APPENDIX N

BRT "LITE" OPTION

This memo provides an overview of "BRT Lite," and describes how it differs from standard BRT systems. The memo provides examples of BRT Lite investments in other cities and provides implementation options for Pierce Transit to consider for its Stream program.

MEMORANDUM

To: **Darin Stavish, Pierce Transit**

From: **Nelson\Nygaard Project Team**

Date: **January 31, 2023**

Subject: **Bus Rapid Transit "Lite" Application for Stream System Expansion Study**

What is BRT "Lite"?

Cities across North America are investing in better bus service, recognizing the value of fast, reliable, and accessible transit to reducing emissions and encouraging more transit use. These investments can range from bus rapid transit (BRT) projects that are hundreds of millions of dollars to quick-build projects that are far less than a million dollars per mile.

More recently, cities are planning and implementing BRT "Lite" projects, which have similar service standards and branding to a typical BRT project but at a lower cost and with less intensive capital improvements. BRT "Lite" projects are typically corridor or route based, often with a segmented approach to right-size the design to the characteristics of each street segment. BRT "Lite" improvements vary based on the local planning context and transit operating environment. For example, some BRT "Lite" projects use the standard fleet with limited branding elements focusing investments on speed and reliability or safety improvements, whereas others focus investments on vehicles and stations to offer more comfort and convenience for longer trips.

BRT "Lite" is popular in cities large and small because it allows for more cost-effective and context-sensitive investments in transit while still delivering high-quality, reliable bus service that attracts more riders. Figure 1 outlines some of the key differences and similarities between BRT and BRT "Lite" projects.[1]

[1] ResearchGate.net. The BRT and the danfo: A case study of Lagos' transport reforms from 1999-2019.

Figure 1 BRT compared to BRT "Lite"

BRT (over $50 million)	BRT "Lite" ($5-50 million)
Unique BRT bus and station branding	Unique BRT bus and stop branding
Stations are ¼ mile apart or further	Stations are a ¼ mile apart or further
15 minute or better service	15 minute or better service
Bus lanes along majority corridor	Segmented or partial bus lanes
Level-boarding	Near-level boarding
Off-board fare payment	Off-board fare payment at select stops
Real-time passenger information, and full weather protection at stations	Shelters, with real-time passenger information at high ridership stops
Transit signal priority (TSP) and queue jumps	TSP at some intersections and queue jumps
New medians and corridor-wide streetscape elements	Intersection safety improvements including curb bulbs and curb ramps
Requires property acquisition at stations, or along corridor segments to build out improvements	Uses existing right-of-way

STREAM BRT Context

Pierce transit is in the middle of the design phase for its first BRT project – Pacific Avenue/ State Route 7, a 14.4-mile corridor connecting Downtown Tacoma to Spanaway. Route 1 on Pacific Avenue accounts for 12% of activity for the entire Pierce County Transit System. Land use, block lengths, and intersections vary widely along Pacific Avenue from Downtown Tacoma to Spanaway. A one-size fits all approach to BRT would fail to address the diverse mobility needs of the corridor.

Covid-19 budget impacts led Pierce Transit to limit dedicated bus lanes to key intersections, with median, bi-directional, and business access transit lanes throughout the corridor. Stops are spaced 1/3-1/2 mile apart depending on sidewalk access, block length, and proximity to major destinations. In addition, there are bike lanes along key segments of the corridor as well as traffic calming element such as roundabouts and refuge islands. By applying multiple approaches Pierce Transit are effective stewards of limited resources while still delivering high-quality BRT service.

There is a spectrum to BRT investments, with many projects including some elements that are representative of full BRT projects and others that are more consistent with BRT "Lite" projects. Based on peer examples of BRT projects that are $10 million a mile or less, this memo outlines different design approaches to right sizing BRT improvement to the local context accounting for budget, right-of-way, and timeline constraints. One of the tradeoffs to

BRT “Lite” design approaches is that they’re typically less comprehensive concentrating only on specific segments where collision rates are high or there are frequent delays. This could lead to discontinuous sidewalk or bike lanes improvements or future delays if traffic increases on route segments where there are limited speed and reliability improvements.

BRT "Lite" Planning and Design Approaches

Design approaches to BRT vary based on ridership, traffic congestion, density, land use, sidewalk access, and proximity to major destinations. Below outlines common design approaches to BRT "Lite" projects based on peer examples across the U.S.

