# Ⅳ FEASIBLITY STUDY

# CHAPTER 4
# ROAD IMPROVEMENT CONCEPT FOR ROUTE 14A

# CHAPTER 4 ROAD IMPROVEMENT CONCEPT FOR ROUTE 14A

## 4.1 Introduction

This chapter describe the road improvement concept for Route 14A, based on the survey results, i.e., road inventory, natural condition and hydrological survey, used for the environmental and economic for preliminary engineering design. (Table 4.1.3 summarizes the outline of Route 14A)

Route 14A starts from Ban Houay Phek, which is located 2.0 km west of Pakse Bridge, and ends at Ban Sukhuma the capital of Sukhuma District, meaning that the entire route is located in Champasack Province and is 59.75 km in survey length*. The characteristics of this route are as follows:

(i) Terrain is flat over the entire route.
(ii) The route passes through Champasack Town, which is the second largest town in the province.
(iii) Wat Phou and Champasack Ancient City are located along the route.
(iv) The 25 km Missing Link section is located in the northern part of the route.
(v) Flooding from the Mekong River has inundated around 35 km of the route and effective countermeasures are therefore crucial.

Traffic volumes (inter and intra-zonal trip) for the target year of 2020 are shown in Table 4.1.1. Based on the values contained in the table, it has been decided that this road should be a Class III road in the preliminary design.

**Table 4.1.1 Traffic Volume Forecast for Design 2020**

| Section | PCU (per day) |
|---|---|
| STA. 0+000 – STA. 34+500 | 2,017 |
| STA. 34+500 – STA. 59+750 | 1,494 |

The return period floodwater level to decide embankment height is 50 years.

Table 4.1.2 shows how the route is divided into sections to establish the improvement concept.

**Table 4.1.2 Sections to Consider Improvement Concept**

| Section | Survey STA. | to | Survey STA. | Survey Length (km) * |
|---|---|---|---|---|
| (1) | 0+000 | | 6+400 | 6.40* |
| (2) | 6+400 | | 25+000 | 18.60* |
| (3) | 25+000 | | 29+050 | 4.05* |
| (4) | 29+050 | | 35+800 | 6.75* |
| (5) | 35+800 | | 41+500 | 5.70* |
| (6) | 41+500 | | 43+000 | 1.50* |
| (7) | 43+000 | | 59+750 | 16.75* |
| Total | | | | 59.75* |

**Table 4.1.3 Summary of Route 14A**

| **Route** | **14 A** | **Road Length** | L = 59.75 km in Survey Length* |
|---|---|---|---|
| **Origin** | Ban Houay Phek (JCT. of Route 16) | **Destination** | Ban Sukhuma |
| **Surface Type :** Paved road 13.8 km, Gravel road 20.95 km, Missing link 25.0 km | | | |
| **Terrain Conditions :** This road runs through flat terrain with paddy fields. There are small villages along the road, especially some residences concentrated at the beginning of the missing link (25 km) section. In the Champasack town section, there are many houses along the existing road. | | | |
| **Road Condition :** The 25 km of the missing link is located at the section between JCT of Route 16 and Km post 25. The road surface between Km post 25 and Wat Phou (Km post 38.8) is pave road in fair to good condition with 5.0 m to 7.9 m width. The section between Km post 38.8 and 59.75 is a gravel road and has a width of 9.0m. The surface condition is fair. The average running speed is 50km/hr. | | | |
| **Crossing Conditions:** There are small to medium scale rivers without bridge, ranging from12 to70m in width in the missing section. In addition, 4 small rivers cross the existing road with a bailey bridge in the section after missing link. | | | |
| **Socio-economic Conditions:** This is the northern part of Route 14A and runs in Phonthong, Champasack, and Sukhuma Districts of Champasack Province. This route goes through a rice rich and densely populated area along the Mekong River. These three districts have considerable size of workforce in industrial and service sector. Wat Phou, a ruin of ancient Kumer civilization with World Heritage status, generate more some into this route. No significant problem is found with the social aspects of this area. | | | |

* The road length in this chapter is tentatively determined based on survey works. The design (preliminary design) will finalize the road length based on topographic map developed by the survey.

## 4.2 Road Alignment, Design and Alternatives

### 4.2.1 Section (1): STA.0+000 – STA. 6+400 (Survey Length = 6.40km)

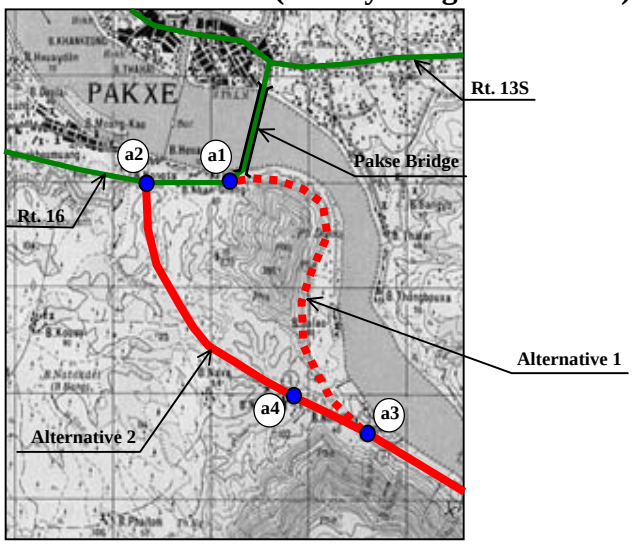


**Figure 4.2.1 Alternatives for STA.0+000 – STA.6+400**

There are two alternatives for this section. Alternative 1 (a1 – a3) is located on the east side of Mt. Phou Xala and was earlier proposed as national road Route 14A. Alternative 2 (a2 – a3), is on the west side of the mountain and is a former provincial road. The existing road width of Alternative 1 is from 1.0 to 1.5m and has been designated as "missing link" for motorized traffic. For Alternative 2, the width varies from 1.5 to 2.5m. However, the road surface (which is earth) is seriously deteriorated and it is impassable for motorized traffic during the rainy season. Therefore, Alternative 2 is also in practical terms a "missing link" for motorized traffic. Refer to Table 4.2.1 for a comparison of these 2 alternatives.

