Update and Discussion of Future Broadway Corridor High Capacity Transit Improvements

Carlos de Leon, Deputy Director

City of Tucson Department of Transportation

BROADWAY BOULEVARD

EUCLID to COUNTRY CLUB

Purpose of Presentation

To provide more information to the Broadway Citizens Task Force (CTF) for them to consider in determining how to accommodate HCT on Broadway during development of corridor concepts, including:

- Update the CTF on rough initial Bus Rapid Transit (BRT) modeling results
- Provide BRT design concept and best practices information for consideration during this Broadway segment's planning & design process

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Presentation Outline

- Brief Review of Current Bus Transit Services
- Brief Review of PAG's High Capacity Transit Plan (HCTP) Recommendations
- Overview of Bus Rapid Transit (BRT) and BRT Elements
- Results from Initial BRT Conceptual Analysis
- Considerations for How to Preserve the Opportunity to Implement Future HCT on Broadway

Brief Review of Current Bus Transit Service

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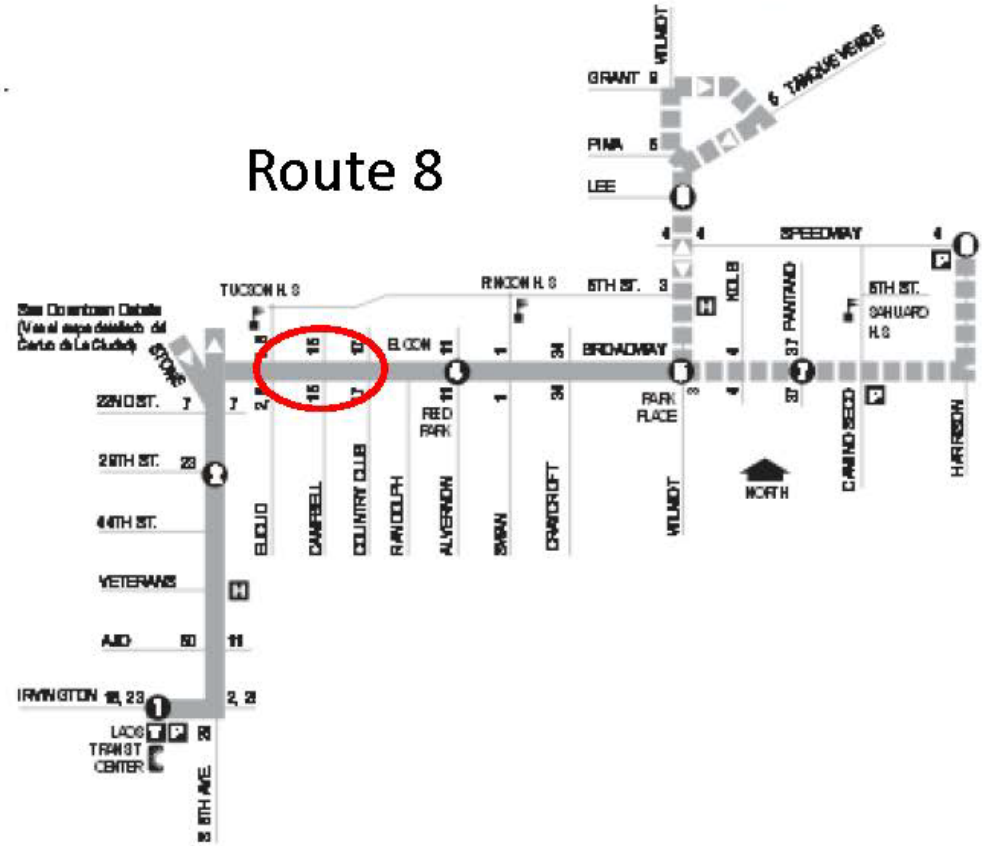
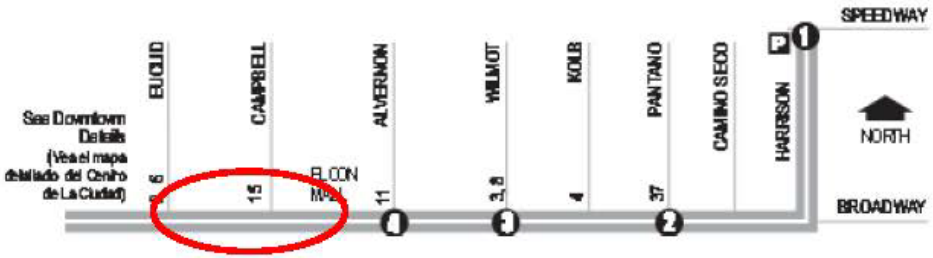
Current Transit on Broadway

- Two Routes
  - Route 8
  - Route 108 Express

Route 8

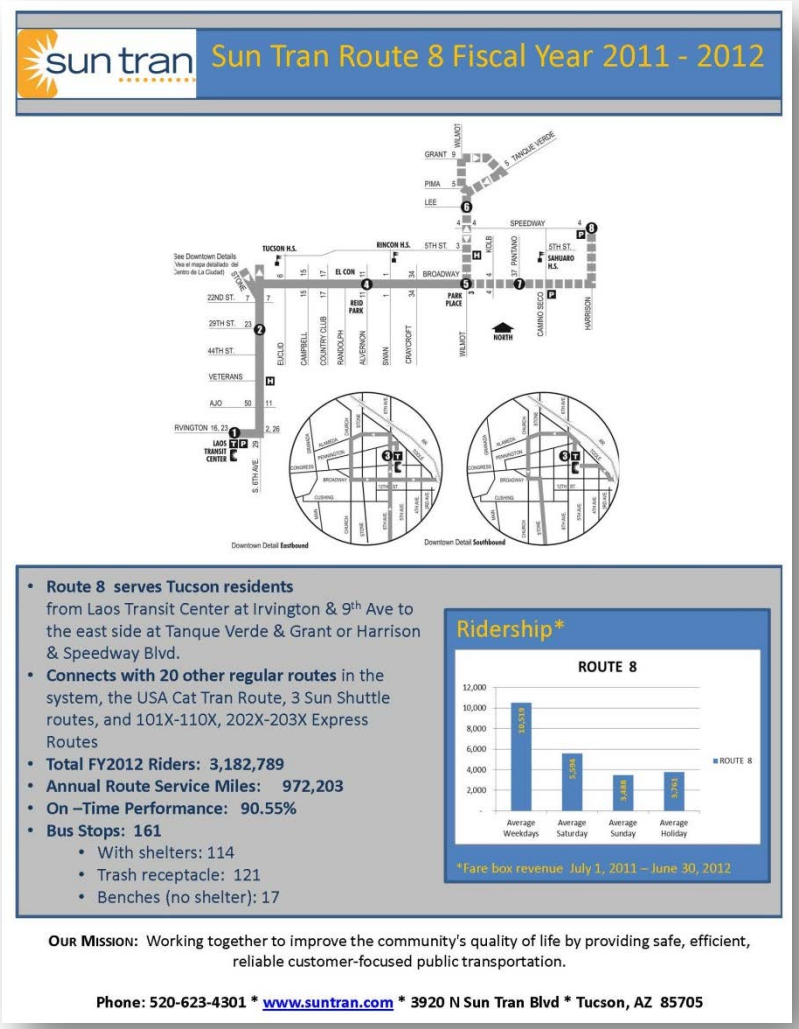


Route 108



Current Transit on Broadway

- **Route 8**
  - Runs Broadway Blvd. & S. 6th Ave. every 15 mins.; Branches at Broadway & Wilmot, every 30 mins.
  - 161 Bus Stops
  - Highest ridership route in Sun Tran system
    - 3,182,789 million boardings, FY11-12
    - About 55% (1,733,666) boardings along Broadway Blvd.
    - About 9 % of total Sun Tran ridership



sun tran

Sun Tran Route 8 Fiscal Year 2011 - 2012

- **Route 8 serves Tucson residents** from Laos Transit Center at Irvington & 9th Ave to the east side at Tanque Verde & Grant or Harrison & Speedway Blvd.
- **Connects with 20 other regular routes** in the system, the USA Cat Tran Route, 3 Sun Shuttle routes, and 101X-110X, 202X-203X Express Routes
- **Total FY2012 Riders: 3,182,789**
- **Annual Route Service Miles: 972,203**
- **On –Time Performance: 90.55%**
- **Bus Stops: 161**
  - With shelters: 114
  - Trash receptacle: 121
  - Benches (no shelter): 17

