Absolutely Positively
Wellington City Council
Me Heke Ki Pōneke

ORDINARY MEETING

OF

WELLINGTON CITY COUNCIL

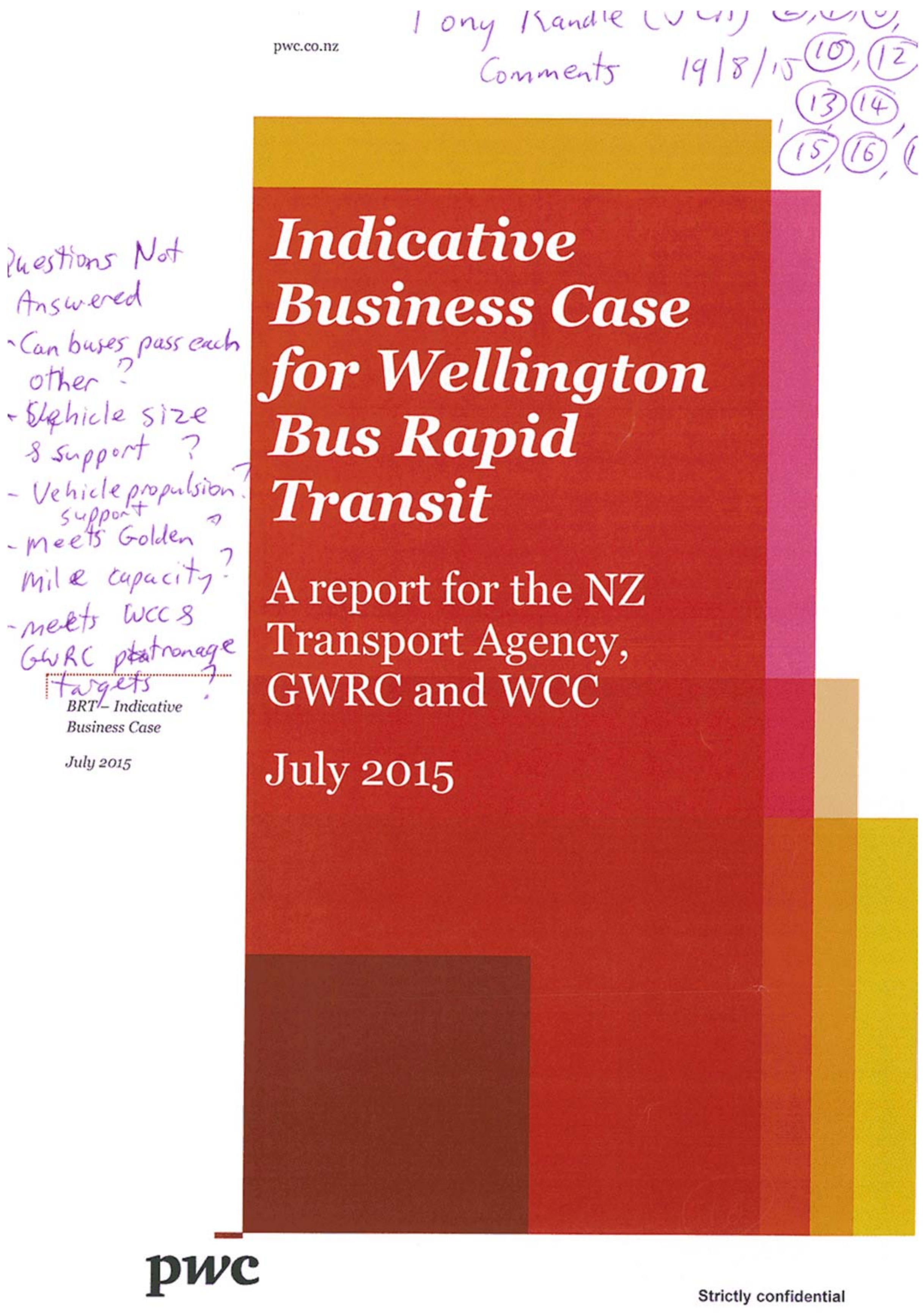
MINUTE ITEM ATTACHMENTS

Time: 5.33pm
Date: Wednesday, 19 August 2015
Venue: Committee Room 1
Ground Floor, Council Offices
101 Wakefield Street
Wellington

Business **Page No.**

1.7.1 Tabled Item A - Tony Randle

1. Tabled Item A - Tony Randle's comments on Indicative Business Case for Bus Rapid Transit 2



Tony Randle (WCC)
Comments 19/8/15 ⑩, ⑫, ⑬⑭, ⑮, ⑯, (

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Questions Not Answered
- Can buses pass each other?
- Vehicle size & support?
- Vehicle propulsion support?
- meets Golden Mile capacity?
- meets WCC & GWRC patronage targets?

BRT – Indicative
Business Case

July 2015

Indicative Business Case for Wellington Bus Rapid Transit

A report for the NZ Transport Agency, GWRC and WCC

July 2015

pwc

Strictly confidential

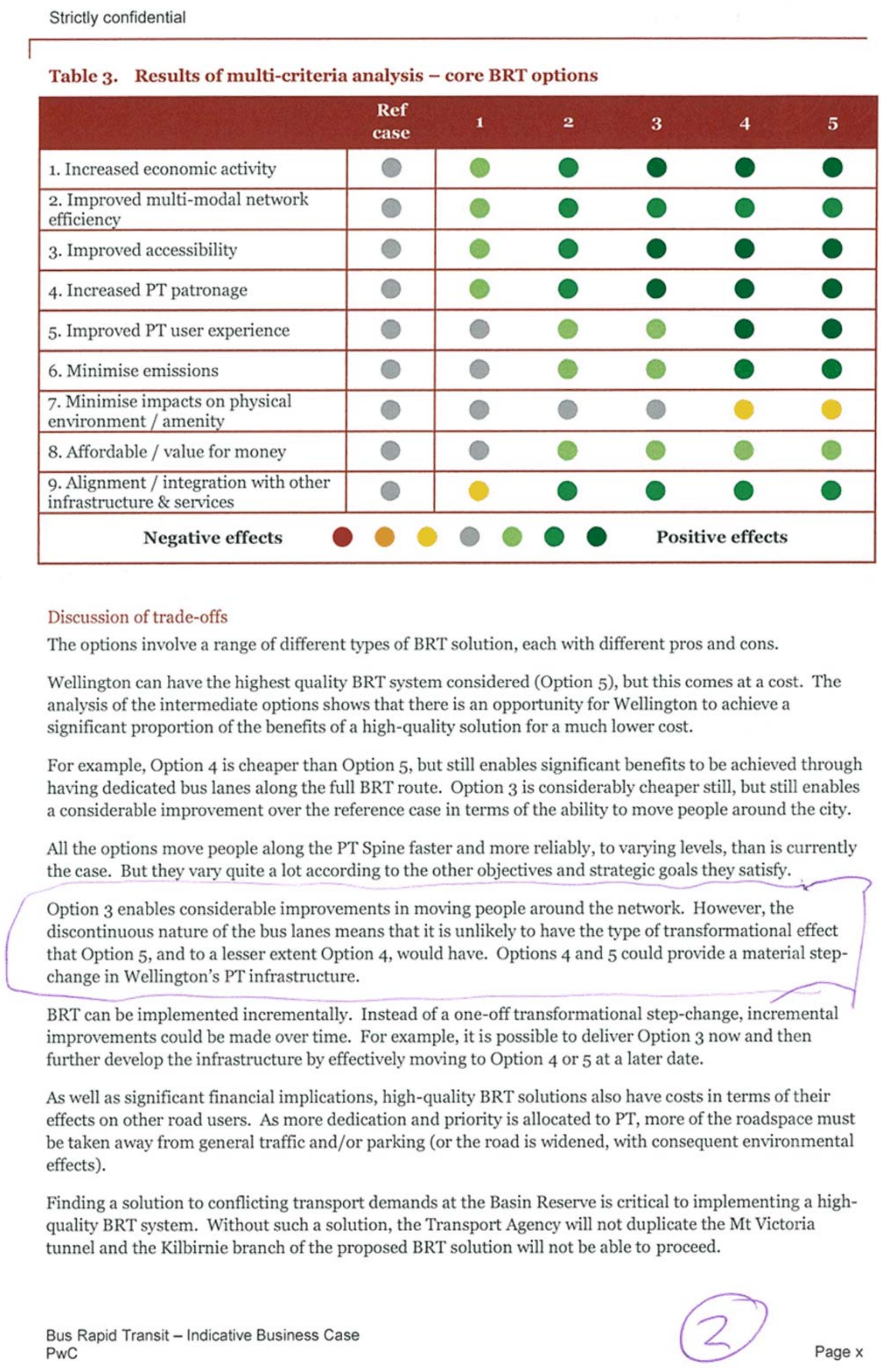

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Table 3. Results of multi-criteria analysis – core BRT options

	Ref case	1	2	3	4	5
1. Increased economic activity	⚪	◔	◑	●	●	●
2. Improved multi-modal network efficiency	⚪	◔	◑	◑	◑	◑
3. Improved accessibility	⚪	◔	◑	●	●	●
4. Increased PT patronage	⚪	◔	◑	●	●	●
5. Improved PT user experience	⚪	⚪	◔	◔	●	●
6. Minimise emissions	⚪	⚪	◔	◔	◑	◑
7. Minimise impacts on physical environment / amenity	⚪	⚪	⚪	⚪	🟡	🟡
8. Affordable / value for money	⚪	⚪	◔	◔	◔	◔
9. Alignment / integration with other infrastructure & services	⚪	🟡	◑	◑	◑	◑

Negative effects 🔴 🟠 🟡 ⚪ ◔ ◑ ● **Positive effects**

Discussion of trade-offs

The options involve a range of different types of BRT solution, each with different pros and cons.

Wellington can have the highest quality BRT system considered (Option 5), but this comes at a cost. The analysis of the intermediate options shows that there is an opportunity for Wellington to achieve a significant proportion of the benefits of a high-quality solution for a much lower cost.

For example, Option 4 is cheaper than Option 5, but still enables significant benefits to be achieved through having dedicated bus lanes along the full BRT route. Option 3 is considerably cheaper still, but still enables a considerable improvement over the reference case in terms of the ability to move people around the city.

All the options move people along the PT Spine faster and more reliably, to varying levels, than is currently the case. But they vary quite a lot according to the other objectives and strategic goals they satisfy.

Option 3 enables considerable improvements in moving people around the network. However, the discontinuous nature of the bus lanes means that it is unlikely to have the type of transformational effect that Option 5, and to a lesser extent Option 4, would have. Options 4 and 5 could provide a material step-change in Wellington's PT infrastructure.

