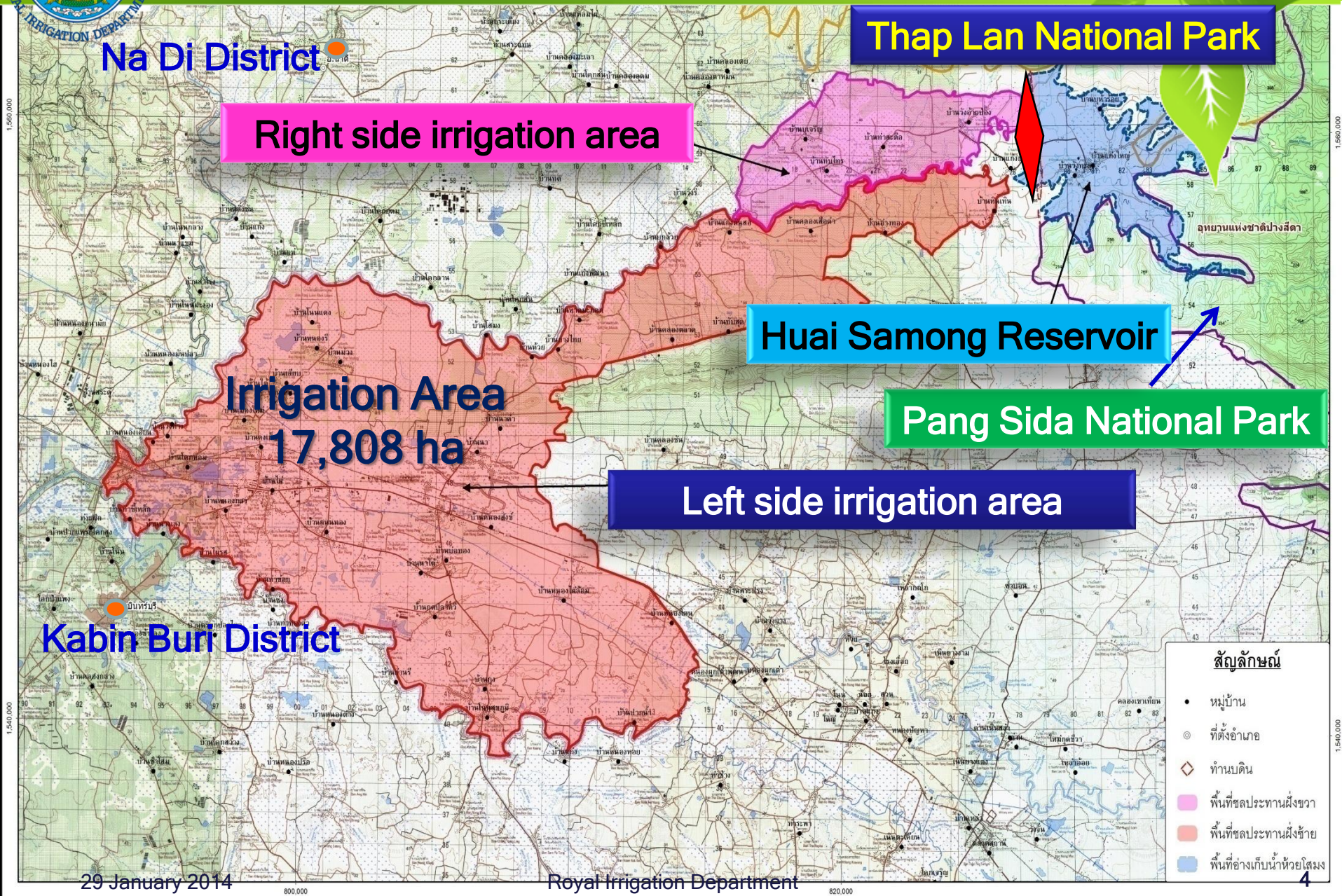


June 24 - July 6, 2012

36 th World Heritage Committee's Decision @ Saint Petersburg, Russian Federation



Project Boundary



Project Objectives



1. To irrigate agricultural area of 17,808 ha in Nadee and Kabin Buri districts, Prachin Buri Province and upstream of the Bang Pakong river



2. To supply water for domestic consumption in Nadee and Kabin Buri districts, Prachin Buri Province



- To mitigate floods in Prachin Buri Province and upper Bang Pakong river basin

- To maintain downstream ecosystem

- To generate a new source of fish breeding and supplementary food

- To promote its potential as a place of ecotourism

- To promote industrial development in the project area as well as those in its surrounding area



Project Component

Location : Kaeng Dinso sub-district,
Na Di district, Prachin Buri Province

Catchment Area : 443 km²

Annual Inflow : 319.67 million m³

Dam : Length 3,967.51 m., Height 32.75 m.

Capacity : 295 million m³

Surface Area : 2,600 ha

Irrigation Area : 17,808 ha



Retention Storage 295 million m³

Retention Level +48.0 m(MSL)

Dead Storage 19.5 million m³

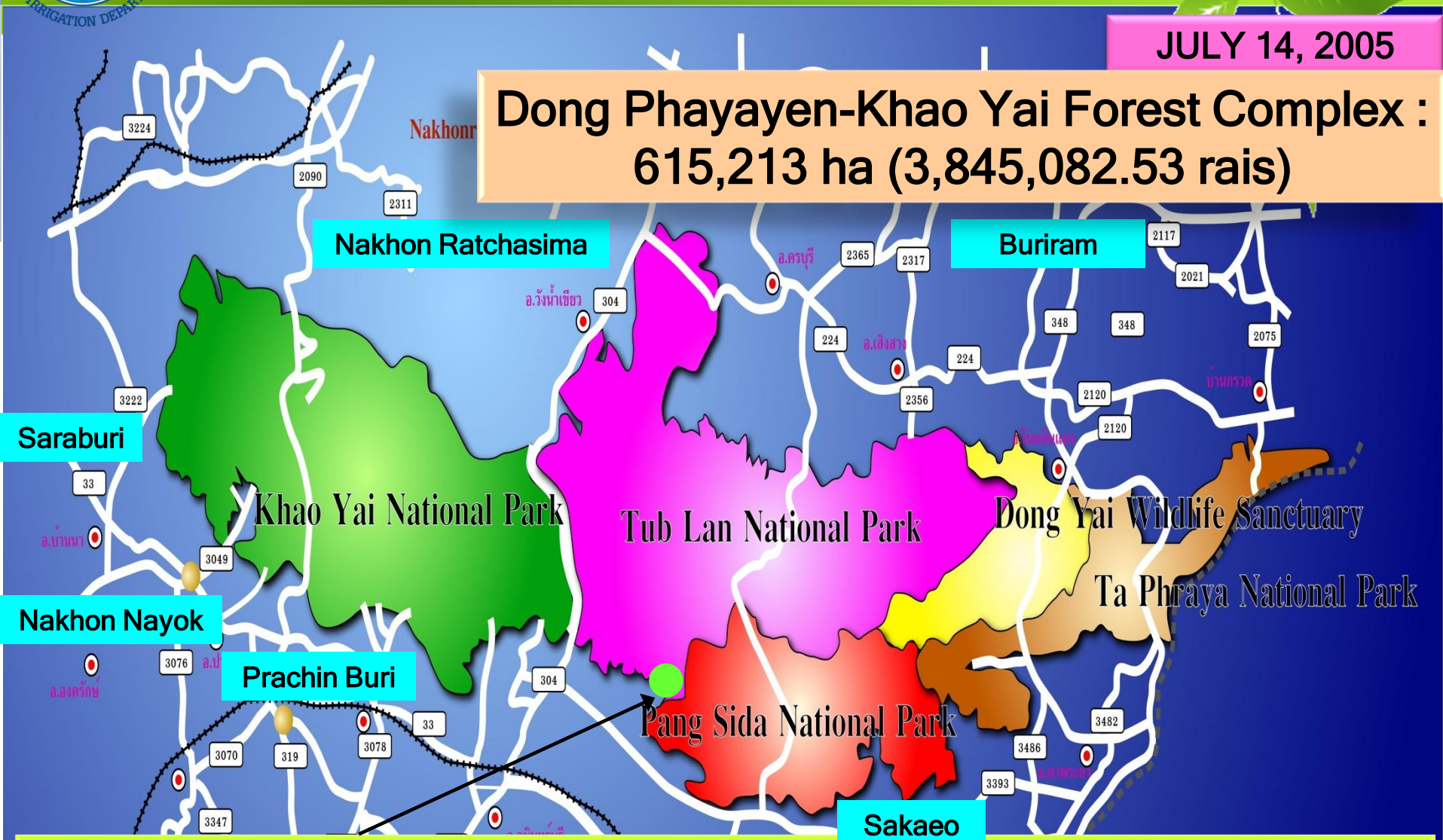
Minimum Water Level +32.2 m (MSL)



Dong Phrayayen-Khao Yai Forest Complex Boundary

JULY 14, 2005

**Dong Phayayen-Khao Yai Forest Complex :
615,213 ha (3,845,082.53 rais)**



**Part of Huai Samong Reservoir intrude into the world heritage site 263 ha
(1,643.92 rais) (0.04% of Dong Phayayen-Khao Yai Forest Complex)**

Huai Samong Head Work

Head Work + Reservoir Area (2,745.44 ha)

Reserved Forest	735.2 ha
-----------------	----------

National Park	263.2 ha
-Thap Lan 186.40 ha	
- Pang Sida 76.80 ha	

Agricultural Land Reform	1,747.04 ha
--------------------------	-------------

**Thap Lan
National Park**
186.40 ha



- Dam Crest Alignment
- Boundary of Project Area
- Boundary of Thap Lan National Park
- Boundary of Pang Sida National Park
- Flooded Area in Thap Lan
- Flooded Area in Pang Sida

**Pang Sida
National Park**
76.80 ha



Showing overlapping area of boundary and project area at max. water level

35th World Heritage Committee's Decision

35th World Heritage Committee's Decision May 6, 2011 Paris, France



World Heritage

35 COM

Distribution Limited

WHC-11/35.COM/20
Paris, 7 July 2011
Original: English / French

UNITED NATIONS EDUCATIONAL, SCIENTIFIC
AND CULTURAL ORGANIZATION

CONVENTION CONCERNING THE PROTECTION OF
THE WORLD CULTURAL AND NATURAL HERITAGE

World Heritage Committee

Thirty-fifth session
Paris, UNESCO Headquarters
19-29 June 2011

**DECISIONS ADOPTED
BY THE WORLD HERITAGE COMMITTEE
AT ITS 35th SESSION
(UNESCO, 2011)**

Decision: 35 COM 7B.19

The World Heritage Committee,

1. Having examined Document WHC-11/35.COM/7B,
2. Recalling its Decision 34 COM 7B.18, adopted at its 34th session (Brasília, 2010),
3. Notes the State Party's statement that it is conducting an Environmental Impact Assessment for the expansion of Highway 304, and expresses its concern over reports that highway expansion works are already underway;
4. Also expresses its concern about reports of escalating threats to the property's Outstanding Universal Value from encroachment, the proposed Huay Samong Dam, cattle grazing, and ineffective management;
5. Urges the State Party to rapidly halt any ongoing encroachment and cattle grazing affecting the property, and requests that all construction work on the Huay Samong Dam be halted until the World Heritage Committee has had the opportunity to review a completed Environmental Impact Assessment and assess its potential impacts on the property's Outstanding Universal Value, in line with Paragraph 172 of the *Operational Guidelines*;
6. Encourages the State Party to consider submitting a boundary modification request to the World Heritage Committee for Thap Lan National Park in order to better address forest conservation and encroachment issues in this area;
7. Also encourages the State Party to revise the property's management approach, and to develop long-term management policies, as well as a comprehensive tourism management plan;
8. Invites the State Party to submit an International Assistance request to support this process, and further encourages the States Parties of Thailand and the United States of America to consider the sister-parks proposal as an opportunity to explore capacity-building initiatives;
9. Also requests the State Party to invite a joint World Heritage Centre/IUCN monitoring mission to the property prior to its 36th session in 2012, in order to assess the potential impacts of encroachment, the Huay Samong Dam, cattle grazing, and the expansion of Highway 304 on the property's Outstanding Universal Value, and to review its management and financial plans;
10. Further requests the State Party to submit to the World Heritage Centre, by 1 February 2012, a detailed report on the state of conservation of the property, including information on the status of the Highway 304 Environmental Impact Assessment and the Huay Samong Dam, the progress achieved in halting any large-scale encroachment and cattle grazing, for examination by the World Heritage Committee at its 36th session in 2012.

35th World Heritage Committee's Decision

Requests

Also requests the State Party to **invite** a joint World Heritage Centre/IUCN Monitoring mission to the property prior to its 36th session in 2012, **in order to assess** the potential impacts of encroachment, the **Huai Samong Dam**, the progress achieved in halting any large-scale encroachment and cattle grazing, for examination by the World Heritage Committee at its 36th session in 2012.

Action

Meeting at ONEP
On 5 March 2012



Experts from UNESCO and IUCN surveyed
Huai Samong project area
on 29 February 2012





36th World Heritage Committee's Decision

June 24 - July 6, 2012

Saint Petersburg, Russian Federation



World Heritage

36 COM

WHC-12/36.COM/19

Original: English / French

UNITED NATIONS EDUCATIONAL, SCIENTIFIC
AND CULTURAL ORGANIZATION

CONVENTION CONCERNING THE PROTECTION OF
THE WORLD CULTURAL AND NATURAL HERITAGE

WORLD HERITAGE COMMITTEE

Thirty-sixth session

Saint Petersburg, Russian Federation
24 June – 6 July 2012

**DECISIONS ADOPTED
BY THE WORLD HERITAGE COMMITTEE
AT ITS 36TH SESSION
(SAINT-PETERSBURG, 2012)**

6. Considers that cattle grazing in the property represents a serious concern, and that the on-going encroachment of the property has not yet been adequately addressed, and encourages the State Party to secure the appropriate high-level political support to tackle these threats;
7. Requests furthermore the State Party to submit to the World Heritage Centre, by 1 February 2013, an updated and detailed report on the state of conservation of the property, including a report on the progress achieved in the implementation of the 2012 mission recommendations, for examination by the World Heritage Committee at its 37th session in 2013, when the Committee should also consider the need for a further reactive monitoring mission, and the possible inscription of the property on the List of World Heritage in Danger.

17. Dong Phrayayen-Khao Yai Forest Complex (Thailand) 590

Decision: 36 COM 7B.17

The World Heritage Committee,

1. Having examined Document WHC-12/36.COM/7B.Add,
2. Recalling Decision **35 COM 7B.19** adopted at its 35th session (Saint Petersburg, 2011),
3. Notes with concern that expansion works on Highway 304 have been completed outside the property without the implementation of appropriate mitigation measures along the sections of the highway within the property, and requests the State Party to:
 - a) Urgently submit the completed EIA for section 26-29 km along with detailed plans for ecologically effective wildlife corridors including a detailed timeline, financial planning and resources for construction of the corridors, and mitigation actions to be implemented during construction and long-term enforcement actions to prevent encroachment,
 - b) Implement and enforce speed limits and impact mitigation actions on the sections of Highway 304 running within the boundaries of the property, as well as other roads that bisect the property, and to monitor use of other roads as shortcuts and transport routes through the property;
4. Also notes with concern that construction continues at the Huay Samong Dam site, and also requests the State Party to halt construction of the Huay Samong Dam until appropriate resources are committed to ensure mitigation, enforcement and anti-encroachment actions are effectively in place, including enhanced cooperation between management authorities and enforcement actions to prevent further impacts on the property;
5. Further requests the State Party to implement all the other recommendations from the
 - b) Strengthen enforcement measures, provide adequate resources to the management authority and law enforcement agencies, work with surrounding communities to increase awareness of the boundaries of the property and garner support for the conservation of the property and its OUV,
 - c) Prioritize reduction of illegal grazing activities within the property and pay particular attention to stopping grazing activities conducted by commercial agricultural companies,
 - d) Consider extending the property in order to include areas that better represent its Outstanding Universal Value, based on the mapping of encroachments recommended above, and considering current levels of encroachment, realistic boundaries for enforcement, and impacts and mitigation from construction of the Huay Samong Dam,
 - e) Strengthen efforts in implementing the Management Plan for Dong Phrayayen – Khao Yai Forest Complex, including an updated and revised plan for the complex that involves and encourages cooperation and coordination of all relevant ministries and agencies, and stakeholders at both national and local levels,
 - f) Develop and implement a detailed, integrated, extensive and long-term tourism management plan that includes actions to address the current impacts from high intensive tourism and encourages them to submit a request for International Assistance to the Committee to support the development of the tourism plan,
 - g) Consider a detailed management related zoning plan for the property, to ensure core areas of habitat are identified and provided with increased levels of protection, including designation of an appropriate buffer zone around the property to ensure protection against adjacent developments;

36th World Heritage Committee's Decision

Requests

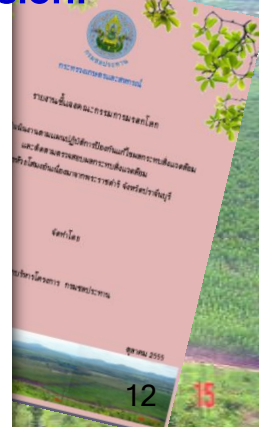
Also requests the State Party to **halt construction of the Huai Samong Dam** until appropriate resourced are committed to ensure mitigation, enforcement and anti encroachment actions are effectively in place, including enhanced cooperation between management authorities and enforcement actions to prevent further impacts on the property.