**Table 4.2.1 Comparison of Alternatives 1 & 2**

| Item | Alternative 1 (a1 – a3) | Alternative 2 (a2 – a3) |
|---|---|---|
| Proposed length | 6.6km | 6.4km |
| Outline of route | ・ Rocky surface<br>・ No road structure<br>・ New road construction necessary<br>**(Evaluation: C)** | ・ Rt. is former provincial road<br>・ Road structure exists up to a4 (STA.5+300)<br>・ Road surface seriously damaged<br>**(Evaluation: B)** |
| Current condition of roadside | ・ 1 village east of the Rt.<br>・ Small impact on regional development<br>・ Major land-use is forest<br>・ Land acquisition easy<br>・ Removal of residences unnecessary<br>**(Evaluation: B)** | ・ Many villages west of the Rt.<br>・ Large impact on regional development<br>・ Major of land-use are paddy & forest<br>・ Land acquisition easy<br>・ Removal of residences unnecessary<br>**(Evaluation: A)** |
| Road structure | ・ Countermeasures for flooding from Mekong River & mountain streams important<br>・ Proposed embankment height is 1 – 3m<br>**(Evaluation: C)** | ・ Partial countermeasures for flooding necessary<br>・ Proposed embankment height is 0 – 2.5m<br>**(Evaluation: B)** |
| Junction condition | ・ Alignment inadequate for junction<br>・ Too close to Pakse Bridge with | ・ Alignment adequate for junction<br>・ Junction intersects Rt.16 at a 90˚ angle |

| | | |
|---|---|---|
| | extremely small horizontal curvature radius<br>**(Evaluation: C)** | **(Evaluation: A)** |
| Bridge planning | 2 | 1 |
| Workability of Construction | ・ Excavation of rock necessary on mountainous section<br>・ Detour unnecessary<br>・ Land acquisition for temporary road easy<br>**(Evaluation: B)** | ・ Excellent workability due to level terrain<br>・ Detour unnecessary<br>・ Land acquisition for temporary road easy<br>**(Evaluation: A)** |
| Construction Cost | High<br>・ Special work necessary (rock excavation)<br>・ High embankment structure required<br>**(Evaluation: C)** | Low<br>・ No special work necessary<br>・ Low embankment structure acceptable<br>**(Evaluation: A)** |
| **Overall Evaluation** | **C** | **A** |

Note: Evaluation ranking is from A to C, with A being the highest or best score.

As a result of the above comparison, Alternative 2 is selected as the best alignment. The main reasons for this selection are summarized as follows:

(i) The proposed junction for Alternative 1 is inadequate due to the horizontal curvature radius being too small to meet the required design standards for preliminary design. For example, securing necessary sight distance is impossible.

(ii) Regarding construction cost, Alternative 1 is higher than Alternative 2 because of the special construction work required (i.e., rock excavation) and also because Alternative 1 has a larger volume of earthwork than Alternative 2 due to the higher embankment height.

(iii) There will be a larger positive impact on regional development in the case of Alternative 2 because of the many villages west area of the alignment.

Figure 4.2.2 shows a typical cross section for this route. Since there are no villages that border the route, a 1.0m shoulder width is applied.

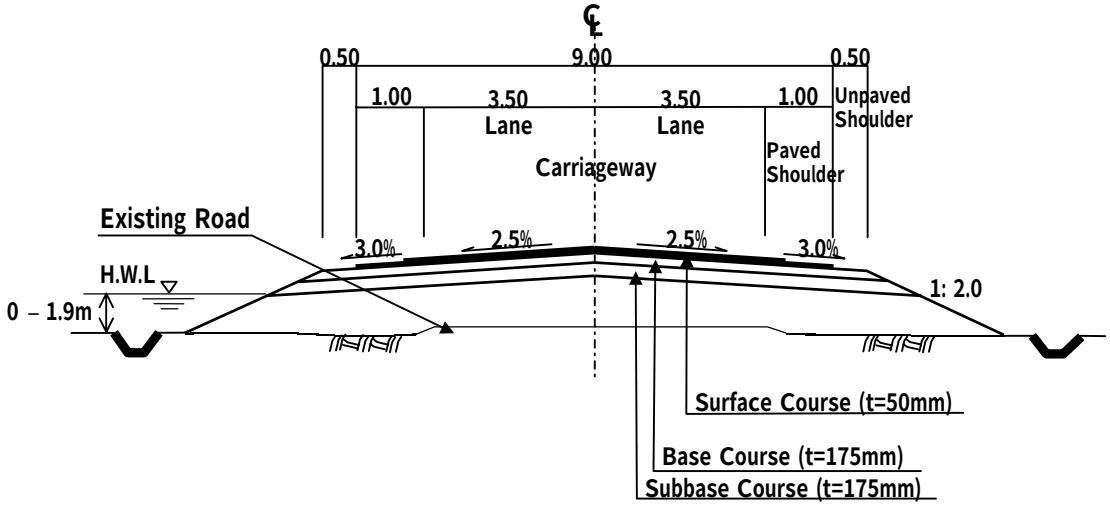


**Figure 4.2.2 Typical Cross Section for Alternative 2 (L = 6.40km)**

### 4.2.2 Section (2): STA. 6+400 – STA. 25+000 (Survey Length = 18.60km)

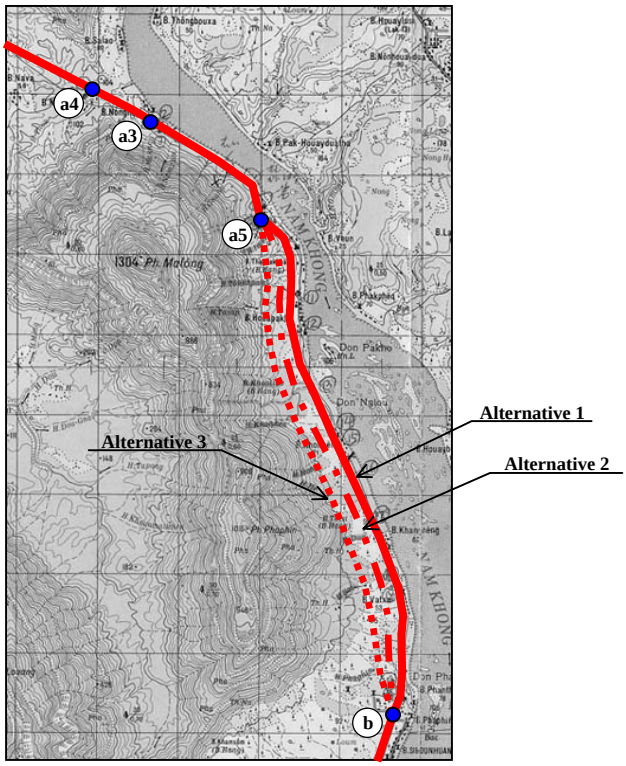


**Figure 4.2.3 Alternatives for STA. 6+400 – STA. 25+000**

There is no motorized traffic on this section at the moment. Village people along the route mainly utilize the Mekong for transport. Flooding from the Mekong sometimes poses a very serious problem with basic access for this section and flooding countermeasures need to be carefully considered. There are a large number of rivers and streams originating from Mt. Phou Malong. Therefore, it is important that there be planning for crossing drainage structures (i.e., box culverts, pipe culverts). Taking into account access to a new route, a role of the road and flooding, there are three possible alternative alignments. Table 4.2.2 compares the alternatives.