1. **Enhanced Stations**: Investments are focused on station enhancements, creating new mobility hubs and transit centers that increase access to transit and spur economic development. Stops are typically further apart to speed up bus service, with bus lanes concentrated at segments of the route with high bus delay.
2. **Multi-modal**: Investments in transit include accessibility upgrades, crossings at stations, and may include filling in sidewalk gaps or bike lane gaps. Thus, transit is the trigger for creating a more complete street for all users.
3. **Speed and Reliability**: Investments are focused on transit priority treatments that reduce travel time such as bus lanes along the full length of the corridor, TSP, queue jumps, and off-board fare collection or all-door boarding.
4. **Local Service Extension**: The route core, which is typically where the most density and ridership is projected, operates as BRT while extensions outside the core operate as less frequent local service.

Figure 2 Snapshot of BRT "Lite" Systems across North America

BRT "Lite" System	Design Approach	Total Capital Cost	FTA Funding Eligibility
Geary Rapid (2021)	Multi-modal	$38 million, ~4 miles	Locally funded
Webster Ave, Bronx, New York (2013), *second phase (2014-15)*	Speed and Reliability	$9 million, 5.3 miles (Phase 1) $26 million (Phase 2)	Local and federal funds (non-CIG)
Mill Plain BRT C-TRAN Vancouver, WA	Enhanced Stations	$49.86, 10 miles	Small Starts, CIG share: 49.9%
RapidRide I Line, Renton, Kent, Auburn WA (in development)	Station-Based, *additional improvements depend on corridor context*	$141 million, 17 miles	Small Starts, CIG share: 47.3%.
CMAX, Columbus, OH	Local Service Extension	$48.6 million, 15.6 miles	Small Starts, CIG share: 78%.

Enhanced Stations Approach

In cities where driving is the main way people get around, providing station investments elevate the experience of waiting for and riding transit, encouraging occasional riders to take transit more often. Common amenities include complete weather protection with multiple BRT branded shelters, seating, lighting, real-time arrival information, and off-board fare payment. At major hubs, stations may include multiple bays for different bus routes, customer service or an operations center, and restrooms. In lower density areas, where there are limited, walking, rolling, biking or transit connections to stations, some cities and agencies offer parking.

Station based BRT "Lite" projects prioritize investments at stations, station intersections, and intersections where there is heavy congestion or frequent transit delays. This allows cities and agencies to deliver BRT "Lite" improvements and service along longer routes or route segments.

Below outlines different level of investments depending on station ridership and activity.

- *Transit/ Mobility Hubs* -> Multiple shelters, benches, real-time information, off-board fare payment, bike parking, seamless transfer to other routes
    - *May include* parking, transit-oriented development, layover facilities for operators, customer service center, restrooms
- *Enhanced Stations* ->Multiple shelters, benches, real-time information, off-board fare payment
- *Standard Station* -> Single shelter and bench, real-time information, off-board fare payment

For stops that don't meet agency ridership thresholds, cities and transit agencies may limit investments to only a shelter or only a bench with a route branded flag and schedule. Stops without out shelters are more appropriate along BRT "Lite" routes with local extensions, described in more detail in the next approach.

Planning & Implementation Considerations

- **Walk/ bike access:** One of the biggest barriers to riding transit is that there is often no safe way to access the station. Transit agencies should coordinate with the city transportation or public works departments on crossing and sidewalk improvements to provide safe and accessible pathways to stations.
    - At locations adjacent to bike lanes or bike trails consider short and long-term bike parking options like bike rack and bike lockers.

- **Transit oriented development:** In low density areas near stations consider upzoning and lower parking minimums to encourage more development, spur economic activity, and grow transit ridership. If implementing park and ride facilities consider underground parking options or a long-term strategy to redevelop surface parking.

Peer Example: Rapid Ride, King County, WA

Source: King County Metro and Seattle DOT

King County Metro's RapidRide program launched in 2010 with the A line. In 2023 King County will launch its seventh RapidRide route – H Line. King County and its primary implementation partner, the Seattle Department of Transportation (SDOT), bucked pre-pandemic national ridership trends because of their BRT "Lite" investments in RapidRide, SDOT service enhancements, and new light-rail connections. The E Line project along Aurora Ave connecting Shoreline to Downtown Seattle increased ridership by 35% with travel time savings of up to 20%.[2] The RapidRide program includes both full-BRT projects with median running lanes like show above on Madison Avenue, and BRT "Lite" projects on longer and more suburban routes like the I Line, which connects the cities of Auburn, Rent, and Kent to nearby light and commuter rail services.

