



LAO PEOPLE'S DEMOCRATIC REPUBLIC

Peace Independence Democracy Unity Prosperity

MINISTRY OF PUBLIC WORKS AND TRANSPORT

DEPARTMENT OF TRANSPORT

Vientiane Sustainable Urban Transport Project (VSUTP)

**BIDDING DOCUMENT FOR
PROCUREMENT OF
WORKS**

PACKAGE : CW1E Traffic Signaling

Volume 2

PART II SCHEDULE OF SUPPLY

Section 6 - Schedule of Supply

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List of Goods and Related Services

Lot No. : One				
Lot Name : CW1E – Traffic Signaling				
Item No.	Name of Goods or Related Services	Description	Unit of Measurement	Quantity
1	Supply of Traffic Signaling Equipment	As per manufacturer's standards and as per given below specification	As specified	As Specified in the BoQ
2	Installation of Traffic Signaling Equipment and Modification of Existing Equipment	As per technical specifications and requirements given below	As specified	As specified in the BOQ
3	Manufacturer's recommended spare parts and tools	As per manufacturer's standard as per given below specification	As specified	As specified in the BOQ
4	Related Services	As per technical specifications and requirements given below	As specified	As specified in the BOQ

Delivery and Completion Schedule

The delivery period shall start at contract signing

Item No.	Description of Goods	Delivery Schedule (Duration)	Location CIP (named place of destination)	Required Arrival Date of Goods
1	Supply of Traffic Signaling Equipment	3 months	Vientiane, Lao PDR ⁽¹⁾	Not Later than 30 August 2023
2	Installation of Traffic Signaling Equipment and Modification of Existing Equipment	9 months after delivery	Vientiane, Lao PDR	Not Later than 30 May 2024
3	Manufacturer's recommended spare parts	12 months	Vientiane, Lao PDR	Not Later than 30 May 2024
4	Related Service	As per technical specifications and requirements given below	Vientiane, Lao PDR	As per requirements stated below

⁽¹⁾CIP (named place of destination) is:

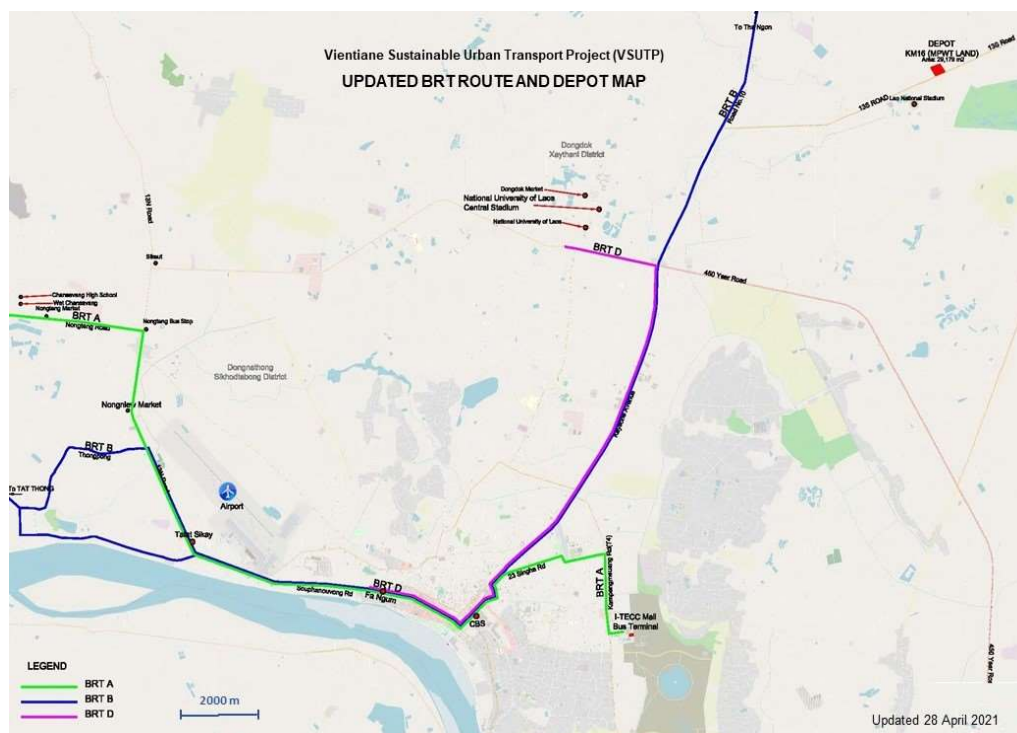
Ministry of Public Works and Transport
 Department of Public Works and Transport of Vientiane Capital
 Setthathirat Road, Khao Ngot Village, Sisattanak District,
 Vientiane Capital, Lao PDR

PREAMBLE

Project Description

The Vientiane Sustainable Urban Transport Project (VSUTP) will finance the construction of 12.9 kilometers of BRT bus-exclusive lanes and 27 BRT stations forming the BRT Corridor. The layout of the BRT corridor is represented on the location map below by the BRT Route D running from Fa Ngum Park to National University of Laos (purple line). BRT route A and Route B extend outside the corridor.

The BRT buses will run in bus-exclusive lanes strictly reserved for the express buses (BRT) with the exception of officials and emergency services (police, fire brigade, ambulances). The BRT lanes are mostly laid out in the road median away from regular traffic on the busy side lanes. Traffic segregation will be by concrete kerbs, which prevents vehicles from intruding but allows the BRT buses to exit from the bus lane in case of emergency. BRT buses are given priority at traffic intersections.



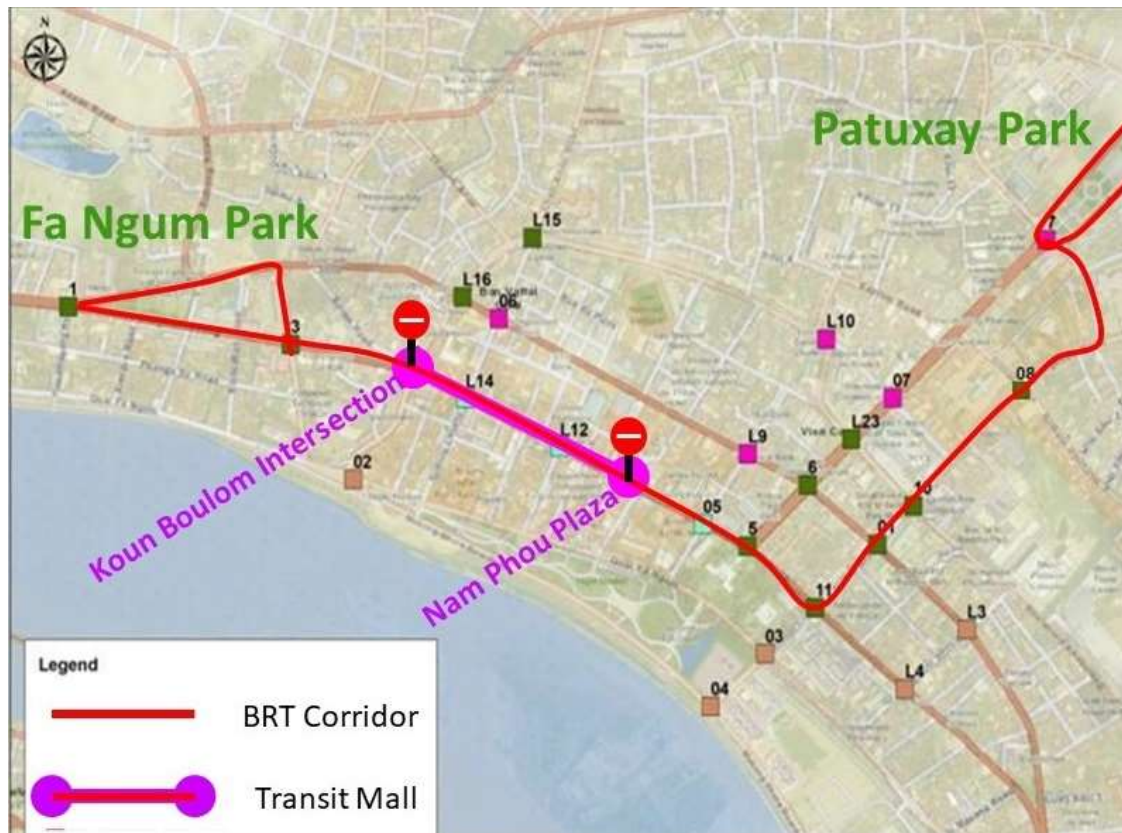
This document provides the Technical Specifications for implementation of the Vientiane Sustainable Urban Transport Project (VSUTP) under the Urban Transport Management Section (UTMS) of the Department of Public Works and Transport (DPWT) of Vientiane Capital and deals with the supplies and services for the Package CW1E – Traffic Signaling. While this Contract package is under the Department of Transport (DOT) of Ministry of Public Works and Transport (MPWT), Traffic management in Vientiane is under the responsibility of DPWT and UTMS in particular for the BRT corridor.

This package is for the supply, installation, testing, commissioning, training and spare parts for the new traffic signal system to be installed to regulate the traffic along the BRT corridor and in the environs of the corridor.

The scope of supply includes the Traffic Signaling equipment design, manufacture in factory, transport and installation on site, including any civil engineering works required for installation, testing, commissioning including provision of documentation, training of operators on maintenance of the equipment, supply spare parts and assistance during the warranty period for the traffic signals and related equipment.

Transit Mall

A 600 m section of the BRT Corridor located in a popular downtown area will be reserved to non-motorized vehicle, pedestrian and BRT Buses only.



This one-way section of Setthathirath Road running from West to East will be permanently closed to the normal traffic of motorcycles, cars and lorries. The West-to-East traffic will be diverted to parallel roads (Koun Boulom and quay Fa Ngum), while the East-to-West traffic stays along Samsenthai Road. Of particular note, a one-hour daily window from 6:00 a.m. to 7:00 a.m. will be allowed for delivery trucks in the Transit Mall. These vehicles would need to secure a sticker-permit from the UTMS. Furthermore, the delivery vehicles will only be allowed to stop at the station for not more than 3 minutes if a BRT bus is in queue.

BRT Priority System

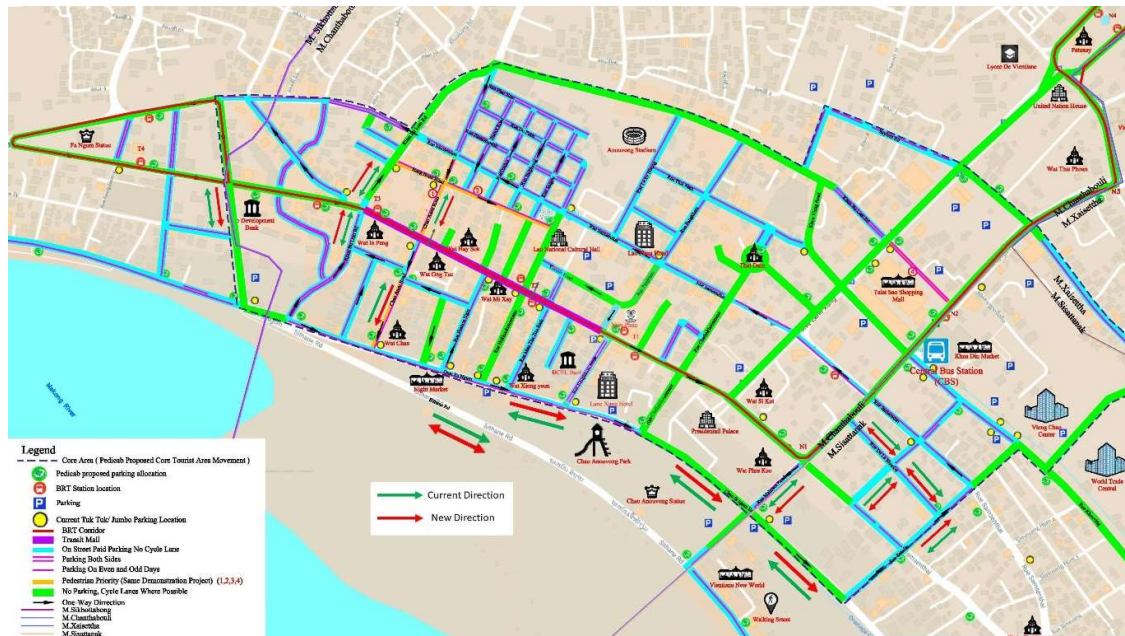
The new traffic signal system will provide priority to BRT buses at every traffic-signalized junction by means of pre-emptive system. Standard traffic loops will be embedded in the pavement of the BRT exclusive lanes and integrated with the signal controller. The transmitters fitted under the BRT busses will be detected by the standard traffic loop as the BRT bus is approaching, this will be transmitted to the signal controller that will interrupt normal traffic control cycle to give priority to BRT.

The BRT Bus priority system is a distributed Transit Signal Priority (TSP) system i.e., implemented at individual intersections instead of an entire street system. All priority decisions are made at the intersection level. In other words, there is no need for a priority request generator at a centralized management location, neither a strategy for prioritizing requests, nor an overall TSP management system to manage the priority traffic lights.

This requires only a system aboard transit vehicles. In this type of system, the transit vehicle itself delivers a request for priority each time it approaches an intersection (with BRT exclusive lane, there is no risk of confusion of priority vehicles).

New Traffic Management Plan

A Traffic Model has been developed to assess the impact of the closure of the transit mall to the general traffic. To accommodate the diverted traffic a new traffic management plan is proposed based on the modelling results. The proposed plan is designed to alleviate traffic congestion in the adjacent roads. This requires changes of direction of some of the one-way roads in the Vientiane core area.



Changes of direction of some of the one-way roads are proposed in Vientiane core area to provide alternative routes to the transit mall. The transit mall is currently East-bound one-way street.