Ridership*

ROUTE 8

	Average Weekdays	Average Saturday	Average Sunday	Average Holiday
ROUTE 8	10,533	5,304	3,188	3,783

*Fare box revenue July 1, 2011 – June 30, 2012

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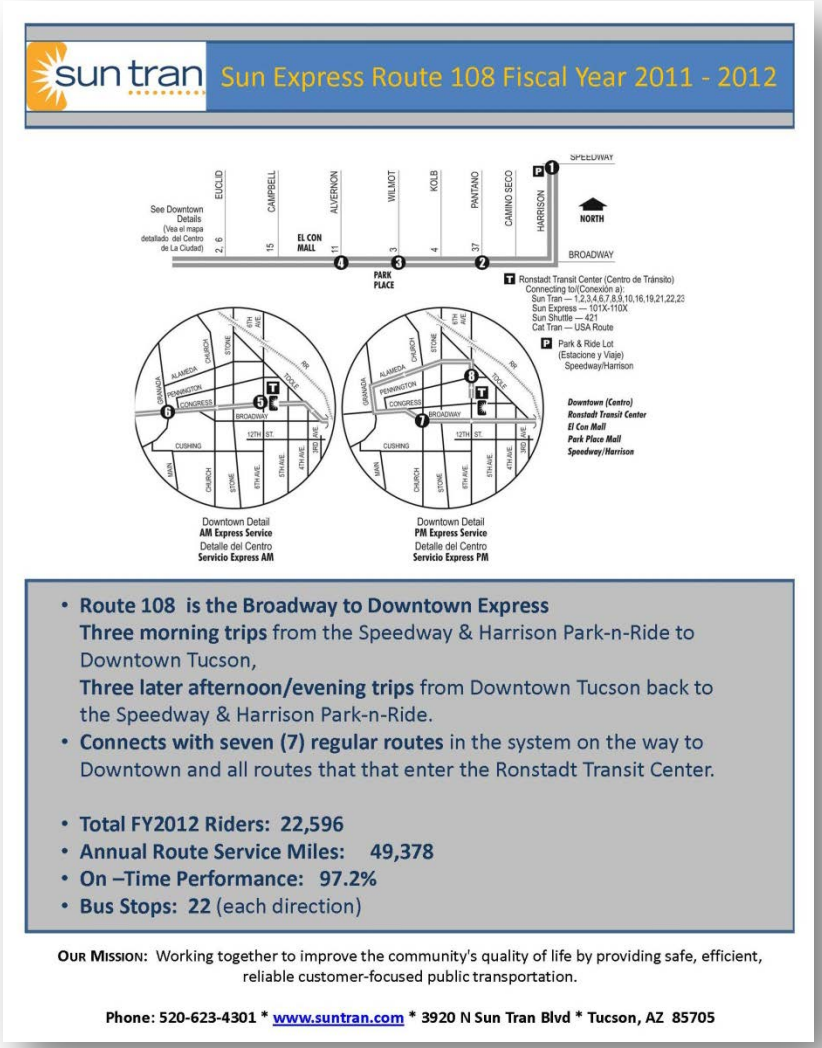
Phone: 520-623-4301 * www.suntran.com * 3920 N Sun Tran Blvd * Tucson, AZ 85705

Current Transit on Broadway

- **Route 108 Express**
  - 3 trips in A.M.,
    3 trips in P.M.
  - Limited stops, only
    22 in each direction
  - 22,596 boardings, FY11-12
  - Performs at average of
    Sun Express system
  - The only express route
    with parallel Sun Tran
    service along entire route



sun tran Sun Express Route 108 Fiscal Year 2011 - 2012

See Downtown Details (Vea el mapa detallado del Centro de La Ciudad)
EUCLID 2 6 · CAMPBELL 15 · ALVERNON 11 · EL CON MALL · WILMOT 3 · KOLB 4 · PANTANO 37 · CAMINO SECO · HARRISON · SPEEDWAY · NORTH · BROADWAY
PARK PLACE

Ronstadt Transit Center (Centro de Tránsito)
Connecting to(Conexión a):
Sun Tran — 1,2,3,4,6,7,8,9,10,16,19,21,22,23
Sun Express — 101X-110X
Sun Shuttle — 421
Cat Tran — USA Route

Park & Ride Lot (Estacione y Viaje) Speedway/Harrison

Downtown (Centro)
Ronstadt Transit Center
El Con Mall
Park Place Mall
Speedway/Harrison

Downtown Detail
AM Express Service
Detalle del Centro
Servicio Express AM

Downtown Detail
PM Express Service
Detalle del Centro
Servicio Express PM

- **Route 108 is the Broadway to Downtown Express**
  Three morning trips from the Speedway & Harrison Park-n-Ride to Downtown Tucson,
  Three later afternoon/evening trips from Downtown Tucson back to the Speedway & Harrison Park-n-Ride.
- **Connects with seven (7) regular routes** in the system on the way to Downtown and all routes that that enter the Ronstadt Transit Center.

- **Total FY2012 Riders: 22,596**
- **Annual Route Service Miles: 49,378**
- **On –Time Performance: 97.2%**
- **Bus Stops: 22** (each direction)

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Brief Review of PAG's 2009 High Capacity Transit Plan Recommendations

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2009 High Capacity Transit Plan Recommendations

- 2009 Plan completed by Pima Association of Governments
- Provides a financially unconstrained menu of options, to be implemented based on funding availability
  - High Capacity Transit (HCT)
    - High volume of passengers
    - Fast and convenient service
  - Types
    - Express Bus
    - Modern Streetcar
    - Bus Rapid Transit
    - Light Rail
    - Commuter Rail

2009 High Capacity Transit Plan Recommendations

- 2009 High Capacity Transit System Plan performed initial evaluations and identified priority corridors
  - Sixteen Initial Corridors Identified
  - Eight Selected Corridors for Evaluation:
    - Ridership
    - Right of Way Availability
    - Potential Capital and Operating Costs
  - Two Priority Corridors Identified:
    - Broadway Blvd.
    - 6th Avenue/Nogales Highway

2009 High Capacity Transit Plan Recommendations

- Identified Broadway Corridor for BRT
  - Favorable future ridership projections
    - 3,887 daily riders (~ 120,497 monthly ridership)
    - In 2011-2012 counts, this would be the 4th highest ridership route in the system
  - Existing bus lanes
  - Planned expansion
  - Relative low cost
  - Conducive to Transit-Oriented Development (TOD)
  - Serves transit-dependant populations

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2009 High Capacity Transit Plan Recommendations

"There do not appear to be any constraints to implementing BRT service on Broadway Boulevard in the near term. In fact, the existing transit facilities within this corridor, including dedicated transit lanes and the upcoming transit priority signal timing upgrade, make implementation of BRT relatively straightforward."

This statement is generally true of Broadway to the east of Alvernon, but within this Broadway: Euclid to Country Club project area, there are challenges.

