TASK OBJECTIVE

Downtown Definition examines routing and alignment options for the Red Rapid Transit Line between the Downtown Transit Center and the Capitol Avenue/Illinois Street one-way pair in downtown Indianapolis. For the north leg of the Red Rapid Transit Line, the 2013 Red Rapid Transit Line Alternatives Analysis proposed the downtown routing and stations shown in Figure 1. This routing uses the Capitol Avenue (southbound)/Illinois Street (northbound) one-way pair and the Maryland Street (eastbound)/Washington Street (westbound) one-way pair. Per the report, BRT service would operate in mixed-traffic lanes along with automobile traffic on Washington and Maryland Streets, and in dedicated bus lanes on Illinois Street and Capitol Avenue.

FIGURE 1: RED RAPID TRANSIT LINE ROUTING, NORTH LEG

This task examines alternatives for Red Line accommodation on the east/west one-way pair of Washington Street and Maryland Street. This includes identifying opportunities for dedicated lanes on one or both streets. The objective is to identify routing and configuration alternatives that provide good downtown travel time, effective and understandable transit service, and acceptable impacts to other transportation users and adjacent properties. A separate evaluation is currently being conducted for the MPO to evaluate the feasibility of two-way Red Line operation on Capitol Avenue rather than using the Capitol/Illinois one-way pair.
Downtown Definition focused on the portion of the Red Rapid Transit Line north of the Downtown Transit Center, but also considered the south Red Line as well as the Blue Rapid Transit Line.

ASSUMPTIONS

For the purposes of this evaluation, several assumptions were made concerning the Red Rapid Transit Line service, Downtown Transit Center (DTC), and downtown traffic operations. These assumptions are described below.

RAPID TRANSIT AND LOCAL BUS SERVICE

The Red Rapid Transit Line is assumed to operate as separate routes north and south of the DTC, each with 10 minute peak frequency. South of 16th Street, the north Red Line route will use the Capitol Avenue and Illinois Street one-way pair or will use two-way operations on Capitol Avenue. South of the DTC, the Red Line route will use Virginia Avenue to Fountain Square.

This analysis also assumes that the Blue Rapid Transit Line will be implemented in addition to the Red Rapid Transit Line. When appropriate, the Red and Blue Rapid Transit Lines will use the same routing and exclusive transit lanes.

The 2015 local bus routing and headways recommended in IndyGo Forward are assumed. Two local bus stops are located within the study area. The existing stop at Maryland Street and Pennsylvania Street is assumed to remain for local service. Use of a currently unused local bus stop at Washington Street and Meridian Street is also assumed, to be located where currently identified in the municipal code. Local buses will use exclusive transit lanes if they are available along the local route.

Two signal queue jumps currently exist for transit vehicles within the study area. It is assumed that these queue jumps will remain in place to serve both local and BRT vehicles as needed. One queue jump is currently provided for westbound buses traveling on Maryland Street at Pennsylvania Street. The second queue jump is provided for buses traveling northbound on Delaware Street at Washington Street.

DOWNTOWN TRANSIT CENTER

It is assumed that the Red Rapid Transit Line will serve the DTC. And that the DTC and surrounding street changes will be in place at the time of the Red Rapid Transit Line implementation. Midblock signals are planned at the DTC driveways on Alabama Street and Delaware Street (Figure 2). A northbound contraflow transit-only lane is planned on Alabama Street.

Although the BRT stations should be as close to each other and other transit routes as possible, it is assumed that neither the Red Rapid Transit Line nor the Blue Rapid Transit Line will stop within the DTC. The north Red Rapid Transit Line will use the 60 foot bus bay on Delaware Street. The south Red Rapid Transit Line will use this same bay if possible, but could use a bay on Alabama
Street. It is assumed that the Blue Rapid Transit Line stations will be on Washington Street, between Delaware Street and Alabama Street.

**FIGURE 2: DOWNTOWN TRANSIT CENTER**

Source: IndyGo

**DOWNTOWN TRAFFIC OPERATIONS**

Washington Street is classified as a Primary Arterial roadway through Marion County and serves an important role in carrying regional traffic, with at least two travel lanes in each direction throughout the county. Through the heart of downtown Indianapolis, the arterial function of Washington Street is served by the one-way pair of Washington Street (westbound) and Maryland Street (eastbound). As shown in Figure 3, this one-way pair maintains at least two travel lanes in each direction through downtown, with the segment of Washington Street from Pennsylvania Street to Illinois Street being the most constrained. It is assumed that any BRT configuration will continue to provide at least two through travel lanes in each direction for automobile traffic.