BRT can be implemented incrementally. Instead of a one-off transformational step-change, incremental improvements could be made over time. For example, it is possible to deliver Option 3 now and then further develop the infrastructure by effectively moving to Option 4 or 5 at a later date.

As well as significant financial implications, high-quality BRT solutions also have costs in terms of their effects on other road users. As more dedication and priority is allocated to PT, more of the roadspace must be taken away from general traffic and/or parking (or the road is widened, with consequent environmental effects).

Finding a solution to conflicting transport demands at the Basin Reserve is critical to implementing a high-quality BRT system. Without such a solution, the Transport Agency will not duplicate the Mt Victoria tunnel and the Kilbirnie branch of the proposed BRT solution will not be able to proceed.

②

2.3.3 *Calculation of costs*

Capital and operating cost values are also sourced from the PTSS work. These were developed by Davis Langdon, and peer reviewed. As with the transport effects, we apply the PTSS Bus Priority and BRT costs to Options 1 and 5, and then interpolate to develop the costs for the other options.

Capital expenditure

Table 19 below shows the indicative costs of the bus priority and BRT options from the PTSS work.

Table 19: Capital expenditure of construction ($2013 m)

	Bus Priority		BRT [2]	
Central spine	16.1		79.8	
Newtown branch	5.9	41.1	29.4	
Kilbirnie branch	14.1 [1]		25.6	144.6
General allowances	5.0	(20%)	9.8	(2
Design and construction contingencies (20%)	~~9.8~~	8.22	~~32.2~~	28.92
Total construction cost	~~58.6~~ [3]	49.32	**173.5**	173.52

Source: Wellington Public Transport Spine Study Appendix E Option Cost Methodology
Note: (1) Option 1 does not include the Kilbirnie branch. However we use the PTSS value for this part of the route to help interpolate the values for other options. (2) The BRT values exclude the amount included in the PTSS for high-capacity buses, since these are part of the reference case for our analysis. (3) The Bus Priority values exclude amounts for the Constable St part of the route, since this is not part of any BRT option.

The interpolation method used for capital costs differed to that applied to journey times, given the different drivers of the values. Our method uses professional judgement to determine the relative costs of each option compared to the 'bookends'. The approach used a different relative allocation for road infrastructure and signalling and telemetry. Table 20 and Table 21 set out the approach used to interpolate the capital costs.

Table 20: Infrastructure cost allocation

Option 1	Option 2	Option 3	Option 4	Option 5
Bus Priority costs	Midway between BP and BRT costs	BP costs plus 25%	Midway between BP and BRT costs	**BRT costs**

Table 21: Signalling cost allocation

Option 1	Option 2	Option 3	Option 4	Option 5
Bus Priority costs	Same as BP costs	Same as BP costs	Same as BRT costs	**BRT costs**

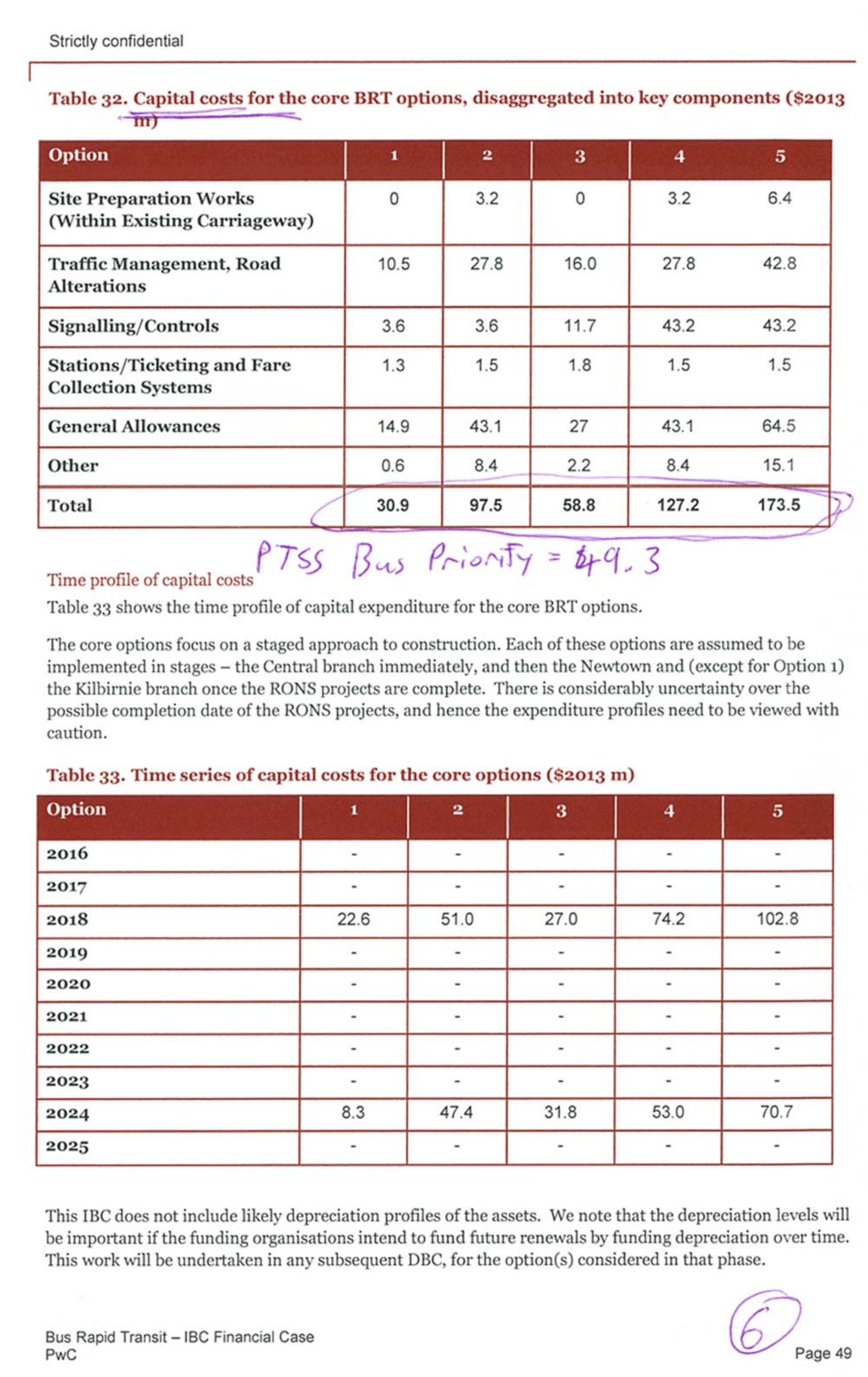

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Table 32. Capital costs for the core BRT options, disaggregated into key components ($2013 m)

Option	1	2	3	4	5
Site Preparation Works (Within Existing Carriageway)	0	3.2	0	3.2	6.4
Traffic Management, Road Alterations	10.5	27.8	16.0	27.8	42.8
Signalling/Controls	3.6	3.6	11.7	43.2	43.2
Stations/Ticketing and Fare Collection Systems	1.3	1.5	1.8	1.5	1.5
General Allowances	14.9	43.1	27	43.1	64.5
Other	0.6	8.4	2.2	8.4	15.1
Total	**30.9**	**97.5**	**58.8**	**127.2**	**173.5**

PTSS Bus Priority = $49.3

Time profile of capital costs

Table 33 shows the time profile of capital expenditure for the core BRT options.

The core options focus on a staged approach to construction. Each of these options are assumed to be implemented in stages – the Central branch immediately, and then the Newtown and (except for Option 1) the Kilbirnie branch once the RONS projects are complete. There is considerably uncertainty over the possible completion date of the RONS projects, and hence the expenditure profiles need to be viewed with caution.

Table 33. Time series of capital costs for the core options ($2013 m)

Option	1	2	3	4	5
2016	-	-	-	-	-
2017	-	-	-	-	-
2018	22.6	51.0	27.0	74.2	102.8
2019	-	-	-	-	-
2020	-	-	-	-	-
2021	-	-	-	-	-
2022	-	-	-	-	-
2023	-	-	-	-	-
2024	8.3	47.4	31.8	53.0	70.7
2025	-	-	-	-	-

This IBC does not include likely depreciation profiles of the assets. We note that the depreciation levels will be important if the funding organisations intend to fund future renewals by funding depreciation over time. This work will be undertaken in any subsequent DBC, for the option(s) considered in that phase.

Other features

- Cycles and taxis will be able to use some of the bus lanes, with details to be determined on a road-by-road basis later.
- Some additional lanes will only operate at certain periods, depending on inter-peak congestion levels.
- High-capacity buses will run at a frequency necessary to cater for demand and growth, as assumed in the reference case.
- Bus services can continue to other destinations on local roads.
- Additional lanes implemented immediately (currently modelled as 2019).

Variants

As this option is designed to reflect a possible option developed by WCC, no alternative variants are considered.

Option 2 – Bus lanes along the whole route, at peak periods, with limited intersection priority

Key points

- Provides for dedicated bus lanes along the Central spine, and Newtown and Kilbirnie branches. These lanes would only operate at peak periods.
- Buses will get signal priority over general traffic at intersections at peak periods. This will occur through the 'B phase' method.

Specific details

- Where no dedicated bus lane currently exists, either general traffic lanes or on-street parking space will be converted to bus lanes at peak periods.
- Exact location of lanes within the roadspace to be determined at a later date. But given only peak usage, likely to be on the outside of the roadway.
- Possible specifics for each road section:
    - Railway Station to Courtenay Place:
        - dedicated bus lanes (both directions) at peak times
        - no general traffic lanes along southern Lambton Quay, Willis St and Manners St; these bus lanes operate 24/7
        - some removal of peak time parking on Courtenay Place
    - Kent/Cambridge Terraces:
        - dedicated bus lanes (both directions) at peak times
        - some removal of peak time parking
    - Basin Reserve:
        - assumes Basin Bridge or similar RONS solution (as per do minimum)
    - Adelaide Rd to Riddiford St:
        - dedicated bus lanes (both directions)

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- Exact location of any dedicated lanes within the roadspace to be determined at a later date.
- The exact location of the new bus lanes will be determined at a later date. But possible specifics for each road section are:
  - Railway Station to Courtenay Place:
    - dedicated bus lanes (both directions)
    - no general traffic lanes along southern Lambton Quay, Willis St and Manners St
    - some removal of peak time parking on Courtenay Place
  - Kent/Cambridge Terraces:
    - dedicated bus lanes (both directions) either side of Vivian St intersection
    - some removal of parking around Vivian St
  - Basin Reserve:
    - assumes Basin Bridge or similar RONS solution (as per do minimum)
    - dedicated bus lanes, with signal priority, at entrances from Adelaide Road and the Mt Victoria tunnel
  - Adelaide Rd to Riddiford St:
    - dedicated bus lanes (both directions) either side of the John St intersection
    - some removal of parking around John St
  - Mt Victoria tunnel to Kilbirnie:
    - buses mix with general traffic in duplicate Mt Vic tunnel
    - dedicated bus lanes (both directions) at peak times, on Ruahine St; which is already widened through the RONS work
    - restricted general traffic turning movements at Wellington St / Kilbirnie Cres intersection
    - no bus lanes on Kilbirnie Cres

Other features

- Cycles and taxis may be able to use some of the bus lanes, with details to be determined on a road-by-road basis later.
- Dedicated lanes could potentially only operate during the day. This can be determined at a later date.
- High-capacity buses will run at a frequency necessary to cater for demand and growth, as assumed in the reference case.
- Bus services can continue to other destinations on local roads.

