Exhibit 8 – Annual Demands and Reference Fleet

Index

1. INTRODUCTION

This **synthesis** Technical Report describes an **exploratory study** about the DEMAND AGGREGATION POTENTIAL to the current Suburb Train, against the possible physical and operational improvements in the current railway line of the city of Salvador/BA, transforming them for the operation of a **LRV – Light Rail Vehicle** Line.

Some aspects that guided this study are highlighted: the update of the database with the information of the recent survey OD/2012; the zoning used in the analysis within the influence areas of the railway line/LRV; and the main PREMISES adopted in this work that, logically, will induce the results to be obtained.

The conditions that guided the conception of EACH SCENARIO are described and present the parameters used in the respective simulations.

The synthesis of the results generated by the simulations performed are presented and incorporates a COMPARATIVE TABLE of the daily values, **estimated for the POTENTIAL DEMAND** in each of the seventeen scenarios studied and some critical evaluations on them, with the FINAL CONSIDERATIONS on the main results.

The complete reports, as well as their annexes where the bus lines that were part of the feeding of users integrated to the Suburb LRV are listed, discriminated in isolation for each LRV stop, linked to the scenarios that considered the NON-COMPETITION with the Suburb LRV, are available at SEDUR for consultation of the interested parties.

2. REFERENCE DEMAND

Recently, SEINFRA (Infrastructure Secretariat) of the State of Bahia), contracted the performance of a new field work to update the former database on the daily displacement of the population, also encompassing the whole Metropolitan Region of Salvador (MRS) – the so-called **Survey OD/2012** – whose results were disclosed in the second half of 2013.

In addition, other changes were incorporated in the daily life of the city of Salvador, such as the integration between the CTSB lines that allow the free transshipment in a period of 2 hours and the planned integration between bus and subway.

This work, using these new situations as a REFERENCE HYPOTHESIS, also considered **OTHER SCENARIOS** of integrated use with the LRV Line, as described here and with its main results commented in this Technical Report.

Although Salvador presented a significant urban evolution in the first decade of this century, which has put it as the third Brazilian city in population, this occupation growth focused in areas northeast of BR-324 ("Core") and axis of Av. Luís Viana (Av. Paralela) with Orla Atlântica.

Thus, the region called **"Railway Suburb"** remained with practically vegetative growth, and having the mobility of its population highly depending on the **CTSB** (Collective Transportation System by Bus) of Salvador and some **Metropolitan Lines**, which use the Av. Afrânio Peixoto corridor (or Av. Suburbana, as it is commonly known), to reach the diverse destinations in the city, from the Calçada region and of the old downtown of the city.

In this region there is an **old railway line** that also enables the transport of its population and that, including, fomented the occupation of this area in the beginning of the last century but that, currently, has a utilization practically restricted to its bordering users – with around 15 thousand daily passengers (in a BD) – facing the permeability that the bus system naturally allows, by its greater flexibility of special attendance.

Facing that, with this study it was planned to evaluate the **enlargement of the attendance level of the collective transportation demand** of this region of Salvador, by a significant PHYSICAL AND OPERATIONAL IMPROVEMENT OF THE CURRENT RAILWAY LINE that today connects the neighborhoods of Calçada and Paripe, partially using the existing railway line and starting to operate it as a **LRV – Light Rail Vehicle**.

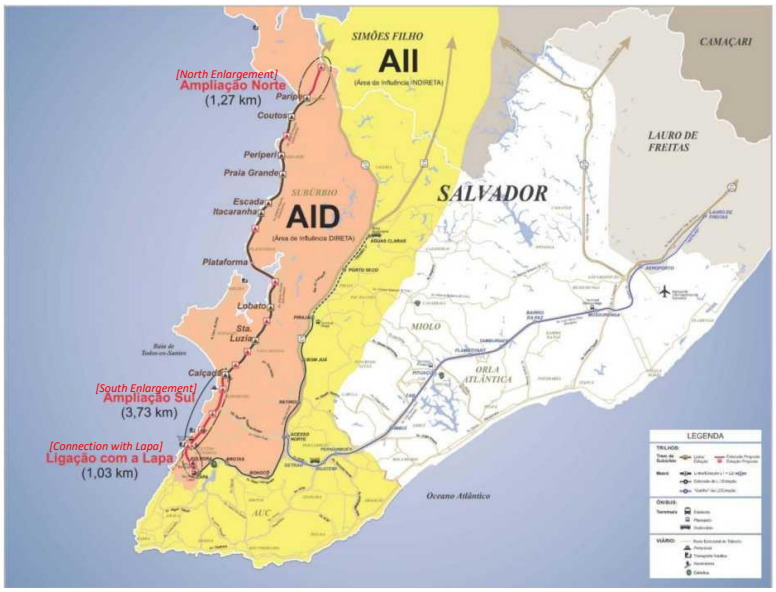
In this way, the "**enlargement of the current railway line (13.54 km)"** was imposed as the BASIC HYPOTHESIS in three stretches:

(i) At north, from **Paripe to BA-528** (road connection with Porto de Aratu and BR-324), in the region of São Luiz, with **1.27 km**;

(ii) At south, with the purpose to directly reach the central area of Salvador, from **Calçada to Comércio** (or Cidade Baixa in Centro Histórico), with around **3.73 km**;

(iii) As an additional extension, connecting the future LRV, **from Comércio to Estação Lapa**, where it articulates and integrates with Line 1 of the Subway, with **1.03 km** of extension from the region of Mercado Modelo, by a tunnel under the region of Pça Castro Alves, also passing by Terminal da Barroquinha.

Figure 1 – Influence Areas (DIA and IIA) of the Enlargement of the Suburb Railway



As main purpose of this work, it was fixed the determination of the estimate of users to the aggregated in the current railway line **– POTENTIAL DAILY DEMAND –** enlarged in its space coverage and with operational and accessibility improvements to the stations, respecting the information from the recent Survey OD/2012 and compatible with the studies previous to the Subway's PMI, and considering the current time integrations in the CTSB system and the plain operation of the Subway, that already occurs in its L1.

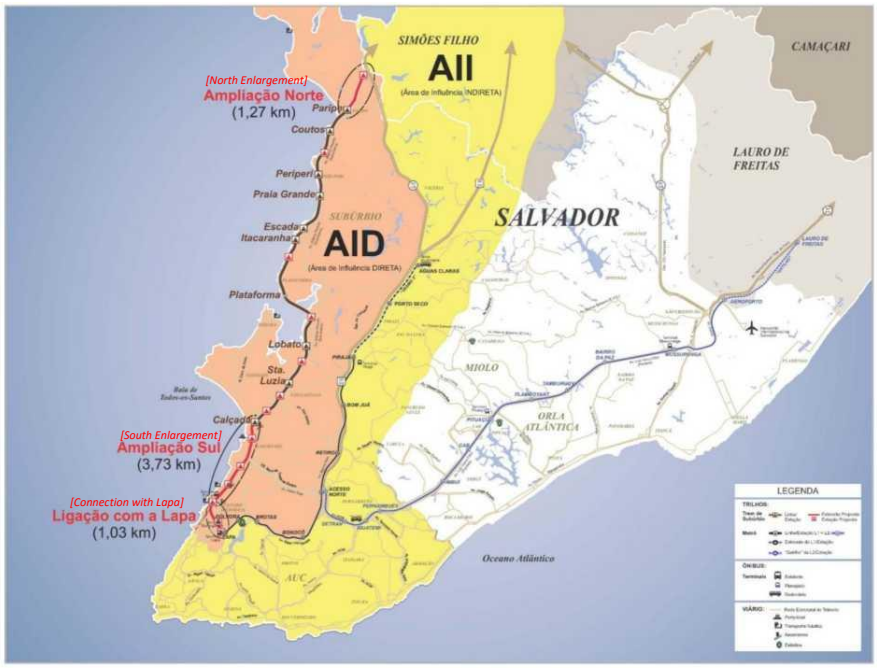
3. INFLUENCE AREA

Due to the analysis of displacement existing in the region of Av. Suburbana (of bus users) observed in the region of R. dos Ferroviários (Lobato/LUSO), main point of convergence of flows, and location that separates the north of the railway suburb (Plataforma-Paripe), of the south (Lobato-Calçada) and downtown (Comércio = old downtown; Iguatemi = new downtown) it can be defined as INFLUENCE AREAS of this study of improvements of the railway line and **LRV of the Suburb**:

(i) **Direct Influence Area (DIA) ->** area west of BR-324, covering the region of Porto de Aratu, Peninsula of Itapagibe and **Cidade Baixa**, in **CENTRO HISTÓRICO**;

(ii) **Indirect Influence Area (IIA) ->** areas of RMS closer to the axis of BR-324 and what is left of AUC (Consolidated Urban Area) of Salvador, incorporating, for example, the areas of Iguatemi, Brotas, Barra, Graça, etc., in addition to the margins close to BR-324.

Figure 2 – Influence areas (DIA and IIA), of the Enlargement of Suburb Railway Line



4. INFORMATION BASE ON THE CURRENT DEMAND

The studies now developed are **TOTALLY based** on the information from **Survey OD/2012**, which quantified a total of **5,937,620 travels/BD (in 2012)**, in the whole RMS, disaggregated as illustrated in the table below, about its modal principles of performance:

Table 1 - Participation of Modes of Transport in Everyday Travel (2012)

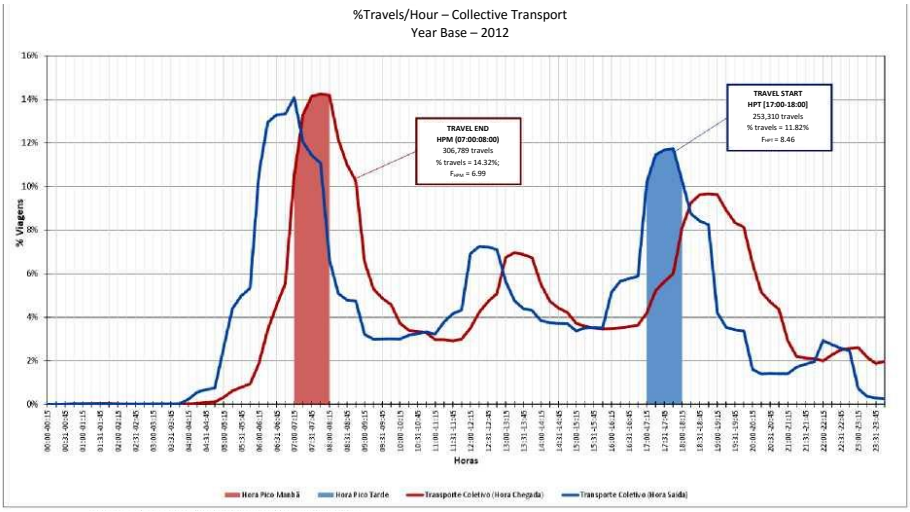
Mode OD – 2012	Travels (BD)	Modal	Travels (BD)	%
Municipal Bus	1,873,028	Collective (Public)	2,143,093	36.1%
Metropolitan Bus	203,094			
Van	66,972			
Driving Vehicle	803,172	Individual	1,642,559	27.7%
Vehicle Passenger	332,567			
School Transport	167,240			
Freight Bus	130,754			
Motorcycle	113,702			
Taxi	64,467			
Moto taxi	16,685			
Others	13,973			
On foot	2,097,843	Non-Motorized	2,151,967	36.2%
Bicycle	54,124			
TOTAL	**5,937,620**		**5,937,620**	**100%**

Source: Survey OD/2012 (SEINFRA/GEB)

Normally, in the **demand analysis studies** of public transportation, the conditions in which the **maximum demands** occur in the different modal subsystems are evaluated. Thus, when determining the need of offer to satisfy those maximum demands, in the hours remaining of a Business Day, the others demands will also be met.

So, from the analysis of this Survey OD/2012, about the **HOURLY FLUCTUATION of daily travels by Collective Transport** (see Figure 3), it was verified that the maximum concentration occurred in the morning period, with the **Rush Hour in the Morning (RHM)** representing a total of **14.32% of the daily travels**, in other words, having a **Rush Hour Factor (RHF) equal to 6.99**, factor used to represent its relation with the TOTAL FLOW in a typical business day (BD) in the year of reference of the Survey (2012).

Figure 3 – Hourly Fluctuation of the Travels by Collective Transport (CT)



Source: Survey OD/2012 (SEINFRA/GEB)

Following, due to the estimates of growth in the region (performed in the PMI studies of the Subway) and to the **adequacy of this Rush Factors,** of the Morning ($FPH_{morning}$) and Afternoon ($FPH_{afternoon}$), the daily demands of the alternative horizons studied in these works (see Table 2) for the years of 2012 (of the Survey OD) and **2017** were estimated as reference for this study of the operation of the "**Suburb LRV**".

Table 2 – Participation of the CT in Rush Hours

Total Travels per Collective Transport	Survey OD	Estimative
	2012	2017
	306,789	339,326
	253,310	283,927
Daily	2,143,093	2,502,727

Daily Adjustment Factor	Survey OD	Estimative
	2012	2017
Morning Rush Hour (F_{HPM})	6.99	7.38
Afternoon Rush Hour (F_{HPT})	8.46	8.81
Daily (F_D) =	3.83	4.02

M+T		

Source: Survey OD/2012 and TTC estimates

5. PREMISES OF THIS STUDY

In addition to the **basic hypothesis, "of extension of the space coverage"** of the railway line/New LRV – with its two initial enlargement stretches, representing more than 5.0 km of rails (see chapter 2) – and with the PURPOSE to enlarge the demand of the current users of the suburb train, some PREMISES that guided the evaluation of the results obtained in the simulation of the various **scenarios studied here** for the OPERATION OF THE SUBURB LRV were defined. They are:

a) **Improvement of the Accessibility of the Railway Line** – with the implementation of a greater number of stops/stations for boarding the LRV, in order to **enable a real competition with the CTSB** of Salvador. Thus, those stops/stations must have a distance between them **similar to the offered by the current bus lines**, notably in the downtown area (where most of the destinations are) of the LRV users. Such fact resulted in an increase of **ONE** new stop/station to the north; **SIX** stops/stations in the current stretch; and **SIX** stop/stations in the south stretch (close to the old/traditional downtown) of Salvador;

b) **Reorganization of the System by Bus –** scenarios were simulated in which the CTSB and metropolitan lines were sectioned ("CUT") in the LRV stops to promote a rationalization of the current system of the TC and a more adequate feeding to the rails. In addition, scenarios were simulated where the LRV is fed by the future BRT corridors, planned at Av. Gal Costa (connection in Lobato) and Av. 29 de Março (connection in Paripe);

c) **Increase in the Operational Speed –** even if the compositions may reach superior travel speed (up to 80 km/h), two practical circumstances that the reality imposes to the project were considered and conditioned the analysis: **(i)** the higher amount of stops/stations (23), which brings the performance of this line closer to a bus corridor; **(ii)** the necessary **coexistence** with the normal traffic, in shared traffic in the main corridors, notably in the new stretch with the central area (Calçada <> Comércio). Such facts conditioned to an **Operational Speed of 25 km/h**, as medium value to be adopted in the simulations for a New LRV Line.

d) **Reduction of the Interval between TUEs** – the necessary higher competition that a rail system has on a bus system presupposes a greater frequency of travels, in other words, less intervals between successive vehicles on the line, in order to reduce the waiting time of the users in the **boarding** stops/stations**.** Due to its supposed capacity to be offered in each composition (TUEs of 600pax/comp.), SEDUR/GEB fixed, as the **probable interval, 10 min between successive TUEs;**

e) **Tariff Policy –** despite that, currently, the railway service has a tariff of BRL 0.50 to its users (generally, bordering the existing stations), the precarious operational and space coverage conditions of the current railway line do not ensure a demand of passengers in accordance with an average capacity service. In accordance with the philosophy of creating an Transport Integrated Network (TIN) in Salvador, which covers all Collective Transport modals and with several connection points, **the same policy fixed in the subway studies** was adopted, adapted to the configurations of the "LRV Stops":

(i) **Current Tariff:** the **TRAIN** costs **BRL 0.50**; the **SUBWAY** in assisted operation, (information referring to September 2015), is not collecting tariff (**BRL 0.00**) and the **BUS** of the CTSB with a tariff of **BRL 3.00** and free time integration (2 hours);

(ii) **Bilhete Único (BU):** where the user only pays a single tariff when using the first transport mode that composes their travel: **TRAIN/LRV, SUBWAY** or **BUS** with a tariff of **BRL 3.00**, and the **other transfers** between the same or other modes are **free**;

(iii) **Integrated Tariff:** Following the same premises of the tariff system of the Bilhete Único, but with an increase of:

Option 1. **BRL 0.60** in the first transfer between the rails and the bus. The tariff charged for the exclusive use of the **LRV, SUBWAY and BUS** is of **BRL 3.00**; the first transshipment has an increase of BRL 0.60, which totals BRL 3.60, and the second transshipment is free.