**Table 4.2.2 Comparison of Alternatives 1, 2 and 3**

| Item | Alternative 1 (a5 – b) | Alternative 2 (a5 – b) | Alternative 3 (a5 – b) |
|---|---|---|---|
| Proposed length | 13.8km / 18.6km (a3 – b) | 13.8km / 18.6km (a3 – b) | 13.8km / 18.6km (a3 – b) |
| Outline of route | ・Rt. located in paddy field behind villages<br>**(Evaluation: A)** | ・Rt. located btw. Mekong River & foot of mountain<br>・No villages along Rt.<br>**(Evaluation: B)** | ・Rt. at foot of mountain<br>・No villages along Rt.<br>**(Evaluation: C)** |
| Current condition of roadside | ・Major land-use is paddy field & forest<br>・Land acquisition easy<br>**(Evaluation: A)** | ・Major land-use is paddy field & forest<br>・Land acquisition easy<br>**(Evaluation: A)** | ・Major land-use is forest & bush<br>・Land acquisition easy<br>**(Evaluation: A)** |
| Social environment | ・Top priority according to interviews with villagers<br>・Good accessibility from villages<br>**(Evaluation: A)** | ・Second priority according to interviews with villagers<br>・Good accessibility from cultivated land<br>**(Evaluation: B)** | ・Lowest priority according to interviews with villagers<br>・Far from villages<br>**(Evaluation: C)** |

| | | | |
|---|---|---|---|
| Road structure | ・Proposed embankment height is 0 – 3.3m<br>・Large no. of pipe & box culverts<br>**(Evaluation: B)** | ・Proposed embankment height is 0 – 2.5m<br>・Large no. of pipe & box culverts<br>**(Evaluation: B)** | ・Cut section<br>・Large no. of pipe & box culverts<br>・No flooding issue<br>**(Evaluation: A)** |
| Bridge Planning | 13 bridges | 13 bridges | 13 bridges |
| Workability of Construction | ・Land acquisition for temporary road easy<br>・Excellent workability due to level terrain<br>**(Evaluation: A)** | ・Land acquisition for temporary road easy<br>・Excellent workability due to level terrain<br>**(Evaluation: A)** | ・Site clearance in mountain terrain necessary<br>・Land acquisition for temporary road easy<br>**(Evaluation: B)** |
| Construction Cost | Cost nearly the same for all 3 alternatives | | |
| **Overall Evaluation** | **A** | **B** | **B** |

Note: Evaluation ranking is from A to C, with A being the highest or best score.

As a result of the above comparison, the main reasons for the selection of Alternative 1 as the route with the highest priority are summarized as follows.

(i) Alternative 1 provides the best accessibility to and from villages and will therefore contribute to regional development.

(ii) According to interviews with villagers during a socioeconomic survey of the Study Team, Alternative 1 is a top priority.

(iii) Although a large volume of earthwork for embankments is necessary for Alternative 1 and 2, a significant amount of excavation work is necessary for Alternative 3. In fact, the amount of earthworks is nearly same for the 3 alternatives.

Figure 4.2.4 shows a typical cross section for this section. Shoulder width for sparsely populated sections is 1.0m and 2.0m for built-up sections.

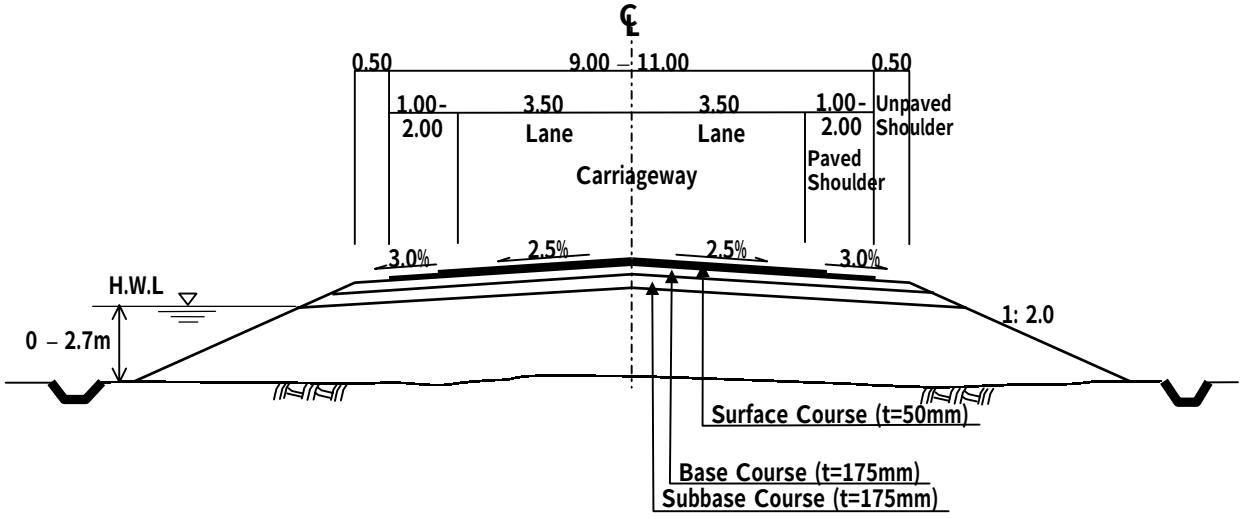


**Figure 4.2.4 Typical Cross Section for Alternative 1 (L = 18.6km)**

### 4.2.3 Section (3): STA. 25+000 – STA. 29+050 (Survey Length = 4.05km)

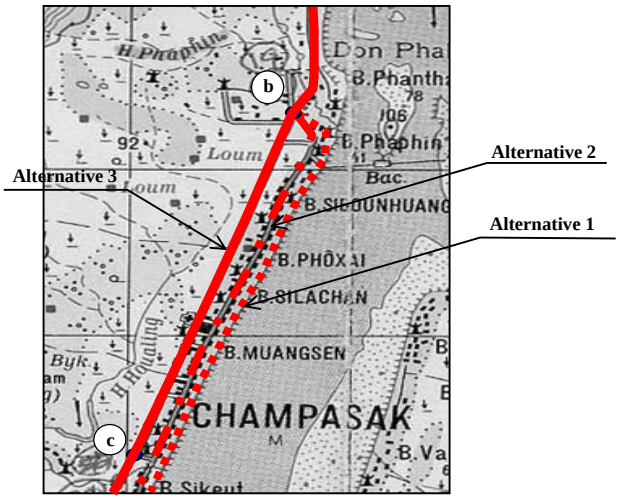


**Figure 4.2.5 Alternatives for STA. 25+000 – STA. 29+050**

This section goes through Champasack Town and there are three alternative alignments, including the improvement of the existing road. Table 4.2.3 contains a comparison of the alternatives.