Variants based on timing

Along with the core option, 2 additional variants of this option are assessed, based on different timing of implementation for each branch. These are shown in Table 49.

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- buses mix with general traffic in duplicate Mt Vic tunnel
- dedicated bus lanes (both directions) at peak times, on Ruahine St; which is already widened through the RONS work
- dedicated bus lanes (both directions) at peak times, on Kilbirnie Cres

Other features

- Cycles and taxis may be able to use some of the bus lanes, with details to be determined on a road-by-road basis later.
- Dedicated lanes could potentially only operate during the day. This can be determined at a later date.
- High-capacity buses will run at a frequency necessary to cater for demand and growth, as assumed in the reference case.
- Bus services can continue to other destinations on local roads.

Variants based on timing

Along with the core option, 4 additional variants of this option are assessed, based on different timing of implementation for each branch. These are shown in Table 50.

Table 50. Variants for Option 4

Assumed timing	Option 4	Option 4a	Option 4b	Option 4c	Option 4ac
Central spine	Immediately	To coincide with completion of RONS	Immediately	Immediately	To coincide with completion of RONS
Newtown branch	To coincide with completion of RONS	To coincide with completion of RONS	To coincide with completion of RONS	To coincide with completion of RONS	To coincide with completion of RONS
Kilbirnie branch	To coincide with completion of RONS	To coincide with completion of RONS	Never	To coincide with completion of RONS	To coincide with completion of RONS

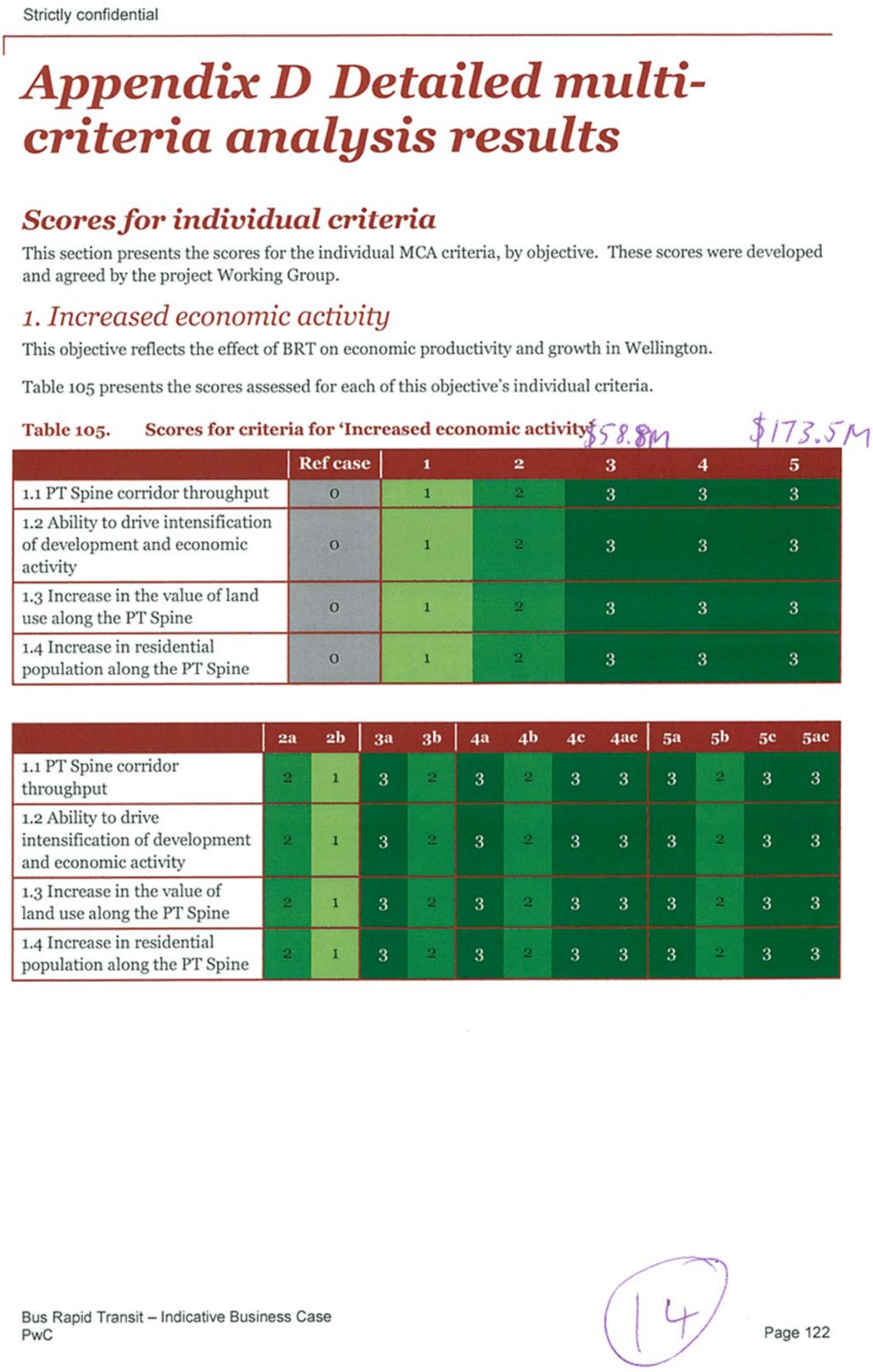
Note: (1) 'Immediately' assumes it is completed prior to 2019. (2) The RONS are assumed to be completed prior to 2025.

Option 5 – Physically separated bus lanes along the whole route, 24/7, with full intersection priority

This option is designed to be, in effect, the PTSS BRT option.

Key points

- Provides for dedicated bus lanes, physically separated from general traffic lanes, along the Central spine, and Newtown and Kilbirnie branches. These lanes would operate at all times. Physical separation will be through a small curb or median.
- Buses will get signal priority at intersections. This includes both pre-emption of signals before the bus arrives at the intersection, and the extension of phases.



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Appendix D Detailed multi-criteria analysis results

Scores for individual criteria

This section presents the scores for the individual MCA criteria, by objective. These scores were developed and agreed by the project Working Group.

1. Increased economic activity

This objective reflects the effect of BRT on economic productivity and growth in Wellington.

Table 105 presents the scores assessed for each of this objective's individual criteria.

Table 105. Scores for criteria for 'Increased economic activity'

$58.8M $173.5M

	Ref case	1	2	3	4	5
1.1 PT Spine corridor throughput	0	1	2	3	3	3
1.2 Ability to drive intensification of development and economic activity	0	1	2	3	3	3
1.3 Increase in the value of land use along the PT Spine	0	1	2	3	3	3
1.4 Increase in residential population along the PT Spine	0	1	2	3	3	3

	2a	2b	3a	3b	4a	4b	4c	4ac	5a	5b	5c	5ac
1.1 PT Spine corridor throughput	2	1	3	2	3	2	3	3	3	2	3	3
1.2 Ability to drive intensification of development and economic activity	2	1	3	2	3	2	3	3	3	2	3	3
1.3 Increase in the value of land use along the PT Spine	2	1	3	2	3	2	3	3	3	2	3	3
1.4 Increase in residential population along the PT Spine	2	1	3	2	3	2	3	3	3	2	3	3

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Bus Rapid Transit – Indicative Business Case
PwC

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3. Improved accessibility

This objective reflects the effect of BRT on the ability for Wellingtonians to move around the city, and to access key destinations.

Table 107 presents the scores assessed for each of this objective's individual criteria.

Table 107. Scores for criteria for 'Improved accessibility'

$58.8m ↓ $173.5M ↓

	Ref case	1	2	3	4	5
3.1 Increase in PT Spine corridor carrying capacity	0	1	2	3	3	3
3.2 Improved options for mode choice	0	1	2	3	3	3
3.3 Reduction in bus-on-bus congestion	0	1	2	3	3	3
3.4 Reduction in PT journey times	0	1	2	3	3	3

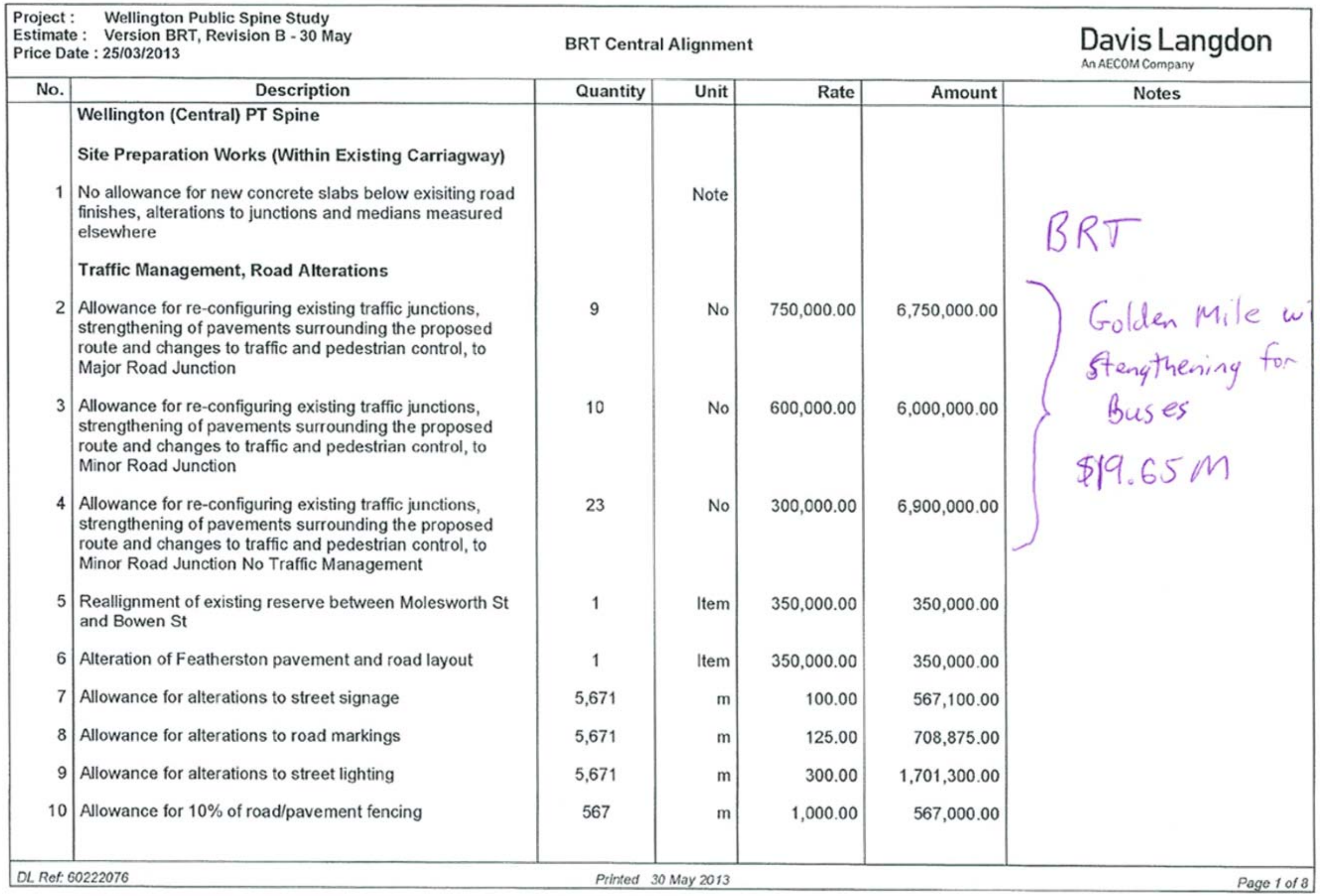
	2a	2b	3a	3b	4a	4b	4c	4ac	5a	5b	5c	5ac
3.1 Increase in PT Spine corridor carrying capacity	2	1	3	2	3	2	3	3	3	2	3	3
3.2 Improved options for mode choice	2	1	3	2	3	2	3	3	3	2	3	3
3.3 Reduction in bus-on-bus congestion	2	1	3	2	3	2	3	3	3	2	3	3
3.4 Reduction in PT journey times	2	1	3	2	3	2	3	3	3	2	3	3

