

Appendix K

Capital Cost Estimates

Appendix K

Construction Cost Estimates for Proposed Transportation Infrastructure

1. Proposed Infrastructure

As part of the Transportation Master Plan and after extensive travel demand modelling for 2021 and 2031, numerous roadway and highway improvements were identified including road widenings, new roads to be constructed, improved or new highway interchanges, and railway grade separations proposed for safety and traffic reasons.

With respect to transit infrastructure, the Spadina subway extension is expected to reach Vaughan Metropolitan Centre (VMC) and be finished and operational by 2015, and the Yonge Subway is planned to be extended to the Langstaff Urban Growth Centre at Highway 7. In addition, an at-grade Bus Rapid Transit (BRT) facility is being implemented along Highway 7 and additional similar facilities are included in the TMP. A number of new GO Rail stations are also proposed, two along the existing Barrie line and 5 along the proposed service to Bolton. Finally, the proposed 407 Transitway is proposed to be a two-lane grade separated exclusive bus roadway.

All infrastructure costs for recommended TMP projects are included, not just those within the City's jurisdiction. Regarding improvements planned to extend beyond the City of Vaughan's boundaries, only the portion within the City is included in the costing.

2. Sources of Estimates and Unit Costs

Projects included in the TMP were grouped into infrastructure categories and unit costs developed for each category, either a per kilometre unit cost or in the case of some (e.g., freeway interchanges) a lump sum.

The unit costs and lump sums that were used in estimating the construction of these infrastructure types were taken from the best available sources. Below, is the list indicating the appropriate unit cost or lump sum and where each was obtained in an effort to get to the total construction cost for the Vaughan TMP as shown subsequently in **Tables K.1 and K.2** and which are reproduced in Exhibits 7.1 and 7.4 contained in the main body of the report.

Highways and Roads:

The costs of highways and roads included in Tables K.1 and K.2 and Exhibits 7.1 and 7.4, and proposed as part of the overall City of Vaughan improvement plan were taken from multiple sources for each roadway category as follows:

- **Provincial Freeways:**

- ▶ **New 6-Lane Freeways and Interchanges:**

The total cost for the Highway 427 extension was estimated at \$300 million, and this cost was taken from the 427 Transportation Corridor Environmental Assessment Report prepared by MTO and found on the internet. It should be noted that the total cost included not only the construction costs, but also engineering, contract administration, and contingencies. The cost for new interchanges was based on the cost of the current King Road / Highway 400 interchange reconstruction estimated by MTO at \$41.3 million, and rounded up to \$42 million in our cost estimations.

- ▶ **Interchange Improvements:**

The cost for interchange improvements was taken as a lump sum of \$15 million that was based on an extensive search on MTO highway projects built in the GTA area. This cost is considered conservative.

- ▶ **Highway Widening:**

The unit cost per kilometre per lane from the Highway 427 extension was used to estimate the widening of Highway 400. A unit improvement cost of \$4 million per lane kilometre was used. It should be noted that the proposed improvement staging for Highway 400 is to widen the highway in the first phase from 8 to 10 lanes from Major Mackenzie Drive to Teston Road, and from 6 to 8 lanes from Teston Road to King-Vaughan Road. It is assumed that the highway will be widened from 8 to 10 lanes from Teston Road to King-Vaughan Road in a second phase.

- **Regional Road Improvements:**

- ▶ **New Regional Roads:**

In the Vaughan Transportation Master Plan, two new regional roadways are proposed – the Langstaff Road crossing of the CN yards and the Teston Road missing link between Keele and Dufferin Streets. An allocation of \$45 million for the Langstaff CN Rail Yard crossing was made given that it would be primarily grade-separated for a distance of 1.7 km, whereas Teston Road was estimated at approximately \$40 million for the total length of 2 kilometres, based on a 2003 EA estimate.

- ▶ **Regional Road Widening:**

Construction costs for Regional road widenings in the Western Vaughan study area were taken from the Western Vaughan Transportation Improvements Individual Environmental Assessment. From these, an overall average unit construction cost value of \$9.575 million per kilometre was calculated and applied for all widenings in the remaining Eastern part of the City (east of Highway 400). Assumed Regional road widenings are listed in **Tables K.3 and K.4** for both the 2021 and 2031 horizons. Appropriate adjustments have been made to the list, so as not to include 4-6 lane widenings to accommodate rapid transit projects, which have been costed separately in Table K.2.