Option 2. **BRL 1.20 in the Subway** and **BRL 1.80 in the LRV** for the first transfer between rails and bus. The tariff charged for the exclusive use of the **LRV, SUBWAY and BUS** is of **BRL 3.00**; the first transshipment has an increase of BRL 1.20 in the Subway and BRL 1.80 in the LRV, which totals BRL 4.20 in the Subway and BRL 4.80 in the LRV and the second transshipment is free (option simulated only with the purpose of analysis of tariff sensibility).

6. STRUCTURATION OF THE CT SIMULATIONS ON THE SUBURBS REGION

For the performance of this study, several scenarios of project simulation were defined. Each scenario is made of combinations of three situations of use of the Collective Transport (CT) regarding: (i) offer in the rails; (ii) offer in the bus lines; and (iii) tariff policy.

These situations are defined below, with highlight to the modifications between scenarios:

(i) Offer of CT Lines in the Rails:

- Configurations of the Train/LRV Line:
> Current: Train = Paripe <> Calçada.
> Future (1): LRV = São Luiz <> Calçada.
> Future (2): LRV = São Luiz <> Comércio.
> Future (3): LRV = São Luiz <> Lapa.

- Configuration of the Subway Lines:
> Current: L1 = Lapa <> Retiro (operation assisted in September 2015).
> Future (1): L1 = Lapa <> Pirajá; **L2** = Acesso Norte <> Aeroporto.
> Future (2): L1 = Lapa <> Águas Claras; **L2 =** Acesso Norte <> Lauro de Freitas.
(ii) Offer of the CT Lines, in Bus Lines (CTSB/STEC and Metropolitans):

- Configuration of the Bus Lines:
> Current: WITH COMPETITION in the Train; WITHOUT COMPETITION in the Subway.
> Future (1): WITH COMPETITION in the LRV; Without Competition in the Subway.
> Future (2): WITHOUT COMPETITION in the LRV; Without Competition in the Subway.

- Configuration in the BRT Lines:
> Current: WITHOUT Transversal BRT.
> Future (1): WITHOUT Transversal BRT.
> Future (2): WITH Transversal BRT – at Av. 29 de Março and at Av. Gal Costa.

(iii) Tariff Policy:

The evaluation of the tariff impact for the user, in the use of the CT system of the region, considered the **situation effective in September 2015** for the several modals, which enables the **CALIBRATION** of the offer simulation model, using as reference the CTSB Tariff of Salvador (= BRL 3.00).

- Tariff: CURRENT (in September 2015):
> Train: BRL 0.50
> Subway BRL 0.00 (assisted operation; at the time)
> **Bus: BRL 3.00** (BASIC REFERENCE)
> Transfer: There was no integration between the suburb train and the bus

- Tariff: BILHETE ÚNICO:
> LRV: BRL 3.00
> Subway: BRL 3.00
> Bus: BRL 3.00
> Transfer: **Free** (between all modals)

Tariff: INTEGRATED:
Option 1:
> LRV: BRL 3.00
> Subway: BRL 3.00
> Bus: BRL 3.00
> Transfer subway and LRV: 1st Transshipment = **BRL 0.60** and 2nd transshipment = Free

Option 2:
> LRV: BRL 3.00
> Subway: BRL 3.00
> Bus: BRL 3.00
> Transfer LRV: 1st Transshipment = **BRL 1.80** and 2nd Transshipment = Free
> Transfer Subway: 1st Transshipment = **BRL 1.20** and 2nd Transshipment = Free

The scenarios studied were elaborated based on the three large situations previously defined, where each scenario was made by the combination between a configuration of offer of rails, with a configuration of an offer of bus and with a configuration of tariff policy.

Table 3 below summarizes these combinations performed in the scenarios simulated (identified from "A" to "O"), where the stretches considered of the lines (Subway/VLT), tariff value of the integration and the form of consideration of the integrated bus lines (WITH or WITHOUT sectioning of these lines, in the LRV Stops) are displayed.

Table 3 – Configuration of the Simulated Scenarios:

PHYSICAL/OPERATIONAL CHARACTERISTICS OF THE CT NETWORKS: YEAR 2017
TRAIN -> HDW = 40 min; Operational Speed = 20 km/h
LRV -> HDW= 10 min; Operational Speed = 25 km/h

SCENARIO		STRETCH IN OPERATION					TARIFFS (BRL)				
		SUBWAY		TRAIN/LRV			Exclusive			With Transshipment	
		Stretch	Integration	Stretch	Integration	Length (Km)	Train/LRV	Subway	Bus	Train/LRV	Subway
PRELIMINARY STUDY SEDUR (dec/2013 – BASE)		L1 = LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Program Contract	São Luiz <> Comércio	WITH "cuts"	18.54	3.00	3.00	3.00	4.80	3.00
CURRENT SITUATION (set – 2015) CALIBRATION	A	L1 = LAPA <>RETIRO	Assisted Operation	Paripe <> Calçada	WITHOUT "cuts"	13.54	0.50	0.00	3.00	3.50	3.00
STEP 4 Subway "Basic"	B	L1 = LAPA <> PIRAJA L2 = AC. NORTE <> AEROPORTO	Integration	Paripe <> Calçada	WITHOUT "cuts"	13.54	0.50	3.00	3.00	3.50	3.00
	C	L1 = LAPA <> PIRAJA L2 = AC. NORTE <> AEROPORTO	Integration	São Luiz <> Comércio	WITH "cuts"	18.54	3.00	3.00	3.00	3.00	3.00
	D	L1 = LAPA <> PIRAJA L2 = AC. NORTE <> AEROPORTO	Integration	São Luiz <> Lapa	WITH "cuts"	19.57	3.00	3.00	3.00	3.00	3.00
STEP 5 Subway "Extended"	E	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	Paripe <> Calçada	WITHOUT "cuts"	13.54	0.50	3.00	3.00	3.50	3.00
	F	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Calçada	WITHOUT "cuts"	14.81	3.00	3.00	3.00	3.00	3.00
	G	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	WITHOUT "cuts"	18.54	3.00	3.00	3.00	3.00	3.00
	H	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	WITH "cuts"	18.54	3.00	3.00	3.00	3.00	3.00
	I	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Lapa	WITH "cuts"	19.57	3.00	3.00	3.00	3.00	3.00
	J	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	With Transversal BRT	São Luiz <> Lapa	WITH "cuts"	19.57	3.00	3.00	3.00	3.00	3.00
	K	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	WITH "cuts"	18.54	3.00	3.00	3.60	3.60	3.60
	L	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Lapa	WITH "cuts"	19.57	3.00	3.00	3.60	3.60	3.60
	M	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	With Transversal BRT	São Luiz <> Lapa	WITH "cuts"	19.57	3.00	3.00	3.60	3.60	3.60
	N	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	WITH "cuts"	18.54	3.00	3.00	4.80	4.80	4.20
	O	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Lapa	WITH "cuts"	19.57	3.00	3.00	4.80	4.80	4.20

In the sequence of this technical document, each SCENARIO that composed the simulations performed in this study that were named with the letters from "A" to "O" are briefly described, accompanied by the respective synthetic map that illustrates them:

NOTE: To enable a homogeneous evaluation/comparison in the results obtained, they were simulated only for the year defined as the REFERENCE YEAR of **2017**, for operation of the systems on rails.

- **CURRENT Scenario** – Recalibration Situation

The reference scenario for the new simulations, named CURRENT SITUATION, described the offer of transport in the date in which this study is based:

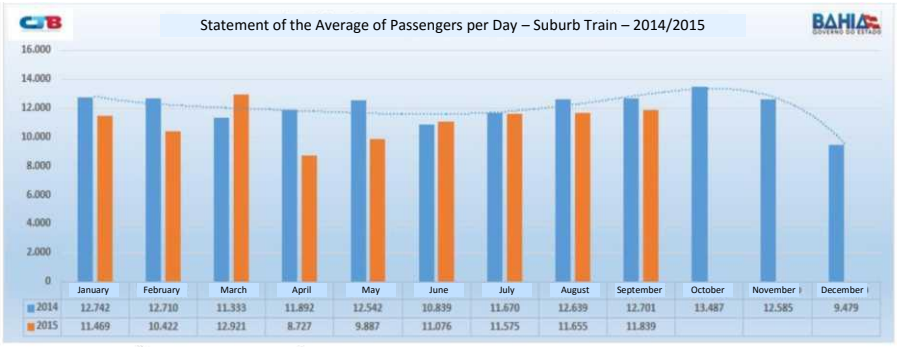
> Period of **calibration of the model -> September 2015.**
> Existing train (PARIPE <> CALÇADA and 10 stations).
> Subway L1 (LAPA <> RETIRO) -> with assisted operation.
> Bus Lines EXISTING (CTSB/STEC and Metropolitans).

This scenario was created to allow the calibration of the new model to the data of demand observed **in the Train and Subway** with the reference of September 2015. The referred data were obtained in CTB – Companhia de Transportes do Estado da Bahia website. The suburb train was simulated with its operational parameters and effective tariffs in the reference dates, as well as L1 of the Subway with the **assisted operation**, without charge of tariff (at the time).
The parameters of the model were adjusted in a way that the quantity of passengers modeled was equivalent to the demand data obtained.

The **parameters** that defined this **Scenario A – CURRENT SITUATION** can be synthetized in:

- Existing Railway (Paripe <> Calçada) = 13.45 km existing)
- Operational Speed = 20 km/h.
- Current headway = 40 min (at HPM).
- Subway -> L1 = Lapa <> Retiro (Assisted Operation).
- Bus Lines (CTSB + STEC + Metropolitans) WITHOUT “cuts” (competition with the Subway and Train).
- Tariffs -> Train = BRL 0.50 (without integration).
  Subway = BRL 0.00 (assisted operation).

Figure 4 – Calibration Data of the SUBURB TRAIN



REFERENCE VALUE = 14,100 pax/BD

NOTE: The value of 11,839 pax/BD referring to September 2015 was adjusted by dividing by the factor of 0.84 for the correction between the weekly daily average and the business days daily average; thus, the reference demand of the Train is 14,100 pax/BD.

- <u>Scenario B</u>

Scenario B was the first scenario simulated as an offer of future line of collective transport. The purpose of this scenario was to evaluate the impact of the initial implantation of both railway lines, on the demand of the Suburb Train.

Thus, the offer of transports of **Scenario B** is described below:

> Existing train (PARIPE <> CALÇADA and 10 stations).
> Subway **L1 (LAPA <> PIRAJÁ) + L2 (ACESSO NORTE <> AEROPORTO).**
> Bus Lines **<u>WITHOUT "cuts" in the Suburb Train</u>.**
> Bus Lines **<u>WITHOUT "cuts" in the Subway</u>.**

The **parameters** that defined this **Scenario B** can be synthetized in:

- Existing Railway (Paripe <> Calçada) = 13.54 km existing.
- Operational Speed = 20 km/h
- Current Headway = 40 min (at HPM).
- Subway -> L1 = Lapa <> Pirajá.

- Subway -> L2 = Acesso Norte <> Aeroporto.
- Bus Lines (CTSB + STEC + Metropolitans) -> WITHOUT "cuts" (competition with the Subway and Train).
- Tariffs -> Train = BRL 0.50 (without integration); Subway – BRL 3.00 (with integration with the bus = BRL 3.00 + BRL 0.00).

- **Scenario C**

Scenario C described below was the first scenario simulated with the UNION OF FUTURE OFFER of the Subway and LRV jointly. The purpose of this scenario was to obtain the first estimate of demand of the LRV, from São Luiz to Comércio, already considering the bus lines of CTSB and metropolitans "cut" and integrated in their tariff with the bilhete único (BU), but with the Subway still "short", in other words, L1 to Pirajá and L2 to Aeroporto.

The offer of transports of **Scenario C** is described below:

> LRV (SÃO LUIZ <> COMERCIO and 21 stations).
> Subway **L1 (LAPA <> PIRAJÁ) + L2 (ACESSO NORTE <> AEROPORTO).**
> Bus Lines **WITH "cuts" in the Subway.**
> Bus Lines **WITH "cuts" in the Suburb LRV.**

The **parameters** that defined this **Scenario C** may be synthetized in:

- Extended LRV (São Luiz <> COMÉRCIO) = 18.54 km.
- Operational Speed = 25 km/h
- Current Headway = 10 min (at HPM).
- Subway -> L1 = Lapa <> Pirajá.
L2 = Acesso Norte <> Aeroporto.
- Bus Lines (CTSB + STEC + Metropolitans) -> WITH "cuts" (without competition with the Subway and LRV).
- Tariffs -> LRV = BRL 3.00 (integrated with the bus = BRL 3.00 + BRL 0.00); Subway – BRL 3.00 (with integrated with the bus = BRL 3.00 + BRL 0.00).

- **Scenario D**

Scenario D described below is a variation of Scenario C, because it contains the Subway with Lines 1 and 2 in Step 4 and the future LRV extended from São Luiz to station Lapa, and integrated freely to the subway in this station. The objective of this scenario is to capture the impact on the LRV demand when extending it to station LAPA and integrating it physically and with its tariff to the Subway.