(16)

Tony Randle (JCA)
Comments 19/8/2015

Appendix E

Option Cost Methodology



Project : Wellington Public Spine Study
Estimate : Version BRT, Revision B - 30 May
Price Date : 25/03/2013

BRT Central Alignment

Davis Langdon
An AECOM Company

No.	Description	Quantity	Unit	Rate	Amount	Notes
	Wellington (Central) PT Spine					
	Site Preparation Works (Within Existing Carriagway)					
1	No allowance for new concrete slabs below exisiting road finishes, alterations to junctions and medians measured elsewhere		Note			BRT
	Traffic Management, Road Alterations					
2	Allowance for re-configuring existing traffic junctions, strengthening of pavements surrounding the proposed route and changes to traffic and pedestrian control, to Major Road Junction	9	No	750,000.00	6,750,000.00	Golden Mile with pavemen Stengthening for High Capaci Buses $19.65M
3	Allowance for re-configuring existing traffic junctions, strengthening of pavements surrounding the proposed route and changes to traffic and pedestrian control, to Minor Road Junction	10	No	600,000.00	6,000,000.00	
4	Allowance for re-configuring existing traffic junctions, strengthening of pavements surrounding the proposed route and changes to traffic and pedestrian control, to Minor Road Junction No Traffic Management	23	No	300,000.00	6,900,000.00	
5	Reallignment of existing reserve between Molesworth St and Bowen St	1	Item	350,000.00	350,000.00	
6	Alteration of Featherston pavement and road layout	1	Item	350,000.00	350,000.00	
7	Allowance for alterations to street signage	5,671	m	100.00	567,100.00	
8	Allowance for alterations to road markings	5,671	m	125.00	708,875.00	
9	Allowance for alterations to street lighting	5,671	m	300.00	1,701,300.00	
10	Allowance for 10% of road/pavement fencing	567	m	1,000.00	567,000.00	

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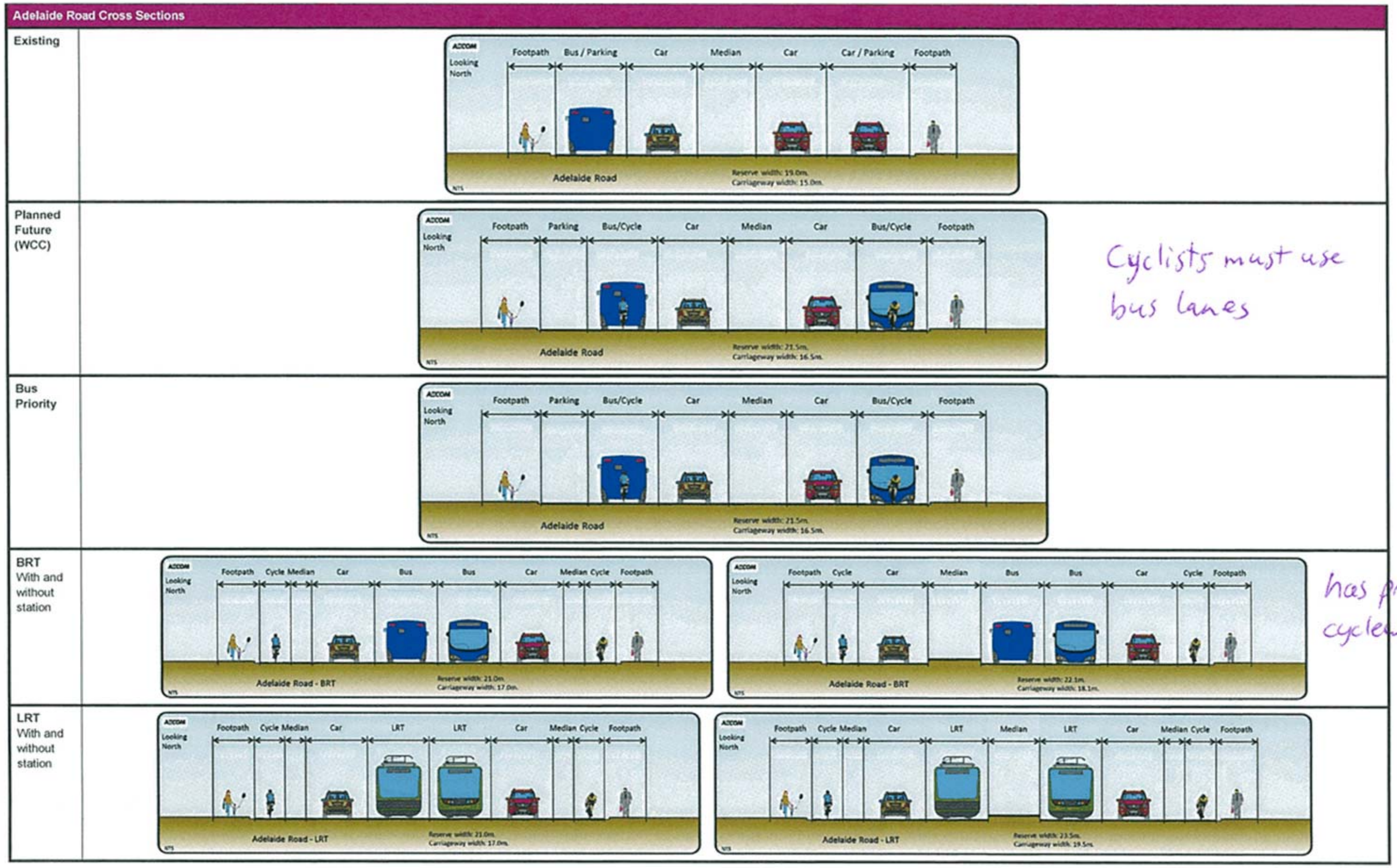
Tony Randle (JCA)
Comments 19/8/2015

Appendix B

Short List Cross Sections

Southern Spine



Cyclists must use bus lanes

has protecte cycleways

Do recommended Options 3 and 4 include or exclude the protected cycleways that are part of Otion 5 BRT

Control Center

3 points maximum

Control centers for BRT systems are increasingly becoming a requirement for a host of service improvements, such as avoiding bus bunching, monitoring bus operations, identifying problems, and rapidly responding to them.

A full-service control center monitors the locations of all buses with GPS or similar technology and can:

- Respond to incidents in real-time
- Control the spacing of buses
- Determine and respond to the maintenance status of all buses in the fleet
- Record passenger boardings and alightings for future service adjustments
- Use Computer-Aided Dispatch (CAD)/Automatic Vehicle Location (AVL) for bus tracking and performance monitoring

A full-service center should be integrated with a public transport system's existing control center as well as the traffic signal system.

Control Center	POINTS
Full-service control center	3
Control center with most services	2
Control center with some services	1
No control center	0

The control center in Medellín, Colombia allows the operator to monitor BRT service across the system.

Demand Profile

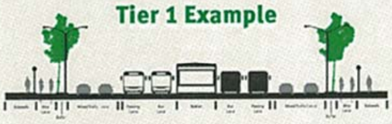
3 points maximum

Building the highest-quality BRT infrastructure in the highest-demand segments of a road ensures that the greatest number of passengers benefit from the improvements. This is most significant when the decision is made whether or not to build a corridor through a downtown; however, it can also be an issue outside of a downtown on a road segment that has a variable demand profile.

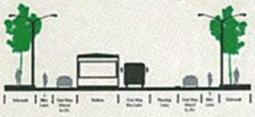
Scoring Guidelines: The BRT corridor must include the road segment with the highest demand within a 2-kilometer distance of either end of the corridor. This segment should also have the highest quality of busway alignment in that section, and the score thus relates to that. The corridor configurations defined in the Busway Alignment Section (see page 20) are used here to score the demand profile.