- Traffic direction on Quai Fa Ngum will revert to Eastbound (red arrow).
- Sithane Road (Mekong waterfront) will be changed to two-way traffic.
- Souphanouvong road traffic to the north will turn left into Koun Boulom.
- Souphanouvong road traffic to the south will turn right into Sithane road, through Quai Fa Ngum.
- Traffic from the east is undisturbed using either Samsenthai, Koun Boulom or Mekong waterfront.
- Sakarin Road from Quai Fa Ngum to Samsenthai will be one-way northbound

SCOPE OF WORK

The scope of work under this contract includes 16 new traffic signals at intersections of the BRT corridor currently deprived from any traffic signal. The configuration and phasing of the new traffic signaled intersections are described in these technical specifications and will integrate the BRT bus pre-emptive system providing priority to the BRT Buses.

In addition, the scope of work includes the modification of 12 existing traffic signals located along the BRT corridor alignment, which have to be replaced according to the specified configuration including BRT bus pre-emptive system as referred to above for the new traffic signals. All existing traffic signals located along the BRT corridor, except for No 25, shall be replaced by complete brand-new equipment. The existing traffic signaling equipment to be replaced along the BRT corridor shall be thoroughly dismantled and stored at the disposal of the client.

The scope of the BRT Priority System will include the supply and installation of the Transmitters to be fitted underneath the BRT buses to trigger the traffic signals to green for BRT upon approaching of the buses. The Transmitters being part of the BRT priority system must be installed by the Contractor in the buses upon delivery in Vientiane. They will be tested and accepted together with the traffic signals. There is need for 55 units + 8 spares.

Due to the updated Traffic Management Plan for Vientiane Core area, adapted to the new BRT system, further works are required outside the BRT corridor. The contract includes the supply and installation of traffic signals at 8 intersections currently deprived from any traffic lights and the modification of 5 existing traffic signals within the environs of the BRT corridor in the Vientiane core area. The existing traffic signals outside the BRT corridor that need to be modified can be reused.

Summary of the Scope of Work

Type	Status	No. Intersections		
		New	Modified	Total
Pre-emptive	New	16		16
	Existing to be replaced	12		12
Total Pre-emptive		28		28
Non pre-emptive	New	8		8
	Existing to be modified		5	5
Total non-preemptive		13		13
Grand Total		41		41

Detailed inventory of Intersections being part of the scope of work and proposed solutions

Code No	Type	Status	Location	Proposed Solution
1	Pre-emptive	New	Setthathirath/Samsenthai	3 Phase (U-Turn, pedestrian crossings, free two ways)
2	Pre-emptive	New	Samsenthai/Sithane	Special BRT - Permanent Green - BRT Triggered Red
3	Pre-emptive	Existing	Sithane / Setthathirath	Existing Traffic Lights to be replaced (2 Phases)
4	Pre-emptive	Existing	Khun Bu Lom / Setthathirath	Existing Traffic Lights to be replaced (2 Phases)
5	Pre-emptive	Existing	Lane Xang / Setthathirath	Existing Traffic Lights to be replaced (2 Phases)
6	Outside Corridor	Existing	Lane Xang / Samsenthai	Phasing to be modified
7	Pre-emptive	Existing	Lane Xang / Patuxay	Existing Traffic Lights to be replaced (4 Phases)
8	Pre-emptive	Existing	Asean Road / Kaysone Phomvihane	Existing Traffic Lights to be replaced (2 Phases)
10	Pre-emptive	Existing	Khouvieng/Nongbone	Existing Traffic Lights to be replaced (2 Phases)
11	Pre-emptive	Existing	Setthathirath/ Mahosot Road	Existing Traffic Lights to be replaced (2 Phases)
12	Pre-emptive	Existing (x2)	Kaysone Phomvihane /Kamphengmeuang (12) & Phomphanao Phontong (12A)	Existing Traffic Lights at both intersections to be replaced (2& 3 Phases) and synchronized
U-turn1	Pre-emptive	New	Kaysone Phomvihane Km 3+450	2 Phases (Through traffic and U-turn)
13	Pre-emptive	Existing	Kaysone Phomvihane/Nongnieng	Existing Traffic Lights to be replaced (2 Phases)
U-turn2	Pre-emptive	New	Kaysone Phomvihane Km 5+250	2 Phases (Through traffic and U-turn)
U-turn3	Pre-emptive	New	Kaysone Phomvihane Km 6+500	2 Phases (Through traffic and U-turn)
14	Pre-emptive	Existing	Kaysone Phomvihane/450 - Dongdok Rd	Existing Traffic Lights to be replaced (3 Phases)

U-turn4	Pre-emptive	New	450 Year Road km 7+805	2 Phases (Through traffic and U-turn)
17	Pre-emptive	New	Setthathirath/Chao Anou	Transit Mall crossing with BRT priority
18A	Pre-emptive	New	Setthathirath/Francois Ngin/Hom 2	Transit Mall crossing with BRT priority
18	Pre-emptive	New	Setthathirath / Nokeokoummane	Transit Mall crossing with BRT priority
18B	Pre-emptive	New	Setthathirath/Manthathourath	Transit Mall crossing with BRT priority
19	Pre-emptive	New	Setthathirath / Pangkham	3 Phases (Pangkham North, South, pedestrian)
19A	Pre-emptive	New	Setthathirath / Brunei Embassy Way in/out	Special manually controlled blinking warning light
20	Pre-emptive	New	Setthathirath / Chanthakoummane	3 Phase (West-East & Left turn, North-South, South-North)
21	Pre-emptive	New	Samsenthai/Nongbone	2 Phases – No left turn
23	Pre-emptive	Existing	Nongbone Road/Saylom (Dongpalane) Road	Existing Traffic Lights to be replaced (3 Phases)
24	Pre-emptive	New	Nongbone/Road-link to Patuxay	3 Phase (Left turn, Through and Pedestrian)
25	Non-preemptive	Existing	Patuxay/23 Singha Road	Mixed Traffic - Two Phase traffic lights to be modified
27	Non-preemptive	New	Kaysone Phomvihane/Lounalath	2 Phase - No left turn
29	Outside Corridor	Existing	Khun Bu Lom / Samsenthai	Change of Traffic Directions - time split adjustment
30	Outside Corridor	New	Chao Anou/ Samsenthai	New Traffic Light to be provided
31	Outside Corridor	Existing	Lane Xang / Khou Vieng	Reduction to 3 phases, to be modified
34	Outside Corridor	New	Sithane / Quai Fa Ngum	New Traffic Light to be provided
35	Outside Corridor	New	Mahosot / Mekong Waterfront	New Traffic Light to be provided
36	Outside Corridor	New	Mahosot / Quai Fa Ngum	New Traffic Light to be provided
37	Outside Corridor	New	Sakarine / Samsenthai	New Traffic Light to be provided
38	Outside Corridor	New	Sakarine / Setthathirath	New Traffic Light to be provided
39	Outside Corridor	New	Samsenthai / Chanthakoummane	New Traffic Light to be provided
40	Outside Corridor	Existing	Kounboulom/Kouvieng	Phasing to be modified
49	Pre-emptive	New	Dongdok Village / 450 Year Rd	New two-phase traffic lights to be provided

A description of each intersection and the design requirements can be found in Annex 1.

Figure 2 overleaf Present the location of the Intersections

Figure 2 – Traffic Signals Location Map (Central Corridor)

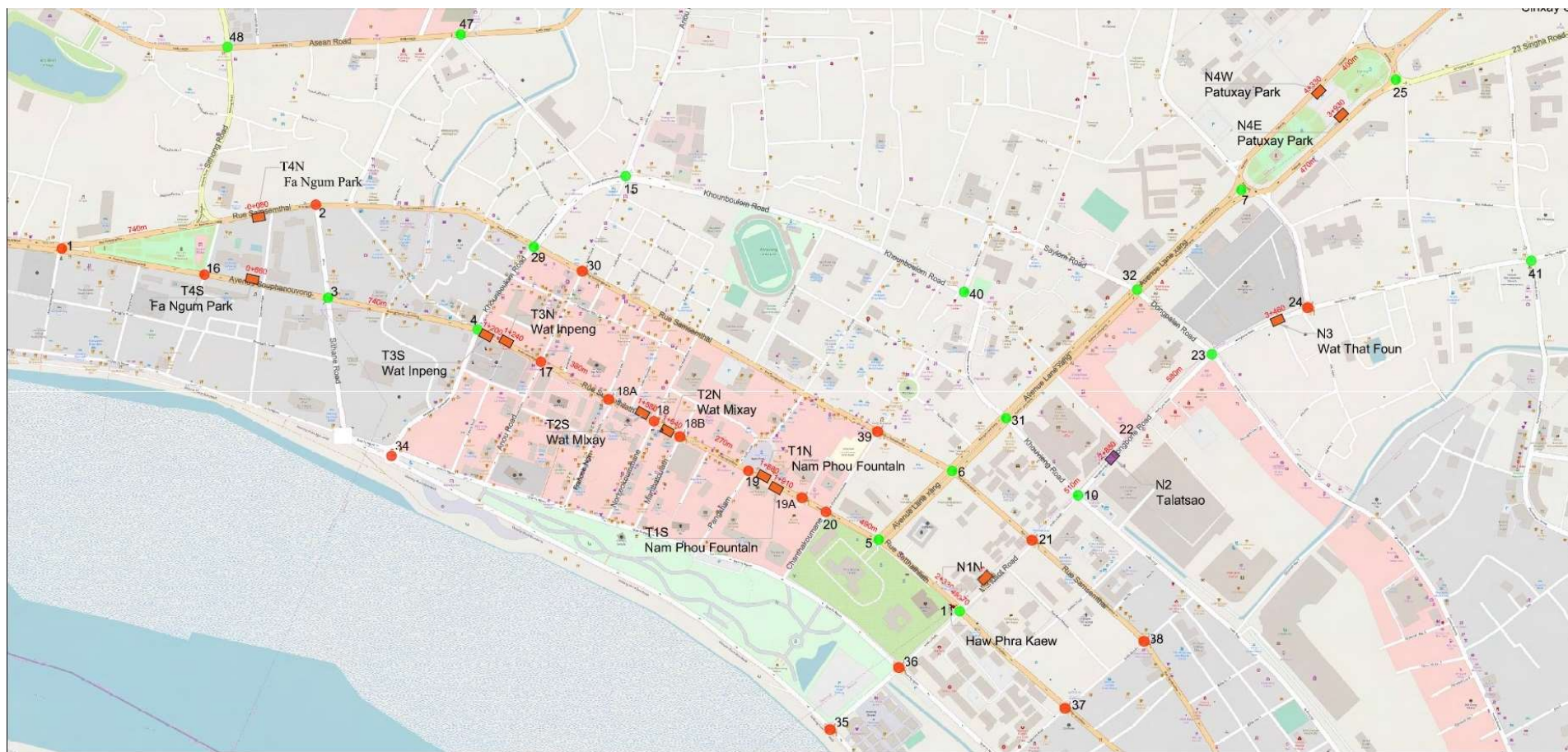
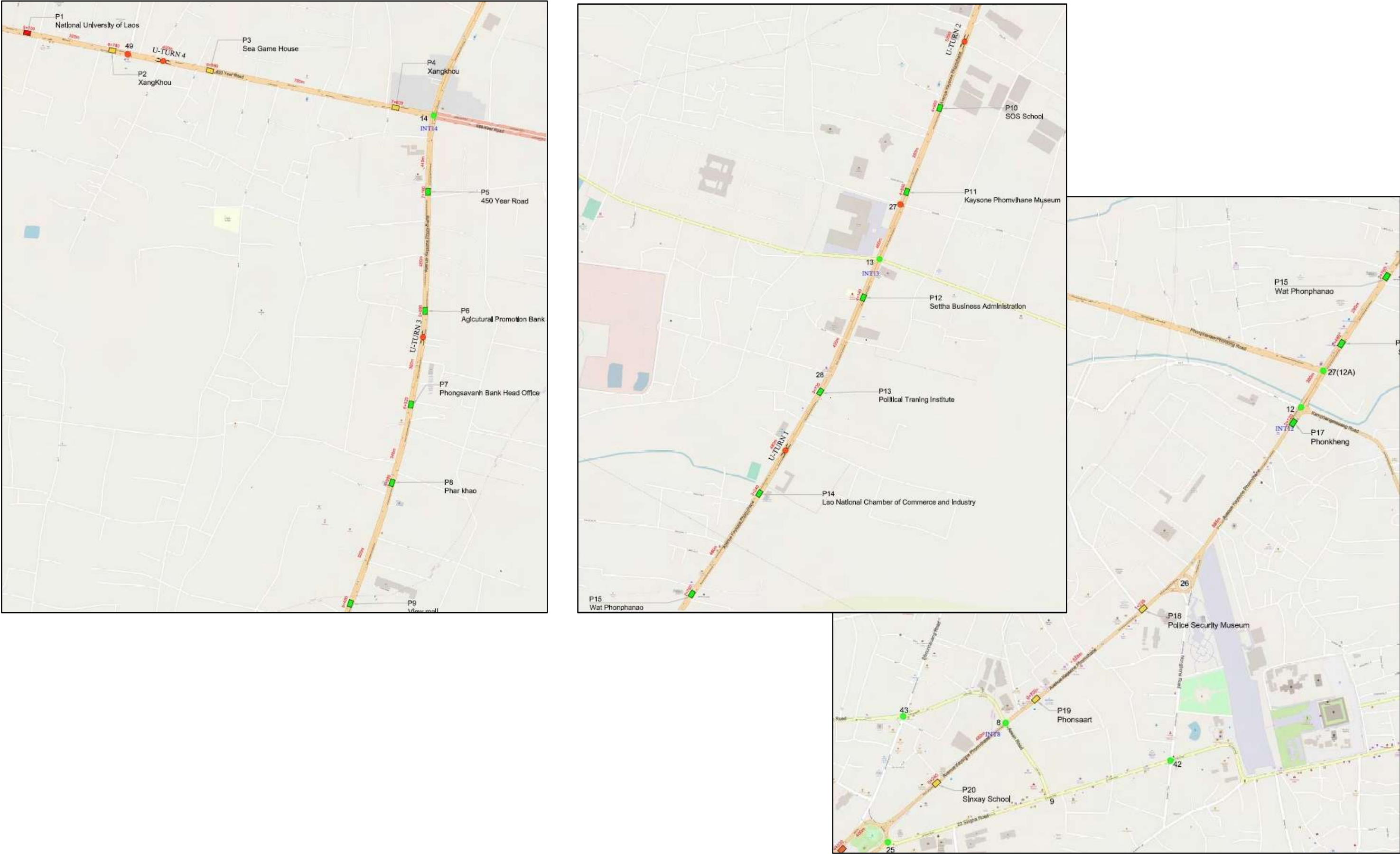


Figure 3 – Traffic Signals Location Map (North Corridor)



Technical Specifications

1. GENERAL

1.1 Standards

The international standards quoted in this document are assumed to be known to the contractor and are not attached. The complementary technical specifications are for materials and equipment that are not defined by the standards. Priority is given to Lao standards over international standards.