The offer of transports of **Scenario D** is described below:

> LRV (SÃO LUIZ <> LAPA and 23 stations).
> Subway L1 (LAPA <> PIRAJÁ) + L2 (ACESSO NORTE <> AEROPORTO).
> Bus Lines **WITH "cuts" in the Subway.**
> Bus Lines **WITH "cuts" in the Suburb LRV.**

The **parameters** that defined this **Scenario D** may be synthetized in:

- Extended LRV (São Luiz <> LAPA) = 19.57 km.
- Operational Speed = 25 km/h
- Current Headway = 10 min (at HPM).
- Subway -> L1 = Lapa <> Pirajá.
L2 = Acesso Norte <> Aeroporto.
- Bus Lines (CTSB + STEC + Metropolitans) -> WITH "cuts" (without competition with the Subway and LRV).
- Tariffs -> LRV = BRL 3.00 (integrated with the bus = BRL 3.00 + BRL 0.00); Subway – BRL 3.00 (with integrated with the bus = BRL 3.00 + BRL 0.00).

- Scenario E

Thus, **Scenario E** described below was the first of a set of scenarios that cover the **Subway in its complete project**. This first test had the purpose to simulate the impact of the Subway in the Train in its current configuration. It can be compared to Scenario B.

The difference between Scenario E and Scenario B is the impact in the extension of the Subway to Águas Claras in the current train. Still, this Scenario also becomes the new reference to evaluate the implantation of the future LRV, together with the Subway in its complete project.

The offer of transports of **Scenario E** is described below:

> LRV (SÃO LUIZ <> LAPA and 23 stations).

> Subway L1 (LAPA <> **ÁGUAS CLARAS**) + L2 (ACESSO NORTE <> **LAURO DE FREITAS**).
> Bus Lines **WITH "cuts" in the Subway.**
> Bus Lines **WITH "cuts" in the Suburb Train.**

The **parameters** that defined this **Scenario E** may be synthetized in:

- Existing Railway (Paripe <> Calçada) = 13.54 km.
- Operational Speed = 20 km/h
- Current Headway = 40 min (at HPM).
- Subway -> L1 = Lapa <> **Águas Claras** L2 = Acesso Norte <> **Lauro de Freitas**.
- Bus Lines (CTSB + STEC + Metropolitans) –
> WITHOUT "cuts" (with competition with the LRV).
- Tariffs -> Train = BRL 0.50 (without integration with the bus); Subway – BRL 3.00 (with integration with the bus = BRL 3.00 + BRL 0.00).

- Scenario F

Scenario F described below covers the subway in its complete project and the implantation of the LRV from São Luiz to Calçada. It is the first test of demand considering the implantation of the **LRV only in its north extension**, with the subway complete and integrated in tariff.

The offer of transports of **Scenario F** is described below:

> LRV (**SÃO LUIZ** <> CALÇADA and 17 stations).
> Subway L1 (LAPA <> ÁGUAS CLARAS) + L2 (ACESSO NORTE <> LAURO DE FREITAS).
> Bus Lines **WITH "cuts" in the Subway.**
> Bus Lines **WITHOUT "cuts" in the Suburb LRV.**

The **parameters** that defined this **Scenario F** may be synthetized in:

- Extended LRV (Paripe <> Calçada) = 14.81 km.
- Operational Speed = 25 km/h
- Current Headway = 10 min (at HPM).
- Subway -> L1 = Lapa <> Águas Claras L2 = Acesso Norte <> Lauro de Freitas.
- Bus Lines (CTSB + STEC + Metropolitans)
> WITHOUT "cuts" in the LRV (with competition with the LRV).
> WITH "cuts" in the Subway (without competition with the Subway).

- Bus Lines (CTSB + STEC + Metropolitans)
> WITHOUT “cuts” in the LRV (with competition with the LRV).
> WITH “cuts” in the Subway (without competition with the Subway).
- Tariffs -> LRV = BRL 3.00 (with integration with the bus = BRL 3.00 + BRL 0.00).
Subway – BRL 3.00 (with integration with the bus = BRL 3.00 + BRL 0.00).

- Scenario G

Scenario G described below covers the subway in its complete project and the implantation of the LRV now extended both in the North way until São Luiz, and also in the South way until Comércio. This scenario can be compared to the previous scenario to identify the impact of the extent of the LRV from Calçada to Comércio, but always with the tariff integration.

The offer of transports of **Scenario G** is described below:

> LRV (SÃO LUIZ <> **COMÉRCIO** and 21 stations).
> Subway L1 (LAPA <> ÁGUAS CLARAS) + L2 (ACESSO NORTE <> LAURO DE FREITAS).
> Bus Lines **WITH “cuts” in the Subway.**
> Bus Lines **WITHOUT “cuts” in the Suburb LRV.**

The **parameters** that defined this **Scenario G** may be synthetized in:

- Extended LRV (São Luiz <> Calçada) = 18.54 km.
- Operational Speed = 25 km/h
- Current Headway = 10 min (at HPM).
- Subway -> L1 = Lapa <> Águas Claras L2 = Acesso Norte <> Lauro de Freitas.
- Bus Lines (CTSB + STEC + Metropolitans)
> WITHOUT “cuts” in the LRV (with competition with the LRV).
> WITH “cuts” in the Subway (without competition with the Subway).

- Tariffs -> LRV = BRL 3.00 (with integration with the bus = BRL 3.00 + BRL 0.00).
Subway – BRL 3.00 (with integration with the bus = BRL 3.00 + BRL 0.00).

- Scenario H

Scenario H described below in a simulation considering the **"cut" of the bus lines** in the LRV in its whole extension from São Luiz to Comércio. It has the purpose to evaluate the impact of the "line cuts", if compared to the previous scenario; always considering the tariff integration.

The offer of transports of **Scenario H** is described below:

> LRV (SÃO LUIZ <> COMÉRCIO and 21 stations).
> Subway L1 (LAPA <> ÁGUAS CLARAS) + L2 (ACESSO NORTE <> LAURO DE FREITAS).
> Bus Lines **WITH "cuts" in the Subway.**
> Bus Lines **WITHOUT "cuts" in the Suburb LRV.**

The **parameters** that defined this **Scenario H** may be synthetized in:

- Extended LRV (São Luiz <> Calçada) = 18.54 km.
- Operational Speed = 25 km/h
- Current Headway = 10 min (at HPM).
- Subway -> L1 = Lapa <> Águas Claras
L2 = Acesso Norte <> Lauro de Freitas.
- Bus Lines (CTSB + STEC + Metropolitans) > WITH "cuts" (without competition with the LRV and with the Subway).
- Tariffs -> LRV = BRL 3.00 (with integration with the bus = BRL 3.00 + BRL 0.00).
Subway – BRL 3.00 (with integration with the bus = BRL 3.00 + BRL 0.00).

- Scenario I

Scenario I described below is an evaluation of the impact in the demand of the LRV with its extension to Lapa and performing the physical and tariff integration with the Subway. If compared to the previous scenario, it determines the **INCREASE IN DEMAND** due to the extension of the LRV to Lapa, even with the tariff integration.

The offer of transports of **Scenario I** is described below:

> LRV (SÃO LUIZ <> LAPA and 23 stations).
> Subway L1 (LAPA <> ÁGUAS CLARAS) + L2 (ACESSO NORTE <> LAURO DE FREITAS).
> Bus Lines **WITH "cuts" in the Subway.**

> Bus Lines **WITHOUT "cuts" in the Suburb LRV.**

The **parameters** that defined this **Scenario I** may be synthetized in:

- Extended LRV (São Luiz <> Calçada) = 19.57 km.
- Operational Speed = 25 km/h
- Future Headway = 10 min (at HPM).
- Subway -> L1 = Lapa <> Águas Claras
L2 = Acesso Norte <> Lauro de Freitas.
- Bus Lines (CTSB + STEC + Metropolitans) > WITH "cuts" (without competition with the LRV and with the Subway).
- Tariffs -> LRV = BRL 3.00 (with integration with the bus = BRL 3.00 + BRL 0.00).
Subway – BRL 3.00 (with integration with the bus = BRL 3.00 + BRL 0.00).

- Scenario J

Scenario J described below is an evaluation of the impact of the implementation of two Transversal BRT lines in the LRV demand. This scenario also maintains the characteristics of the rails if the previous scenario and adds the BRTs of Av. Gal Costas and Av. 29 de Março. The difference between Scenarios J and I is the impact of the BRT in the new LRV of the Suburb.

The offer of transports of **Scenario J** is described below:

> LRV (SÃO LUIZ <> LAPA and 23 stations).
> Subway L1 (LAPA <> ÁGUAS CLARAS) + L2 (ACESSO NORTE <> LAURO DE FREITAS).
> Bus Lines **WITH "cuts" in the Subway.**
> Bus Lines **WITH "cuts" in the Suburb LRV.**
> Transversal BRTs.
> Av. 29 de Março.
> Av. Gal Costa

The **parameters** that defined this **Scenario J** may be synthetized in:

- Extended LRV (São Luiz <> LAPA and 23 stations) = 19.57 km.
- Operational Speed = 25 km/h
- Future Headway = 10 min (at HPM).
- Subway -> L1 = Lapa <> Águas Claras
L2 = Acesso Norte <> Lauro de Freitas.

- Transversal BRTs > A) Av. Gal Costa; B) Av. 29 de Março.
- Bus Lines (CTSB + STEC + Metropolitans) > WITH "cuts" (without competition with the LRV and with the Subway).
- Tariffs -> LRV = BRL 3.00 (with integration with the bus = BRL 3.00 + BRL 0.00).
Subway – BRL 3.00 (with integration with the bus = BRL 3.00 + BRL 0.00).

- Scenario K

Scenario K described below is a simulation where an increase of BRL 0.60 in the tariff is implemented for the performance of integrations between bus and LRV and also between bus and Subway. The effect of this additional tariff integration can be analyzed separately if this scenario is compared to Scenario H.

The offer of transports of **Scenario K** is described below:

> LRV (SÃO LUIZ <> COMÉRCIO and 21 stations).
> Subway L1 (LAPA <> ÁGUAS CLARAS) + L2 (ACESSO NORTE <> LAURO DE FREITAS).
> Bus Lines **WITH "cuts" in the Subway.**
> Bus Lines **WITHOUT "cuts" in the Suburb LRV.**

The **parameters** that defined this **Scenario k** may be synthetized in:

- Extended LRV (SÃO LUIZ <> COMÉRCIO and 21 stations) = 18.54 km.
- Operational Speed = 25 km/h
- Future Headway = 10 min (at HPM).
- Subway -> L1 = Lapa <> Águas Claras
L2 = Acesso Norte <> Lauro de Freitas.
- Bus Lines (CTSB + STEC + Metropolitans) > WITH "cuts" (without competition with the LRV and with the Subway).
- Tariffs -> LRV = BRL 3.00 (with integration with the bus = BRL 3.00 + **BRL 0.60**).
Subway – BRL 3.00 (with integration with the bus = BRL 3.00 + **BRL 0.60**).

- Scenario L

Scenario L described below is a simulation where the impact of an additional tariff and integration of BRL 060 between rails and bus, in the scenario with the LRV extended to Lapa was evaluated. The difference between this scenario and Scenario I indicates what is the impact in the LRV demand with the additional tariff for the integration.

The offer of transports of **Scenario L** is described below:

> LRV (SÃO LUIZ <> LAPA and 23 stations).
> Subway L1 (LAPA <> ÁGUAS CLARAS) + L2 (ACESSO NORTE <> LAURO DE FREITAS).
> Bus Lines **WITH "cuts" in the Subway.**
> Bus Lines **WITHOUT "cuts" in the Suburb LRV.**

The **parameters** that defined this **Scenario k** may be synthetized in:

- Extended LRV (SÃO LUIZ <> LAPA and 23 stations) = 19.57 km.
- Operational Speed = 25 km/h
- Future Headway = 10 min (at HPM).
- Subway -> L1 = Lapa <> Águas Claras
L2 = Acesso Norte <> Lauro de Freitas.
- Bus Lines (CTSB + STEC + Metropolitans) > WITH "cuts" (without competition with the LRV and with the Subway).
- Tariffs -> LRV = BRL 3.00 (with integration with the bus = BRL 3.00 + **BRL 0.60**).
Subway – BRL 3.00 (with integration with the bus = BRL 3.00 + **BRL 0.60**)

- Scenario M

Scenario M described below is a simulation where it was evaluated the impact of an additional tariff of BRL 0.60 for integration between rails and bus, in the scenario of the LRV extended to Lapa and with the implementation of the Transversal BRTs. The difference between this scenario and scenario J indicates what is the impact in the LRV demand with the integration tariff and the implantation of the transversal BRTs.

The offer of transports of **Scenario M** is described below:

> LRV (SÃO LUIZ <> LAPA and 23 stations).
> Subway L1 (LAPA <> ÁGUAS CLARAS) + L2 (ACESSO NORTE <> LAURO DE FREITAS).
> Bus Lines **WITH "cuts" in the Subway.**
> Bus Lines **WITHOUT "cuts" in the Suburb LRV.**

The **parameters** that defined this **Scenario M** may be synthetized in:

- Extended LRV (SÃO LUIZ <> LAPA and 23 stations) = 19.57 km.
- Operational Speed = 25 km/h

- Future Headway = 10 min (at HPM).
- Subway -> L1 = Lapa <> Águas Claras
L2 = Acesso Norte <> Lauro de Freitas.
- Transversal BRTs > A) Av. Gal Costa. B) Av. 29 de Março.
- Bus Lines (CTSB + STEC + Metropolitans) > WITH "cuts" (with competition with the LRV and with the Subway).
- Tariffs -> LRV = BRL 3.00 (with integration with the bus = BRL 3.00 + **BRL 0.60**).
Subway – BRL 3.00 (with integration with the bus = BRL 3.00 + **BRL 0.60**)

- Scenario N

Scenario N described below is a simulation of the LRV implanted from São Luiz to Comércio that has the purpose to evaluate a large additional tariff of integration in the value of BRL 1.80 between the LRV and bus. It is a sensibility test of the LRV demand with a sensible increase in the integration tariff. This Scenario can be compared to Scenario L, where the integration tariff is free, but also to Scenario K, where the additional integration tariff is of BRL 0.60.

The offer of transports of **Scenario N** is described below:

> LRV (SÃO LUIZ <> COMÉRCIO and 21 stations).
> Subway L1 (LAPA <> ÁGUAS CLARAS) + L2 (ACESSO NORTE <> LAURO DE FREITAS).
> Bus Lines **WITH "cuts" in the Subway.**
> Bus Lines **WITHOUT "cuts" in the Suburb LRV.**

The **parameters** that defined this **Scenario N** may be synthetized in:

- Extended LRV (SÃO LUIZ <> COMÉRCIO and 21 stations) = **18.54 km**.
- Operational Speed = 25 km/h
- Future Headway = 10 min (at HPM).
- Subway -> L1 = Lapa <> Águas Claras
L2 = Acesso Norte <> Lauro de Freitas.
- Bus Lines (CTSB + STEC + Metropolitans) > WITH "cuts" (with competition with the LRV and with the Subway).
- Tariffs -> LRV = BRL 3.00 (if integrated with the bus = BRL 3.00 + **BRL 1.80**).
Subway – BRL 3.00 (if integrated with the bus = BRL 3.00 + **BRL 1.20**)

- Scenario O

Scenario O described below is an analysis of sensibility to the integration tariff of BRL 1.80 with the LRV extended to Lapa. This scenario allows several comparisons to identify impacts in the LRV demand. It is possible to compare it to Scenario N to identify the increase of demand with the extension to Lapa, maintaining the same integration tariff. It is also possible to make a comparison with Scenarios L and J to identify the impact in the LRV demand due to an increase in the value of the integration with the LRV and bus.