RapidRide has uniquely branded buses, enhanced stations, off-board payment and frequent service all-day as well as late-night options. The station branding elements of RapidRide stops were recently modernized as part of a new RapidRide "kit-of-parts." King County Metro

[2] https://doi.org/10.5038/2375-0901.20.1.5

developed the kit-of-parts with an architecture firm providing technical specs and illustrations for all the passenger amenities you might find at a RapidRide station with guidance on how to implement them. Based on ridership some stops are classified as stations, enhanced stops, or standard stops. King County Metro installs shelters in the City of Seattle at stops with 50 boardings a day or more, and outside of Seattle they install shelters at stops with 25 boardings or more.[3] All stops have the same look and feel but investments are right-sized to match ridership levels.

Peer Example: C-TRAN Mill Plain BRT, Vancouver WA

Mill Plain BRT is C-TRAN's second BRT line, connecting historic, Downtown Vancouver, Washington to the Columbia Tech Center to the east. Mill Plain Boulevard is a major east-west connection in Vancouver serving hospitals, colleges, and affordable housing.

BRT service is primarily in mixed traffic, with a few acute applications of speed and reliability features to avoid delays. In addition, to the 21 stations the project also includes a new nine-bay transit with an operator relief building and restroom and customer service office. Mill Plain BRT is under construction now with service expected to launch in early 2023.[4]

Source: Mike Schultz, ClarkCountyToday.com

Multi-modal Approach

Key transit corridors with high ridership are often along wide arterials built for auto use with high-posted speeds, multi-lane intersections, and long distances between protected crossings. These arterial streets have become places with high collision rates, traffic congestion, poor lighting – and are also the places where destinations like retail are located that people need to access. BRT "Lite" investments require upgrades to the walking

[3] https://kingcounty.gov/~/media/depts/metro/design-construction-standards/passenger-facilities/construction/TRF_Guidelines_Final_2020.pdf

[4] https://www.hdrinc.com/portfolio/mill-plain-bus-rapid-transit

environment around station locations, but can be extended throughout the corridor in partnership with the roadway owner. Transit can be the impetus to create a more complete street.

On streets with high rates of collisions, investments in roadway infrastructure are an important opportunity to improve safety in addition to transit speed and reliability. Many BRT "Lite" projects offer multi-modal improvements because they reconfigure the roadway to calm traffic and address intersection conflicts. Common features of multi-modal, BRT "Lite" projects include off-set bus lanes, curb extensions, refuge islands and more. Treatments are selected through a detailed transit, traffic, and safety review identifying peak passenger loads, transit delays, collision rates, instances of speeding, and issues with traffic queueing. Projects typically prioritize safety and speed and reliability improvements over more robust station enhancements. In the case of San Francisco for example there is no off-board fare payment, because systemwide they off all-door boarding.

Treatment selection depends on collision patterns and conflicts between people, walking, biking, rolling, driving, and riding transit. Below outlines different conflict types and potential design treatments.

- *Collisions at intersections* -> signalized intersections, pedestrian refuge islands, pedestrian beacons
- *Congested intersections* -> TSP and queue jumps
- *Right-turning collisions or site-line issues* –> curb extensions, leading pedestrian intervals (LPI's), dedicated right-turn lanes, no rights on red
- *Left-turning collisions* –> protected phases, LPI's, hardened center lines and vertical lane protection
- *Speeding* –> off-set and curbside bus lanes, or other road diet treatments such as bike lanes

Planning & Implementation Considerations:

- **Managing turns:** Turning queues can slow down buses and lead to more aggressive driving behaviors. Managing queues through dedicated lanes and signal phases or by prohibiting rights-on-red can improve transit speed and reliability and roadway safety.
- **Bus-bike interactions:** In cases where there are bike lanes intersecting or overlapping with a transit corridor, consider treatments like bike boxes, and floating bus stops to minimize conflicts between buses and people biking.
- **Interagency coordination:** A multi-modal approach requires a strong vision and partnership between the city and transit agency, with the city likely leading a lot of

the design decisions. If the transit agency is the project lead, cost sharing agreements with the city to cover costs for additional safety treatments can improve grant competitiveness and project outcomes.