**Table 4.2.3 Comparison of Alternatives 1, 2 and 3**

| Item | Alternative 1 (b – c) | Alternative 2 (b – c) | Alternative 3 (b – c) |
|---|---|---|---|
| Proposed length | 4.05km | 4.05km | 4.05km |
| Outline of route | ・Embankment road along Mekong River<br>・Useful for preventing flooding<br>・New road construction<br>**(Evaluation: C)** | ・Improvement of existing paved road (DBST) necessary<br>**(Evaluation: C)** | ・Improvement of existing farm road (earth surface) necessary<br>・Located 150m west of Alternative 2<br>**(Evaluation: A)** |
| Current condition of roadside | ・School, temple, houses are on alignment<br>・Necessary to remove large no. of buildings<br>・High land acquisition cost<br>・UNESCO planning scenic area in this part of town.<br>**(Evaluation: C)** | ・Schools, temples, houses are along road without clearance<br>・Necessary to remove large no. of buildings including temples & schools<br>・High land acquisition cost<br>・UNESCO planning scenic area in this part of town.<br>**(Evaluation: C)** | ・Major land-use is paddy field (2km) & residential (2km)<br>・Houses needing removal few<br>・Low land acquisition cost<br>・Public buildings to locate along Rt.<br>・<br>**(Evaluation: A)** |
| Road structure | ・Proposed embankment height is 1 – 2m<br>・Revetment of river bank necessary<br>**(Evaluation: C)** | ・Proposed embankment height is 1 – 2m<br>・Embankment divides town into east & west portions<br>**(Evaluation: C)** | ・Proposed embankment height is 2.5 – 3.6m from surface of paddy field<br>**(Evaluation: B)** |
| Bridge Planning | 1 | 1 | 1 |
| Workability of construction | ・Work in built-up area (revetment of river bank & road construction)<br>・Land acquisition for temporary road difficult new construction<br>**(Evaluation: C)** | ・Construction work in built-up area<br>・Land acquisition for temporary road difficult<br>・Alternative 3 is for detour expanding existing road<br>**(Evaluation: C)** | ・Excellent workability due to level terrain<br>・Land acquisition for temporary road easy<br>・Alternative 2 is used for existing detour road<br>**(Evaluation: A)** |
| Construction | High | Middle | Low |

| | | | |
|---|---|---|---|
| Cost | ・Revetment work of river bank<br>・High land acquisition cost<br>**(Evaluation: C)** | ・High land acquisition cost<br>**(Evaluation: B)** | ・Low land acquisition cost<br>・Easy workability<br>**(Evaluation: A)** |
| **Overall Evaluation** | **C** | **C** | **A** |

Note: Evaluation ranking is from A to C, with A being the highest or best score.

As a result of the above comparison, the main reasons for Alternative 3 being selected as the alignment with the highest priority are summarized as follows:

(i) A large number of buildings, including temples and schools, would have to be removed in the case of either Alternative 1 or 2.

(ii) The embankment of Alternative 2 will physically separate the town into east and west portions.

(iii) There is a school on the alignment of Alternative 2. Also, if the alignment shifts to avoid the school, many houses will have to be removed.

(iv) Therefore, it is proposed that Alternative 2 remain as a local community road and Alternative 3 be improved to a national arterial road. This will promote efficient regional development.

Figure 4.2.6 shows a typical cross section on this route. Shoulder width for sparsely populated sections is 1.0m and 2.0m for built-up sections.