The offer of transports of **Scenario O** is described below:

> LRV (SÃO LUIZ <> LAPA and 23 stations).
> Subway L1 (LAPA <> ÁGUAS CLARAS) + L2 (ACESSO NORTE <> LAURO DE FREITAS).
> Bus Lines **WITH "cuts" in the Subway.**
> Bus Lines **WITHOUT "cuts" in the Suburb LRV.**

The **parameters** that defined this **Scenario N** may be synthetized in:

- Extended LRV (SÃO LUIZ <> COMÉRCIO and 23 stations) = **19.57 km**.
- Operational Speed = 25 km/h
- Future Headway = 10 min (at HPM).
- Subway -> L1 = Lapa <> Águas Claras
L2 = Acesso Norte <> Lauro de Freitas.
- Bus Lines (CTSB + STEC + Metropolitans) > WITH "cuts" (with competition with the LRV and with the Subway).
- Tariffs -> LRV = BRL 3.00 (if integrated with the bus = BRL 3.00 + **BRL 1.80**).
Subway – BRL 3.00 (if integrated with the bus = BRL 3.00 + **BRL 1.20**)

6.1 SYNTHESIS OF THE RESULTS OBTAINED – SCENARIOS "A" TO "O"

As the **ESTIMATE OF THE DEMAND CAPTATION POTENTIAL** is the purpose of this study, due to the eventual **set of physical, operational and tariff improvements**, for the current users of the Collective Transport in the Suburb region were tested, by simulation with the software *EMME.4*, **Fourteen alternative Scenarios**, representing the situations estimated for the **year of 2017**, and compared with a **BASE Scenario**, determined from the recent information from the Survey OD/2012.

These scenarios had the purpose to simulate, **INDIVIDUALLY**, the impacts on the Suburb LRV demand due to the extensions of the line, competition or not of the bus system, different subway configuration, different values in the collection of the integration tariff, etc.

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In the following table, the values of the **DEMAND POTENTIAL** are presented, which can be aggregated to the operation of the **new line on rails**, if it is modernized in accordance with the specific parameters stipulated, for each scenario studied:

Table 4 – Salvador/BA Metropolitan Region – Study of the Potential Demand of the "Suburb LRV"

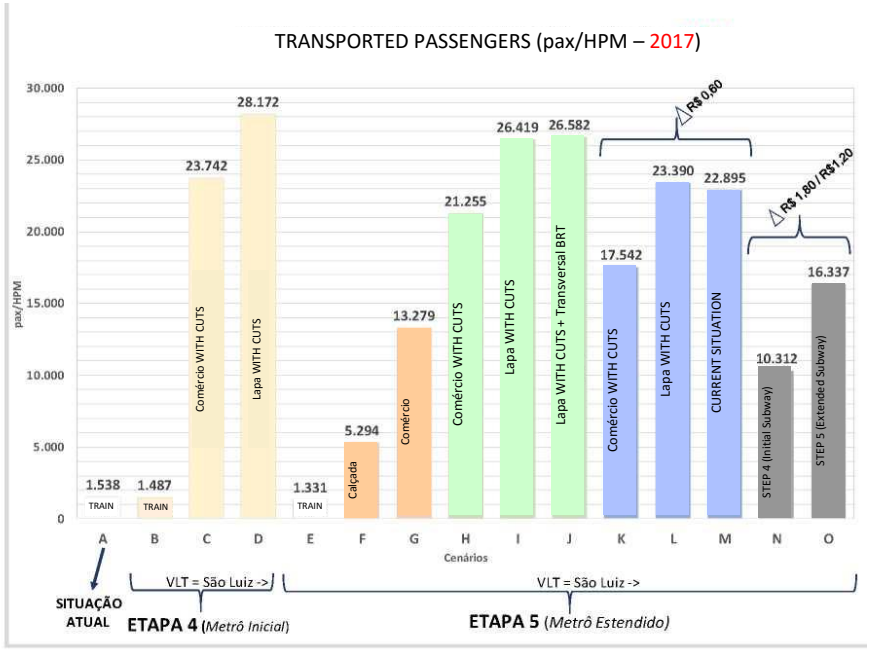
PHYSICAL/OPERATIONAL CHARACTERISTICS OF THE CT NETWORKS: YEAR 2017
TRAIN -> HDW = 40 min; Operational Speed = 20 km/h
LRV -> HDW= 10 min; Operational Speed = 25 km/h

SCENARIO		STRETCH IN OPERATION					TARIFFS (BRL)					TRANSPORTED PASSENGERS					
		SUBWAY		TRAIN/LRV			Exclusive			With Transshipment		TRAIN/LRV					
		Stretch	Integration	Stretch	Integration	Length (Km)	Train/LRV	Subway	Bus	Train/LRV	Subway	BOARDINGS (pax at HPM) Urbans (CSTB)	Metrop. (AGERBA)	Total	DAILY Pax/BD FPH=7.38	Cycle TIME (min)	Operational FLEET (TUEs)
PRELIMINARY STUDY SEDUR (dec/2013 – BASE)		L1 = LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Program Contract	São Luiz <> Comércio	WITH "cuts"	18.54	3.00	3.00	3.00	4.80	3.00	7,638	19	7,657	61,409	97	10
CURRENT SITUATION (set – 2015) CALIBRATION	A	L1 = LAPA <>RETIRO	Assisted Operation	Paripe <> Calçada	WITHOUT "cuts"	13.54	0.50	0.00	3.00	3.50	3.00	1,538	0	1,538	11,350	91	3
STEP 4 Subway "Basic"	B	L1 = LAPA <> PIRAJA L2 = AC. NORTE <> AEROPORTO	Integration	Paripe <> Calçada	WITHOUT "cuts"	13.54	0.50	3.00	3.00	3.50	3.00	1,487	0	1,487	10,974	91	3
	C	L1 = LAPA <> PIRAJA L2 = AC. NORTE <> AEROPORTO	Integration	São Luiz <> Comércio	WITH "cuts"	18.54	3.00	3.00	3.00	3.00	3.00	22,113	1,629	23,742	175,216	97	10
	D	L1 = LAPA <> PIRAJA L2 = AC. NORTE <> AEROPORTO	Integration	São Luiz <> Lapa	WITH "cuts"	19.57	3.00	3.00	3.00	3.00	3.00	26,539	1,633	28,172	207,909	102	10
STEP 5 Subway "Extended"	E	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	Paripe <> Calçada	WITHOUT "cuts"	13.54	0.50	3.00	3.00	3.50	3.00	1,331	0	1,331	9,823	91	3
	F	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Calçada	WITHOUT "cuts"	14.81	3.00	3.00	3.00	3.00	3.00	5,285	9	5,294	39,070	81	8
	G	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	WITHOUT "cuts"	18.54	3.00	3.00	3.00	3.00	3.00	13,260	19	13,279	97,999	97	10
	H	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	WITH "cuts"	18.54	3.00	3.00	3.00	3.00	3.00	20,262	993	21,255	156,862	97	10
	I	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Lapa	WITH "cuts"	19.57	3.00	3.00	3.00	3.00	3.00	25,201	1,218	26,419	194,972	102	10
	J	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	With Transversal BRT	São Luiz <> Lapa	WITH "cuts"	19.57	3.00	3.00	3.00	3.00	3.00	25,443	1,139	26,582	196,175	102	10
	K	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	WITH "cuts"	18.54	3.00	3.00	3.60	3.60	3.60	16,567	975	17,542	129,460	97	10
	L	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Lapa	WITH "cuts"	19.57	3.00	3.00	3.60	3.60	3.60	22,190	1,200	23,390	172,618	102	10
	M	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	With Transversal BRT	São Luiz <> Lapa	WITH "cuts"	19.57	3.00	3.00	3.60	3.60	3.60	21,774	1,121	22,895	168,965	102	10
	N	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	WITH "cuts"	18.54	3.00	3.00	4.80	4.80	4.20	9,683	629	10,312	76,103	97	10
	O	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Lapa	WITH "cuts"	19.57	3.00	3.00	4.80	4.80	4.20	15,428	909	16,337	120,567	102	10

The following figure indicates an absolute and relative (visual) comparison of these same TRANSPORTED DEMANDS in each scenario simulated, at the Morning Rush Hour for the year of 2017 (supposed as

indicator for the operation of the modernized systems on rails), highlighting the main differences of each scenario:

Figure 5 – Aggregated Potential Demand to the "Suburb LRV"



It is important to observe that in this evaluation the increase of the LRV demand in relation to the current TRAIN was not considered; only the variables studied after the implantation of the future LRV were considered.

Note: after the analysis above, it was possible to identify the maximum impacts on the POTENTIAL DEMAND of the future LRV due to the following events:

a) to the cut of the bus lines = +60% (Scenario H versus Scenario G)
b) extension to Lapa = +58% (Scenario O versus Scenario N)
c) increase of BRL 1.20 on the integration tariff = -51% (Scenario N versus Scenario H).

These results indicate that the three aspects mentioned have **similar importance in the LRV demand**, and that the demand is very sensible to the tariff policy adopted in the integration with the bus, as well

as the effect of LRV competition with the bus system ("cuts" of lines) is important and that the extension of the LRV to Lapa increase the LRV demand in a considerable way.

7. ADDITIONAL STUDIES

In a **Complementary** character to the studies originally performed, new scenarios with global results were simulated in comparison to the fifteen scenarios originally studied and they present the specific results of the new scenarios with a conclusion based on the analysis of these results, considering two new situations:

(i) an alternative possibility to have a LRV BRANCH directly attending the region of RETIRO station, articulating with the Railway L1; and

(ii) considering the option originally named as Scenario G of the previous study, referring to the LRV operation between S. Luiz (North) and Comércio (Central Area), but **maintaining the current bus lines** of the regions of Suburb of Salvador.

These conceptual premises refer to the NEW tracing ALTERNATIVES, considering the connection of the LRV with Railway Line 1 at Retiro Station, with **two distinct operational forms**: WITH or WITHOUT the possibility of a **compulsory transfer** in the future LRV Station at Baixa do Fiscal. In addition to those, **five new** options were evaluated as an Operational Reinforcement, to meet the critical stretch of the line.

The report, in a character **Additional to the Studies** originally performed, describes the new scenarios simulated, presents the global results comparatively to the fifteen scenarios originally studied, presents the specific results of new scenarios now studied and obtain a comparative conclusion based on the analysis of these results.

In this **complementation**, new studies of demand estimate in the **additional scenarios** to the original studies were performed.

The report of the previous study had the results of the simulation of **15 scenarios** identified as codes from A to O, which studied variations of the LRV extension, tariff policy and proposals of "cuts" bus lines.

This additional report illustrates the **new alternatives studied**, due to the attendance of the **critical stretch** (in the region of Baixa do Fiscal) of the LRV, at Av. San Martin and operational variations for reinforcement of the whole attendance.

7.1. LRV BRANCH AT AV. SAN MARTIN

This new alternative uses as basic directive the axis of Av. San Martin and has **two new scenarios** for analysis: where the alternative studied herein of the LRV line performs integration with the subway in **two stations: Retiro and Lapa**, both of Line 1 of the SMSL. What **makes a difference in these scenarios** is the form of operation, named "T" and "Y", which are described in chapter 8 below. These two new scenarios were identified in sequence to the original study with the codes: **P** = "operation in **Y**" and **Q** = "operation in **T**".

The greatest difference between them, about their operational characteristics, is in the **headway of both lines.** The headway for the **P** alternative is of **20 minutes** in each LRV line; while the headway for the **Q** alternative is of **10 minutes** in both, in other words, resulting in a same value than that used in the other alternatives originally simulated, for attendance of the specific stretch.

This difference can be explained by the fact that in alternative P there is an overlap of two routes in the stretch São Luiz <> Baixa do Fiscal, at the LRV line. In this stretch, the overlap of two lines with headways of 20 minutes generated an **equivalent headway** of 10 minutes, which indicates a similarity with the options originally analyzed, for the attendance of the Suburb region, **allowing the equitable comparison** between the results obtained in the simulations, current and previous.

- Operational Reinforcement

After the analysis of the results obtained in both additional scenarios, as well as of the scenarios A to O of the previous study, **SCENARIO G WAS CHOSEN** (originally studied) **as the most indicated** and also the most probable to be implemented.

Thus, this report also presents the detail of the results obtained in the simulations for **Scenario G** and with new options of **operational reinforcement** to the complete LRV Line, in order to better attend the critical stretch identified in the region of Baixa do Fiscal.

- **Physical-Operational Characteristics**

To allow the comparative evaluation between the results, only the physical configuration aspects (directives of alignment and stations) of the new tracing operation were altered; the other operational aspects were maintained in a way similar to the used in the original study, except in the final option that was specified as an operational reinforcement of Scenario G.

Thus, the new scenarios simulated have the same average operational speed of the scenarios previously studied **(25 km/h)**; the tariff scheme was simulated as having an integration of the type **"Bilhete Único"**,

in which the user pays only a tariff and has the right to perform the integration between rails (subway or LRV) and the bus, if they judge necessary to complete their travel; in this way, it maintains the same operational and tariff scheme of the alternatives originally studied. All these aspects van be consulted in details in the report of the previous study.

Table 5 synthesizes the physical characteristics of the scenarios evaluated, with highlight to **both new scenarios** named in the sequence of the study in **P and Q** (with branch at Av. San Martin):

SCENARIO		STRETCH IN OPERATION					TARIFFS (BRL)				
		SUBWAY		TRAIN/LRV			Exclusive			With Transshipment	
		Stretch	Integration	Stretch	Integration	Length (Km)	Train	Subway	Bus	Train/LRV	Subway
PRELIMINARY STUDY SEDUR (dec/2013)		L1 = LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Program Contract	São Luiz <> Comércio	WITHOUT competition	18.18	3.30	3.30	3.30	1.80	4.60
CURRENT SITUATION (set – 2015) CALIBRATION	A	L1 = LAPA <>RETIRO	Assisted Operation	Paripe <> Calçada	without "cuts"	13.54	0.50	0.00	3.30	4.00	3.30
STEP 4 Subway "Basic"	B	L1 = LAPA <> PIRAJA L2 = AC. NORTE <> AEROPORTO	Integration	Paripe <> Calçada	without "cuts"	13.54	0.50	3.30	3.30	3.30	3.30
	C	L1 = LAPA <> PIRAJA L2 = AC. NORTE <> AEROPORTO	Integration	São Luiz <> Comércio	MODERATE	18.18	3.30	3.30	3.30	3.30	3.30
	D	L1 = LAPA <> PIRAJA L2 = AC. NORTE <> AEROPORTO	Integration	São Luiz <> Lapa	MODERATE	19.21	3.30	3.30	3.30	3.30	3.30
STEP 5 Subway "Extended"	E	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	Paripe <> Calçada	without "cuts"	13.54	0.50	3.30	3.30	4.00	3.30
	F	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Calçada	without "cuts"	14.77	3.30	3.30	3.30	3.30	3.30
	G	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	without "cuts"	18.18	3.30	3.30	3.30	3.30	3.30
	H	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	MODERATE	18.18	3.30	3.30	3.30	3.30	3.30
	I	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Lapa	MODERATE	19.21	3.30	3.30	3.30	3.30	3.30
	J	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	With Transversal LRV	São Luiz <> Lapa	MODERATE	19.21	3.30	3.30	3.30	3.30	3.30
	K	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	MODERATE	18.18	3.30	3.30	3.30	4.20	4.20
	L	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Lapa	MODERATE	19.21	3.30	3.30	3.30	4.20	4.20
	M	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	With Transversal LRV	São Luiz <> Lapa	MODERATE	19.21	3.30	3.30	3.30	4.20	4.20
	N	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	MODERATE	18.18	3.30	3.30	3.30	4.80	4.50
	O	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Lapa	MODERATE	19.21	3.30	3.30	3.30	4.80	4.50
STEP 5 NEW ALTERNATIVES (November 2016)	P	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	With Transversal BRT	São Luiz <> Lapa São Luiz <> Retiro "V"	MODERATE	22.56	3.30	3.30	3.30	3.30	3.30
	Q	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	With Transversal BRT	Baixa do Fiscal <> Lapa São Luiz <> Retiro "T"	MODERATE	22.56	3.30	3.30	3.30	3.30	3.30

* Tariff = Bus and Subway current tariff = BRL 3.30

- <u>SCENARIO P (OPERATION OF THE LRV IN "Y")</u>

Figure 6 below illustrates the operational scheme of the LRV lines in Scenario P and their articulation with the Railway Network.