It is specified that the use of processes, products or materials not corresponding to any standard or escaping it, will be allowed only on presentation of the technical opinion to and agreement of the Project Manager. The standards cited in this document are not exhaustive: Any standard in force at the date of the signature of the contract is applicable.

The equipment must not interfere with or be interfered with by any third-party equipment. The equipment must not interfere with existing systems, sub-systems and equipment. The equipment complies with the electromagnetic compatibility (EMC) standard EN 300 827 V1.1.1 based on the generic standards:

- Immunity: EN 50082-1 and EN 50082-2 (level 4),
- Emission: EN 50081-1 and EN 50081-2.

The following standards are applied:

Standard	Electromagnetic disturbances
EN 61000-4-2	Test and measurement techniques - Electrostatic discharge immunity tests
EN 61000-4-3	Immunity test to radiated electromagnetic fields at radio frequencies
EN 61000-4-4	Immunity tests to fast electrical transients in bursts
EN 61000-6-1	Electromagnetic compatibility (EMC) - Part 6: Generic standards
EN 61000-6-3	Electromagnetic Compatibility (EMC) - Part 6-3: Generic Standards - Emission Standard for Residential, Commercial and Light Industrial Environments
EN 61000-6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
	Electrical Installations
	Official texts on the protection of workers in establishments where electrical currents are used (11-88, add. 02.89, add. 2 02-92) decree 88-1056 of 14/1/88; 74-657 of 9/7/74; 78-72 of 20/1/78; 78-846 of 28/9/79; 82-167 of 16/2/82 and orders
	Compendium of General Electrical Safety Instructions (1989; updated 1994; 1997)
	Low voltage electrical installations.
	Common rules for electrical equipment - Degree of classification of enclosures.
	Surge protectors for low voltage installations.
	Protection against electromagnetic interference
IEC 801-1 to 801-4	Protection against electromagnetic interference
IEC 1312-1	Protection against the electromagnetic pulse generated by lightning.
ISO 8402 and 2382 X 50-120 and 60-010	Standards and recommendations related to Reliability Availability Maintainability (RAM).
	Lightning Protection
IEC 1312-1	Protection against the electromagnetic pulse generated by lightning
	Road Vehicles
ISO 16750-2	Environmental Specifications and Testing of Electrical and Electronic Equipment Part 2: Electrical constraints

1.2 Site Facilities

The plan of the site installations shall be drawn up by the Contractor and submitted to the Project Manager for approval at least one week before any intervention on the site. These installations established on places proposed by the contractor and validated by the project manager, will include the site offices (offices of the project manager and meeting room), the equipment (printer, PC, Wifi...), the sanitary facilities, storage area of the supplies

The attention of the Contractor is drawn to the conditions of execution of the projected works with regards to the correct maintenance of the site, its external appearance, cleanliness and full restoration after the installation works of the conditions prevailing before the works.

1.3 Project Team

The attention of the contractor is drawn to the fact that the persons mobilized in the work site must correspond to those proposed in the technical proposal.

Key members of the project

1. The project manager, site manager;
2. The engineer in charge of functional, technical and security studies;
3. The engineer in charge of the Installation works;
4. The engineer in charge of the civil works required for installation;
5. The engineer in charge of the tests;
6. The person in charge of hygiene safety at works;
7. The quality inspector

No replacement, except for dismissal, death or serious illness of a member of the project team, can take place without an express request from the incumbent and prior agreement from the Project manager.

2. OPERATING PRINCIPLES

2.1 DESCRIPTION OF THE BRT DETECTION SYSTEM AT THE INTERSECTION

In the project of the first BRT line in Vientiane city, the priority system to be implemented will be of the electromagnetic loop type. The bus, when approaching the intersection, establishes a dialogue between the intersection and itself. The presence of the bus on the magnetic loops, communicates to the intersection controller its situation in real time with respect to the intersection and ends with an acknowledgement of the traffic light and the intersection.

The initialization of the dialogue is done when the bus is approaching the intersection and is in the controller's zone of influence.

The BRT corridor signaled intersections include 12 existing traffic signaled intersections and 16 intersections to be equipped with new traffic signals. All 28 Intersections must be equipped with a Distributed Transit Signal Priority (TSP) bus priority, pre-emptive system¹. The approach of the BRT bus will cut out all other movements. All signaled intersections along the BRT corridor will be equipped with a BRT priority system. Standard traffic loops will be embedded in the pavement of the BRT exclusive lanes and integrated with the signal controller. Priority is triggered by a Transmitter fitted underneath the BRT bus. The Transmitter will be detected by the standard traffic loop as the BRT bus is approaching and the controller shall interrupt normal traffic control cycle to give priority to BRT.

Early Green: Phase If the signal is red when the bus approaches, the system will cut the red phase short and turn the signal into green so that the bus can pass through the intersection faster.

¹ Including access to Brunei Embassy; Transit mall special BRT traffic signals and U-turns, totally 28 intersections; except however, for the following 2 intersections located along the BRT Corridor, which will not be equipped with TSP pre-emptive system:
Intersection No 25: Patuxay/23 Singha Road – BRT buses are merging into mixed traffic - Existing traffic signals to be merely modified
Intersection No 27: Kaysone Phomvihane/Lounalath – T-Junction - No left turn - 2 Phase new traffic signals to be installed.

Green Phase Extension: If the signal is green when the bus approaches the intersection, the system will extend green phase until the bus passes through the intersection.

After the passage of the BRT bus across the intersection, the system returns as soon as possible to the normal traffic control cycle.

2.2 COORDINATION OF INTERSECTION

The following intersection will be synchronized:

No 12 and 12A

2.3 TRANSIT MALL

The principle governing the crossing of the transit mall from the adjacent roads is permanent green – with BRT Bus preemption. This is applicable at the following intersections: No 17, 18, 18A and 18B. In consideration of BRT stations T2 - Wat Mixay, two curbside stations intermingled with intersections 18A, 18 and 18B, the contractor will propose a layout of magnetic loops along the transit mall designed to optimize the crossing time of adjacent roads, notably when the BRT bus stops at the BRT station P2.

2.4 ACCESS TO THE BRUNEI EMBASSY

Official accesses to the embassy of Brunei will be done through the main entrances along Sethattirath Road, crossing the BRT lanes from/to the westbound traffic lane, with conditional traffic lights upon manual activation from Embassy's security guard post, used ONLY when Embassy's gates are open: - for BRT lane: blinking orange light - for general vehicles lane: blinking orange light.

2.5 OPERATION IN DEGRADED MODE

The operation in degraded mode corresponds to a partial or slowed down operation of the installations in case of malfunction of one or several components at the same time. This may cause the traffic signals to turn off, or to trigger flashing yellow safety mode. To get out of the degraded mode, a manual control device is needed at each intersection to enable the traffic police to operate the defective equipment, including BRT priority.

2.6 MANUAL OPERATION BY THE TRAFFIC POLICE

In order for the traffic police officer to be able to intervene at the intersections located along the BRT Corridor, a degraded mode must be provided by putting the traffic light in flashing yellow. This mode is triggered by the police officers via a switch that forces the controller to switch to this type of operation. Thus, they will be able to regulate and manage the traffic in these particular situations (to allow the passage in priority of an official convoy, to manage the movements during an accident, etc.).

A manual operation mode is otherwise required to allow the traffic police officer to control the intersection signals by switching to the desired phase by push buttons, and neutralizing the BRT pre-emptive device.

A similar manual operation mode will additionally be available to allow the traffic police officer to control the intersection signals while allowing for BRT bus preemption. When the BRT bus is approaching, the agent loses control of the manual operations for automatic priority to the BRT.

The agent box is equipped with a 4-position switch (1 automatic, 2 manual/BRT priority, 3 Manual /no BRT priority, and 4 flashing yellow). The agent box must be locked by a different key than the one of the controller cabinet.

3. TRAFFIC SIGNALING EQUIPMENT

3.1 SIGNALS

3.1.1 Vehicle and BRT traffic light signals

All signal heads shall be high efficiency, high brightness LED type with visual angle 30 and power consumption of less than 10W per light. All traffic signal housing material shall be UV resistance Polycarbonate (PC).

All Vehicle traffic signal heads (including BRT, directional signal heads and countdown meters) shall have a diameter of 200mm.

Traffic signals will include 2 ½ digit tri-color 600 x 400 mm LED countdown meter.



200 mm Traffic Signals

The BRT bus traffic signals are identical in construction and recommendations to the road traffic signals. All the characteristics of the lanterns are applicable to the bus signals. Green and Red general traffic signal appear with a mask reading "BRT"

All signal heads will meet the following specifications:

- Wide operating temperature range
- Minimized phantom effect with smoked polycarbonate lens, class 5 according to NF EN12368
- Diffusing optical lens for homogeneous light distribution
- High intensity and high power LED light source
- Red, yellow or green LEDs with low energy consumption
- Long life cycle - more than 80,000 working hours
- Lantern in black UV resistance PC
- Mounting system with aluminum mounting brackets
- Aluminum mounting brackets
- Easy design, installation and maintenance
- Electromagnetic compatibility in accordance with NF EN50293 Standard

The visors must be adjustable in case the traffic signals are placed horizontally

The signal heads should be connected in a way that no cables are visible outside the poles.

3.1.2 Pedestrian traffic light signals

All Pedestrian traffic signal heads shall have a diameter of 200mm with black UV resistance PC housing.

Signal heads shall be of LED type with a power consumption of less than 10W per light.

Pedestrian signals are equipped with the acoustic signals (facilities for the visually impaired).



3.2 POLES

3.2.1 General

The poles supporting the traffic signs will be made of cylindrical or octagonal hot galvanized steel painted silver shade to be agreed by Project Manager. The dimensions will depend on the equipment that will be installed on the poles. All poles will have access doors with minimum dimensions 450 x 85 mm at 600 mm from the base with a vandal proof lock. The posts will have a fixing plate with holes for the anchor rods with a center distance of 200 x 200 mm. The anchor base must have oblong fixing holes that allow the support to be oriented at an angle of at least 15° in order to correct any possible misplacement of the anchor rods. A sealing device must be provided at the top (supply of caps).

3.2.2 2.7m Pole

This post is made of hot galvanized steel. It will have a height of 2,70m, a diameter of 120 mm and a thickness of 4 mm. It will support only the pedestrian signals. The pole shall be painted.

3.2.3 3.m Pole

This post is made of hot galvanized steel. It will have a height of 3.70m, a diameter of 120 mm and a thickness of 4 mm. It will support vehicle signals in 200 mm diameter, BRT signals in 200 mm diameter and pedestrian signals. The pole shall be painted.

3.2.4 7 m Pole with arm

The pole must be made of cylindrical or octagonal hot galvanized steel painted with height above the road of 7 m (axis of fixation of the visualization equipment of 200mm) a minimum diameter of 300 mm at the base and 160 mm at the top and a thickness of 8mm. It will support vehicle signals in 200 mm diameter, BRT signals in 200 mm, directional signals, countdown meters and pedestrian signals.

The span of the arm will depend on the number of lanes to be spanned as 3.50m (1 lane), 6.50m (2 lanes across), 10 m (3 lanes across) or 13.5 m arm (4 lanes across), with a minimum diameter of 150 mm until the end. The type of post will be chosen according to the arm span.

The base of the pole will have a fixing plate with holes for the anchor rods with a centre distance of 300 x 300 mm or 400 x 400 mm depending on the type. Access hatches must have a vandal-proof lock at both ends of the door. The fixing system (aluminium bracket) of the lights on the stem will be integrated in the price of the stem.

3.2.5 Class II connection box

These boxes will be used on all types of supports (poles, posts, gallows). Their price will be integrated in the price of the corresponding media.

The Class II connection boxes will be equipped with spring-loaded terminals for 4mm² conductors. These boxes will have a visible part allowing to see the connection inside them. The following minimum technical specifications will be required for this box:

IP44 - IK08 in closed position

IP2X in open position

The minimum number of terminals required is 20.

3.3 INTERSECTION CONTROLLER

At each traffic-signalized intersection the controller operates completely autonomously;
BRT Bus detection information is sent to the controller;
The switching actions of the traffic light lines are taken at the level of the controller;
The BRT bus priority actions are managed locally by the controller;

3.3.1 Principles of Implantation of Cabinets for Intersection Controllers

The layout of the cabinets must meet the following criteria:

- easy access for a maintenance vehicle;
- easy vision on a maximum of traffic light lines of the intersection;
- minimize cable lengths;
- respect for pedestrian paths;
- respect of the aesthetics of the site (not very visible cabinet...).

3.3.2 Equipment of the Intersection Cabinets

- Intersection Controller;
- Power terminals and I/O terminals linked to the controller;
- Bus detectors (loops) and their corresponding terminal block;
- The various relays, electrical outlets, terminal blocks, protection and PCs required;
- The circuit breaker and its protections;
- The inverter if it is not provided in a separate cabinet.

3.3.3 Technical specifications

The intersection controller cabinets will be made of painted aluminum or electro-galvanized material and shall be mounted on the back of the cabinet. The controller cabinets will be resistant to corrosion, oxidation, condensation and impact. The performance of this equipment will meet the applicable Standard requirements.

The holder must check with the calculation note of heat dissipation if it is not necessary to provide a ventilation grid or a fan. Also the justification with the calculation note must take into account the periods where it is very hot in the history of the city of Vientiane if we exceed the max temperatures that the controllers, inverters, and switches can support.

The cabinet shall be equipped with an efficient and robust internal ventilation system if necessary. The exterior cladding will be provided with anti-graffiti protection.