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Major Activity Centers Along Broadway

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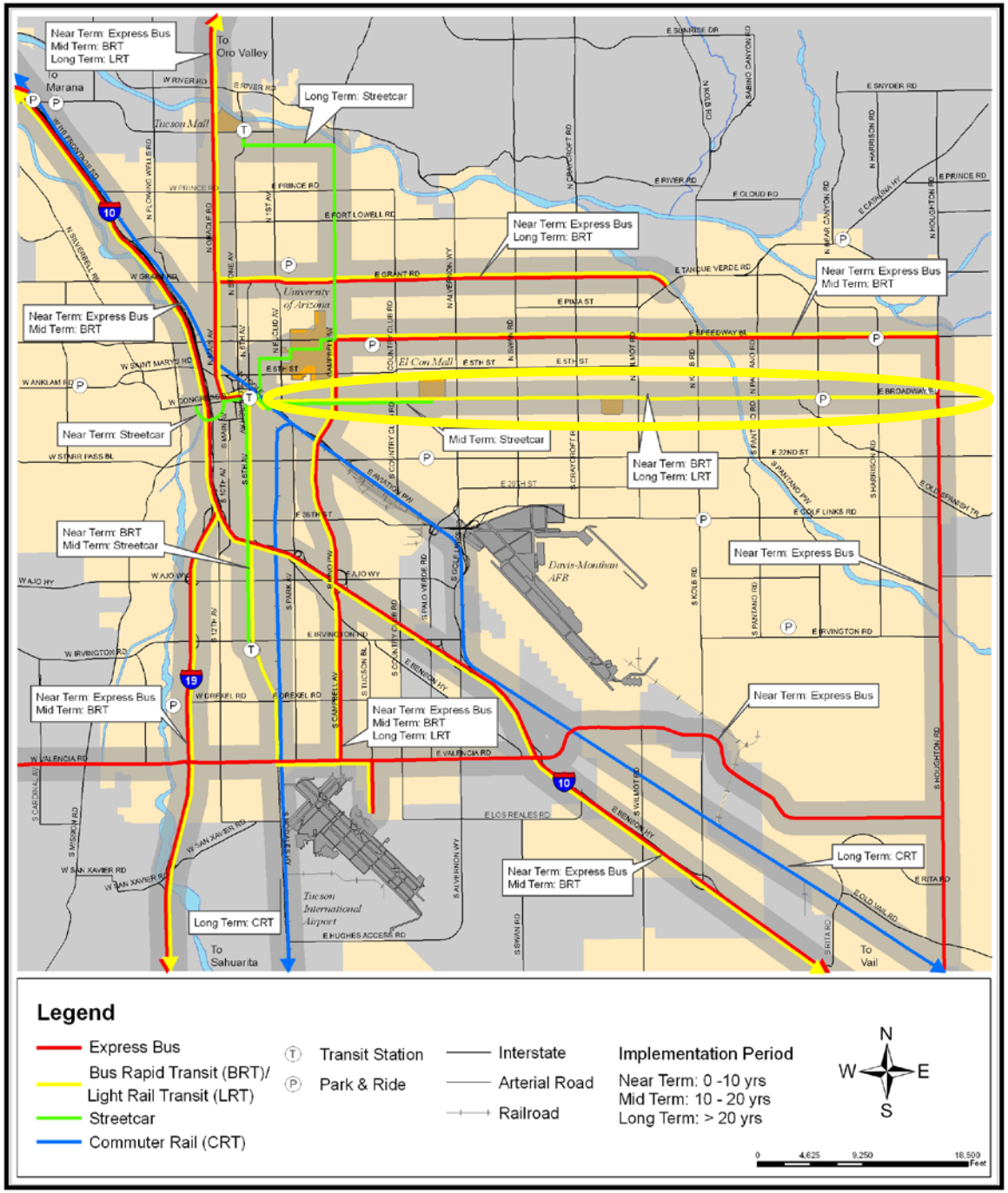
Near Term: Express Bus
Mid Term: BRT
Long Term: LRT
To Marana
To Oro Valley
Long Term: Streetcar
Tucson Mall
Near Term: Express Bus
Long Term: BRT
Near Term: Express Bus
Mid Term: BRT
Near Term: Express Bus
Mid Term: BRT
University of Arizona
El Con Mall
Near Term: Streetcar
Mid Term: Streetcar
Near Term: BRT
Long Term: LRT
Near Term: BRT
Mid Term: Streetcar
Davis-Monthan AFB
Near Term: Express Bus
Near Term: Express Bus
Mid Term: BRT
Near Term: Express Bus
Mid Term: BRT
Long Term: LRT
Near Term: Express Bus
Near Term: Express Bus
Mid Term: BRT
Long Term: CRT
Tucson International Airport
Long Term: CRT
To Sahuarita
To Vail
Legend
Express Bus
Bus Rapid Transit (BRT)/ Light Rail Transit (LRT)
Streetcar
Commuter Rail (CRT)
Transit Station
Park & Ride
Interstate
Arterial Road
Railroad
Implementation Period
Near Term: 0 -10 yrs
Mid Term: 10 - 20 yrs
Long Term: > 20 yrs
N
W
E
S
0
4,625
9,250
18,500
Feet

Broadway HCT Options

- Bus Rapid Transit in Near Term, 0-10 years

- Streetcar between Downtown and El Con Mall in Mid Term, 10 to 20 Years

- Light Rail in Long Term > 20 years

Overview of Bus Rapid Transit (BRT) and BRT Elements

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BRT Spectrum & Related Capital Costs

BRT – "Lite"
Swift BRT - Everett

"Hybrid" BRT
Eugene EmX

Full BRT
Orange Line - LA

$2-5 million per mile*

$5–10 million per mile*

$10–30 million per mile*

Image credit: Viggiano and Gonsalves, Parsons Brinckerhoff

** Likely overestimates Broadway's full cost, since much of the Right-of-Way on the corridor is already available.*

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BRT Spectrum

BRT Attribute	"Lite" Basic Implementation	"Hybrid" Intermediate Implementation	Full Full-Featured Implementation
Right-of-Way	Mixed Traffic	Designated/HOV/Barrier-Separated Lanes	Exclusive/Grade Separation
Stations	Improved Passenger Amenities	Enhanced Passenger Information & Fare Collection	Enhanced Loading
Service	Improved Service Frequency	Skip Stop & Express Service Options High Frequency & Reliability	Convenient Transfers
Route Structure	Single Route with Transfers, Color Coding	Multiple Route Operations with Transfer Facilities Integration with Regional Transit	One Seat Rides Transfer Reduction
Intelligent Transportation System	Signal Priority	Automated Passenger Information	Vehicle Location and System Surveillance

Bus Rapid Transit

"Bus Rapid Transit can best be described as a combination of facility, systems, and vehicle investments that ***convert conventional bus services into a fixed-facility transit service***, greatly increasing their efficiency and effectiveness to the end user."

Federal Transit Administration, Bus Rapid Transit Demonstration Program, December 2002.