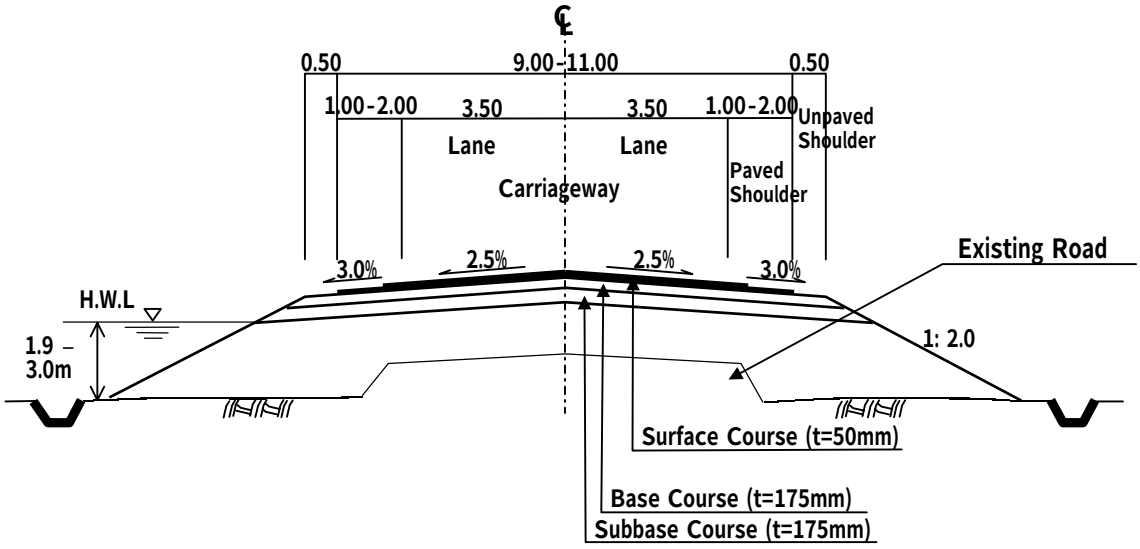


**Figure 4.2.6 Typical Cross Section for Alternative 3 (L = 4.05km)**

### 4.2.4 Section (4): STA. 29+050 – STA. 35+800 (Survey Length = 6.75km)

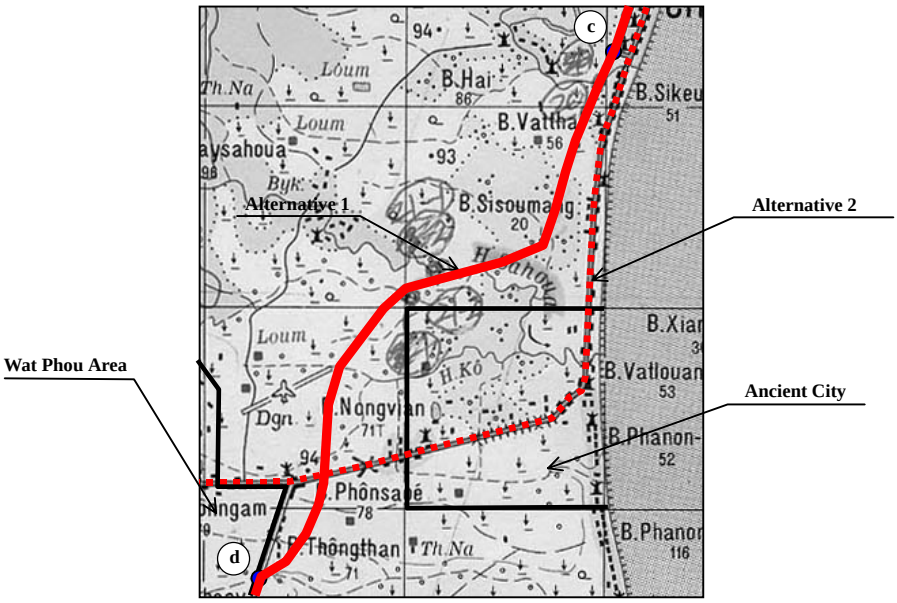


**Figure 4.2.7 Alternatives for STA. 29+050 – STA. 35+800**

There are two large-scale historic sites; namely, Champasack Ancient City and the Wat Phou Preservation Area on this section. The latter has been designated as a "World Heritage Site" by UNESCO. There are two alternative alignments for this section. Alternative 1 avoids these areas, while Alternative 2 utilizes existing Route 14A that runs through the middle of the Ancient City. Table 4.2.4 shows a comparison of the 2 alternatives.

**Table 4.2.4 Comparison of Alternatives 1 and 2**

| Item | Alternative 1 (c – d) | Alternative 2 (c – d) |
|---|---|---|
| Proposed length | 6.75km | 7.2km |
| Outline of route | • New road construction avoids Ancient City Area<br>• Connects with existing road after passing behind populated town section near Jct. with Wat Phou Rd.<br>**(Evaluation: A)** | • Improvement of existing Rt. 14A<br>• Current road surface is DBST<br>• Rt. is in the middle of Ancient City<br>**(Evaluation: C)** |
| Current condition of roadside | • Land-use is paddy field<br>• No villages<br>• Low land acquisition cost<br>**(Evaluation: A)** | • Land-use is paddy field & residential<br>• Removal of houses necessary due to widening<br>• Land acquisition cost is higher than Alternative 1<br>• Road construction will cause damage to heritage site<br>**(Evaluation: C)** |
| Road structure | • Proposed embankment height is 0 – 4m<br>• Afforestation will interfere with road structure<br>**(Evaluation: B)** | • Proposed embankment height is 0 – 3m<br>• Afforestation will interfere with road structure<br>• Speed limitation through the route shall be required to avoid an affect of vibration from vehicles to remains under the ground.<br>**(Evaluation: B)** |

| Bridge Planning | 2 | 1 |
|---|---|---|
| Workability of Construction | ・ Land acquisition for temporary road easy<br>・ Excellent workability due to no house being along Rt.<br>**(Evaluation: A)** | ・ Land acquisition for temporary road & detour difficult<br>・ Difficult workability due to being inside of Ancient City<br>**(Evaluation: C)** |
| Construction Cost | Low<br>・ Low land acquisition cost<br>**(Evaluation: A)** | High<br>・ High land acquisition cost<br>・ Special precautions necessary to protect heritage site<br>**(Evaluation: C)** |
| **Overall Evaluation** | **A** | **C** |

Note: Evaluation ranking is from A to C, with A being the highest or best score.

As a result of the above comparison, the main reasons for selecting Alternative 1 as the alignment with the highest priority are summarized as follows:

(i) Although Alternative 2 consists of improving an existing road, the road runs through the middle of the Ancient City area. As a result, serious negative damage to the area from construction work is predicted.

(ii) No removal of houses is necessary along Alternative 1.

(iii) It is proposed that Alternative 2 remain as a local community road and that Alternative 1 be improved to a national arterial road, as this will promote desirable regional development

Figure 4.2.8 shows a typical cross section for this section. Since there are no villages along the route, a shoulder width of 1.0m is applied.