Only one cabinet size will be implemented based on need (allowing for a 30% margin). Approximate cabinet sizes will be approximately: W = 1200 mm ; H = 1400 mm ; D = 550 mm). The cabinet will be raised at least 20 cm above the finished floor (concrete slab)

The cabinets will have 2 doors that can be opened on one side only with a system that allows them to be locked in the open position. The opening angle will be 135° minimum. The bidder shall propose a locking system for the cabinet. The locking system shall be strong and vandal resistant.

A device to hold the plans and documents of the intersection will be attached to the inside wall of the door. The layout plans of the cabinets as well as the detailed description of all the sub-assemblies constituting it must be provided in the proposal.

The Cabinets will also have a lockable hatch for access to the Agent control devices (buttons and switches) The cabinet shall have a four-position key switch and phase activation push buttons to handle:

1. Normal position: automatic operation.
2. Manual mode without BRT priority. Police intervention in manual mode as explained in 2.6
3. Manual mode with BRT priority. The agent loses control of the manual operations when BRT Priority is triggered.
4. Yellow Safety Flashing.

3.3.4 Accessories and equipment inside the cabinet

The cabinet will contain (in addition to the controller) the following accessories and equipment:

- A low voltage, single-phase 230V power supply unit protected by a 15A/500mA 2P differential circuit breaker;
- An earth connection is made by a disconnectable earth bar (allowing an earth measurement) and an earth distribution bar;
- 2 general circuit breakers.
- Interference suppression;
- 2 sockets 2P 10/16A 230V + earth ;
- An interior lighting of the cabinet controlled by a switch and protected by a 30mA circuit breaker, with a sufficient lighting power to allow night work;
- A DIN rail to accommodate the 230 V power supply for the detectors and the detector sockets;
- A 230V power supply for the detectors protected by a 2A circuit breaker;
- A sectionalized cartridge lightning arrestor system. The system will be mounted in a protective box with cover;

3.4 ELECTROMAGNETIC LOOPS

3.4.1 Detection loop

The detection loop is a prefabricated type connected via a connecting cable to the magnetic detector. The connection of the loop to the connecting cable is generally made in a manhole located in the immediate vicinity of the loop by means of waterproof connections. The part of the cable between the loop itself and the connecting cable is called the loop tail, and is usually the same cable. This cable must be twisted (20 twists/m).

3.4.2 Connecting cable

In order to ensure that the cables are held together mechanically, a twisted cable is recommended (20 twists/m). This avoids parasitic detections generated by vibrations.

The connecting cable must be twisted (20 turns/m) and must be shielded. The connection of the shielding to the ground must be made on the detector side only.

The connection between the loop tail and the connecting cable must be crimped and/or screwed and overfolded in a waterproof housing.

The insulation of the assembly must be at least 1 Megohm, measured under 500V, in relation to the ground. The maximum recommended length of the connection cable is 150 m.

3.4.3 Loop shape and depth

The loop will be rectangular in shape. The usual recommended dimension is width 2 m, so that, under all circumstances, the on-board transmitter can travel above the loop.

The loop will be installed in a groove in the pavement using the same installation techniques as for conventional road loops. Great care should be exerted not to damage the wire during installation (no angular tool should be used to push it). The loop should be sealed with an appropriate product (bitumen, silicone, resin ...). The loop must be perfectly immobilized.

The usual depth is 50 to 80 mm. For the selective detection of priority vehicles, the maximum recommended depth is 120 mm. Beyond that, a loss of magnetic sensitivity can be observed.

3.4.4 Remote box for remote loop

In order for the information from the loops to reach the controller when the loops are far away, a remote box will be installed as close as possible to the loops. The box will be made of solid and waterproof PVC. To avoid vandalism of the remote box, it shall be installed in a pulling chamber; the box shall not be installed on the ground in the pulling chamber. The contractor shall propose a solution to fix it at a height of more than 40 cm from the ground.

The cabinet is to be equipped with DIN rail, loop bases, electrical protection and will be fully wired according to the detection elements. The Contractor shall provide a secure anti-vandalism locking system. The accessibility part of the power and detection cables must also be waterproof.

The Contractor shall provide to the Employer the technical data sheets and the proposed solution for validation.

3.4.5 On-board equipment

The BRT buses will be equipped with an on-board transmitter mounted in the bus and the control box. Each embedded transmitter will emit a different signature (different emission frequencies, different content of the emitted messages...). This signal will be generated and maintained for a limited time based on information transmitted by the BRT.

4 INSTALLATION AND MODIFICATION OF EXISTING EQUIPMENT

4.1 WIRING INSTALLATION

The scope of the Contract includes for all equipment supplied:

- Installation and connection of the cabinets and their contents;
- The supply of ducts, their implementation in trenches, the support blocks for manholes;
- The installation and connection of the light supports;
- The realization of the detection loops;
- Supply, installation and connection of the necessary cables:
 - to the supply of the controller cabinet from the nearest authorized power supply cabinet;
 - to the connections between the cabinets and the equipment;
 - to the power supply of the equipment;
 - to equipment grounding;
 - to the inter-hub connections;
 - the connection of the magnetic loops to the cabinets;
- All the necessary markers, end caps and accessories in enclosures, panels and cabinets;
- All assemblies and connections of equipment or cables that it supplies;
- All special parts for mechanical assemblies.

4.2 CIVIL ENGINEERING INSTALLATION WORKS

The Contractor shall execute all civil engineering works required to install the equipment in accordance with the approved drawings. The civil engineering works include the construction of trenches, pulling chambers, and ducts to ensure the connection of equipment to the work carried out (so-called "secondary" traffic light network).

4.3 MODIFICATION OF EXISTING INSTALLATIONS

Five intersections, which are currently controlled with traffic lights, have to be modified in accordance with the new traffic management, as described in these technical specifications. These interventions consist of reducing or adjusting the number of phases and timing of the phases of the existing traffic signals.

As a general rule the light poles, signal heads, controllers and related outfitting and wiring will be checked and maintained in existing conditions or repaired if need be. The supplier will only supply the components of equipment required if any, to change the phasing and will operate the changes.

5. SERVICE

5.1 IMPLEMENTATION STUDIES

The Contractor must carry out all the studies required to execute the works under the contract. The studies due under this contract include:

- layout plans of all the equipment covered by this contract;
- execution studies of secondary networks;
- civil works construction detailed plans
- execution studies for the regulation of intersections;
- controller programming studies;
- Intersection coordination studies;
- schematic diagrams and as-built drawings

As part of the execution studies for the secondary networks the contractor will check the layout documents provided in Volume 4 and design the layout of all the equipment covered by this contract including layout of magnetic loops where applicable, traffic light signaling blocks and cable ducts. The contractor will have to locate precisely these traffic light poles. The contractor will have to present optimizations of the numbers of equipment at the level of the crossroads for validation of the project manager.

The Contractor will provide the execution studies related to the traffic light signal of all the crossroads including layout of equipment and wiring related to the traffic light signals of all the intersections. He must comply with the standard wiring plans for the intersections, specifying for each traffic light intersection. The execution studies shall include:

- ✓ The location and numbering of supports and lanterns;
- ✓ The location of controller cabinets and electrical power cabinets and their connections;
- ✓ The position of the bus detection loops and their connection to the controllers;
- ✓ The type and precise location of the ductwork;
- ✓ The type and location of pulling chambers and intermediate manholes;
- ✓ Wiring routing and marking.

These studies will be materialized by installation plans of the equipment and traffic light networks at a scale of 1:200, which will be transmitted to the project manager in the form of computerized AUTOCAD plans, PDFs and the corresponding paper prints.

The contractor implementation studies shall include the regulation of traffic signals. The purpose of these studies is to translate, in an operational form adapted to the equipment proposed by the contractor, the functional requirements described in this document including Transit Signal Priority for BRT where applicable. The contractor will produce a regulation file for each intersection.

The implementation studies will include modification of existing installations. Five intersections, which are currently controlled with traffic lights, have to be modified in accordance with the new traffic management as described in these technical specifications. These interventions consist of reducing or adjusting the number of phases and timing of the phases of the existing traffic signals.

As a general rule the light poles, signal heads, controllers and related outfitting and wiring will be checked and maintained in existing conditions or repaired if need be. the supplier will only supply the components of equipment required to change the phasing and operate the changes.

5.2 TESTING AND COMMISSIONING

5.2.1 Testing

The detailed programs of tests and trials both in factory and in Vientiane, Lao PDR should be attached to the bidder's proposal and include:

- ✓ The procedures for carrying out the tests (equipment, timeframe, participants)
- ✓ A precise step-by-step description of the tests to be performed and the expected results,
- ✓ A test template for recording results

The required tests shall consist of:

1. Static tests

Static tests will be piloted by the Contractor and will allow the validation of the installation of each intersection. The tests will be performed by the contractor to demonstrate:

- ✓ that the equipment has not been damaged since leaving the factory;
- ✓ that the equipment has been correctly installed on site
- ✓ that the equipment functions correctly under the operational conditions of the site.

The static test will include:

- ✓ checking the wiring and connections at the electrical level (continuity and insulation)
- ✓ checking that the main functions of the equipment are working properly.

These tests must be carried out before the system is put into service. No intersection will be put into service without a favorable opinion from the technical controller. Under no circumstances may compliance be the subject of a request for additional payment.

2. Dynamic tests

These tests will allow the validation of the priority request at the traffic lights for each approach to each intersection. The Contractor will attend all these tests to make the necessary adaptations and adjustments to the operation of the priority system. These tests will be carried out using a BRT e-bus.

The dynamic tests will make it possible to validate the request for priority at the traffic lights for each approach to each intersection. These tests will notably involve for each intersection the realization of multiple approaches ("nominal" approaches with and without stopping). Test of the manual modes with and without preemption shall be carried out as well as the yellow safety flashing mode. The purpose of system testing is to demonstrate that the system's degraded modes are in accordance with the demands of the specification. The recovery times of incidents will also be verified.

The tests are an opportunity to adjust the various regulation parameters of each intersection including the BRT priority settings. These parameters will continue to be refined until final acceptance. The testing and adjustment phases are carried out with the assistance of the Project Manager's representatives. Adjustments will be made in prior testing then the results will be verified during the final tests.

The acceptance tests for intersection equipment follow the detailed program of test and trials proposed by the Contractor and validated by the project manager. All test results will be recorded in the test template provided by the Contractor. A compendium of all test results shall be submitted by Contractor in the report of test and trials.

5.2.2 Commissioning

Commissioning of Road Intersection corresponds to commissioning for road mode operation (without buses).

Commissioning of the TSP system priority at BRT corridor Intersections corresponds to the commissioning integrating the bus detection functionalities.

5.2.3 As-Built Drawings

The contractor shall supply the executed works file (as-built drawings) for each intersection not later than 15 days from commissioning of the intersection.

5.2.4 Regular Service Verification (RSV)

After the equipment has been checked for suitability and following the testing of all intersections, a regular service check will be carried out. This verification will make it possible to check that the performances observed on site during the tests are maintained over time. During a 24-month period from provisional acceptance, Regular Service Verification will be carried out on monthly basis. Any replacement of equipment, defective work or resumption of the program are at the expense of the Contractor.

5.3 TRAINING AND DOCUMENTATION

5.3.1 Training

The Contractor will prepare a training plan which will identify all necessary training programs: general schedule, purpose, contents and duration of each training session. Training manuals are an integral part of the documentation and will include the user's manual.

The training program should include two levels of training:

A technical level training module allowing maintenance personnel to deal with troubleshooting as prescribed in the manuals. This training will be given to at least 20 engineers and technicians nominated by the Department of Public Works and Transport (DPWT) of Vientiane Capital.

A functional level training module to master the intersection functionalities. This training will be given to not less than 20 officers from Vientiane traffic police with participation of the DPWT staff above.

The training sessions will be carried out prior to the commissioning. They will be held at the premises provided by the Project Manager and on the site on the basis of one-day session for each level, for a group of 5 people maximum per level. The training sessions shall be repeated as many times as required to train the whole group of trainees. The training shall be given by Lao trainers in Lao language. The trainer will have been trained by the Contractor for the purposes.

5.3.2 Documentation

The catalogues of proposed Equipment should be attached to the bidder's proposal.

In particular, the Contractor shall provide all documents, notices and manuals for all hardware and software equipment supplied, including test and maintenance equipment. These documents will contain for each equipment delivered:

- ✓ Drawings and manufacturing diagrams
- ✓ Detailed technical specifications
- ✓ Description of the maintenance tests
- ✓ Correspondence of error messages
- ✓ Troubleshooting manuals including methods of troubleshooting (Diagnostic flowcharts)

5.4 WARRANTY

The contractor guarantees, from the date of provisional acceptance of the works, the equipment and installations forming part of this contract. This guarantee commits the Contractor, during the fixed period, to carry out or to have carried out at its own expense, on request, all repairs or repairs necessary to remedy any defects which may be found, whether these are due to a defect in the products or materials used or in the conditions of execution of these works.

The warranty covers parts replacement, labor and travel. The warranty period will be extended for each defective part or assembly replaced, except for parts that require periodic replacement. Each intervention relating to the guarantee or the adjustment must be recorded on a specific report, mentioning in particular the nature of the breakdown, its origin, the date of the intervention, the duration of the repair, the parts or assemblies changed and the modifications made.

For a period of 10 years from the date of final acceptance, the Contractor undertakes to supply all interchangeable components and spare parts supplied under this contract, or their equivalents.

5.5 MAINTENANCE SERVICE AND TECHNICAL SUPPORT

During a period of 24 month starting from commissioning of the intersections the Contractor shall have to carry out, in due course and at his own expense, all the work necessary to ensure the correct operation of the installations, i.e. he undertakes to carry out, in particular, the following services:

- Its intervention on the field, on call of the operator or a representative of the UTMS (see preamble) within four (4) hours, 7 days a week;
- Replacement on site of defective materials, components and products, within a maximum of twelve (12) hours, 7 days a week;
- Modification of the controllers' programs in the event of a malfunction within a maximum period of twelve (12) hours, 7 days a week;

5.6 SPARE PARTS

The spare parts listed in BOQ shall be delivered not later than the time indicated in the delivery and completion schedule.

