A Proposed Design Alternative for Inserting Dedicated Light Rail Transit Lanes and Other Facilities in a Constrained Arterial Roadway

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ABSTRACT

Plans for inserting new light rail transit (LRT) tracks and other facilities directly into existing streets and arterial roadways often encounter the problem of constrained right-of-way. This can present a serious challenge, especially when maintenance of basic traffic lane capacity is desired together with dedicated transit lanes. This paper suggests, as an example, a design solution that may be applicable or adaptable to similarly challenging situations. In a right-of-way width limited to 80 feet/24.2 m , inserting dedicated lanes for LRT while maintaining four traffic lanes plus adequate pedestrian and bicycle facilities was a significant design challenge. The proposed solution utilizes the adaptation of a very similar example of San Francisco's Muni Metro (LRT) N-Line running in Judah Street. It also relies on Best Practices from several existing LRT systems and other sources such as the National Association of City Transportation Officials.

Hopefully the design concept described in this paper may be useful to the intended audience in suggesting a possible approach to solving similar problems involving the installation of LRT alignments in constrained arterial roads. It is expected to have applicability, potential adaptability, and transferability for a broad range of North American communities confronting similar design challenges.

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BACKGROUND

In the fabric of an urban area, major arterial streets and roadways are key travel corridors, linking residential, employment, commercial, educational, recreational, and other crucial origins and destinations. Thus they represent some of the most logical and promising routes and "opportunity assets" for higher-capacity and higher-quality public transit services, such as light rail transit (LRT).

Increasingly, local planners, transit agency personnel, other professionals, and civic and community leaders have been focusing on the functionality of these types of travel corridors, and considering the insertion of new LRT infrastructure (tracks and other system facilities), with dedicated lanes, directly into these arterial assets. Such proposals have been particularly encouraged in the context of Complete Streets policies that stipulate that roadway facilities be designed for the needs of all users, including transit services.

However, proposals for dedicating travel space for LRT (or any transit service for that matter) in an existing arterial almost invariably encounter two issues: (1) the desire of traffic officials, political and civic leaders, and much of the local population to maintain at least the existing motor vehicle travel lane capacity; and (2) arterial right-of-way (ROW) width constraints that may limit options for inserting dedicated transit lanes. The ROW width constraint is often found with narrow major roads where early motor vehicle access stimulated corridor development and traffic that have intensified in more recent decades — thus resulting in sufficient residential and employment density, level of activity, and travel volumes to justify rail, but within the confines of a relatively narrow physical corridor.

This type of situation, encountered in Austin, Texas has evoked the proposed design alternative described in this paper. This concept emerged in the context of technical work performed on behalf of an informal coalition of interested community stakeholders, addressing the design of an LRT starter line proposed for the city's central north-south Guadalupe-Lamar corridor (consisting predominantly of the major arterials North Lamar Blvd. and Guadalupe Street — see Figure 1). Currently, the Austin community, like those in other cities, is engaged with issues of fashioning high-capacity, high-quality transit systems that effectively meet the needs of existing heavy-traffic corridors rapidly increasing in residential and employment density with constraints imposed by associated land use and redevelopment.

