Quebec-Ontario High Speed Rail Project

Preliminary Routing Assessment and Costing Study

Interim Report No. 3
Infrastructure Costs

February, 1994

SNC-LAVALIN and DELCAN

in association with:

- **CANARAIL**
- **SOFRERAIL**
- **SWEDERAIL**

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INTRODUCTION

This comprises the third Interim Report submitted by SNC-Lavalin/DELCAN in association with CANARAIL and Swederail under their mandate for Alignment Selection and Costing which forms part of the Québec-Ontario High Speed Rail Study. This report presents the Cost Estimates for the components of the infrastructure included in this study. These are Land Acquisition, Earthworks, Bridges and Viaducts, Grade Separations, other Accommodation Works, Track, Electrification, and Stations.

The report is divided into 8 sections. The first provides a brief description of each of the speed/routing options evaluated. Further detailed definition and quantification of each of these options is included in Interim Report #2 and will not be repeated here.

The second section provides a description of the structure of the cost estimate. It defines the contents and scope of each of the components and explains the breakdown into geographical segments, the development of unit costs and quantities, and the approach to contingencies.

The next section addresses the key assumptions upon which the estimate is based. This includes basic conditions such as base year for costs, taxes, escalation, etc. and identification of the areas where there is potential for variation in the scope of the project.

Sections 4, 5, and 6 present the basic cost estimates for each of the representative speed/routing options. This includes breakdowns by each of the major geographical segments of the project and by province. Cost estimates for the two composite routes retained for the financial and economic analyses are presented in Interim Report No. 4.

Section 7 presents the analysis and estimate of the accuracy of the cost estimates produced under this study. The final section is an evaluation of the impact on costs that could be achieved by building certain segments of the line as a single-track railway with long passing sidings.

In addition, the report includes 6 appendices. Appendix A provides a definition of each of the cost items and an explanation of how the unit costs and quantities were

developed for that item. Appendix B lists the unit costs used in the estimate and includes a worksheet showing the development of each unit cost.

Appendices C, D, and E provide the cost estimates for each geographical segment. These include Summary Cost Tables, detailed Cost Reports, and cash flows for the total cost and the material, plant, and skilled/un-skilled labour breakdowns for each of the speed/routing options. It also includes the detailed estimate for each sub-segment of the lines.

1. DEFINITION OF ALTERNATIVES

1.1. 200+ km/hr - EXISTING RIGHTS-OF-WAY

In accordance with the Terms of Reference, the objective of this technology/ROW scenario is to maximize the use of existing railway ROW. The representative route developed between downtown Windsor and Québec has a total length of 1249 km made up of 546 km of CN ROW, 377 km of CP ROW, 105 km of abandoned rail ROW now owned by VIA Rail and 215 km of new ROW.

1.1.1. Windsor to Toronto

The route starts at the south end of the Windsor - Detroit Tunnel in downtown Windsor and, with the exception of new bypasses of Tilbury and Chatham, follows the CP ROW to London. From London, it continues east to Hamilton, bypassing Woodstock and Paris. The route skirts the northern limits of Hamilton and after passing through Burlington, Oakville and Mississauga along the CN ROW, enters Metropolitan Toronto.

The CN ROW along the lakeshore through Etobicoke is used to reach Union Station. Continuing eastward, the CN ROW is again used to leave the urban area through Scarborough, Pickering, Ajax, Whitby and Oshawa.

1.1.2. Toronto to Montréal

From Oshawa, the route continues eastward in the CN ROW, passing through Port Hope, Cobourg and Trenton en route to Kingston and Brockville. The National Capital Region is reached from the Brockville area by bypassing the town to the west and following the CP ROW up to Smiths Falls. The route also bypasses Smiths Falls to the west and then joins the CN ROW which is used to continue north-east up to the National Capital Region.

After bypassing Richmond, the route enters Ottawa along the CN ROW through Federal junction and on to the existing VIA Station. From the station the route leaves

the Ottawa urban area using the CN ROW leading to the abandoned CP ROW which continues eastward through Bourget, Vankleek Hill and St-Eugene to Rigaud. A bypass of Rigaud and Hudson rejoins the CP ROW at Vandreuil and Dorion from where the route enters the Montréal urban area along the combined CN and CP ROW. This ROW is followed through Baie D'Urfé, Beaconsfield, Kirkland, Pointe Claire and Dorval to Lachine where the CN ROW is adopted to reach Central Station.

1.1.3. Montréal to Québec

Since the selected representative route for the Montréal-Québec segment follows the north shore of the Saint-Laurent River, the route leaves Central Station northward through the Mont Royal Tunnel. It passes through Laval along the CP ROW, which is then followed to Trois-Rivières passing south of L'Épiphanie, north of Berthierville and including bypasses of Maskinongé, Louiseville and Yamachiche.