Drawings

Drawings are attached in Volume 4 and are comprised of :

BRT Corridor Layout Plans CW1A	1-12
BRT Corridor Layout Plans CW1B	1-26

Personnel requirements

CW1E

PERSONNEL REQUIREMENTS

Using Form PER - 1 and PER - 2 in Section 4 (Bidding Forms), the Bidder must demonstrate that it has personnel who meet the following requirements:

Nº.	Position	Total Work Experience [years]	Experience In Similar Work [years]
1	Project Manager, Site Manager	15	10
2	Engineering Studies Manager	10	5
3	Installation Engineer	10	5
4	Civil Works Engineer	10	5
5	Testing Engineer	5	3
6	Hygiene and Safety Engineer	5	5
7	Quality Inspector	5	3

For similar works there will be considered Supply and installation of Traffic signaling.

The Bidder shall provide details of the proposed personnel and their experience records in the relevant Information Forms included in Section 4, Bidding Forms.

The Bidder shall ensure that 30% of unskilled labor jobs in civil works are provided to women, and that this is stipulated in civil work contract.

Equipment Requirements

CW1E

EQUIPMENT REQUIREMENTS

Using Form EQU in Section 4 (Bidding Forms), the Bidder must demonstrate that it has the key equipment listed below:

Nº	Equipment Type and Characteristics	Minimum Number Required
1	Excavator, up to 28 " Bucket	1
2	Compact mini-excavators	2
3	Concrete cutter	4
4	Rammers	4
5	Vibratory tampers	4
6	Concrete mixer	4
7	Wheel Crane, 5 tonne	1
8	Dump Truck, 6 Cu-m Capacity	2

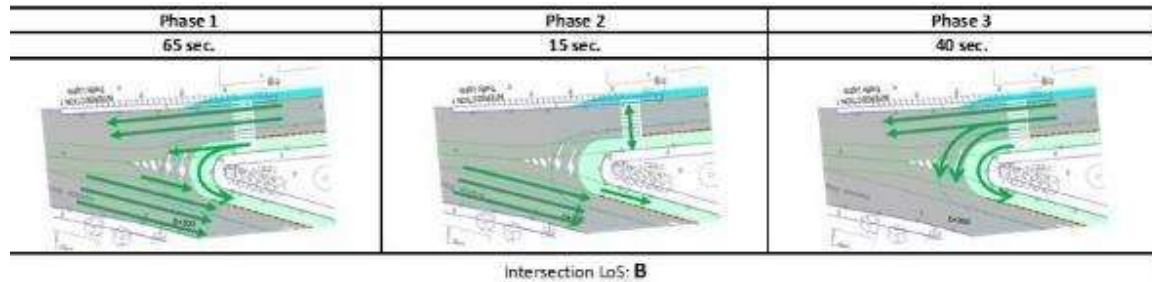
The Bidder shall provide further details of proposed items of equipment using the relevant Form in Section 4, Bidding Forms.

Annex 1 : Description of Intersections and Design Requirements

INTERSECTION 1. SETTHATHIRATH / SAMSENTHAI

Without project, this intersection is working without traffic lights. It has only one main flow westbound and a “U” turn to go back to the city. This “U” turn has not difficulties since there are three lanes going eastbound.

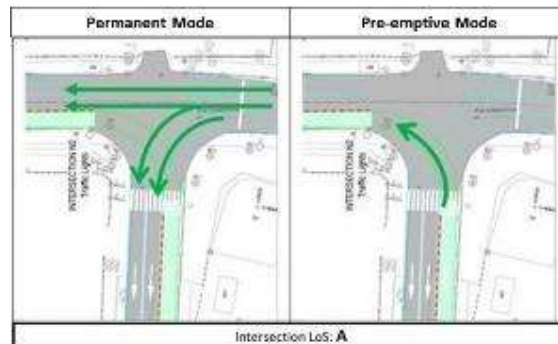
With the BRT running along the park and reducing road capacity, it is wise to control the junction with traffic signals. 3 phases will be required for through traffic, pedestrian crossings, and U-Turn including line D buses U-turning at this location.



Pre-emptive device to be triggered to give priority to the BRT bus if approaching during the second phase. The projected service level obtained is “B”. This means that each vehicle will have an average delay of less that 20 secs.

INTERSECTION 2. SAMSENTHAI / SITHANE

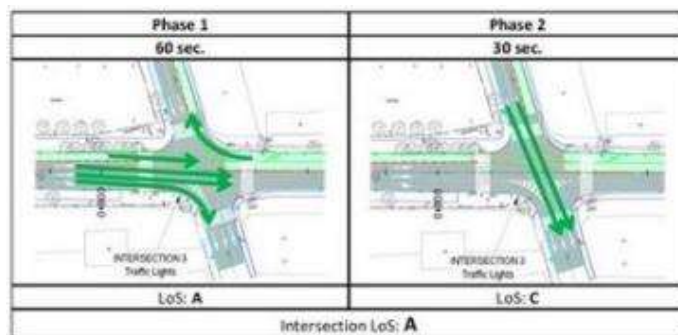
Sithane changes from two directions to one only (southbound) with the BRT running counterflow northbound and turning left to Samsenthai. There is no traffic lights at present.



A special traffic signal is required with permanent green for traffic coming from Samsenthai going through or left. The signal turns red in preemptive mode to give priority to either the BRT buses when approaching the intersection or pedestrian by action of a push-button.

The projected service level obtained is “A”. This means that each vehicle will have an average delay of less that 10 secs.

INTERSECTION 3. SITHANE / SETTHATHIRATH



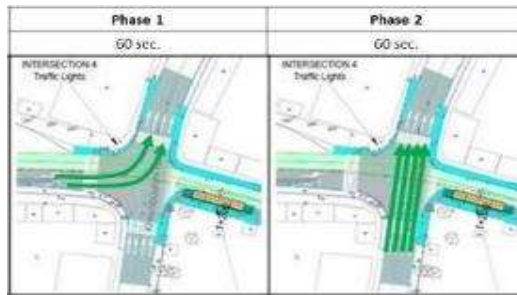
Sithane is currently two-ways with Setthathirath one-way inbound. The junction is controlled with traffic lights (3 phases) which need to be replaced. With the BRT, Sithane becomes a one-way road going southbound.

The existing traffic lights have to be adjusted to 2 phases. Pre-emptive device to be triggered to give priority to BRT bus approaching during phase 2.

Projected Level of service is “A”. This means that each vehicle will have an average delay of less that 10 secs.

INTERSECTION 4. KHOUN BOU LOM / SETTHATHIRATH

Khoun Bou Lom is a two directions road crossing with Setthathirath Road. Now, it is currently controlled with traffic lights (3 phases), which needs to be replaced.

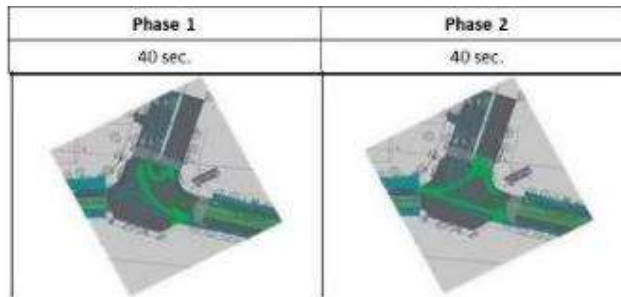


With the BRT, Transit Mall starts at this point and Khoun Bou Lom changes to one-way northbound. To make it work the new traffic signals need to be 2 phases (Koun Boulom through traffic and Setthathirath traffic turning left). Pre-emptive device to be triggered to give priority to BRT bus through traffic at any time.

Projected Level of service is "C". This means that each vehicle will have an average delay of less that 35 secs.

INTERSECTION 5. LANE XANG / SETTHATHIRATH

This intersection is located next to the Presidential Palace, where Lane Xang joins with Setthathirath. Lane Xang is the main avenue coming from the north corridor with 3+3 lanes that ends at Setthathirath going eastbound. Now, it is controlled with traffic lights, which need to be replaced.

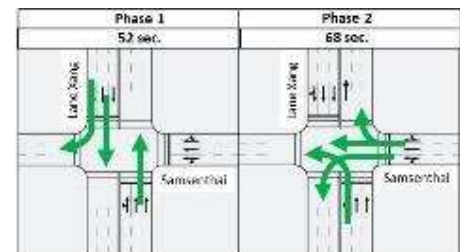


With the BRT, Setthathirath will have only one lane westbound. To improve accessibility at this point, an "U" turn movement at the southern end of Lan Xang Avenue is proposed. Traffic lights will be implemented in 2 phases. Pre-emptive device will be triggered to give priority to BRT bus at any time. The Level of service is "B" which means average delays under 20 sec.

INTERSECTION 6. LANE XANG / SAMSENTHAI

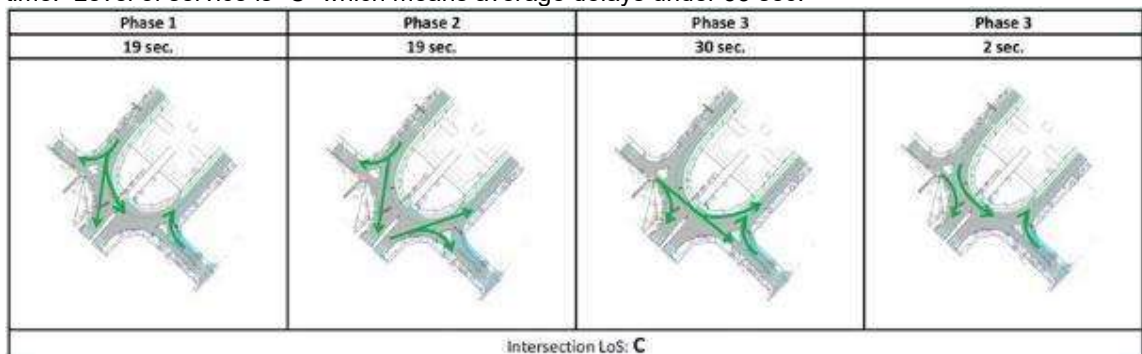
At present the intersection is controlled by 3-phase traffic signals, which phasing can be reduced to two phases making use of the reduction of traffic northbound on Lane Xang.

In that configuration LOS is C



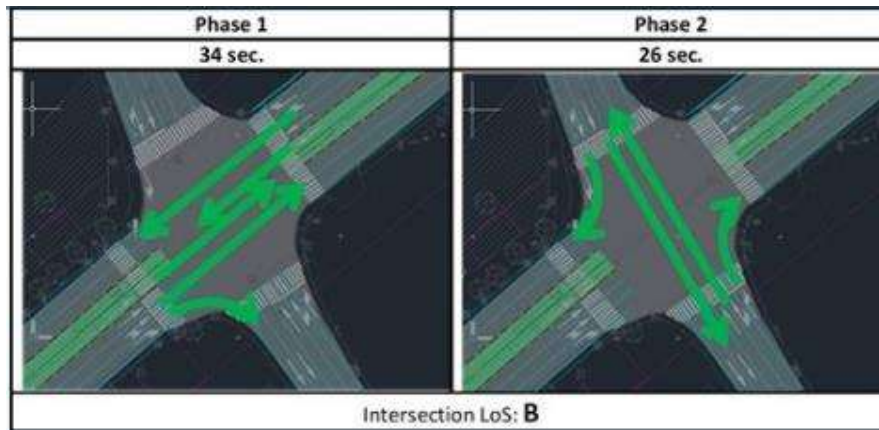
INTERSECTION 7. LANE XANG / PATUXAY

It is located to the south end of Patuxay. Now, it is controlled with traffic lights, which need to be replaced. With the BRT, the configuration does not change, but capacity is reduced due to the BRT. It is a complex intersection with many movements, but it has enough space to channel all of them through a well designed four phase traffic signal. Pre-emptive device will give priority to BRT bus through traffic at any time. Level of service is "C" which means average delays under 35 sec.



INTERSECTION 8. ASEAN ROAD / KAYSONE PHOMVIHANE

The intersection is Asean Road (two-ways) with Kayson Phomvihane (two-ways). At present, it is controlled with traffic lights, which need to be replaced. In the without project scenario, the main flow goes through Kayson Phomvihane, but there are also relevant flows from Asean Road and left turn movements that account for around 20% of the overall traffic.



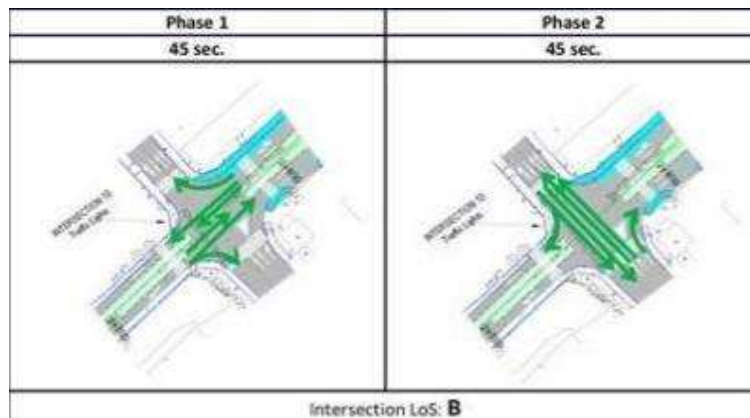
With the BRT if left turn movements are not forbidden, all traffic volumes keep similar levels. That will make not possible to reduce phases to increase capacity and, with one lane reduction for the BRT, the level of service will be E.

In the proposed configuration there will be 2-phase traffic

lights and left turn will not be allowed. The capacity improves and level of services becomes "B", which means delays under 20 sec/vehicle. Left turns can be channelized through nearest turning locations. Pre-emptive device will give priority to BRT bus approaching during the second phase.

INTERSECTION 10. KHOUVIENG / NONGBONE

It is located at Nongbone with Khouvieng Road, near the Morning market and the Central Bus Station. It is currently controlled with traffic lights which need to be replaced.