BRT Benefits to Passengers

User Experience

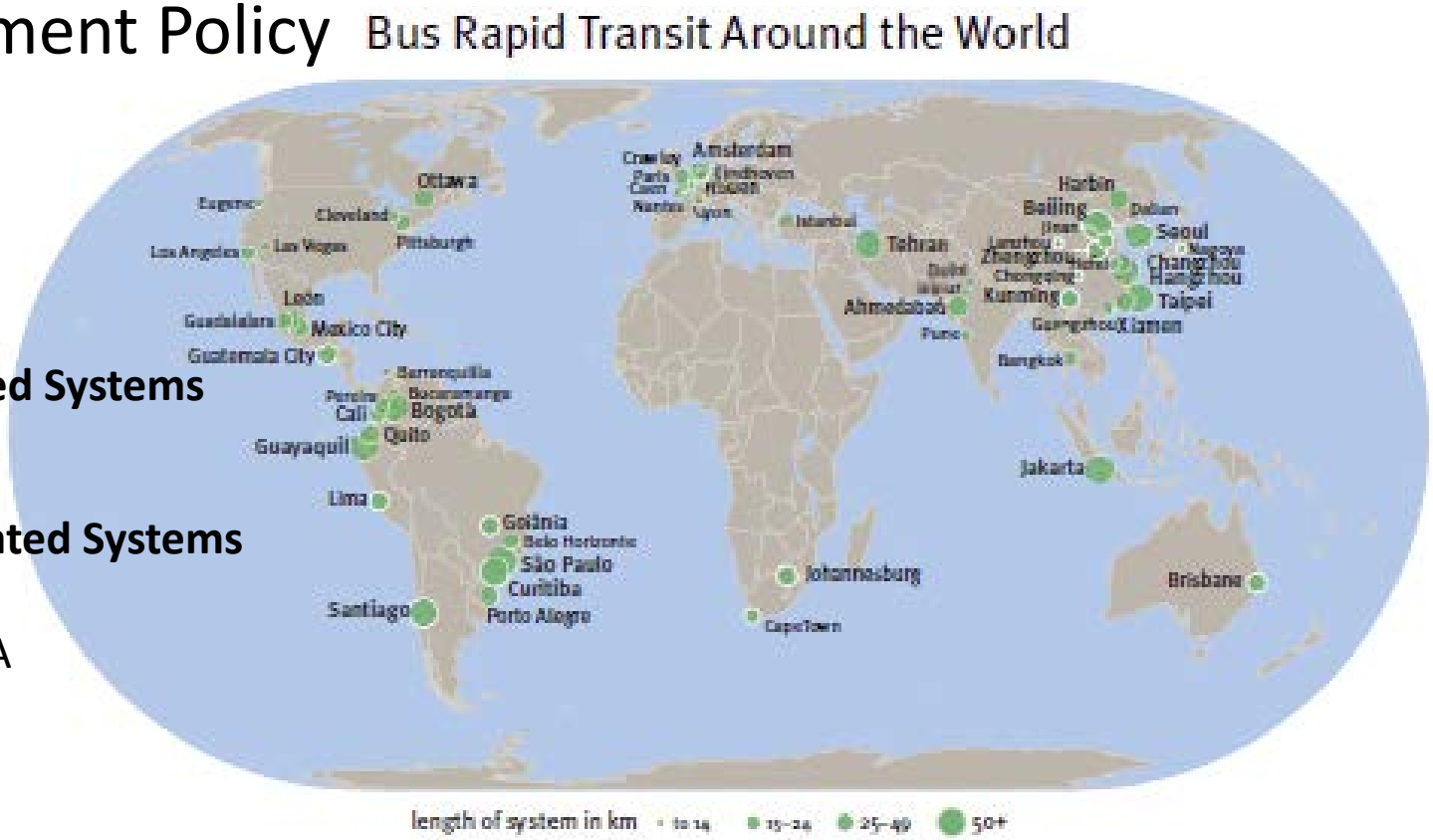
- Reduced transit travel time
- Increased trip reliability
- Improved transit connections and more direct service
- Decreased station stop dwell times and waiting times
- Enhanced system identity
- Increased travel comfort
- Enhanced safety and security

Broad Benefits

- Capital Cost Effectiveness
- Operating Cost Efficiency
- Transit-supportive land development
- Environmental Quality

BRT Systems

- Started in Curitiba, Brazil in 1974
- Applied world wide in major urban areas
- 20 systems in U.S., 1 systems rated as silver and 4 bronze by Institute of Transportation and Development Policy



U.S. Silver Rated Systems
Cleveland, OH

U.S. Bronze Rated Systems
Eugene, OR
Los Angeles, CA
Pittsburg, PA
Las Vegas, NV

BRT Elements

- Running ways
- Stations
- Vehicles
- Fare Collection
- Intelligent Transportation Systems (ITS)
- Service Structure & Relationship to Existing Bus Transit
- Branding

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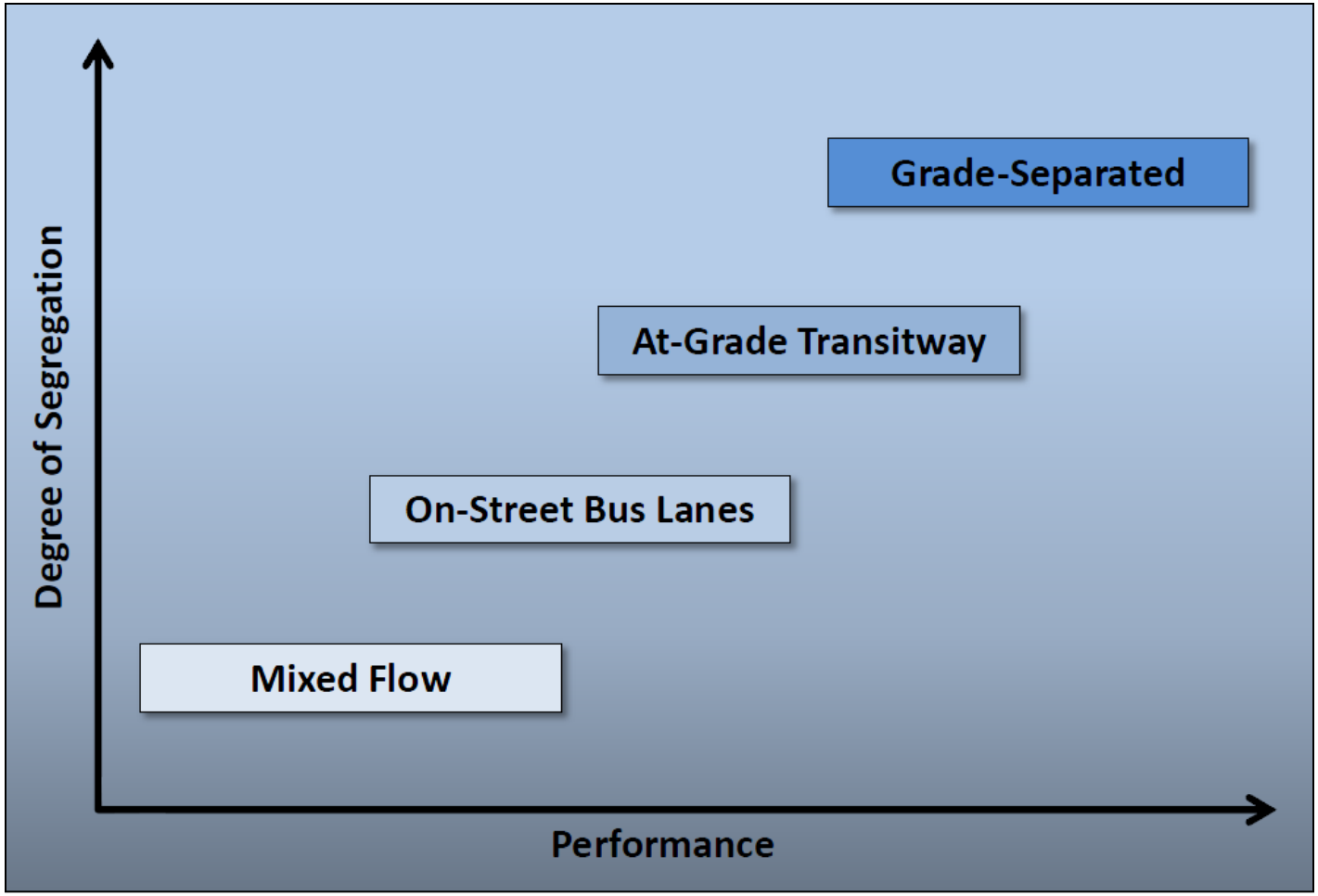
Running Way

- Defines BRT travel parameters
- Most critical component in determining system performance
- Important to public perception and identity
- Characteristics of running ways
  - Running way type
  - Running way markings
  - Running way guidance

Running Way Types



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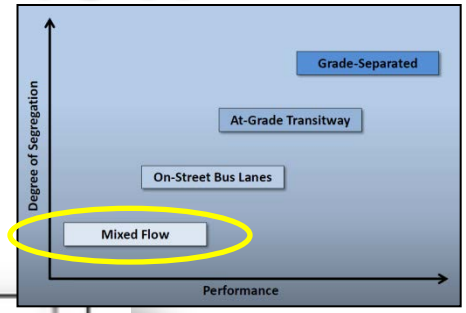
Running Way – Mixed Flow



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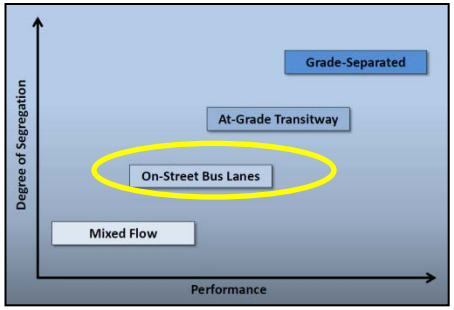
Running Way – On Street Bus Lane