Demand Profile	POINTS
Corridor includes highest demand segment, which has a Tier 1 Corridor configuration	3
Corridor includes highest demand segment, which has a Tier 2 Corridor configuration	2
Corridor includes highest demand segment, which has a Tier 3 Corridor configuration	1
Corridor does not include highest demand segment	0

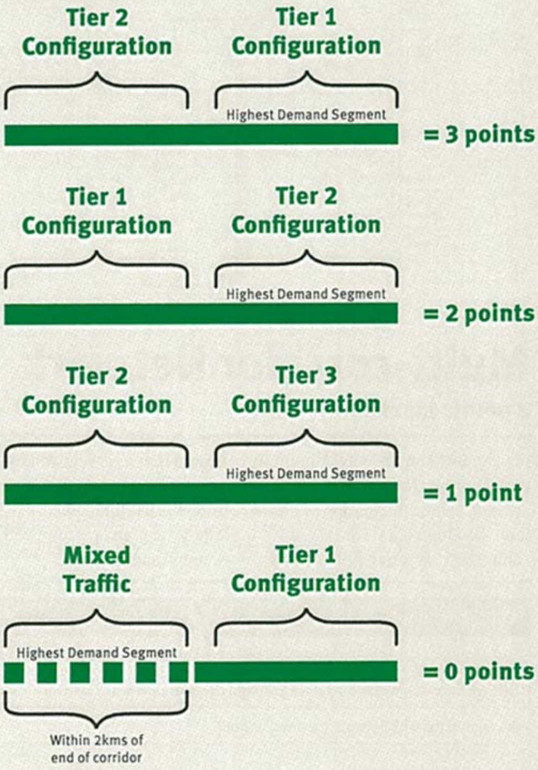
Tier 1 Example

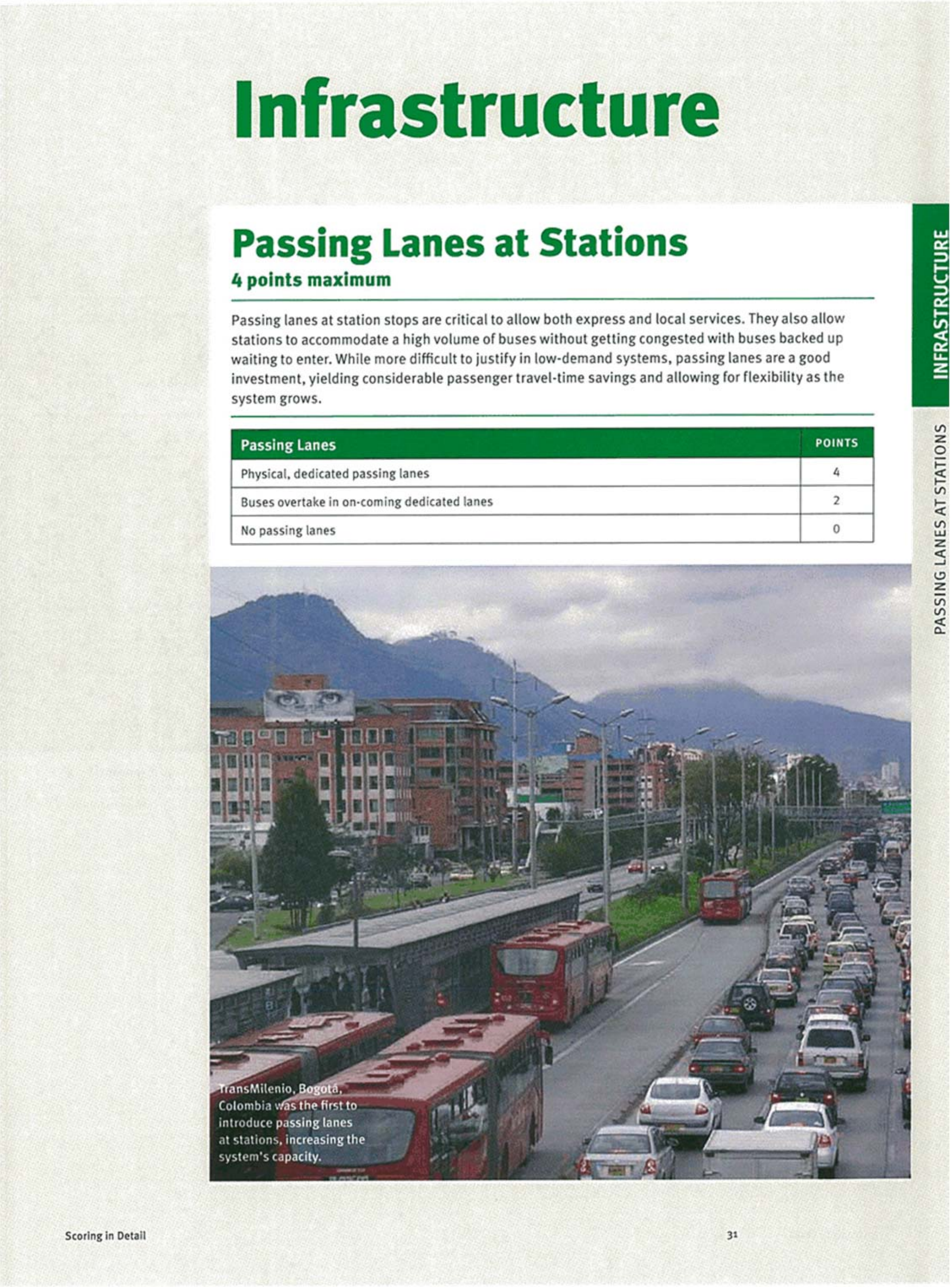


Tier 2 Example



For more detail about the tiers and more examples, please see page 18, Busway Alignment.





Infrastructure

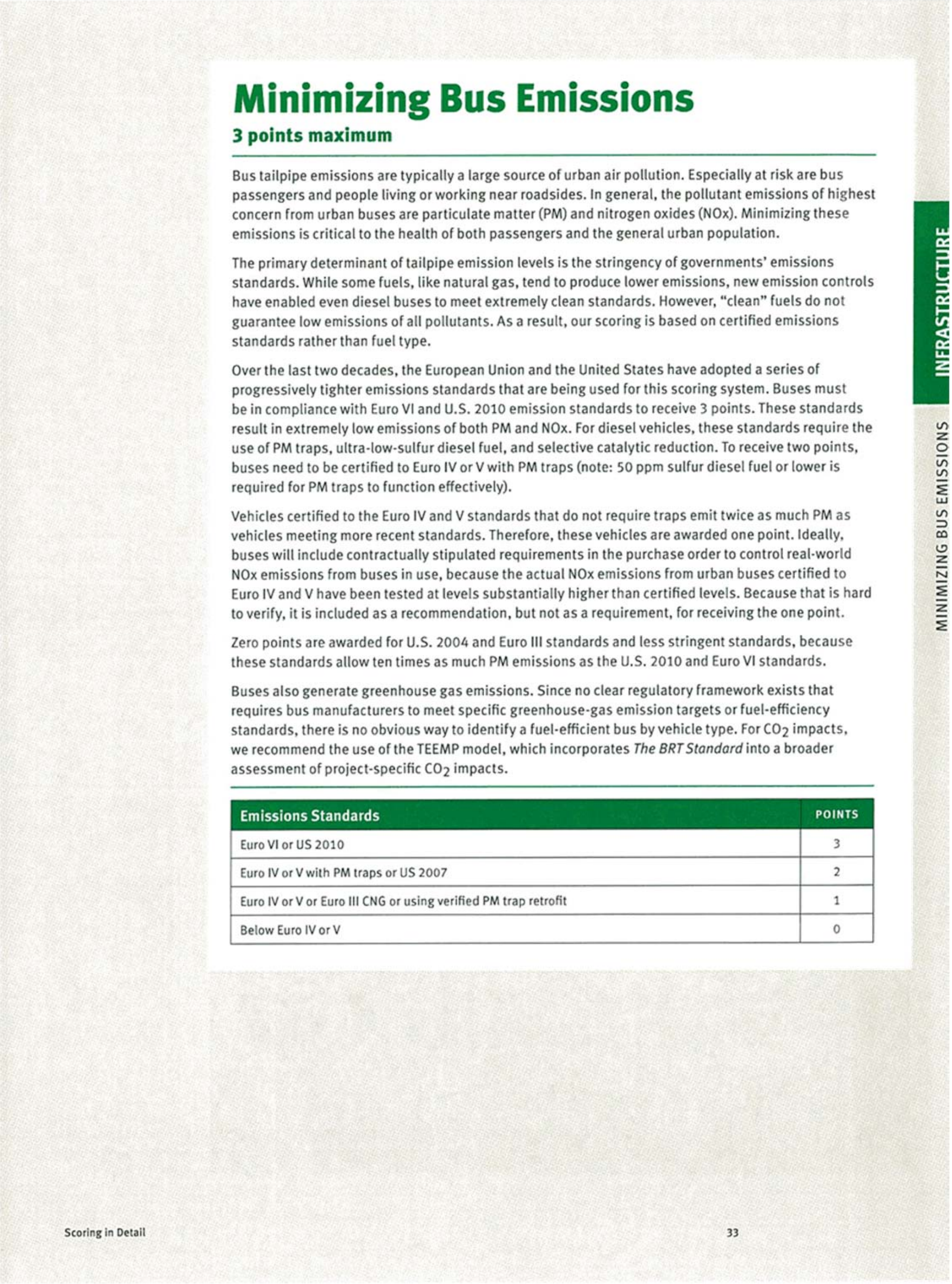
Passing Lanes at Stations

4 points maximum

Passing lanes at station stops are critical to allow both express and local services. They also allow stations to accommodate a high volume of buses without getting congested with buses backed up waiting to enter. While more difficult to justify in low-demand systems, passing lanes are a good investment, yielding considerable passenger travel-time savings and allowing for flexibility as the system grows.

Passing Lanes	POINTS
Physical, dedicated passing lanes	4
Buses overtake in on-coming dedicated lanes	2
No passing lanes	0

TransMilenio, Bogotá, Colombia was the first to introduce passing lanes at stations, increasing the system's capacity.



Minimizing Bus Emissions

3 points maximum

Bus tailpipe emissions are typically a large source of urban air pollution. Especially at risk are bus passengers and people living or working near roadsides. In general, the pollutant emissions of highest concern from urban buses are particulate matter (PM) and nitrogen oxides (NOx). Minimizing these emissions is critical to the health of both passengers and the general urban population.

The primary determinant of tailpipe emission levels is the stringency of governments' emissions standards. While some fuels, like natural gas, tend to produce lower emissions, new emission controls have enabled even diesel buses to meet extremely clean standards. However, "clean" fuels do not guarantee low emissions of all pollutants. As a result, our scoring is based on certified emissions standards rather than fuel type.

Over the last two decades, the European Union and the United States have adopted a series of progressively tighter emissions standards that are being used for this scoring system. Buses must be in compliance with Euro VI and U.S. 2010 emission standards to receive 3 points. These standards result in extremely low emissions of both PM and NOx. For diesel vehicles, these standards require the use of PM traps, ultra-low-sulfur diesel fuel, and selective catalytic reduction. To receive two points, buses need to be certified to Euro IV or V with PM traps (note: 50 ppm sulfur diesel fuel or lower is required for PM traps to function effectively).

Vehicles certified to the Euro IV and V standards that do not require traps emit twice as much PM as vehicles meeting more recent standards. Therefore, these vehicles are awarded one point. Ideally, buses will include contractually stipulated requirements in the purchase order to control real-world NOx emissions from buses in use, because the actual NOx emissions from urban buses certified to Euro IV and V have been tested at levels substantially higher than certified levels. Because that is hard to verify, it is included as a recommendation, but not as a requirement, for receiving the one point.

