Appendix A:
Transportation Model Runs of Proposed Alternatives

Appendix A – Transportation Model Runs of Proposed Alternatives

This appendix presents preliminary transportation model results for the initial set of feasible alternatives developed for the Bi-National Partnership Planning/Need and Feasibility (P/NF) Study. The results presented reflect work undertaken since the preparation of the Existing and Future Travel Demand Working Paper, which documented the transportation need for a new or expanded crossing. These model runs and attached documentation identifies the transportation impacts for to be considered with land use, environmental, technical factors and impacts in the analysis of feasible alternatives as presented in the Feasible Transportation Alternatives Working Paper and at the first round of Public Consultation in October/November 2002.

The following sections describe the alternatives, major assumptions and provide a transportation assessment of the crossing alternatives in terms of demand, congestion relief, level-of-service, traffic diversion impacts and transportation system performance. The results are based on transportation model runs performed for the Base Case, one Optimization Alternative and five Alternative Improvements for the 2010, 2020 and 2030 horizon years and consider queuing delays at the bridge/customs plaza and congestion impacts on the road network given growth in cross-border and local background traffic.

Alternatives

The Base Case and five Alternative Improvements are described below. The five Alternative Improvements assume controlled access highway connections to and from the crossing, with border processing facility improvements to accommodate future needs. In addition, border crossing tolling rates were assumed to be the same for all alternatives, thereby eliminating this variable from the routing decisions. For modelling purposes, a representative alignment was tested for each alternative to provide a general indication of the ability of a new crossing to meet future cross-border capacity needs at different locations and assist in the identification of study area corridors to be carried forward for subsequent environmental studies:

- **Base Case** – the existing transportation system plus committed new projects, which includes the Ambassador Gateway Project, Highway 401 widening in the Windsor Area, and Jefferson Avenue improvements in the vicinity of the Detroit Windsor Tunnel, among others. All Build Alternatives and the Optimization Alternative also incorporate these committed improvements. The Base Case and associated assumptions are fully documented in the *Existing and Future Travel Demand Working Paper,* November 2002.
- **South Crossing** – crossing between LaSalle and Wyandotte with direct highway connections to I-75 and Highway 401 was tested. Access to/from I-94 is assumed to be achieved via Eureka Road[1] and I-275 for vehicles using a South Crossing.

[1] Further analysis is required to confirm the feasibility of Eureka Road or other roads to carry cross border truck traffic to access I-275/I-94 from I-75 under the South Crossing Alternative.

- **Central Crossing** –a controlled access highway connection to Highway 401 via a corridor east of Highway 3/Huron Church Road in Canada and a direct highway connection to I-75 in the US with a river crossing in the Ojibway Parkway/Zug Island area of Windsor/Detroit was tested. Access to/from I-94 is assumed to be achieved via the Southfield Highway for vehicles using a Central Crossing.
- **Twinned Ambassador Bridge** – an upgrading of Huron Church Road to six-lane grade-separated facility from Highway 401 to the Ambassador Bridge plaza and a second span across the Detroit River connecting to the bridge plazas was tested[2].
- **Rail Corridor** – the DRTP proposal, involving conversion of the existing rail tunnel to a two-way rail corridor and a new high-clearance rail tunnel was tested. Access to the rail corridor is achieved by constructing a new two-lane truckway in the existing Canada Southern (CASO) rail corridor from Highway 401 to the rail corridor on the Canadian side of the border. On the US side, a direct connection from the rail corridor to I-75 is assumed[3].
- **East Crossing** – a crossing at Belle Isle with controlled access highway connections to Highway 401 and I-94 on the Canadian and US sides of the border, respectively, was tested.

In each case, for modelling purposes, it is assumed that the alternative is opened in 2010.

Modelling Approach and Assumptions

The transportation model runs performed for each alternative were based on work documented in the following Working Papers:

- ***Travel Demand Analysis Working Paper -*** describes the development and calibration of the Regional Travel Model to estimate future demand at existing and potential new crossings. The Region Model is the primary analysis tool to evaluate the transportation impacts in this study, designed to estimate diversions due to a new crossing and assess the impacts at the crossing and on the connecting road and highway system and impacts on local traffic.
- ***Existing and Future Travel Demand Working Paper –*** documents existing conditions and presents future cross-border traffic forecasts and the impact on the border crossing system for the horizon years of 2010, 2020 and 2030. The Base Case forecasts and the associated assumptions presented in this Working Paper describe the horizon year demand forecasts used for comparison of alternatives.

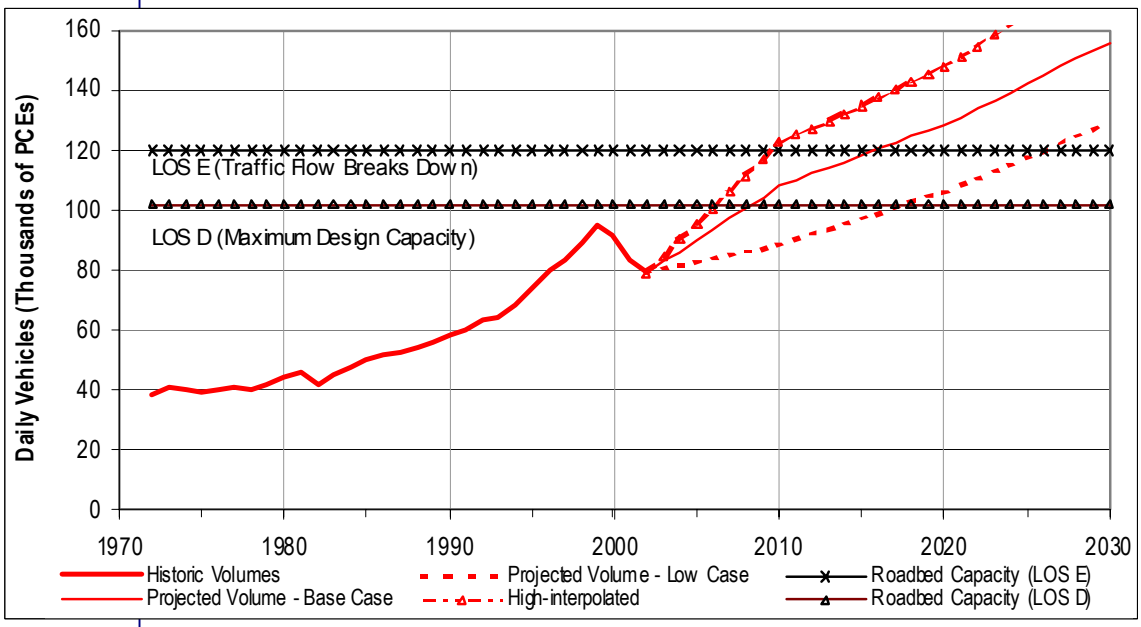
Future travel demand estimates have been prepared for High, Low and Base Case scenarios[4], as shown in Exhibit 1. The traffic forecasts and analyses are presented in this document for the Base Case, which falls in the middle of the band defined by the future projections and reflects the most probable or most likely scenario for planning purposes.

[2] Further analysis is required to confirm the feasibility of grade separating Huron Church Road to the bridge plaza

[3] Further analysis is required to confirm the feasibility of a direct connection to I-75 from the DRTP corridor

[4]High and Low Trade Scenarios and the Base Case are presented in the Existing and Future Travel Demand Working Paper.

EXHIBIT 1: HISTORIC AND PROJECTED WINDSOR-DETROIT CROSS-BORDER TRAFFIC



Major Assumptions

Major assumptions pertaining to the modelling of the specific alternatives and border processing assumptions are provided in attachments to this Technical Memorandum:

- **Capacity and Network Assumptions** - Attachment A presents the design capacities for each of the crossing alternatives and the process and assumptions used to estimate them. It also includes network assumptions, describing number of lanes, design speeds and capacities and other factors for the crossings and access/egress roads.
- **Border Processing Assumptions** – Attachment B presents the processing rate assumptions used to determine the border inspection capacities, as determined in consultation with US and Canada inspection agencies.

Analysis of Alternatives

Over the 30-year horizon for this study, the cross-border traffic forecasts project an approximate 40% increase in car and 120% increase in truck traffic at the Windsor-Detroit Gateway. This corresponds to an increase in daily cross-border car trips from 52,000 to 70,000 trips and an increase in daily truck trips from 13,000 to 28,000 trips. A summary of the modelling results is provided in Exhibits 2 through 10.

Exhibit 2 presents the travel distance and travel time differences associated with the alternatives. The exhibit provides a graphical representation of the major travel movements across the border, and overlays travel times/distances associated with different routings between Highway 401 and Interstates 75 and 94 based on transportation model

assignments. The travel timesavings identified in Exhibit 2 are expressed in relation to the Base Case (Do Nothing) alternative.

Exhibit 3 provides an overview of the analysis findings, presenting the volumes, volume/capacity (V/C) ratios and performance statistics for the Existing Crossings (Ambassador Bridge and Detroit-Windsor Tunnel) and for each new crossing alternative for each horizon year. The V/C ratio for Huron Church Road is indicated as it is currently the bottleneck in the border crossing system on the Canadian side. The Ambassador Gateway Project is assumed to be implemented on the US side, addressing current operational problems for international traffic accessing the interstate highway system.

Exhibit 4 graphically portrays the V/C ratios for the roadbed capacity of the crossings for each horizon year. For planning purposes, a V/C ratio for the roadbed based on Level-of-Service D (LOS D) is assumed, with the need for a new crossing indicated when the V/C exceeds 0.83. LOS D has been determined by the Partnership as the appropriate basis for determining future infrastructure requirements, given the importance, lead-time and level of investment associated with a major international crossing. LOS E reflects conditions when traffic flow breaks down.

Exhibits 5 to 10 graphically present the travel flows for traffic crossing the border at Windsor-Detroit and the extent of diversion of traffic between crossings. The travel flows are shown from Canada to the US, with the reverse move from the US to Canada similar to those shown. Each exhibit shows car and truck flows in the year 2030 through the use of desire lines, which show travel orientations and diversions associated with each alternative where the thickness of the line is proportional to the traffic flow. From a roadbed capacity perspective, one truck is assumed to be equivalent to three passenger cars. Where the data reflects trucks and cars combined, this information is therefore expressed in Passenger Car Equivalents (PCEs).

The analysis results are described below for each alternative.