Action

Reviewed-EIMP (approved by the Cabinet resolution) Meeting was hold on Oct 2,2012 in order to ensure the appropriated of Mitigation Plan.



Preparation of The Huai Samong Explanation Report towards the Word Heritage Committee Decision.





Materials for World Heritage Committee Meeting, 37th Session Phnom Penh, Cambodia 16-27 June 2013



United Nations
Educational, Scientific and
Cultural Organization
Organisation
des Nations Unies
pour l'éducation,
la science et la culture

World Heritage

37 COM

WHC-13/37.COM/7B
Paris, 3 May 2013
Original: English / French

UNITED NATIONS EDUCATIONAL, SCIENTIFIC
AND CULTURAL ORGANIZATION

CONVENTION CONCERNING THE PROTECTION OF
THE WORLD CULTURAL AND NATURAL HERITAGE

WORLD HERITAGE COMMITTEE

Thirty-seventh session

Phnom Penh, Cambodia
16 - 27 June 2013

Item 7B of the Provisional Agenda: State of conservation of World Heritage
properties inscribed on the World Heritage List

15. Dong Phrayayen-Khao Yai Forest Complex (Thailand) (N 590rev)

Year of inscription on the World Heritage List
2005

Criteria
(x)

Year(s) of inscription on the List of World Heritage in Danger
N/A

Previous Committee Decisions
See page <http://whc.unesco.org/en/list/590/documents/>

Current conservation issues

On 1 February 2013, the State Party submitted a report on the state of conservation of the property, which provides information on impacts from expansion works on Highway 304, land encroachment and cattle grazing within components of the property, and construction of the Huay Samong Dam. A report on Environmental Mitigation Measures and Environmental Monitoring Plans related to the construction of Huay Samong Dam is annexed to the report. In addition, the State Party submitted the Environmental Impact Assessment of the Wildlife Corridor and Road Widening Project on Highway 304 to the World Heritage Centre in November 2012. It deals with one of the sections where the road crosses the property boundaries. This report includes details and an assessment of proposed options for wildlife corridors for the expansion project from km 26 – 29 on Highway 304.

d) *Huay Samong Dam*




The State Party confirms that construction work on the Huay Samong Dam continues and indicates that all relevant agencies are working towards mitigation of the impacts on the property's OUV during construction. However, details on actions to limit the impact during construction are limited. The State Party states that the area of the property flooded on completion of the dam will serve as a protection zone against encroachment.

However, no details were provided on timelines for implementation of these work plans and which specific actions, if any, have already been implemented. Reports have also been received indicating that there has been no progress on assigning oversight of the dam reservoir area including providing a mandate for DNP to oversee management of the water area to prevent eventual poachers using fishing boats to enter deep into the parks. This issue has been identified as a problem at other sites where DNP does not have the authority to interdict criminals on the water as the management belongs to other authorities that do not have law enforcement authority in regards to the property. Finally, IUCN notes that consideration should be given to associated risks, such as the introduction of exotic commercial fish species into the reservoir, and would strongly advise that preventive measures are taken to avoid the introduction, intentional or accidental, of exotic fish species. The World Heritage Centre requested the State Party to provide further information on this issue on 12 April 2013. No comments have been received so far.

Exactly Timeline and Budget

Approved by Cabinets on October 29, 2009

Total Budget USD 277 million

Activities	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Land Acquisition, Compensation, Land and Property	<u>(2011 - 2015)</u>															
Dam and Structures Construction	<u>(2011 - 2015)</u>															
Irrigation System Construction				<u>(2014 - 2018)</u>												
Prevention and Monitoring Implementation																
- Prevention Impact Plans (27 Plans)						<u>(2011 - 2026)</u>										
- Monitoring Plans (20 Plans)						<u>(2011 - 2026)</u>										

Environmental Impact Mitigation Plan (EIMP)

EIMP Duration : 15 years (from 2012 to 2026)

Total Budget : USD 16.7292 million

Preventing the Impacts Plans

Total : 27 Plans

Budget : USD 13.7363 million

**Construction Period :
12 Plans**

**Operation Period :
8 Plans**

**Plan for the World Heritage
Area : 5 Plans**

**Before Construction Period
: 4 Plans**

**Construction Period :
9 Plans**

**Operation Period :
8 Plans**

**Plan for the World Heritage
Area : 6 Plans**

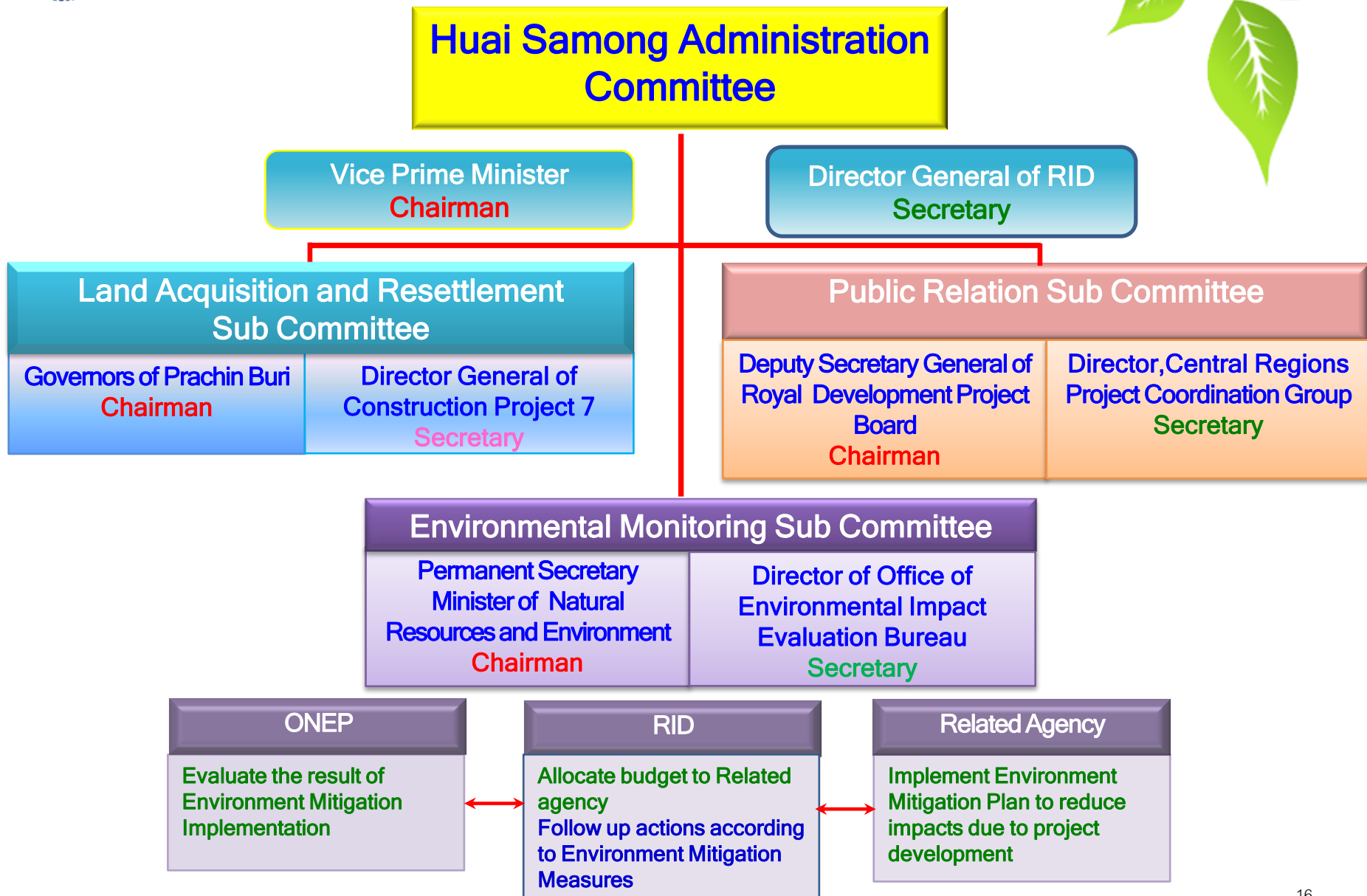
Monitoring Plans

Total : 20 Plans

Budget : USD 2.9929 million



Effective Project Management



17



Encroachment Prevention



1. Encroachment Prevention during construction period

- Set up Check Point and Patrol in the area Plan 2(2.9)
- Promote conservation awareness Plan 1.2(4), 1.4 (1)



2. Monitoring implementation of the concerned agencies to follow the plans Plan 2.18, 2.19, 2.20

- Progress Meeting every 3 month
- Follow up the encroachment prevention activities every month



3. Implementing construction work under the measure in EIA Report Plan 2.18, 2.19, 2.20

- situate project office, official residence and bunkhouses away from National Park boundary
- Providing knowledge on related laws to labor
- Set up warning sign around project area



Encroachment Prevention

4. Establishment permanent protection unit and Check Point in World Heritage property (Plan 1.4)

- 3 protection units, 1 check point
- Communication equipment
- Vehicle



5. Establishment the Fishery Conservation Unit Plan 1.2 (3), 1.3 (2)

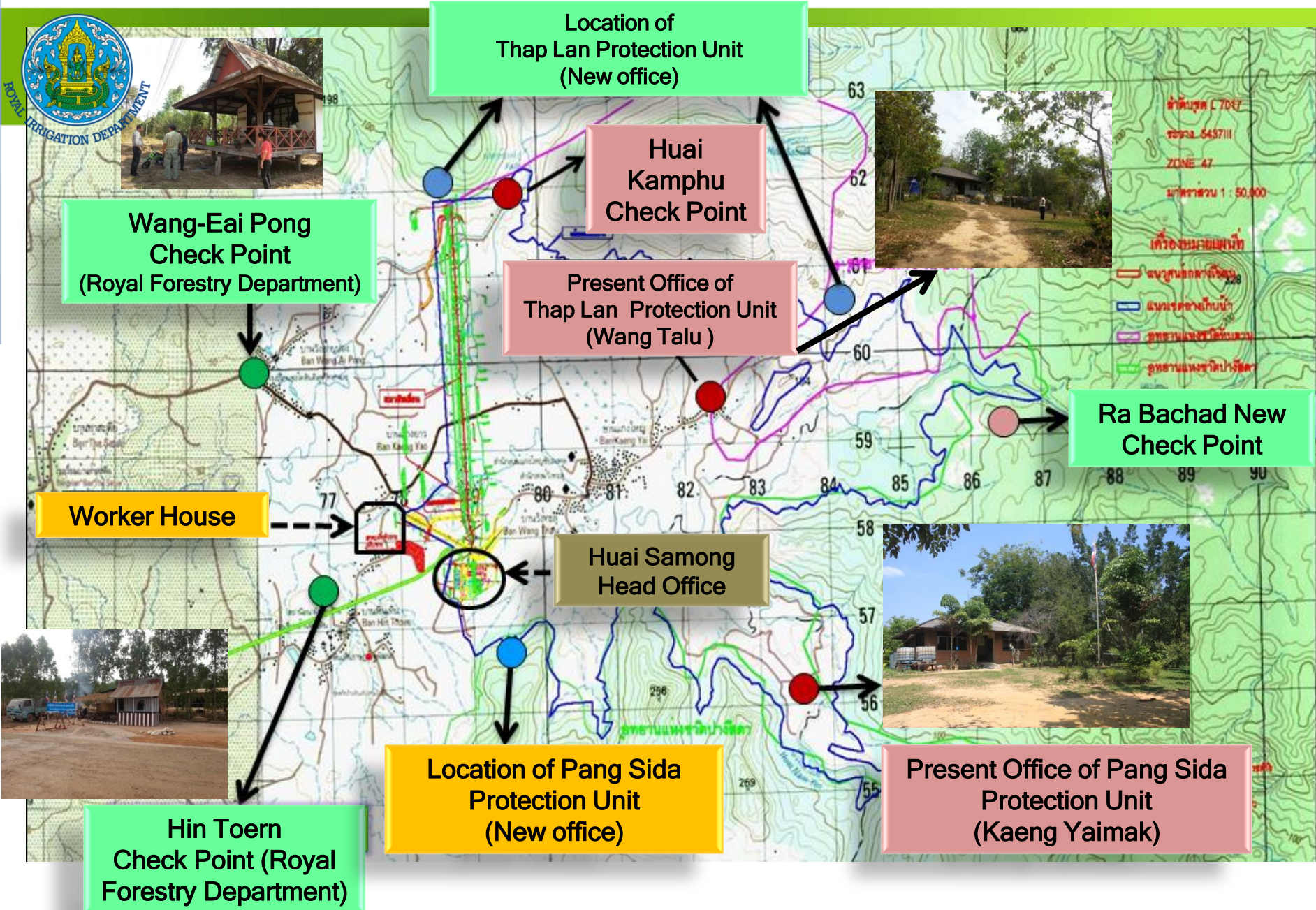
- Patrol illegal fishing
- Equipment Providing



6. Restore the area back to DNP (Plan 1.4)

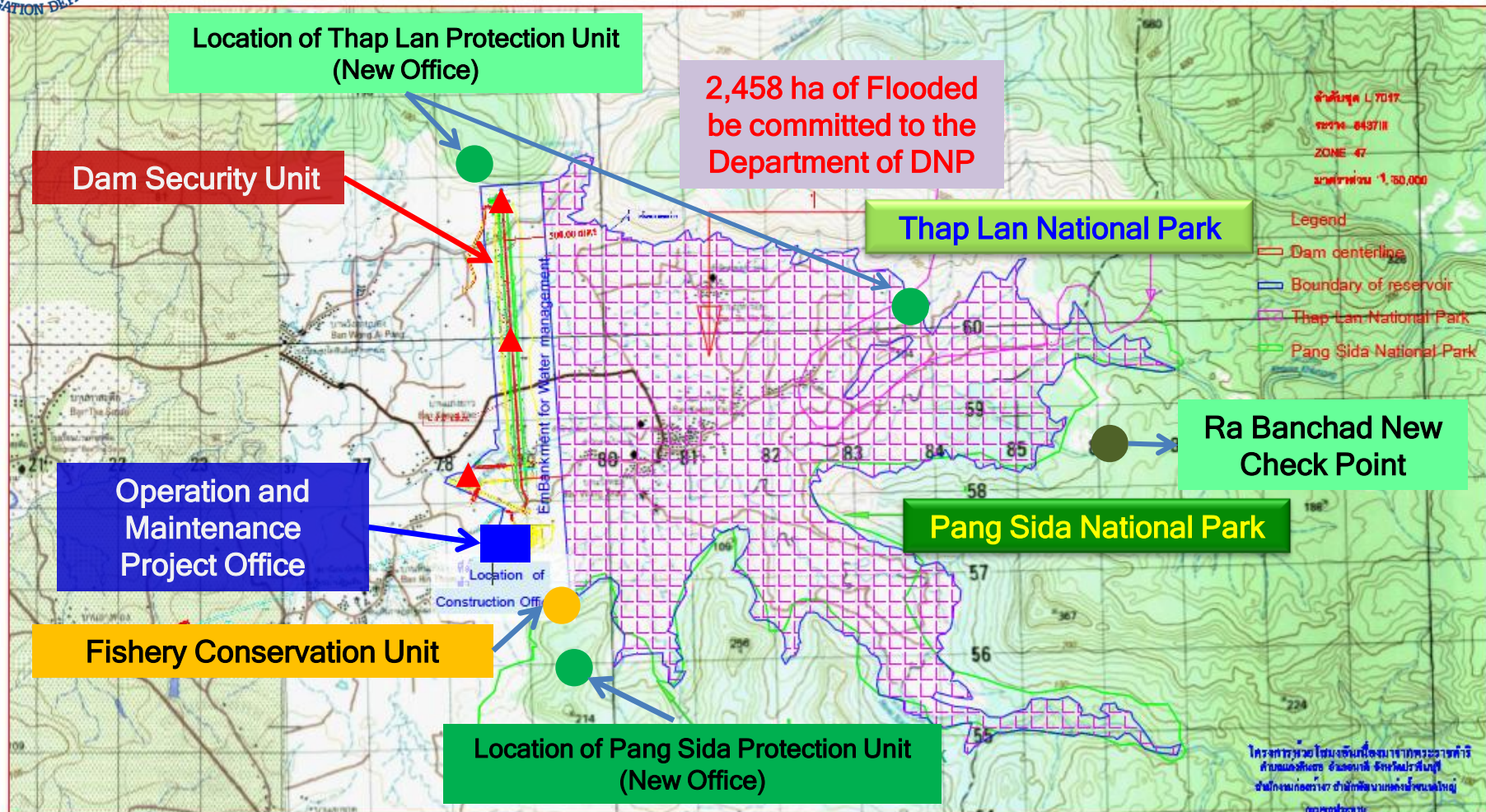
The area of 2,458 ha will be restored back to the DNP (Thap Lan National Park 186.40 ha, Pang Sida Park 76.80 ha and Reservoir area 2,194.80 ha)





Map on Project Location and World Heritage Site Encroachment Protection

Encroachment Prevention



Preliminary Map of Haui Samong Boundary, Prachinburi Province committee to the Department of National Park Wildlife and Plant Conservation

Concern about Associated Risks



1. Establishment the Fishery Conservation Unit **Plan 1.2 (3), 1.3 (2)**

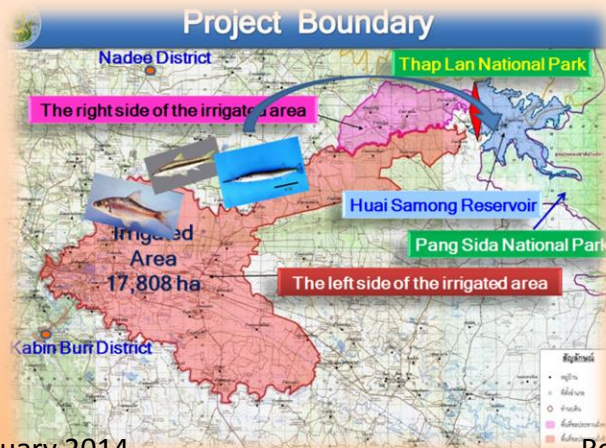
- Establish fishery conservation centre to culture fish for local economic value
- Patrol illegal fishing
- None of plan to introduce alliance fish species to grow in reservoir area

3. Mitigate impact on Biological Resource **Plan 2.18,2.19 ,2.20**

- strictly monitor and control the construction process
- increase awareness of people



2. Migrate fish from downstream to upstream **Plan 1.2 (5), 2.8**



4. Monitor Biological Resource **Plan 2.8**

- Acknowledge changes of aquatic ecosystem and resources.