Figure 6 – Scheme of the LRV Lines of Scenario P (operation in "Y")

Scenario P described below is an alternative based on **Scenario J** originally studied and detailed in the report of the original study, where a LRV line is maintained from São Luiz to Lapa (with headway of 20 min) and another LRV line is added from São Luiz to Retiro (also with headway of 20 minutes).

This kind of operation in which the LRV line was **separated in two lines** and that has a shared stretch, was named as alternative in **"Y"**.

This alternative considers the implementation of a <u>new stretch of the way of the LRV</u>, comprised between Baixa do Fiscal station to Retiro station, by a directive of Av. San Martin.

This **Scenario P** presents the **operation of two distinct LRV lines**, being that in the stretch shared by both (São Luiz <> Baixa do Fiscal), the **effective headway is of 10 minutes**. As in this scenario the BRTs of Av. Gal Costa and Av. 29 de Março is maintained, the difference between scenarios P and J is only the

implantation of a new LRV stretch at Av. San Martin, and the possibility of its connection with L1, also, in station RETIRO.

Briefly, it is possible to describe the transport offer of **Scenario P**:

> **LRV 1**: (SÃO LUIZ <> LAPA and 23 stations).
> **LRV 2**: (**SÃO LUIZ <> RETIRO and 19 stations).**
> Composition = Trains of 350 pax/TUE (initial proposal, from the previous study).
> Subway L1 (LAPA <> ÁGUAS CLARAS) + L2 (ACESSO NORTE <> LAURO DE FREITAS) -> Named STEP 5.
> Bus Lines **WITH "cuts" in the Subway.**
> Bus Lines **WITH "cuts" in the Suburb LRV. (Focused on the line of the LRV 1).**

NOTE: **No "cuts" were performed** on the conventional bus lines, linked to the LRV 2 line at Av. San Martin.

> **Transversal BRTs:**
> Av. 29 de Março > S. Luiz <> Águas Claras <> Bairro da Pax.
> Av. Gal Costa > Lobato <> Pirajá <> Pituaçu.

The **parameters** that defined this **Scenario P** may be synthetized in:

- Extended LRV (SÃO LUIZ <> Baixa do Fiscal <> LAPA and 23 stations) = **19.57 km**.
- New LRV (SÃO LUIZ <> Baixa do Fiscal <> RETIRO and 19 stations) = 17.15 km.
- Operational Speed = 25 km/h (to enable comparisons with other Scenarios).
- **Headway of the LRV: *hdw* = 20 min (at HPM)** = in each line, equal to 10 min in the common stretch
- Subway -> L1 = Lapa <> Águas Claras: *hdw* = 3 min.
L2 = Acesso Norte <> Lauro de Freitas: *hdw* = 3 min.
- Transversal BRTs > A) at Av. Gal Costa: *hdw* = 4 min. (from Lobato)
B) at Av. 29 de Março: *hdw* = 4 min. (from São Luiz).
- Bus Lines (CTSB + STEC + Metropolitans) > WITH "cuts" (without competition with the LRV and with the Subway).

- Tariffs -> in case of “Bilhete Único (BU)” in the Collective Transport System.
-> LRV = BRL 3.30 (with integration with the bus = BRL 3.30 + BRL 0.00).
-> Subway – BRL 3.30 (with integration with the bus = BRL 3.30 + BRL 0.00)

NOTE: The tariff in Reais (BRL) corresponds to a penalty of time of 40 minutes in the calibrated simulation model. In other words, at every charged tariff, 40 is added to the travel time of the passenger. In **case of tariff readjustment**, in the monetary value of the tariff, the model continues to consider 40 min/tariff.

Figure 7 below illustrates the operational scheme of both lines that operate the LRV in Scenario P. The **LRV 1** Line (drawn in green) has direct attendance from São Luiz to Lapa, with headway of 20 minutes; and the **LRV 2** Line (in red) performs the direct operation between stations **São Luiz** and **Retiro**, also with headway of 20 minutes.

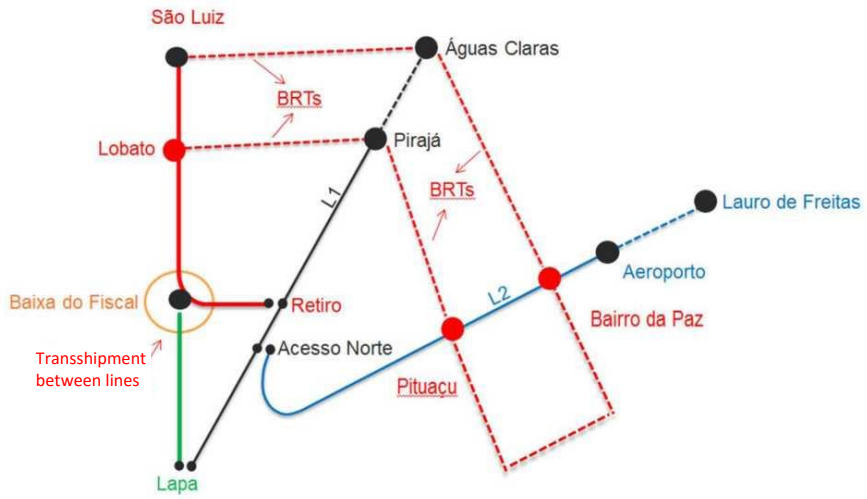
By the figure identifying the stretch of **shared operation** of both LRV lines (São Luiz <> Baixa do Fiscal, with 13.9 km, and 15 common stops), where the **effective headway** is of 10 minutes.

Figure 7 – Suburb LRV: Operational Scheme of the Lines, on Scenario P

- <u>SCENARIO 1 (OPERATION OF THE LRV IN "T")</u>

Figure 8 below illustrates the operational scheme of the LRV lines in **Scenario Q** and its articulation with the railway network:

Figure 8 – scheme WITH Transshipment between Lines, in Scenario Q (Operation in "T")



The new **Scenario Q**, described below, is an **alternative operational option** based on scenario P illustrated above. The difference between the scenarios is the operation method of the LRV, because this scenario **does not have overlap of lines**.

The LRV operation was **divided in two lines**, being that the first **originates in station Baixa do Fiscal to Lapa**, and the second line operates on the stretch **from São Luiz to Retiro**, imposing a transfer for the users, in this transshipment station located at the stop Baixa do Fiscal. Due to this operational configuration, this scenario was names scenario in **"T"**.

Both LRV lines operate with a headway of 10 minutes each. Thus, in this scenario, the user that boards in the stretch between São Luiz and Baixa do Fiscal, and has their destination in the region of Calçada/Comércio/Lapa, **must mandatorily perform a transshipment** at Baixa do Fiscal

Briefly, the offer of transport of **Scenario Q** can be described:

> Short LRV 1: (BAIXA DO FISCLA <> LAPA and eight stations).
> LRV 2: (SÃO LUIZ <> BAIXA DO FISCAL <> RETIRO and nineteen stations). > (one transshipment station > Baixa do Fiscal).
> Composition of the LRV = Trains of 350 pax/TUE (initial proposal, from the previous study).
> Subway L1 (LAPA <> ÁGUAS CLARAS) + L2 (ACESSO NORTE <> LAURO DE FREITAS) -> Named STEP 5.
> Bus Lines **WITH "cuts" in the Subway.**
> Bus Lines **WITH "cuts" in the Suburb LRV. (Focused on the line of the LRV 1).**

NOTE: **No "cuts" were performed** on the conventional bus lines, at the LRV 2 line at Av. San Martin.

> **Transversal BRTs:**
> **Av. Gal Costa >** Lobato <> Pirajá <> Pituaçu.
> **Av. 29 de Março** > São Luiz <> Águas Claras <> Bairro da Paz.

The **parameters** that defined this **Scenario P** may be synthetized in:

- New trace of the Short LRV (BAIXA DO FISCAL <> LAPA and eight stations) **= 5.41 km**.
- New LRV (SÃO LUIZ <> Baixa do Fiscal <> RETIRO and 19 stations) = **17.15 km.**
- Operational Speed = 25 km/h (to enable comparisons with Scenario J).
- Headway of the LRV: *hdw* = 10 min (at HPM) = on both lines
- Subway -> L1 = Lapa <> Águas Claras: *hdw* = 3 min.
L2 = Acesso Norte <> Lauro de Freitas: *hdw* = 3 min.
- Transversal BRTs > A) at Av. Gal Costa: *hdw* = 4 min. (from Lobato)
B) at Av. 29 de Março: *hdw* = 4 min. (from São Luiz).
- Bus Lines (CTSB + STEC + Metropolitans) > WITH "cuts" (without competition with the LRV and with the Subway).
- Tariffs -> in case of "Bilhete Único (BU)" in the Collective Transport System.
-> LRV = BRL 3.30 (with integration with the bus = BRL 3.30 + BRL 0.00).
-> Subway – BRL 3.30 (with integration with the bus = BRL 3.30 + BRL 0.00)

NOTE: The tariff in Reais (BRL) corresponds to a penalty of time of 40 minutes in the calibrated simulation model. In other words, at every charged tariff, 40 is added to the travel time of the passenger. In **case of tariff readjustment**, in the monetary value of the tariff, the model continues to consider 40 min/tariff.

On the other hand, Figure 9 highlights the operational system in "T" simulated in this alternative Scenario Q. The LRV 2 (in red) directly attends the whole stretch between São Luiz and Retiro, with headway of 10 minutes; and the LRV 1 (in green) is more central and performs the direct operation between Baixa do Fiscal and Lapa, also with headway of 10 minutes.

It is possible to observe that there is no line with operation between the extreme North (São Luiz) and south (Lapa); so, the stop Baixa do Fiscal starts to perform the function of a transshipment station for the users, between both lines.

Figure 9 – Suburb LRV: Operational Scheme of the Lines, on the alternative Scenario Q

8. SYNTHESIS OF THE RESULTS OBTAINED

- <u>GENERAL EVALUATION OF THE ALTERNATIVES "P & Q"</u>

On Table 1 below, the values of the **DEMAND POTENTIAL** are presented, which can be aggregated to the operation of the **new line on rails (LRV)**, now considering both new scenarios studied. In this table, the **transported passengers** are presented, always for the initial year of 2017 and on the HPM:

Table 6 – Metropolitan Region of Salvador/BA – Study of the Potential Demand of the "Suburb LRV"

YEAR 2017 – TRANSPORTED PASSENGERS, By Scenario analyzed
LRV -> HDW= 10 min; Operational Speed = 25 km/h (scenario Q)
LRV -> HDW= 20 min; Operational Speed = 25 km/h > Scenario P
TRAIN -> HDW = 40 min; Operational Speed = 20 km/h

SCENARIO		STRETCH IN OPERATION					TARIFFS (BRL)						TRANSPORTED PASSENGERS						
		SUBWAY		TRAIN/LRV			Exclusive			With Transshipment			BOARDINGS (pax at HPM)			TRAIN/LRV			
		Stretch	Integration	Stretch	Integration	Length (km)	Train/LRV	Subway	Bus	Train/LRV	Subway		Urbano (CSTB)	Metrop. (AGERBA)	Total	DAILY Pax/BD FPH=7.38	Cycle TIME (min)	Headway (min)	Operational FLEET (TUEs)
PRELIMINARY STUDY SEDUR (dec/2013 – BASE)		L1 = LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Program Contract	São Luiz <> Comércio	WITHOUT competition	18.54	3.30	3.30	3.30	1.80	4.60		7,638	19	7,657	61,409	97	10	10
CURRENT SITUATION (set – 2015) CALIBRATION	A	L1 = LAPA <>RETIRO	Assisted Operation	Paripe <> Calçada	WITHOUT "cuts"	13.54	0.50	0.00	3.30	4.00	3.00		1,538	0	1,538	11,350	91	10	3
STEP 4 Subway "Basic"	B	L1 = LAPA <> PIRAJA L2 = AC. NORTE <> AEROPORTO	Integration	Paripe <> Calçada	WITHOUT "cuts"	13.54	0.50	3.30	3.30	3.30	3.30		1,487	0	1,487	10,974	91	10	3
	C	L1 = LAPA <> PIRAJA L2 = AC. NORTE <> AEROPORTO	Integration	São Luiz <> Comércio	WITH "cuts"	18.54	3.30	3.30	3.30	3.30	3.30		22,113	1,629	23,742	175,216	97	10	10
	D	L1 = LAPA <> PIRAJA L2 = AC. NORTE <> AEROPORTO	Integration	São Luiz <> Lapa	WITH "cuts"	19.57	3.30	3.30	3.30	3.30	3.30		26,539	1,633	28,172	207,909	102	10	10
STEP 5 Subway "Extended"	E	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	Paripe <> Calçada	WITHOUT "cuts"	13.54	0.50	3.30	3.30	4.00	3.30		1,331	0	1,331	9,823	91	10	3
	F	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Calçada	WITHOUT "cuts"	14.81	3.30	3.30	3.30	3.30	3.30		5,285	9	5,294	39,070	81	10	8
	G	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	WITHOUT "cuts"	18.54	3.30	3.30	3.30	3.30	3.30		13,260	19	13,279	97,999	97	10	10
	H	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	WITH "cuts"	18.54	3.30	3.30	3.30	3.30	3.30		20,262	993	21,255	156,862	97	10	10
	I	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Lapa	WITH "cuts"	19.57	3.30	3.30	3.30	3.30	3.30		25,201	1,218	26,419	194,972	102	10	10
	J	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	With Transversal BRT	São Luiz <> Lapa	WITH "cuts"	19.57	3.30	3.30	3.30	3.30	3.30		25,443	1,139	26,582	196,175	102	10	10
	K	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	WITH "cuts"	18.54	3.30	3.30	3.30	4.20	4.20		16,567	975	17,542	129,460	97	10	10
	L	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Lapa	WITH "cuts"	19.57	3.30	3.30	3.30	4.20	4.20		22,190	1,200	23,390	172,618	102	10	10
	M	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	With Transversal BRT	São Luiz <> Lapa	WITH "cuts"	19.57	3.30	3.30	3.30	4.20	4.20		21,774	1,121	22,895	168,965	102	10	10
	N	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Comércio	WITH "cuts"	18.54	3.30	3.30	3.30	4.80	4.50		9,683	629	10,312	76,103	97	10	10
	O	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	Integration	São Luiz <> Lapa	WITH "cuts"	19.57	3.30	3.30	3.30	4.80	4.50		15,428	909	16,337	120,567	102	10	10
STEP 5 NEW ALTERNATIVES (November/2016)	P	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	With Transversal BRT	São Luiz <> Lapa São Luiz <> MORetiro "Y"	MODERATE	22.56	3.30	3.30	3.30	3.30	3.30		20,208	734	20,942	154,552	102+94	20	5+5
	Q	L1 – LAPA <> ÁGUAS CLARAS L2 = AC. NORTE <> LAURO FREITAS	With Transversal BRT	São Luiz <> Lapa São Luiz <> Retiro "Y"	MODERATE	22.56	3.30	3.30	3.30	3.30	3.30		27,398	703	28,101	207,385	94+36	10	10+4

On the other hand, Figure 10 indicates an absolute and relative comparison (visual) of these same TRANSPORTED DEMANDS in each scenario simulated, at the Morning Rush Hour (HPM) for the year of

2017 (supposed as indicator for the start of the operation of the modernized systems on rails), highlighting the main differences of each scenario simulated (originals and those now contemplated).