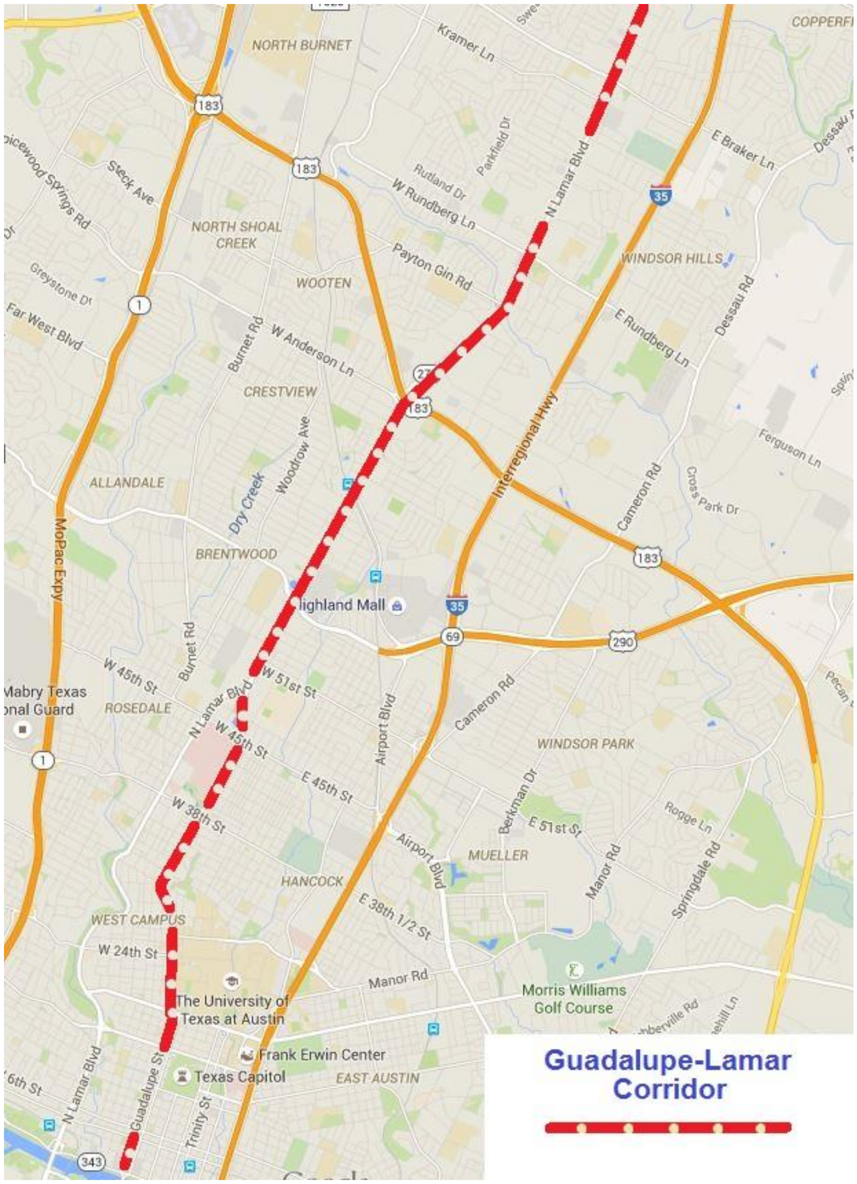

Figure 1. Map indicating Austin's Guadalupe-Lamar corridor

AUSTIN'S GUADALUPE-LAMAR CORRIDOR

For decades, Guadalupe-Lamar has been considered Austin's heaviest central-city local traffic corridor, and an appropriate route for high-capacity transit — see, for example "Long saga of Guadalupe-Lamar light rail planning told in maps" (*1*). It is a very busy commercial corridor with major public and private activity centers, including the University of Texas and the state's Capitol Complex of office sites, and it serves numerous established core neighborhoods, including the West Campus, one of the highest-density neighborhoods of Texas cities. It's also the pre-eminent travel corridor connecting these clusters and strips of activity centers, plus the city's Central Business District, with rapidly growing high-population residential areas to the north.

Accordingly, in 1989 Capital Metro Transportation Authority (CMTA, locally branded Capital Metro), the region's primary transit agency, proposed LRT for this corridor and designated it the locally preferred alternative (LPA) for federally supported planning. The agency further developed LRT plans for the corridor in the early 1990s and in 1999-2000, although the latter proposal was very narrowly defeated in a public referendum in 2000. (See *1*.)

In early 2014, with Small Starts funding from the Federal Transit Administration (FTA), CMTA launched a nominal "bus rapid transit" service in this corridor, branded MetroRapid and running overwhelmingly in mixed traffic. However, a loose coalition of neighborhood associations and other community organizations, as well as local urban and transportation activists, have continued to advance the case for rail transit in Guadalupe-Lamar — particularly in the context of a failed official plan for "urban rail" to be routed in other areas of the city. (*2, 3, 4, 5, 6, 7*)

While the arterials defining the corridor continue to exhibit high travel volumes, they are also somewhat constrained as major travel arteries (see Figure 2), with a predominant ROW width of just 80 feet/24.2 m (*8*) — a constraint making it difficult to utilize these arteries as an "opportunity asset" for a surface LRT alignment. As currently configured, within this ROW are provided two 11-foot/3.3-m traffic lanes in each direction, a center turning lane, and sidewalks on each side.