**Reforestation Plot
2012**



Wildlife Survey



Spillway



Dam Construction



Drainage pipe in existing canal



**Wang-Eai Pong
Check Point**



Hin Toern Check Point



Thank you

Appendix B

IUCN's Monitoring Reactive Monitoring Mission Presentation (15 January 2014)



Welcome RM Mission Party



Huai Samong Reservoir Project

Prachin Buri Province

Dr.Sompop Sucharit

Ministry of Agriculture and Cooperatives

HUAISAMONG DAM





2015

Implementation response to the World Heritage Committee's Decision

35th , 36th and 37th

Huai Samong Reservoir Project

Prachin Buri Province

Dr.Somkiat Prajamwong

Director, Office of Project Management
Ministry of Agriculture and Cooperatives

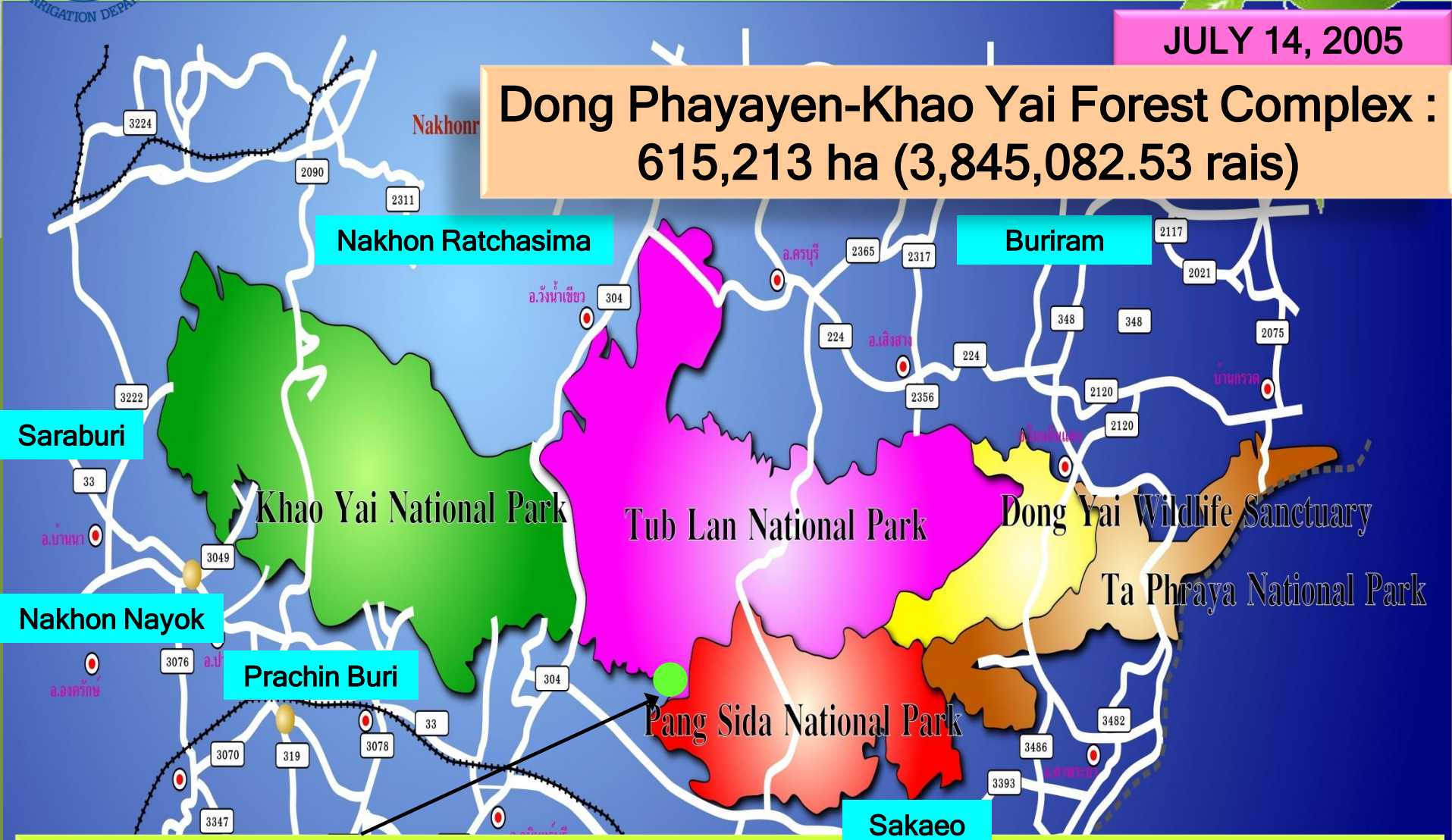
HUAI SAMONG DAM



Dong Phrayayen-Khao Yai Forest Complex Boundary

JULY 14, 2005

**Dong Phayayen-Khao Yai Forest Complex :
615,213 ha (3,845,082.53 rais)**



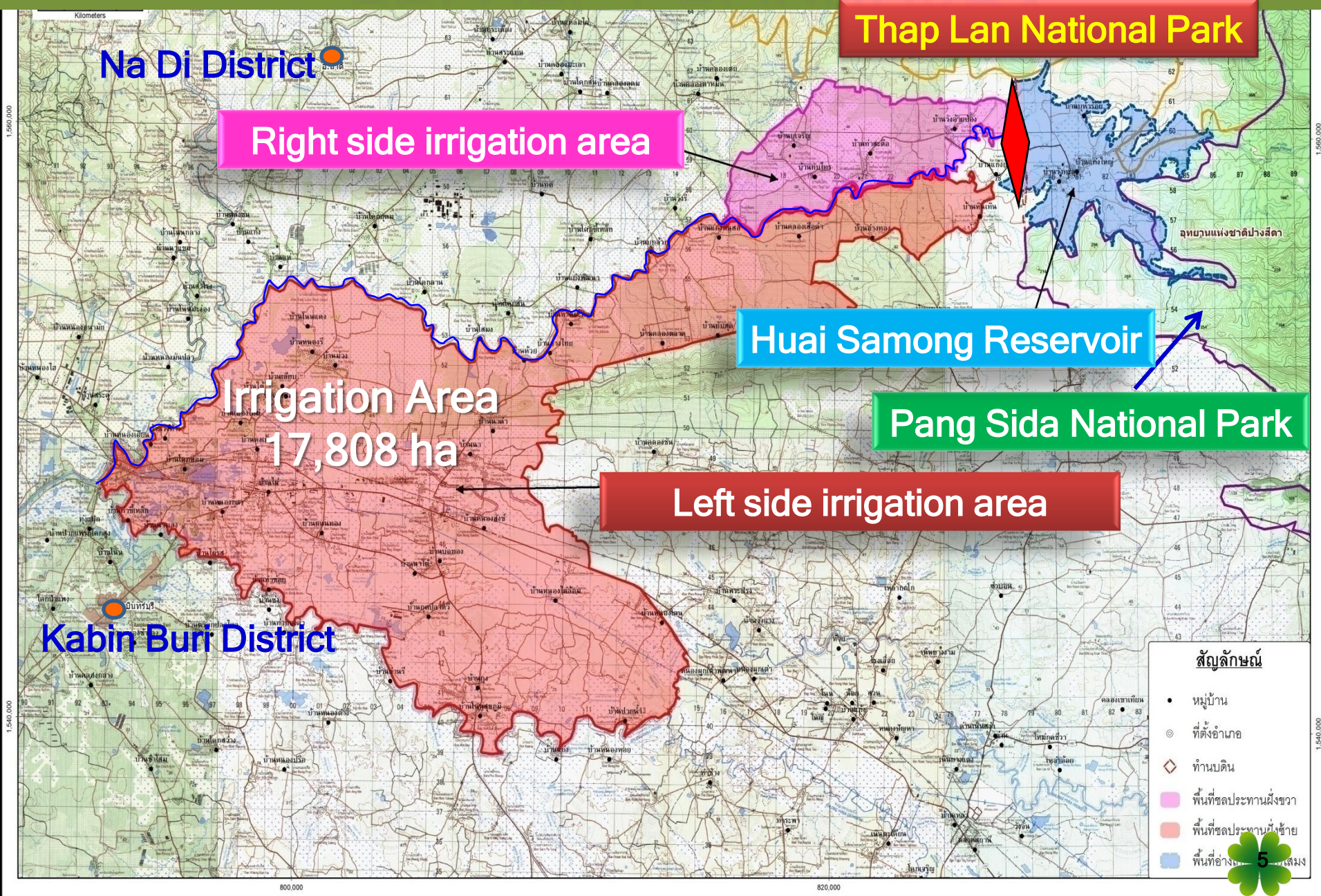
**Part of Huai Samong Reservoir intrude into the world heritage site 263 ha
(1,643.92 rais) (0.04% of Dong Phayayen-Khao Yai Forest Complex)**







PROJECT BOUNDARY



PROJECT OBJECTIVES



1. To irrigate agricultural area of 17,808 ha in Nadee and Kabin Buri districts, Prachin Buri Province and upstream of the Bang Pakong river



2. To supply water for domestic consumption in Nadee and Kabin Buri districts, Prachin Buri Province



- To mitigate floods in Prachin Buri Province and upper Bang Pakong river basin

- To maintain downstream ecosystem

- To generate a new source of fish breeding and supplementary food

- To promote its potential as a place of ecotourism

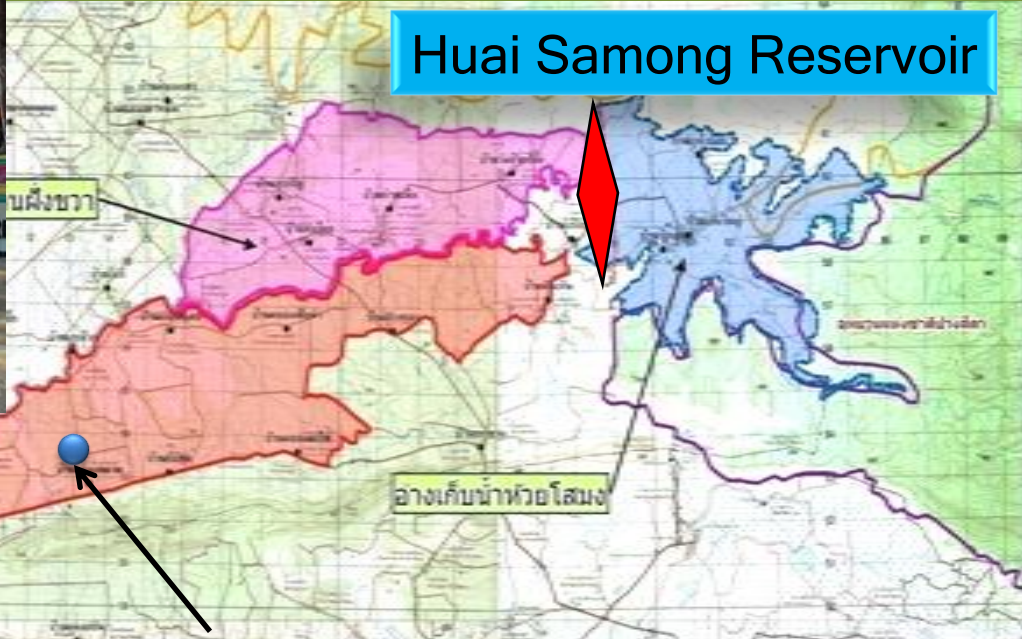
- To promote industrial development in the project area as well as those in its surrounding area



Flooded area in 2013



Huai Samong Reservoir





PROJECT COMPONENT



Location : Kaeng Dinso sub-district,
Na Di district, Prachin Buri Province

Catchment Area : 443 km²

Annual Inflow : 319.67 million m³

Dam : Length 3,967.51 m., Height 32.75 m.

Capacity : 295 million m³

Surface Area : 2,600 ha

Irrigation Area : 17,808 ha



Retention Storage 295 million m³

Retention Level +48.0 m(MSL)

Dead Storage 19.5 million m³

Minimum Water Level +32.2 m (MSL)



Project Benefits



1. To increase irrigated area of 17,808 ha (111,300 rais) in wet season and 7,200 ha (45,000 rais) in dry season, covering 37 villages, 6 sub-districts in Nadee and Kabin Buri districts, Prachin Buri province.



2. To supply water for consumption of 4,632 households.

3. To mitigate impact from natural disasters in Kabin Buri district and Huai Samong river bank area. The expected flood level will decrease about 0.50 meter or 30% of runoff water.