Figure 10 – Potential Demand Aggregated to the "Suburb LRV" (2017 – pax/HPM)

Table 7 below illustrates the amount of passengers **transported** and the "payers" in the new scenarios P and Q. The alternative of Scenario Q is that **where there are transfers between the LRV lines** (at Baixa do Fiscal), what causes the difference between payers and transported passengers.

Table 7 – Transported Passengers and Payers in the New Scenarios (2017, pax/HPM)

SCENARIO	PASSENGERS		TRANSFERS between LRV Lines (pax/HPM)
	TRANSPORTED (pax/HPM)	PAYERS (pax/HPM)	
P	20,942	20,942	0

Q	**28,101**	**22,361**	**5,740**

8.1. CRITICAL EVALUATION OF THE TWO NEW SCENARIOS SIMULATED – "P & Q"

- SCENARIO P

It is possible to observe that this **Scenario**, with the **operation in "Y"**, indicated a total of 20,942 pax/hpm in the LRV subsystem. In this total, there are no double boardings in the LRV, **because there are two lines** that run through the whole system on rails (São Luiz <> Lapa and São Luiz <> Retiro).

This total of passengers is 21% smaller (20,942 / 26,582) than the value transported at Scenario J, adopted as **reference for comparison**. The only difference between scenarios P and J is the additional stretch at Av. San Martin, which represents the connection of the LRV with the subway L1 (at Retiro).

This effect can be explained by the increase of the headway value of 10 minutes to 20 minutes on Scenario P. Even with an effective headway of 10 minutes at the stretch with overlapped operation (São Luiz <> Baixa do Fiscal), the passenger that boards with destination to the region of Calçada and Comércio (most of the destinations) must wait 20 minutes on Scenario P to board the LRV, while they waited 10 minutes on Scenario J, in other words, for this user, the LRV became less attractive.

Other point to be considered is that Scenario P presents a higher cost of construction that alternative J due to the additional stretch of 3.2 km to be built at Av. San Martin and transports less passengers. Due the reduction of the headway (on each LRV Line), the fleet of TUEs necessary for the operation of both LRV lines is the same on both scenarios P x J (10 compositions; TUEs), defined due to the headway adopted.

- SCENARIO Q

Scenario Q presented a total of 28,101 pax/HPM boardings in the LRV subsystem. This value, despite being the second largest in all scenarios simulated (behind only alternative D), presents a double counting of boardings at Baixa do Fiscal station (due to the transshipments).

This scenario with **operation in "T"** makes mandatory a transfer at stop Parada do Fiscal for the users that board between São Luiz and Santa Luzia and has destination to the region between Calçada and Comércio (most of the destinations) of the Suburb region.

It can be observed that the number of transfers between both new lines of the LRV at the stop Baixa do Fiscal is of 5,740 pax/hpm. If this value is subtracted from the total of passengers transported in the LRV subsystem, the result is that the scenario with the operation in "T" transported 21,658 pax/hpm, in other words, 19% (21,658 / 26,582) less passengers than Scenario J, used as reference for comparison.

This alternative also presents a higher cost of construction and, in addition, **14** vehicles are necessary for the LRV operation (10 for the operation of the stretch between São Luiz and Retiro and four for the operation on the stretch between Baixa do Fiscal and Lapa).

In other words, this alternative is more expensive, transports less passengers and makes 26% (5,740 / 21658) of its users perform a transfer LRV x LRV at the stop Baixa do Fiscal.

8.2. Evaluation of Both New Alternatives

After analysis of the seventeen (17) alternatives simulated with distinct configurations of **offer of LRV, competition with the bus system and different tariff systems**, and after several technical meetings, it was found that the best alternative to be considered for the initial implantation of the LRV would be **SCENARIO G: São Luiz <> Comércio**, with tariff integration of the type **bilhete único (BU)** and **"without cuts"** of the competing bus lines at Av. Suburbana.

The "cut" of lines is difficult due to the LRV not being able to absorb the whole boarding demand of the Suburb region, due to its specific topography or by locations where Av. Suburbana is far from the existing railway line (region of Largo do Luso).

Before this context and after analysis of the **cargo profiles** of the LRV lines, previously presented, in addition to the current infrastructure situation, **the LRV is indicated as a possible transport modal to be considered for the region**. But considering the LRV operation as a DIRECT LINE, from São Luiz to the region of Comércio (Scenario G of the original study), REINFORCED for operation of the critical stretch close to Sta. Luzia station (coming from the Platform stop/station, with both LRV Lines reaching the region of Comércio, composing two "carousels", which complement themselves.

9. FINAL EVALUATION OF ALTERNATIVES

9.1. OPERATIONAL SCENARIOS STUDIED

After the critical analysis about the results obtained in the simulation of the previously exposed alternatives, both arising form the initial study (Scenarios A to O) – as well as the new alternatives simulated hereby (Scenarios P and Q), the **Scenario G** (original) was selected to be used in the continuity of this study on the **future LRV of the Suburb**, with the following adjustments (new **Scenarios G1 to G5)**.

In general, these scenarios may be synthetized considering the following PREMISES (supplementary, in **bold**):

(i) complete LRV = S. Luiz <> Comércio;
(ii) 18.2 km of extension and 21 LRV stops;
(iii) Subway lines:

a. L1 = Águas Claras <> Lapa

b. L2 = Acesso Norte <> Lauro de Freitas

(iv) **Without sectioning** of the bus lines of the CTSB, in the Suburbs;

(v) Tariff with single value for all modals (equal value than the buses, of the CTSB)

(vi) Temporary integrations, until two transshipments, with the use of the *Bilhete Único*;

(vii) **Natural integration** (optional, for the users of the LRV);

(viii) LRV Compositions, with use of TUEs of 600 pax/vehicle (with occupation rate of 6 standing pax/m^2);

(ix) Operational speeds of the LRV, differentiated:

a. In exclusive lane = 32 km/h (next to Av. Suburbana);

b. In shared traffic = 16 km/h (in avenues Eng. Oscar Pontes and França).

As a result of the notes prepared in item 8.2 and, due to the new configuration of the transportation logistics for the Suburb region, resulting from the assumptions formulated above, some **OPERATIONAL OPTIONS** have been developed, containing the following characteristics:

G1 = Consideration of possible integrated users using the bus lines, in relation to the original version of the Scenario G – generating only one **natural integration** (bus<>LRV);

G2 = Creation of operational "carousel", for reinforcement of the offer in the critical stretch identified, with VERY SHORT coverage (Lobato <> Calçada), which proved to be insufficient;

G3 = Operational reinforcement, with use of a MORE EXTENSIVE "carousel", with about 9 km (Platform <> Comércio);

G4 = As a result of the existence of TWO LRV lines in the suburban corridor, REDUCTION of intervals in both (*hdw* = 15 min).

G5 = **Extension of the operational reinforcement**, with the implementation of a TRIPLE carousel, using two locations for return of TUEs (in stations Periperi and Plataforma).

Moreover, with the consideration of differentiated operational speeds for the course of the LRV line – exclusive stretches with *speed* = 32 km/h and shared stretches with speed = 16 km/h – it is possible to make a re-evaluation of the cycle times of each line, and the specified values result in the Table 8, which presents the consolidated comparison of results arising from the respective simulations, of these five operational options.

Table 8 – Suburb LRV: Comparison of Operational Alternatives (Scenario G1 to G5)

7,38 =FHP

TUEs = 600

OPERATIONAL ALTERNATIVES		INTERVAL LOADING (2017)			LOADING (2017)					CRITICAL STRETCH			EXTENSION			CYCLE TIME			FLEET (TUEs)								
		VLT 1	VLT 2	VLT 3	TOTAL	VLT 1	VLT 2	VLT 3		VLT 1	VLT 2	VLT 3	VLT 1	VLT 2	VLT 3	VLT 1	VLT 2	VLT 3	f (pax/hpm)			f (frequency)					
Code	Description	(min)	(min)	(min)	(pax/DU)	(pax/HPM)	(pax/HPM)	(pax/HPM)	(pax/HPM)	(pax/HPM)	(pax/HPM)	(pax/HPM)	(km)	(km)	(km)	(min)	(min)	(min)	VL I 1	VL I 2	VL I 3	VL I 1	VL I 2	VL I 3	Adopted Fleet	Common Reserve	System Total
G	Original (hsw – 10 min)	10	-	-	97,999	13,79	13,279	-	-	12,048	-	-	18.2	-	-	97	-	-	32.5	-	-	9.7	-	-	-	-	-
G1	Adjusted	10	-	-	78,575	10,47	10,647	-	-	8,967	-	-	18.2	-	-	88	-	-	21.9	-	-	8.8	-	-	22	2	24
G2	SHORT reinforcement	10	10	-	83,697	11,41	10,631	710	-	8,979	606	-	18.2	3.4	-	88	19	-	21.9	1.0	-	8.8	1.9	-	23	2	25
G3	LONG reinforcement	10	10	-	92,826	12,78	9,315	3,263	-	8,034	2,968	-	18.2	9.0	-	88	48	-	19.6	4.0	-	8.8	4.8	-	14	2	16
G4	Headway 15 min (2x)	15	15	-	63,276	8,574	6,094	2,490	-	5,364	2,251	-	18.2	9.0	-	88	48	-	13.1	3.0	-	5.9	3.2	-	9	1	10
G5	**TRIPLE carousel**	**20**	**20**	**10**	81,852	**22,091**	**4,40**	**3,384**	**3,467**	**3,702**	**3,102**	**3,154**	**18.2**	**14.1**	**9.0**	**88**	**72**	**48**	**9.0**	**6.2**	**4.2**	**4.4**	**3.6**	**4.8**	**13**	**1**	**14**

Travel strategy	%	Pax/DU
Exclusive	31.6%	25,865
LRV -> Bus	45.6%	37,324
Bus -> LRV	12.6%	10,313
Bus -> LRV -> Bus	10.2%	8,349
Total		81,852

9.2 CHOSEN SCENARIO

From these results it was defined the use of the information arising from simulation for the **ALTERNATIVE G5 (= two lines of reinforcement, composing a "TRIPLE Operational Carousel")**, which detailed results about the movement of users in several stops of the LRV and respective load profile in the three lines (in HPM-2017) are illustrated in Table 9 to Table 11 and Figure 11 to Figure 13, individually presented for each LRV line.

Table 9 – Suburb LRV: Movement in Stops of the LRV 1 (Scenario G5)

LRV 1 – Direction 1 (São Luiz-Comércio) LRV hdw: 20/20/10 (min)

LINE	PLATFORM	BORDERING		INTEGRATED		TOTAL		Loading in Trains
		Boarding (pax/hpm)	Disembarkment (pax/hpm)	Boarding (pax/hpm)	Disembarkment (pax/hpm)	Boarding (pax/hpm)	Disembarkment (pax/hpm)	
BAIRRO>CENTRO	SÃO LUIZ	295	0	137	0	432	0	432
	PARIBE	70	0	0	128	70	128	374
	COUTOS	226	0	0	0	226	0	600
	SETUBAL	0	0	0	0	0	0	600
	PERIPERI	611	0	67	11	678	11	1,267
	PRAIA GRANDE	193	0	0	0	192	0	1,459
	ESCADA	104	0	0	0	103	0	1,562
	ITACARANHA	107	0	14	0	120	0	1,682
	SÃO BRAZ	287	0	0	0	286	0	1,968
	SÃO JOÃO	198	32	0	0	198	32	2,134
	PLATAFORMA	106	0	0	0	106	0	2,240
	UNIÃO	315	0	233	0	548	0	2,788
	LOBATO	507	6	171	0	678	6	3,460
	SUBURBANA	188	15	0	0	188	15	3,633
	SANTA LUZIA	84	15	0	0	84	15	3,702
	BAIXA DO FISCAL	68	8	20	114	87	122	3,667
	CALÇADA	0	174	0	229	0	403	3,264
	SÃO JOAQUIM	0	206	0	139	0	345	2,919
	PORTO	0	0	0	38	0	38	2,881
	FRANCA	0	600	0	792	0	1,392	1,489
	COMÉRCIO	0	465	0	1,024	0	1,489	0
TOTAL		3,356	1,521	640	2,475	3,996	3,996	

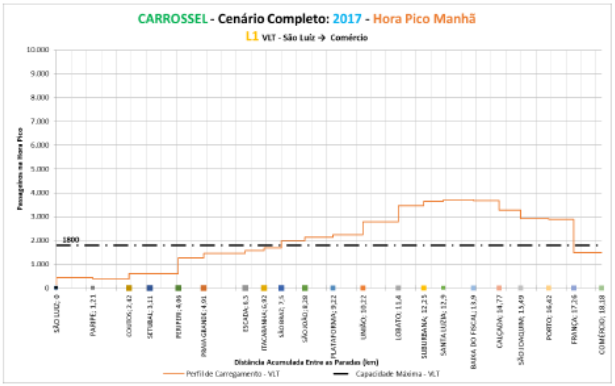
Existing Stations (2017)

LRV 1 – Direction 2 (Comércio-São Luiz) LRV hdw: 20/20/10 (min)