As noted previously, this kind of problem can be found in other cities desiring to install dedicated transit lanes in major corridors that have developed along originally somewhat narrow roadways. For Austin's Guadalupe-Lamar corridor, this constraint has presented a special challenge in terms of reconciling community desires for high-quality LRT service on affordable dedicated surface lanes with concomitant desires to maintain four lanes of traffic capacity.

Figure 2. Peak-period northbound traffic on North Lamar Blvd. (Photo: Author)

MODEL: SAN FRANCISCO'S F-JUDAH LINE

In the search for a solution, the need to conserve available ROW for traffic lanes and LRT running way suggested the use of side-mounted traction electrification system (TES) poles for the overhead contact system (OCS) rather than the more common center-mounted (i.e., between tracks). Researching LRT alignments in other cities as potential models for such a design configuration, the author included a review of surface arterial segments of San Francisco's Muni Metro LRT network.

In a 4 December 2014 Email, consulting transportation engineer John Schumann (an emeritus member and past chairman of the Light Rail Transit Committee of the Transportation Research Board) suggested as an example a segment of Muni Metro's N-Judah line on Judah Street between 9th and 19th Avenues (running through San Francisco's Inner Sunset district). As Fig. 3 illustrates, despite a ROW constraint of just 80 feet/24.2 m (*9*), this alignment design in San Francisco's major Judah St. arterial, with TES poles set curbside in the sidewalk, thus minimizing horizontal clearance, provides a raised LRT reservation that isolates the tracks from motor vehicle traffic, eliminating the need for additional barriers such as channelization buttons or other separation devices (yet the raised reservation is mountable by motor vehicles, such as emergency vehicles). Besides the LRT reservation, this design allows four motor vehicle lanes (a traffic lane and parking lane for each direction) and parallel sidewalks.

It should be noted that this design must be modified at station locations. At these points, parking space is eliminated, traffic is channeled into a single curbside lane, and the station-stop platform occupies approximately the width of a lane.

Figure 3. Muni Metro N-Judah line train in dedicated alignment on Judah St. (Photo: Eric Haas)

Another important consideration is that there are alterative possible allocations of the remaining space for motor vehicles, pedestrians, and bicycles. Examples include four full traffic lanes, plus sidewalks; two traffic lanes (one per direction), plus wider sidewalks; two traffic lanes, plus two bike lanes and sidewalks; and other variants (e.g., a wider sidewalk on one side, a bike lane on just one side, etc.). Designs could be tailored to the needs of a given community.

A design option considered in Santa Monica (Fig. 4) provides an example. (*9*) Evaluating alternative surface alignments in 2009 on the city's Colorado Avenue for the Expo LRT line then under construction by the Los Angeles County Metropolitan Transportation Authority, Santa Monica's Planning and Community Development Department proposed a configuration "which would reduce the track-way width to 24’ (similar to other cities) with parking maintained on both sides." The memo continues:

> The proposed alternative replaces the center power catenary poles between the tracks with a support system utilizing the street lights on either side of the street. This configuration would also better facilitate truck turning radius for driveway, alley and cross street access. ... This configuration is successfully used in other California Cities.

