



October 15, 2015

To: Urban Design Committee, City of Richmond

RE: *Median-Running BRT from Foushee Street to 9<sup>th</sup> Street*

**UDC/PC Comment 1:** That the BRT planning team investigates utilizing a median-running operation from N. Foushee Street to N. 9<sup>th</sup> Street and what potential impacts not doing so would have on plans for a future light-rail system, fully recognizing the need for two general purpose lanes and the addition of left turn lanes and local transit stops as needed.

**Applicant Response:** Utilizing a median-running operation from N. Foushee Street to N. 9<sup>th</sup> Street through Downtown would have negative impacts on the Broad Street corridor and is not recommended for the following reasons:

- Operating a BRT in the curb running lane will not preclude a light rail system from being constructed in the median of Broad Street at a future time.
- The project budget did not include the cost of a median running guideway or stations along this section of Broad Street. It is estimated to be an additional cost of \$1.8 million in City funds.
- There are a significant amount of transfers that take place on this section of Broad Street. It is essential that transfers between the BRT and local bus be safe and efficient, which is best done curbside rather than from the median.
- Left turns as allowed in the downtown section of Broad Street today would be limited to accommodate median-running BRT.
- There is insufficient right-of-way to accommodate the median running guideway and allow for local bus service to operate on a curb lane.

## SUPPORTING DOCUMENTATION

### Potential for Future Light-Rail

The configuration of Broad Street for median-running BRT would require modifications to the existing median from Foushee Street to 9<sup>th</sup> Street. The raised and landscaped median would be narrowed to provide 11 foot wide dedicated BRT lanes. A future light-rail transit (LRT) system operating in the median would require extensive modifications beyond those required for BRT operations. Full reconstruction of the center of Broad Street would be necessary to lay tracks and proper foundations for heavier transit vehicles (BRT vehicles weigh approximately 20 tons loaded while LRT vehicles weight approximately 50 tons loaded). The width of dedicated guideway required for light-rail is greater than that of BRT to account for larger vehicles, overhead catenary system support poles for power, and desired separation from vehicular traffic for safety. Any improvements constructed for median-running BRT would not meet the needs for a future light-rail system without major reconstruction.

**Increased Cost of Construction**

The construction of median-running BRT lanes from Foushee Street to 9<sup>th</sup> Street would cost approximately \$1.8 Million more than the current proposed concept for mixed flow and curb running operations within the same segment. The additional four blocks of construction from Foushee Street to 4<sup>th</sup> Street is not currently in the project budget, as the current plan proposes no roadway modifications for this stretch where the BRT will operate in mixed flow conditions.

Median-running BRT requires stations be located in the center of Broad Street. The current proposed 9<sup>th</sup> Street stations would require the westbound station be located in the block between 8<sup>th</sup> Street and 9<sup>th</sup> Street and the eastbound station be located in the block between 9<sup>th</sup> Street and 10<sup>th</sup> Street. Therefore continuing median-running BRT to 9<sup>th</sup> Street would actually require dedicated lanes through 10<sup>th</sup> Street.

Median-running from 4<sup>th</sup> Street to 10<sup>th</sup> Street would require greater and more costly median modifications than curb-running operations. The current curb-running concept is able to preserve much of the existing median from 4<sup>th</sup> Street to 8<sup>th</sup> Street, whereas median-running would require additional paving and construction of new concrete curb, median, and landscaping in these blocks. Median-running BRT would also require the reconstruction of several traffic signal poles and mast arm sign poles that are currently located in the median; these poles are proposed to remain with curb-running operations. Relocated signal poles would need to be placed on the curb where existing utilities, underground electric power vaults, and basements of adjacent buildings, including the General Assembly Building on the southeast corner of Broad Street and 9<sup>th</sup> Street, could all be impacted at the project’s expense.