- **City Road Improvements:**

- ▶ **New City (Local) Roads:**

New City roads are proposed in this TMP and will generally be implemented as new developments occur. The construction cost used for these roadways is \$5 million per kilometre for a 4-lane road and \$3.8 million per kilometre for a 2-lane road. These values were taken from other projects in York Region for which AECOM had prepared construction costs.

- ▶ **City Road Widenings:**

The cost of widening City roads from 2 to 4 lanes was also taken from previously completed projects by AECOM in York Region, and the value used is \$2.5 million per kilometre.

Rapid Transit Infrastructure

- ▶ **Subway Extensions:**

Toronto Transit Commission (TTC) has fully developed construction cost estimates for both subway line extensions, Yonge and Spadina, and these were available online. The cost values shown in the tables were reduced proportionally by distance to represent the cost of the part of the extension within the City.

- ▶ **VIVA RT Lines:**

A Bus Rapid Transit (BRT) construction cost estimate was provided directly by York Region Rapid Transit for the Highway 7 project. This provided the basis for a \$30 million per kilometre unit cost, which was also applied to the Dufferin / Bathurst line. To be consistent with York's TMP, the Major MacKenzie and Steeles lines were assumed to be LRT (at \$50 million per km), while the Jane line was assumed to initially be LRT south of Highway 7 (at \$50 million per km) and a phased project north of Highway 7 (initially built as BRT, but upgraded to LRT) using a base \$30 million per km, plus an upgrade to LRT cost of \$40 million per km.

- ▶ **New GO Rail Stations:**

A construction cost of \$4 million for each new GO Rail station was initially obtained from GO Transit, but a higher value of \$5 million was used to take into consideration special design requirements that may arise during the construction of these stations.

- ▶ **407 Transitway:**

A preliminary cost for the 407 Transitway was directly obtained from the Ministry of Transportation Ontario, which equated to \$60 million per kilometre.

- ▶ **New Railway Grade Separations:**

For projects west of Highway 400 and south of Nashville/Teston Road, the grade separation construction costs were taken from the Western Vaughan Transportation Improvement IEA. Based on these estimates, a lump sum figure of \$4.5 million was applied to projects in other areas of the City.

- ▶ **Car-pool / Park-n-Ride Lots:**

The construction costs of these two types of parking lots were assumed at \$2 million per site. This value was chosen from previous projects that were undertaken in York Region, and was rounded to the nearest million.

Table K.1 Construction Cost Estimates for Short & Medium Term (2011-2021) Projects

TMP Improvements	Per km or Unit Cost	Distance (km) within Vaughan or # of Units	Cost (in Millions)				
			Federal	Province	Region	City	Total
A Rapid Transit							
1 Spadina Subway Extension to VMC – On the Vaughan Side (expected completion by 2015)		2.4	\$195.0	\$243.0	\$352.0		\$790.0
2 Highway 7 BRT West to Pine Valley Drive	\$30M	14.0	\$140.0	\$140.0	\$140.0		\$420.0
3 GO Rail to Bolton (3 full + 2 urban stations proposed)	\$5M each	5		\$25.0			\$25.0
4 Additional GO Stations on Barrie Line (2 proposed)	\$5M each	2		\$10.0			\$10.0
B Highways and Roads							
1 Highway 427 Extension (including 3 new & 1 improved interchanges)		5.3		\$172.5			\$172.5
2 Highway 400 Widening		6.1		\$18.0			\$18.0
3 New Partial Interchange on ETR 407 at Martin Grove Rd.	\$25M	1		\$25.0			\$25.0
4 Highway 400 Interchange Improvements @ Steeles Ave., Highway 7 and Langstaff Road	\$15M each	3		\$45.0			\$45.0
5 New 400 Highway Crossings							
▶ 2 New Crossings (North Maple bridge and within the Highway 400 North Employment Lands)	\$15M Each	2			\$10.0	\$20.0	\$30.0
▶ Special Case – Colossus Crossing (south of Highway 7)	\$40M	1			\$13.3	\$26.7	\$40.0
6 Regional Road Widenings*							
▶ Regional Road Widenings – Western Vaughan	\$9.575M	23			\$240.0		\$240.0
▶ Regional Road Widenings – Eastern Vaughan	\$9.575M	19			\$182.0		\$182.0
7 New City Roads**							
▶ 4 Lanes	\$5M	11.5				\$67.5	\$67.5
▶ 2 Lanes	\$3.8M	3.0				\$19.0	\$19.0
8 City Road Widenings (2 Lanes to 4 Lanes)	\$2.5M	14.0				\$69.0	\$69.0
C New Railway Grade Separations (4)							
1 CP (Rutherford, Major Mackenzie)	\$4.5M each	2	\$4.5M		\$4.5M		\$9.0
2 CN (Rutherford, Langstaff)	\$4.5M each	2	\$4.5M		\$4.5M		\$9.0
D Active Transportation/TDM							
1 Cycling Paths/Facilities							
▶ Multi-Use Recreational or Boulevard Pathway (Class 1)	\$225K	210.9				\$47.4	\$47.4
▶ Bike Lane (Widening) / Paved Shoulder (Class 2)	\$150K	32.5				\$4.9	\$4.9
▶ Bike Lane (No Widening)	\$20K	54.4				\$1.1	\$1.1
2 Sidewalks and Pedestrian Paths	\$110K	15.5				\$1.7	\$1.7
3 Carpool Lots (10 sites) and Additional Park-n-Ride Lot	\$2M	11		\$10.00	\$11.00	\$1.0	\$22.0
Total			\$344	\$689	\$948	\$258	\$2,248