Zero points are awarded for U.S. 2004 and Euro III standards and less stringent standards, because these standards allow ten times as much PM emissions as the U.S. 2010 and Euro VI standards.

Buses also generate greenhouse gas emissions. Since no clear regulatory framework exists that requires bus manufacturers to meet specific greenhouse-gas emission targets or fuel-efficiency standards, there is no obvious way to identify a fuel-efficient bus by vehicle type. For CO_2 impacts, we recommend the use of the TEEMP model, which incorporates *The BRT Standard* into a broader assessment of project-specific CO_2 impacts.

Emissions Standards	POINTS
Euro VI or US 2010	3
Euro IV or V with PM traps or US 2007	2
Euro IV or V or Euro III CNG or using verified PM trap retrofit	1
Below Euro IV or V	0

A center platform station in Quito, Ecuador allows for convenient transfers.

Center Stations

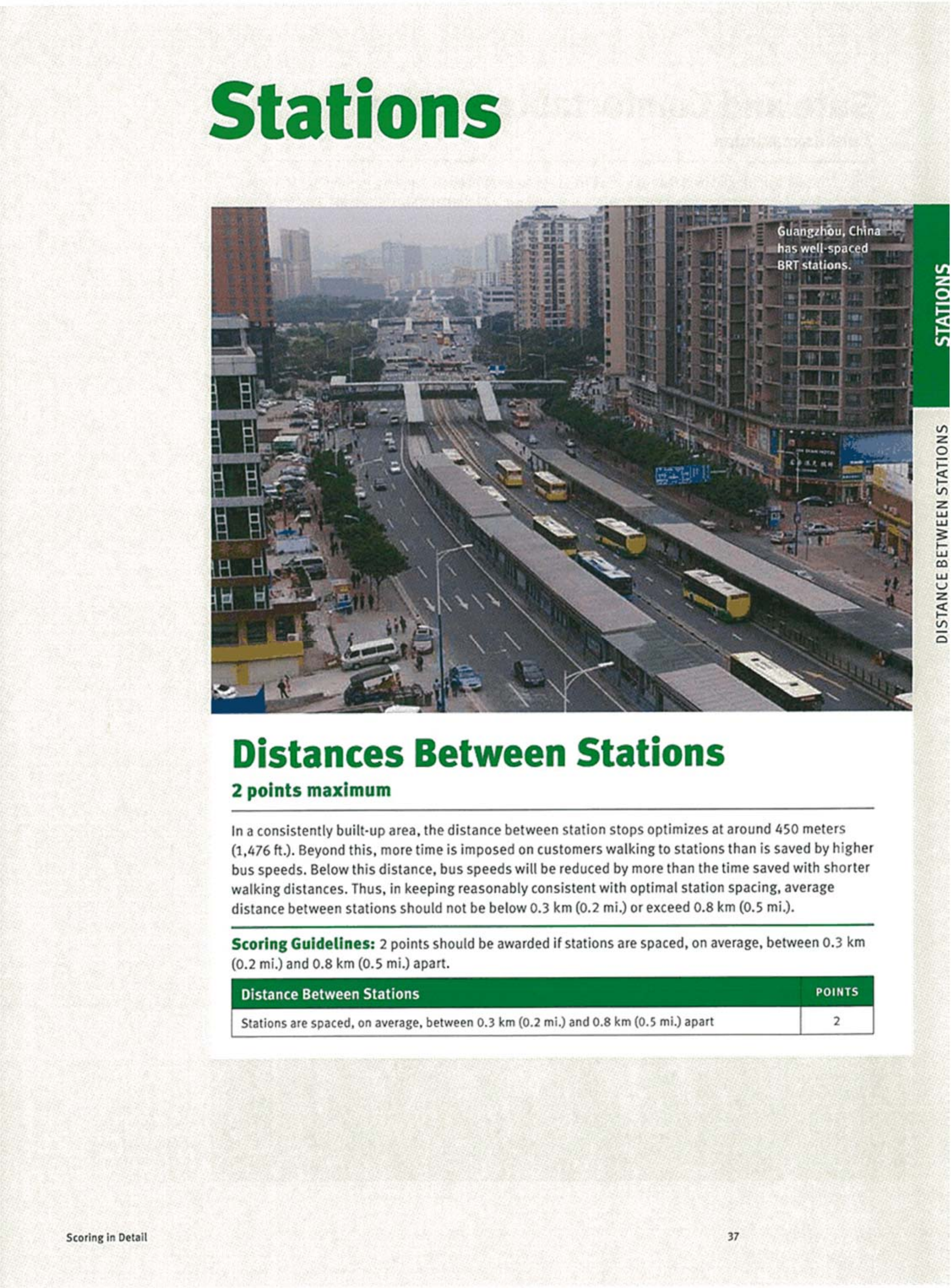
2 points maximum

Having a single station serving both directions of the BRT system makes transfers between the two directions easier and more convenient—something that becomes more important as the BRT network expands. It also tends to reduce construction costs and minimize the necessary right-of-way. In some cases, stations may be centrally aligned but split into two—called split stations, with each station housing a particular direction of the BRT system. If a physical connection between the two directions is not provided, fewer points are awarded.

Bi-lateral stations (those that, while in the central verge, are curb-aligned) get no points.

Scoring Guidelines: The BRT corridor must include the road segment with the highest demand within a 2 kilometer distance from either end of the corridor. This segment should also have the highest quality of busway alignment in that section and the score thus relates to that. The corridor configurations defined in the Busway Alignment Section are used here to score the demand profile.

Center Stations	POINTS
80% and above of stations on corridor have center platforms serving both directions of service	2
50% of stations on corridor	1
‹ 20% of stations on corridor	0



Stations

Guangzhou, China has well-spaced BRT stations.

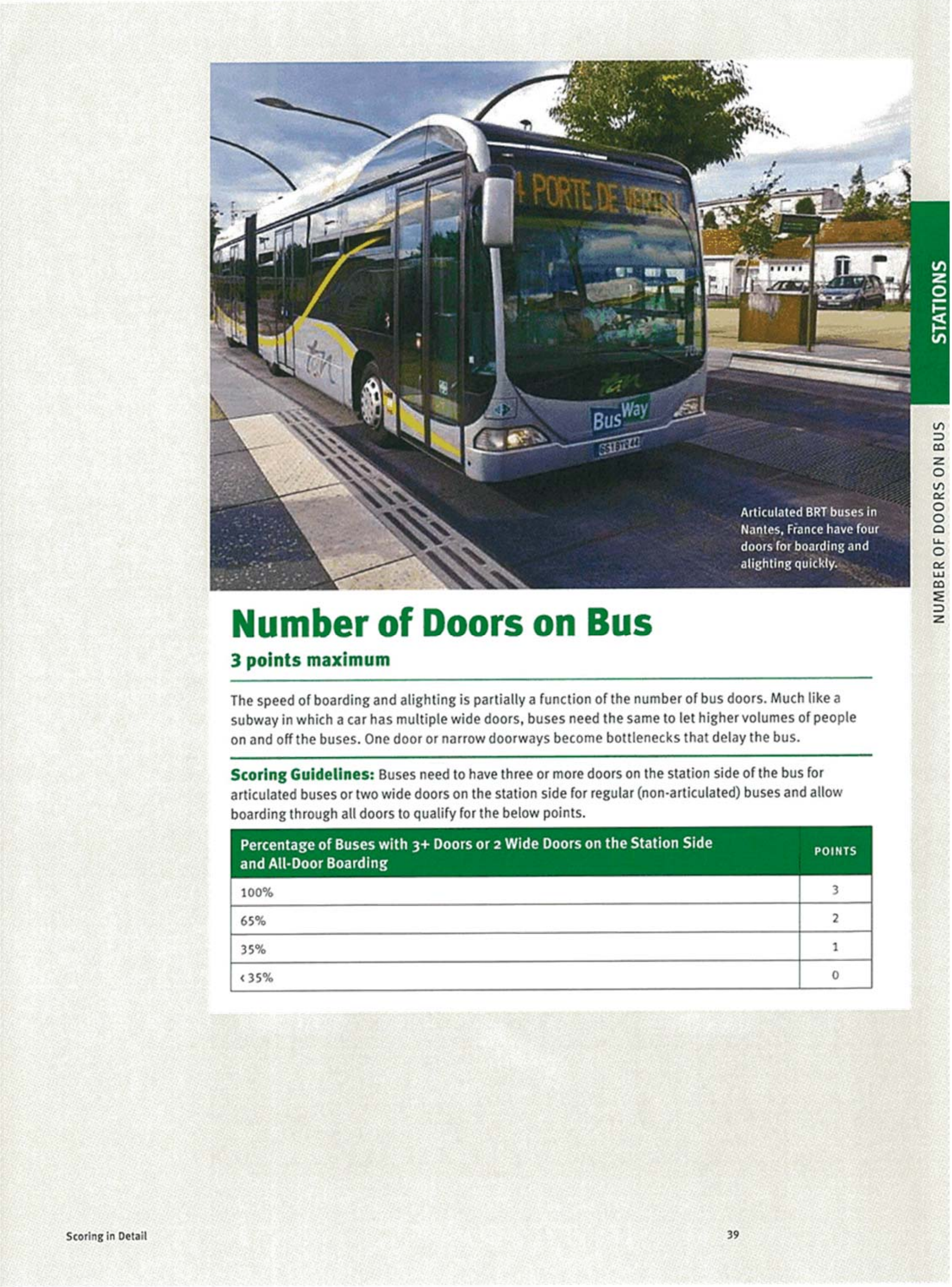
Distances Between Stations

2 points maximum

In a consistently built-up area, the distance between station stops optimizes at around 450 meters (1,476 ft.). Beyond this, more time is imposed on customers walking to stations than is saved by higher bus speeds. Below this distance, bus speeds will be reduced by more than the time saved with shorter walking distances. Thus, in keeping reasonably consistent with optimal station spacing, average distance between stations should not be below 0.3 km (0.2 mi.) or exceed 0.8 km (0.5 mi.).

Scoring Guidelines: 2 points should be awarded if stations are spaced, on average, between 0.3 km (0.2 mi.) and 0.8 km (0.5 mi.) apart.

Distance Between Stations	POINTS
Stations are spaced, on average, between 0.3 km (0.2 mi.) and 0.8 km (0.5 mi.) apart	2



Articulated BRT buses in Nantes, France have four doors for boarding and alighting quickly.