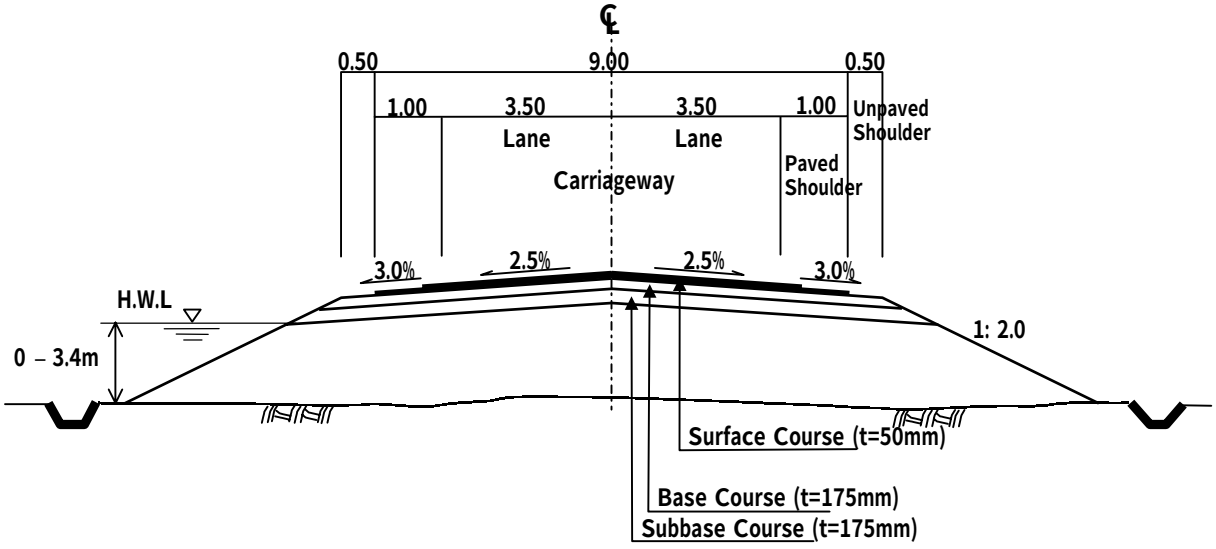


**Figure 4.2.8 Typical Cross Section for Alternative 1 (L = 6.75km)**

### 4.2.5 Section (5): STA. 35+800 – STA. 41+500 (Survey Length = 5.70km)

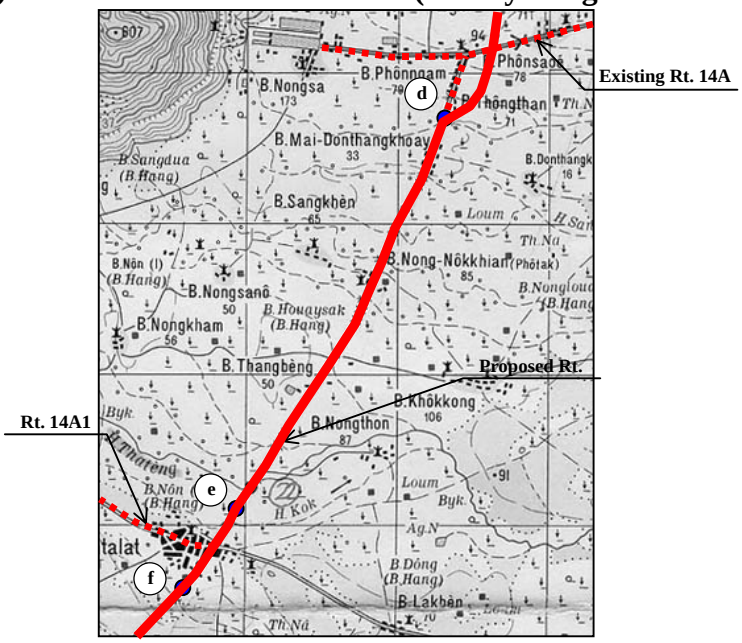


**Figure 4.2.9 Proposed Route in STA. 35+800 – STA. 41+500 (d – e)**

The existing road has a large horizontal curvature radius and the vertical gradient is also gentle. Therefore, improvement of the existing road is proposed. However, inundation has often occurred in the west side of the existing road in rainy season. Due to a lack of sufficient flow capacity of transverse drainage facilities along the section, the inundated water sometimes overflows the road or rapid flow causes souring the embankment. In fact, one road section was flushed away when the pipe culvert at that position lost its flow capacity due to blockade by debris and a temporary bridge was installed in 2002.

Consequently, an appropriate road elevation should be set while considering sufficient flow capacity of transverse drainage facilities. Since road width of the existing road is approximately 10m, widening can be minimized.

Figure 4.2.10 shows a typical cross section for this section. Shoulder width is to be 1.0m on rural sections and 2.0m on built-up sections.

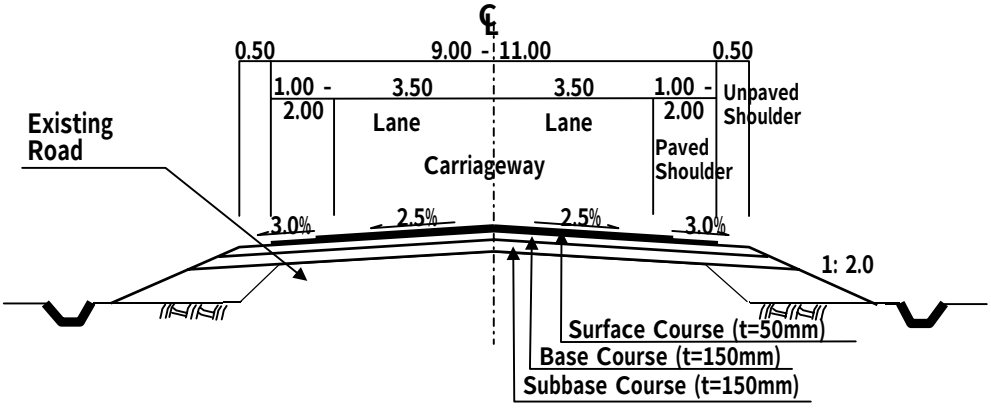


**Figure 4.2.10 Typical Cross Section for Proposed Route (L = 5.70km)**

### 4.2.6 Section (6): STA. 41+500 – STA. 43+000 (Survey Length = 1.50km)

The section goes through the populated village "Ban Dontalat" and a large number of houses border the road without any clearance. Considering compensation for the moving, there are 2 alternatives including by-pass route. Table 4.2.5 shows comparison of them.

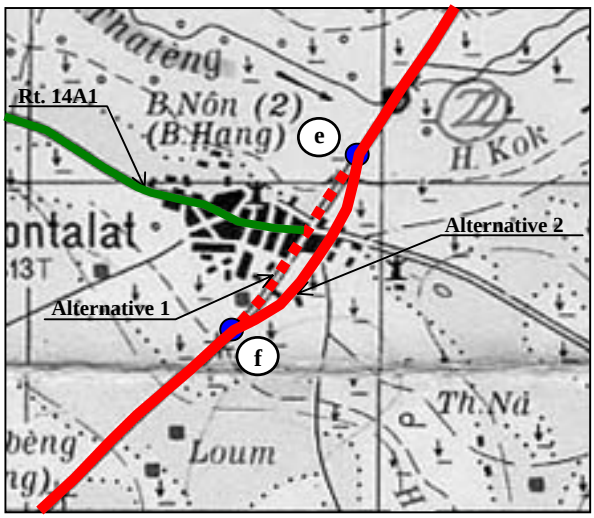


**Figure 4.2.11 Alternatives for STA. 41+500 – STA. 43+000**

**Table 4.2.5 Comparison of Alternatives 1 and 2**

| Item | Alternative 1 (e – f) | Alternative 2 (e – f) |
|---|---|---|
| Proposed length | 1.5km | 1.7km |
| Outline of route | ・ Improves existing road<br>・ Large no. of buildings border road without clearance<br>**(Evaluation: C)** | ・ Utilizes village road located on 150m east side of existing road<br>・ By-pass route<br>・ Some houses along Rt.<br>**(Evaluation: B)** |
| Current condition of roadside | ・ Removal of large no. of buildings due to widening<br>・ High land acquisition cost<br>**(Evaluation: C)** | ・ Some houses should be removed<br>**(Evaluation: B)** |
| Road structure | ・ Small volume of earthworks<br>・ Parking lot is necessary for local market<br>**(Evaluation: B)** | ・ Embankment height is 1 – 1.5m in paddy field<br>**(Evaluation: B)** |
| Bridge Planning | 0 | 0 |
| Effect of the project | ・ Impact on development of roadside area<br>・ Removal of large no. of shops<br>**(Evaluation: B)** | ・ Impact on development of whole region<br>**(Evaluation: A)** |
| Workability of construction | ・ Construction work in built-up area<br>・ Land acquisition for temporary road difficult | ・ Density of housing is lower than Alternative 1<br>・ Land acquisition for temporary road difficult |

| | (Evaluation: C) | (Evaluation: B) |
|---|---|---|
| Construction Cost | High<br>・ High land acquisition cost<br>**(Evaluation: C)** | Low<br>・Land acquisition cost is lower than Alternative 1<br>**(Evaluation: B)** |
| **Overall Evaluation** | **C** | **B** |

Note: Evaluation ranking is from A to C, with A being the highest or best score.