Note: * See text on page K-2 for assumptions.

** Excludes development driven local roads.

Table K.2 Construction Cost Estimates (2011-2031) for Full TMP

TMP Improvements	Per km or Unit Cost	Distance (km) within Vaughan or # of Units	Cost (in Millions)				
			Federal	Province	Region	City	Total
A Rapid Transit							
1 Spadina Subway Extension to VMC – north of Steeles Avenue (expected completion by end of 2015)		2.4	\$195.0	\$243.0	\$352.0		\$790.0
2 Highway 7 BRT West to Pine Valley Drive	\$30M	14.0	\$140.0	\$140.0	\$140.0		\$420.0
3 Yonge Subway Extension – north of Steeles Avenue		4.7	\$477.0	\$572.0	\$858.0		\$1,907.0
4 GO Rail to Bolton (3 full + 2 urban stations proposed)	\$5M each	5		\$25.0			\$25.0
5 Additional GO Stations on Barrie Line (2 proposed)	\$5M each	2		\$10.0			\$10.0
6 407 Transitway (From Highway 50 to Yonge Street)	\$60M	21.0		\$1260.0			\$1,260.0
7 Highway 7 BRT (Pine Valley to Highway 50)	\$30M	6.0	\$60.0	\$60.0	\$60.0		\$180.0
8 Major Mackenzie LRT (Bathurst to Weston portion)	\$50M	8.0	\$133.3	\$133.3	\$133.4		\$400.0
9 Jane Rapid Transit (Steeles to Major Mackenzie)	\$67M	8.0	\$178.7	\$178.7	\$178.6		\$536.0
10 Dufferin/Bathurst Rapid Transit (Steeles to Gamble)	\$25M	12.0	\$100.0	\$100.0	\$100.0		\$300.0
B Highways and Roads							
1 Highway 427 Extension (including 3 new & 1 improved interchanges)		5.3		\$172.5			\$172.5
2 Highway 400 Widening		10.2		\$27.0			\$27.0
3 Partial Interchanges on ETR 407 @ Martin Grove Road and Centre Street	\$25M each	2		\$50.0			\$50.0
4 Highway 400 Interchange Improvements @ Steeles Avenue, Highway 7 and Langstaff Road	\$15M each	3		\$45.0			\$45.0
5 New 400 Highway Crossings							
▶ 2 New Crossings (North Maple bridge and within the Highway 400 North Employment Lands)	\$15M each	2			\$10.0	\$20.0	\$30.0
▶ Special Case – Colossus Crossing (South of Highway 7)	\$40M	1			\$13.3	\$26.7	\$40.0
6 New Regional Roads (Teston and Langstaff)*		3.9			\$85.0		\$85.0
7 Regional Road Widenings*							
▶ Regional Road Widenings – Western Vaughan	\$9.575M	51			\$488.0		\$488.0
▶ Regional Road Widenings – Eastern Vaughan	\$9.575M	25			\$240.0		\$240.0
8 New City Roads**							
▶ 4 Lanes	\$5M	12.0				\$60.0	\$60.0
▶ 2 Lanes	\$3.8M	3.5				\$13.3	\$13.3
9 City Road Widenings (2 Lanes to 4 Lanes)	\$2.5M	28.0				\$70.0	\$70.0
C New Railway Grade Separations (13)							
1 CP (Islington, Kipling, Rutherford, Huntington Connector, Major Mackenzie, Nashville, Huntington)	\$4.5M each	7	\$15.75		\$9.0	\$6.75	\$31.5
2 CN (King-Vaughan, Kirby, Teston, Rutherford, Langstaff, Snidercroft)	\$4.5M each	6	\$13.5		\$6.75	\$6.75	\$27.0
D Active Transportation/TDM							
1 Cycling Paths/Facilities							
▶ Multi-Use Recreational or Boulevard Pathway (Class 1)	\$225K	210.9				\$47.4	\$47.4
▶ Bike Lane (Widening) / Paved Shoulder (Class 2)	\$150K	32.5				\$4.9	\$4.9
▶ Bike Lane (No Widening)	\$20K	54.4				\$1.1	\$1.1
2 Sidewalks and Pedestrian Paths	\$110K	15.5				\$1.7	\$1.7
3 Carpool Lots (10 sites) and Additional Park-n-Ride Lot	\$2M each	11		\$10.00	\$11.00	\$1.0	\$22.0
Total			\$1,313	\$3,027	\$2,685	\$260	\$7,284