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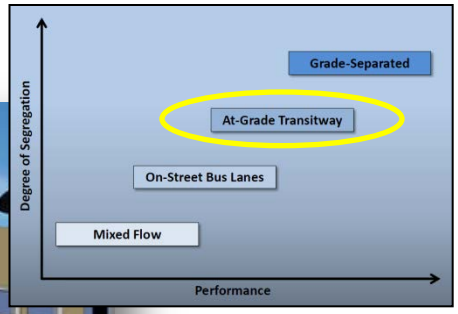
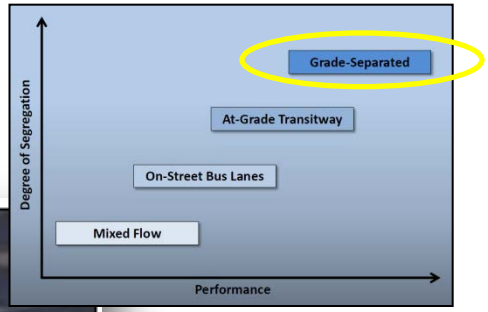
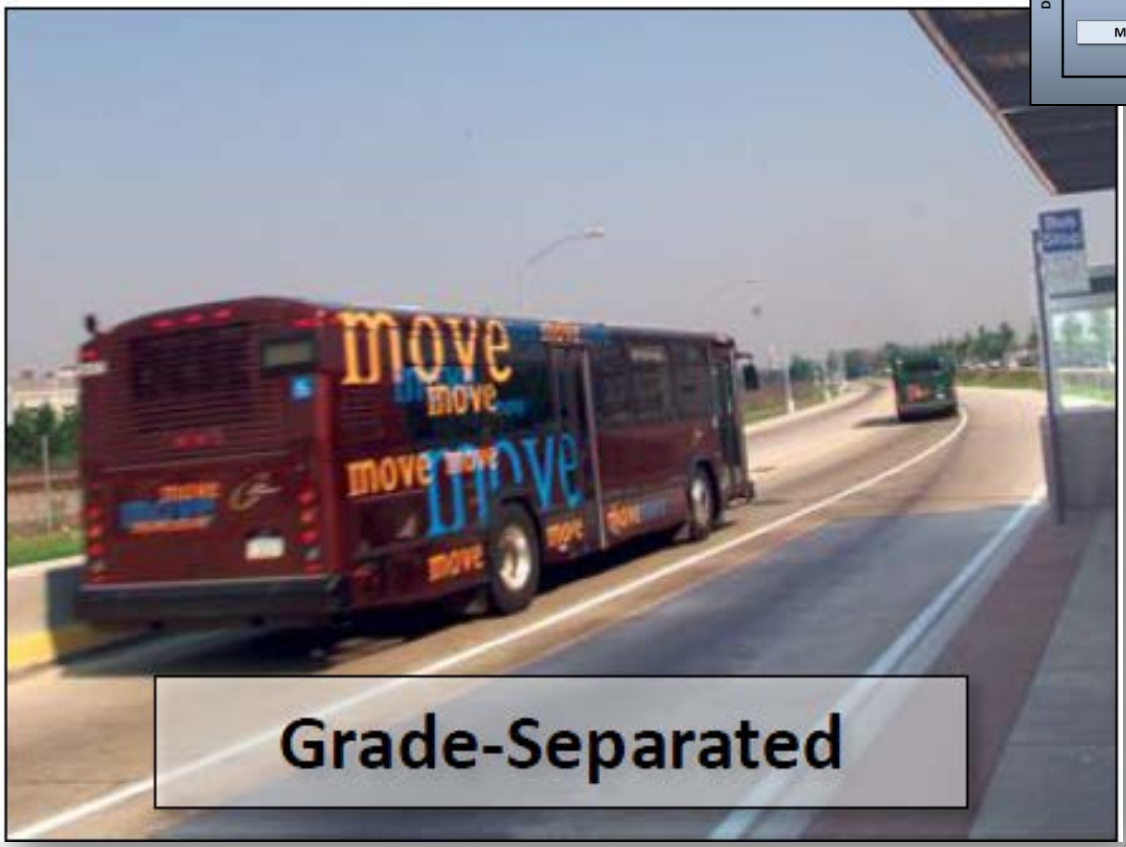
Running Way – At Grade Separated



Running Way – Grade Separated





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Stations

- Level boarding
- Real-time information
  - Arrival time
  - Route maps
  - Schedule
- Enhanced amenities
  - Increased comfort: shade, fare vending, other vending
  - Enhanced safety: lighing, emergency telephones, video cameras

Vehicles

Conventional Standard

Stylized Standard

Conventional Articulated

Stylized Articulated (partial low floor)

Specialized BRT Vehicle (full low floor)

Fare Collection

- On-Board, Driver-Validated System
- On-Board, Conductor-Validated System
- Off-Board Barrier System
- Off-Board, Barrier-Free, or Proof-of- Payment (POP) System
- Fare Medium
  - Cash
  - Magnetic Card
  - Smartcard

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Intelligent Transportation Systems (ITS)

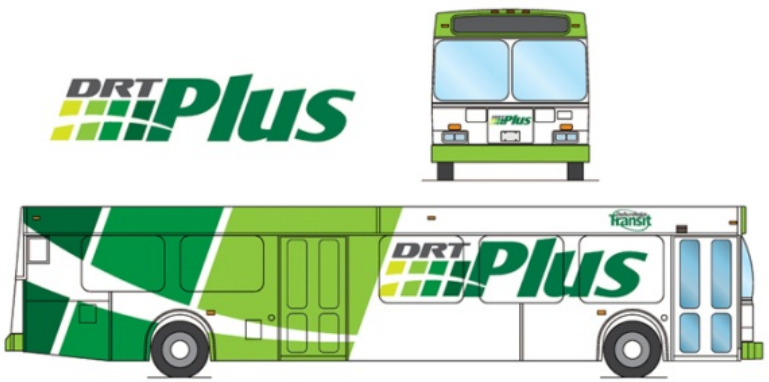
- Transit Vehicle Prioritization
- Intelligent Vehicle Systems
- Operations Management Systems
- Passenger Information Systems
- Safety and Security Systems

Service Structure & Relationship to Existing Bus Transit

- Route Length
- Route Structure
- Service Span
- Service Frequency
- Station Spacing
- Methods of Schedule Control

Branding

- Provides system identity
- Creates impression of high quality
- Helps boost ridership



Results from Initial BRT Conceptual Analysis

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PAG Initial BRT Alternatives Analysis

- "Sketch level" analysis provides very rough information; helps to guide focus of next level of analysis
- Coordinated by Pima Association of Governments (PAG) staff, in conjunction with the PAG Transit Working Group
- Performed as part of a partnership between PAG and University of Arizona
- To evaluate potential time savings of BRT and impact on existing traffic