EXHIBIT 2 – TRAVEL TIME AND DISTANCE COMPARISON OF EACH CORRIDOR ALTERNATIVE VERSUS DO NOTHING

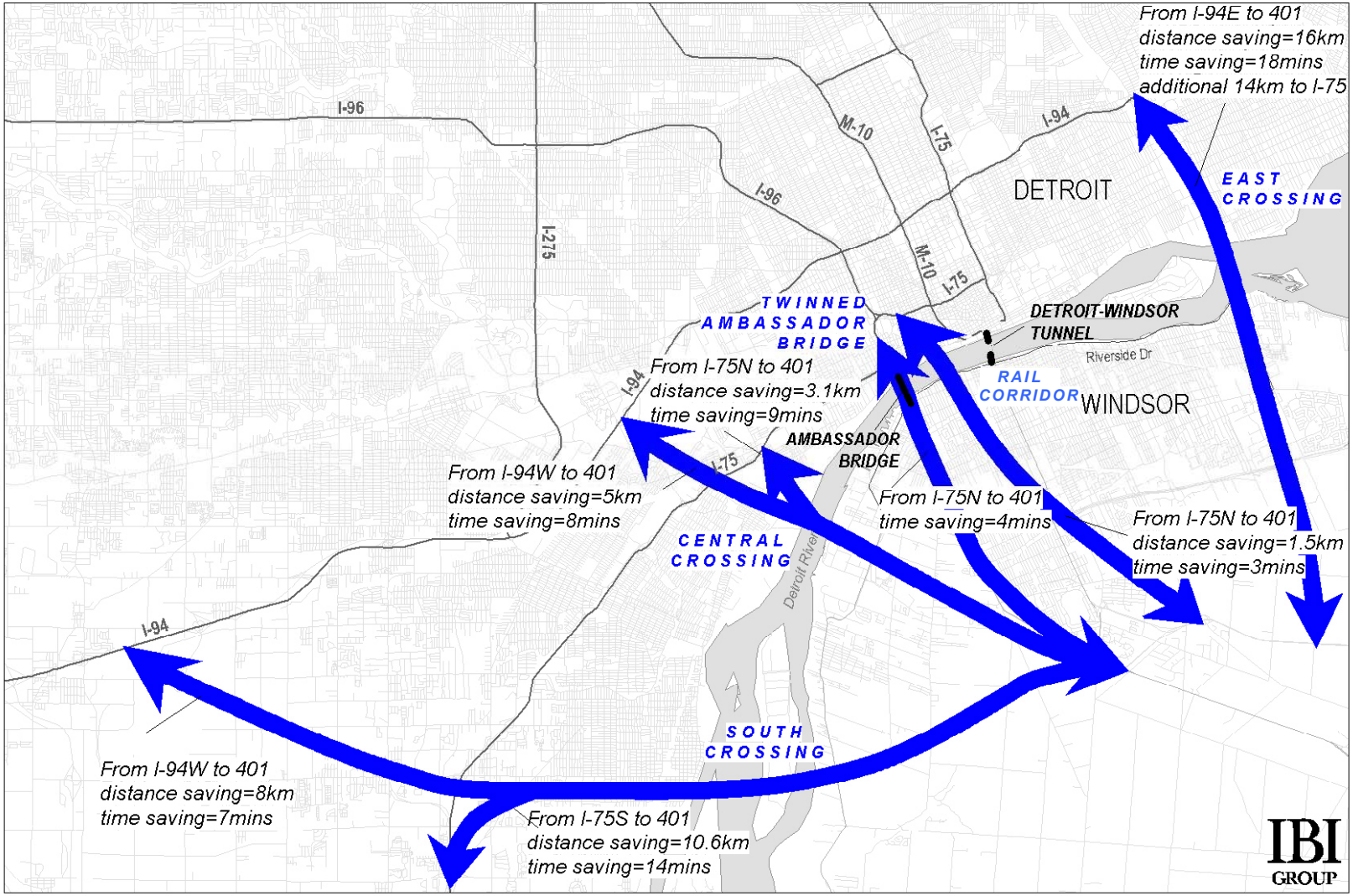


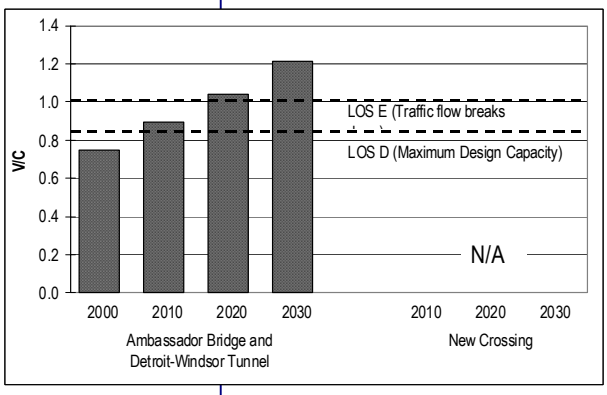
EXHIBIT 3 – COMPARISON OF ALTERNATIVES

2000															
	Existing Crossings Daily Volumes			New Crossing Daily Volumes			Roadbed V/C			Time savings (veh-h/day)			Distance Savings (veh-km/day)		
Name	Cars	Trucks	PCEs	Cars	Trucks	PCEs	Ex Crossings	New Cr	H-C Rd	Car	Truck	Vehicle	Car	Truck	Vehicle
Base Case	51,600	12,800	89,900	-	-	-	0.75	-	0.86	-	-	-	-	-	-
2010															
	Existing Crossings Daily Volumes			New Crossing Daily Volumes			Roadbed V/C			Time savings (veh-h/day)			Distance Savings (veh-km/day)		
Name	Cars	Trucks	PCEs	Cars	Trucks	PCEs	Ex Crossings	New Cr	H-C Rd	Car	Truck	Vehicle	Car	Truck	Vehicle
Base Case	59,200	15,800	106,500	-	-	-	0.89	-	1.00	-	-	-	-	-	-
Rail Corridor	59,200	4,900	73,900	-	10,900	32,600	0.70	0.63	0.67	11,780	250	12,030	900	11,300	12,200
East Crossing	52,700	15,000	97,600	6,500	800	8,900	0.82	0.10	0.93	12,390	80	12,470	13,900	600	14,500
Central Crossing	45,500	2,900	54,300	13,700	12,800	52,200	0.54	0.47	0.40	12,580	1,100	13,680	15,200	32,200	47,300
Twinned Ambassador Br	59,200	15,800	106,500	-	-	-	0.52	-	0.56	12,440	540	12,980	- 14,900	- 2,200	- 17,000
South Crossing	53,000	5,400	69,100	6,200	10,400	37,400	0.67	0.30	0.60	12,450	1,340	13,790	37,300	84,000	121,300
2020															
	Existing Crossings Daily Volumes			New Crossing Daily Volumes			Roadbed V/C			Time savings (veh-h/day)			Distance Savings (veh-km/day)		
Name	Cars	Trucks	PCEs	Cars	Trucks	PCEs	Ex Crossings	New Cr	H-C Rd	Car	Truck	Vehicle	Car	Truck	Vehicle
Base Case	65,200	20,500	126,700	-	-	-	1.04	-	1.10	-	-	-	-	-	-
Rail Corridor	65,200	6,000	83,200	-	14,500	43,500	0.80	0.79	0.76	19,650	380	20,030	1,500	7,700	9,200
East Crossing	58,000	19,400	116,300	7,200	1,100	10,400	0.95	0.12	1.05	20,270	120	20,390	17,600	700	18,400
Central Crossing	49,800	3,700	60,800	15,400	16,800	65,800	0.60	0.59	0.43	20,560	1,460	22,020	16,500	42,600	59,200
Twinned Ambassador Br	65,200	20,500	126,700	-	-	-	0.61	-	0.66	20,480	760	21,250	- 15,400	- 1,700	- 17,000
South Crossing	58,400	7,100	79,600	6,800	13,400	47,000	0.76	0.38	0.68	20,400	1,800	22,200	42,700	110,400	153,100
2030															
	Existing Crossings Daily Volumes			New Crossing Daily Volumes			Roadbed V/C			Time savings (Veh-h/day)			Distance Savings (veh-km/day)		
Name	Cars	Trucks	PCEs	Cars	Trucks	PCEs	Ex Crossings	New Cr	H-C Rd	Car	Truck	Vehicle	Car	Truck	Vehicle
Base Case	70,200	27,800	153,600	-	-	-	1.21	-	1.22	-	-	-	-	-	-
Rail Corridor	70,200	8,600	95,900	-	19,200	57,700	0.93	0.94	0.93	26,150	21,960	48,110	700	10,700	11,400
East Crossing	61,700	26,000	139,800	8,500	1,800	13,800	1.05	0.22	1.15	26,810	21,540	48,350	16,000	- 2,500	13,500
Central Crossing	53,600	5,000	68,600	16,600	22,800	85,000	0.67	0.73	0.49	27,130	23,440	50,570	16,000	57,100	73,100
Twinned Ambassador Br	70,200	27,800	153,600	-	-	-	0.71	-	0.77	27,100	22,520	49,620	- 17,800	- 2,100	- 19,900
South Crossing	63,000	9,600	91,800	7,300	18,200	61,800	0.86	0.48	0.79	26,970	23,960	50,930	44,100	147,700	191,800

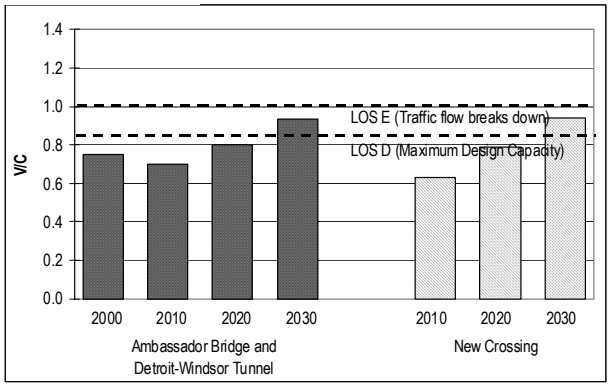
Note: From a roadbed capacity perspective, one truck is assumed to be equivalent to 3 passenger cars (1 truck = 3 PCEs).

