TECHNICAL ASSESSMENT

1. The proposed Mass Rapid Transit (MRT) Line 2 is a large complex project which requires significant coordination of key design elements to ensure successful implementation of the works. As the MRT is a new type of investment for ADB, the technical assessment summarizes key issues and the solutions adopted during project design to provide a more comprehensive understanding of how these key issues interact and have affected the other project features.

A. Transport Masterplan Issues

2. Transport Masterplan Amendments. A Transport Network Master plan for HCMC was approved by the Prime Minister in January 2007. This plan is part of the recommendations for future transport development of the city, which envisage very high priority for public transport development. Modal share of travel in urban areas by public transport is targeted to be 40-50% by year 2025, compared with only around 5% today, and development of an urban rail network is seen as the backbone to achieve this objective.

3. The review of the Master plan recommended (i) the line at Ben Thanh was not optimal from a network point of view, (ii) a new Line 3B is created running parallel to the northwest of the former Line 3 and across Line 2, (iii) realign Line 4 central section to bypass Ben Thanh market and run along the river instead, and (iv) Line 5 realigned as an MRT circular line, completing the “missing link”. The recommendations in the Optimised MRT Master Plan were partially adopted, with major changes subject to a more extensive government internal consultation process. The latest Master Plan is indicated in Figure 1 below.

Figure 1 – Optimised MRT Master Plan
4. **Inter-Operability of MRT Lines.** The term “inter-operability” between MRT lines refers to the ability to physically run trains from one line on the tracks and system of another. This may be advantageous for purposes such as shared depot and maintenance facilities – provided that connections are in place between the various lines to maneuver trains from one line to another. For limited or small scale MRT networks it would generally be desirable for inter-operability between lines. For larger scale MRT networks such as that planned for HCMC, it is likely that each line will require its own depot facilities and that physical connection between all lines may not be feasible. Most cities world-wide with extensive MRT networks tend to have more than one type of system and full inter-operability between all lines is not a key issue. Examples of such cities in Asia include Tokyo, Singapore, Bangkok and Shanghai.

5. MRT Line 1 characteristics generally conform to standards and rolling stock with key features of the system include: (i) Standard gauge (1,435mm) steel track and (ii) Overhead catenary 1,500V power supply to trains. Whereas Line 2 characteristic and key features of the system include: (i) Standard gauge (1,435mm) steel track, (ii) Third rail 750V power supply to trains, and (iii) 6-car trains with cars 3.2m wide x 22m long. Thus in the case of Lines 1 and 2, the trains operating on each line would not be able to run on the tracks of the other line. In other words, inter-operability between Lines 1 and 2 would not be possible.

6. After analysis and study of the planned HCMC MRT network, it was concluded as follows: (i) inter-operability between groups of lines would be desirable, but full inter-operability between all lines across the whole network was neither practical nor necessary (as noted with other major cities), (ii) physical connection between Lines 1 and 2 (which would have to be at or near Ben Thanh Station) would be extremely difficult if not impossible, due to the many high rise buildings and committed land plots in the area, (iii) inter-operability between Lines 2 and 6 on the other hand was essential, since Line 6 would share the Line 2 depot, and (iv) as Line 1 and Line 3A would necessarily be designed to the same standards for the same rolling stock; with the possible connection of Line 3B to Line 3A, then inter-operability between these lines was desirable. It was confirmed by the Management Authority for Urban Railways (MAUR) that the MRT lines should be planned as two main groups: inter-operability within each group of lines would be desirable or essential; whilst inter-operability between different groups was not essential. The two groups of lines are Lines 1, 3A and 3B and Lines 2, 6. The grouping of Lines 4 and 5 remains subject to further study.

B. **Design Characteristics**

7. **Design Principles and Criteria.** The key underlying design criteria and principles for the civil works were (i) to minimize visual and noise intrusion along the dense urban corridor, (ii) to provide a system with reasonable operating headways to serve both initial and future patronage demands, (iii) to provide cars of sufficient size and capacity to meet long term demands, (iv) a modern system using trains with or without drivers, but with ATP (Automatic Train Protection), ATS (Automatic Train Supervision), and ATO (Automatic Train Operation), (v) to set the underground station platform level as shallow as possible for passenger convenience, (vi) to optimise the alignment to minimize impacts on properties and hence the resettlement cost, (vii) adopting construction methods to avoid traffic and utilities diversions and optimize construction time, (viii) use twin tunnels to raise as high as possible the rail level in stations and to limit settlement under buildings and utilities, (ix) use “U” shape structure for elevated sections to limit the visual impact of the viaduct in the street and optimize the construction cost, (x) use Tunnel Boring Machines (TBM) to avoid traffic and utilities diversions and optimize construction.
time, and (xi) use cut and cover method of construction for stations with the top-down method (ensuring the street always has at least one lane in each direction operational).

8. **Station design.** Underground stations have a central island platform to suit the choice of twin tunnels, and the width of the central platform fixes the spacing of the twin tunnels at stations at 16.5m. Platform levels are generally around 15m below ground, with a concourse above the platform level. The public areas of the stations are designed and dimensioned in order to give conformity to both comfort in everyday use and in emergency. All public parts of the stations are accessible to those of reduced mobility by means of lifts. Escalators are generally provided in the upward direction only, with down escalators in cases where demands are very high or level difference is high.