Geometric constraints in Trois-Rivières are avoided by adopting a new route north of the City. The new route rejoins the CP ROW east of Cap-de-la-Madeleine, bypasses Portneuf and Pont-Rouge and follows the existing ROW eastward to Ancienne-Lorette. From Ancienne-Lorette, the route continues into the Québec urban area along the CP ROW as far as Allenby Junction where it joins the CN ROW. The CN ROW is used to reach Gare du Palais through Vanier and the Limoilou Yards

1.2. 300+ km/hr - EXISTING RIGHTS-OF-WAY

As with the 200-250 kph tilting technology scenario, the objective in defining this route is again, to maximize the use of existing railway ROW. The detailed analysis for this scenario has highlighted the need to include more sections of new ROW to avoid existing geometry constraints which preclude operation at speeds in the 300 kph range. This requirement, the adoption of a shorter route on new ROW between Kingston and Smiths Falls, and a preferent route between Vankleek Hill and downtown Montréal are the major differences between this route and that described for the tilting technology scenario in Section 1.1. Of the total length of 1211 km, between Windsor and Québec, 310 km is in CP ROW, 336 km uses CN ROW, 504 km is new ROW and the remaining 73 km is the abandoned CP ROW between Ottawa and Rigaud now owned by VIA Rail.

1.2.1. Windsor to Toronto

Starting at the south end of the Windsor-Detroit Tunnel in downtown Windsor, the route generally follows the CP ROW to London, except for new bypasses around Tilbury and Chatham. Geometric constraints in London are avoided with a new ROW bypassing the city to the south. From London, the route continues east to Hamilton using both CP and CN ROW along with new bypasses of Woodstock, Paris and Brantford.

The route skirts the northern limits of Hamilton and rejoins the CN ROW to pass through Burlington, Oakville and Mississauga before entering Metropolitan Toronto.

In Toronto, the CN ROW through Etobicoke is used to reach Union Station in downtown. Continuing eastward from the station, the CN ROW is again used to exit the urban area through Scarborough, Pickering, Ajax, Whitby and Oshawa.

1.2.2. Toronto to Montréal

From Oshawa, the route generally follows the CN ROW to Kingston, however, bypasses to avoid alignment geometry constraints are required at Port Hope and Cobourg. Sharp curvature again precludes use of the CN ROW through Napanee and Kingston, hence a new route across the north of the urban areas was developed, leading to a new corridor linking Kingston and Smiths Falls. After bypassing Smiths Falls to the west, this new corridor rejoins the CN ROW between Smiths Falls and Ottawa.

The route follows the CN ROW to Richmond, which it bypasses, entering Ottawa at Federal Junction from where it continues to the existing VIA Station. From the station, the route leaves the National Capital Region using the CN ROW to reach the abandoned CP ROW which is followed eastward to Vankleek Hill. East of Vankleek Hill the route leaves the CP ROW, turning north to cross the Ottawa River near Pointe Fortune. It then continues in a north-easterly direction in a new ROW up to the existing CP north-shore ROW which it joins south-west of Mirabel Airport. From this point the route could either follow the CP ROW eastward to Laval or be diverted through the airport rejoining the CP ROW in Sainte-Therese before continuing south into Laval. The direct route along the CP ROW is included in the cost estimate.

The CP ROW is used to cross the Rivière des Prairies from where a new tunnelled ROW links the route to the CN ROW entering the existing Mont Royal Tunnel. The existing tunnel is used to access Central Station in downtown Montréal.

1.2.3. Montréal to Québec

Since the selected representative route for the Montréal-Québec segment follows the north shore of the Saint-Laurent River, the route leaves Central Station northward through the Mont Royal Tunnel. It passes through Laval along the CP ROW which is then followed to Trois-Rivières passing, south of L'Épiphanie, north of Berthierville and including bypasses of Maskinongé, Louiseville and Yamachiche.

Geometric constraints in Trois-Rivières are avoided by adopting a new route north of the City. The new route rejoins the CP ROW east of Cap-De-la-Madeleine, bypasses Portneuf and Pont-Rouge and follows the existing ROW eastward to Ancienne-Lorette.

This section includes some re-alignment to improve curve radii and permit speeds over 300 kph. From Ancienne-Lorette, the route continues into the Québec urban area along the CP ROW as far as Allenby Junction where it joins the CN ROW. The CN ROW is then used to access the existing Gare du Palais through Vanier and the Limoilou rail yard.

1.3. 300+ km/hr - NEW RIGHTS-OF-WAY

For this scenario, the principal objective was to determine the infrastructure required to provide HSR service at over 300 kph mostly in new ROW between Windsor and Québec. The detailed analysis of alignment options revealed that the only feasible route through the major urban areas was the sharing of existing rail ROWs. The route developed for this scenario has a total length of 1245 km, of which 215 km is shared ROW in urban areas.

1.3.1. Windsor to Toronto

As with the other scenarios described previously, this route begins at the south end of the Windsor-Detroit Tunnel, however it remains within the CN Caso ROW up to the limits of the Windsor urban area. From here the route turns east into a new ROW between the CP ROW and the Highway 401 corridor. After bypassing Tilbury and Chatham, the route swings to the north-east and continues towards the southern limits of London generally following the Highway 401 corridor and paralleling the farm property grid.