EXHIBIT 4 – EXISTING AND PROJECTED ROADBED LEVEL-OF-SERVICE

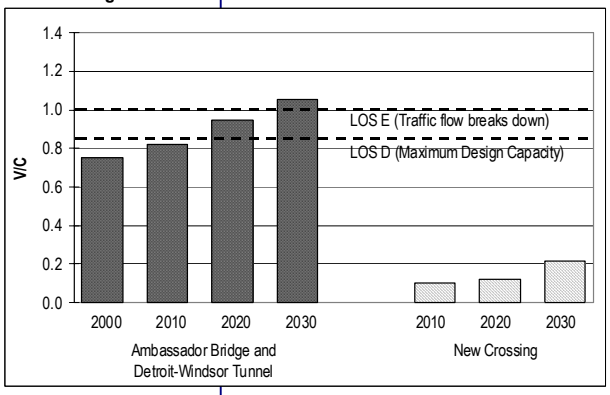
Base Case



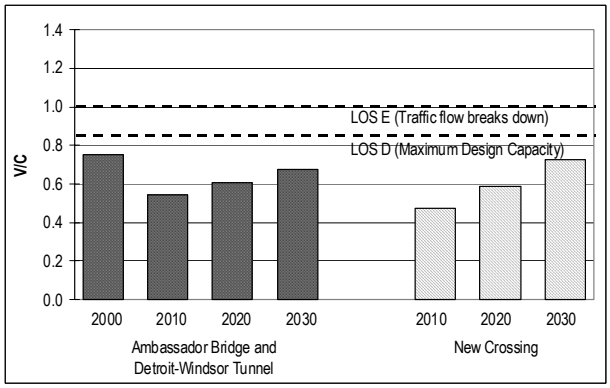
Rail Corridor



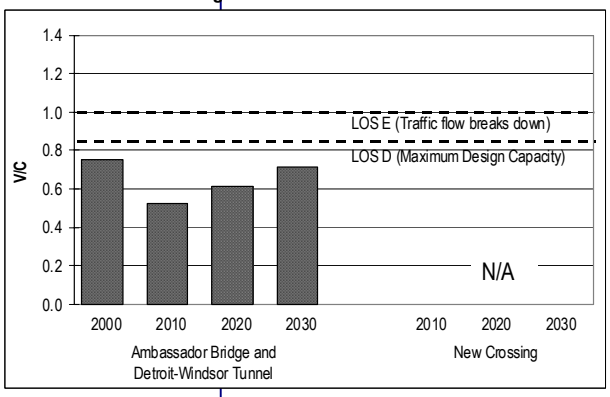
East Crossing



Central Crossing



Twinned Ambassador Bridge



South Crossing

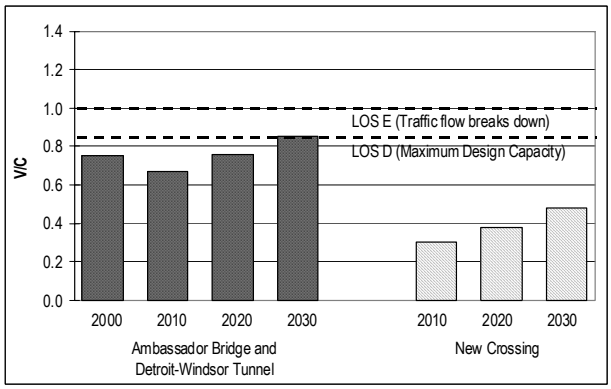
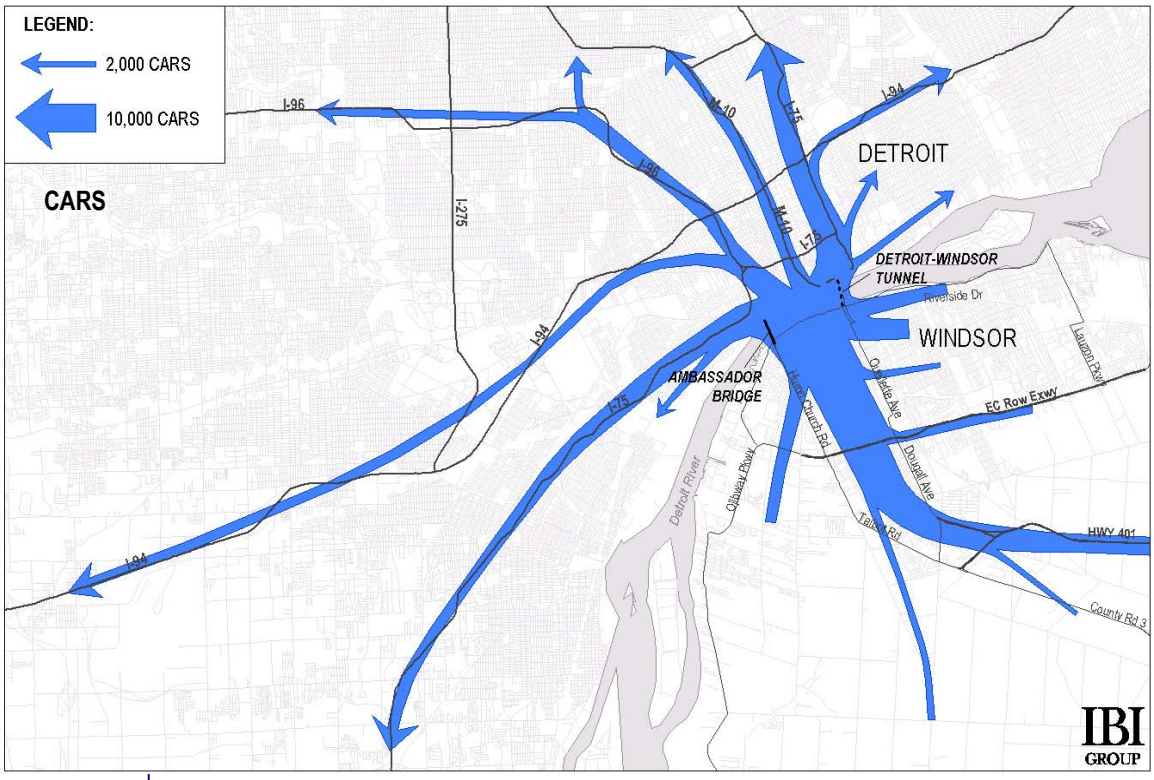
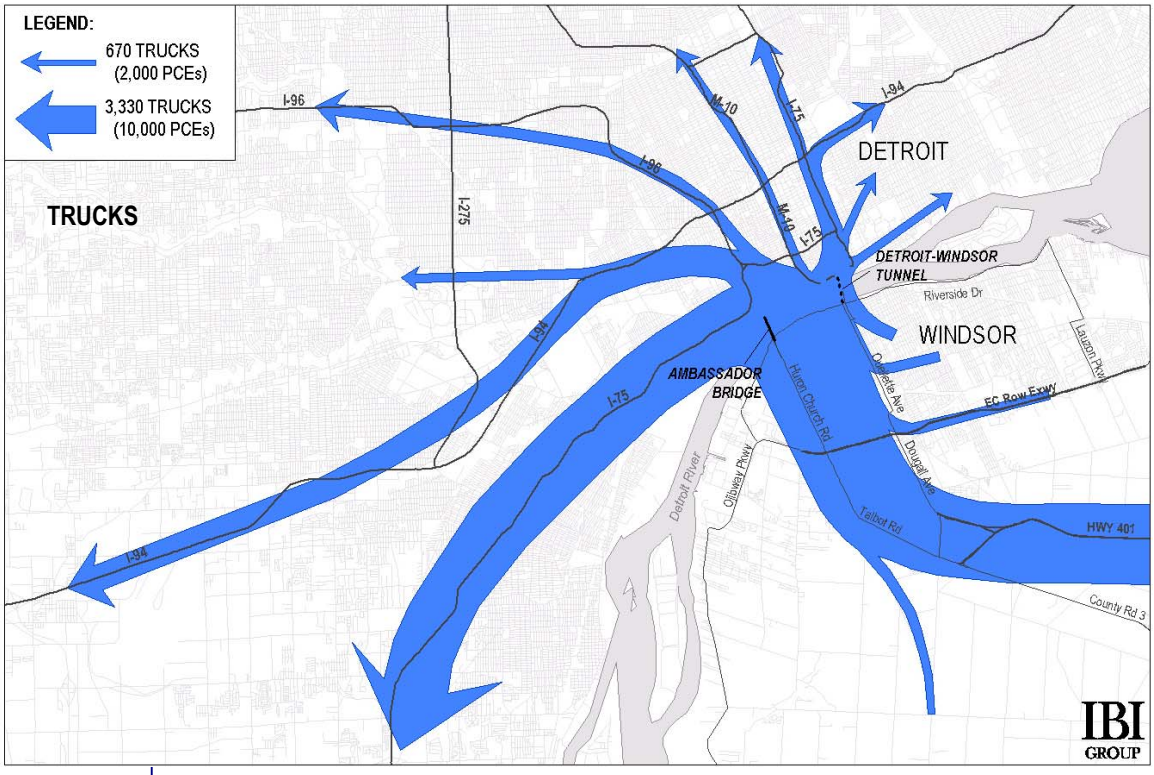