Peer Example: Geary Rapid, San Francisco, CA

Source: Jeremy Menzies, San Francisco Municipal Transportation Agency (SFMTA)

The San Francisco Municipal Transportation Agency adapted its Geary BRT plans to implement the project in phases, the first being a BRT "Lite" application on the eastern segment of the corridor. The Geary Rapid project included full-time, off-set bus lanes, curb extensions, refuge islands, enhancements to perpendicular bike lanes, and new curb ramps. The total project cost was $38 million, but there was an additional $30 million spent on upgrades to water and sewer infrastructure that was coordinated with the roadway improvements.

The project was completed in 2021 and is consider a huge success delivering both faster and more reliable service and safer conditions for all roadway users. Prior to the project, a person crossing Geary was eight times more likely to be hit by a vehicle than the city average. With the off-set lanes and other safety treatments, speeding over 40 mph is down 81%. Bus travel times improved by 18% and general-purpose vehicle traffic decreased by about 15%, which amounts to less than a minute, with minimal diversions on parallel streets.[5] Geary Rapid,

[5] https://www.sfmta.com/sites/default/files/reports-and-documents/2022/12/geary_rapid_before-after_evaluation.pdf

provides a strong precedence for other agencies that BRT "Lite" projects and off-set bus lanes can offer substantial safety benefits.

Geary Rapid was entirely locally funded through the County Transit Performance Initiative, sales taxes, vehicle registration fees and the City's Capital Improvement Budget. Geary Rapid was not eligible for Small Starts nor was that a priority for the SFMTA because they plan to implement a full BRT system in the future. The key reason it wasn't eligible was because of the projects limited station improvements and its lack of unique branded buses or stations.

Speed & Reliability Approach

BRT "Lite" projects quickly and cost effectively get the bus out of traffic to improve bus speed and reliability and win back riders. BRT "Lite" projects on routes with frequent delays prioritize BRT elements that are proven to yield the most travel time savings. Improvements are often incremental – focusing on shorter segments to target investments where they'll have the highest impact. While speed and reliability improvements are essential to all BRT and BRT "Lite" projects, it is typically a bigger priority in larger cities where service is slower and less reliable, and the right-of-way is more constrained. Often cities will make incremental improvement to deliver speed and reliability improvements more quickly. In these cases, improvements are typically limited to painted bus lanes, TSP, and targeted intersection improvement.

The BRT "Lite" features that offer the most speed and reliability benefits are bus lanes, stop consolidation (if not already present), off-board fare payment or all-door boarding, and turn restrictions. Bus lanes are typically curbside or off-set. Center-running lanes, while offering the most travel time savings, are often cost prohibitive for BRT "Lite" projects because of the new median boarding platforms and stations.

Treatment selection is centered on diagnosing transit delays[6], where and when they occur and at what times of day:

- *Traffic delays* -> curbside and off-set bus lanes, TSP, queue jumps
- *Queueing delays* -> queue jumps
- *Turning delays* -> dedicated turn lanes, turn restrictions, queue jumps

[6] The City of Philadelphia developed a decision tree to support bus priority treatment selection in their recent Transit Plan (pg 100-101).

- *Boarding delays* -> in-lane and farside stops, off-board fare collection, all-door boarding[7]
- *Freight/Loading delays* -> Part-time bus lanes, designated loading zones

Planning & Implementation Considerations

- **Enforcement:** Bus lanes are only effective if prohibited vehicles stay out of the lane. Enforcement through design treatments like paint and posts is one of the most effective ways to keep prohibited vehicles out. Several agencies are also exploring automated enforcement through on-board cameras to ticket vehicles parked in the bus lane. This is more equitable and sustainable than traditional enforcement methods.
- **Curbside management:** Unless there is alleyway access freight and delivery vehicles need curbside access along busy commercial corridors. For curbside lanes consider time-of-day restrictions that allow for loading and unloading when there isn't congestion.
- **Off-board fare technology:** Off-board fare technology is expensive, costing $25-40k per ticket vending machine. To maximize benefits new technology should be paired with other passenger amenity improvements like real-time passenger information and enhanced shelters.