4. To maintain ecosystem in downstream area.



5. To increase humidity which helps in forest restoration and richness.



6. To provide water supply for distinguishing forest

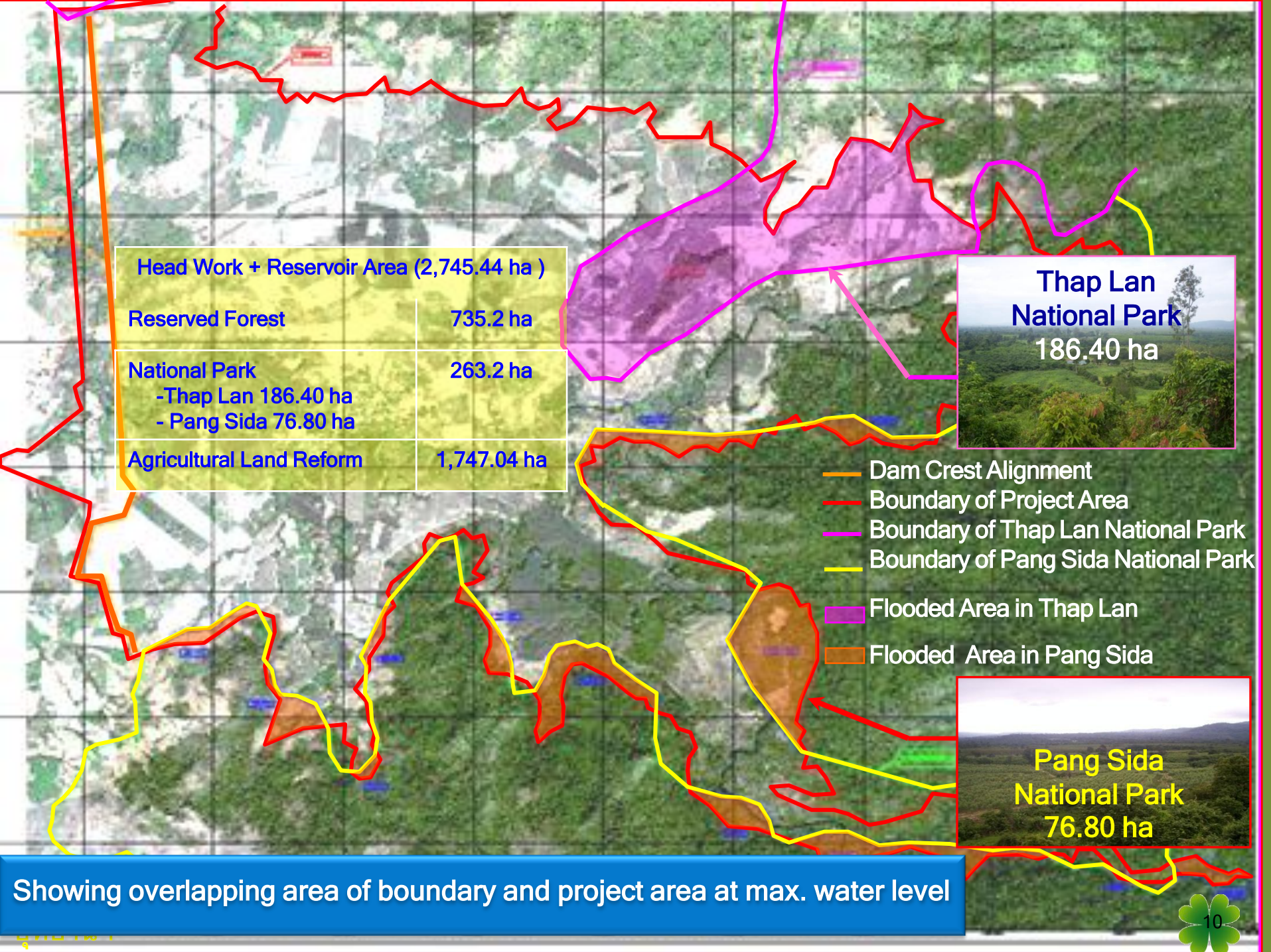


7. To build a buffer to prevent forest invasion.



8. To decrease migration of population to the capital.







35th World Heritage Committee's Decision

35th World Heritage Committee's Decision May 6, 2011 Paris, France



World Heritage

35 COM

Distribution Limited

WHC-11/35.COM/20
Paris, 7 July 2011
Original: English / French

UNITED NATIONS EDUCATIONAL, SCIENTIFIC
AND CULTURAL ORGANIZATION

CONVENTION CONCERNING THE PROTECTION OF
THE WORLD CULTURAL AND NATURAL HERITAGE

World Heritage Committee

Thirty-fifth session
Paris, UNESCO Headquarters
19-29 June 2011

**DECISIONS ADOPTED
BY THE WORLD HERITAGE COMMITTEE
AT ITS 35th SESSION
(UNESCO, 2011)**

19. Dong Phrayayen-Khao Yai Forest Complex (Thailand) (N 590)

Decision: 35 COM 7B.19

The World Heritage Committee,

1. Having examined Document WHC-11/35.COM/7B,
2. Recalling its Decision 34 COM 7B.18, adopted at its 34th session (Brasilia, 2010),
3. Notes the State Party's statement that it is conducting an Environmental Impact Assessment for the expansion of Highway 304, and expresses its concern over reports that highway expansion works are already underway;
4. Also expresses its concern about reports of escalating threats to the property's Outstanding Universal Value from encroachment, the proposed Huay Samong Dam, cattle grazing, and ineffective management;
5. Urges the State Party to rapidly halt any ongoing encroachment and cattle grazing affecting the property, and requests that all construction work on the Huay Samong Dam be halted until the World Heritage Committee has had the opportunity to review a completed Environmental Impact Assessment and assess its potential impacts on the property's Outstanding Universal Value, in line with Paragraph 172 of the *Operational Guidelines*;
6. Encourages the State Party to consider submitting a boundary modification request to the World Heritage Committee for Thap Lan National Park in order to better address forest conservation and encroachment issues in this area;
7. Also encourages the State Party to revise the property's management approach, and to develop long-term management policies, as well as a comprehensive tourism management plan;
8. Invites the State Party to submit an International Assistance request to support this process, and further encourages the States Parties of Thailand and the United States of America to consider the sister-parks proposal as an opportunity to explore capacity-building initiatives;
9. Also requests the State Party to invite a joint World Heritage Centre/IUCN monitoring mission to the property prior to its 36th session in 2012, in order to assess the potential impacts of encroachment, the Huay Samong Dam, cattle grazing, and the expansion of Highway 304 on the property's Outstanding Universal Value, and to review its management and financial plans;
10. Further requests the State Party to submit to the World Heritage Centre, by 1 February 2012, a detailed report on the state of conservation of the property, including information on the status of the Highway 304 Environmental Impact Assessment and the Huay Samong Dam, the progress achieved in halting any large-scale encroachment and cattle grazing, for examination by the World Heritage Committee at its 36th session in 2012.



35th World Heritage Committee's Decision

Requests

Also requests the State Party to **invite** a joint World Heritage Centre/IUCN Monitoring mission to the property prior to its 36th session in 2012, **in order to assess** the potential impacts of encroachment, the **Huai Samong Dam**, the progress achieved in halting any large-scale encroachment and cattle grazing, for examination by the World Heritage Committee at its 36th session in 2012.

Action


Meeting at ONEP
On 5 March 2012



Experts from UNESCO and IUCN surveyed
Huai Samong project area
on 29 February 2012



Recommendations of RM Mission



United Nations
Educational, Scientific and
Cultural Organization
Organisation
des Nations Unies
pour l'éducation,
la science et la culture

World Heritage 36 COM
Patrimoine mondial

Distribution limited / Paris, 2 May 2012 / 2 mai 2012
distribution limitée Original: English

UNITED NATIONS EDUCATIONAL,
SCIENTIFIC AND CULTURAL ORGANIZATION
ORGANISATION DES NATIONS UNIES
POUR L'ÉDUCATION, LA SCIENCE ET LA CULTURE

CONVENTION CONCERNING THE PROTECTION OF THE WORLD
CULTURAL AND NATURAL HERITAGE
CONVENTION CONCERNANT LA PROTECTION DU PATRIMOINE
MONDIAL, CULTUREL ET NATUREL

WORLD HERITAGE COMMITTEE / COMITE DU PATRIMOINE MONDIAL
Thirty-sixth session / Trente-sixième session
Saint Petersburg, Russian Federation / Saint Pétersbourg, Fédération de Russie
24 June – 6 July 2012 / 24 juin – 6 juillet 2012

Item 7 of the Provisional Agenda: State of conservation of properties inscribed on the World
Heritage List and/or on the List of World Heritage in Danger.
Point 7 de l'Ordre du jour provisoire: Etat de conservation de biens inscrits sur la Liste du
patrimoine mondial et/ou sur la Liste du patrimoine mondial en péril

MISSION REPORT / RAPPORT DE MISSION
Dong Phrayayen – Khao Yai Forest Complex (Thailand) (N 590)
Complexe forestier de Dong Phrayayen-Khao Yai (Thaïlande) (N 590)
28 February – 6 March 2012 / 28 février – 6 mars 2012

5. CONCLUSIONS AND RECOMMENDATIONS

R1. In relation to the issues and impacts from Highway 304;

- Urgently submit the completed EIA for section 26-29 km along with detailed plans for ecologically effective wildlife corridors including a detailed timeline, financial planning and resources for construction of the corridors, and mitigation actions to be implemented during construction and long-term enforcement actions to prevent encroachment;
- Implement and enforce speed limits and impact mitigation actions on the sections of Highway 304 running within the boundaries of the property, as well as other roads that bisect the property, and to monitor use of other roads as shortcuts and transport routes through the property.

R2. In regards to construction and impacts of the Huay Samong Dam:

- Halt construction of the Huay Samong Dam until appropriate resources are committed to ensure mitigation, enforcement and anti-encroachment actions are effectively in place including enhanced cooperation between management authorities and enforcement actions to prevent further impacts on the property;
- Submit as soon as possible the completed EIA for the dam and implement mitigation, enforcement and anti encroachment activities at the construction site and provide details of this implementation to the World Heritage Committee;

R3. In regards to issues of encroachment.

- Closely monitor the level of encroachment, including undertaking detailed mapping of the encroachments, including location, land use and magnitude, in relation to current boundaries of the World Heritage Property and to assess any increase in encroachment since inscription using satellite imagery and topographic analysis and consider submitting a boundary modification request where appropriate, following the relevant procedures as outlined in the *Operational Guidelines*;

R2. In regards to construction and impacts of the Huay Samong Dam:

- Halt construction of the Huay Samong Dam until appropriate resources are committed to ensure mitigation, enforcement and anti-encroachment actions are effectively in place including enhanced cooperation between management authorities and enforcement actions to prevent further impacts on the property;
- Submit as soon as possible the completed EIA for the dam and implement mitigation, enforcement and anti encroachment activities at the construction site and provide details of this implementation to the World Heritage Committee;

ement authority and
awareness of the
ty and its OUV;

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36th World Heritage Committee's Decision

June 24 - July 6, 2012

Saint Petersburg, Russian Federation



World Heritage

36 COM

WHC-12/36.COM/19

Original: English / French

UNITED NATIONS EDUCATIONAL, SCIENTIFIC
AND CULTURAL ORGANIZATION

CONVENTION CONCERNING THE PROTECTION OF
THE WORLD CULTURAL AND NATURAL HERITAGE

WORLD HERITAGE COMMITTEE

Thirty-sixth session

Saint Petersburg, Russian Federation
24 June – 6 July 2012

**DECISIONS ADOPTED
BY THE WORLD HERITAGE COMMITTEE
AT ITS 36TH SESSION
(SAINT-PETERSBURG, 2012)**

6. Considers that cattle grazing in the property represents a serious concern, and that the on-going encroachment of the property has not yet been adequately addressed, and encourages the State Party to secure the appropriate high-level political support to tackle these threats;
7. Requests furthermore the State Party to submit to the World Heritage Centre, by 1 February 2013, an updated and detailed report on the state of conservation of the property, including a report on the progress achieved in the implementation of the 2012 mission recommendations, for examination by the World Heritage Committee at its 37th session in 2013, when the Committee should also consider the need for a further reactive monitoring mission, and the possible inscription of the property on the List of World Heritage in Danger.

17. Dong Phrayayen-Khao Yai Forest Complex (Thailand) 590

Decision: 36 COM 7B.17

The World Heritage Committee,

1. Having examined Document WHC-12/36.COM/7B.Add,
2. Recalling Decision **35 COM 7B.19** adopted at its 35th session (Saint Petersburg, 2011),
3. Notes with concern that expansion works on Highway 304 have been completed outside the property without the implementation of appropriate mitigation measures along the sections of the highway within the property, and requests the State Party to:
 - a) Urgently submit the completed EIA for section 26-29 km along with detailed plans for ecologically effective wildlife corridors including a detailed timeline, financial planning and resources for construction of the corridors, and mitigation actions to be implemented during construction and long-term enforcement actions to prevent encroachment,
 - b) Implement and enforce speed limits and impact mitigation actions on the sections of Highway 304 running within the boundaries of the property, as well as other roads that bisect the property, and to monitor use of other roads as shortcuts and transport routes through the property;
4. Also notes with concern that construction continues at the Huay Samong Dam site, and also requests the State Party to halt construction of the Huay Samong Dam until appropriate resources are committed to ensure mitigation, enforcement and anti-encroachment actions are effectively in place, including enhanced cooperation between management authorities and enforcement actions to prevent further impacts on the property;
5. Further requests the State Party to implement all the other recommendations from the
 - b) Strengthen enforcement measures, provide adequate resources to the management authority and law enforcement agencies, work with surrounding communities to increase awareness of the boundaries of the property and garner support for the conservation of the property and its OUV,
 - c) Prioritize reduction of illegal grazing activities within the property and pay particular attention to stopping grazing activities conducted by commercial agricultural companies,
 - d) Consider extending the property in order to include areas that better represent its Outstanding Universal Value, based on the mapping of encroachments recommended above, and considering current levels of encroachment, realistic boundaries for enforcement, and impacts and mitigation from construction of the Huay Samong Dam,
 - e) Strengthen efforts in implementing the Management Plan for Dong Phrayayen – Khao Yai Forest Complex, including an updated and revised plan for the complex that involves and encourages cooperation and coordination of all relevant ministries and agencies, and stakeholders at both national and local levels,
 - f) Develop and implement a detailed, integrated, extensive and long-term tourism management plan that includes actions to address the current impacts from high intensive tourism and encourages them to submit a request for International Assistance to the Committee to support the development of the tourism plan,
 - g) Consider a detailed management related zoning plan for the property, to ensure core areas of habitat are identified and provided with increased protection, including designation of an appropriate buffer zone around the property to ensure protection against adjacent developments;



36th World Heritage Committee's Decision

Requests

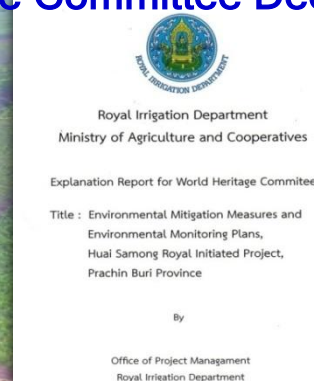
Also requests the State Party to **halt construction of the Huai Samong Dam** until appropriate resourced are committed to ensure mitigation, enforcement and anti encroachment actions are effectively in place, including enhanced cooperation between management authorities and enforcement actions to prevent further impacts on the property.

Action

Reviewed-EIMP (approved by the Cabinet resolution) Meeting was hold on Oct 2,2012 in order to ensure the appropriated of Mitigation Plan.



Preparation of The Huai Samong Explanation Report towards the Word Heritage Committee Decision.



Recommendations of RM Mission

Recommendations

Action

The State Party urgently **submit** the **completed EIA** for construction of the **Huay Samong Dam**, including plans for mitigation actions during construction; **timeline for implementation** and a **detailed budget for mitigation activities**.



The **completed EIA** of the **Huay Samong Dam**, the Environmental mitigation plans report **contained** actions during construction; **timeline for implementation** and a **detailed budget for mitigation activities** were submitted to WHC by April, 2013


37th World Heritage Committee's Decision

16-27 June 2013

Phnom Penh, Cambodia

8. Also notes that construction continues at the Huay Samong Dam site, and also reiterates its request to the State Party to undertake all necessary mitigation, enforcement and anti-encroachment actions to ensure this project does not impact the Outstanding Universal Value of the property;
9. Further reiterates its request to the State Party to implement all the recommendations of the 2012 joint UNESCO/IUCN reactive monitoring mission, including a clear statement on the extent and status of cattle grazing in the property, by **June 2014**;
10. Further request the State Party to invite an IUCN reactive monitoring mission to the property before the 38th session of the Committee in 2014, in order to assess progress in the implementation of the above recommendations and those made by the 2012 reactive monitoring mission, and to consider whether the property should be considered for inscription on the List of World Heritage in Danger;
11. Requests furthermore the State Party to submit to the World Heritage Centre, by **1 February 2014**, an updated and detailed report on the state of conservation of the property, including a report on the progress achieved in the implementation of the 2012 mission recommendations and those actions outlined above, for examination by the World Heritage Committee at its 38th session in 2014.





United Nations
Educational, Scientific and
Cultural Organization
Organisation
des Nations Unies
pour l'éducation,
la science et la culture

World Heritage

37 COM

WHC-13/37.COM/20
Paris, 5 July 2013
Original: English / French

UNITED NATIONS EDUCATIONAL, SCIENTIFIC
AND CULTURAL ORGANIZATION

CONVENTION CONCERNING THE PROTECTION OF
THE WORLD CULTURAL AND NATURAL HERITAGE

World Heritage Committee

Thirty-seventh session
Phnom Penh, Cambodia
16 - 27 June 2013

**DECISIONS ADOPTED
BY THE WORLD HERITAGE COMMITTEE
AT ITS 37TH SESSION (PHNOM PENH, 2013)**



37th World Heritage Committee's Decision

Requests

8. Also notes that construction continues at the Huay Samong Dam site, and also reiterates its request to the State Party to undertake all necessary mitigation, enforcement and anti-encroachment actions to ensure this project does not impact the Outstanding Universal Value of the property;

10. Further request the State Party to invite an IUCN reactive monitoring mission to the property before the 38th session of the Committee in 2014, in order to assess progress in the implementation of the above recommendations and those made by the property should be considered for inscription on the list of World Heritage in Danger:



Action

1. Seriously implement EIMP plan especially plan related to the world heritage, the budget allocation to response agencies, progress monitoring,

2. Continually implementation other measures i.e. warning sign, communicating staffs and workers on the forest law and regulation

3. Establish a mechanism to continually monitor the outcomes of EIMP implementation





UNESCO Office, Bangkok, and independent consultant

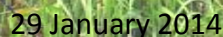
While in Bangkok the n for the property Depart of Natural Resources a institutions. During the conservation of the pro Government Organisa Zusammenarbeit, the G

The mission visited the works and to clarify the and notes that these a Executive Summary Report the highway from km 2 the section from km 4; documents include assistance to complete and submit need to finalize plans for the road expansion and

The mission also visited the construction site for the Huay Samong Dam and areas adjacent to the construction site of the dam wall including sites within Thap Lan and Pang Sida NPs which will be inundated by flooding resulting from the dam wall. The mission was able to inspect detailed maps of the area including current land use, highlighting the extent to which encroachment by Eucalyptus plantation has already impacted on the property in the areas surrounding the dam wall construction site. Areas of the property that will be affected by flooding post construction are facing serious potential threats and impacts such as illegal poaching and encroachment during and post construction work, increased tourism pressures post construction, heavy traffic on existing roads, and construction of new roads, all of which have the potential for significant negative impacts on the property.