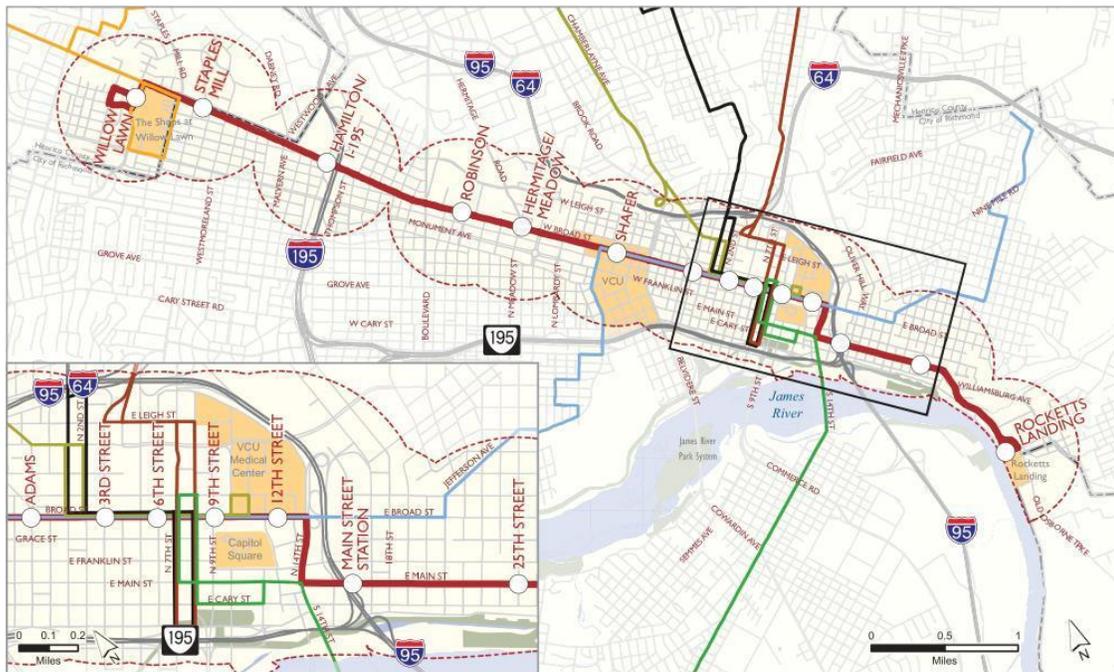
**Table 1: Summary of approximate cost impacts**

<b>BRT Component</b>	<b>Additional Cost for Median-Running*</b>
Roadway (median, guideway, landscaping, etc.)	\$1,050,000
Stations	\$200,000
Utilities (relocations and upgrades)	\$150,000
Signals and Systems	\$400,000
<b>TOTAL</b>	<b>\$1,800,000</b>

\*Applies to downtown Broad Street corridor from Foushee Street to 11<sup>th</sup> Street only

**Transfers to Local Routes**

Downtown Richmond has the highest concentration of GRTC's transfers between local bus routes. Consequently the area will serve a high volume of transfers between local bus routes and the BRT system. Figure 1 shows a map of the five routes with the most transfers to GRTC's Route 6, which most closely resembles the proposed BRT route. Each of these routes has between 135 and 235 transfers per day to Route 6, all within the Foushee Street to 14<sup>th</sup> Street Downtown corridor.



**Figure 1: Local routes with most transfers to proposed BRT**

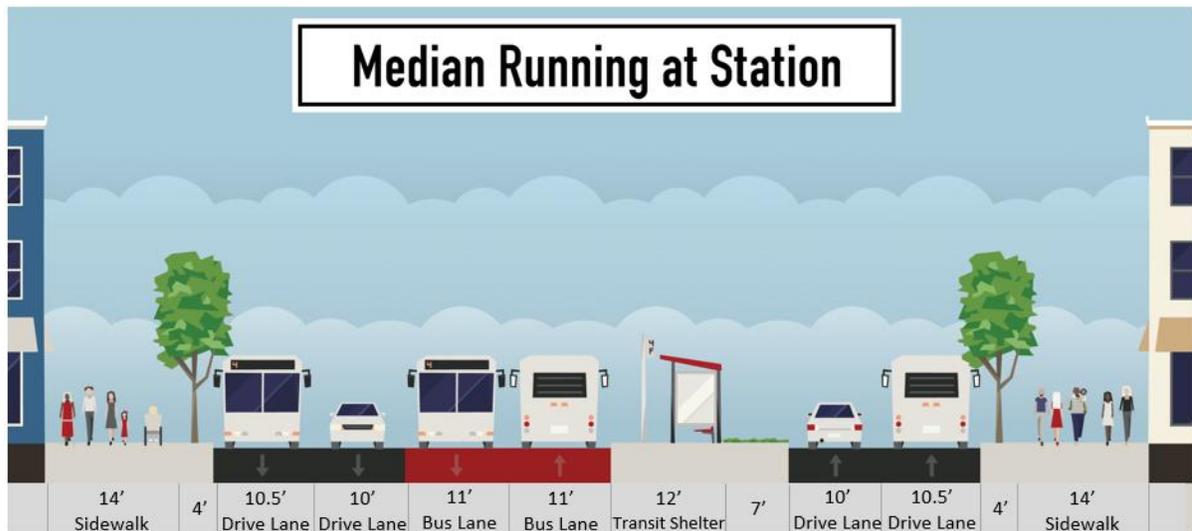
A separate GRTC BRT Technical Services study is currently underway to examine how to best accommodate connections between local routes and the BRT. Preliminary findings of this study prepared by Nelson/Nygaard proposed consolidating several local stops currently spread across a few blocks into one stop located adjacent to the BRT station to facilitate transfers. This is referred to as a consolidated stop.