As a result of the above comparison, the main reasons for selecting Alternative 2 as the alignment with the highest priority are summarized as follows:

(i) To improve Alternative 1, a large number of residences must be removed.

(ii) It is proposed that Alternative 1 remain as a local community road and that Alternative 2 be improved as a national arterial road. This will promote efficient regional development.

Figure 4.2.12 shows a typical cross section for this route. Shoulder width is 1.0m on rural sections and 2.0m on populated sections.

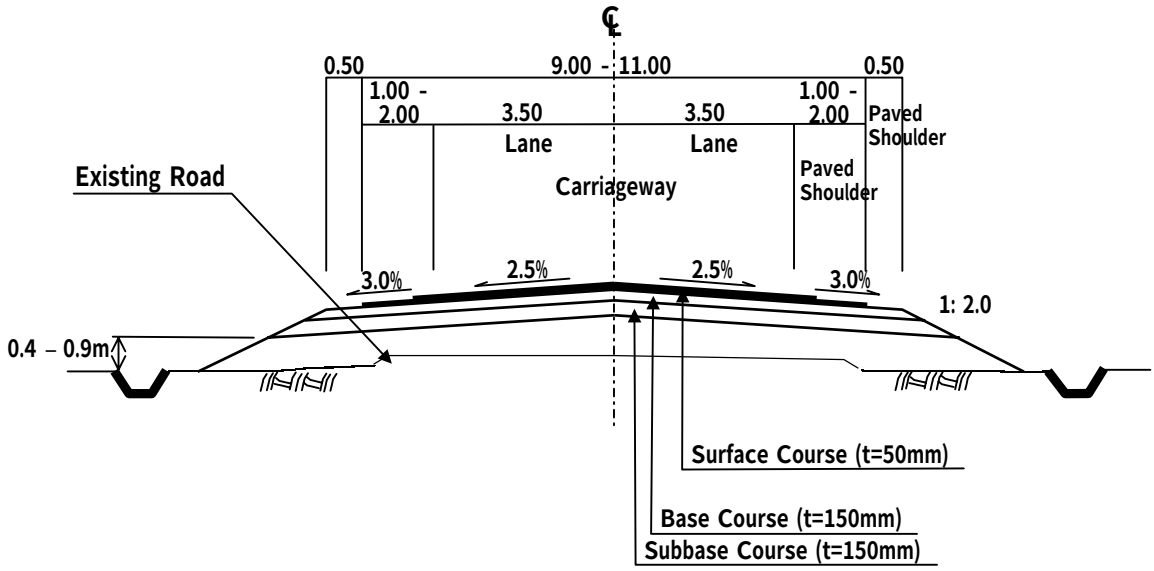


**Figure 4.2.12 Typical Cross Section for Alternative 2 (L = 1.70km)**

### 4.2.7 Section (7): STA. 43+000 – STA. 59+750 (Survey Length = 16.75km)

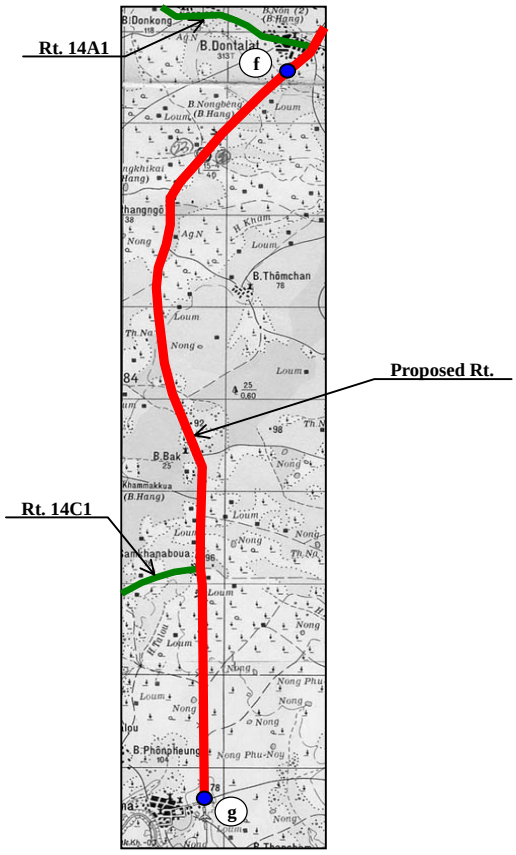


**Figure 4.2.13 Proposed Route for STA. 43+000 – STA. 59+750 (f – g)**

The existing road has a large horizontal curvature radius and a vertical gradient that is also gentle. Therefore, improvement of the existing road is proposed. Since there has been no flooding in the past, the existing road structure will be utilized as a sub-grade. Since existing road width is approximately 10m, little widening work is required.

Figure 4.2.14 shows a typical cross section for this route.

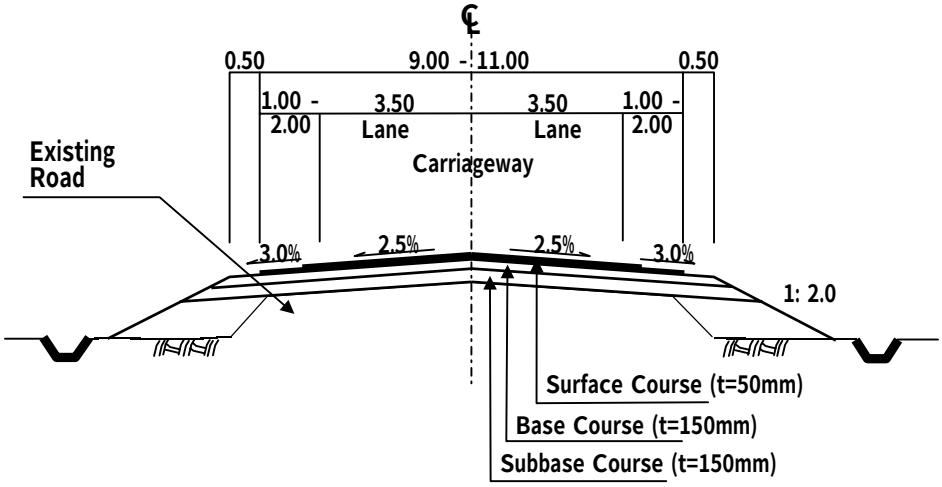


**Figure 4.2.14 Typical Cross Section for STA. 43+000 – STA. 59+750 (L = 16.75km)**

## 4.3 Bridge and Structure

There are 25 rivers and streams to be examined for crossing structure. All rivers and streams can be categorized as small to medium sized with a relatively small catchment area. Most of the rivers have backwater affect from the Mekong in the rainy season, and the high water levels are dominated by the water level of the Mekong.