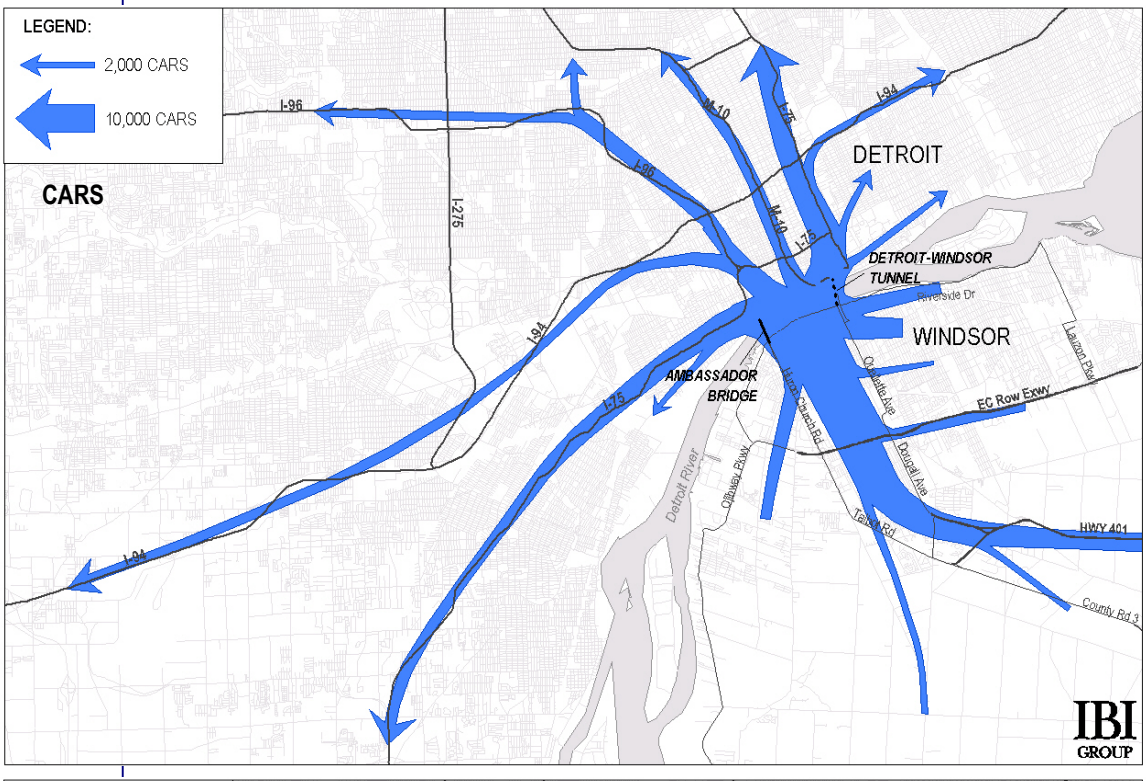
EXHIBIT 5 – BASE CASE, 2030 DAILY FLOWS

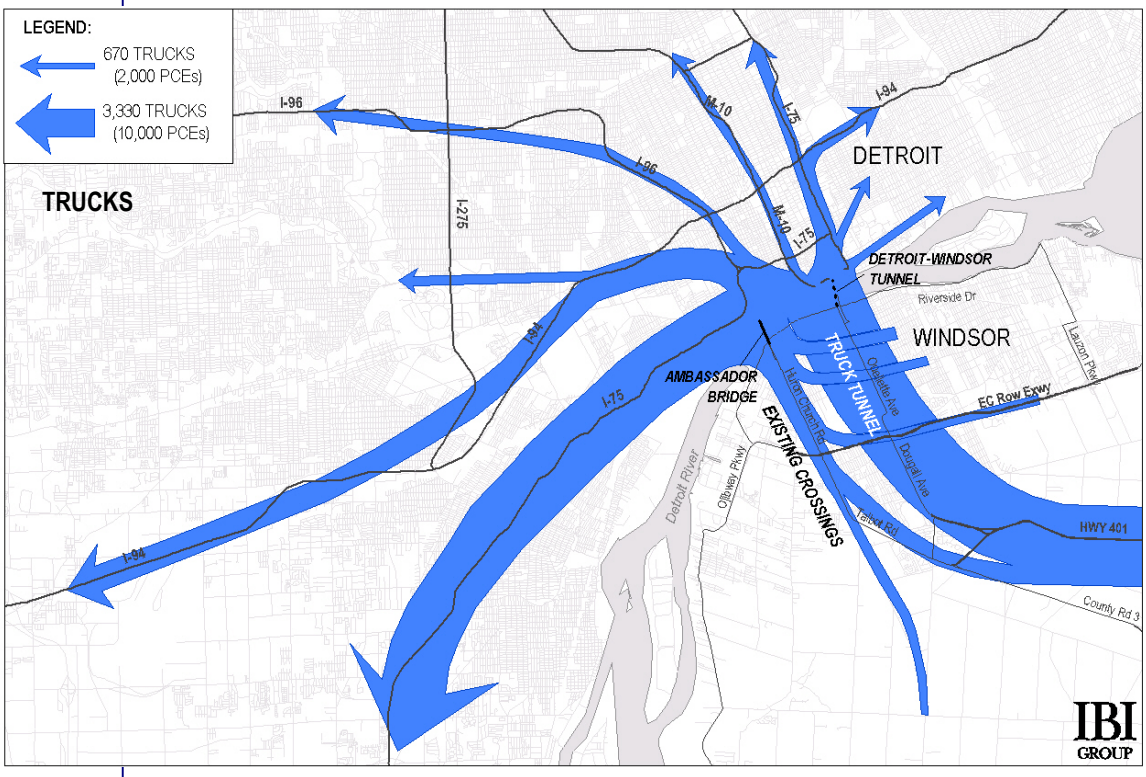




Note: 1 truck is assumed to be 3 passenger car equivalents.

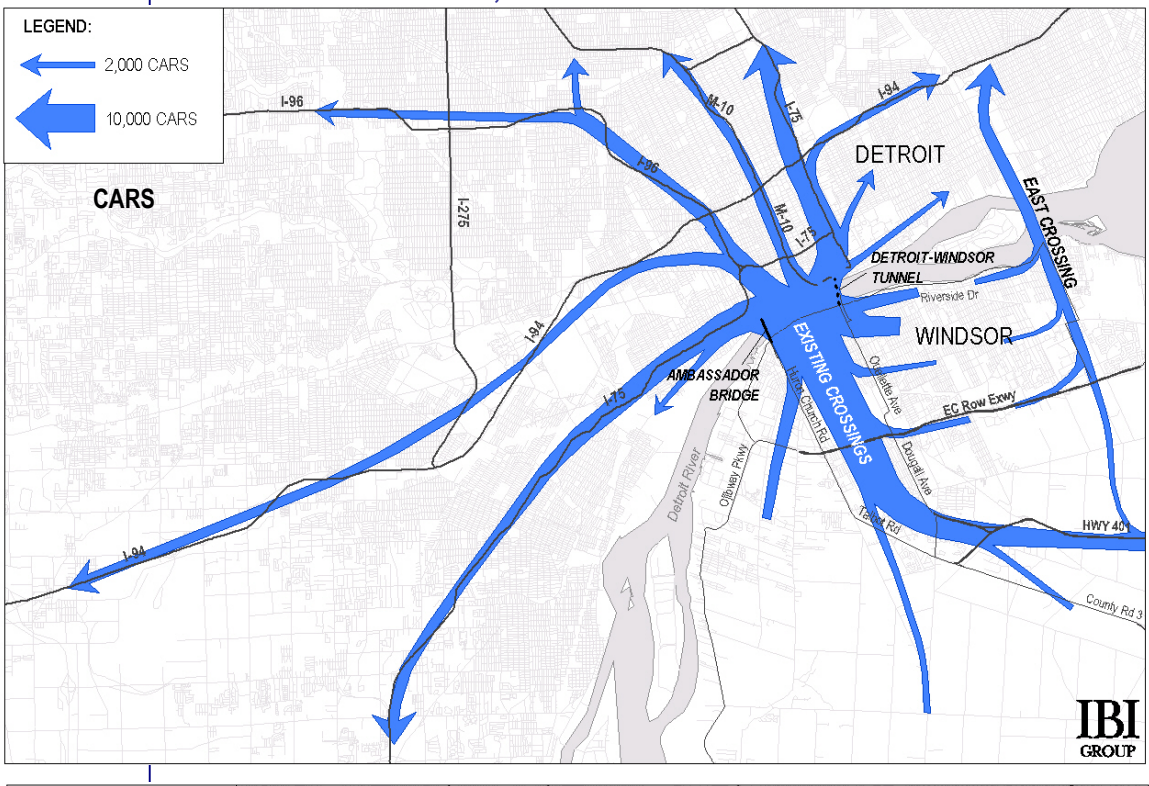
EXHIBIT 6 – RAIL CORRIDOR, 2030 DAILY FLOWS

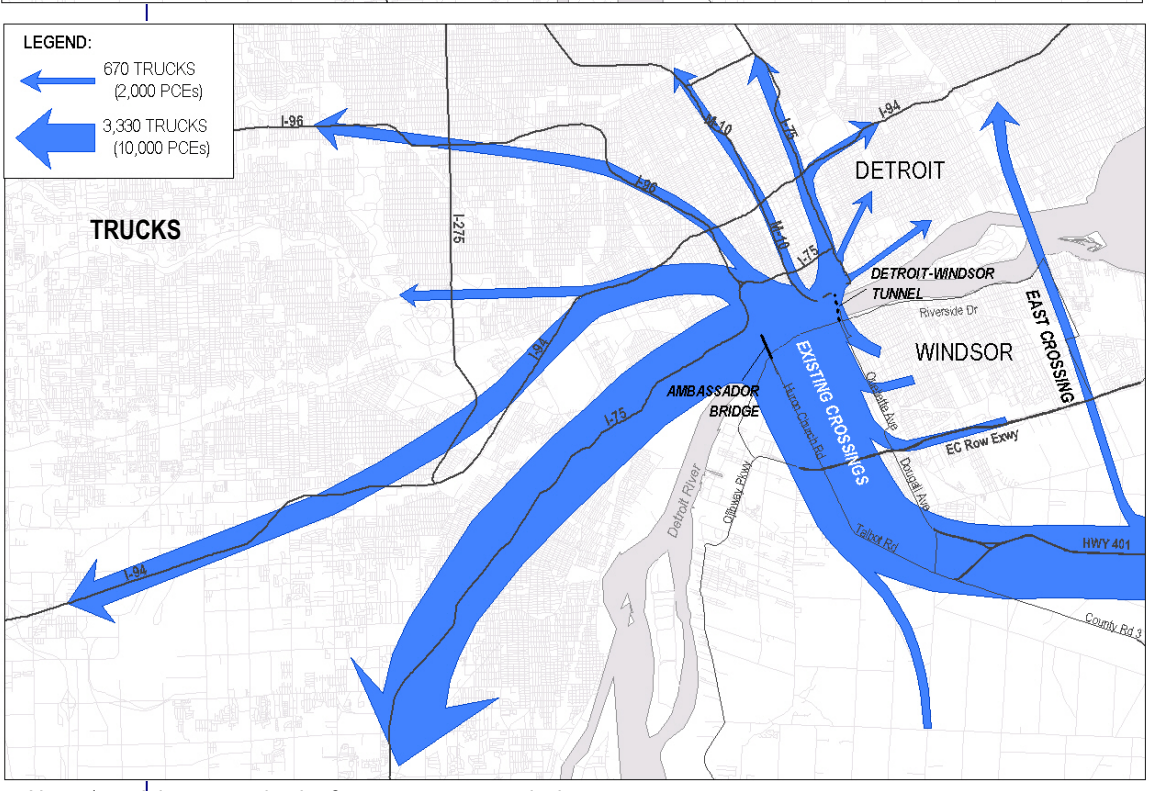




Note: 1 truck is assumed to be 3 passenger car equivalents.

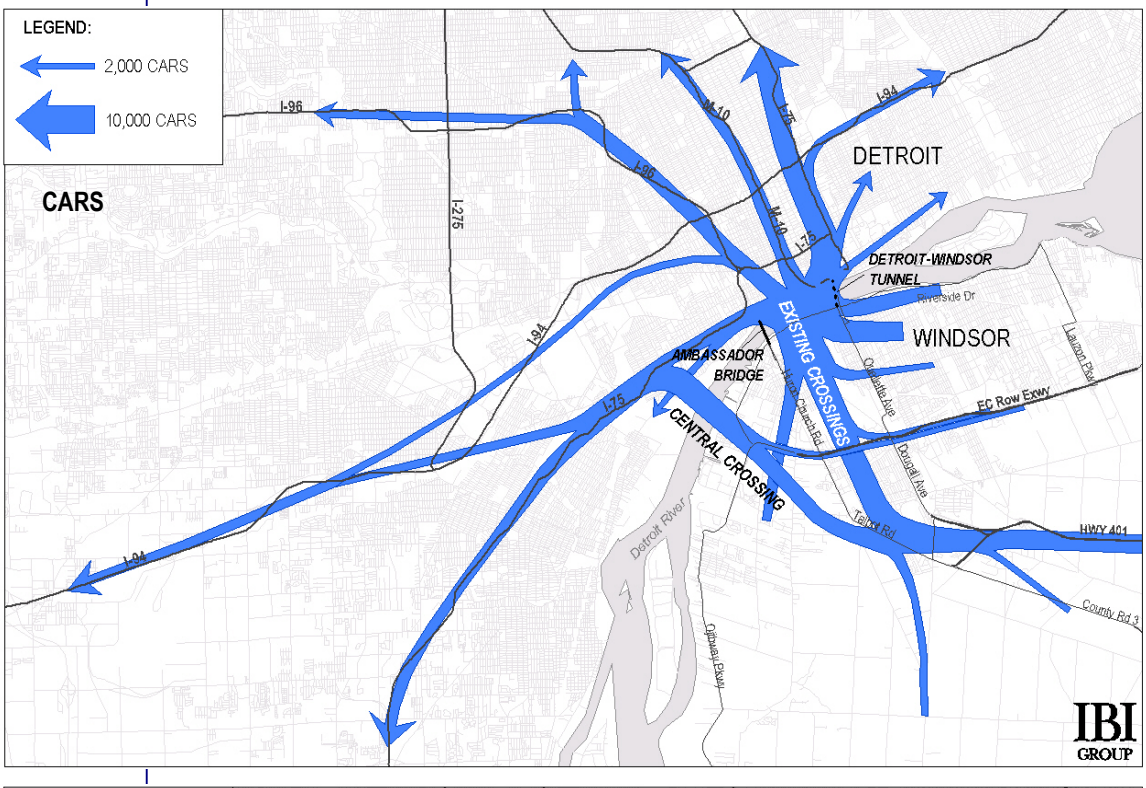
EXHIBIT 7 – EAST CROSSING, 2030 DAILY FLOWS





Note: 1 truck is assumed to be 3 passenger car equivalents.