If the BRT stations are located on the curb as currently proposed, passengers will be able to make a safer connection to local routes via the sidewalk. Passengers may have to cross a minor north-south street at some locations to make these transfers. However, if the BRT stations are located in the median for median-running BRT, passengers will have to cross Broad Street to access curbside local route stops whether they are consolidated or not. While these passengers will be utilizing crosswalks on Broad Street, exposing a larger volume of transferring passengers to Broad Street vehicular traffic is less safe than connections that don't require a major street crossing. Creating higher pedestrian crossings of Broad Street also will impact traffic operations as turning vehicles are delayed by pedestrians in crosswalks. This safety issue is less of a concern in the median-running section of

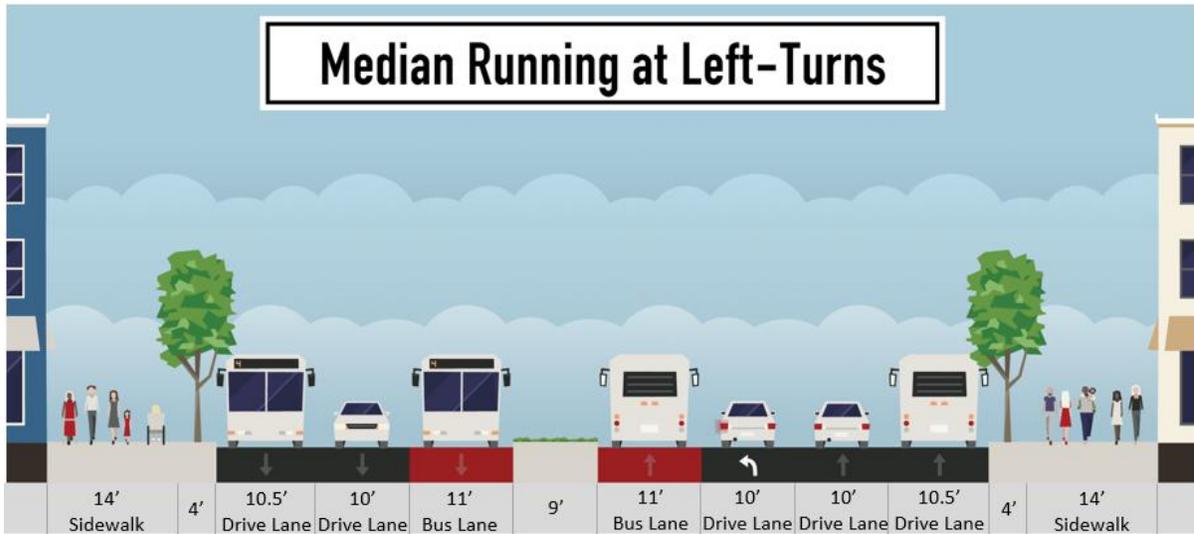
BRT from Thompson Street to Foushee Street due to the much lower volume of expected transfers to local routes.

**Left Turn Access**

As demonstrated in the current concept, providing left-turn access in a median-running segment of BRT requires dedicated turn lanes. The following typical sections demonstrate how a BRT station and a left turn lane cannot be accommodated at the same location without roadway widening. Broad Street is approximately 82’ from curb to curb and any widening to either side would be very costly due to the high concentration of public and private utilities and drainage structures within 3 feet of the curb. Figure 2 shows what a typical section of Broad Street at a BRT station would be for the 5<sup>th</sup> Street or 9<sup>th</sup> Street stations. Figure 3 shows what a typical section of Broad Street would be at a dedicated left turn lane. Lane widths shown in each section reflect the minimums agreed upon by project partners after extensive consideration, conversation, and review.