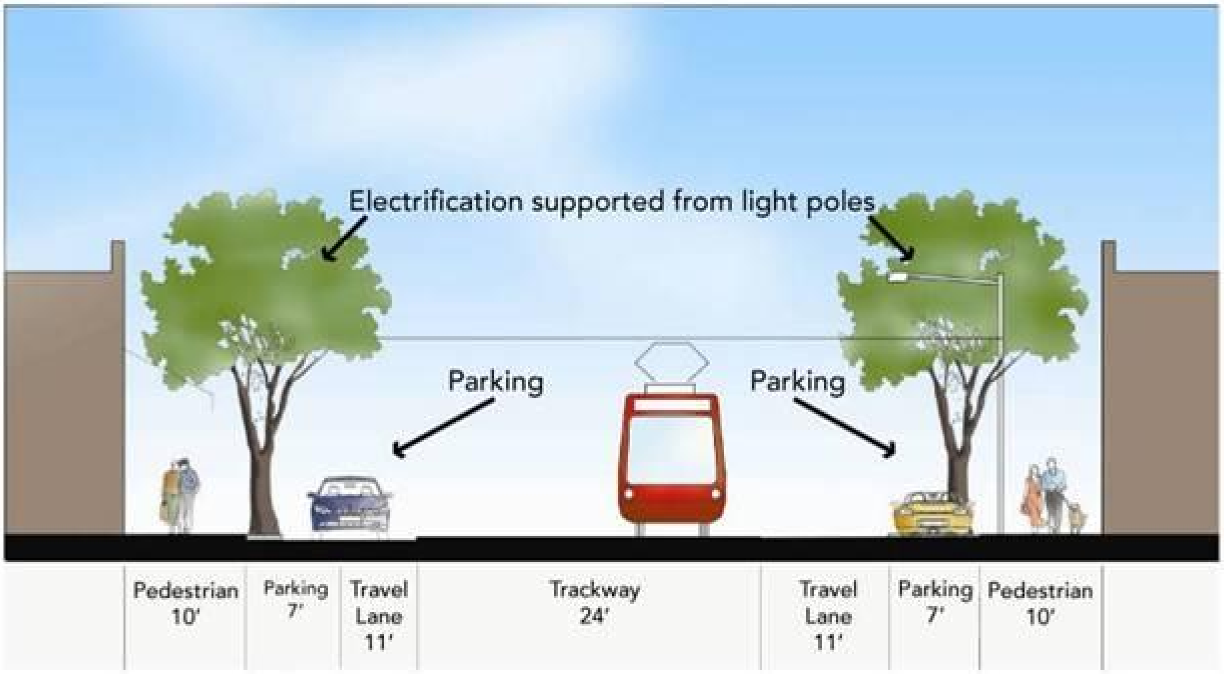

Figure 4. Santa Monica design for LRT in Colorado Avenue, with 80-foot/24.2-m ROW. (Graphic: City of Santa Monica)

Additional LRT surface design configurations for constrained arterial ROW are exemplified in 2006 proposals from Houston's Metropolitan Transit Authority of Harris County (Metro) for a MetroRail LRT alignment in Richmond Avenue (a project now on hold because of political obstacles). As shown in Fig. 5, Metro proposed configurations for ROW widths of 76 feet/23.0-m (running way) and 86 feet/26.1-m (turning lane, with additional lane, and station, with 10-foot-wide/3.0-m platform).

Thus the running way ROW under consideration was even more constrained than those in San Francisco, Santa Monica, and Austin. As was pointed out with respect to the Muni Metro N-Judah line, stations require a change in the design cross-section profile — typically, accommodating an additional ten feet/3.0 m of width.

Also worth noting are the designed traffic lane widths of 10 feet/3.0 m. Narrower than the more traditional 11-foot and 12-foot (3.3-m and 3.6-m) standards, this minimum design width is increasingly being recommended to permit a more diverse use of available urban roadway space. According to the National Association of City Transportation Officials (NACTO), "Restrictive policies that favor the use of wider travel lanes have no place in constrained urban settings, where every foot counts." (*11*) NACTO emphasizes that "Lane widths of 10 feet are appropriate in urban areas and have a positive impact on a street’s safety without impacting traffic operations."

This assessment is corroborated by other experts, such as professional engineer Theodore Petritsch, Director of Transportation Services for Sprinkle Consulting. Petritsch also affirms that "In general safety and capacity are not adversely impacted by reducing lanes widths to as little as 10 feet." (*12*)