EXHIBIT 8 – CENTRAL CROSSING, 2030 DAILY FLOWS



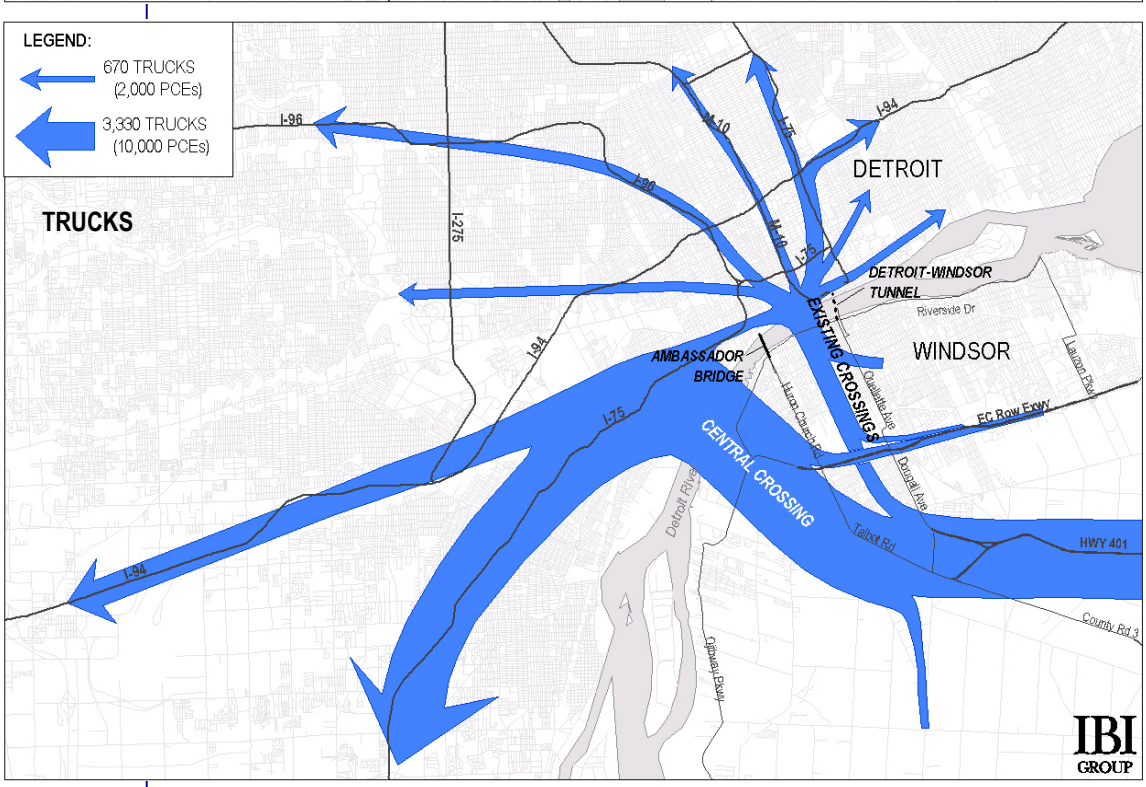
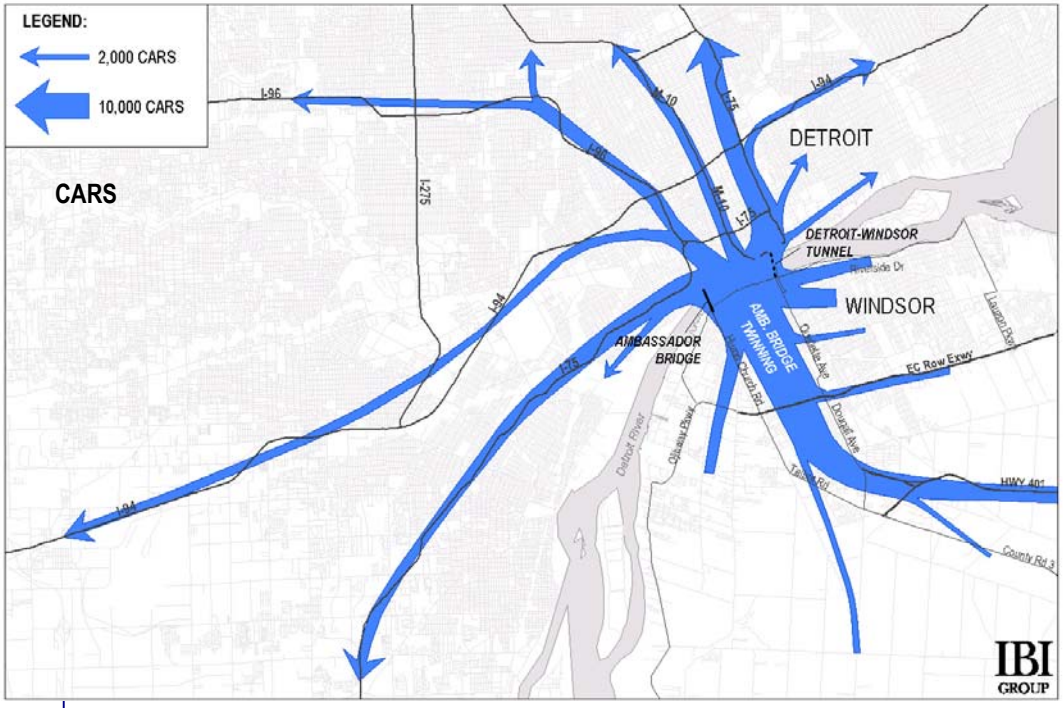
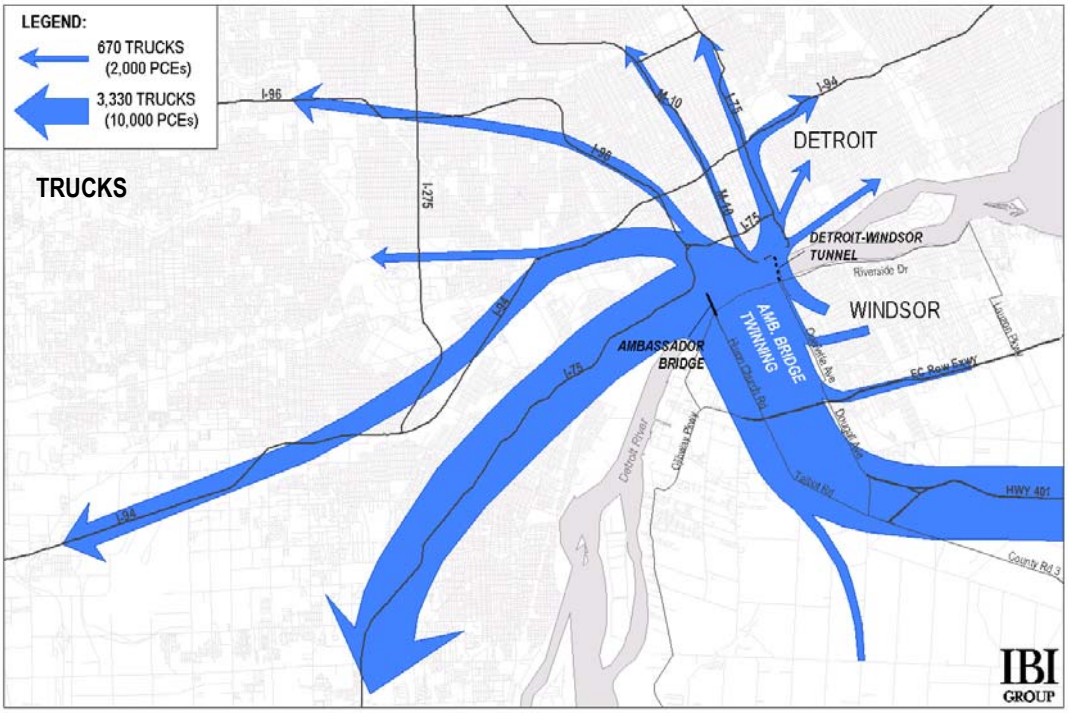