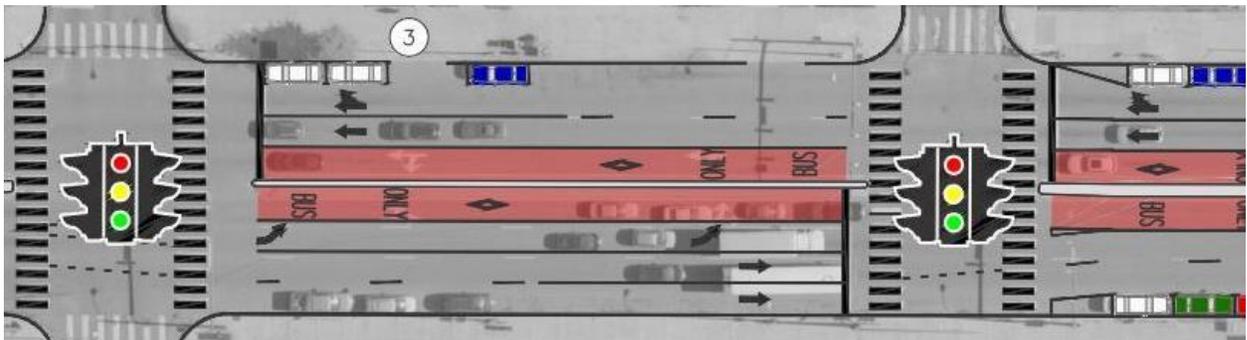
**Figure 2: Typical section at station**



**Figure 3: Typical section at left-turn lane**

In Figure 2 at the BRT station, there is only 7' in the median unallocated to lanes or stations, narrower than the 10' required for a turn lane. In Figure 3 there is only 9' in the median unallocated to lanes, narrower than the 12' required for a station. Therefore left turns cannot be accommodated in the blocks where stations are located.

Left turn movements adjacent to a median-running transit lane, BRT in this case, must be protected left-turns (when the signal shows only a green arrow, yellow arrow, or red arrow) from dedicated left-turn lanes. Allowing permitted-protected left turns (when the signal shows a green ball and the driver decides if a left turn is safe in front of oncoming traffic) is not advisable and creates a safety issue when a left-turning vehicle must look behind them to see if a BRT bus is coming. Figure 4 shows an example of protected left turn lanes adjacent to dedicated median-running BRT lanes.



**Figure 4: Example of dedicated left turn lane adjacent to median-running BRT**

Table 2 details the existing left turns allowed from Broad Street today between Foushee Street and 10<sup>th</sup> Street and which turns could be accommodated with median-running BRT operations.

**Table 2: Summary of changes to left turn locations**

Turn	Existing	Proposed Curb-Running	Proposed Median-Running
WB to Foushee Street	● *	X	X
WB to 1 <sup>st</sup> Street	●	●	●
EB to 2 <sup>nd</sup> Street	●	●	●
EB to 3 <sup>rd</sup> Street	●	●	X
WB to 3 <sup>rd</sup> Street	X	X	●
WB to 5 <sup>th</sup> Street	●	●	X
EB to 6 <sup>th</sup> Street	● *	● *	X
WB to 6 <sup>th</sup> Street	● *	● *	●
EB to 7 <sup>th</sup> Street	● *	● *	●
WB to 8 <sup>th</sup> Street	●	●	X
EB to 9 <sup>th</sup> Street	●	●	X