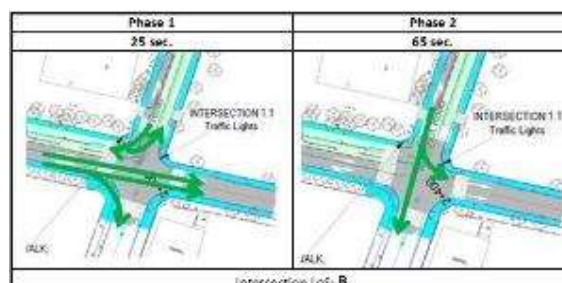


With the BRT, this intersection will play a significant role, since some of the diverted traffic from the transit mall will come through it. In order to make it work properly, left turns have to be forbidden. Left turns can be channelized with one block detour. Then it is possible to arrange a two-phase signal that improve fluidity at the junction. Pre-emptive device will give priority to BRT bus approaching during the second phase

With these changes, level of service is "B", with average delays under 20 sec per vehicle.

INTERSECTION 11. SETTHATHIRATH / MAHOSOT

It connects Setthathirath Road with Mahosot Road. It is currently controlled with traffic lights, which need

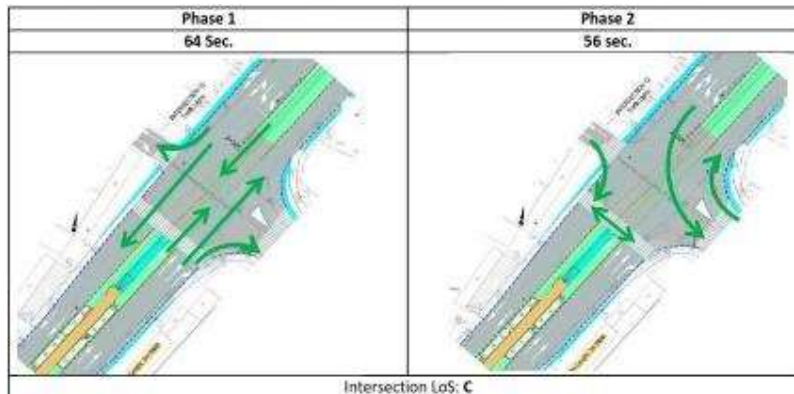


to be replaced with 2-phase traffic signals as Mahosot road will become a one-way southbound for general traffic and 2-ways BRT lanes. This is the turning of the BRT corridor from Setthathirath to Nongbone road. Pre-emptive device will give priority to BRT bus approaching during the second phase.

The Level of Service Is "B" In The Future Situation, With Less Than 30 Sec Average Delay Per Driver

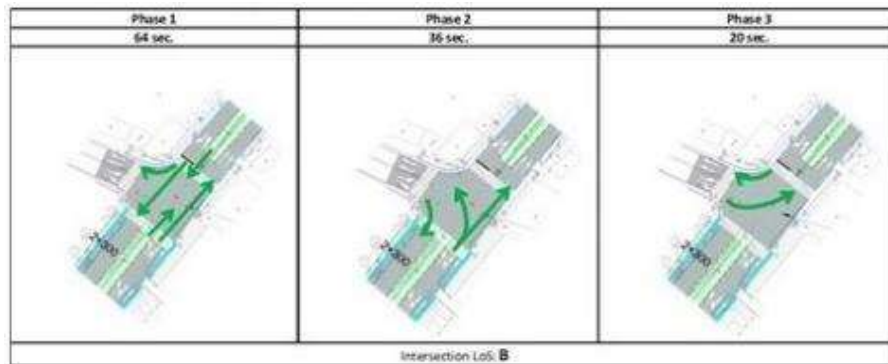
INTERSECTION 12/12A. BOULEVARD KAMPHENGMEUANG / KAYSONE PHOMVIHANE

These two junctions are 120 m apart. In the With Project scenario, both intersections lose capacity to the BRT. In order to make them work properly they have to be treated as a whole. The existing traffic lights will have to be replaced and synchronized.



Junction # 12 (south of the canal) will not allow left turn movements out of Khampengmeuang road giving fluidity to the main north-south moves. Pre-emptive device will give priority to BRT bus at any time. In Phase 2, the main road stops for pedestrians. Then, vehicles from the small road to the Lao-American college will be allowed to make a controlled right turn.

VCSBE Route 12 requires buses to turn right from Khampengmeuang road to K. Phoumvihamne, make a U-turn and turn left into Khampengmeuang road again to return.

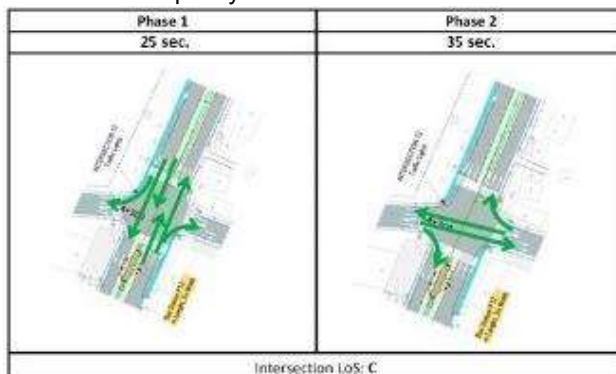


Conversely to junction #12, the T-Junction No 12A (to the north) has one lane reserved for left turn to the west. The two junctions combined together give response to all movements without saturating them. Pre-emptive device will give priority to

BRT bus at any time. Level of service is "B" and "C" with synchronized Traffic control of the two junctions.

INTERSECTION 13. NONGNIENG / KAYSONE PHOMVIHANE

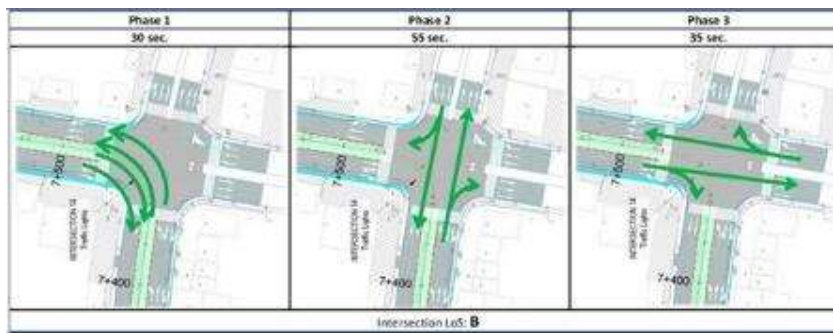
It is located at Kaysone Phomvihane Road with Nongnieng Road. At present, it is controlled with traffic lights that will have to be replaced; it is a busy intersection with LOS D. With the BRT, the intersection loses further capacity and left turns must not be allowed so traffic is fluid.



With this configuration change, the junction works reasonably well with two phases. Two "U" turn facilities are provided to the north and to the south of the junction for left turn movements, which are not allowed at the intersection. The level of service has been optimized by reducing the timing of the 2 phases to 25 sec. and 35 sec. respectively. Then from the current "D" level of service it is expected to be "C" with BRT. Pre-emptive device will give priority to BRT bus approaching during phase 2.

INTERSECTION 14. DONGDOK / KAYSONE PHOMVIHANE

This is a major intersection along the BRT corridor where the BRT Route D turns left from Kaysone Phoumvihamne Avenue into the 450 Years road towards the National University of Laos and BRT Route B runs through to the North where it mixes with the general traffic. It is currently controlled with traffic lights, which need to be replaced.

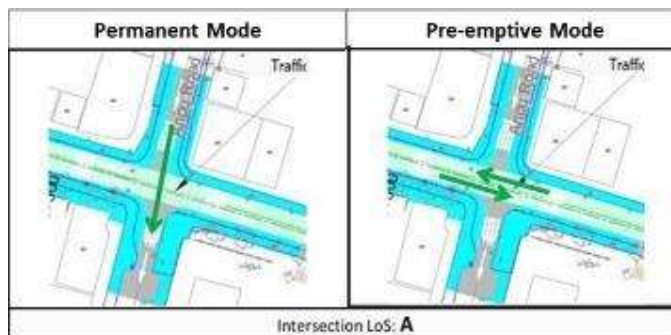


The Intersection will be controlled with 3-phase traffic signals (1. South-West, 2. North-South and 3. East-West moves. Left turns into the eastern part of 450 Years road will not be allowed, neither the left turns from 450 Years road East into Kaysone Phoumvihane.

U-turn is provided along the 450 years road near the intersection, to the west, allowing for both the movements. Pre-emptive device will give priority to BRT bus approaching during phase 2 and 3. LOS is B.

INTERSECTION 17 SETTHATHIRATH / CHAO ANOU

At present Chao Anou is going northbound and does not have traffic lights to control the intersection with Setthathirath. With the project, the traffic direction will change for southbound and traffic has to cross the transit mall. In the base situation, this road has little traffic at Chao Anou and the main flow comes from Setthathirath. With the project, Chao Anou traffic increases its volume with traffic coming from Setthathirath. Therefore, new traffic lights are needed to control the crossing of the transit mall.

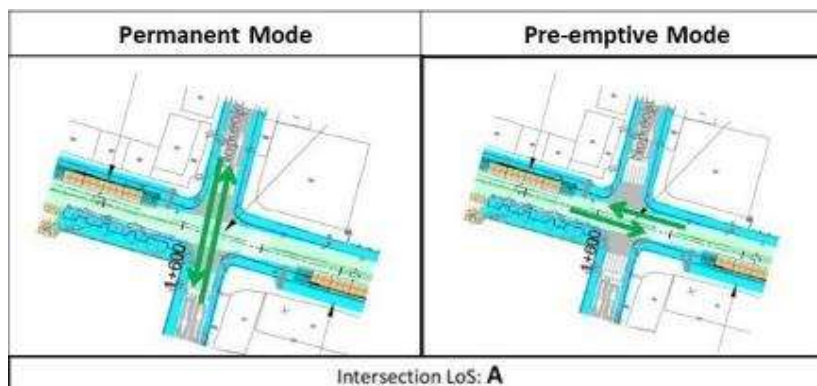


This special configuration provides permanent green for Chao Anou traffic across the transit mall. The traffic signals will turn to yellow/red by pre-emption when a BRT Bus running along the Transit mall approaches the intersection. This special configuration is common to Intersections 17, 18, 18A and 18B. The intersection is fluid with a level of service A. This means that each vehicle will have an average delay of less than 10 secs.

INTERSECTION 18 SETTHATHIRATH / NOKEOKOUMMANE

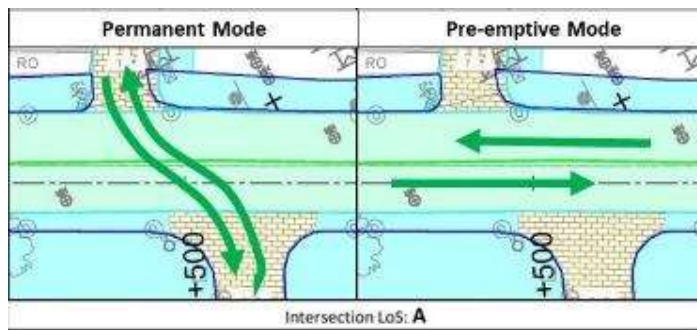
At present the northern section of Nokeokoummane is going southbound and the Southern section is going north with no traffic lights to control the intersection with Setthathirath. With the project, this road will be changed to two-ways to ease the north-south traffic across the middle part of the transit mall.

In the without project situation, the traffic comes from Samsenthai and Nokeokoummane has small volumes crossing Setthathirath. With the project, Nokeokoummane will increase its flows, but will not get high volumes since mobility is channeled before and after the transit mall.

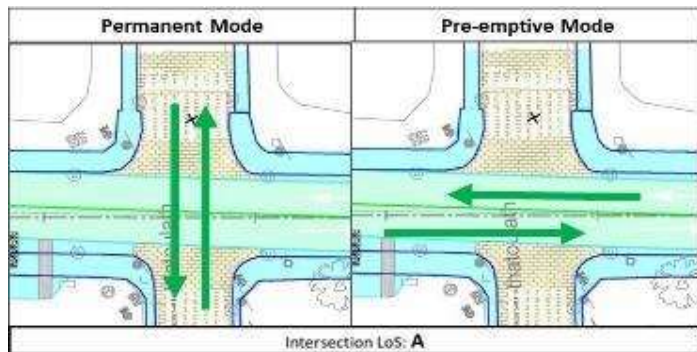


To control the crossing of the transit mall and the BRT lanes, traffic lights are needed. Similar to Intersection 17, permanent green will be provided for Nokeokoummane traffic across the transit mall, that will turn yellow/red by pre-emption when a BRT Bus running along the Transit mall approaches the intersection.

The intersection is fluid with a level of service A. This means that each vehicle will have an average delay of less than 10 secs.

INTERSECTION 18A SETTHATHIRATH / FRANCOIS NGIN / HOM 2

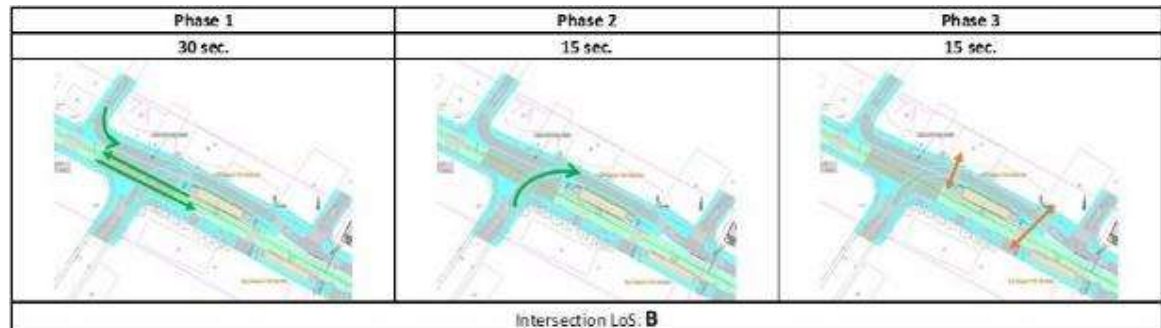
At present the crossroads of Rue François Ngin and Hom 2 with Sethathirath road has no traffic lights. With the project, a traffic signal is required to control the crossing of the transit mall and the BRT lanes. Similar to Intersection 17, permanent green will be provided for the traffic across the transit mall, that will turn yellow/red by pre-emption when a BRT Bus running along the Transit mall approaches the intersection.