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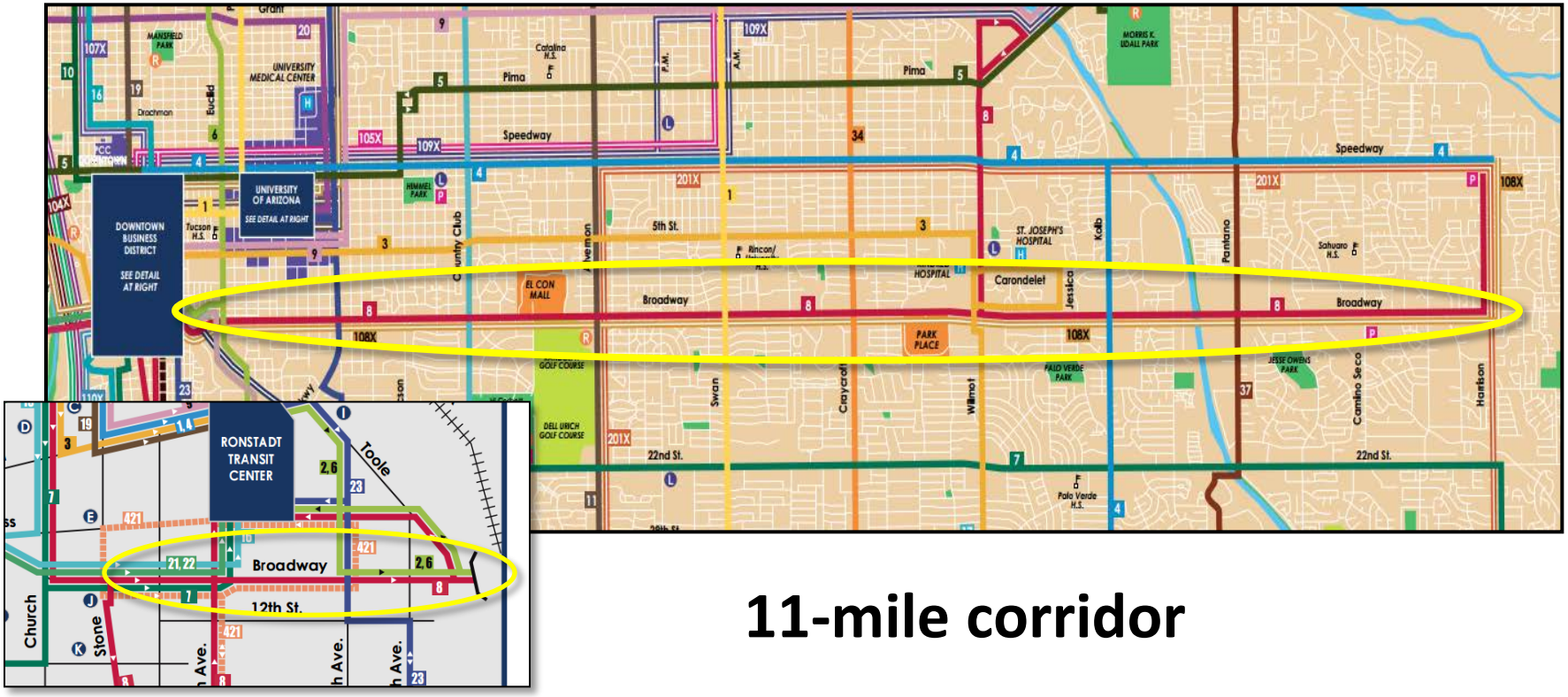
BRT Study Area



11-mile corridor

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BRT Initial Alternatives Analysis Modeling

- Model Inputs
  - Overall lane configuration:
    - Indirect left turns assumed at every intersection
    - Hybrid & Outside-running lane model:
      - Includes center-running lane in project area (Euclid-C. Club)
      - Reintegrate with outside-running traffic lanes from C. Club to Columbus
      - Diamond Lanes between Columbus and Camino Seco
      - Back to mixed traffic between Camino Seco and Houghton

BRT Initial Alternatives Analysis Modeling

- Model Inputs
  - 12 stops in each direction (approx. every 1 - 1½ miles)
    - 2 stops in project area: Euclid and Campbell; next stop El Con Mall
  - Interaction with other traffic
    - Center-running only interact with traffic at intersections (possible conflicts if traffic backs up in indirect cue lane as buses would need to wait until vehicles clear)
    - No bus pullouts
  - Bus operation frequency

PAG Initial BRT Alternatives Analysis
Alternatives Reviewed

1: Center Running Dedicated Lanes

- Buses given signal priority and vehicle left-turns limited to major intersections

2: Outside Lane Mixed Traffic

- Vehicles operate in diamond lanes or mixed traffic
- Some use of BRT elements

3: Hybrid Center Lane and Outside Lane/Mixed Traffic

- Dedicated median running way along Broadway Euclid to Country Club expansion
- After Country Club, reintegrate with traffic and travel in diamond lanes to Columbus, travel in diamond lanes from Columbus to Camino Seco, then back to mixed to Houghton

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PAG Initial BRT Alternatives Analysis
Alternative 1

Center Running Dedicated Lanes

Buses given signal priority and vehicle left-turns limited to major intersections

Image credit: San Francisco County Transportation Authority

PAG Initial BRT Alternatives Analysis Alternative 2

Outside Lane Mixed Traffic

Vehicles operate in diamond lanes or mixed traffic; Some use of BRT elements

Image credit: San Francisco County Transportation Authority

PAG Initial BRT Alternatives Analysis Alternative 3

Hybrid Center Lane and Outside Lane/Mixed Traffic

- Dedicated median running way along Broadway Euclid to Country Club expansion
- After Country Club, reintegrate with traffic and travel in diamond lanes to Columbus, travel in diamond lanes from Columbus to Camino Seco, then back to mixed to Houghton

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PAG Initial BRT Alternatives Analysis
BRT Alternatives Descriptions

BRT Element	Alternative 1 Dedicated Center	Alternative 2 Outside Busway	Alternative 3 Mixed Center/Outside
Running Way	Dedicated Center	On-street Bus/Shared Turning	Mix Alt 1/Alt 2
Stations	Level Boarding/Real Time Info	Unique Bus Shelter	Mix Alt 1/Alt 2
Vehicles	Specialized BRT	Specialized Articulated	Specialized BRT
Fare Collection	Off-Board, Smart Card	On-Board, Smart Card	Mix Alt 1/Alt2
Intelligent Transportation System (ITS)	Transit Priority/Cue Jump	None	Transit Priority/Cue Jump
Branding	Unique Branding	Unique Branding	Unique Branding

PAG Initial BRT Alternatives Analysis Travel Time Comparison

- Modeling assumed one-way trips between Ronstadt TC and Harrison
- Estimated total travel time based on departure time
- Travel times compared between alternatives and against current Route 8
- Route 8 trip times represent Ronstadt to/from Harrison only, no S. 6th or Wilmot legs