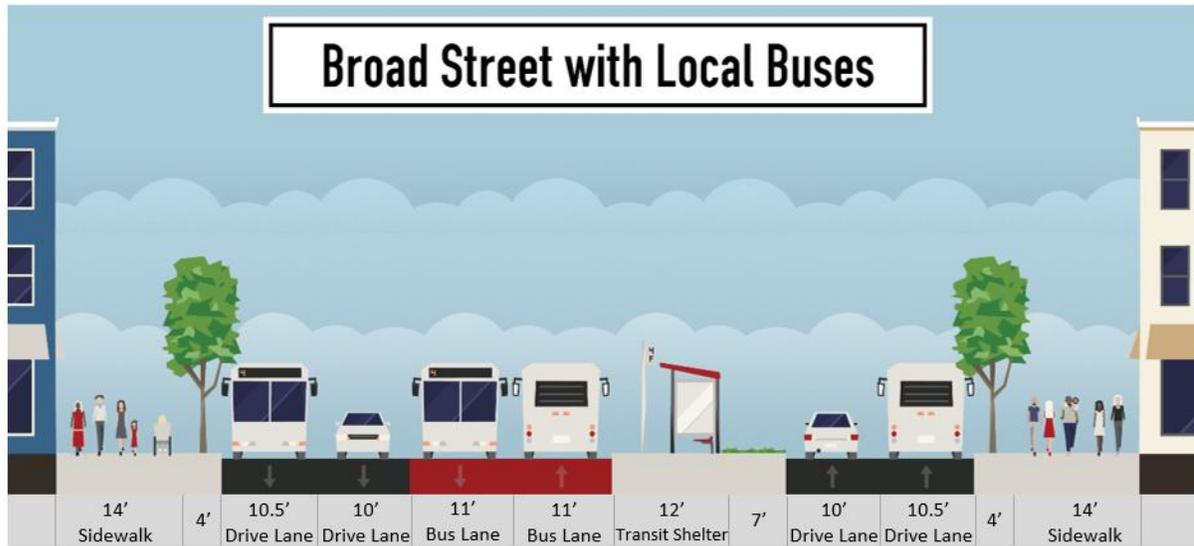
Key: ● = Allowed, X = Prohibited, \* = Time Restricted

The loss of left turn access at some locations due to BRT station locations could have critical impacts on traffic flow within Downtown. The westbound left-turn onto 8<sup>th</sup> Street is the first allowable left turn off of Broad Street for vehicles exiting from Interstate 95 and carries approximately 280 vehicles/hour in the peak hour. 8<sup>th</sup> Street is a four-lane, principal arterial providing a vital connection to the Manchester Bridge and Richmond’s Southside. These vehicles would be forced to travel two more blocks and utilize 6<sup>th</sup> Street, a two-lane local street with far less capacity than 8<sup>th</sup> Street. The additional loss of the westbound left-turn at 5<sup>th</sup> Street (80 vehicles/hour in the peak hour) would push these left turning vehicles westward on Broad Street. To alleviate the additional left turn demand, a dedicated westbound left at 3<sup>rd</sup> Street could be added; however as many as 360 additional vehicles in the peak hour would be displaced to smaller streets between the loss of 8<sup>th</sup> Street and 5<sup>th</sup> Street left turn access.

Some lost left turns could be maintained by shifting the BRT stations to an adjacent block. However, moving stations would adversely affect left turns on the adjacent blocks and could place the stations at less desirable locations for transit service. For example the westbound left turn onto 8<sup>th</sup> Street could be maintained; however this would push the 9<sup>th</sup> Street BRT stations from the blocks between 8<sup>th</sup> Street and 10<sup>th</sup> Street to the blocks between 9<sup>th</sup> Street and 11<sup>th</sup> Street – very close to the proposed 12<sup>th</sup> Street BRT stations. This station shift would also prohibit the eastbound left turn onto 11<sup>th</sup> Street and shift the end of dedicated BRT lanes to 11<sup>th</sup> Street having additional cost implications.

**Local Buses in Shared Lanes**

Curb-running BRT vehicles will share dedicated lanes with local bus routes, whereas median-running BRT vehicles would have a lane dedicated solely to BRT. While this is a potential improvement for BRT operations, it would require general traffic to share the outside travel lane with local buses. Figure 5 below shows what the typical section could look like when local buses are present. Today more than twenty GRTC local routes have at least one stop on Broad Street between Foushee Street and 12<sup>th</sup> Street. When local buses are making stops, general traffic in the outside travel lane must to wait behind the stopped bus or be forced into the one lane available for general traffic. Additionally, traffic analysis shows that peak hour vehicle queues are expected to extend beyond the dedicated lane and into general travel lane. Queue spillback into inside travel lanes coupled with local bus service running in the outside travel lanes would significantly reduce through capacity on Broad Street assuming a median-running BRT.



**Figure 5: Broad Street with both BRT buses and local buses**

**Median Landscaping**

Landscaping in the existing median of Broad Street is aesthetically pleasing and serves as an enhancement to this place-making corridor. Continuing median-running BRT from Foushee Street to 10<sup>th</sup> Street would require greater reduction of the existing median than curb-running BRT. The current plan for curb-running BRT preserves all medians and landscaping from Foushee Street to 8<sup>th</sup> Street, with the exception of one block. Median-running BRT would reduce the width of the median due to the presence of a station or dedicated left turn lane, and thus eliminate more of the existing landscaping.