The mission also visited the construction site for the Huay Samong Dam and areas adjacent to the construction site of the dam wall including sites within Thap Lan and Pang Sida NPs which will be inundated by flooding resulting from the dam wall. The mission was able to inspect detailed maps of the area including current land use, highlighting the extent to which encroachment by Eucalyptus plantation has already impacted on the property in the areas surrounding the dam wall construction site. Areas of the property that will be affected by flooding post construction are facing serious potential threats and impacts such as illegal poaching and encroachment during and post construction work, increased tourism pressures post construction, heavy traffic on existing roads, and construction of new roads, all of which have the potential for significant negative impacts on the property.

The mission visited areas of Thap Lan NP which surround the Lam Plai Mart dam in Ban Rat, where the work of the ranger unit is focused on issues related to encroachment and in particular impacts from cattle grazing and illegal removal of forest products, including wildlife. The mission was able to meet with a number of local residents and discuss some of the key issues with them. The issues of release of cattle for long term grazing, by commercial agricultural companies is one that will require a high level of political will and increased enforcement. However, action on this issue is critical to the maintenance of the property's OUV.

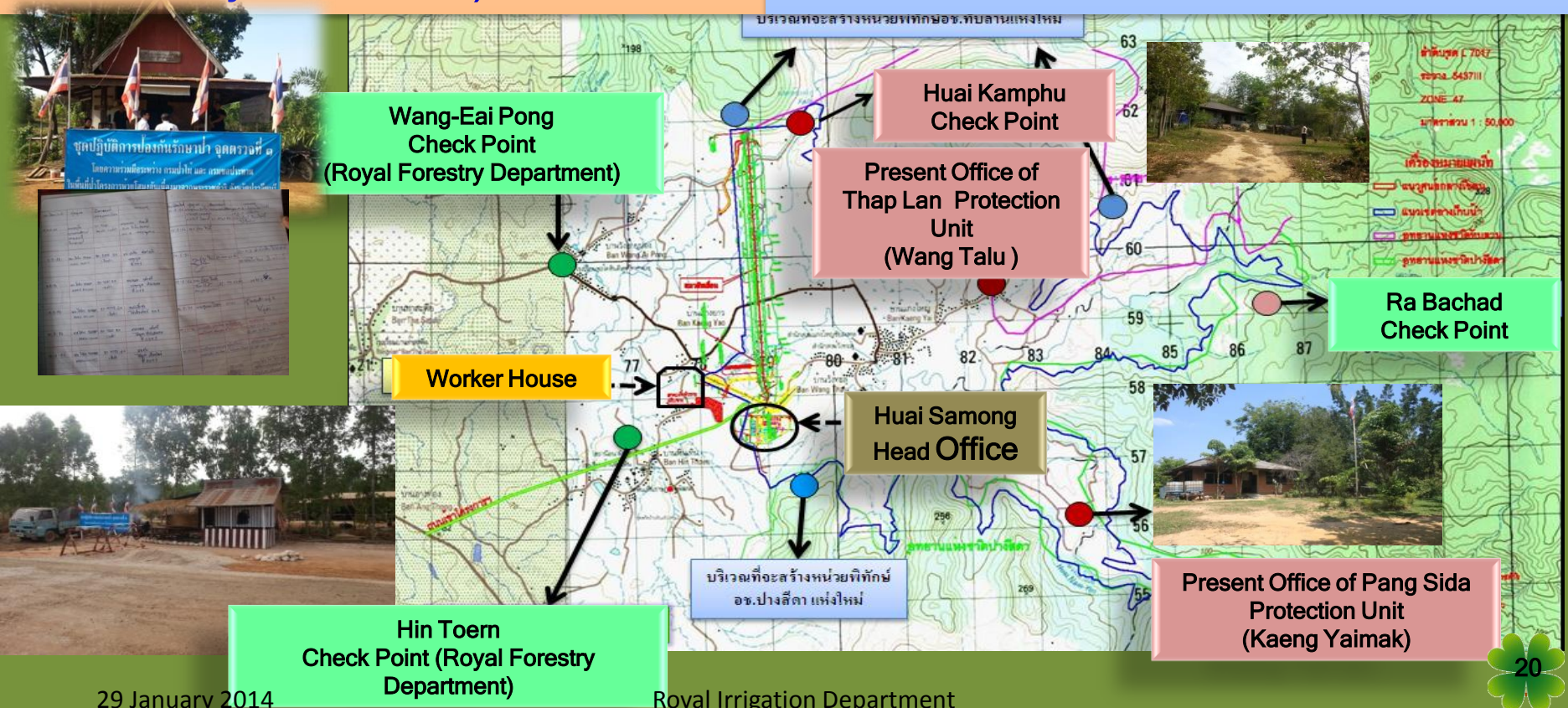


Encroachment Prevention during Construction Phase

1. Check points to prevent and monitor illegal logging and forest encroachment (although the area was already revoked)

2. Patrol Activities

- Training staffs to protect encroachment
- Patrol both protected area (Forestry Dep.) and conservation area (DNP)



Encroachment Prevention during Construction Phase

3. Fencing in the buffer zone

8 kms length along Thap Lan National Park boundary



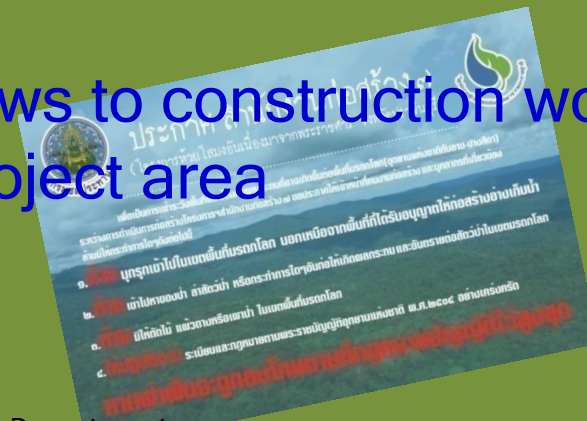
4. Migration

- 1,443 plots, 683 households have to migrate from flooded area



5. Monitoring encroachment prevention

- establish project office, residence for staffs away from national park area
- Provide knowledge on related laws to construction workers
- Set up warning sign around project area



Encroachment Prevention during Construction Phase

6. Encouraging conservation awareness to encourage student, local people about conservation awareness

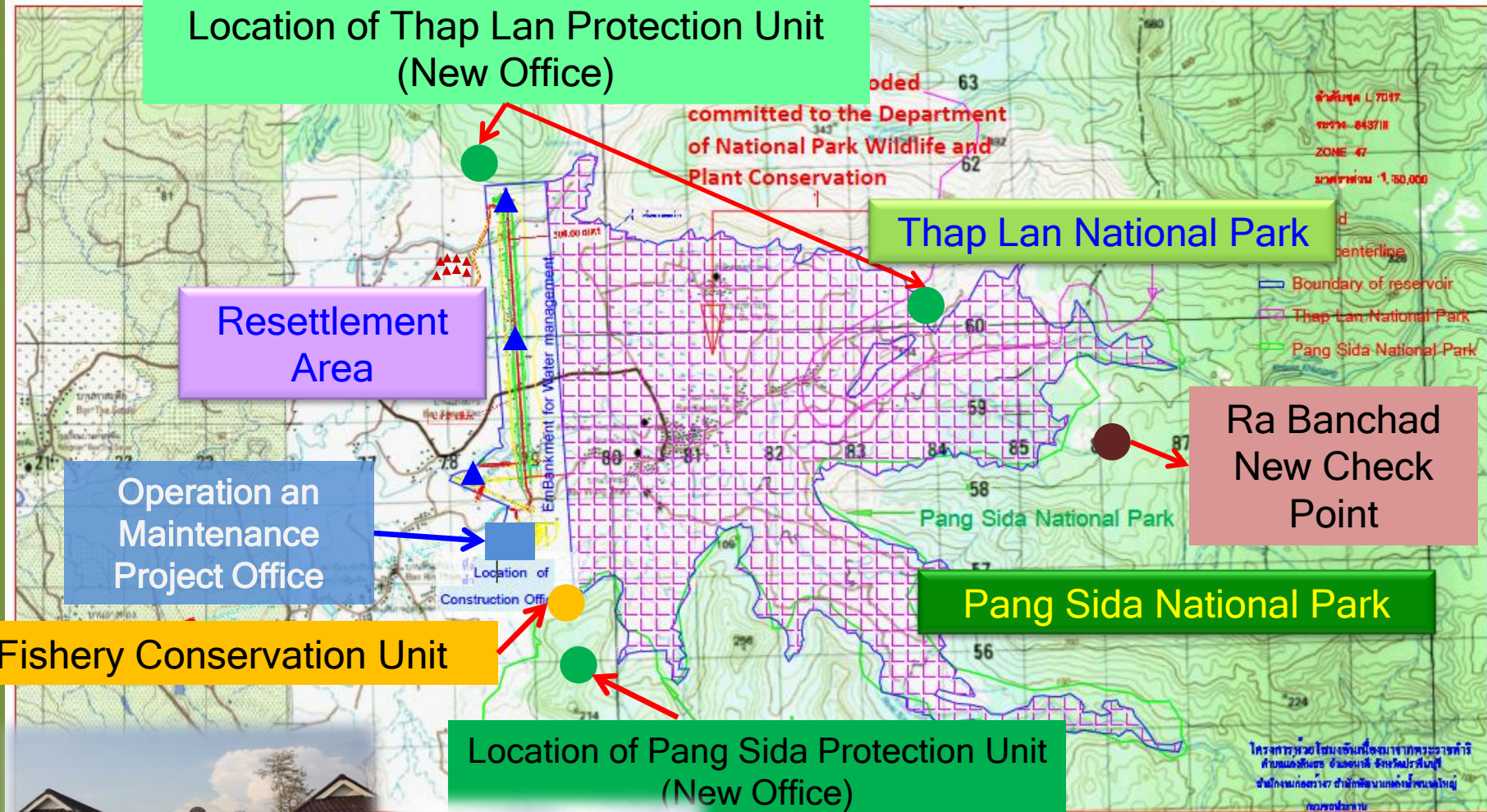


7. Promoting Career for local people

Training affected people on the sustainable career



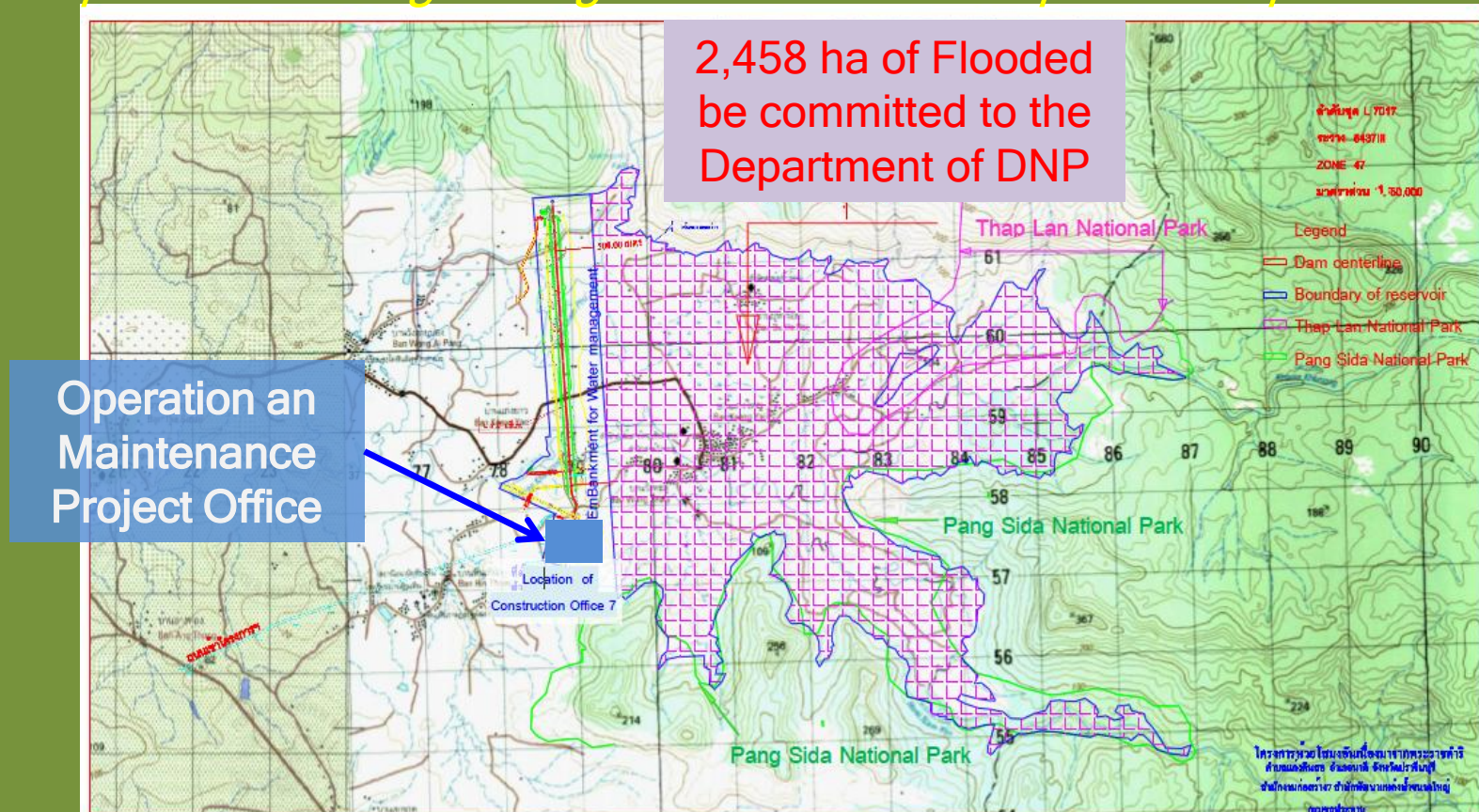
Encroachment Prevention during Operation Phase



Encroachment Prevention during Operation Phase

Announcement of Reservoir Area as National Park

The area of 2,458 ha will be restored back to the DNP (Thap Lan National Park 186.40 ha, Pang Sida Park 76.80 ha and Reservoir area 2,194.80 ha). The DNP *will have the authorities that to interdict criminals on the water , prevent poachers using fishing boats to enter deep into the park.*



Preliminary Map of haui Samong Boundary, Prachinburi Province committed to the Department of National Park Wildlife and Plant Conservation

Support the Outstanding Universal Value of the property

1. Reforestation

- restoring the degraded forest
- Forage crop plantation
- Planting vetiver grass to minimize the soil erosion



2. Raising moisture to the forest

- construct temporary and semi-permanent weir in the watershed area



3. Firebreak for wildfire protection



Dam and Appurtenant Structures



Left canal outlet



Spillway



River outlet

Right canal outlet

Storage Dam



office

Since the head work is located outside world heritage area.
The construction work has continued with 17.861% Overall
Progress (December, 2013)

The implementation of other measures during the construction phase i.e. Issuing a no trespassing notice, Warning sign, forest law and regulations training to staffs and workers



Do not trespassing into the world heritage area prohibited except the construction area

Do not gather forest products, hunting or any action that affect wildlife in the world heritage area.