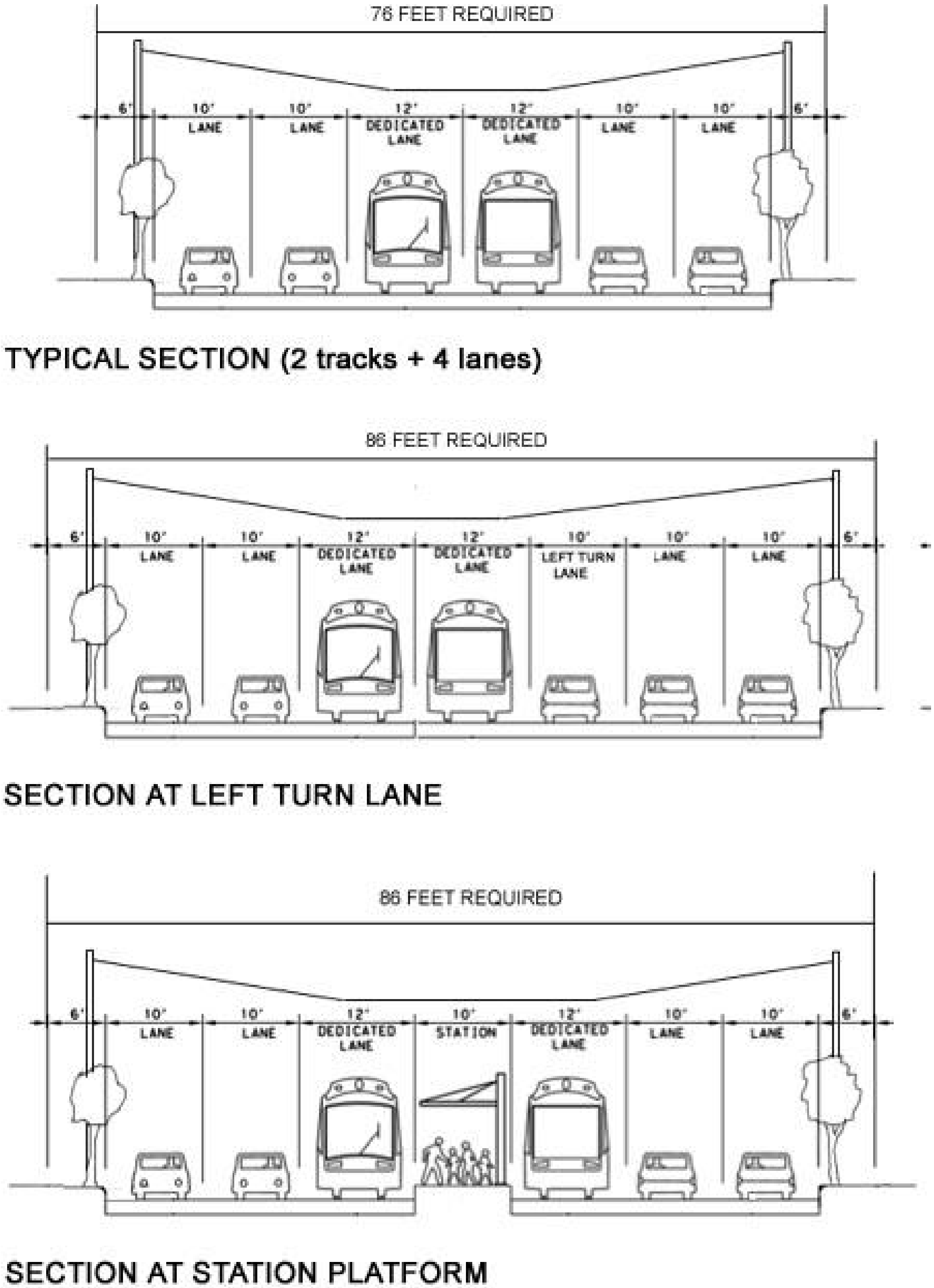

Figure 5. Houston MetroRail designs for surface LRT in Richmond Ave. (Graphics: Houston Metro, via Citizens Transportation Coalition)

COMPLETE STREETS LRT DESIGN ALTERNATIVE

The working example of the Muni Metro N-Judah line in San Francisco, and the precedent of planning examples in Santa Monica and Houston, provided the basis for the proposed LRT running-way design alternative described in this paper. (See Fig. 6.) Although it has been developed as a specific solution for installing a dedicated LRT reservation while maintaining existing traffic capacity in Austin's Guadalupe-Lamar corridor, it could represent, in whole or in part, a design solution for LRT projects in other communities.

Critical to the narrow alignment design (24-foot/7.3-m width) required for this alternative is appropriate design of the TES. As previously explained, to minimize LRT alignment width, this design would use an alternative OCS configuration whereby the contact wire or catenary would be carried by cross-span cables suspended from side poles inserted at curbside. Thus, unlike numerous other modern new-start LRT installations, this OCS power wire suspension design would not require TES center poles with bracket arms. Examples of this type of OCS curbside-suspension can be found in other LRT operations, such as in Baltimore, Houston, San Diego, and San Jose, as well as San Francisco.