Note: * See text on page K-2 for assumptions.

** Excludes development driven local roads.

Table K.3 Regional Road Widening Assumed by 2021

Road Segment	From _____ to _____	Distance (km)	Widening (lanes)
Western Vaughan (west of Highway 400)			
Rutherford Road	Highway 50 to Highway 27	3	4 to 6
Highway 7	East of Islington Avenue to West of CP Rail Line	1	4 to 6
Major Mackenzie Drive	Weston Road to Highway 50	9	2 to 6
Weston Road	Highway 7 to Major Mackenzie Drive	6	4 to 6
Weston Road	Major Mackenzie Drive to Teston	2	2 to 4
Highway 27	Steeles Avenue to Highway 7	2	4 to 6
Highway 27	Major Mackenzie Drive to King-Vaughan Road	6	2 to 4
Highway 50*	Steeles Avenue to Langstaff Road	4	4 to 6
Highway 50*	Rutherford Road to Albion-Vaughan	6	4 to 6
Total Western Vaughan		39	
Eastern Vaughan (east of Highway 400)			
Langstaff Road	Dufferin Street to Keele Street	2	2 to 4
Teston Road	Bathurst Street to Dufferin Street	2	2 to 4
Kirby Road	Dufferin Street to Keele Street	2	2 to 4
King-Vaughan Road	Bathurst Street to Keele Street	4	2 to 4
Dufferin Street	Langstaff Road to Major Mackenzie Drive	4	4 to 6
Dufferin Street	Major Mackenzie Drive to King-Vaughan Road	6	2 to 4
Keele Street	Steeles Avenue to Rutherford Road	6	4 to 6
Total Eastern Vaughan		26	

Note: * Cost of Highway 50 widenings assumed to be shared equally by York and Peel Regions

Table K.4 Additional Regional Road Widening Assumed by 2031

Road Segment	From _____ to _____	Distance (km)	Widening (lanes)
Western Vaughan (west of Highway 400)			
Rutherford Road	Weston Road to Highway 27	6	4 to 6
Teston Road	Highway 400 to Pine Valley Drive	3	2 to 4
Weston Road	Steeles Avenue to Highway 7	2	4 to 6
Weston Road	Teston Road to King-Vaughan Road	4	2 to 4
Pine Valley Drive	Steeles Avenue to Highway 7	2	4 to 6
Highway 27	Highway 7 to Major Mackenzie Drive	6	4 to 6
Highway 50*	Langstaff Road to Rutherford Road	2	4 to 6
Total Western Vaughan (additional – i.e., beyond 2021)		25	
Total Required for 2021		39	
Grand Total TMP – Western Vaughan		64	
Eastern Vaughan (east of Highway 400)			
King-Vaughan Road	Keele Street to Highway 400	3	2 to 4
Keele Street	Rutherford Road to Major Mackenzie Drive	2	4 to 6
Jane Street	Teston Road to King-Vaughan Road	4	2 to 4
Total Eastern Vaughan (additional – i.e., beyond 2021)		9	
Total Required for 2021		26	
Grand Total TMP – Eastern Vaughan		35	

Note: * Cost of Highway 50 widenings assumed to be shared equally by York and Peel Regions

3. Summary of Construction Costs

The overall cost of the transportation infrastructure proposed in the Vaughan TMP, including road widenings, new roadway construction, implementation of rapid transit, Highway construction, and construction of new and improved interchanges, will add up to a total cost of approximately \$7.3 billion. The cost of rapid transit investment alone is estimated to be over \$5.2 billion.

Tables K.1 and K.2 show the breakdown of construction costs for projects planned to be undertaken during the 2011-2021 period, and the overall TMP total cost assumed to be expended by 2031.