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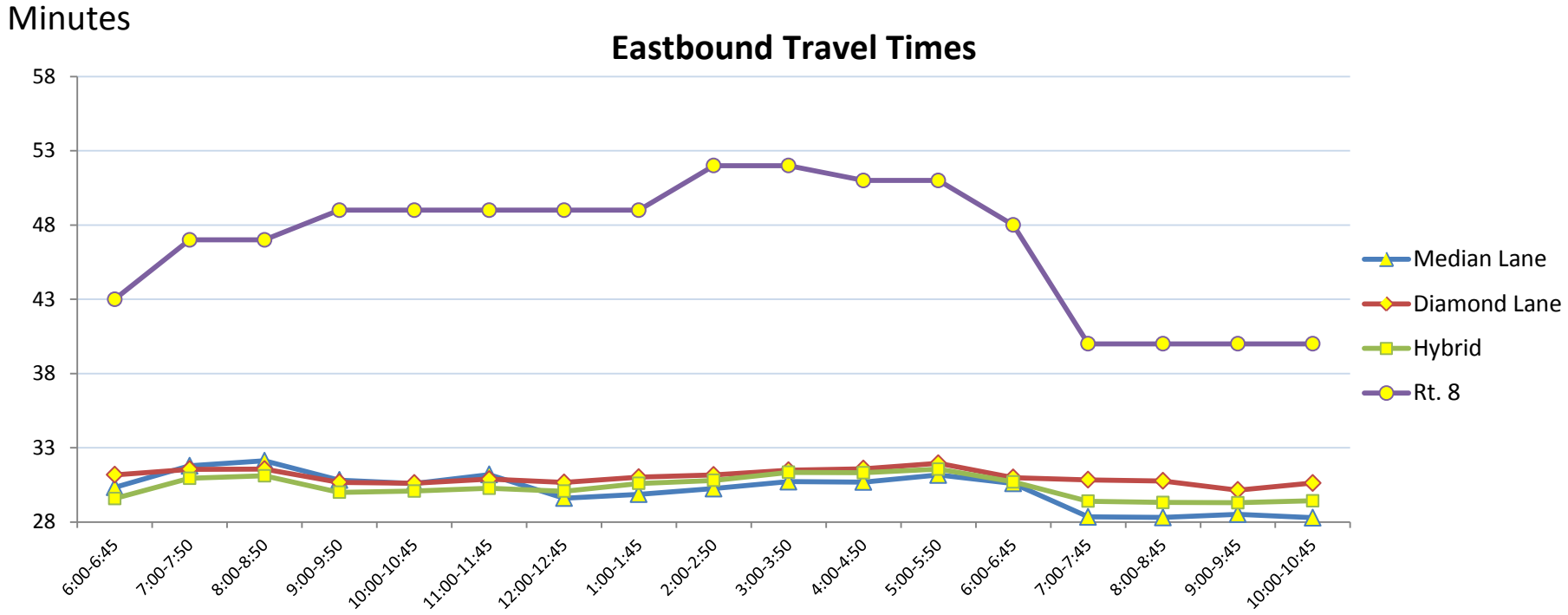
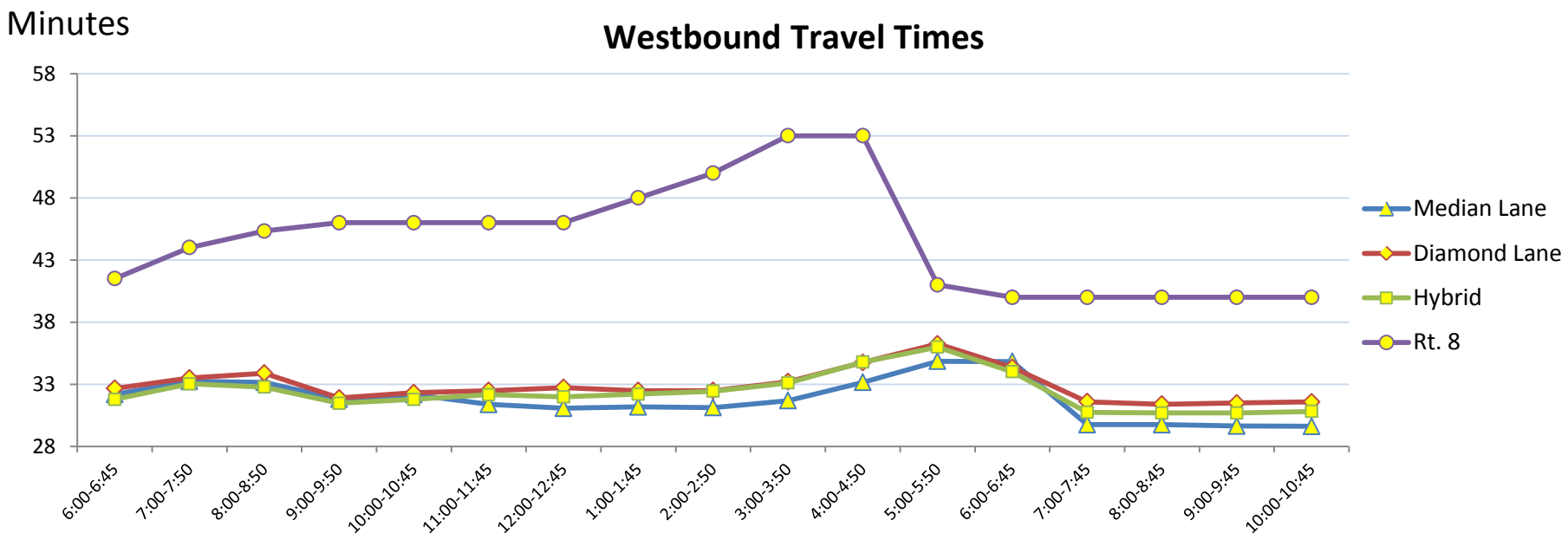
PAG Initial BRT Alternatives Analysis 2017 Travel Time Results

	Alternative 1	Alternative 2	Alternative 3
Eastbound Total Operation Time	40.9 hours	42 hours	41.1 hours
Annual Cost	$1,200,442	$1,231,736	$1,206,799
Westbound Total Operation Time	43.1 hours	44.6 hours	44 hours
Annual Cost	$1,265,476	$1,308,995	$1,289,925
Total	84.1 hours	86.6 hours	85.1 hours
Total Annual Cost	$2,465,918	$2,540,731	$2,496,723

- Difference between alt 1 and 2 is enough to save 1-2 trips each way, saving a vehicle.
- Westbound travel time is affected by back-up in Michigan left turn (indirect left) cue lanes.

BRT Alternative Lanes Vehicle Travel Times vs. Route 8





BRT vs. Rt. 8 Travel Time Comparison

Route 8 corridor trip	45 minutes
BRT corridor trip	31 minutes
BRT savings over Rt. 8	14 minutes
BRT savings per mile	1.2 minutes per mile

*All calculations represent average trip times over total 11-mile corridor length

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Summary of Results

- Broadway continues to lead the region with highest ridership counts
- 2009 projected ridership for Broadway HCT would make Broadway BRT the 4th highest ridership, if compared to 2011-2012 system ridership counts
- Initial analysis focused on travel time to try to identify the type of running way that would work best on Broadway
  - Modeling indicates that separated/dedicated running ways provide the most significant savings
  - Hybrid model is an improvement over outside-running only lanes

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Considerations for How to Preserve the Opportunity to Implement Future HCT on Broadway

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Realities of Implementing HCT on Broadway

- Additional planning and analysis required to select a preferred service system (costs money; takes time)
- Funding source(s) need to be identified and committed before HCT can be implemented
  - Federal funds require local match
  - Local funding requires finding funding streams
- Commitment to Operations and Maintenance Costs and responsibilities is needed

Realities of Implementing HCT on Broadway

- Schedule/timing of implementation is uncertain until key decisions made and funding identified
- Current activities are conducive to continued, accelerated BRT planning efforts:
  - Downtown development (and related construction, population, and jobs which has created congestion)
  - Convenient circulation once passengers are downtown, particularly once Streetcar is built
  - Additional population and jobs in other centers along Broadway
  - New Park-N-Ride built at Broadway/Houghton

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Design Considerations for Broadway Planning & Design

- Broadway Roadway Project funding does not include money to implement BRT service, but can support facility construction that works today and could accommodate BRT in the future
  - Potential to use as cost match for Federal funding in the future
- RTA Plan includes funding for transit enhancements on Broadway, but not BRT
  - Supports incremental improvements of existing bus service, and potential future BRT

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Design Considerations for Broadway Planning & Design

Bottom Line:

Allow enough Right-of-Way in improved roadway to accommodate future HCT ("preserve the opportunity")

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Design Considerations for Broadway Planning & Design

- **Relationship to Existing Local Bus Service**
  - BRT would operate at higher frequencies (for example, every 10-15 mins.)
  - Local bus could be reduced in frequency (for example, from every 10-15 mins. to every 30 mins.)
  - With pullouts for local bus service and reduced frequency of local bus service, vehicular flow can continue to move quickly

Design Considerations for Broadway Planning & Design

- **Dedicated lanes**
  - Center-running performed the best in the initial modeling (with 30% time-savings)
  - Center-running lanes assumed for project area for Hybrid model
  - Removal of traffic lanes in the future could be very challenging
  - Access to roadway's adjacent properties
    - Center-running limits left turns
    - Outside-running limits right turns into adjacent properties
  - Interaction with traffic mainly occurs at intersections

Design Considerations for Broadway Planning & Design

- **Intersection design**
  - Indirect left was assumed at all major intersections
  - Center-running lanes
    - No left turns permitted on any section
    - Transit stations built in center median, on far side of intersection

DESIGN INNOVATIONS —

Indirect Left Turn

FASTER • SAFER • GAS SAVING

HOW THE INDIRECT LEFT TURN BENEFITS YOU ...

A Shorter Wait at Light

- Reduces the amount of time vehicles are stopped at the intersection by 42%.