Figure 3 also shows the location of the Cultural Trail with respect to Washington and Maryland Streets. The Cultural Trail currently crosses both streets and runs along the north side of Washington Street. For the safety of Cultural Trail users, exclusive protected traffic signal phases are provided for all vehicular traffic crossing the trail. It is assumed that these protected signal phases will remain for all alternatives.
Five alternatives were developed for downtown routing and configuration of the north segment of the Red Rapid Transit Line. These alternatives are briefly described below. For each of these alternatives, the south segment of the Red Rapid Transit Line is assumed to operate along the route shown in the 2013 Alternatives Analysis.

ALTERNATIVE 1 – MIXED TRAFFIC LOOP ROUTE

Alternative 1 (Figure 4) is the routing and configuration proposed in the 2013 Alternatives Analysis. Under this alternative, transit would operate in mixed traffic lanes along Washington Street and Maryland Street. No exclusive transit lanes would be provided.
ALTERNATIVE 2 – CONCURRENT DEDICATED LANES LOOP ROUTE

Alternative 2 (Figure 5) would follow the same route as Alternative 1, but would provide concurrent dedicated transit lanes along the north side of Washington Street and south side of Maryland Street. Concurrent dedicated lanes mean that transit would travel in the same direction as other vehicular traffic.

FIGURE 5: ALTERNATIVE 2 – CONCURRENT DEDICATED LANES LOOP

ALTERNATIVE 3 – CONTRAFLOW DEDICATED LANES LOOP ROUTE

Alternative 3 (Figure 6) would provide contraflow dedicated transit lanes along Washington Street and Maryland Street. Contraflow dedicated lanes travel against the direction of existing traffic. Transit would travel east on Washington Street in a dedicated lane along the south curb and west on Maryland Street in a dedicated lane along the north curb.

FIGURE 6: ALTERNATIVE 3 – CONTRAFLOW DEDICATED LANES
ALTERNATIVE 4 – TWO-WAY OPERATION ON WASHINGTON STREET

Alternative 4 (Figure 7) would provide two-way transit operation on Washington Street. Westbound transit would travel in mixed traffic lanes, while a dedicated contraflow lane for eastbound transit would be provided in the south curb lane. This lane is currently used for parking and left turns. Red Line vehicles would travel clockwise around the DTC to turn around. A contraflow transit lane would be required on the north side of Maryland Street between Alabama Street and Delaware Street.

FIGURE 7: ALTERNATIVE 4 – TWO-WAY ON WASHINGTON

ALTERNATIVE 5 – TWO-WAY OPERATION ON MARYLAND STREET

Alternative 5 (Figure 8) would provide two-way transit operation on Maryland Street. Eastbound transit would travel in mixed traffic lanes, while a dedicated contraflow lane for westbound transit would be provided in the north curb lane. This lane is currently used for parking and left turns.

FIGURE 8: ALTERNATIVE 5 – TWO-WAY ON MARYLAND
PRELIMINARY SCREENING OF ALTERNATIVES

Preliminary screening of alternatives focused on the ability of each alternative to provide proposed dedicated transit lanes and still maintain at least two through travel lanes for automobile traffic. As previously illustrated in Figure 3, the segment of Washington Street between Pennsylvania Street and Illinois Street currently provides only two through traffic lanes, and this was examined as the critical segment for accommodating dedicated lanes. Figure 9 shows additional detail and highlights the following constraints that affect the feasibility of dedicated lanes along this segment:

A. The Cultural Trail and on-street parking on the north side of Washington Street reduce useable street width.
B. Exclusive right turn lanes are necessary to provide a protected turn phase across the Cultural Trail. Two right turn lanes are needed at Illinois Street due to turning volumes of approximately 400 vehicles per hour during peak hours.
C. On-street parking is provided on the south side of Washington Street between Pennsylvania Street and Meridian Street. At Meridian Street this becomes an exclusive left turn lane and west of Meridian Street there is no on-street parking on the south side of Washington Street.
D. The Conrad Hotel loading zone is located on the north side of Washington Street, adjacent to the right turn lanes from Washington Street to Illinois Street. Operations at the hotel sometimes interfere with traffic flow.
E. The entrance to the underground Circle Centre parking garage is on the south side of Washington Street between Meridian Street and Illinois Street.