Peer Example: Webster Ave, Bronx, New York City, NY

[7] All-door boarding is an alternative to ticket vending machines requiring a proof of payment system with RFID payment devices at both doors. SFMTA's all door boarding pilot increased bus speeds systemwide by 2% despite population growth and increasing congestion.

Source; NYCDOT

New York launched its Select Bus Service (SBS) program in 2008 and now has a total of 16 SBS routes throughout all five boroughs. The SBS program applies BRT "Lite" features, typically with a complete streets or speed and reliability focus to routes with frequent all-day service and limited stop spacing. Because the routes already meet BRT service standards and changes are primarily to roadway design NYCDOT is the program lead.

SBS projects include curbside or off-set bus lanes, TSP, queue jumps, off-board fare payment, and operational improvements like new turn lanes on a majority of the route. On Webster Avenue in the Bronx pictured above, BRT "Lite" improvements resulted in a 19-23% travel time savings and a 25% increase in ridership, without any substantial changes in congestion.[8] The success of SBS projects like Webster Ave spurred the expansion of the program and the introduction of limited access busways, that restrict access to buses and trucks only. Following the success of the 14th Street Busway in 2019, New York City introduce five new busways throughout the city to improve transit speed and reliability along some of the busiest transit corridors in Manhattan, Brooklyn, and Queens.

Local Service Extension

The longer the route, the more difficult it is for bus service to stay on time, and the more costly it is to operate. For longer routes that begin and end in lower density areas, cities and transit agencies are segmenting their projects and routes to concentrate BRT features where they're needed most. This includes a local service extension approach, where BRT standard service operates along the core of a route, with local service along the remainder as an "extension". For example, the BRT segment could operate at 10-minute headways along 70% of the route, with the remaining 30% at longer headways on par with local bus services. Speed and reliability improvements, including increased stop spacing, bus lanes, and signal priority are concentrated on the BRT segment.

Station Design

Another way that BRT corridors can be "lightened" is by station design. BRT stations represent a significant proportion of capital investment, with the application of benches, shelters, real-time bus arrival screens, and other amenities. As such, some BRT "Lite" designs have adopted a "value engineering" approach to stagger the intensity of station designs by local context and anticipated ridership at specific locations, especially in local service extensions. Key destinations such as transit centers, university campuses, major retail and grocery malls are given more extensive station upgrades. Locations with lower foot traffic

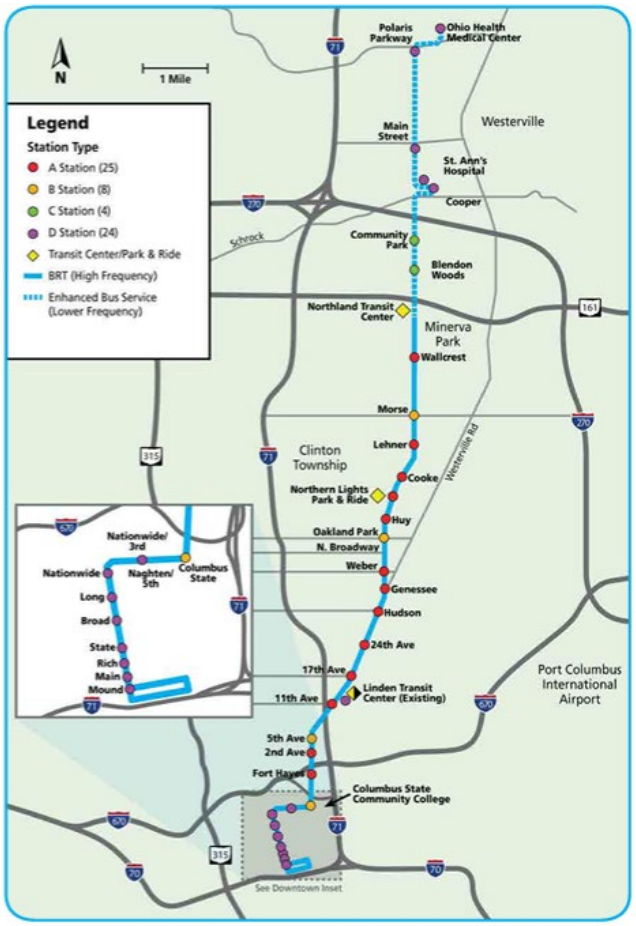
[8] https://www.nyc.gov/html/brt/downloads/pdf/2014-08-25-brt-websteravenue-progressreport.pdf

may not have ticketing or fare payment systems, and rely on paper maps and schedules rather than real-time information screens.