INTERSECTION 18B SETTHATHIRATH / MANTHATHOURATH

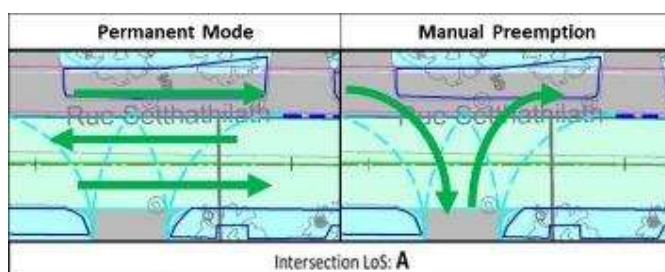
At present the crossroads of Manthathourath with Sethathirath road has no traffic lights. With the project, a traffic signal is required to control the crossing of the transit mall and the BRT lanes. Similar to Intersection 17, permanent green will be provided for the traffic across the transit mall, that will turn yellow/red by pre-emption when a BRT Bus running along the Transit mall approaches the intersection.

INTERSECTION 19 SETTHATHIRATH / PANGKHAM

At present the crossroads of Pangkham with Sethathirath road has no traffic lights. Traffic from both the Northern and southern sections of Pangkham will be allowed to turn into Sethathirath, eastbound. 3-phase traffic signals will be required to control the movements and the crossing of the BRT lanes.



A special phase needs to be included for pedestrians accessing the BRT Station T1 – Nam Phou located at this place. Pre-emptive device will give priority to BRT bus approaching during phase 2 and 3. Level of service will be B, with delays not higher than 20 seconds.

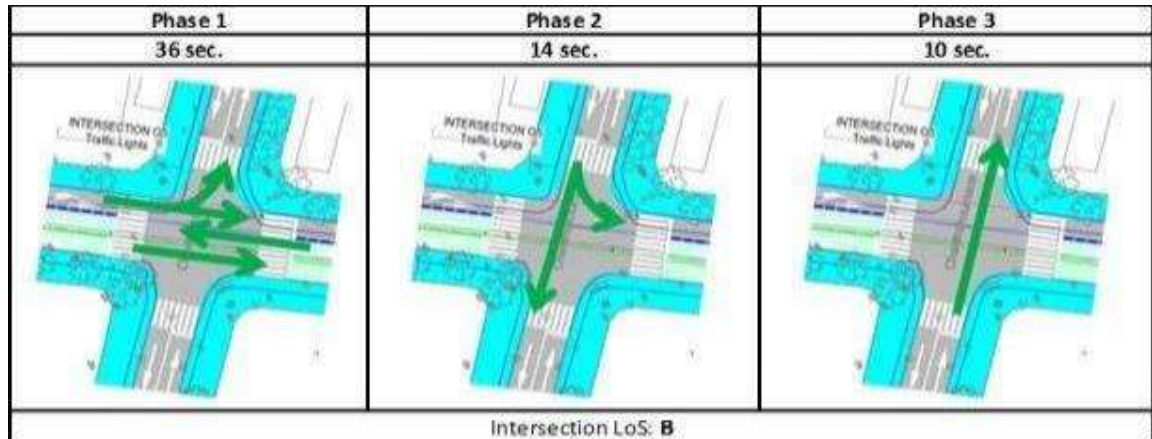
INTERSECTION 19A ACCES TO BRUNEI EMBASSY

Official accesses to the Brunei Embassy will be done through the main entrance along Sethathirath Road, crossing the BRT lanes from/to the westbound traffic lane. This will be arranged by special yellow blinking warning lights manually controlled from the Embassy's security post when the Embassy gates are open.

Pre-emptive device will give approaching BRT bus priority by neutralizing the manual activation of the blinking warning lights.

INTERSECTION 20 SETTHATHIRATH / CHANTHAKOUMMANE

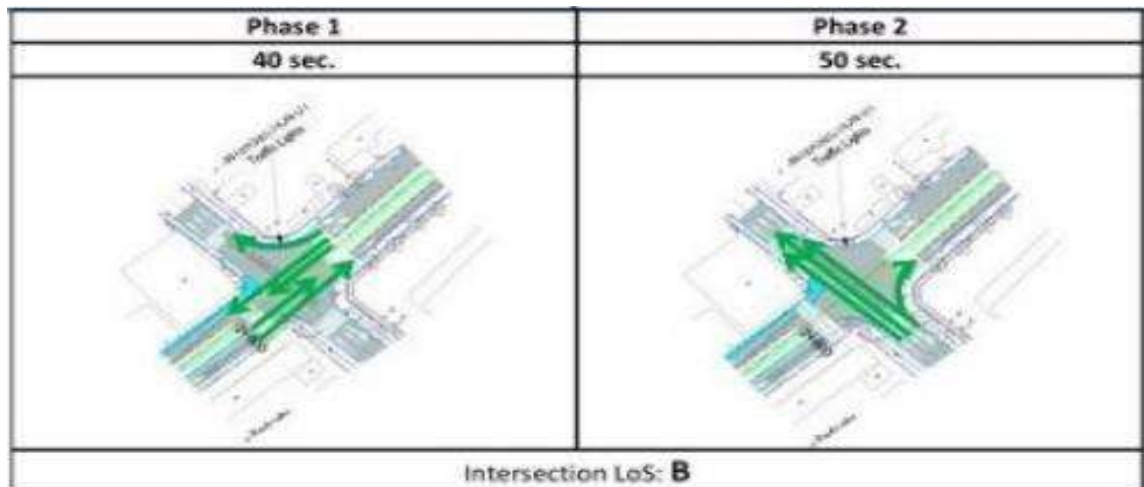
No changes are made to Chanthakhoumane street, which is two-way without traffic signals currently used as an auxiliary road to access the facilities in the surrounding area. The traffic is low without project and will still be low with the project. At present the intersection is not controlled by traffic lights.



With the project, to cross transit mall, this intersection has to be controlled by 3 phase traffic lights. Pre-emptive device will give priority to BRT bus approaching during phase 2 and phase 3. Level of service is B, which means average delay of less than 20 sec. per vehicle.

INTERSECTION 21 SAMSENTHAI / NONGBONE

This junction is located at Nongbone with Samsenthai Road. Nongbone Road has two directions to the north and only one southbound to the south. There is no traffic lights at present. New traffic signals need to be installed to control the intersection and give priority to BRT busses.



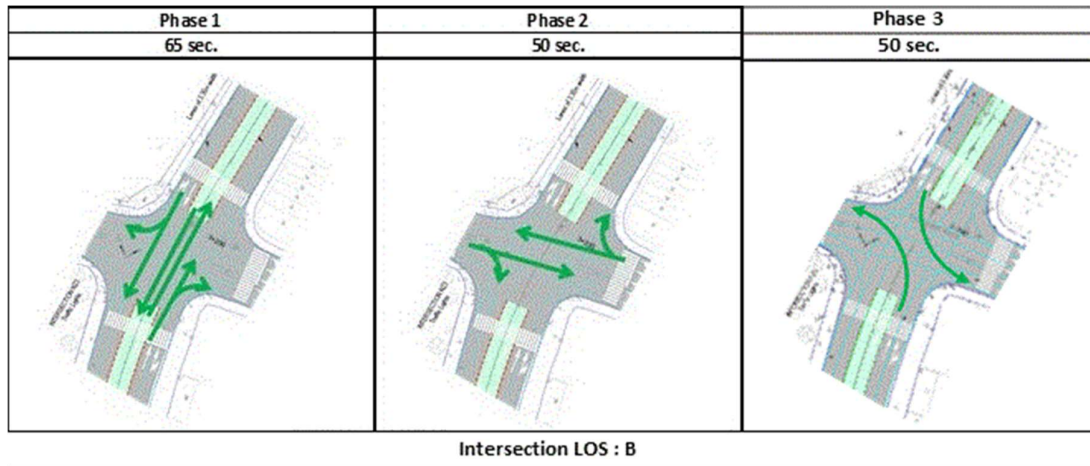
With the BRT, Nongbone stays two-way road to the north and becomes two-way road to the south of the intersection providing an exit lane from the French Embassy.

The BRT corridor runs in the middle of Nongbone road. Left turns from Samsenthai East into Mahosot south and from Mahosot South into Samsenthai West will not be allowed and can be channellized with one block detour.

The junction will be regulated with 2-phase traffic signals. Pre-emptive device will give priority to BRT bus approaching during phase 2. Level of service is "B" with average delays lower than 20 sec.

INTERSECTION 23. NONGBONE / SAYLOM (DONGPALANE)

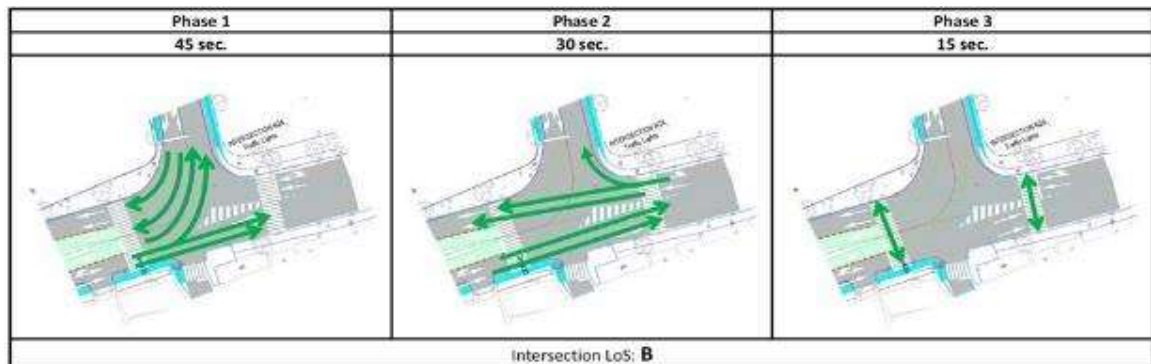
This intersection has traffic signals with 4 phases that need to be replaced. With the BRT, not allowing left turns out of Dongpalane road this can be simplified to only three phases. Left turns from North



Nongbone to Dongpalane to the East and from South Nongbone to Dongpalane down town will be allowed during a third phase of traffic signals. Pre-emptive device will give priority to BRT bus approaching during phase 2 and phase 3. Level of Service B.

INTERSECTION 24 NONGBONE TO PATUXAY

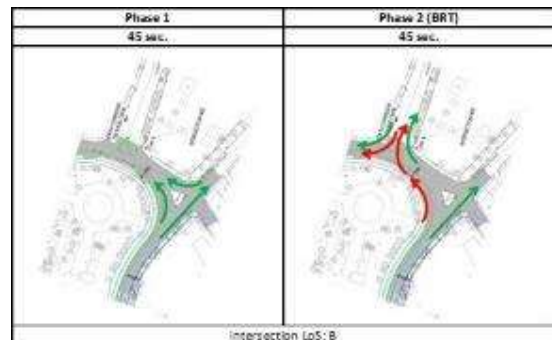
This is a road-link from Nongbone to Patuxay that is not controlled with traffic lights at present. The BRT corridor turns off Nongbone towards Patuxay at this point. There is not enough space for exclusive lanes for the BRT along this road-link. Thus, this is a section where the BRT traffic is mixed with the general traffic.



With the BRT this intersection needs to be controlled by 3-phase traffic signals including one phase for pedestrian crossing. Pre-emptive device will give priority to BRT bus approaching during phase 2 and phase 3. Level of service is "B" with very little delay for vehicles.

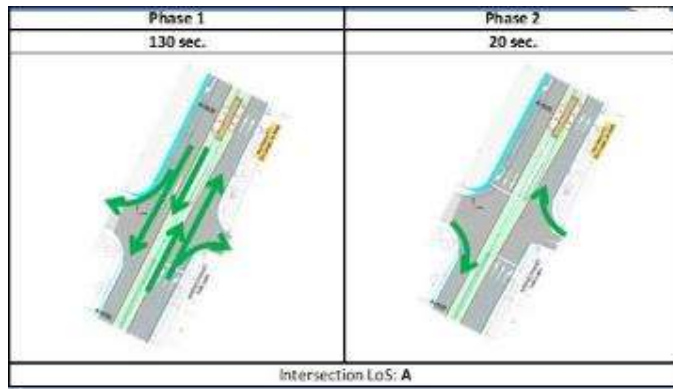
INTERSECTION 25. PATUXAY / 23 SINGHA ROAD

It is located at the north end of Patuxay. It is currently controlled with traffic lights. With the project, the BRT busses are running across mixed traffic at this particular junction without preemption: red arrows for BRTB, D and BRT route A splitting out along 23 Singha Road. The configuration of the intersection does not change, but the capacity is reduced due to the BRT. The intersection can be controlled with a two phases traffic light, the phasing of the existing traffic lights need to be modified. Level of service B.



INTERSECTION 27. KAYSONE PHOMVIHANE / LOUNALATH

It is located at the crossroads of Kaysone Phomvihane Road with Lounalath Road. It has no traffic lights.



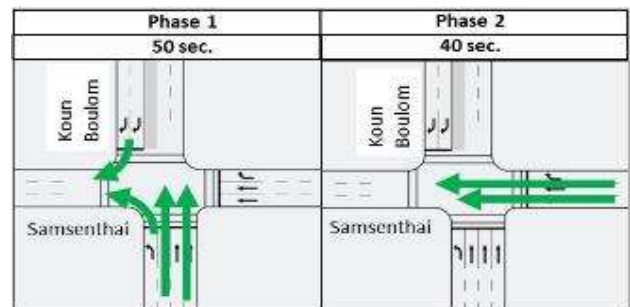
With the BRT, traffic from Lounalath Road will not be allowed to get across Kaysone Phoumviham Road, as the intersection is affected by BRT Station P11, Kaysone Phoumviham Museum. Traffic lights are proposed to allow traffic in and out of Lounalath Road and to protect pedestrian crossings for the Station mentioned above.