CONCURRENT TRANSIT LANE ACCOMODATION ON WASHINGTON STREET (ALTERNATIVE 2)

A concurrent dedicated transit lane on Washington Street from Pennsylvania Street to Illinois Street would be configured as shown in Figure 10 and Figure 11. Between Pennsylvania and Meridian Streets, on-street parking would be maintained adjacent to the Cultural Trail on the north side. However, the parking and exclusive left turn lane on the south side of Washington Street must be removed in order to maintain two through travel lanes and an exclusive right turn lane with protected traffic signal phase across the Cultural Trail. At Meridian Street, all lanes would shift to the right, with the dedicated transit lane shifting to operate in the right curb lane between Meridian and Illinois. Operation of the transit lane along the right curb would result in the loss of on-street parking and one of the two right turn lanes provided for automobiles in this block. The curb line at the southwest corner of Washington and Meridian Streets would likely be reconstructed to allow a smooth lane transition for through
traffic, which could decrease the number of stacking spaces available for users of the Circle Centre Mall parking garage entry.

At both the Meridian Street and Illinois Street intersections, west-bound through transit vehicles in the dedicated lane would be stopped when westbound auto Washington Street to Illinois Street right turns are allowed across the Cultural Trail. Westbound to northbound turning transit vehicles, including the proposed Red Line and other local transit routes, would therefore need to turn right across the Cultural Trail at the same time that trail users are actively crossing Illinois Street (so as to not delay westbound through transit vehicles behind turning transit vehicles), but this situation is considered to be acceptable for trained transit drivers. Because the single remaining automobile right turn lane on Washington Street at Illinois Street is expected to be regularly queued during peak hours, any blockage of the adjacent curbside transit lane could result in significant delay to buses. Operation of the Conrad Hotel loading zone would therefore have to be strictly monitored to ensure free passage of buses.

FIGURE 10: CONCURRENT DEDICATED TRANSIT LANE—WASHINGTON AT MERIDIAN (ALTERNATIVE 2)

Washington Street looking east between Meridian Street and Pennsylvania Street: An offset dedicated transit lane allows on-street parking adjacent to the transit-only lane. Here a combined left turn and through lane is required to maintain at least two through lanes.

FIGURE 11: CONCURRENT DEDICATED TRANSIT LANE—WASHINGTON AT ILLINOIS (ALTERNATIVE 2)

Concurrent dedicated transit lane on Washington Street, looking east from Illinois Street. The Red Rapid Transit Line would turn north onto Illinois Street, while the Blue Rapid Transit Line would continue west.
CONTRAFLOW TRANSIT LANE ACCOMMODATION ON WASHINGTON STREET (ALTERNATIVES 3 AND 4)

Both Alternative 3 (Contraflow Dedicated Lane Loop) and Alternative 4 (Two-Way Operation on Washington Street) would require implementation of a contraflow transit lane on Washington Street. As shown in Figure 12, the restricted width along Washington Street would require removing either the Circle Centre parking garage entrance or the Conrad Hotel loading area. The contraflow lane would also require elimination of the exclusive left turn lane on Washington Street at the Intersection with Meridian Street and elimination of all on-street parking along the south side of Washington Street from Delaware Street to Capitol Avenue. Department of Public Works representatives considered the impacts of this contraflow lane to be unreasonable, and these alternatives were eliminated from consideration.

FIGURE 12: ALTERNATIVE 3 (CONTRAFLOW DEDICATED LANES) WASHINGTON STREET SECTION

Contraflow transit lane on Washington Street, looking east from Illinois Street. Implementation would require removal of the Circle Centre garage entrance or the Conrad Hotel loading area.

DETAILED COMPARISON OF ALTERNATIVES

Alternatives 3 and 4 are recommended for elimination based on preliminary assessment of the impacts of a contraflow dedicated transit lane on Washington Street. The following remaining alternatives were developed and examined in more detail to compare their advantages and disadvantages:

- Alternative 1 (Mixed Traffic Loop)
- Alternative 2 (Concurrent Dedicated Lanes Loop)
- Alternative 5 (Two-Way on Maryland)

A detailed route map for each of these three alternatives is attached to this report to show the preliminary proposed locations of exclusive transit lanes, mixed traffic lanes, queue jumps and stations.
The predicted transit travel time through the study area was considered as part of the comparison of alternatives, as well as the impacts of the alternatives on:

- Auto traffic operations
- Pedestrians and Cultural Trail users
- Business driveway access and outdoor areas
- On-street parking and loading zones
- Planned BlueIndy electric car share charging stations
- Red Line implementation and operating costs

Transit travel time and auto traffic impacts were analyzed using a traffic simulation of projected 2021 AM peak hour and PM peak hour operating conditions in the downtown street network. Automobile traffic volumes were forecast by applying a 1% annual growth rate to traffic volumes that were counted in 2012. Transit volumes were forecast using the draft 2021 local transit network plan provided by IndyGo, along with the proposed Red and Blue Rapid Transit Line volumes and routes.