Do not logging, clearing or burning forest in the world heritage area

Strictly comply with the law and regulations of National Park Act B.E. 2504 (1961)



The implementation of EIMP

especially plans related to the world heritage, progress monitoring and budget allocation to agencies

RID provided staffs to monitor the implementation followed EIMP strictly



A total of 47 plans of EIMP (Environmental Impact Mitigation and Monitoring Plan) include:

27 Prevention and Mitigation plans

20 Monitoring plans

- ❖ 19 response agencies
- ❖ Period of time : 2011-2025
- ❖ Total budget : USD 15.61 Million
- ❖ Budget on the World heritage : USD 9.57 Million



In 2011 budget from the office of the Royal Development Board 0.07 USD Million

In 2012 budget 2.63 USD Million

In 2013 budget 1.40 USD Million

In 2014 budget 1.32 USD Million



29

Co-operating and Integrating the implementation of EIMP

Observe and monitor the wildlife population

National Park Protection Unit/Check point

Reforestation/Check dam/Firebreaks/ Patrol

Attend and protect the Thup Lan National Park and the Pang Sida National Park

Department of National Parks, Wildlife and Plant Conservation



Department of Fisheries

Observe and monitor aquatic ecosystem

Office of Natural Resources and
Environmental Policy and Planning

Evaluate the implementation of EIMP
and propose to the National
Environment Board and the World
Heritage Committee

Royal Irrigation Department

Control the construction site/ workers/staffs

Migration/Land and Property Compensation

Declare Protected Area Zone

Declare surface area of reservoir to
national park area

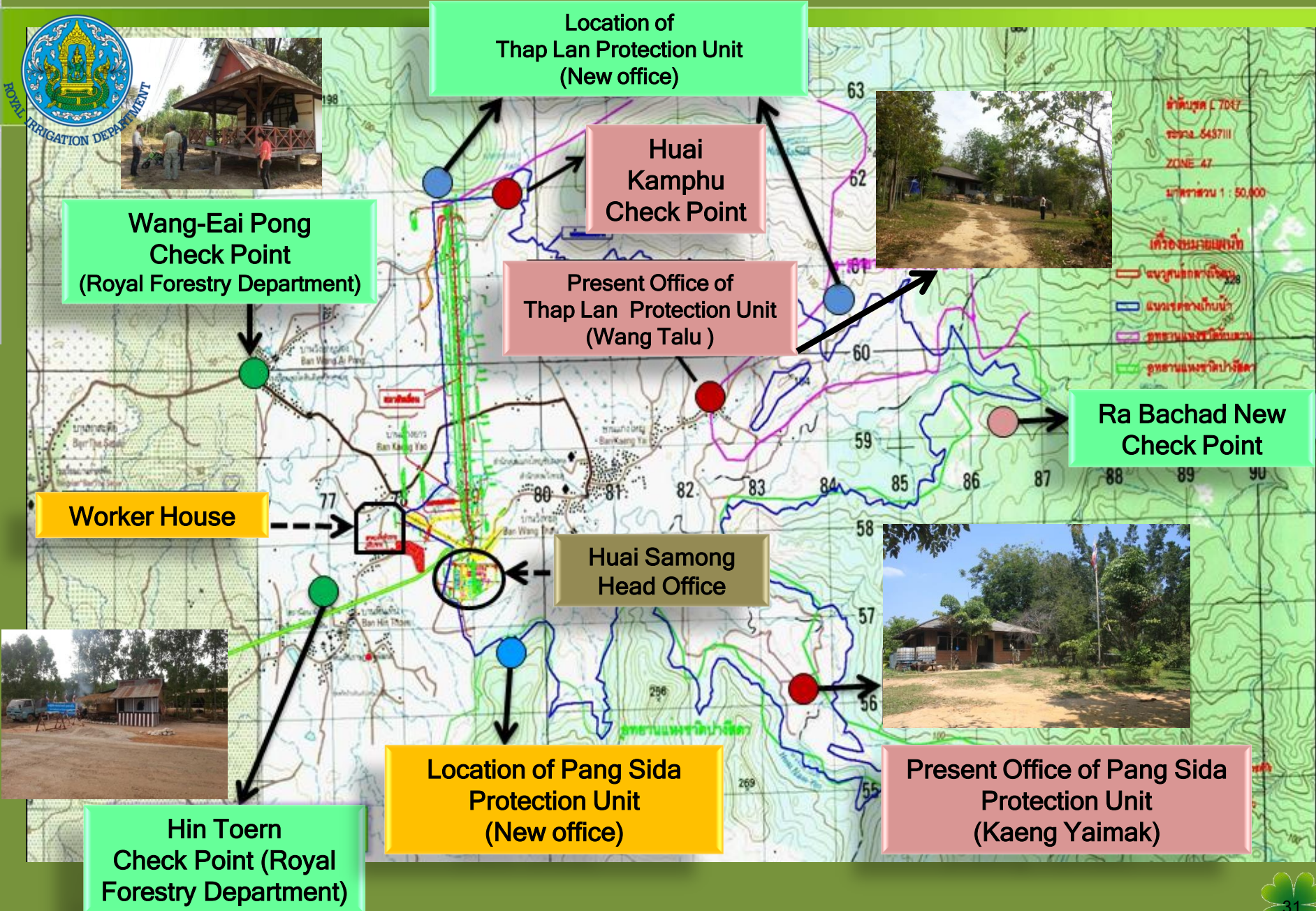
Royal Forestry Department

Attend the national reserved forest area

Forest protection Unit /Reforestation

Preventing encroachment of the national reserved forest





Map on Project Location and World Heritage Site Encroachment Protection

Environmental Impact Prevention and Mitigation during the construction phase

Public relation of Huai Samong Reservoir Project

Training young irrigation professionals : study visit on the construction of irrigation works
(3 generations 180 attendants)



Workshop on the participation in water resources development
(2 generations 172 attendants)



Expected Benefits

Publicized media production

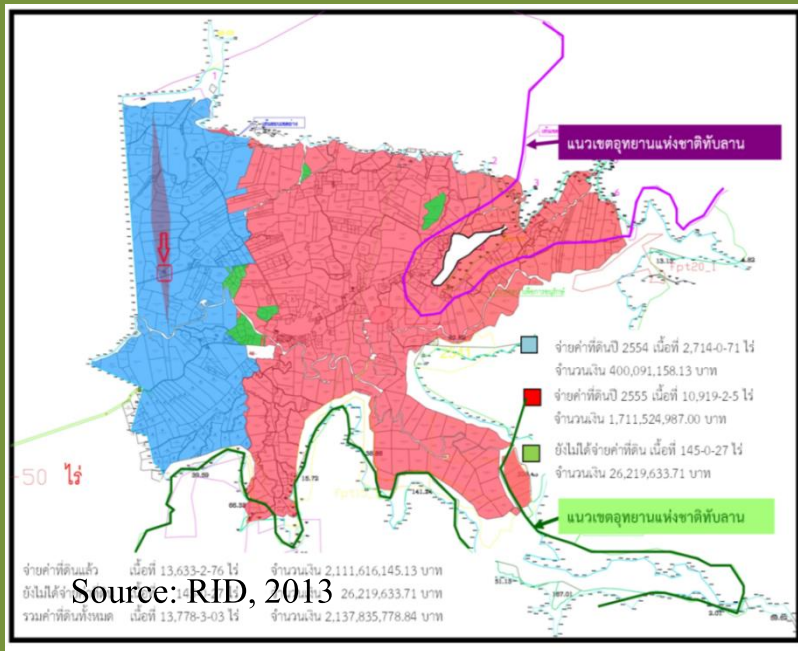


Target groups : local communities in the project area and students of school around the project area
To acknowledge project information, study visit on water user group in order to promote communities participation on the project
Moreover, help to reduce the problem that against the project

Environmental Impact Prevention and Mitigation during the construction phase

Survey and Compensation for land and property

97 % of compensation for land and land resettlement and 75% of people who emigrate out of project area



Old residence



New residence



Expected benefits

To move affected people from reservoir area into appropriate resettlement area in order to reduce the encroachment of forest and the world heritage areas and support the good quality of life (due to the budget for land development and resettlement program is provided for establishing residence)

Environmental Impact Prevention and Mitigation during the construction phase

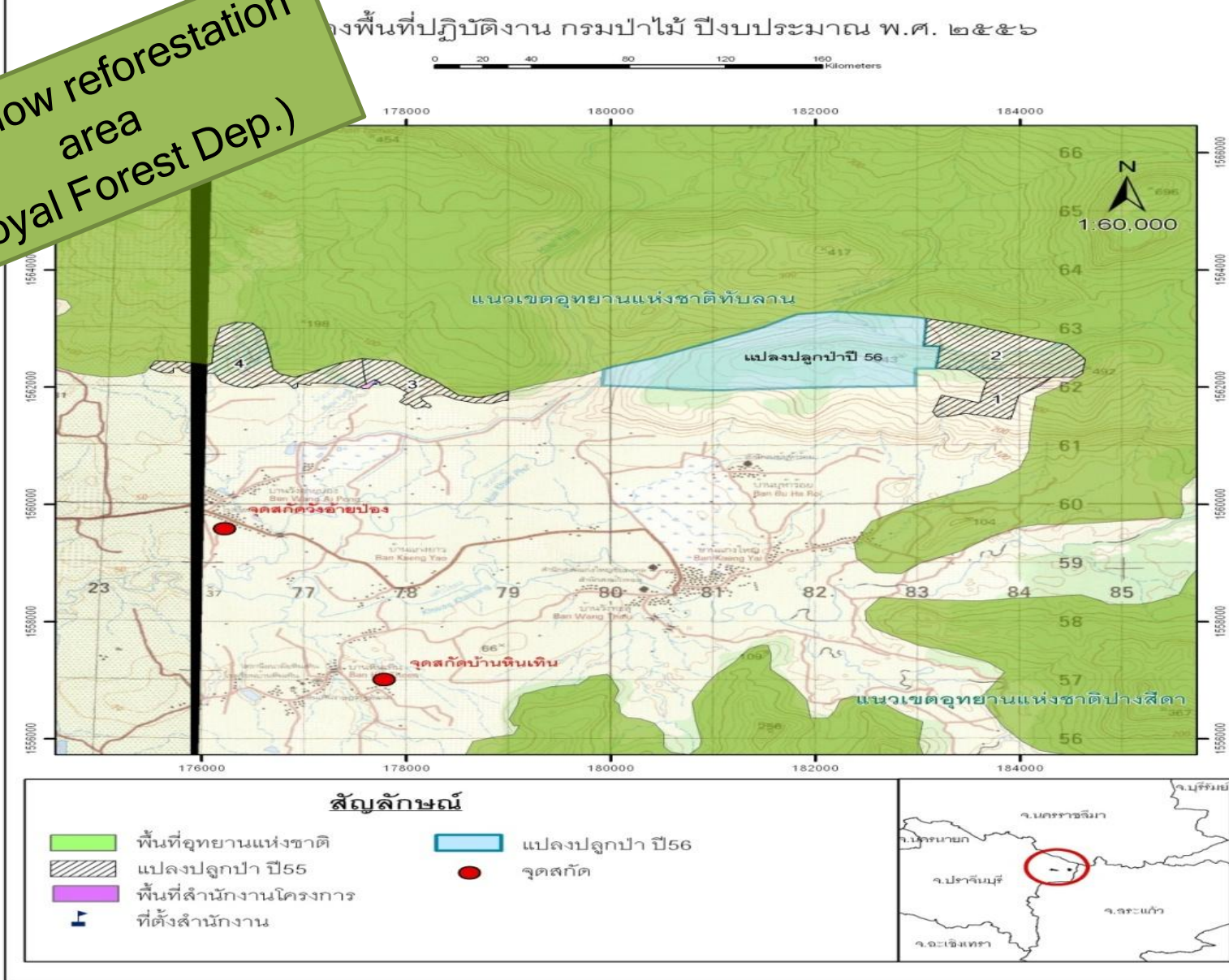
Prevention and reforestation in surrounding area of reservoir

In 2012 total reforestation area of 416 ha.
and in 2013 total reforestation area of 592 ha.

1. Improvement of watershed ecosystem
2. Wild rattan plantation
3. Reforestation
4. Forage crops plantation
5. Growing native tree for wildlife feeding
6. Growing eaglewood plantation for the world heritage area
7. Growing valued tree replacing exotic tree



Map show reforestation
area
(Royal Forest Dep.)



Source: Royal Forest Department, 2013

[illegible]

Environmental Impact Prevention and Mitigation during the construction phase

Wildlife migration and conservation

Responsible agencies: Office of Wildlife Conservation, DNP

Survey was conducted and divided into 4 groups as followed

1) **Large mammals**: Using camera traps



2) **Small mammals**: using cage traps



3) **Birds**: Using conducting point transect



4) **Reptiles and amphibians**: Using direct count survey during the night along water source in the project area



Expected benefits

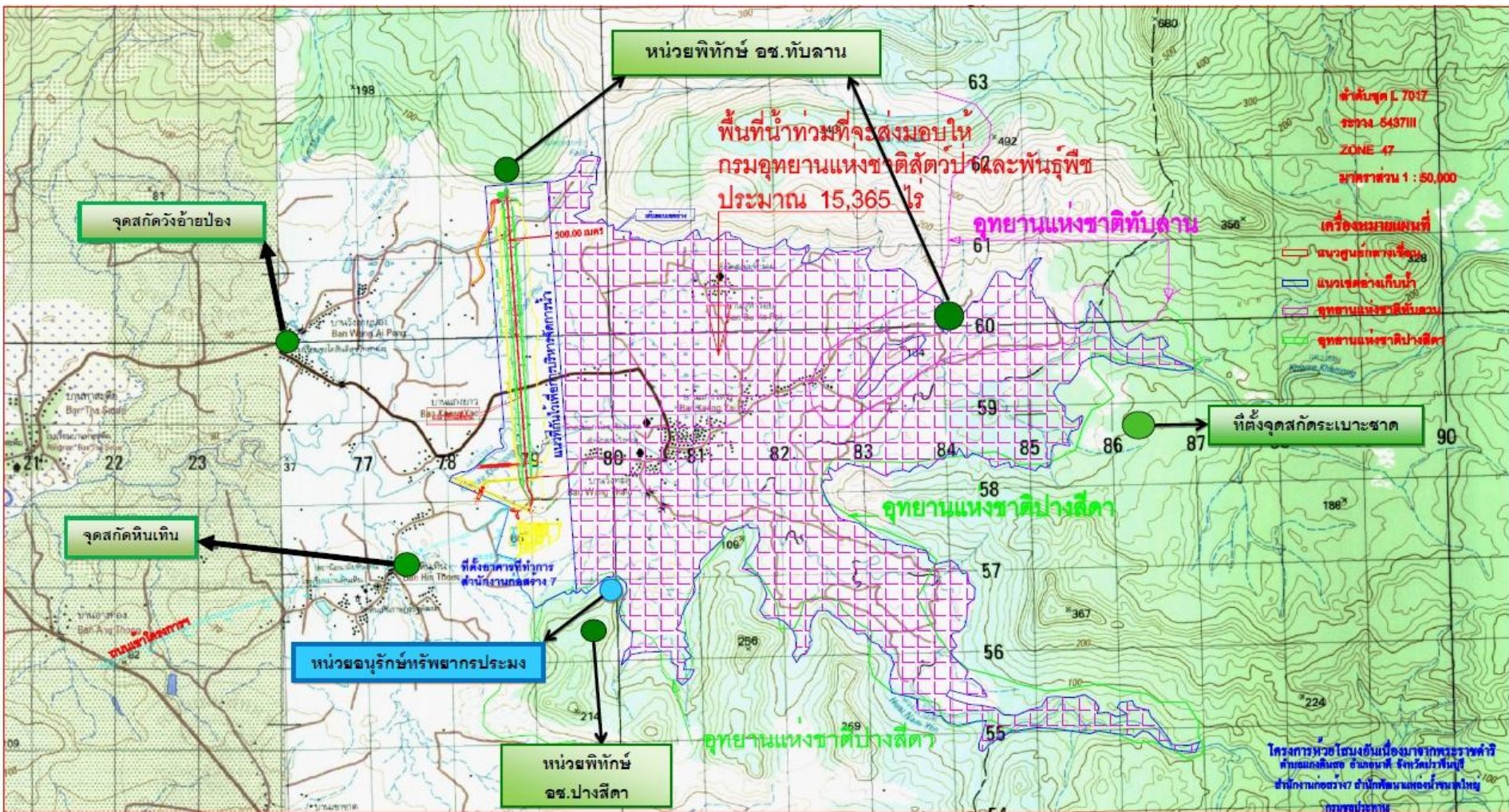
To observe diversity and richness of wildlife
To provide the area for removed wildlife from flood area

Announcement of Reservoir Area as National Park

Preliminary, reservoir area in the *Dong Phrayayen-Khao Yai Forest Complex* will be firstly considered.