No pre-emptive device is needed Two "U" turn facilities are provided to the north and to the south of the junction for left turn movements, which are not

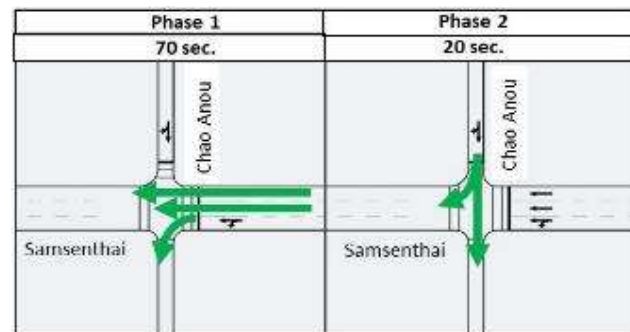
allowed at the intersection. Level of service will be A.

INTERSECTION 29 KHUN BU LOM / SAMSENTHAI

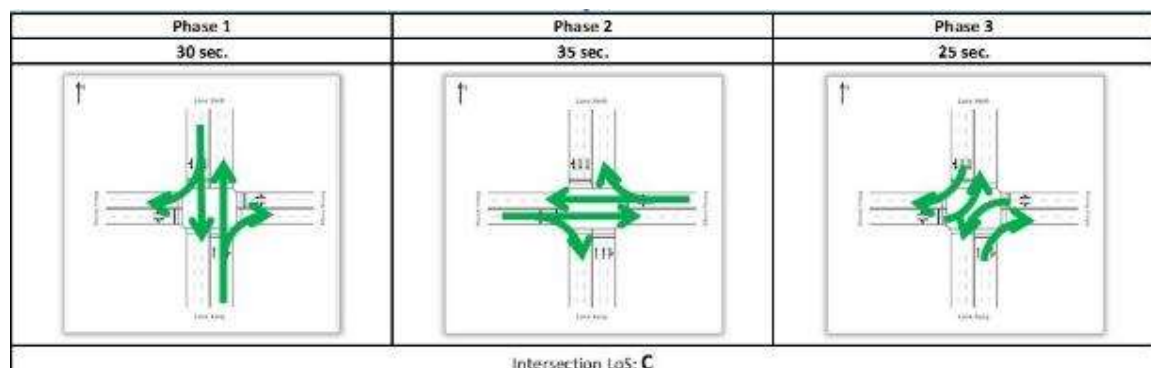
From 2-way road at present Koun Boulom will change for a one-way northbound road. Samsenthai stays one-way road westbound. The intersection is controlled with traffic lights at present, which need to be modified with 2 phases in order to optimize traffic movements. Phase A is 50 sec and Phase B 40. LOS is B.

**INTERSECTION 30 CHAO ANOU / SAMSENTHAI**

Chao Anou one way traffic will be reversed to southbound with the project. This intersection has no traffic lights at present but with BRT, control is required with two phases. As Samsenthai has the main flow, the phasing will be 70 sec for this road and 20 sec for Chao Anou which the traffic is small. Level of service LOS will be A for Samsenthai and C for Chao Anou.

**INTERSECTION 31 LANE XANG / KHOUVIENG**

It is located at Lane Xang with Khouvieng Road. Now, it is controlled with traffic lights, which need to be modified. With the BRT, the road configuration will not change, but more traffic will be channeled through it due to transit mall and the left turn movements forbidden at other intersections.

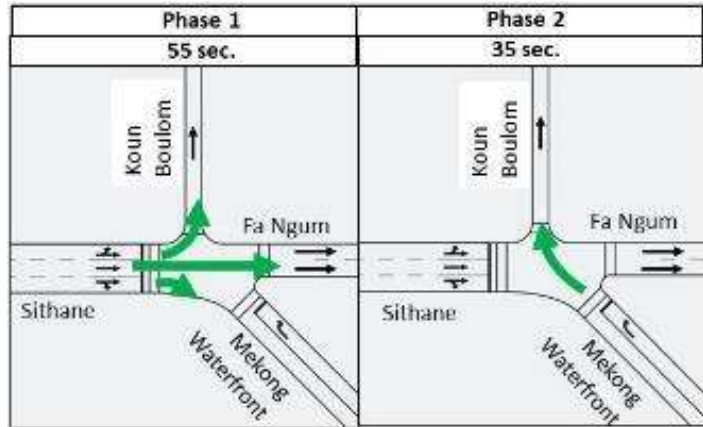


Left turn movements from Khouvieng Road to Lane Xang have to be allowed to make possible free access to Lane Xang main north-south corridor. However, these movements will not be allowed from Lane Xang to Khouvieng Road in order to make the intersection work more fluently. Forbidden turns can be channelized within one block. Three phases will be needed, one for each road and a third one for the allowed left turns. Level of service will be "C", meaning average delays below 35 seconds per vehicle.

INTERSECTION 34 SITHANE / QUAI FA NGUM

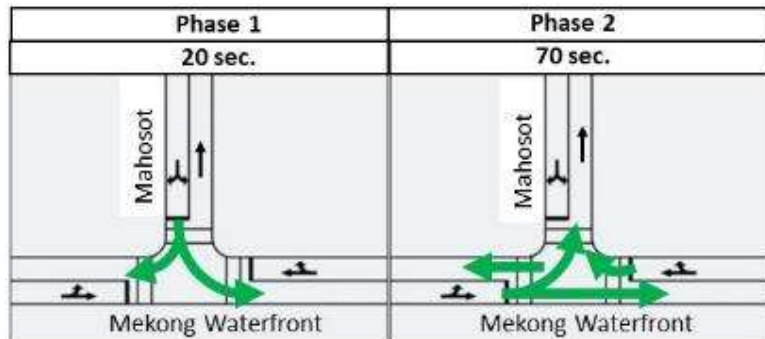
This intersection has no traffic lights at present. The Koun Boulom road (two directions) intersects both Sithane and Quai Fa Ngum roads (one direction each) at a roundabout to manage all movements.

With the project the Mekong waterfront becomes two-way traffic. New 2-phase traffic signals need to be installed to control the traffic diverted from Souphanouvong road due to the closure of the Transit Mall, through Sithane road and further through either the Mekong waterfront or Quai Fa Ngum. Phase 2 will allow traffic from the Mekong waterfront up to Koun Boulom. LOS is B for Sithane road and C for the Mekong waterfront.

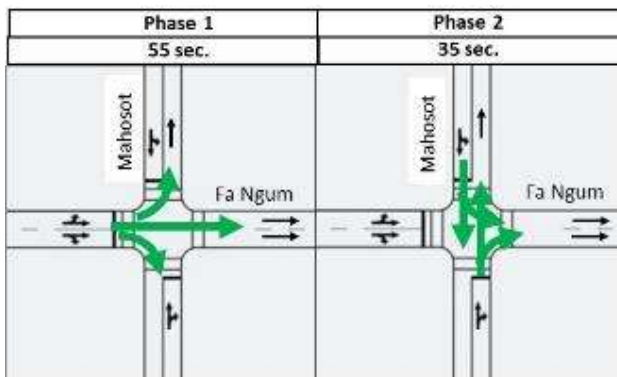


INTERSECTION 35 MAHOSOT / MEKONG WATERFRONT

Currently an uncontrolled T-junction of Mahosot Road with the one-way Mekong waterfront. With the project the Mekong waterfront becomes a two-way traffic road, new two-phase traffic signals are required to control the traffic at the intersection. LOS is A for the Mekong Waterfront and C for Mahosot Road.

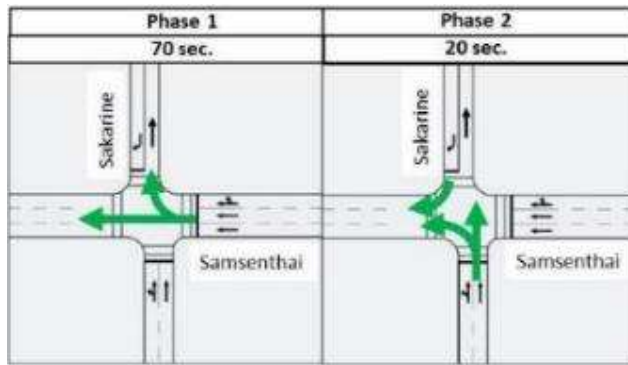


INTERSECTION 36 MAHOSOT / QUAI FA NGUM



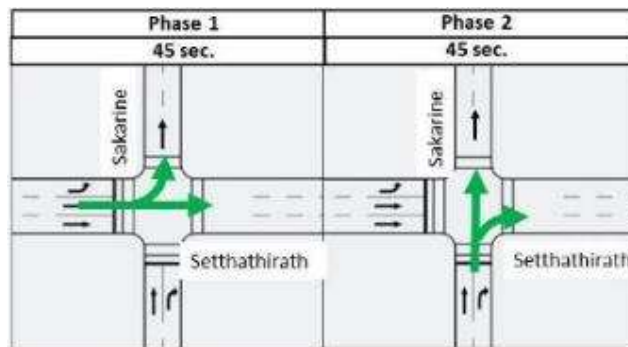
Currently an uncontrolled intersection. With the project, Fa Ngum quai one-way road direction is reversed to Eastbound, while Mahosot road remains a two-way traffic road. New two-phase traffic signals are required to control the traffic at the intersection.

Main flow will run through Quai Fa Ngum, so this road should have priority in the phasing with 55 sec (Phase 1) and 35 sec for the rest of movements (Phase 2). LOS is B for Fa Ngum Quai and C for Mahosot road.

INTERSECTION 37 SAKARINE / SAMSENTHAI

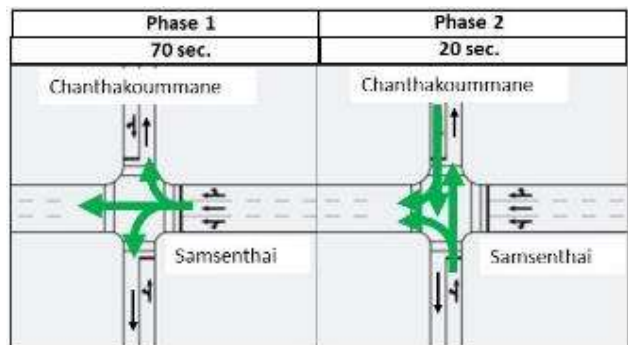
This intersection has no traffic signals at present. To the south of the intersection, Sakarin will become a one-way street northbound and will play a more important role in future scenarios. Two-phase traffic signals are required.

LOS is A for Samsenthai and C for Sakarine.

INTERSECTION 38 SAKARINE / SETTHATHIRATH

This intersection has no traffic signals at present. With the project, Sakarin will become a one-way street northbound while Setthathirath stay one-way traffic road Eastbound. Sakarin is to play an important role in future scenarios. Two-phase traffic signals are required.

LOS is B.

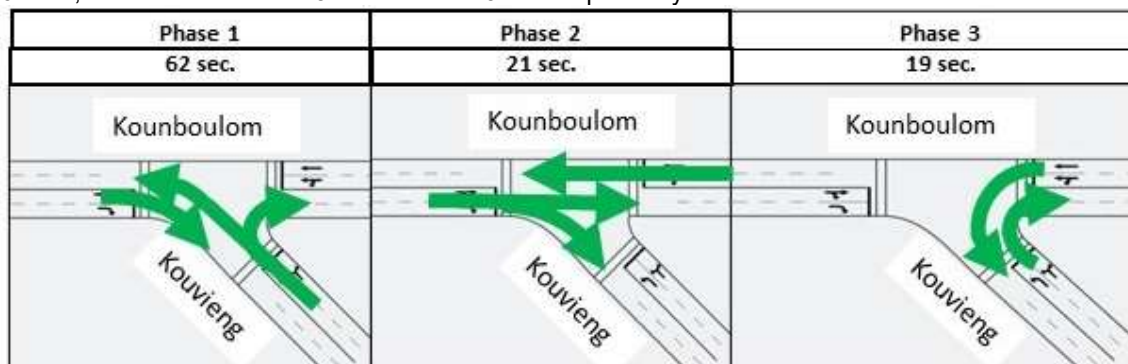
INTERSECTION 39 SAMSENTHAI / CHANTHAKOUMMANE

This intersection has no traffic signals at present. New Traffic Light to be provided to control the intersection with two phases. As Samsenthai Rue is the main flow, the phasing will be 70 sec for this road and 20 sec for Chanthakoummane road.

LOS is A for Samsenthai and C for Chanthakoummane.

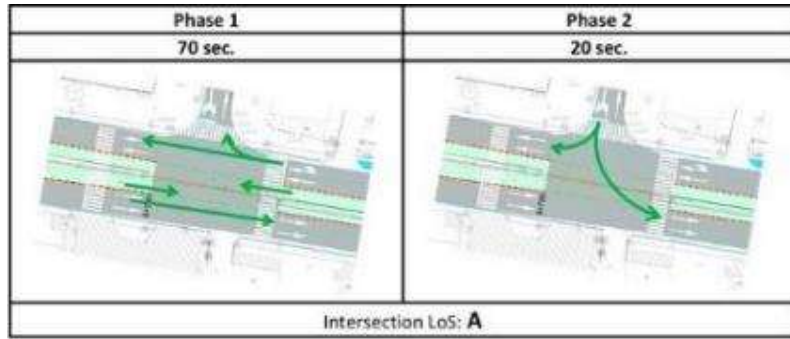
INTERSECTION 40 KOUNBOULOM / KOUVIENG

This T-junction has existing traffic signals, which need to be modified to be three phases: Phase 1 with 62 sec, Phase 2 and Phase 3 with 21 and 19 sec respectively.



INTERSECTION 49. DONGDOK VILLAGE / 450 YEAR RD

This intersection provides access around Dongdok village and has no traffic lights at present. 2-phase traffic lights are required to control the traffic and ensure Priority to the BRT Buses. Pre-emptive device will give priority to BRT bus approaching during the second phase. Level of Service is A.

**U-TURNS 3+450, 5+250, 6+500, 7+805**

Four U-Turns will be accommodated along Kaysone Phomvihane Road. Traffic signals will be required to control the crossing of the BRT exclusive lanes. The traffic lights will be two phases: Green U-Turn for general traffic with no BRT bus in sight, red U-Turn for general traffic whenever a bus approaches the U-Turn, using pre-emptive device. Level of service should be **A**.