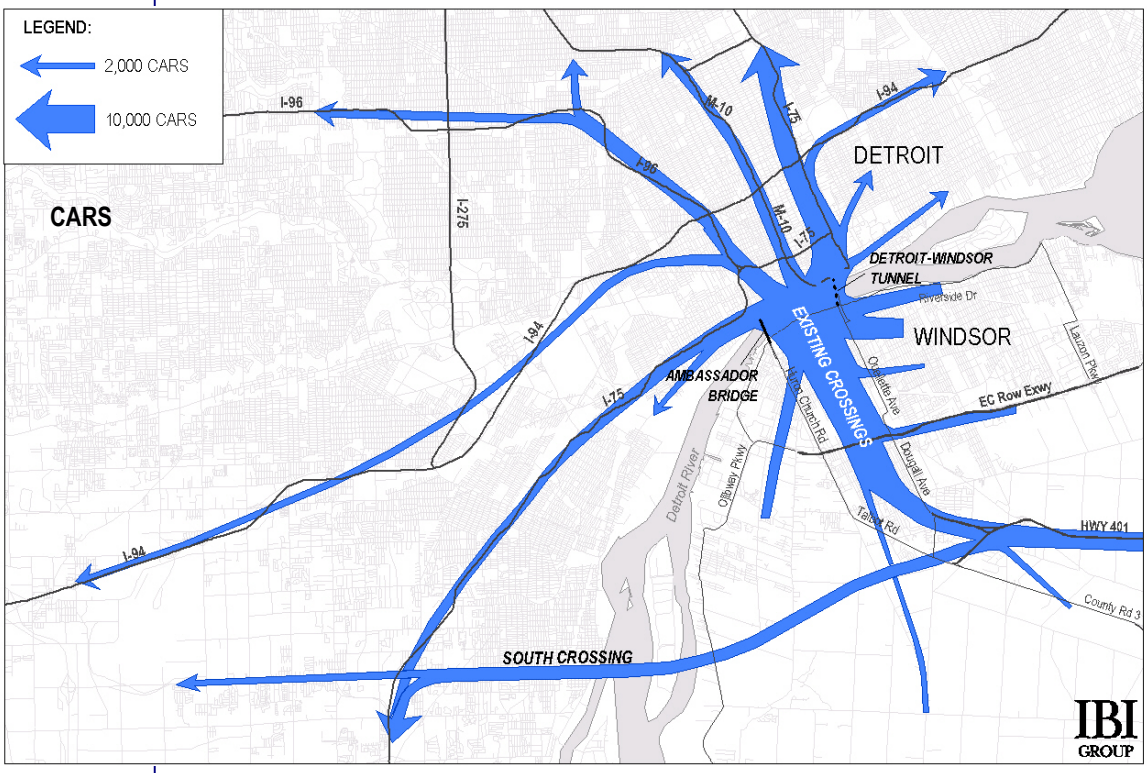
EXHIBIT 9 – TWINNED AMBASSADOR BRIDGE, 2030 DAILY FLOWS

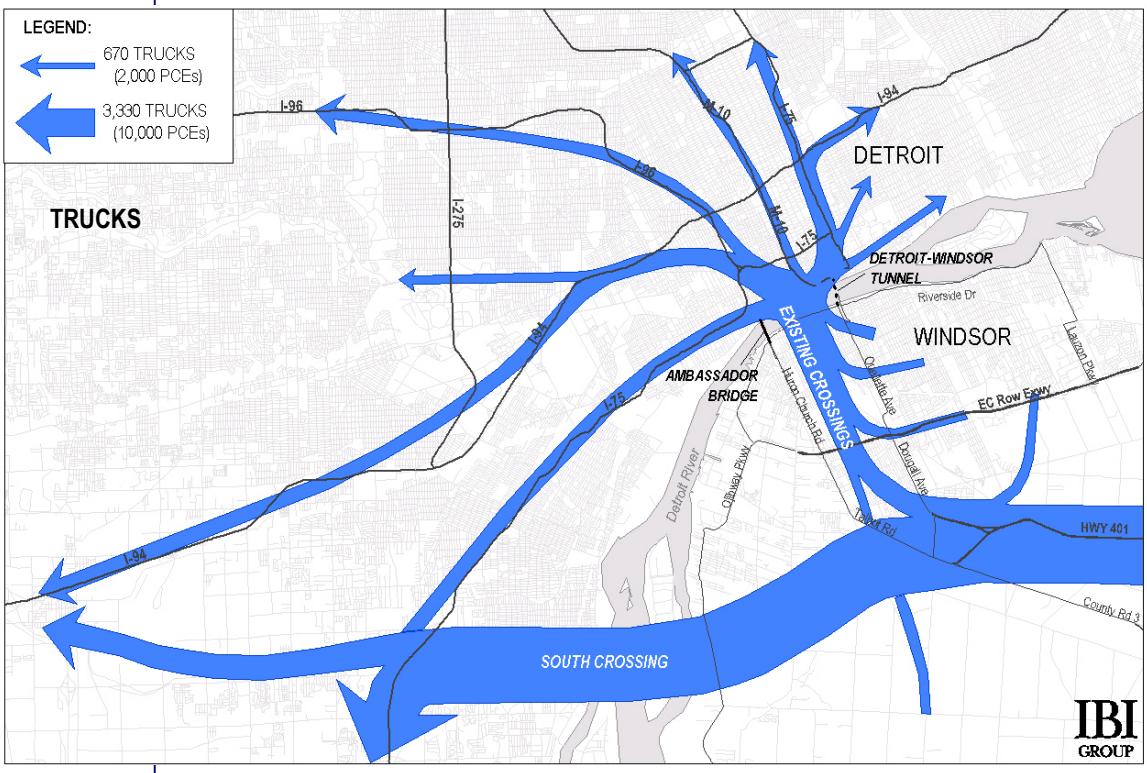




Note: 1 truck is assumed to be 3 passenger car equivalents.

EXHIBIT 10 – SOUTH CROSSING, 2030 DAILY FLOWS





Note: 1 truck is assumed to be 3 passenger car equivalents.

Base Case

Under the Base Case, future cross-border traffic is projected to significantly exceed the existing roadbed capacity of the Ambassador Bridge and Windsor-Detroit Tunnel with a V/C ratio of 1.46 in 2030, establishing a capacity need for a new crossing in the future. Based on LOS D, the need for a new crossing may be justified by the year 2010, when the projected V/C ratios for the Existing Crossings and Huron-Church Road are projected to be 0.89 and 1.00, respectively.

Exhibit 4 presents the travel flows under the Base Case Alternative, with the existing Ambassador Bridge and Detroit Windsor Tunnel to accommodate cross border traffic demands. In 2030, 70,200 daily car and 27,800 daily truck trips are projected at the Existing Crossings. The travel flows shown for the Base Case reflect the significant differences in the truck and car markets. The truck movements reflect longer distance travel with the predominant flows between Highway 401 and I-75/I-94. Approximately 75-80% of Ontario based truck traffic is from Highway 401, with the remaining 20-25% from the local Windsor area. Among cross-border truck traffic to the US, approximately 50% is destined to I-75 (South to Toledo and beyond), 20% to I-94 (West to Chicago), 25% to northerly directions via I-75, I-96 and M-10. Car traffic is much more local in nature with the predominant flows between Detroit and Windsor, as reflected in the car desire line flows. Approximately 20% of the Ontario based traffic is from Highway 401 with most of the remaining 80% from the local Windsor area. In Michigan, 12% of car traffic is oriented to /from I-75 and 8% to I-94, with most of the remaining 80% to the more centrally located road facilities that better accommodate shorter and more local cross-border trips.

Rail Corridor Alternative

The Rail Corridor Alternative tested provides one-truck lane of traffic in each direction and is projected to accommodate approximately 19,200 daily trucks in 2030. This provides much needed truck capacity that can indirectly benefit passenger car traffic, but is inadequate to provide the total capacity needed to accommodate the growth in demand to 2030, as reflected by a projected 2030 V/C ratio of 0.93 for the Existing Crossings, 0.94 for the Rail Corridor and 0.93 for Huron-Church Road.

Exhibit 5 displays the travel flows that are projected with the Rail Corridor Alternative that uses the existing CASO rail right-of-way and rail tunnel conversion. Given the higher speeds and controlled access to the Rail Corridor provided to/from Highway 401 and I-75, significant volumes of trucks are shown to use this alternative, with approximately 70% of daily cross-border truck traffic using the Rail Corridor. This alternative exclusively serves truck traffic.

East Crossing Alternative

The projected traffic for the East Crossing Alternative is the lowest among the alternatives, with a projected daily demand of 8,500 daily cars and 1,800 trucks in 2030, with a V/C ratio of only 0.22. Given this low diversion, the V/C ratio for the Existing Crossings is projected to be 1.06 and 1.16 for Huron-Church Road.

The car and truck travel flows associated with the East Crossing Alternative are shown in Exhibit 6. The truck traffic volumes are quite low compared to the other Alternatives, reflecting the relatively low truck travel movements between east Windsor and east Detroit, compared to the large, more westerly oriented flows between Highway 401 and I-75 (South to Toledo) and I-94 (West to Chicago). In 2030, the East Crossing Alternative is projected to only attract approximately 12% and 6% of the car and truck market, respectively. The longer travel distance of 14 kilometres (8.7 miles) for this movement compared to an Ambassador Bridge routing and the congestion on I-75 for east to west travel through central Detroit needed to reach I-75 and I-94 are the main reasons for the low truck volumes with the East Crossing. Also, truck trip destinations to the northeast that may be more conveniently accessed by an East Crossing may also reached via the Blue Water Bridge, which reduces the potential trips attracted to the East Crossing.

Central Crossing Alternative

The Central Crossing is projected to have the highest traffic among the alternatives, with an estimated 2030 daily traffic of 16,600 cars and 22,800 trucks. This translates to a 2030 V/C ratio of 0.73 and reduces the V/C ratio for the Existing Crossings to 0.67. The V/C ratio for Huron-Church Road is projected to be 0.49.

Exhibit 7 presents the travel flows associated with a Central Crossing Alternative located in the vicinity of E C Row/Ojibway Parkway in Windsor and Zug Island in Detroit. The location of the Central Crossing provides a balance between the westward pull of major truck movements to/from on I-75 (South to Toledo) and west on I-94 (West to Chicago) and the more central Windsor/central Detroit travel orientations associated with the major car movements. For travel between Highway 401 and I-75 (South to Toledo), the Central Crossing Alternative reduces the travel distance by approximately 3.1 kilometres (1.9 miles). For travel between Highway 401 and I-94 (West to Chicago), the distance savings is approximately 5 kilometres (3.1 miles). The ability of the Central Crossing Alternative to serve both car/truck and local/long distance trips results in a significant attraction of traffic while adequately meeting capacity requirements and level-of-service criteria. The Central Crossing Alternative can attract approximately 80% of the truck traffic crossing at Windsor-Detroit, effectively serving almost all cross-border truck traffic to/from I-75 (South to Toledo) and I-94 (West to Chicago). The remaining 20% of the truck traffic using predominantly the Ambassador Bridge is destined to and from northerly locations. In terms of cross-border car traffic, the Central Crossing can attract approximately 25% of this market, comprised largely the long distance car travel component and some local car travel.

Twinned Ambassador Bridge

The Twinned Ambassador Bridge Alternative provides a second span adjacent to the existing bridge, with a controlled access road from Highway 401 to the bridge. While the new roadway does not increase the travel distance for trips between Highway 401 and the crossing, it does increase the length of trips accessing the bridge from Windsor due to the limited number of freeway access points assumed. In 2030, this alternative is projected to have a V/C ratio of 0.67, indicating good utilization with adequate capacity to accommodate future growth and demand needs.

Exhibit 8 presents the travel flows under the Twinned Ambassador Bridge Alternative. Given the identical crossing location and similar access/egress road routings relative to the Base Case, the travel flows are similar to those described for the Base Case, as noted above. However, the additional capacity provided by the second span and the upgrade/improvements to Huron Church Road address the identified capacity deficiencies and satisfies the long-term needs for Windsor-Detroit cross-border traffic.

South Crossing Alternative

The South Crossing Alternative, due to a more southerly alignment and more direct connections to I-75, is able to serve a high portion of truck traffic, but a much less portion of the car traffic. The estimated travel distance savings for a trip from Highway to I-75 (South to Toledo) is 10.6 kilometres (6.6 miles), providing significant savings for long distance travel, but little benefit for local Windsor-Detroit travel. In 2030, approximately 7,300 daily cars and 18,200 daily trucks are projected for the South Crossing, with the V/C ratio estimated to be 0.48 for this new crossing. However, the projected 2030 V/C ratio for the Existing Crossings is estimated at 0.86 and just slightly above the level considered acceptable based on LOS D. The V/C ratio for Huron-Church Road is projected at 0.95.

The projected car and truck travel flows associated with the South Crossing Alternative are shown in Exhibit 9. This alternative can attract approximately 65% of the truck traffic crossing at Windsor-Detroit. The diverted truck traffic corresponds to approximately 12,500 daily trips to/from I-75 (South to Toledo) and approximately 5,500 daily trips to/from I-94 (West to Chicago). The movement from the South Crossing to I-94 was assumed to be made via an I-75/Eureka Road/I-275 routing, which would involve heavy truck movements on a local arterial road. (Improvements/upgrades to local roads and or designation of truck routes to I-94 will be assessed during the later planning stages). The car volumes projected to use the South Crossing Alternative are projected to be low, reflecting approximately 10% of the cross-border car trips in 2030. The car flows reflect largely long distance travel, similar to truck market for this crossing, travelling to/from I-75 (South to Toledo) and I-94 (West to Chicago).