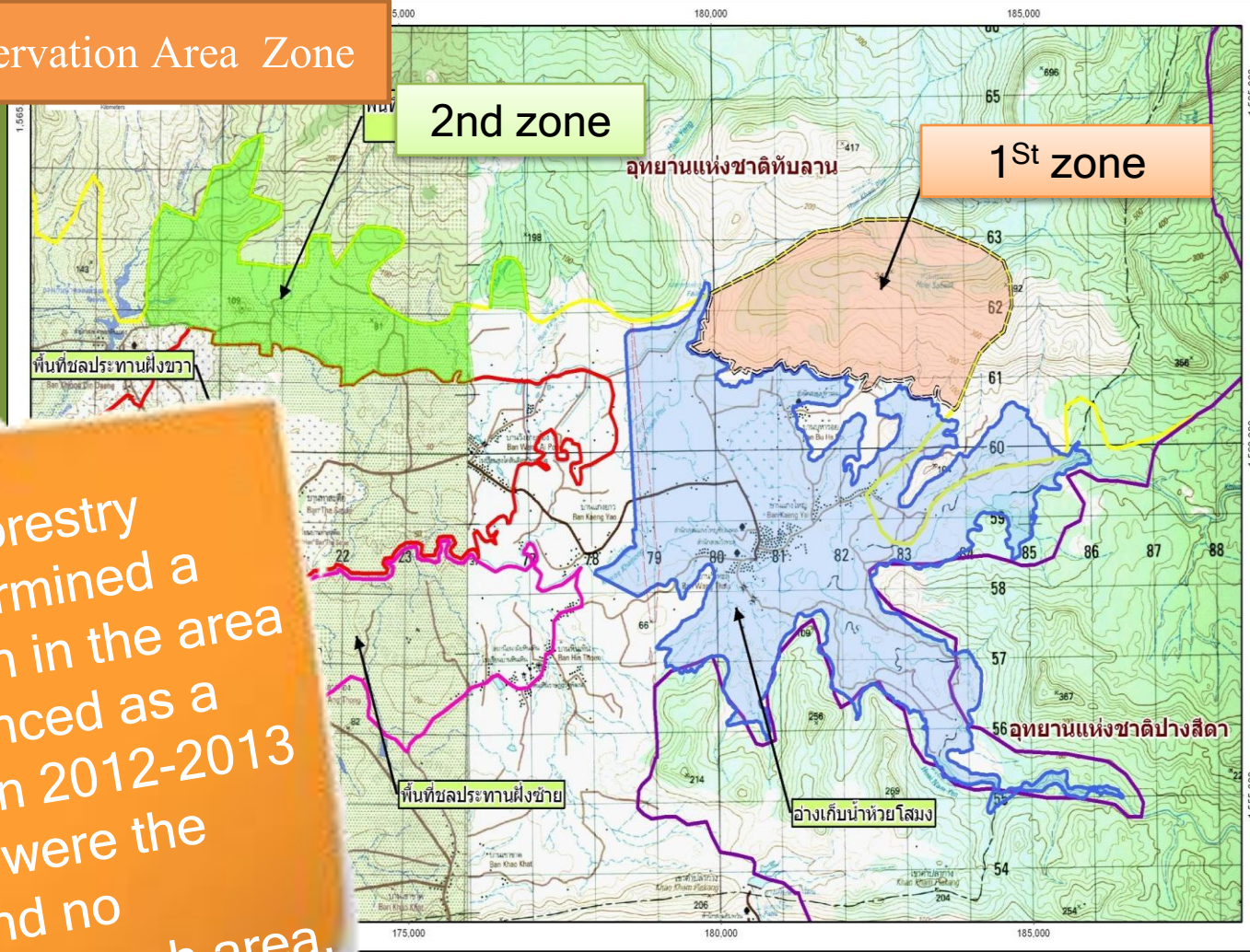
Map shows the flooded area of 2,458.4 ha. which will be formally transfer to Department of National park, wildlife and Plant Conservation



Environmental Impact Prevention and Mitigation during the construction phase

Announcement of Conservation Area Zone

RID and Royal Forestry Department determined a reforestation plan in the area which be announced as a protected area in 2012-2013 by DNP. There were the reforestation and no trespass notice in such area.



Source: RID, 2012

Environmental Impact Prevention and Mitigation during the construction phase

Prevention of encroachment on reservoir area, and Reforestation in world heritage site : *Thap Lan National Park*

1. Wild rattan plantation 500 Rai
2. Forage crops plantation 380 Rai
3. Improvement of watershed ecosystem 1,000 Rai
4. Plant nursery
5. Vetiver grass planting 300,000 plants
6. Permanent dam construction 5 sites
7. Semi-permanent dam construction 15 sites
8. Integrated dam construction 60 sites
9. Fire breaks 40 km.
10. Barbed wire for buffer zone 8 km.



11. Training course of the potential implementation improvement to staff 1 generation
12. Handling a camp on the world heritage conservation for children 1 generation
13. Training course of forest conservation to local people 1 generation
14. Publicized media production

Environmental Impact Prevention and Mitigation during the construction phase

Prevention of encroachment on reservoir area, and Reforestation in world heritage site : *Pang Sida National Park*

1. Forage crops plantation 50 Rai



2. Fire breaks 10 km. and 60 integrated dams



4. Communication system development : providing radio communication for patrolling



5. Setting solar electrification cell system 2 sites

6. Establishment of 10 saltlicks



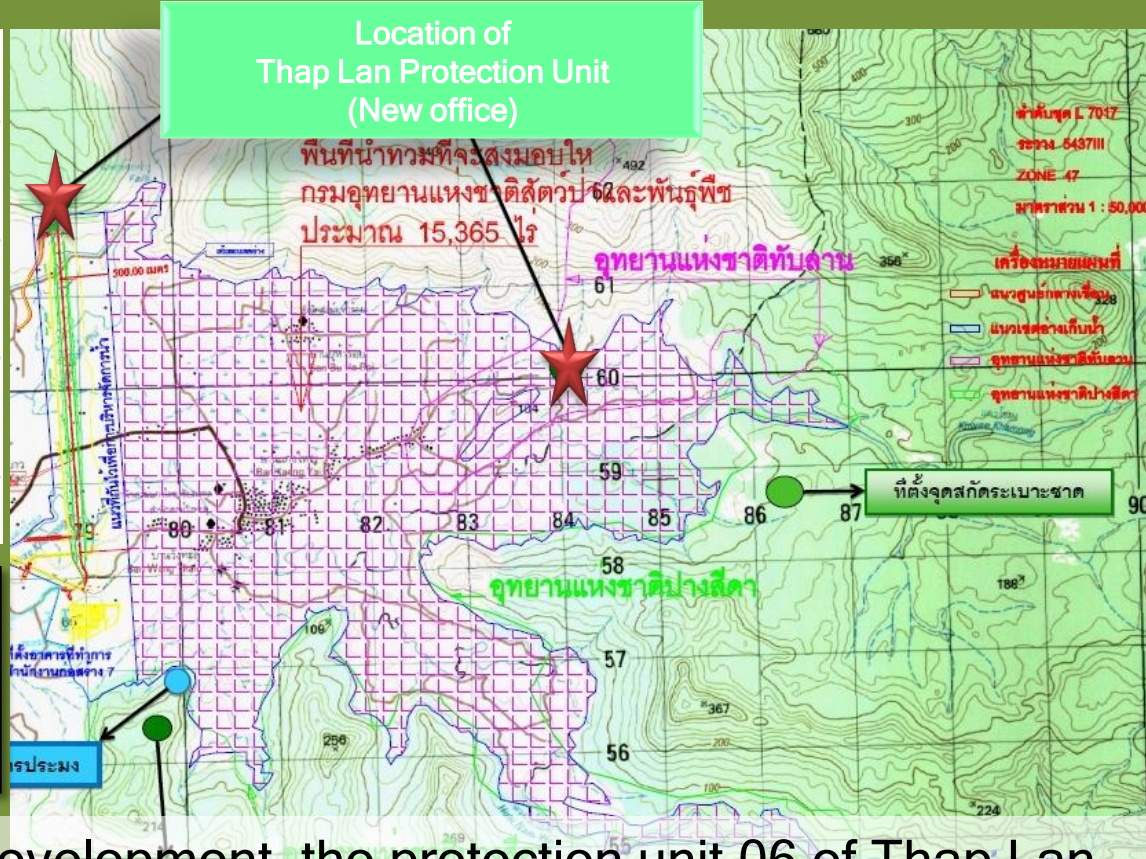
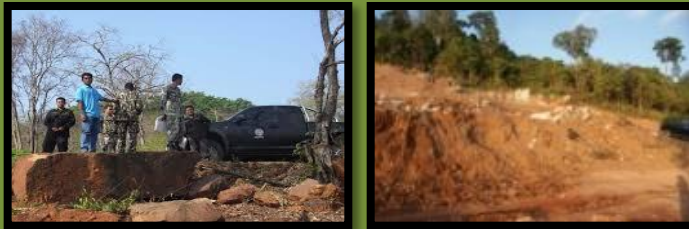
7. Training staff to improve the potential implementation 1 generation



8. Producing publicized media and guideline for environmental study of Huai Samong watershed

9. A camp on the world heritage conservation for children and Training for local people

Setting a Protection Unit of Thap Lan National Park

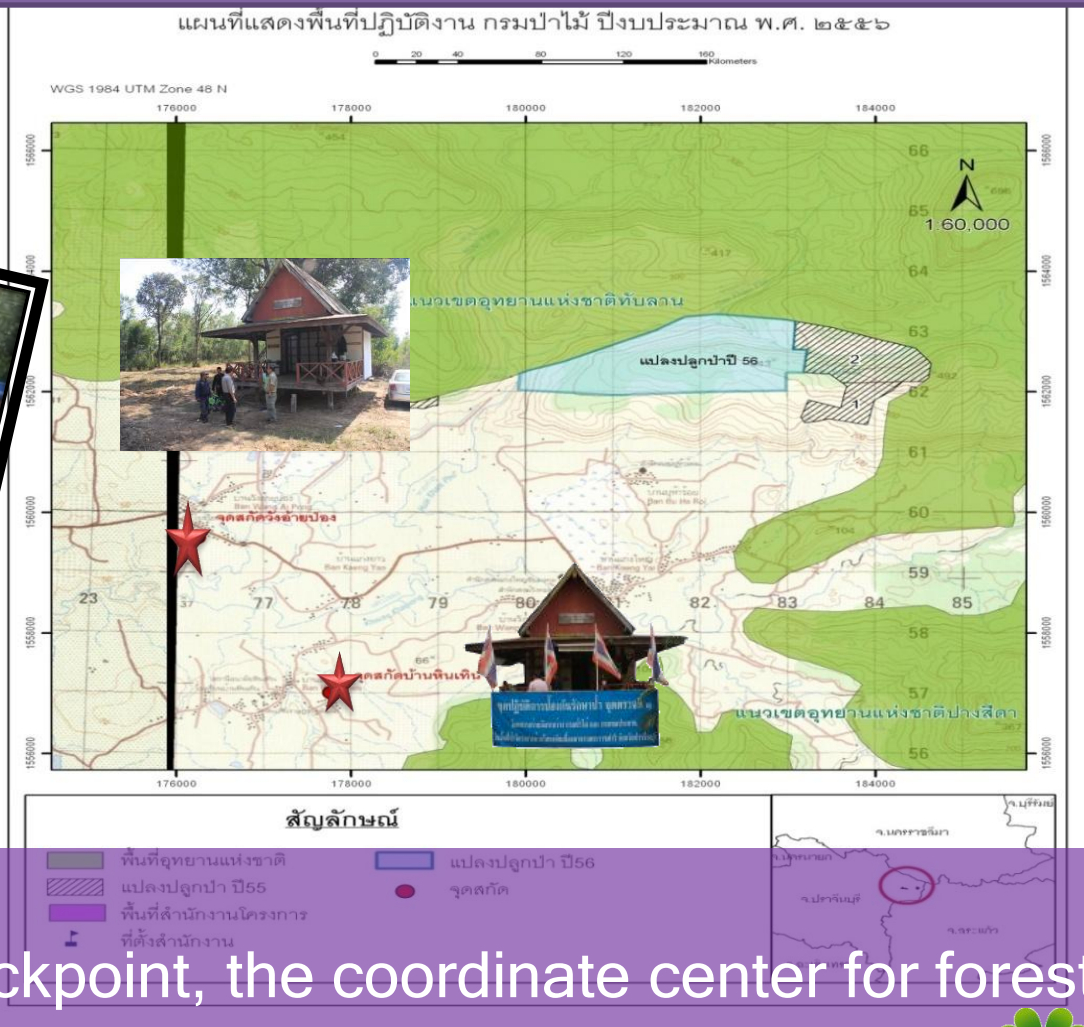


Setting a Protection Unit of Pang Sida National Park



Environmental Impact Prevention and Mitigation during the construction phase

Monitoring prevention of encroachment on reservoir and forest areas, and Reforestation



Royal Forestry Department

- Setting the protection checkpoint, the coordinate center for forest prevention, the patrol team

Environmental Impact Monitoring

Monitoring the implementation of Environmental Mitigation Plan and Environmental Monitoring plan

1. Monitor the implementation of related authorities followed EIMP

Held the meeting to monitor the implementation every 3 months



Follow up the progress every months in the field



2. Prepare the EIMP report twice a year and submit to ONEP



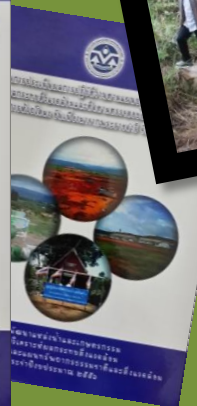
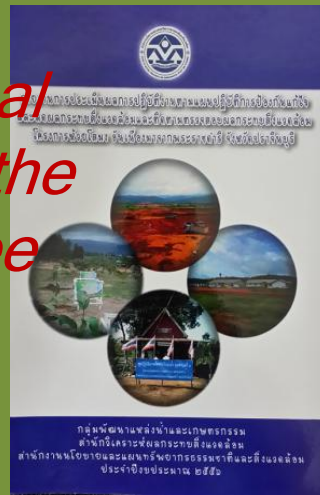
Environmental Impact Monitoring

Evaluating the implementation of Environmental Mitigation Plan and Environmental Monitoring plan

ONEP evaluates the implementation followed EIMP and analyze the trend of environmental impacts purposed to be minimized within 4 elements including:

1. Physical resources
2. Biological resources
3. Human Use Values
4. Quality of Life Values

And submit to the National Environment Board and the World Heritage committee in the next step.



Huai Samong Administration Committee

Public Relation Sub Committee

Land Acquisition and Resettlement Sub Committee

Environmental Monitoring Sub Committee

3. A mechanism to monitor the implementation of EIMP plan

RID monitor the implementation of EIMP

Held the meeting to review the implementation with responsible agencies

Follow up the progress

Follow up the progress every month in the field

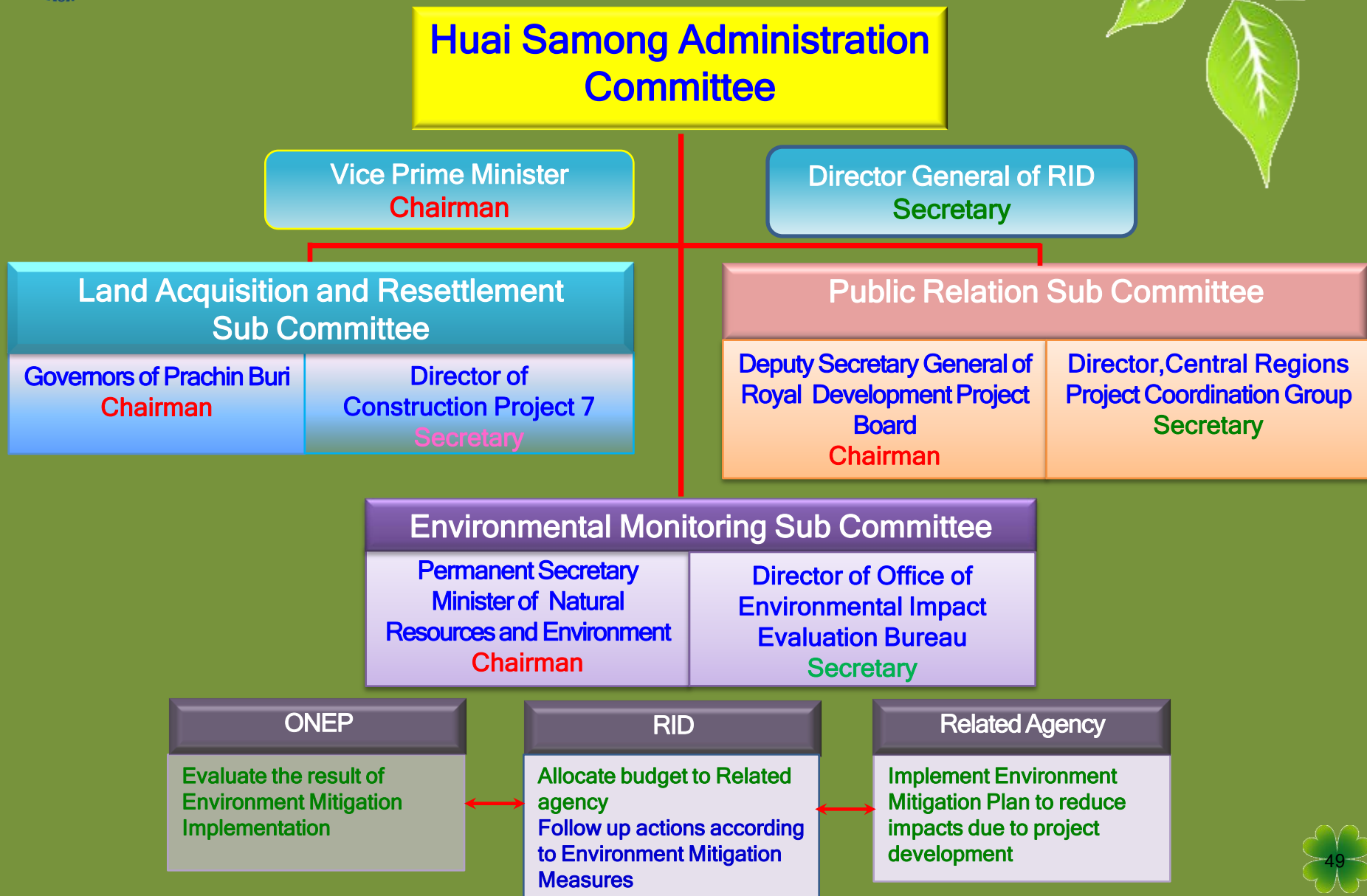
Held the meeting to review the implementation every 3 months