Peer Example: COTA CMAX, Columbus OH

Central Ohio Transit Authority (COTA) unveiled its first BRT line in 2018, traversing a 15.6-mile corridor along Cleveland Avenue from Downtown Columbus to Westerville. The BRT line is notably bisected at Northland, where the first 10.8 miles of the trip from Downtown Columbus is designed with BRT grade stations, transit signal priority, and operates at 15-minute headways (10-minutes at peak).Every other BRT vehicle travels the remaining 4.8 miles from Northland Transit Center to Westerville, effectively operating 30-minute headways. This segment is what COTA has dubbed "Enhanced Bus Service" which utilizes local stops (Station Type "D") upgraded with real-time information screens, but no shelters or seating.

This design approach preserves a one-seat ride along an important urban corridor and to important medical destinations, without unduly providing disproportionately high levels of service to lower ridership neighborhoods. It right-sizes the level of capital investment in lower density areas.



Source: COTA

Funding BRT "Lite" Projects

The Federal Transit Administration Capital Investment Grant Program alleviates some of the financial burden of building BRT and BRT "Lite" projects by funding up to 75% of capital improvement depending on eligibility and the local financial commitment. BRT and BRT "Lite" projects are typically funded as part of Small Starts, which requires BRT branded bus and stations. Cities and transit agencies that opt to limit improvements to the roadway and minor station improvements are not eligible for Small Starts, but may be eligible for other Federal programs, more oriented towards roadway safety and complete streets. CIG is a discretionary grant program requiring agencies to apply for funds and meet FTA's project justification and local commitment requirements. CIG is split into three separate grant programs:

- **Small Starts:** Fixed guideway and corridor-based BRT projects seeking $150 million or less, not to exceed $400 million in total costs

- **New Starts:** Fixed guideway projects seeking $150 million or more, with total capital costs exceeding $400 million.

A project qualifies as "fixed guideway" if the bus is operating in a dedicated lane, exclusive of right-turns, for 50% or more of the route. This is the primary difference between fixed guideway and corridor-based BRT, otherwise the features required for eligibility are similar and include: defined stations, TSP, and frequent bi-directional service on weekdays and weekends. For corridor-based BRT buses can be in mixed traffic, but the project needs to include features like queue jumps and TSP to increase bus speeds through congested intersections. A BRT project does not need to be fixed guideway to qualify for Small Starts.

By the FTA's definition BRT "Lite" is corridor-based BRT, limiting BRT "Lite" projects to Small Starts funding under the CIG Program. There are other grant programs that can support BRT "Lite" projects outside of CIG such as RAISE, and Reconnecting Communities, however they tend to be more competitive.

Cities and transit agencies can streamline the federal funding process through FTA's warrants program, which allows agencies to pre-qualify for a satisfactory or 'medium' rating before formally applying to enter the project development phase. This helps eliminate the need for costly and time-consuming ridership forecasting and simplifies the environmental benefits analyses. Agencies in larger cities with higher projects costs and high ridership may opt to do the ridership forecasting themselves to achieve a 'high' as opposed to medium rating. relieves the lead agency from preparing detailed ridership estimates as well as simplifies the environmental benefits analyses. projects with medium or high ratings based on ridership and projects costs before entering the FTA project development process.

In addition, cities and transit agencies can advance BRT projects through their local planning programs, identifying routes and target timelines for BRT and BRT "Lite" projects. This helps establish political will and identify local funding sources, a core component of the Small Starts Application process that effects a project's competitiveness. Cities and transit agencies interested in applying for federal funding support should coordinate with their local Municipal Planning Organization to develop a project funding strategy. Depending on the scale of investments some projects may be better fit for different federal funding programs or best funded locally.

Both San Francisco and New York fund the majority of their BRT "Lite" projects with local and state funding sources, reserving CIG funds for larger-scale capital projects. Federal regulations and reporting requirements are both time and resource intensive requiring years of planning, design, and environmental review. This leads many agencies to fund BRT "Lite" projects locally as part of the transit agency or city transportation department's capital budget.