Border Processing Delay

The Base Case assumes the current number of inspection booths at the Ambassador Bridge and Detroit-Windsor Tunnel and the border processing delay associated with the Base Case is estimated on this basis. The Alternative Improvements assume the required number of inspection booths to accommodate the projected cross border demands for cars and trucks, with the additional inspection booths considered part of the respective Alternative Improvements. For all alternatives, NEXUS and FAST lanes are assumed, which is estimated to reduce the average processing time for all cars from the current time of 35 seconds per car to 30 seconds by 2030 based on 25% NEXUS participation among cross border travellers. Average truck border processing times are estimated to decrease from 85 seconds per truck currently to 59 seconds by 2030 based on a 75% FAST participation. These border processing rates were determined in consultation with Canada Customs and Revenue Agency, Citizenship and Immigration Canada, United States Immigration and Naturalization Service and the United States Customs Service.

The estimated daily delays for cars and trucks for each horizon year for the Base Case assumed a full staffing of customs booths. Car delays at border inspection/processing are projected to increase significantly as traffic grows over the study horizon with a projected 11,700 daily hours of delay in 2010, 19,500 hours in 2020 and 25,700 hours in 2030. Truck delays at border inspection/processing are not projected over the period to 2020 based on full staffing of booths and the reduced processing times associated with the FAST program. However, projected truck delays at border inspection/processing are projected to be approximately 21,400 hours daily by 2030. The delays estimates are based on August traffic levels, which is the peak month in terms of daily combined car and truck traffic as expressed in PCE's. The peak month for truck traffic is in September and therefore the delays presented based on August traffic levels will underestimate peak truck delay conditions. The analyses to determine border inspection/processing booth requirements, as previously presented to the Partnership, have been based on the peak truck month of September.

Comparison of Alternatives

Based on the above analysis, the following provides a comparison of the alternatives based on a range of transportation measures.

Support Local Windsor Detroit Traffic

Approximately 80% of car traffic and approximately 25% of truck traffic is considered local, with both trip origin and destination within the Windsor-Detroit area. The Twinned Ambassador Bridge Alternative provides the greatest support for local and short distance travel between Windsor and Detroit, owing to its most central location. The Central Crossing Alternative will also serve local cross-border traffic, but adds approximately 3.1 kilometres (1.9 miles) for a local trip, compared to a routing via the Ambassador Bridge. The East and South Crossings do not support local traffic well, given the geographic distance from central Windsor-Detroit. The Rail Corridor does not address the need to support local passenger car traffic.

Support Long Distance Traffic

Approximately 20% of car traffic and approximately 75% of truck traffic is considered long distance traffic. The South Crossing Alternative best supports the long distance traffic as it provides the most direct and shortest distance connection between Highway 401 and I-75 Corridor (South to Toledo), which is the largest component of long distance travel passing through Windsor-Detroit. The Central Crossing Alternative rates next in supporting long distance travel, providing significant capacity and travel distance benefits. The Twinned Ambassador Bridge also rates well. The Rail Corridor and East Crossing provide lower travel distance and time benefits with a reduced ability to reduce cross-border congestion compared to the others noted above.

Relieve Congestion at Crossings

The Alternative Improvements represent potential new crossings to provide the capacity needed to off load the Existing Crossings and provide a satisfactory level-of-service for cross-border travel. Among the alternatives, only the Central Crossing and Twinned Ambassador Bridge Alternatives are able to divert sufficient traffic to reduce the V/C ratio for

the Existing Crossings to an acceptable level of below 1.0 by the year 2030. In 2030, the Central Crossing is projected to have a V/C ratio of 0.88, with the V/C ratio for the Existing Crossings under the Central Crossing Alternative decreases from 1.46 to 0.81. The South Crossing Alternative is very close to satisfying the level-of-service objectives, with a V/C ratio for the Existing Crossings at 1.03 in 2030. The Rail Corridor and East Crossing Alternatives do not divert adequate levels of traffic from the Existing Crossings and therefore do not address the capacity problem for cross-border traffic in Windsor-Detroit based on LOS D and congestion relief considerations.

Relieve Congestion on Huron-Church

All alternatives result in significant decreases in traffic on Huron Church Road; however, only the Central Crossing, Twinned Ambassador Bridge and South Crossing divert sufficient levels of traffic to attain LOS D on Huron Church Road in 2030.

Reduce Travel Time

Exhibit 1, shown previously, summarizes the overall daily time and distance savings for cross-border truck and car traffic. The travel time savings are calculated relative to the Base Case and include the impacts of increased capacity on access/egress roads, more direct travel and additional border processing capacity, as estimated above. The estimates presented only include the travel time savings incurred by cross-border travel, recognizing that there will also benefits to local traffic by diverting international traffic from existing local facilities to new facilities. The daily travel time savings range from approximately 44,000 to 51,000 daily vehicle hours in 2030 for the Alternative Improvements, translating to approximately 30 minutes per cross border trip. Given the large border processing delays associated with the Base Case, there is not a large variation in the relative daily travel time savings among the alternatives. However, the Central Crossing and South Crossing Alternatives provide the greatest time savings.

Reduce Travel Distance

The vehicle-kilometres of savings by alternative provides an additional transportation performance measure and an indication of the differences exclusive of the impacts of the border processing delays that mask the travel time differences among the alternatives. The South Crossing Alternative provides the greatest travel distance savings among the alternatives due to the large travel distance savings it can provide to trucks destined to I-75 Corridor and I-94 Corridor. In 2030, the savings are estimated at approximately 191,900 daily vehicle-kilometres (119,300 vehicle-miles). The Central Crossing provides the next highest savings at 73,100 daily vehicle-kilometres (45,400 vehicle-miles). The Rail Corridor and East Crossing Alternatives also provide marginal travel distance benefits. A net increase in distance travelled is estimated with the Twinned Ambassador Bridge Alternative, given the additional distance travelled by traffic from Windsor to the Ambassador Bridge. This is due to the limited number of access points assumed to a Huron Church freeway.

Summary

The transportation assessment of alternatives provides an indication of the relative strengths and weaknesses of each alternative based on the transportation measures presented. There is no clear overall best alternative, although the Central Crossing, South Crossing and Twinned Ambassador Bridge Alternatives appear more promising than the East and Rail Corridor Alternatives when assessed on an individual basis. The major findings of the transportation analysis include the following:

- The Twinned Ambassador Bridge and Central Crossing Alternatives best address the future network requirements projected for the Windsor-Detroit border crossings and satisfy future demand, based on LOS D.
- The Central Crossing Alternative provides better travel time savings and has a projected higher demand compared to the Twinned Ambassador Bridge Alternative. This is due to its more westerly location, which provides a shorter travel distance for the predominant truck travel flow between Highway 401 in Canada and I-75 Corridor and I-94 Corridor in the US.
- The South Crossing Alternative is projected to divert the highest levels of truck traffic from the Existing Crossings and provides the greatest travel time savings among the alternatives. In terms of car traffic, the southerly alignment does not well serve local Windsor to Detroit travel and therefore the South Crossing is projected to attract very low traffic. The overall traffic diversion from Existing Crossings is lower than the Central and Twinned Ambassador Bridge Alternatives, but is sufficient to satisfy future network requirements to approximately 2030 based on LOS D.
- The Rail Corridor provides significant travel time benefits to cross-border truck traffic and will attract significant truck volumes, indirectly benefiting passenger car traffic. However, the additional two-lanes of traffic provided with the tunnel does not meet future network requirements and the 30-year demand need. It will need to be implemented with a second new crossing if the Rail Corridor is to be part of a 30-year strategy for the border crossing.
- The East Crossing is projected to attract low cross border car and truck traffic over the study horizon and is not able to meet future network requirements.

Appendix A – Attachment A:
Capacity and Network Assumptions

Attachment A – Capacity and Network Assumptions

For the purpose of assessing existing and future capacity deficiencies for the Southwestern Ontario-Southeastern Michigan border crossing facilities, and presenting volume to capacity ratios, the maximum capacity of the facilities was used. Maximum capacity was taken as the upper range of capacity corresponding to Level of Service (LOS E). While this approach is appropriate for documenting deficiencies with the existing infrastructure, it is not appropriate for sizing new infrastructure. That is, one would not plan for new facilities to operate at LOS E. For planning purposes, the study team decided to use LOS D to determine future infrastructure requirements.

This memo documents the development of capacities corresponding to LOS D and compares this to the maximum capacity estimates used in the Existing and Future Travel Demand Report. Network assumptions in terms of number of lanes, facility speeds are also presented for the crossings and access/egress roads and highways.

Border Crossing Facilities (Bridge and Tunnel)

Procedures for estimating bridge and tunnel crossing capacities are described in the Travel Demand Process Working Paper. As described in that report, roadbed capacities were estimated using procedures set out in the Highway Capacity Manual (HCM 2000). The same approach was used to estimate values for LOS. Exhibit 1 provides a comparison of the two sets of values.

For the Ambassador Bridge, applying HCM procedures, the maximum capacity for LOS D is 83% of the maximum capacity for LOS E. Accounting for rounding, the design capacity for a bridge facility would then be 1,450 passenger cars per hour per lane (pc/h/lane). Capacity estimates for the tunnel were carried out using the procedures for two-lane facilities, which differ in methodology with those for multi-lane facilities. For two-lane facilities, LOS criteria is based on average speeds and percent time spent following. As a result, maximum service flow rates for LOS D are substantially less than those for maximum capacity LOS E. It was felt that the criteria for LOS D for two-lane highways would not be appropriate for designing a new tunnel. Therefore, the capacity for LOS D for the tunnel reflects a reduction from LOS E the same as the bridge – 83%.

EXHIBIT 1: MAXIMUM CAPACITY AND DESIGN CAPACITY FOR BORDER CROSSINGS

Facility	LOS E	LOS D
Bridge	1,750 pc/h/lane	1,450 pc/h/lane
Tunnel	1,500 pc/h/lane	1,250 pc/h/lane
Capacity used to assess future lane requirements [1]	1,670 pc/h/lane	1,380 pc/h/lane

[1] Taken as the average capacity based on the existing facilities weighted by number of lanes.

Based on demand analyses and estimates of cross-border demand undertaken in the Existing and Future Travel Demand Working Paper, it was determined that 2 additional lanes in each direction were required to satisfy the future cross-border traffic growth needs over the study horizon. As such, all new crossing alternatives were assumed to be 4-lane cross-sections for model assignment purposes, with a 2-lane facility (1 lane per direction) used for the Rail Corridor, consistent with the design that has been proposed. It may be determined that, to provide flexibility for future (beyond 2030) requirements, a new crossing may be built initially as a 6-lane facility, but incorporating a six-lane crossing would not fundamentally change the results presented.

The average travel speed on new bridge crossings was assumed to be 60 km/h (40 mph) and 50 km/h (30 mph) for the Rail Corridor.