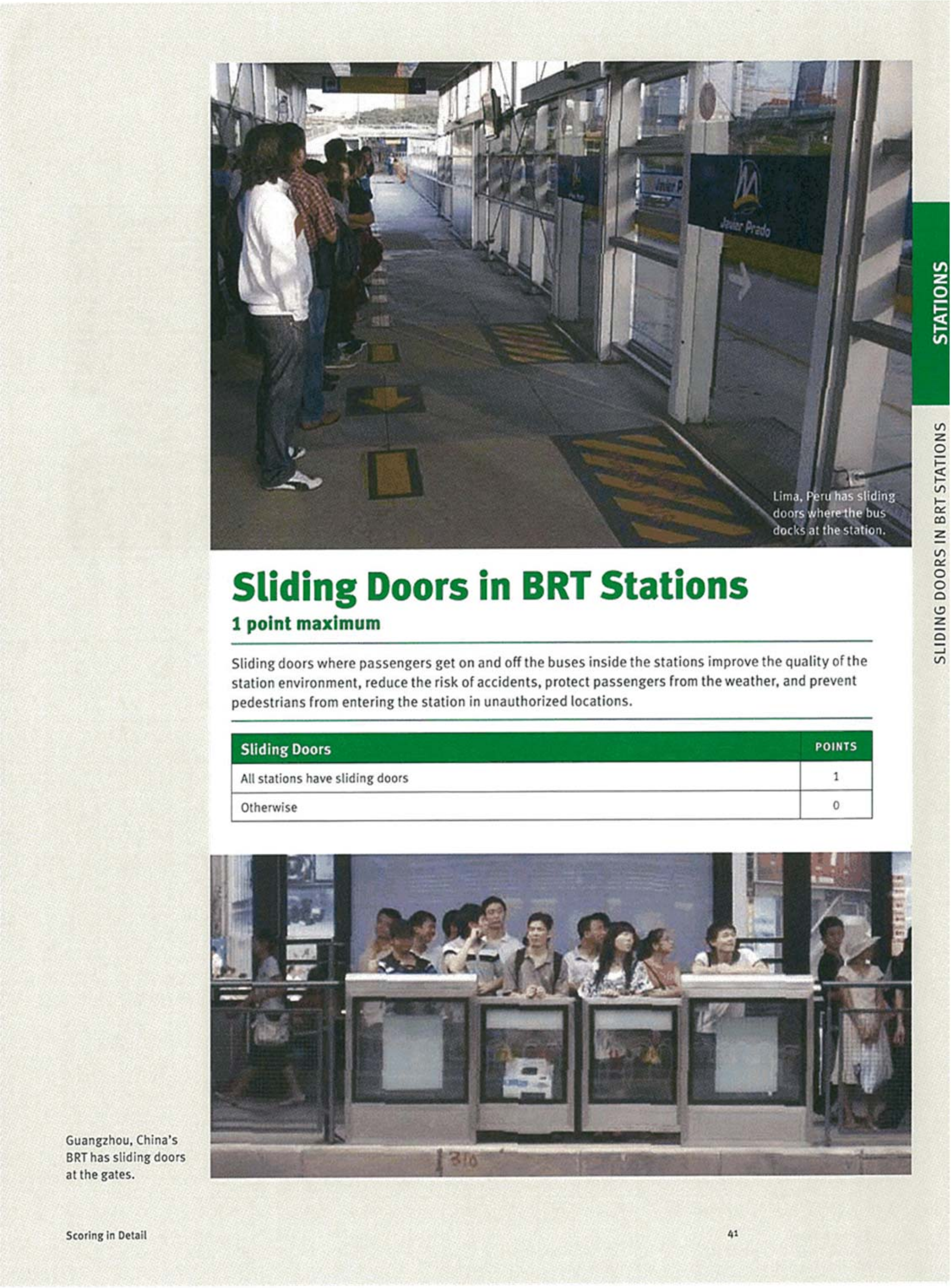
Number of Doors on Bus

3 points maximum

The speed of boarding and alighting is partially a function of the number of bus doors. Much like a subway in which a car has multiple wide doors, buses need the same to let higher volumes of people on and off the buses. One door or narrow doorways become bottlenecks that delay the bus.

Scoring Guidelines: Buses need to have three or more doors on the station side of the bus for articulated buses or two wide doors on the station side for regular (non-articulated) buses and allow boarding through all doors to qualify for the below points.

Percentage of Buses with 3+ Doors or 2 Wide Doors on the Station Side and All-Door Boarding	POINTS
100%	3
65%	2
35%	1
‹ 35%	0



Lima, Peru has sliding doors where the bus docks at the station.

Sliding Doors in BRT Stations

1 point maximum

Sliding doors where passengers get on and off the buses inside the stations improve the quality of the station environment, reduce the risk of accidents, protect passengers from the weather, and prevent pedestrians from entering the station in unauthorized locations.

Sliding Doors	POINTS
All stations have sliding doors	1
Otherwise	0

Guangzhou, China's BRT has sliding doors at the gates.

Passenger Information

2 points maximum

Numerous studies have shown that passenger satisfaction is linked to knowing when the next bus will arrive. Giving passengers information is critical to a positive overall experience.

Real-time passenger information includes electronic panels, digital audio messaging ("Next bus" at stations, "Next stop" on buses), and/or dynamic information on handheld devices. Static passenger information refers to station and vehicle signage, including network maps, route maps, local area maps, emergency indications, and other user information.

Passenger Information (at Stations and on Vehicles)	POINTS
Functioning real-time and up-to-date static passenger information corridor-wide	2
Up-to-date static passenger information	1
Very poor or no passenger information	0

Guangzhou, China has real-time passenger information systems.

Integration with Other Public Transport

3 points maximum

When a BRT system is built in a city, a functioning public transport network often already exists, be it rail, bus, or minibus. The BRT system should integrate into the rest of the public transport network. There are two components to BRT integration:

- **Physical transfer points:** Physical transfer points should minimize walking between modes, be well-sized, and not require passengers to exit one system and enter another;
- **Fare payment:** The fare system should be integrated so that one fare card may be used for all modes.

Scoring Guidelines: The BRT corridor should integrate physically with other public transport modes where lines cross. If no lines cross, points may still be awarded for physical integration. If no other formal public transport modes exist in the city, full points may be awarded for all aspects of integration.

Integration with Other Public Transport	POINTS
Integration of both physical design and fare payment	3
Integration of physical design or fare payment only	2
No integration	0

Guangzhou, China has physical integration, like this tunnel connecting the BRT to the Metro.

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Secure Bicycle Parking

2 points maximum

The provision of bicycle parking at stations is necessary for passengers who wish to use bicycles as feeders to the BRT system. Formal bicycle parking facilities that are secure (either monitored by an attendant or observed by security camera) and weather-protected are more likely to be used by passengers.

Bicycle Parking	POINTS
Secure bicycle parking at least in terminal stations and standard bicycle racks elsewhere	2
Standard bicycle racks in most stations	1
Little or no bicycle parking	0

Secure bike parking is provided at a TransMilenio terminal in Bogotá, Colombia.

A bike locker along the Orange Line in Los Angeles, USA, provides secure bicycle storage.

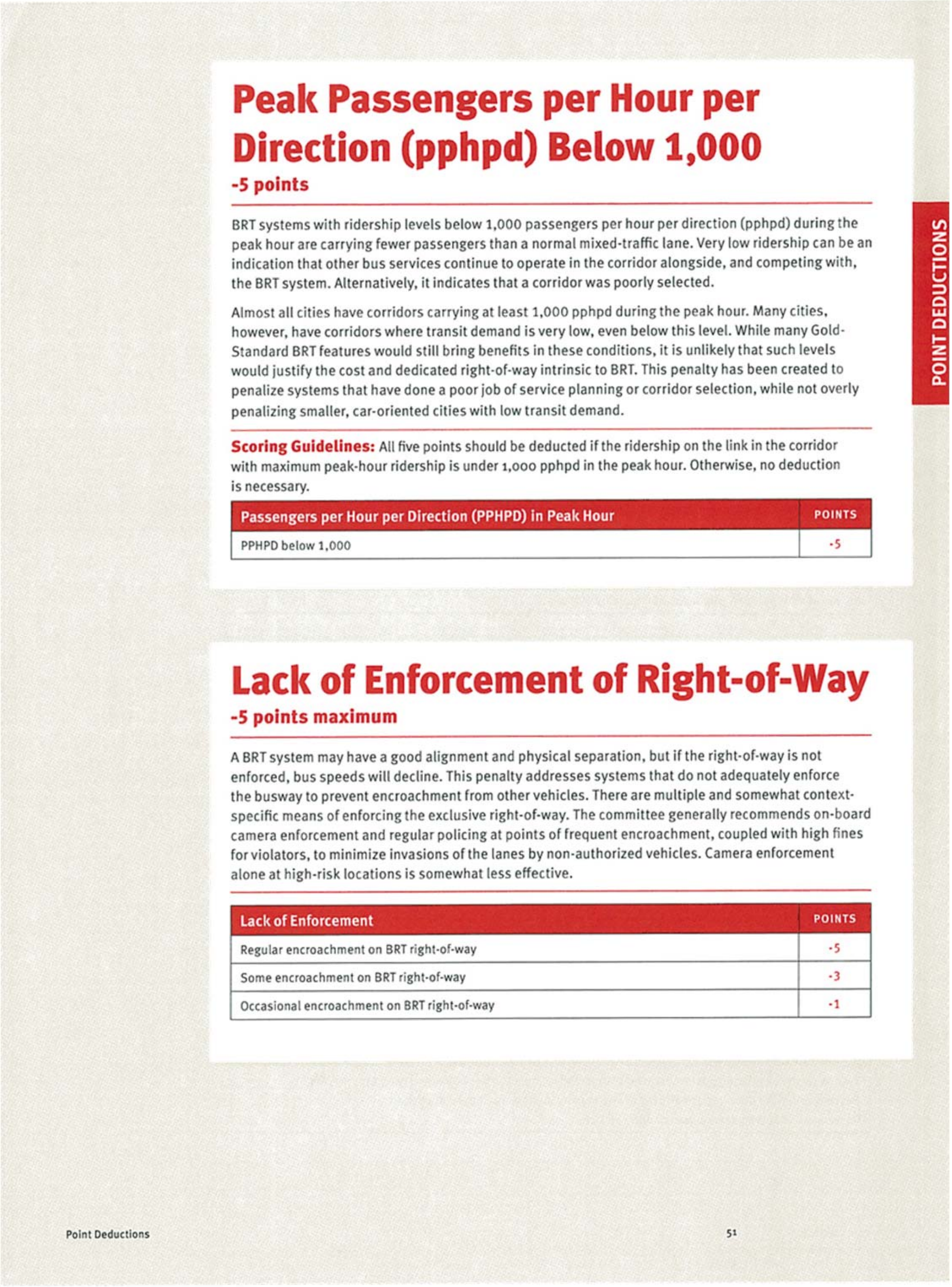
Bicycle-Sharing Integration

1 point maximum

Having the option to make short trips from the BRT corridor by a shared bicycle is important to providing connectivity to some destinations. Operating costs of providing bus service to the last mile (i.e., feeder buses) are often the highest cost of maintaining a BRT network; thus, providing a low-cost bicycle-sharing alternative to feeders is generally seen as best practice.