LINE	PLATFORM	BORDERING		INTEGRATED		TOTAL		Loading in Trains
		Boarding (pax/hpm)	Disembarkment (pax/hpm)	Boarding (pax/hpm)	Disembarkment (pax/hpm)	Boarding (pax/hpm)	Disembarkment (pax/hpm)	
CENTRO>BAIRRO	COMÉRCIO	0	0	2	0	2	0	2
	FRANCA	0	0	0	0	0	0	2
	PORTO	0	0	1	0	1	0	3
	SÃO JOAQUIM	0	0	1	0	1	0	4
	CALÇADA	0	0	24	0	24	0	28
	BAIXA DO FISCAL	0	0	4	2	4	2	30
	SANTA LUZIA	0	0	0	0	0	0	30
	SUBURBANA	0	0	0	0	0	0	30
	LOBATO	0	0	0	0	0	0	30
	UNIÃO	11	4	0	0	11	4	37
	PLATAFORMA	56	35	0	0	56	35	58
	SÃO JOÃO	0	3	0	0	0	2	56
	SÃO BRAZ	0	0	0	0	0	0	56
	ITACARANHA	0	0	0	0	0	0	56
	ESCADA	0	0	0	0	0	0	56
	PRAIA GRANDE	0	0	17	0	17	0	73
	PERIPERI	0	21	0	7	0	28	45
	SETUBAL	0	0	0	0	0	0	45
	COUTOS	0	0	0	0	0	0	45
	PARIBE	0	0	128	145	128	145	28
	SÃO LUIZ	0	28	0	0	0	28	0
TOTAL		67	91	177	153	244	244	

Existing Stations (2017)

Figure 11 – Suburb LRV: Load Profile of Lines of the LRV 1 (Scenario G5)



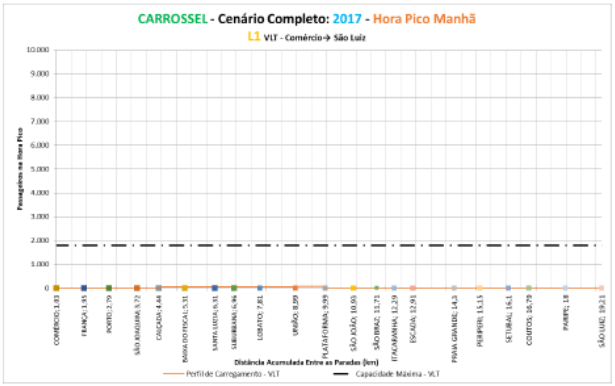


Table 10 – Suburb LRV: Movement in Stops of the LRV 2 (Scenario G5)

LRV 2 – Direction 1 (PeriPeri – Comércio) LRV hdw: 20/20/10 (min)

LINE	PLATFORM	BORDERING		INTEGRATED		TOTAL		Loading in Trains
		Boarding (pax/hpm)	Disembarkment (pax/hpm)	Boarding (pax/hpm)	Disembarkment (pax/hpm)	Boarding (pax/hpm)	Disembarkment (pax/hpm)	
BAIRRO > CENTRO	SÃO LUIZ	0	0	0	0	0	0	0
	PARIPE	0	0	0	0	0	0	0
	COUTOS	0	0	0	0	0	0	0
	SETUBAL	0	0	0	0	0	0	0
	PERIPERI	611	0	67	11	678	11	667
	PRAIA GRANDE	193	0	0	0	192	0	859
	ESCADA	104	0	0	0	103	0	962
	ITACARANHA	107	0	14	0	120	0	1,082
	SÃO BRAZ	287	0	0	0	286	0	1,368
	SÃO JOÃO	198	32	0	0	198	32	1,534
	PLATAFORMA	106	0	0	0	106	0	1,640
	UNIÃO	315	0	233	0	548	0	2,188
	LOBATO	507	6	171	0	678	6	2,860
	SUBURBANA	188	15	0	0	188	15	3,033
	SANTA LUZIA	84	15	0	0	84	15	3,102
	BAIXA DO FISCAL	68	8	20	114	87	122	3,067
	CALÇADA	0	174	0	229	0	403	2,664
	SÃO JOAQUIM	0	164	0	111	0	275	2,389
	PORTO	0	0	0	38	0	38	2,351
	FRANÇA	0	460	0	608	0	1,068	1,283
	COMÉRCIO	0	401	0	882	0	1,283	0
TOTAL		2,765	1,276	503	1,992	3,268	3,268	

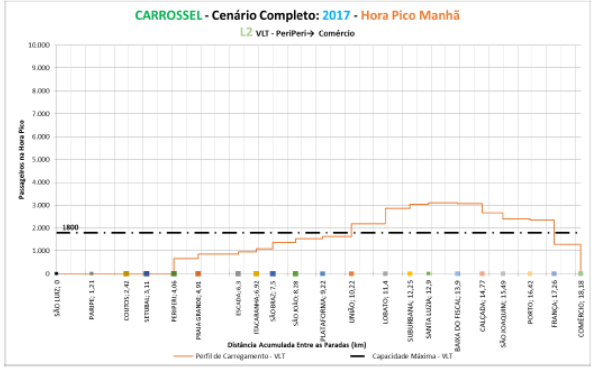
Existing Stations (2017)

LRV 2 – Direction 2 (Comércio - PeriPeri) LRV hdw: 20/20/10 (min)

LINE	PLATFORM	BORDERING		INTEGRATED		TOTAL		Loading in Trains
		Boarding (pax/hpm)	Disembarkment (pax/hpm)	Boarding (pax/hpm)	Disembarkment (pax/hpm)	Boarding (pax/hpm)	Disembarkment (pax/hpm)	
CENTRO > BAIRRO	COMÉRCIO	0	0	2	0	2	0	2
	FRANÇA	0	0	0	0	0	0	2
	PORTO	0	0	1	0	1	0	3
	SÃO JOAQUIM	0	0	1	0	1	0	4
	CALÇADA	0	0	24	0	24	0	28
	BAIXA DO FISCAL	0	0	4	2	4	2	30
	SANTA LUZIA	0	0	0	0	0	0	30
	SUBURBANA	0	0	0	0	0	0	30
	LOBATO	0	0	0	0	0	0	30
	UNIÃO	11	4	0	0	11	4	37
	PLATAFORMA	56	35	0	0	56	35	58
	SÃO JOÃO	0	3	0	0	0	2	56
	SÃO BRAZ	0	0	0	0	0	0	56
	ITACARANHA	0	0	0	0	0	0	56
	ESCADA	0	0	0	28	0	28	28
	PRAIA GRANDE	0	0	17	0	17	0	45
	PERIPERI	0	35	0	10	0	45	0
	SETUBAL	0	0	0	0	0	0	0
	COUTOS	0	0	0	0	0	0	0
	PARIPE	0	0	0	0	0	0	0
	SÃO LUIZ	0	0	0	0	0	0	0
TOTAL		67	76	49	40	116	116	

Existing Stations (2017)

Figure 12 – Suburb LRV: Load Profile of Lines of the LRV 2 (Scenario G5)



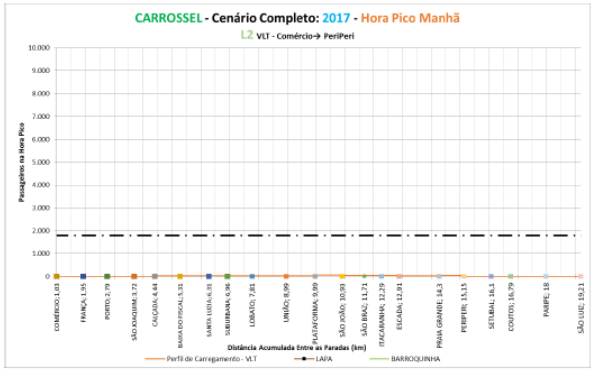


Table 11 – Suburb LRV: Movement in Stops of LRV 3 (Scenario G5)

LRV 3 – Direction 2 (Comércio - Plataforma) LRV hdw: 20/20/10 (min)

LINE	PLATFORM	BORDERING		INTEGRATED		TOTAL		Loading in Trains
		Boarding (pax/hpm)	Disembarkment (pax/hpm)	Boarding (pax/hpm)	Disembarkment (pax/hpm)	Boarding (pax/hpm)	Disembarkment (pax/hpm)	
CENTRO> BAIRRO	COMÉRCIO	0	0	4	0	4	0	4
	FRANÇA	0	0	0	0	0	0	4
	PORTO	0	0	0	0	0	0	4
	SÃO JOAQUIM	0	0	0	0	0	0	4
	CALÇADA	0	0	48	0	48	0	52
	BAIXADA DO FISCAL	0	0	8	4	8	4	56
	SANTA LUZIA	0	0	0	0	0	0	56
	SUBURBANA	0	0	0	0	0	0	56
	LOBATO	0	0	0	0	0	0	56
	UNIÃO	23	8	0	0	22	8	70
	PLATAFORMA	0	71	0	0	0	70	0
	SÃO JOÃO	0	0	0	0	0	0	0
	SÃO BRAZ	0	0	0	0	0	0	0
	ITACARANHA	0	0	0	0	0	0	0
	ESCADA	0	0	0	0	0	0	0
	PRAIA GRANDE	0	0	0	0	0	0	0
	PERIPERI	0	0	0	0	0	0	0
	SETUBAL	0	0	0	0	0	0	0
	COUTOS	0	0	0	0	0	0	0
	PARIPE	0	0	0	0	0	0	0
	SÃO LUIZ	0	0	0	0	0	0	0
	TOTAL	**23**	**79**	**60**	**4**	**82**	**82**	

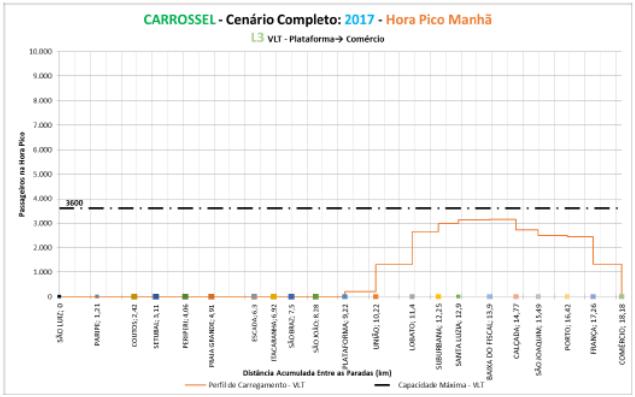
Existing Stations (2017)

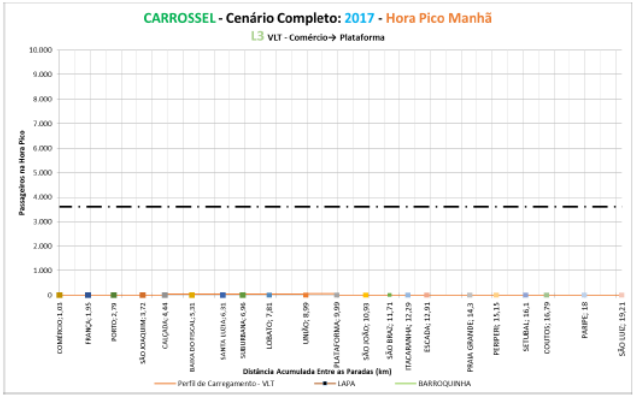
LRV 3 – Direction 2 (Comércio - Plataforma) LRV hdw: 20/20/10 (min)

LINE	PLATFORM	BORDERING		INTEGRATED		TOTAL		Loading in Trains
		Boarding (pax/hpm)	Disembarkment (pax/hpm)	Boarding (pax/hpm)	Disembarkment (pax/hpm)	Boarding (pax/hpm)	Disembarkment (pax/hpm)	
CENTRO> BAIRRO	COMÉRCIO	0	0	4	0	4	0	4
	FRANÇA	0	0	0	0	0	0	4
	PORTO	0	0	0	0	0	0	4
	SÃO JOAQUIM	0	0	0	0	0	0	4
	CALÇADA	0	0	48	0	48	0	52
	BAIXADA DO FISCAL	0	0	8	4	8	4	56
	SANTA LUZIA	0	0	0	0	0	0	56
	SUBURBANA	0	0	0	0	0	0	56
	LOBATO	0	0	0	0	0	0	56
	UNIÃO	23	8	0	0	22	8	70
	PLATAFORMA	0	71	0	0	0	70	0
	SÃO JOÃO	0	0	0	0	0	0	0
	SÃO BRAZ	0	0	0	0	0	0	0
	ITACARANHA	0	0	0	0	0	0	0
	ESCADA	0	0	0	0	0	0	0
	PRAIA GRANDE	0	0	0	0	0	0	0
	PERIPERI	0	0	0	0	0	0	0
	SETUBAL	0	0	0	0	0	0	0
	COUTOS	0	0	0	0	0	0	0
	PARIPE	0	0	0	0	0	0	0
	SÃO LUIZ	0	0	0	0	0	0	0
	TOTAL	**23**	**79**	**60**	**4**	**82**	**82**	

Existing Stations (2017)

Figure 13 – Suburb LRV: Load Profiles of LRV 3 Lines (Scenario G5)





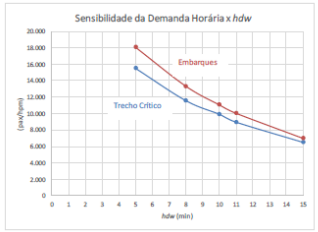
9.3. POTENTIAL DEMAND SENSIBILITY ANALYSIS

After the definition of the operation of the "Suburb LRV System", with the consideration of a "**TRIPLE CAROUSEL"**, the DEMAND in the LRV System was analyzed due to the combination of headways between different lines, always aiming at the greater possible offer in the critical stretch, next to the Calçada region.

This **sensibility analysis** assumed that whenever there would be a combination of multiple values of headways, which results are synthesized in Table 9.12 and respective charts considering the variation of passengers in the critical stretch, in the total of boarding in HPM or in the expansion for the business day, always references to the year 2017.

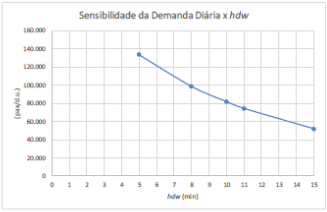
Table 9.12 – Sensibility Analysis of the Potential Demand x Headway of Lines
Operational Assumption – THREE "CAROUSELS"

CAROUSEL LINES				COMBINATION of Headways (min)																
				30/30/15			22/22/11			20/202/10			16/16/8			10/10/5				
Line Type	Description	Extension (km)	Cycle (min)	Critical Stretch (pax/hpm)	Boarding HPM (pax/hpm)	Boarding Day (pax/du)	Critical Stretch (pax/hpm)	Boarding HPM (pax/hpm)	Boarding Day (pax/du)	Critical Stretch (pax/hpm)	Boarding HPM (pax/hpm)	Boarding Day (pax/du)	Critical Stretch (pax/hpm)	Boarding HPM (pax/hpm)	Boarding Day (pax/du)	Critical Stretch (pax/hpm)	Boarding HPM (pax/hpm)	Boarding Day (pax/du)		
LONG	Comércio <> S. Luiz	18,18	88	2,127	2,293	16,922	3,122	3,662	27,026	3,702	4,240	31,291	4,623	5,353	39,505	7,019	8,042	59,530		
MEDIUM	Comércio <> Periperi	14,12	72	2,291	2,437	17,985	2,846	3,129	23,092	3,102	3,384	24,974	3,668	4,132	30,494	4,461	5,079	37,483		
SHORT	Comércio <> Plataforma	8,96	48	2,127	2,293	16,922	3,029	3,280	24,206	3,154	3,467	25,586	3,323	3,882	28,649	4,053	4,970	36,679		
LRV SYSTEM (3 LINES)				**6,545**	**7,023**	**51,830**	**8,997**	**10,071**	**74,324**	**9,958**	**11,091**	**81,852**	**11,614**	**13,367**	**98,648**	**15,533**	**18,091**	**133512**		



SENSIBILITY ANALYSIS (w/ headway)

HEADWAY (min)	Critical Stretch (pax/hpm)	Boarding/ HPM (pax/hpm)	Boarding/D U (pax/DU)
15	6,545	7,023	51,830
11	8,997	10,071	74,324
10	9,958	11,091	81,852
8	11,614	13,367	98,648
5	15,533	18,091	133,512



10. CONCLUSION & RECOMMENDATIONS

10.1. EVALUATION OF LOADINGS IN THE INITIAL YEAR

The simulation works provide indications of loading in each collective transport line under analysis (see Figure 14), resulting from the total of users boarding and disembarking in each LRV stop, with highlight to those users that make NATURAL TRANSSHIPMENT between modals. This result, for being obtained in a simulation process, has an inaccuracy margin in about ten percentage points (for more or for less).

