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Inter-Office Memo

To:	Henrik Zbogar Adrian Smith	Date:	April 27, 2004
From:	Jim Gough / Serdar Oncel	Job. #	16-02083
Subject:	Methodology of calculating volume to capacity (v/c) ratios	CC:	

This memo summarizes the methodology and steps followed to calculate volume to capacity (v/c) ratios across screenlines as part of the TTMP.

Each screenline summarized on the v/c table includes several road locations. Major roads crossing each screenline were included, to the extent possible. Travel in both directions along the links was taken into consideration, although the peak direction results formed the basis for road needs.

The cells were linked to another worksheet where the link volumes (assigned by the model), link capacities and number of lanes were stored. The columns referring to "i" and "j" nodes were used to provide link between the worksheets.

1. "ADJUSTED" LINK VOLUMES

The v/c ratios were calculated based on the "adjusted" link volumes. The "adjustment" is the difference (plus or minus) between the link volumes assigned by the model and the existing site count data provided by the City; this is the "error term". The error terms were calculated and applied to all horizons. This assumes that the model would commit the same approximate error for each run. The site counts peak period data was converted to peak hour data for most of the screenline locations. For locations without base year site count data, it was not possible to calculate the error term.

2. ADJUSTMENT FOR TRUCKS AND BUSES

The adjusted link volumes represent auto volumes only. In order to reflect the impacts of buses and trucks, we assumed the following:

1) An average of 12% additional truck volumes for each screenline. This average percentage is intended to reflect the future truck volume (possible reduction on truck volumes on some corridors)
2) Buses with five minutes headway on major arterials and 10 minutes headway on minor arterials (12 buses per hour on major arterials and six buses on others, respectively).

3. CALCULATION OF ADDITIONAL LANE REQUIREMENTS

Based on the v/c ratios calculated following the procedure described above, the additional number of lanes required was calculated. The main criterion for this calculation was a v/c ratio of 0.90, which was used to represent the limit for acceptable operations on the road link. We identified the road links where additional lanes are needed in order to maintain the v/c ratio under 0.90. On some links the total number of lanes in both directions exceeded the allowed width within the right-of-way (ROW). Given that the numbers of additional lanes would not be implemented, a column displaying an "adjusted" number of additional lanes was included in the spreadsheet. The basis of these "adjusted" numbers was to provide maximum of six-lane cross-section following the ROW allocations outlined in the City's Official Plan.

As shown in the v/c tables, not all roads requiring additional lanes had the maximum six-lane cross-section; it is important to note that the additional lanes were incorporated based on the extensive discussions between the City's planning/engineering staff and the study team. The unavailability of property and high cost of land acquisition were the major constraints preventing the widening of many congested roads to six lanes. As a result, the overall v/c ratios on some screenlines could not be reduced to acceptable operating level.

The same process was applied for each horizon year.

4. TRANSIT ADJUSTMENT

Following these steps, we incorporated the capacity provided by the recommended High Occupancy Vehicles (HOV) lanes and/or Reserved Bus Lanes (RBL), which were defined within the transit framework. The associated capacities were provided by ENTRA Consultants. The following list outlines the capacities incorporated into the v/c table:

Capacities of Recommended Transit Improvement (in persons per hour per direction):

2011

BRT Services

Main Street	: 1,800
Queen Street	: 1,800

HOV Lanes

Kennedy Road	: 1,100
Dixie Road	: 720
Torbram Road	: 720
Bovaird Drive	: 720
Steeles Avenue	: 1,800

2021

BRT Services

Main Street	: 1,800
Queen Street	: 1,800

HOV Lanes

McLaughlin Road	: 720
Kennedy Road	: 1,100
Dixie Road	: 1,100
Airport Raod	: 1,100
Torbram Road	: 1,100
Bovaird Drive	: 720
Steeles Avenue	: 1,800

We used the same capacities for 2031 as in 2021 (details of calculation is explained below through an example).

The transit capacities (in person trips) were first converted to the equivalent of vehicle trips using an average vehicle occupancy (1.15). Wherever the transit services and HOV lanes were recommended, the vehicle (per lane) capacity was subtracted from the total road capacity and the converted transit capacity (per lane) was added instead. In most cases total capacity of the road has increased, but in some cases the transit services recommended for that particular corridor did not provide extra capacity.

Transit capacities provided by ENTRA Consultant were based on their extensive experience and discussed with Brampton Transit. Here are the basics of the transit capacity calculations:

- Person carrying capacity was based on the stated ranges of headways for AcceleRide/primary/secondary corridors: The minimum of each range was used in the calculation (since the figure was theoretical)
- Minimum headways were used to calculate vehicle per hour (VPH=60/H)
- Policy loading capacities were used to calculate total passenger:
    - Standard 40-foot bus: 60 passengers per vehicle in peak
    - 60-foot articulated bus: 90 passenger per vehicle in peak
- These policy capacities were applied to each VPH estimation
- In the scenarios between 2011 and 2021, headways were increased according to the proposed plans; artic buses were added to higher frequency routes.

For example:
Queen Street

- 2011 headway: 3 to 5 minutes (minimum 3 minutes headway was used)
- 3 minutes headway equates to 20 vehicles per hour in each direction
- Assumed vehicle: 60-foot artic - 90 passengers per vehicle

Thus, total capacity per direction was calculated as 20x90 = 1,800 persons

In general

- 3 minutes headway equates to 800 persons per hour with standard bus, 1800 per hour with artic bus
- 5 minutes headways equates to 720 persons per hour with standard bus, 1080 per hour with artic bus
- 10 minutes headways equates to 360 per hour with standard bus, 540 per hour with artic bus

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