Bicycle-Sharing Integration	POINTS
Bicycle-sharing at minimum of 50% of stations on corridor	1
Bicycle-sharing at less than 50% of stations on corridor	0

A bike-share station is located along a BRT corridor in Nantes, France.



Peak Passengers per Hour per Direction (pphpd) Below 1,000

-5 points

BRT systems with ridership levels below 1,000 passengers per hour per direction (pphpd) during the peak hour are carrying fewer passengers than a normal mixed-traffic lane. Very low ridership can be an indication that other bus services continue to operate in the corridor alongside, and competing with, the BRT system. Alternatively, it indicates that a corridor was poorly selected.

Almost all cities have corridors carrying at least 1,000 pphpd during the peak hour. Many cities, however, have corridors where transit demand is very low, even below this level. While many Gold-Standard BRT features would still bring benefits in these conditions, it is unlikely that such levels would justify the cost and dedicated right-of-way intrinsic to BRT. This penalty has been created to penalize systems that have done a poor job of service planning or corridor selection, while not overly penalizing smaller, car-oriented cities with low transit demand.

Scoring Guidelines: All five points should be deducted if the ridership on the link in the corridor with maximum peak-hour ridership is under 1,000 pphpd in the peak hour. Otherwise, no deduction is necessary.

Passengers per Hour per Direction (PPHPD) in Peak Hour	POINTS
PPHPD below 1,000	-5

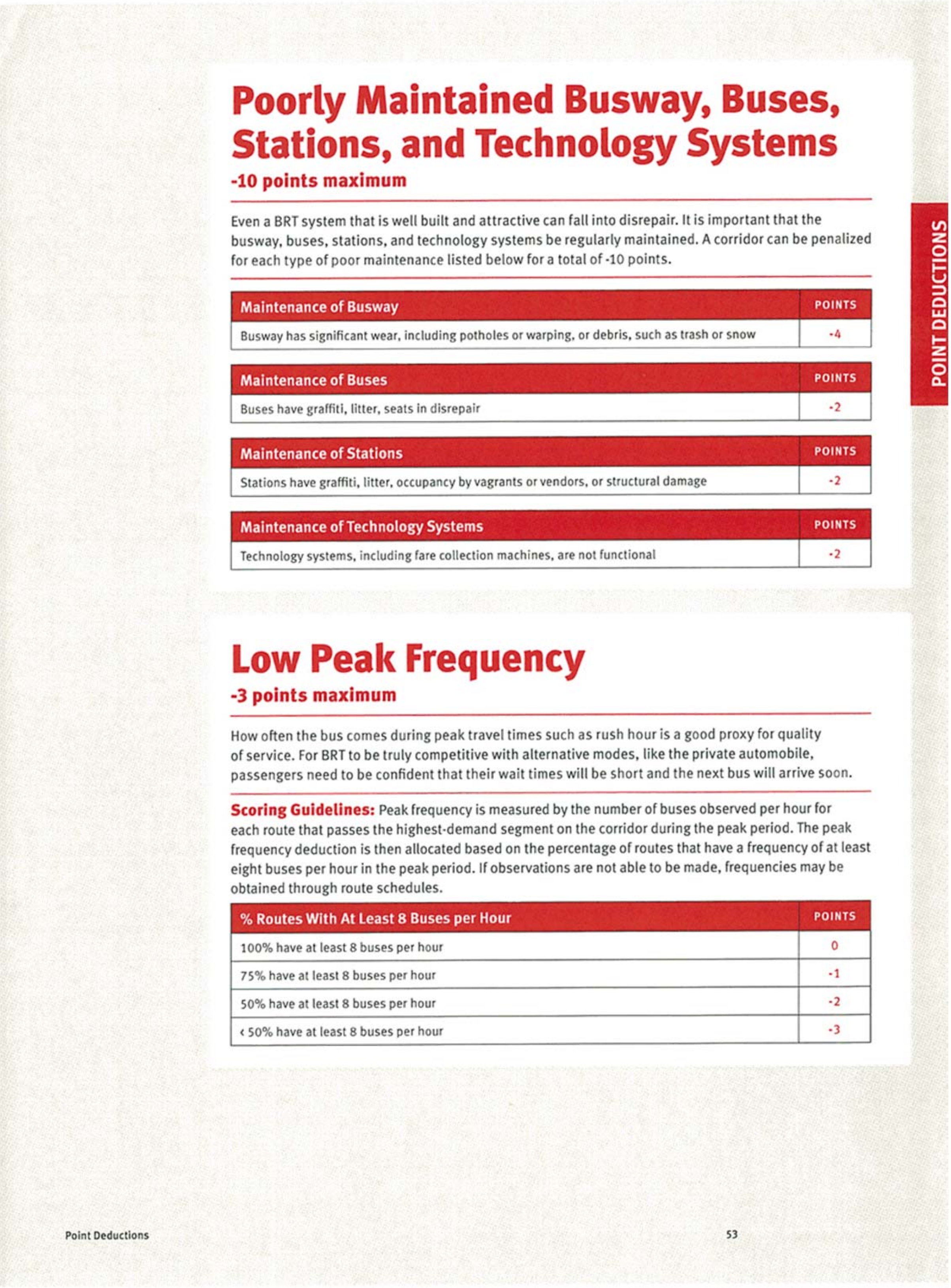
Lack of Enforcement of Right-of-Way

-5 points maximum

A BRT system may have a good alignment and physical separation, but if the right-of-way is not enforced, bus speeds will decline. This penalty addresses systems that do not adequately enforce the busway to prevent encroachment from other vehicles. There are multiple and somewhat context-specific means of enforcing the exclusive right-of-way. The committee generally recommends on-board camera enforcement and regular policing at points of frequent encroachment, coupled with high fines for violators, to minimize invasions of the lanes by non-authorized vehicles. Camera enforcement alone at high-risk locations is somewhat less effective.

Lack of Enforcement	POINTS
Regular encroachment on BRT right-of-way	-5
Some encroachment on BRT right-of-way	-3
Occasional encroachment on BRT right-of-way	-1

<ConfidentialText> Item 1.7.1 Attachment 1



POINT DEDUCTIONS

Poorly Maintained Busway, Buses, Stations, and Technology Systems

-10 points maximum

Even a BRT system that is well built and attractive can fall into disrepair. It is important that the busway, buses, stations, and technology systems be regularly maintained. A corridor can be penalized for each type of poor maintenance listed below for a total of -10 points.

Maintenance of Busway	POINTS
Busway has significant wear, including potholes or warping, or debris, such as trash or snow	-4

Maintenance of Buses	POINTS
Buses have graffiti, litter, seats in disrepair	-2

Maintenance of Stations	POINTS
Stations have graffiti, litter, occupancy by vagrants or vendors, or structural damage	-2

Maintenance of Technology Systems	POINTS
Technology systems, including fare collection machines, are not functional	-2

Low Peak Frequency

-3 points maximum

How often the bus comes during peak travel times such as rush hour is a good proxy for quality of service. For BRT to be truly competitive with alternative modes, like the private automobile, passengers need to be confident that their wait times will be short and the next bus will arrive soon.

Scoring Guidelines: Peak frequency is measured by the number of buses observed per hour for each route that passes the highest-demand segment on the corridor during the peak period. The peak frequency deduction is then allocated based on the percentage of routes that have a frequency of at least eight buses per hour in the peak period. If observations are not able to be made, frequencies may be obtained through route schedules.

% Routes With At Least 8 Buses per Hour	POINTS
100% have at least 8 buses per hour	0
75% have at least 8 buses per hour	-1
50% have at least 8 buses per hour	-2
‹ 50% have at least 8 buses per hour	-3

Application to Rail Corridors

The BRT Standard was specifically designed by BRT experts to be applied to BRT corridors. However, almost all of the elements in *The BRT Standard* could easily be applied to rail transit corridors (including streetcar, tram, light rail, and metro) with minimal modification. Using *The BRT Standard* to evaluate rail transit corridors would allow users to assess the general quality of rail transit services and compare them to other transit corridors, including BRT. It could also provide a more standard definition of rapid transit and determine which rail transit corridors meet that definition. The following section briefly describes a preliminary concept of how *The BRT Standard* might be applied to rail transit corridors.

BRT Basics

The BRT Standard defines the BRT Basics as a set of elements essential to a service's being called BRT. These elements all aim to minimize passenger delay, thus ensuring the "rapid" component of a bus rapid transit system. These same criteria can be applied without modification to rail transit corridors to assess whether they meet a more general definition of rapid transit as well.

Terminology

The BRT Standard often refers to "busways", "BRT", and "buses." When using *The BRT Standard* to assess rail transit corridors, these should be substituted with "transitways", "rapid transit", and "transit vehicles" throughout the text. The definitions of a corridor would also need to be modified to account for rail.

Pavement Quality

The BRT Standard metric of pavement quality should be modified to evaluate rail quality. ITDP is engaging with rail transit experts who understand how railbed and tracks are designed for more guidance on this section. In the meantime, the evaluation of the railbed and tracks can be scored based on whether they are designed to a 30-year life span or not.

Signaling

The distance between rail vehicles is largely governed by the type of signal system that is used. Better signals can allow for increased headways and improved service. Since BRT systems are not limited by signal systems, this is not a part of *The BRT Standard*. Ideally, to evaluate rail transit corridors, a separate section would be added to address signal systems. BRTs would automatically score maximum points in this section, since buses are not constrained by signaling systems and can operate at closer spacings than are permitted by most signal systems. ITDP is consulting rail experts to determine how this section might be developed. Until that work is completed, signaling considerations could simply be ignored, as the effects of low-quality signal systems are likely captured by some of the point deductions for operations (e.g., overcrowding).

Elements Specific to BRT

Some elements of *The BRT Standard* are more common in BRT systems. For example, very few metro and light-rail systems offer express, limited, and local services or multiple routes operating on the same corridor. There are, however, prominent rail examples of both, such as the New York City Subway or the Lyon Tramway. These elements provide a higher quality of transit service for any mode and should be retained, even if they seldom result in points for rail systems.

Grade Separated Systems

Fully grade-separated electric rail transit systems, such as metro, will likely receive maximum points in a number of categories, including Transitway Alignment, Off-Board Fare Collection, Intersection Treatments, Minimizing Emissions, Stations Set Back from Intersections, and Platform-Level Boarding. This is logical, as grade separation removes many of the sources of delay that a transit system might encounter, making them more likely to achieve gold standard.

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