The 24-foot LRT trackway width can be maintained on a predominantly tangent alignment with up to six degrees of curvature allowable. Sharper curvature than that would likely require incremental widening of the distance between tracks because of problems presented by railcar overhang.

In addition to side-mounted TES poles, the implementation of 10-foot/3.0-m traffic lanes adequately reduces total ROW width to include the raised LRT reservation, four traffic lanes, and 8-foot/2.4-m sidewalks on both sides. (Bike lanes in this case could be provided on streets parallel to the main arterials.)

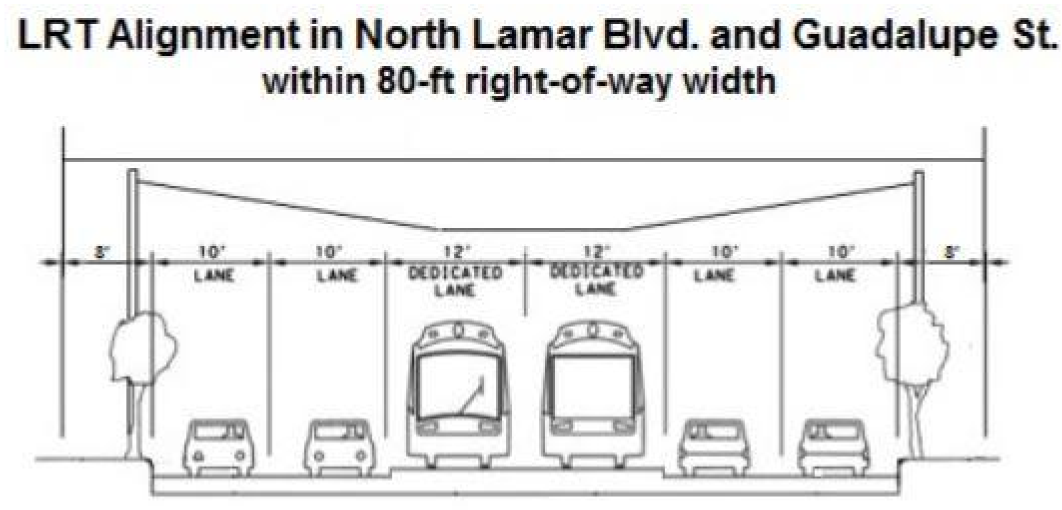

Figure 6. LRT alignment cross-section design for Austin's Guadalupe-Lamar corridor. (Graphic: Author)

There are other alternatives for minimizing ROW requirements. For example, “wireless” power options are available, eliminating a need for TES poles, but these tend to be proprietary, currently experimental technologies, with expense and performance characteristics needing further evaluation. Other lane configurations are possible (e.g., reducing traffic lanes to one per direction, installing bike lanes, etc.), but these may conflict with projected traffic needs and evoke political resistance. The raised-median design, with side-mounted TES poles, presented here, may represent a particularly cost-effective, technologically proven, functional solution for this type of constrained ROW arterial.

It must be noted that this design applies only to the running way. Stations (and possibly turning lanes at intersections) may require additional ROW for platforms or an extra lane. For a station at a major intersection, this could require widening by 10 feet (3.0 m) for roughly 300 feet (91 m) or an entire block each side of the intersection, depending on the length of rolling stock and projected train consists.

However, as in the case of the Guadalupe-Lamar corridor, real estate acquisition at intersections may be less difficult and possibly less costly than elsewhere along the alignment, since lower-value land uses and structures (e.g., motor vehicle service facilities, convenience stores, etc.) often occupy these locations. In any case, minimizing the running-way alignment and thus avoiding ROW acquisition for several or more blocks in between stations could reduce the costs and logistical challenges of an LRT project, increasing cost-effectiveness, feasibility, and public political support.

CONCLUSION

While constrained arterial right-of-way often presents a serious challenge to LRT installation, especially when maintenance of basic traffic lane capacity is desired together with dedicated transit lanes, the techniques described in this paper may suggest a possible solution. In particular, the reconfiguration of traffic lanes to a 10-foot/3.0-m minimum standard, plus the use of side-mounted rather than center-mounted TES poles for OCS suspension, may provide techniques to minimize arterial ROW requirements and avoid additional ROW acquisition. Elements of this design may have applicability, potential adaptability, and transferability for a broad range of North American communities confronting similar design challenges.

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