9. **Station Interchanges.** Ben Thanh will be a major interchange station between Metro Lines 1, 2 and 4 (based on the Latest MRT master plan), together with surface transport (bus terminal, taxis, etc) and surrounding developments. A separate design and planning study is proposed for the station, and the final design of Ben Thanh interchange station will be developed by that study. It is an important requirement that construction of the Ben Thanh Interchange station and associated Line 2 garage and other facilities must be completed in time for opening of Line 2 operations. This will need to include appropriate time to complete the Line 2 track work, control and operating systems at Ben Thanh station and garage, and to allow time for finishings and commissioning tests. Tao Dan station will be an interchange station between Line 2 and Line 3B. Bay Hien will be a future interchange station with Line 5 and based on current plans, will pass beneath Line 2, and that passenger interchange will be provided between the two Lines. Ba Queo station will provide future interchange with Line 6, which is planned as a spur line from Line 2, and will interconnect with Line 2 at Ba Queo in order to share depot facilities.

10. **Depot Design.** The depot to be constructed at Tham Luong for Line 2 may be required to serve three purposes in the long term: (i) the Line 2 "project line" from Ben Thanh – Tham Luong, (ii) for Line 6 spur line, and (iii) for future extensions of Line 2 to Thu Thiem and An Suong. The proposed depot has capacity for stabling 28 6-car trains and is therefore more than adequate for the project requirements up to 2035, and has sufficient capacity to accommodate both the Extended Line 2 and Line 6 until beyond 2025.

11. **Power Supply.** Power is normally supplied to metro systems in one of two ways, either via a conductor rail alongside the track known as ‘3rd Rail’ (usually 750V), or via an overhead catenary wire system (usually 1500V or 25kV). Considerable research was undertaken and concluded that (i) both systems are commonly in use for urban and suburban MRT systems around the world, (ii) 3rd rail is commonly used for urban Metro systems, serving central city areas with dense station spacing, (iii) overhead catenary is generally adopted for longer distance and faster speed routes such as suburban metro (and indeed, inter-city and high speed rail), and (iv) key advantages of 3rd rail for urban Metro include much lower and simpler maintenance requirements and costs, less vertical clearance meaning that tunnels can be smaller for the same size of train, giving a significant saving in costs, less visually intrusive for elevated or at-grade sections, lower electro-magnetic impacts on passengers and equipment in the trains and lower voltage drops between sub-stations. Overall it was concluded that the 3rd rail technology as proposed for Line 2 was entirely suitable for this type of urban MRT line in HCMC.

12. **Fare Collection and Ticketing.** Passenger convenience will be essential for the success of the HCMC metro system, and to this end comprehensive integration of fares and
ticketing across all metro lines, and other public transport systems if possible, should be the target. As tenders for Line 1 have been invited, including implementation of an Automatic Fare Collection (AFC) system, it would be a requirement that Line 2 should adopt and be integrated with the Line 1 AFC system. In principle the system is capable of being expanded, and uses a smart card (Type C) but cash payments will also be accepted. There is no current proposal under the Line 1 contracts to integrate fares with other MRT lines or with bus services. It is assumed that Line 2 will adopt the Line 1 system to provide a basis for full interoperability of ticket products on all MRT lines, and between MRT and bus.

C. Construction Issues

13. The overall estimated construction programme assumes deployment of two TBM’s, both to be launched from the southern end of the project, from award of construction contracts to commencement of services estimated at around 6.5 years. Cut-and-cover excavations for each station must be completed prior to arrival of the TBM’s. Prior to preparation and award of construction contracts, further investigations should be undertaken in order that the contract terms may be clearly defined. These will form some of the functional and basic design studies to be undertaken by the consultant.

14. Civil Works Contract Packaging. It is planned that there will be a turnkey contract under KfW financing for the E&M systems, whilst civil works will be financed by ADB and EIB. An implementation consultant will assist MAUR with functional design, procurement and construction supervision for all packages in two phases: (i) preparation of the operation concept, elaboration of the functional design for the E&M / Rolling Stock Package, tender documents for that package, basic design for up to 4 civil works packages including non-system E&M and respective tender documents as well as the evaluation of offers and the assistance in contract negotiations and (ii) check and approval of designs of E&M/RS and civil works, supervision of construction works and installations for quality assurance and assistance with interface and claim management. This will also cover the commissioning, system integration and final acceptance. For the civil engineering works (including non-system E&M), the consultant will prepare basic design, tender documents and evaluation of tenders. The main components of the civil works will include; bored tunnels (using TBM’s), underground stations, elevated station, viaducts and depot civil works and non-system E&M (tracks, tunnel equipment, station equipment, lighting, ventilation, etc).

D. Service Operations and Maintenance Issues

15. The operations plan is based on the forecast travel demands, with peak loading is estimated at 37,500 pphpd at year 2035. For the off-peak period it is estimated for planning purposes that the traffic will be 75% of the peak load, and the evening demand 50% of the peak load. For Sundays and holidays it is estimated that the traffic represents 75% of the working days passengers.

16. Operations and Maintenance Plans. The proposed Metro line 2 organization is defined according to the operational departments indicated in Figure 2 below.
17. The maintenance department operation staffs are lightly involved in the maintenance process: vehicle reconfiguration by drivers, equipment reset or restarts by station staff. This is fundamental to guarantee the availability of the transit system. These operations are strictly documented by procedures and do not require any special tool equipment. The maintenance division groups all the maintenance activities and the maintenance team is internal and sized to produce the first levels of maintenance. This structure allows the operator to control the maintenance activity (corrective and preventive) and its reactivity. The heavy patrimonial maintenance, line replaceable units fixing or electronic modules and computers maintenance are all contracted. The purchasing and contracts management will be under the responsibility of the engineering team.