**TRANSIT TRAVEL TIME**

Reduced transit travel time and travel time variability are the primary benefits of providing exclusive transit lanes. For this analysis, the round trip transit travel time of each alternative is measured from the intersection of Capitol Avenue and Washington Street to the DTC and back to the intersection of Illinois Street and Washington Street. The travel times were developed with a simulation model created in Transmodeler. A series of 50 simulation runs was completed for each of the AM and PM peak hours. The simulations assumed a 20-second dwell at each station for BRT vehicles and a 30-second dwell at each stop for local buses. No BRT layover at the DTC was assumed.

Table 1 shows the 90th percentile round trip travel times for each of the alternatives. This represents the travel time that would not be exceeded by 90% of buses, and it thus accounts for the variability of travel time due to changing traffic conditions. The travel time for Alternative 2 (Concurrent Dedicated Lanes Loop) is the shortest, but it only has a significant advantage over Alternative 1 (Mixed Traffic Loop) during the PM peak hour. Alternative 5 (Two-way operation on Maryland Street) results in a travel time that is longer than the other two alternatives, despite the provision of a dedicated lane for westbound transit vehicles on Maryland Street. This is primarily due to the longer travel distance for this alternative.
TABLE 1: 90TH PERCENTILE AM/PM TRAVEL TIME (in min:sec)

<table>
<thead>
<tr>
<th></th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Peak Hour</td>
<td>7:26</td>
<td>7:22</td>
<td>8:13</td>
</tr>
<tr>
<td>PM Peak Hour</td>
<td>7:21</td>
<td>6:51</td>
<td>7:57</td>
</tr>
<tr>
<td>Round Trip Travel</td>
<td>.9 mi</td>
<td>.9 mi</td>
<td>1.1 mi</td>
</tr>
</tbody>
</table>

10% of buses are slower than this time. Average of 50 simulation runs.

PARKING AND LOADING ZONE IMPACTS

The number of on-street loading zones and parking spaces that would be removed for each alternative is summarized in Table 2, along with the estimated cost of removing the on-street parking spaces. For each metered parking space removed, the Indianapolis Department of Public Works (DPW) estimates that there is a $50,000 fee payable to the city’s parking concessioner.

Alternative 1 (Mixed Traffic Loop) would require the removal of 5 parking spaces for the station platform on Maryland Street at Capitol Avenue. Alternative 2 (Concurrent Dedicated Lanes Loop) would require the removal of parking from the south side of Maryland Street between Capitol Avenue and Pennsylvania Street, as well as parking on the north side of Washington Street between Meridian Street and Illinois Street. Alternative 5 (Two-Way on Maryland) would require the removal of all parking on the north side of Maryland Street between Illinois Street and Pennsylvania Street.

Modeling and evaluation of Alternative 2 (Concurrent Dedicated Lanes Loop) assumed that 19 on-street parking spaces and 2 loading zones would be removed to implement the dedicated transit lane on Maryland Street. These spaces could be preserved if the right travel lane were converted to transit use instead. However, this would result in additional impacts to auto traffic, and conflicts with the adjacent parking would likely reduce transit travel times.

TABLE 2: PARKING SPACES REMOVED

<table>
<thead>
<tr>
<th></th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mixed Traffic</td>
<td>Concurrent Lanes</td>
<td>Two-Way on Maryland</td>
</tr>
<tr>
<td>Loading Zones Removed</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Parking Spaces Removed</td>
<td>5</td>
<td>39</td>
<td>27</td>
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<tr>
<td>Cost of Removal</td>
<td>$250,000</td>
<td>$1,950,000</td>
<td>$1,350,000</td>
</tr>
</tbody>
</table>

Cost of removal based on $50,000 fee per parking space removed (Source: Indianapolis DPW)
INTERSECTION LEVEL OF SERVICE

The intersection level of service (LOS) for each alternative is calculated using a simulation model in Transmodeler software. A level of service E or F is generally considered unacceptable, while level of service A through D is considered acceptable. The number of intersections with an unacceptable level of service during either the AM or PM peak hour is summarized in Table 3. Only Alternative 2 (Concurrent Dedicated Lane Loop) results in any intersections with unacceptable LOS. This occurs at the intersection of Washington Street and Meridian Street.