General Highway Sections

Within the transportation demand model used to determine deficiencies for the Existing and Future Travel Demand Report, freeway segments are coded with a capacity of 1,850 passenger cars per hour per lane. Based on the procedures for freeways outlined in the Highway Capacity Manual, the maximum capacity corresponding to LOS E at 100 km/hr is 2,300 passenger cars per hour per lane. Even with adjustments to account for lane widths, the capacities coded in the travel demand model would reflect a conservative capacity. As a result, no adjustments to the model capacities were made in determining the lane deficiencies for highway segments.

The number of highway lanes speeds, and locations of interchanges on access highways leading to new crossings is shown in Exhibit 2.

EXHIBIT 2: ACCESS HIGHWAY ASSUMPTIONS

Alternative	No. of Lanes	Speed km/h (mph)	Interchange Locations
Rail Corridor	2 (2-way)	80 (50)	Hwy 401, EC Row, I-96/I-75
East Crossing	4	100 (60)	Hwy 401, Division Rd., EC Row, I-94
Central Crossing	4	100 (60)	Hwy 401/Hwy 3, Ojibway Pkwy., EC Row, I-75
South Crossing	4	100 (60)	Hwy 401/Hwy 3, I-75
Twin Ambassador Bridge	4	90 (55)	Hwy 401, Howard Av., Cabana Rd., Grand Marais, EC Row, Tecumseh, and College with parallel service road.

Arterial Roads

The capacity of arterial roads is typically governed by the throughput of signalized intersections, which is in turn dependent on the ratio of green time to cycle time for the major movement. Within the transportation demand model used for this study, arterial lanes are coded with a capacity of 900 pc/h/lane. This capacity was compared to the northbound through movement capacity for 7 intersections on Huron Church Road, and was determined to represent a reasonable upper limit on lane capacity (i.e. corresponding to LOS E).

In order to develop an average capacity to reflect LOS D, the HCM procedures for multi-lane highways were used as guidance. For a 70 km/hr facility, the ratio of service flow rates between LOS E and D is 0.81 whereas an 80 km/hr facility has a ratio of 0.85. Consistent with the border crossing facilities described above, we have used a factor of 0.83 to reflect the difference between LOS E and LOS D. Therefore, the future lane requirements have been determined using a link capacity of 750 pc/h/lane.

The speeds assumed for access roads ranged from 60 to 80 km/h (35 to 50 mph).

Passenger Car Equivalent (PCE) for Trucks

Consistent with previous work, as documented in the Travel Demand Analysis Working Paper, a PCE factor of 3 was assumed for trucks based on a review of different approaches and discussions with the Modelling Group. Based on this approach, to estimate the capacity of a truck lane can be estimated by dividing the PCE capacity by 3.0. For the Ambassador Bridge, the truck lane capacity corresponding to LOS D would be 495 based on 1,450 passenger cars/hour/lane as shown in Exhibit 1.

The use of a PCE factor of 3 was uniformly applied to all truck trips on all facilities in the model as part of the trip assignment process to determine traffic volumes and diversions. Consideration was given to providing a lower PCE factor (1.5 to 2.0) for trucks on access highways to new crossings, given that no major grades would be encountered. A PCE 3 factor for crossings was originally justified based on the significant bridge/tunnel grades. However, it was decided not to try to adjust the model to reflect differential PCE factors, given the practical difficulties within a regional model framework and given that a 3 PCE factor is appropriate on arterial roads (e.g. Huron-Church) with many stop-starts associated with traffic signals and other disruptions. Also, assigned volumes on new access highways were examined and determined that a change of a PCE factor from 3 to 1.5 or 2 on these facilities would not make any appreciable difference in the assignment, given that sufficient spare capacity was available over the horizon year period.

Appendix A – Attachment B:
Border Processing Assumptions

Attachment B – Border Processing Assumptions

This attachment describes the assumptions used to estimate future border processing requirements with respect to customs and immigration inspection processing. The assumptions were determined in consultation with Canada Customs and Revenue Agency (CCRA), Citizenship and Immigration Canada (CIC) and US Customs Service (USCS) and US Immigration and Naturalization Service (US INS)[1].

Existing Infrastructure

The table below shows the number of inspection booths for the existing situation. It is understood that there are no committed plans to expand the number of booths in the short term. The Ambassador Gateway Project is a committed project, but it does not include commitments for expansion of the inspection area.

NUMBER OF INSPECTION BOOTHS - CURRENT

Facility	To Canada		To US	
	Autos	Trucks	Autos	Trucks
Ambassador Bridge	10/12*	10	12	9**
Detroit-Windsor Tunnel	9	2	9	3
Blue Water Bridge	12	7	8	5

* The regular number of auto booths is 10. When required in special circumstances, two truck booths can be converted to auto booths for a total of 12 booths.

** Nine booths are open for primary inspection. A 10th booth is used for trucks exiting from secondary inspection.

Existing and Future Processing Rates

Three time periods were considered in the development of processing times: i) a year 2000 condition corresponding to the base year travel demand data, ii) the situation as it existed in Fall 2002 and iii) a future situation reflecting the introduction of technological improvements to expedite border processing (e.g. NEXUS and FAST). The processing times for the year 2000 were required to calibrate the base year model. The processing times for the three situations are shown in the table below.

[1] USCS and US INS is now part of the US Department of Homeland Security.

EXISTING AND FUTURE PROCESSING TIMES

Facility	To Canada		To US	
	Autos	Trucks	Autos	Trucks
Base Year (2000)	25	75	30	85
Existing (Fall 2002)	33*	75	35	85

Auto Processing Times

Average future auto processing times were determined by examining the anticipated NEXUS and non-NEXUS markets and applying respective processing times for each category. For NEXUS users, a processing time of 15 seconds was assumed. Non-NEXUS processing times are expected to be similar to the Fall 2002 condition was estimated at 35 seconds. The assumptions and process used to develop average future processing times for auto is shown in the table below. Based on the travel surveys, about 50% of the peak period traffic at the Detroit-Windsor crossings is work-related. Of this traffic, it was assumed that about half of the travellers would enrol in NEXUS over the longer term or 25% of traffic by 2030, with 15% by 2010 and 20% assumed in the intervening years. This ramp-up reflects approximately 15% NEXUS use at present during peak periods at the Ambassador Bridge.

DEVELOPMENT OF AVERAGE FUTURE AUTO PROCESSING RATES

Autos	Horizon Year			
	2002	2010	2020	2030
Distribution				
NEXUS	-	15%	20%	25%
Non-NEXUS	100%	85%	80%	75%
Processing Times				
NEXUS	-	15	15	15
Non-NEXUS	25-35*	35	35	35
Weighted Time	**35**	**32**	**31**	**30**

Truck Processing Times

The process used to develop average future truck processing times is similar to cars as outlined on the previous page. The processing time of 50 seconds for FAST vehicles is based on 33 seconds for inspection and an 18 second allowance for stops and starts, rounded to 50 seconds.

DEVELOPMENT OF AVERAGE FUTURE TRUCK PROCESSING RATES

Trucks	Horizon Year			
	Pre-FAST	2010	2020	2030
Distribution				
Non-PARS	25%	25%	25%	25%
PARS	75%	15%	5%	0%
FAST	0%	60%	70%	75%
Processing Times				
Non-PARS	85	85	85	85
PARS	85	85	85	85
FAST	50	50	50	50
Weighted Time	**85**	**64**	**61**	**59**

The reason that non-PARS times are the same as PAR times is that many non-PAR vehicles are diverted to secondary inspection, in which case primary inspection times are relatively low.

Future Requirements

Future inspection booth requirements were estimated by dividing future peak hour demand estimates by the hourly processing rates corresponding to the above vehicle inspection times. The results are shown in the table below.

FUTURE BORDER INSPECTION REQUIREMENTS

	Demand				Existing	Required Total Booths			Additional Booths		
	2000	2010	2020	2030	Booths	2010	2020	2030	2010	2020	2030
Ambassador Bridge											
Autos and Other to US [1]	1236	1459	1641	1772	12	13	15	15	1	3	3
Autos and Other to Canada [1]	1616	1908	2145	2317	10	17	19	20	7	9	10
Trucks to US (Truck Peak Hr)	357	438	570	787	9	8	10	13	-	1	4
Trucks to Canada (Truck Peak Hr)	415	515	669	891	10	10	12	15	-	2	5
Detroit-Windsor Tunnel											
Autos and Other to US [1]	965	1075	1154	1239	9	10	10	11	1	1	2
Autos and Other to Canada [1]	1226	1366	1466	1575	9	13	13	14	4	4	5
Trucks to US (Truck Peak Hr)	40	51	68	95	3	1	2	2	-	-	-
Trucks to Canada (Truck Peak Hr)	44	54	68	87	2	1	2	2	-	-	-
Blue Water Bridge											
Autos and Other to US [1]	610	708	790	851	8	7	7	8	-	-	-
Autos and Other to Canada [1]	711	825	921	993	12	8	8	9	-	-	-
Trucks to US (Truck Peak Hr)	207	256	340	477	5	5	6	8	-	1	3
Trucks to Canada (Truck Peak Hr)	177	217	281	376	7	4	5	7	-	-	-

[1] Buses and other vehicles are included as 2 passenger car equivalents. Buses and other vehicles are less than 1% of volumes.

Secondary Inspection Requirements

Secondary Inspection requirements for trucks were estimated using the following diversion rates for trucks:

SECONDARY INSPECTION VARIABLES

Facility	Diversion Rates		Inspection Times (min)	
	To Canada	To US	To Canada	To US
Ambassador Bridge	30%	20%	60	45
Detroit-Windsor Tunnel	40%	40%	60	45
Blue Water Bridge	12%	20%	45	30

These diversion rates are assumed to remain constant over the planning period.

The table below shows the impacts of future increases in truck traffic on secondary processing capacity based on the above diversion rates.

FUTURE SECONDARY INSPECTION REQUIREMENTS

	Demand				Existing	Capacity Shortfall			
	2000	2010	2020	2030	Capacity	2000	2010	2020	2030
Ambassador Bridge									
Trucks to US (Truck Peak Hr)	357	438	570	787					
Trucks to Canada (Truck Peak Hr)	415	515	669	891					
Trucks to US (Secondary Volumes)	107	131	171	236	110	-	21	61	126
Trucks to Canada (Secondary Volumes)	83	103	134	178	100	-	3	34	78
Detroit-Windsor Tunnel									
Trucks to US (Truck Peak Hr)	40	51	68	95					
Trucks to Canada (Truck Peak Hr)	44	54	68	87					
Trucks to US (Secondary Volumes)	16	20	27	38	20	-	0	7	18
Trucks to Canada (Secondary Volumes)	18	22	27	35	20	-	2	7	15
Blue Water Bridge									
Trucks to US (Truck Peak Hr)	207	256	340	477					
Trucks to Canada (Truck Peak Hr)	177	217	281	376					
Trucks to US (Secondary Volumes)	41	51	68	95	45	-	6	23	50
Trucks to Canada (Secondary Volumes)	21	26	34	45	100	-	-	-	-