Prepare the EIMP report and submit to ONEP

ONEP evaluate the outcome of EIMP implementation

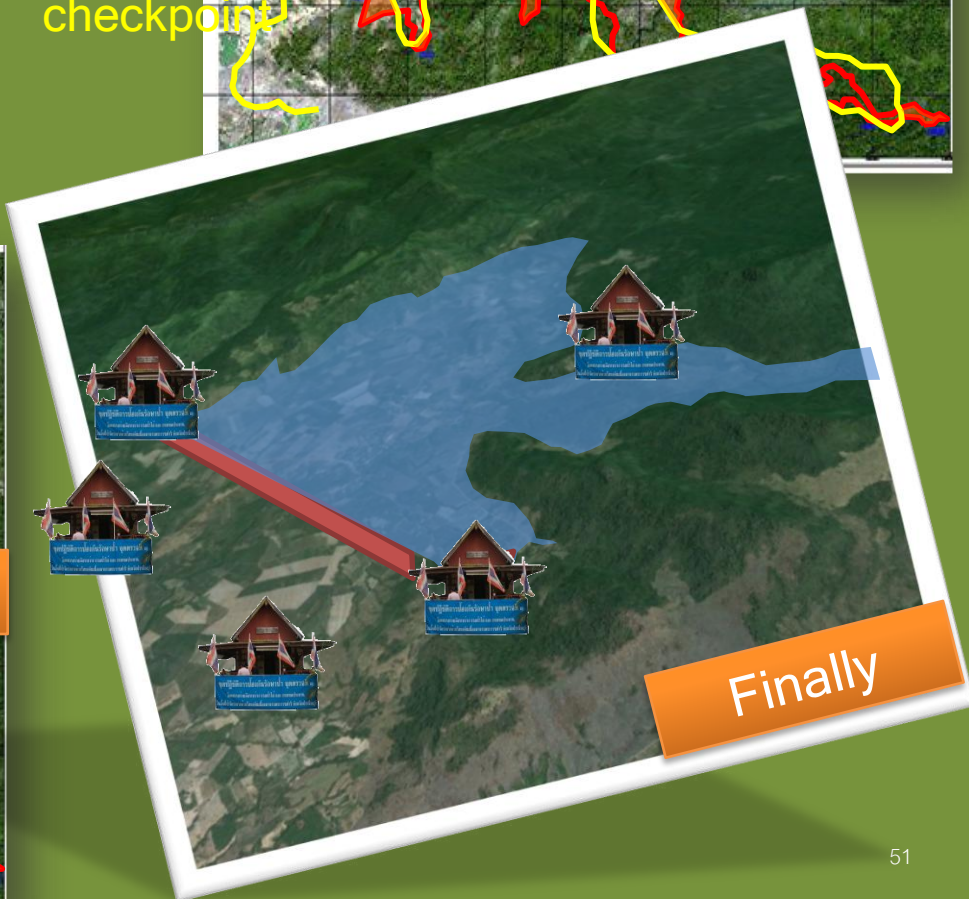
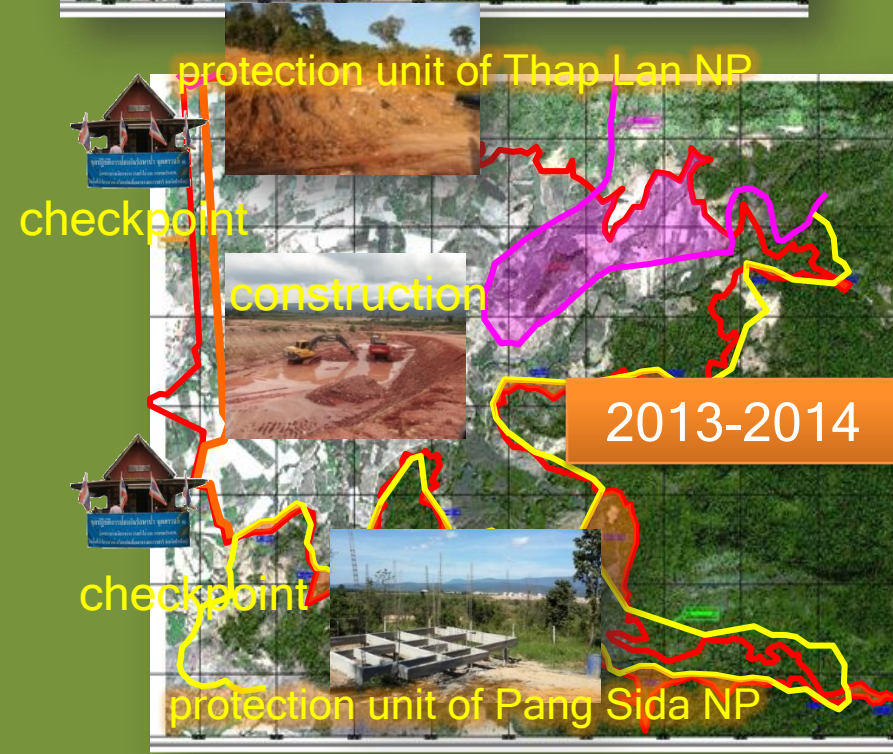
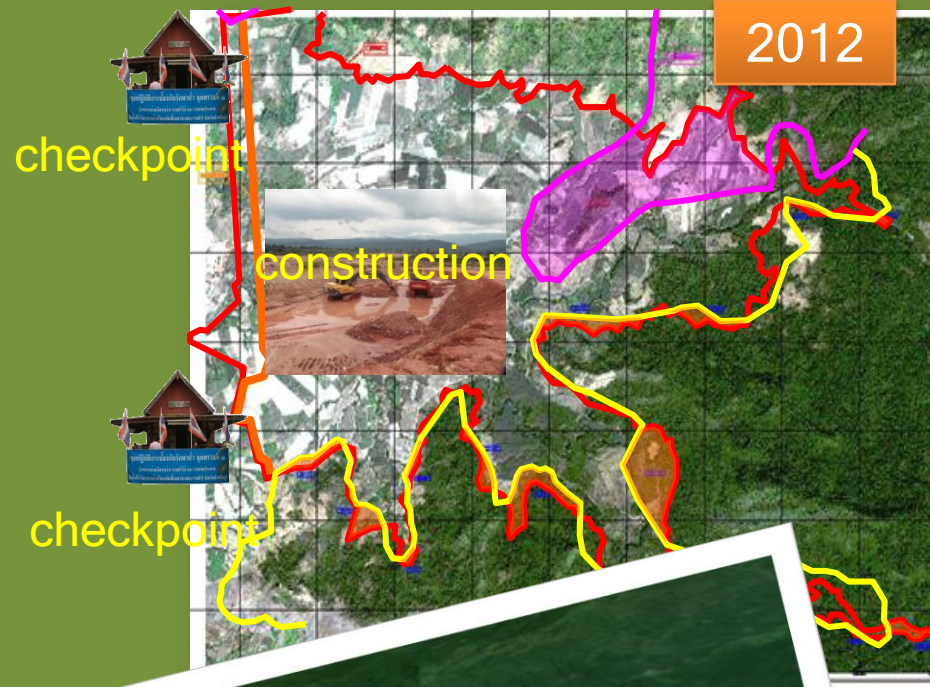
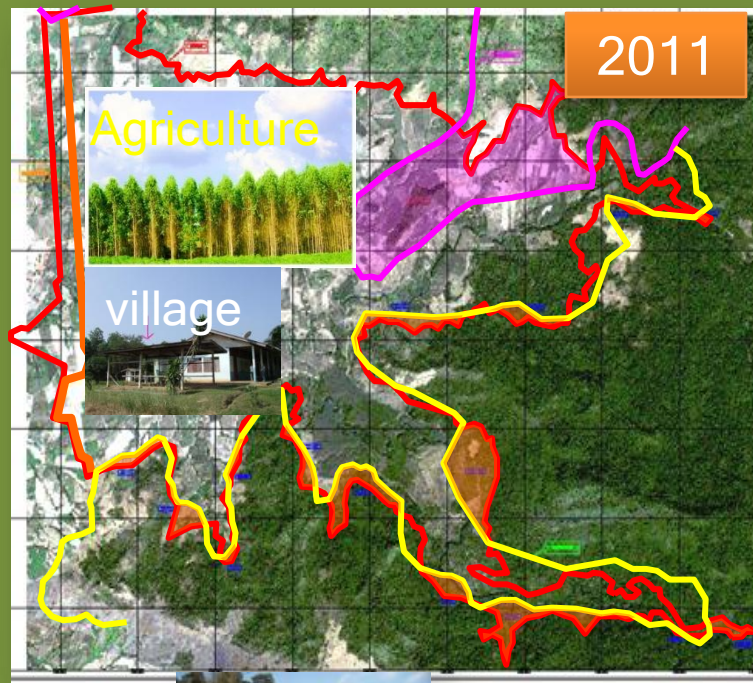


Effective Project Management



Conclusion

- Since 2011, RID conducted Hui Samong Project construction and strictly EIMP implementation with responsible agencies, *result to minimizing encroachment for residence and additional occupation purposes in the surrounding WHC's property* and nearby, as well as the restoration of the forest and ecosystem i.e. reforestation, weir construction
- RID strongly believe that the EIMP of Hui Samong Project is *effective and able to minimize the impacts from the construction* especially maintaining the Outstanding Universal value of WHC.
- RID still continually allocate budget to responsible agencies for implementing the EIMP until Year 2026, in total of 16 years.

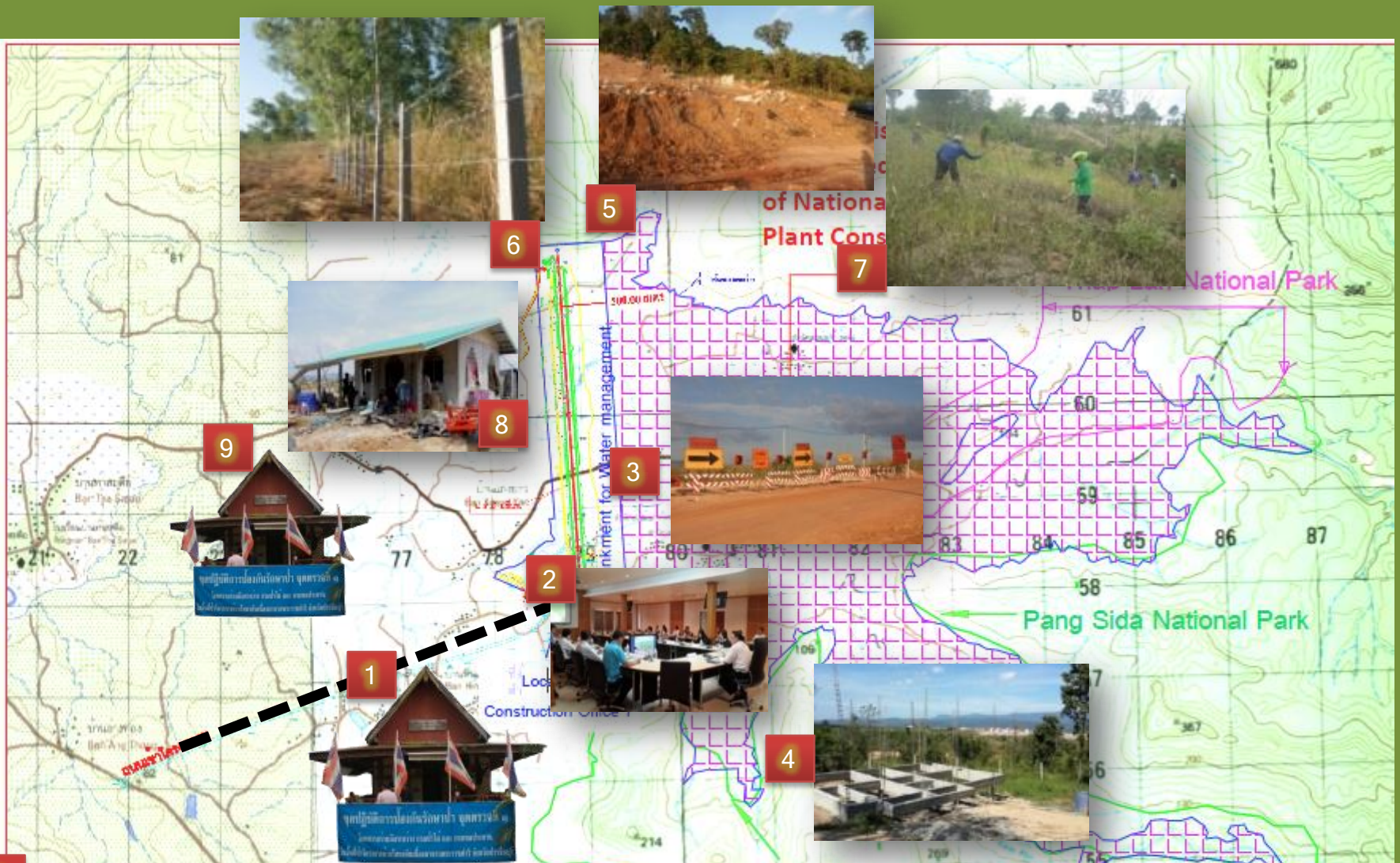


Schedule
Visiting Huai Samong project, Prachinburi Province
for IUCN staffs
January, 15 2014

Time	Program
08.00	Departure from the hotel to Huai Samong reservior and monitor the world heritage impact mitigation plan (checkpoint of Royal Forestry Department)
09.00	Briefing about Huai Samong reservior project <ul style="list-style-type: none">- the progress of construction- the result of EIMP implementation
10.00	<ul style="list-style-type: none">- Visit the headwork of project- Monitor the world heritage impact mitigation plan (setting the protection unit of Pang Sida national park)
12.00	Lunch at Huai Samong project area

Time	Program
13.00	<ul style="list-style-type: none"> - Monitor the world heritage impact mitigation plan setting the protection unit of Thap Lan national park - Survey Huai Samong reservoir area - Monitor the prevention and reforestation surrounding reservoir area plan (Reforestation and weir construction site) Thap Lan National Park - Monitor the prevention and reforestation surrounding reservoir area plan (Reforestation and weir construction site) Royal Forestry Department
14.30	Monitoring the affected people on migration
15.00	Departure to Kantary Hotel Kabinburi, Prachinburi Province





1 Monitoring prevention of encroachment on reservoir and forest areas, and Reforestation : *Forest Check point*

2 Briefing about Huai Samong Dam : *Ton Nam Meeting Hall*

3 Explore the Huai Samong Dam : *Construction Area*

4 EIMP: *Pang Si Da Protection Unit*

5 EIMP: *Thab Lan Protection Unit*

6 EIMP: *Protection NP by fencing*

7 EIMP: *Reforestation and Semi-permanent dam*

8 EIMP: *land resettlement*

9 EIMP: *Forest Check point*

Appendix C

Meeting and Site Surveys with Expert team from UNESCO and IUCN

(During 14-16 January 2013)



Visiting on the prevention and reforestation in the area surrounding reservoir, Royal Forest Department



Visiting on the prevention of reservoir area encroachment and forest restoration in the world heritage site, Royal Forest Department



Visiting on the establishment of new protection unit in Pang Sida National Park



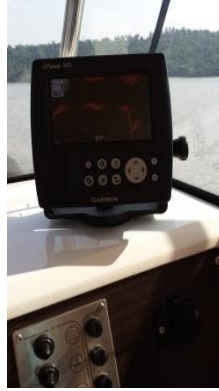
Visiting on the resettlement of affected people



Visiting on the prevention of reservoir area encroachment and forest restoration in the world heritage site, Thap Lan National Park



Visiting on the implementation of protection unit in Thap Lan National Park (Wong Thalu) which will be flooded



Patrol Boat of Huay Samong project to survey Lumpai reservoir related to the concern on livestock



The meeting on the implementation progress followed resolutions of the world heritage committee and recommendations of RM Mission 2012



The meeting with related agencies on the outcomes of visiting the world heritage site

(Dong Phrayayen – Kao Yai Forest Complex)