A bridge or culvert may be the applicable structure type for rivers, which have more than 5m width. From the economic point of view, 10m structural length is the turning point for selecting a bridge or culvert. However, river characteristics are also an important factor in the select; or. In consideration of these aspects, the selection of a bridge type can be undertaken with the following criteria.

- Where there is a existing bridge on the candidate river, a bridge type shall be applied as a new crossing structure
- To have more than 10m of an average channel width at the proposed crossing point. A channel width at adjacent up and downstream sides should be considered.
- To have relatively high river depth, more than around 3m, between riverbed and its bank. A culvert at the deep river shall be economically not feasible.
- To have a catchment area with approximately more than 3 $km^2$.

As a result of application of these criteria to the candidate rivers, a bridge structure is appropriate at 14 crossing points. The selection result is described in Table 4.3.1.

**Table 4.3.1 Structural Type at Each Candidate River**

| No | River Name | Km post | Existing Bridge | | | | River Conditions | | | | Structure Type |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L(m) | Width(m) | No. of Span | Br. Type | Width(m) | HWL(m) | Catchment Area (km2) | Effect of back water of Mekong | |
| 1 | Huay Thok | 5+330 | - | - | - | - | 22 | 6.0 | 9.6 | Yes | Bridge |
| 2 | Huay Maknao | 7+450 | - | - | - | - | 5 | 1.0 | 0.8 | No | Culvert |
| 3 | Huay Namxam | 7+950 | - | - | - | - | 8 | 1.5 | - | Yes | Culvert |
| 4 | No Name | 8+450 | - | - | - | - | 5 | 1.0 | 0.9 | No | Culvert |
| 5 | No Name | 9+50 | - | - | - | - | 5 | 1.0 | 1.6 | No | Culvert |
| 6 | Huay Gnang | 9+380 | - | - | - | - | 6 | 1.0 | 1.2 | No | Culvert |
| 7 | No Name | 9+480 | - | - | - | - | 8 | 1.0 | 1.1 | No | Culvert |
| 8 | Huay Imet | 11+140 | - | - | - | - | 25 | 3.0 | 4.6 | Yes | Bridge |
| 9 | Hauy Kaunam | 11+400 | - | - | - | - | 8 | 1.0 | - | No | Culvert |
| 10 | Huay Khao dam | 12+120 | - | - | - | - | 8 | 4.4 | - | Yes | Culvert |
| 11 | Huay Thakhong | 13+420 | - | - | - | - | 15 | 5.0 | 4.6 | Yes | Bridge |
| 12 | Huay Tabxan | 14+325 | - | - | - | - | 30 | 4.7 | 3.5 | Yes | Bridge |
| 13 | Hauy Khone liao | 15+820 | - | - | - | - | 20 | 6.0 | 1.5 | Yes | Culvert |
| 14 | Huay Khonken | 16+810 | - | - | - | - | 30 | 9.0 | 3.2 | Yes | Bridge |
| 15 | Huay Hong | 18+075 | - | - | - | - | 15 | 9.0 | 3.4 | Yes | Bridge |
| 16 | Huay He | 18+760 | - | - | - | - | 25 | 8.5 | 3.1 | Yes | Bridge |
| 17 | Huay Dua | 19+890 | - | - | - | - | 15 | 5.5 | 0.8 | Yes | Culvert |
| 18 | Huay Sai | 21+160 | - | - | - | - | 50 | 7.0 | 6.6 | Yes | Bridge |
| 19 | Huay Phaphin | 24+010 | - | - | - | - | 15 | 7.0 | 6.0 | Yes | Bridge |
| 20 | Huay Phabang | 29+020 | - | - | - | - | 50 | 7.0 | 22.5 | Yes | Bridge |
| 21 | Huay Sahoua | 31+715 | - | - | - | - | 35 | 7.0 | 20.0 | Yes | Bridge |
| 22 | Huay Kok | 32+140 | - | - | - | - | 8 | 4.1 | 6.4 | Yes | Bridge |
| 23 | No Name | 39+600 | 18.5 | 3.5 | 1 | Bailey | 8 | 2.0 | - | No | Culvert |
| 24 | Huay Thateng | 40+035 | 18.5 | 3.9 | 1 | Bailey | 18 | 2.7 | 11.5 | No | Bridge |
| 25 | Huay Manpha | 45+040 | 24.5 | 4.5 | 1 | Bailey | 24 | 2.5 | 15.0 | No | Bridge |

## 4.4 Outline of Road Improvement Project

The total length of the proposed route is 59.95km, subject to change during the preliminary design. Improvement approach, major work items and measures to mitigate negative impact to be studied are as shown in Table 4.4.1. Preliminary design has undertaken on this basis.

**Table 4.4.1 Improvement Approach by Section**

| Section | Survey STA. | To | Survey STA. | Length (km) | Improvement Approach | Major Work Items | Issues to be Studied in the Design Stage |
|---|---|---|---|---|---|---|---|
| (1) | 0+000 | | 6+400 | 6.40 | Improvement of existing Rd. | ・ Embankment<br>・ Pavement<br>・ Junction with Rt. 16 | ・ Countermeasures for flooding<br>・ Provide access Rd. to villages |
| (2) | 6+400 | | 25+000 | 18.60 | New Rd. construction | ・ Embankment<br>・ Pavement<br>・ Crossing drainage structures | ・ Countermeasures for flooding |
| (3) | 25+000 | | 29+050 | 4.05 | Improvement of existing Rd. | ・ Embankment<br>・ Pavement | ・ Countermeasures for flooding |
| (4) | 29+050 | | 35+800 | 6.75 | New Rd. construction | ・ Embankment<br>・ Pavement | ・ Countermeasures for flooding<br>・ Afforestation |
| (5) | 35+800 | | 41+500 | 5.70 | Improvement of existing Rd. | ・ Widening of pavement<br>・ Improvement of transverse drainage facilities | ・ Sufficient flow capacity of transverse drainage facility |
| (6) | 41+500 | | 43+000 | 1.70 | Improvement of village Rd. | ・ By-pass construction (embankment)<br>・ Pavement | ・ |
| (7) | 43+000 | | 59+750 | 16.75 | Improvement of existing Rd. | ・ Widening of pavement | ・ |
| Total | | | | 59.95 | | | |