4. Assumptions Regarding Cost Sharing and Phasing

The different funding sources for certain types of infrastructure improvements, such as railway grade separations, rapid transit lines, and local road crossings of freeways were also assumed, and were based on arrangements for past projects undertaken in the City of Vaughan and the Region of York. It should be noted that the cost sharing assumptions documented below were used for the purpose of estimating the levels of financial commitments needed for the City of Vaughan, the Region, the Province, and the Federal Government to implement the improvements in this TMP. These may change as a result of project specific agreements or alterations to existing programs.

The cost sharing assumptions used in this study are summarized below.

1. Highways and Roads:

- ▶ In general, roadways will be funded by the jurisdiction responsible for their construction and maintenance, to the exception of Highway 50, which is located in the boundary of Region of York and Region of Peel. In this case, it was assumed an even (50% Region of York and 50% Region of Peel) cost share between the two Regions.
- ▶ Cost for new local road crossings of freeways will be shared as follows:
 - 1/3 Region
 - 2/3 City

2. Rapid Transit Infrastructure

- ▶ The funding of municipal Rapid Transit (RT) projects has been assumed to be equally shared among federal, provincial, and regional entities. Therefore, the assumed cost sharing breakdown is:
 - 1/3 Federal
 - 1/3 Province
 - 1/3 Region
- ▶ Subway extensions: Two subway lines are planned to be extended into the City of Vaughan, Spadina and Yonge. The cost sharing arrangement for the Spadina subway extension has

already been agreed upon, where the 3 senior levels of governments have allocated the following amounts for the portion of the subway extension in York Region:

- Federal: \$195 million (25%)
- Province: \$243 million (30%)
- Region: \$352 million (45%)

For the Yonge subway extension the same cost sharing formula was assumed.

- ▶ GO Rail: 100% improvement costs will be from the Province
- ▶ 407 Transitway: 100% of funds will be from the Province

3. Railway Grade Separations:

- ▶ 50% funding contribution is assumed to come from the Federal Government; and
- ▶ Municipal 50% will be allocated to the authority with jurisdiction of the roadway. Railway grade separations with Regional roads include:
 - CP MacTier Subdivision at Islington Avenue;
 - CP MacTier Subdivision at Rutherford Road;
 - CP MacTier Subdivision at Major Mackenzie Drive;
 - CP MacTier Subdivision at Nashville Road;
 - CN Newmarket Subdivision at Langstaff Road;
 - CN Newmarket Subdivision at Rutherford Road; and
 - CN Newmarket Subdivision at Teston Road.
- ▶ Railway grade separations with City roads include:
 - CP MacTier Subdivision at Kipling Avenue;
 - CP MacTier Subdivision at Huntington Road;
 - CP MacTier Subdivision at spur south of Major Mackenzie Drive;
 - CN York Subdivision at Snidercroft Road;
 - CN Newmarket Subdivision at Kirby Road; and
 - CN Newmarket Subdivision at King-Vaughan Road.

4. Carpool and Park-n-Ride Lots:

- ▶ **Carpool:** An even 50% Provincial / 50% Regional sharing of costs is assumed for this infrastructure, as the Province already has a program in place and the Region is strongly advocating HOV lanes on its arterial road system together with a network of commuter / HOV parking facilities.
- ▶ **Park-n-Ride (remote):** To supplement planned Park-n-Ride facilities for the Spadina subway extension, an additional parking facility has been proposed north of the VMC and, while shared parking is strongly promoted, as a worst case scenario, a construction cost of \$2M is assumed to be shared equally by the Region and the City.

As part of the development of a phasing plan, it was necessary to estimate the portion of the total construction costs to be incurred by the City of Vaughan, and senior levels of government by 2021. These costs tabulated in Table K.1 of this appendix are reproduced in Exhibit 7.4 in the main body of this report. Major rapid transit projects to be complete by 2021 were limited to those for which funding has been committed by Metrolinx (i.e. the Spadina subway extension to the VMC and Highway 7 BRT service as far west as Pine Valley Drive). While the York Region TMP Update shows the Major Mackenzie LRT and the first phase of the Jane RT in place by 2021, given other commitments, it did not seem feasible that projects of this scale would be complete by then. GO Rail service to Bolton and additional GO stations on the Barrie line were, however, assumed to be in place by 2021, although these are not yet committed. The road projects to be completed by 2021 were determined through the corridor deficiency analysis documented in Appendices F.3 and L, and assume the Highway 427 Extension and Highway 400 widening are complete. All three Active Transportation / TDM capital projects were also assumed to be fully in place by 2021, as improved infrastructure to facilitate mobility alternatives needs to lead intensive marketing and promotional activities.