From the analysis of loadings between stops, indicated in each stretch of LRV lines (1, 2 and 3), it is possible to verify that the **maximum load** in each of them occurred between the stops of **Sta. Luzia and Baixa do Fiscal**, as demonstrated in the previous chapter.

In short (Table 13), it is possible to verify a necessity of service, in this critical stretch, of 3,702 **pax/HPM in LRV1** (LONG line), 3,102 **pax/HPM in LRV 2** (MEDIUM operational reinforcement) and 3,154 pax/HPM in LRV 3 (SHORT reinforcement), always in the dominant direction (Neighborhood -> Center, in morning rush hour), which summary of the simulated conditions – **assumptions and results** – are informed below, always regarding the **SELECTED ALTERNATIVE – Scenario G5 = S. Luiz <> Comércio and "TRIPLE CAROUSEL"** (see Figure 14).

It is noted in this same Table 13 the estimate made for BEGINNING of the LRV operation (after the 19th month), even during the partial Implementation Stages (in operational stretches indicated, with restriction of times, gratuitous use, short stretches etc. – stretch Comércio <> Baixa do Fiscal).

Table 13 – Suburb LRV: Pre-dimensioning of the Fleet (HPM-2017)

CENÁRIO				LINHA de VLT			DEMANDA POTENCIAL					OPERAÇÃO		FROTA do Sistema VLT				
Fases de Implantação	Mês de Referência	Trecho em Operação	"Carrossel"	Extensão (km)	Estações (nº)	Cobrança Tarifária	Hora-Pico (pax/hpm)	Expansão Diária			Trecho Crítico (pax/hpm)	Headway na HPM (min)	Tempo de Ciclo (min)	Cálculo com base na		Operação na HPM (nº)	Reserva Técnica (nº)	TOTAL (nº)
								Operação (hs)	Fator (nº)	Fluxo dia (pax/hpm)				Capac. TUE (nº)	Frequencia (nº)			
I	19º ao 21º	Comércio <> Baixa do Fiscal	Linha Única & no entre-picos	4,34	6	grátis	784	8	5,26	4.124	670	20	45	0,84	2,25	2	1	3
II	22º ao 24º	Comércio <> Baixa do Fiscal	Linha Única & horário pico	4,34	6	plena	0	8	5,26	0	0	20	45	0,00	2,25	2	1	3
III - PLENA	25º em diante	Comércio <> S. Luiz	Comércio <> S. Luiz	18,18	21	plena	4.240	19	7,38	31.291	3.702	20	88	9,05	4,40	4	1	14
			Comércio <> Periperi	14,12	17	plena	3.384	19	7,38	24.974	3.102	20	72	6,20	3,60	4		
			Comércio <> Plataforma	8,96	11	plena	3.467	19	7,38	25.586	3.154	10	48	4,21	4,80	5		
									DU = 81.852									

It must be noted that in order to meet the total demand in the short critical stretch and in only a few hours of the day, it is considered an average occupation greater than the occupation rate of 6 pax/standing/m^2 normally considered!

From the considerations demonstrated in the previous chapter hereof, especially the representative diagrams of load profiles (Figure 11 – to Figure 13) it is possible to agglutinate

them for **evaluation of the critical stretch of the LRV** of the Suburb, as indicated in Table 14 and Figure 15 below.

Figure 14 – Suburb LRV: Influence Areas and Proposed Lines (LRV 1 = LONG line; LRV 2 – MEDIUM operational reinforcement; LRV 3 = SHORT operational reinforcement)

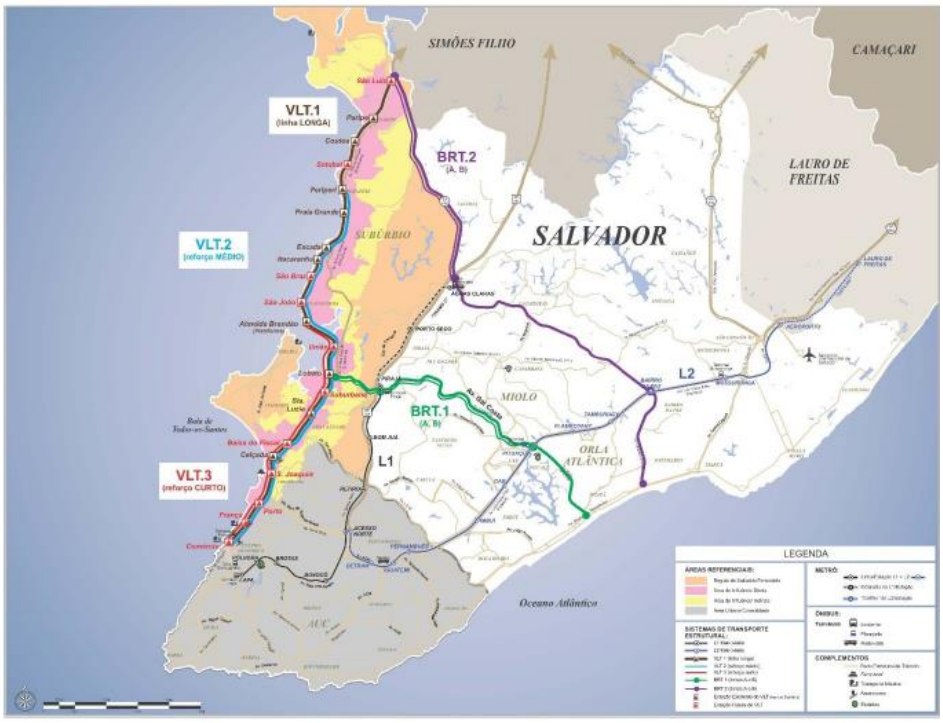
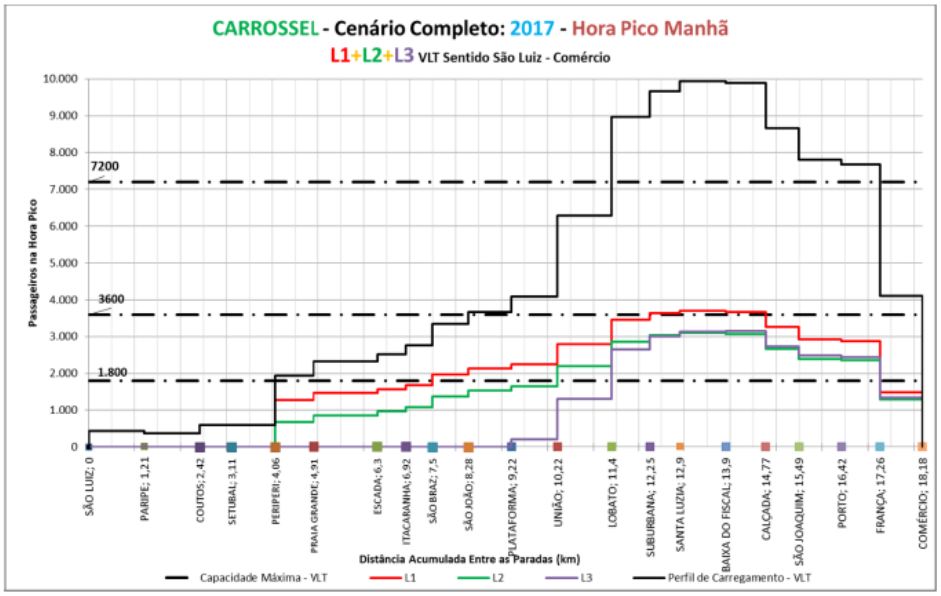


Table 14 – Suburb LRV: Loading in the dominant direction (2017 – pax/HPM)

LRV Stops	Distance until Stops (km)	User Flow (pax/hpm)			
		VLT L1	VLT L2	VLT L3	VLT 1+2+3
SÃO LUIZ	0.00	0	0	0	0
PARIPE	1.21	432	0	0	432
COUTOS	2.42	374	0	0	374
SETUBAL	3.11	600	0	0	600
PERIPERI	4.06	600	0	0	600
PRAIA GRANDE	4.91	1,267	667	0	1,934
ESCADA	6.30	1,459	859	0	2,318
ITACARANHA	6.92	1,562	962	0	2,524
SÃO BRAZ	7.50	1,682	1,082	0	2,764
SÃO JOÃO	8.28	1,968	1,368	0	3,336
PLATAFORMA	9.22	2,134	1,534	0	3,668
UNIÃO	10.22	2,240	1,640	212	4,092
LOBATO	11.40	2,788	2,188	1,310	6,286
SUBURBANA	12.25	3,460	2,860	2,654	8,974
SANTA LUZIA	12.90	3,633	3,033	3,000	9,666
BAIXA DO FISCAL	13.90	3,702	3,102	3,138	9,942
CALÇADA	14.77	3,667	3,067	3,154	9,888
SÃO JOAQUIM	15.49	3,264	2,664	2,730	8,658
PORTO	16.42	2,919	2,389	2,490	7,798
FRANÇA	17.26	2,881	2,351	2,444	7,676
COMÉRCIO	18.18	1,489	1,283	1,332	4,104

Figure 15 – Suburb LRV: Combined Load Profile (2017 – pax/HPM)



10.2. Final conclusion of this study

Evaluating the **"new combined load profile"** of the three LRV lines (Figure 15), it is identified that the **FULL SERVICE OF LOADING OF THE CRITICAL STRETCH**, including a percentage small extension before the total line (<32%) and in the service of few daily hours with a similar demand, **INDUCES** the adoption of a frequency of **12 TUEs/h in this critical stretch;** i.e., **20-min intervals in each of the more extensive LRV lines (LONG and MEDIUM) and 10 minutes in the line of the LRV 3 (shorter),** considering mainly:

a) The necessity of "**minimizing the impact in general traffic"**, in the central stretch (between Calçada e Comércio) before a greater frequency of LRV;

b) The probable "**flattening**" of the current Rush Hour Morning (HPM = 13.6% of the daily total identified by the Research OD/2012, for the Suburb region), resulting from a greater regularity and economy of travel time, when using a reliable transport system in rails;

c) The reduction of "**fleet idleness**" in case it was dimensioned to fully serve an **extremely concentrated rush** (and short extension throughout the day), which indicated the convenience of adopting around 75% of the maximum observed value.

d) The consideration that these results are due to a **"simulation process"**, naturally based on assumptions, which may always be reformulated, as a result of **integration policies and/or physical arrangement** of the transport systems in the region (other modals).

10.3. Annual evolution of the daily demand

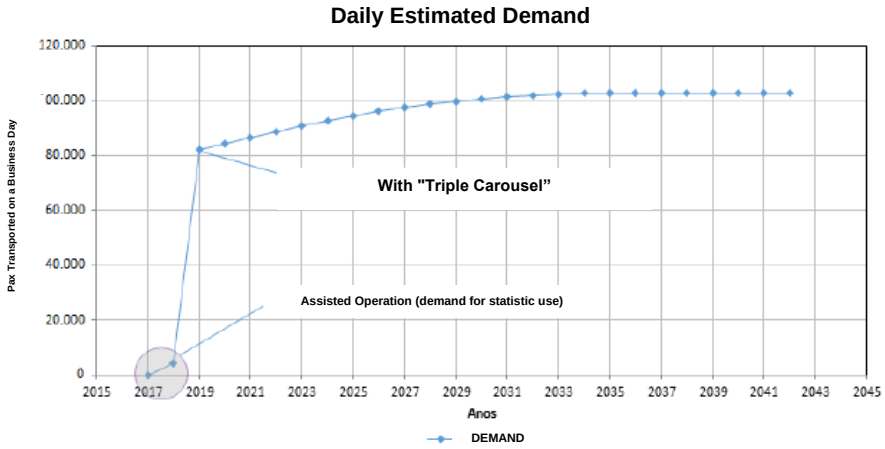
In order to enable an evaluation of Future Demand is indicated in Table 15 and Figure 16, an evolution of estimated demand growth, occurring throughout the study period, adopting an initial annual growth rate of 2.9% per year and annually decreasing, stabilizing from the twentieth year (2037).

Note: An initial period has been admitted (6 months) with partial operation, (8:30 AM – 4:30 PM) only in the initial stretch of the operational reinforcement (between Comércio and Baixa do Fiscal); and assisted operation, therefore, without tariff collection (from the 19th to the 24th month).

Table 15 – Evolution of Daily Demand (2016-2046)
[Reference Year / Annual Growth Rate / Daily Demand]

REFERENCE YEAR	ANNUAL GROWTH RATE (% p.a.)	DAILY DEMAND (pax/DU)	
2017	0	-	
2018	0	4,124	Assisted Op. (free of charge)
2019	0	81,852	
2020	2.9	84,225	
2021	2.7	86,499	
2022	2.5	88,662	
2023	2.3	90,701	
2024	2.1	92,605	
2025	1.9	94,365	
2026	1.7	95,969	
2027	1.5	97,409	
2028	1.3	98,675	
2029	1.1	99,760	
2030	0.9	100,658	
2031	0.7	101,363	
2032	0.5	101,870	
2033	0.4	102,277	
2034	0.3	102,584	
2035	0.2	102,789	
2036	0.1	102,892	
2037	0.0	102,892	
2038	0.0	102,892	
2039	0.0	102,892	
2040	0.0	102,892	
2041	0.0	102,892	
2042	0.0	102,892	
2043	0.0	102,892	
2044	0.0	102,892	
2045	0.0	102,892	
2046	0.0	102,892	
2047	0.0	102,892	

Figure 16 – Daily Estimated Demand (pax/DU)



With these considerations and, **defining the combined interval of 5 minutes to serve the critical stretch and thus, the center of Salvador (Calçada <> Comércio), operating the "TRIPLE CAROUSEL"**, an operational logistic is recommended, for the Rush Hour Morning, of 4 **TUEs in the LONG line** (LRV 1, with Tc=88 min); of 4 **TUEs in MEDIUM operational reinforcement** (LRV 2, with Tc = 72 min); and, 5 TUEs in SHORT reinforcement (LRV 3, with Tc = 48 min) which, with the technical reserve composition, results an **INITIAL FLEET of 14 TUEs** for the Suburb LRV (Figure 6.1).