More Fuel Savings

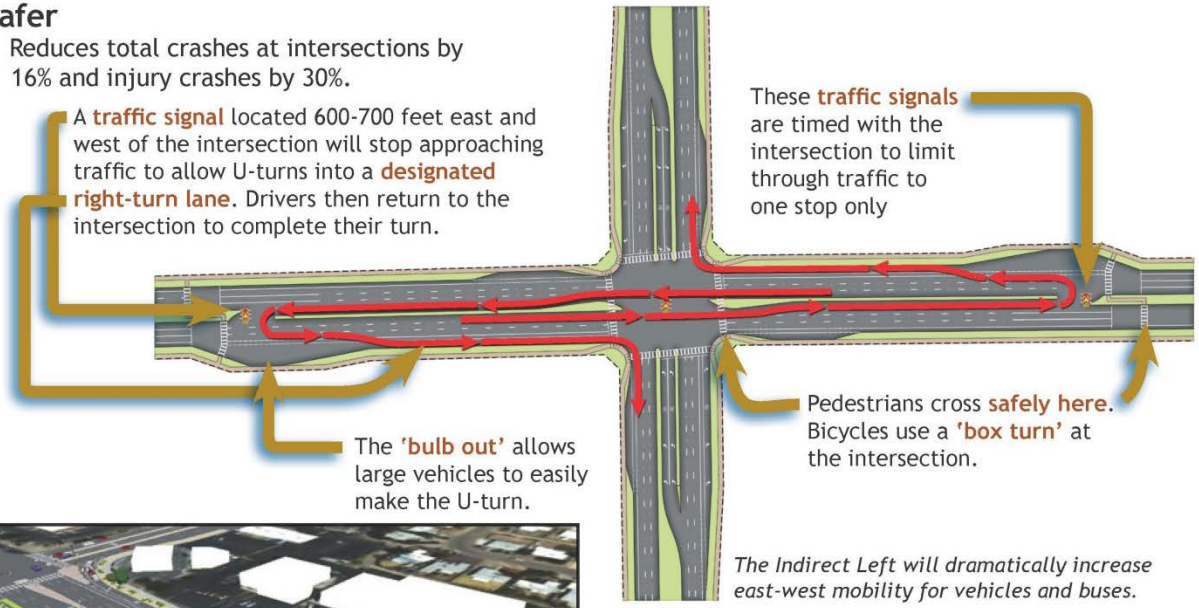
- Reduces fuel consumption by approximately 9% for all vehicles using the intersection.

Safer

- Reduces total crashes at intersections by 16% and injury crashes by 30%.

Smaller Intersections

- Smaller intersection means less right-of-way needed, lower costs, and possibility of preserving existing businesses and reduces the distance pedestrians have to cross by 20 feet.



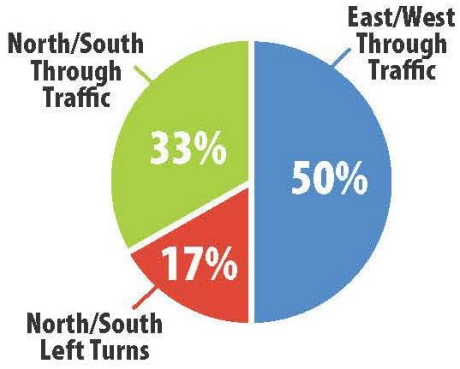
The Indirect Left will dramatically increase east-west mobility for vehicles and buses.

The 'bulb out' allows U-turns for larger vehicles such as buses and semi-trucks.

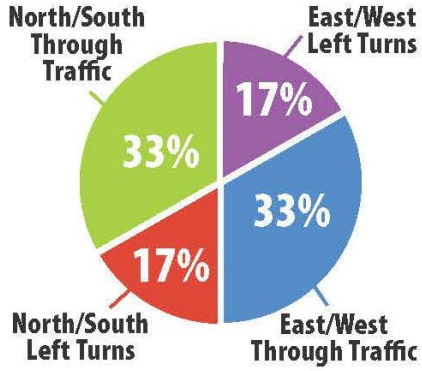
Improving East-West Travel

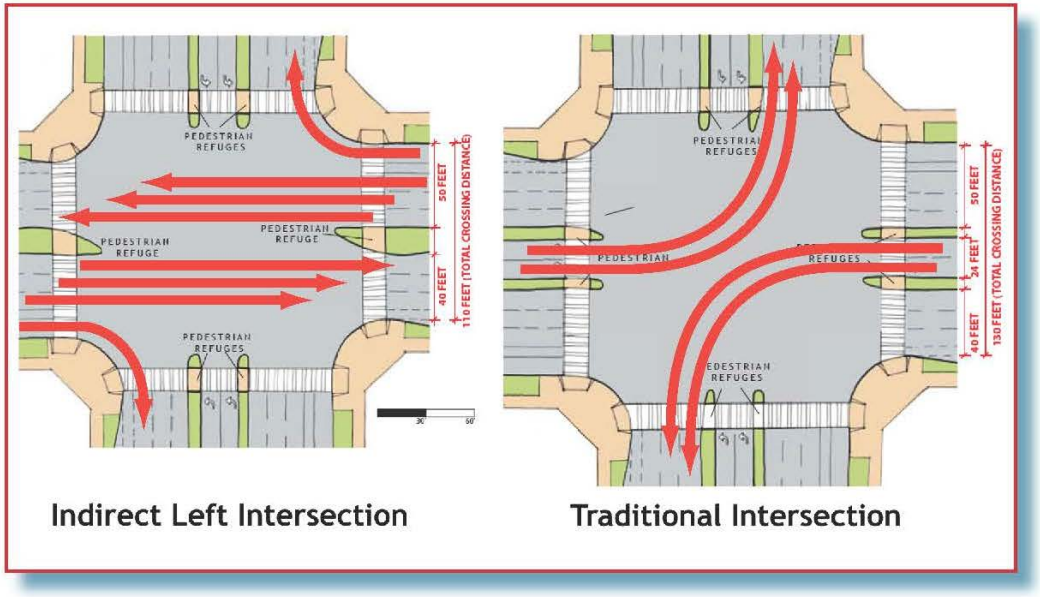
The Indirect Left Turn Intersection Design allows significantly more time to be given to traffic moving east-west along Grant Road.

Indirect Left Turn Traffic Signal Timing



Traditional Traffic Signal Timing





Indirect Left Intersection

Traditional Intersection

The Indirect Left Turn is recommended for seven major intersections along Grant Road:

- Swan Road
- Campbell Avenue
- Oracle Road
- Alvernon Way
- 1st Avenue
- Country Club Road
- Stone Avenue

Design Considerations for Broadway Planning & Design

- **Station design**
  - Bus pullouts are better for vehicular flow, NOT transit
  - Relationship to existing bus transit stops
  - Platforms
  - Bike lanes

LA Metro Rapid: Incremental BRT

- Simple route layout: easy to find/use
- Frequent: 3-10 minutes during peak
- Fewer stops: ¾ mile apart
- Level boarding (LB buses speed-up dwell times)
- Enhanced stations: maps, lighting, canopies, "Next Bus" displays
- Same fare
- Minimal investment:
  - Signal priority
  - Passenger information
  - Strong branding (buses, stations etc.)

Results after demonstration:

- 23-29% reduction in travel times
- 38-42% increase in riders/weekday
- 1/3 of total choice riders, <u>Same</u> <u>cost</u>

*Cliff Henke, PB TR&S, Inc.

Next Steps for PAG and COT for Transit Improvements/Enhancements

- Utilize results from Comprehensive Operational Analysis currently underway to identify opportunities for existing enhancements and/or BRT system funding
  - Incremental system enhancements for bus transit overall
  - Potential local funding of incremental BRT implementation
- Pursue initiating an application for the Federal Small Starts Program funding program
  - Alternatives analysis (would look at BRT, Streetcar extension, and Light Rail Transit)
  - Efforts to commence sometime after SunLinks (Streetcar) is operational

RTA Regional Transportation Authority

CITY OF TUCSON

THE SEAL OF PIMA COUNTY ARIZONA

BROADWAY BOULEVARD
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Thank you

Questions?

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