Traffic simulation of the alternatives did not include pedestrian activity at the intersections, which could be an important consideration when shared through and turn lanes are used in a congested downtown network. Levels of service at all intersections could be somewhat lower when pedestrian activity is considered, especially where the implementation of dedicated transit lanes requires exclusive turn lanes to be removed.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Mixed Traffic</th>
<th>Concurrent Lanes</th>
<th>Two-Way on Maryland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intersections with Peak LOS E or F</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

CONCLUSIONS

DESIRABILITY OF PROPOSED ALTERNATIVES

Alternative 1

Alternative 1 (Mixed Traffic loop) has minimal impacts and should be evaluated in the Red Line environmental study. This alternative would remove 5 on-street parking spaces to accommodate a station at the corner of Maryland Street and Capitol Avenue.

Alternative 2

Alternative 2 (Concurrent Dedicated Lane Loop) has a slight travel time advantage over Alternative 1 (Mixed Traffic). This alternative was found to be 30 seconds faster than the mixed traffic alternative during the PM peak hour but only 4 seconds faster during the AM peak hour. Travel time benefits at other times are expected to be minimal due to lower levels of traffic congestion.

To maintain at least two through lanes along Washington Street, the left-turn only lane at Meridian Street would be converted to a combined left turn and through lane. This is due to the need for dedicated right-turn-only lanes which cross the Cultural Trail only during a protected signal phase. This reduction in lane capacity leads to poor automobile level of service during peak periods. Pedestrian activity at the intersection crosswalks was not simulated in this analysis and
would further degrade automobile operation at this intersection. This is because cars on Washington Street that are waiting for pedestrians to clear before turning left would block through traffic traveling in the same shared lane.

On-street parking activity was not quantified as part of this analysis and is likely to slow the transit travel times observed in Alternative 2 somewhat. Cars crossing the transit lane to enter and leave adjacent on-street parking spaces would impact nearby transit operations in the lane. Cars entering and exiting the Conrad Hotel loading zone would also be required to cross the dedicated transit lane and impact transit operations. These vehicles must not be allowed to block the transit lane.

Modeling and evaluation of this alternative assumed that the dedicated transit lane on Maryland Street would be implemented by removing parking and loading spaces in the south curb lane. These impacts could be reduced significantly if a travel lane were converted to transit use instead, preserving 19 on-street parking spaces and 2 loading zones. However, this would result in additional impacts to auto traffic, and the conflicts with adjacent parking would be expected to slow transit travel times, as noted above.

**Alternative 3**

Alternative 3 (Contraflow Dedicated Lane Loop) is not recommended due to the impacts that implementing a contraflow transit lane would have on Washington Street.

**Alternative 4**

Alternative 4 (Two-Way Operation on Washington Street) is not recommended due to the impacts that implementing a contraflow transit lane would have on Washington Street.

**Alternative 5**

Alternative 5 (Two-Way Operation on Maryland Street) has several negative impacts and provides no operational advantage over operating transit vehicles in mixed traffic in a one-way loop. Alternative 5 requires the removal of 27 parking spaces and three loading zones. The travel time and travel distance is longer than Alternatives 1 (Mixed Traffic) and 2 (Concurrent Dedicated Lanes). However, this alternative should not be dismissed until more detailed analysis proves the feasibility of transit operation on Washington Street. A typical section along Maryland Street is shown in Figure 13: Alternative 5 (Two-Way on Maryland) Section.

One important consideration for implementation of this alternative in conjunction with two-way operation on Capitol Avenue (the feasibility of which is being studied in a separate report) would be the ability to construct a northbound contraflow transit lane on Capitol Avenue from Maryland Street to Washington Street. This segment of Capitol Avenue is currently constrained between the Cultural Trail and the Hyatt Regency Hotel and parking garage.
OTHER CONCLUSIONS

Contraflow Transit Lane on Washington Street from Delaware to Alabama

Although a contraflow transit lane on Washington Street is not recommended west of the Downtown Transit Center, a contraflow lane on Washington Street between Delaware Street and Alabama Street would be beneficial to operation of both the Red Rapid Transit Line and the Blue Rapid Transit Line. Based on discussions with MPO staff, this lane was assumed during analysis of the alternatives for this study. It is shown on the detailed route maps for each of the three feasible alternatives. The lane would allow clockwise movement around the DTC for both the South Segment Red Line route and the westbound Blue Line route. This would allow these routes to stop adjacent to the DTC without circulating through the DTC.

South Red Transit Line routing

This analysis focused on routing of the North Segment Red Rapid Transit Line and assumed that the South Segment of the Red Rapid Transit Line would be routed as shown in the 2013 Alternatives Analysis (Figure 1). However, there may be operational benefits to routing vehicles counterclockwise from Delaware Street to Washington Street to Maryland Street to Virginia Avenue. This would be especially important to consider if a contraflow lane cannot be implemented on Washington Street in front of the DTC.

Attachments: Detailed Routing Diagrams for Alternatives 1, 2 and 5