From the outskirts of London, the route swings north to reach a new more northern ROW which continues eastward between Kitchener-Waterloo and Cambridge to the Niagara Escarpment. After crossing the escarpment in the Highway 401 corridor, the route follows this corridor through Milton where it joins the proposed Highway 407 corridor which provides the opportunity to pass the northern edge of Pearson Airport. At this location, the route swings south into the existing CN ROW which passes through the City of York to access Union Station in downtown Toronto from the west.

1.3.2. Toronto to Montréal

The route for this scenario exits the Metropolitan Toronto urban area by sharing the CP ROW through Leaside, Don Mills and Agincourt Yards in north Scarborough. Continuing north along the CP ROW the route reaches the proposed Highway 407 corridor near Locust Hill. The Highway corridor is used to bypass Pickering and Oshawa.

East of Oshawa the route continues gradually southward to the Highway 401 corridor near Port Hope and Cobourg.

The route leaves the highway corridor at Colborne and continues east in a new more northerly ROW through Frankford to Kingston. From the outskirts of Kingston, the route swings to the north-east and continues, generally parallel to Highway 15, up to Smiths Falls. After bypassing Smiths Falls to the west, the route joins the CN ROW to enter Ottawa through Federal Junction.

Since the representative route between the National Capital Region and Montréal was selected to be along the north shore of the Ottawa River, the route leaves the CN

ROW in Ottawa and follows the CP ROW across the river to enter downtown Hull. Between Hull and Montréal, the new ROW passes through Gatineau, south of Buckingham, north of Montebello and along the north shore to Lachute. After bypassing Lachute to the south, the route swings north to join the CP ROW at the south-west corner of Mirabel Airport. As described in Section 1.2.2 the route could either pass through the airport terminal and then south to Laval, or bypass the property to the south and continue to Laval. The route costed includes the station at Mirabel.

From Laval the CP ROW is used to cross the Rivière des Prairies from where a new tunnelled ROW links the route to the CN ROW entering the existing Mont Royal Tunnel. The existing tunnel is used to access Central Station in downtown Montréal.

1.3.3. Montréal to Québec

For this scenario, the route from Central Station to the eastern limit of the Montréal urban area is identical to that described in Section 1.2.3 for the "Existing ROW" scenario i.e. north through the Mont Royal Tunnel, up to Laval and then north-east along the CP ROW to Mascouche.

From Mascouche, the new ROW parallels the CP ROW as far as Saint-Barthélémy where it joins the Hydro Québec corridor which it follows to north of Louiseville. The route continues across country to join the bypass of Trois-Rivières developed for the other scenarios. Between Trois-Rivières and La Pérade the route generally follows the Autoroute 40 corridor. At La Pérade, a Hydro Québec corridor north of the Autoroute is again joined and followed eastward to a point 15 km west of Ancienne-Lorette. From this point, the route swings across to rejoin the CP ROW south of Québec airport.

The route through the urban area uses the CP ROW, with curve improvements in the Les Saules area, to reach the CN ROW at Allenby Junction. From the junction the CN ROW is shared through Vanier and Limoilou to gain access to Gare du Palais.

2. COST ESTIMATE STRUCTURE AND METHODOLOGY

This section of the report sets out the structure used for presenting the cost estimate by defining its various elements and then describes the approach taken in developing the figures presented.

2.1. DEFINITION OF COST ITEMS

The most basic components of this cost estimate have been designated items or sub-items. These are the elements for which quantities, unit prices, and extensions are presented in the detailed cost estimates. They vary greatly in scale. For example, one item covers a scope as large as a grade separation whereas another is a railway tie. The scale for the items were selected on the basis of the difficulty of and the time available for estimating the quantities and costs under each discipline.

The items have been developed by the particular specialists involved in doing quantity take-offs and estimating unit costs for each of the sub-systems. This has ensured that, overall, the items include all the elements of the work required when the project goes ahead, yet at the same time, incorporates simplification where several elements can be grouped into a single larger cost item.

Appendix A to this report identifies the various cost items and provides a definition for each of these items, indicating what portion of the scope of work for the total project has been included within each cost item. It also provides information regarding the methods used to estimate quantities and to develop the unit costs.

2.2. DEFINITION OF SUB-SYSTEMS

The term "sub-system" is used here to refer to a clearly-defined physical element of the overall project that has common characteristics throughout its length. Contracts for the design and construction of the work would generally be awarded on a sub-system basis. This cost estimate includes the following sub-systems:

- Right-of-Way Acquisition
- Earthworks and Drainage
- Bridges, Viaducts, and Tunnels
- Grade Separations
- Other Accommodation Works
- Track
- Electrification
- Stations

The criteria used in this study for assigning cost items to different sub-systems are presented in the sub-sections which follow.

Examples of other sub-systems required as part of this project but which fall outside the scope of work of this study are:

- Rolling Stock
- Signalling and Telecommunications
- Maintenance Facilities
- Administrative Facilities

2.2.1. Right-of-Way Acquisition

This sub-system is intended to include all costs associated with acquiring the land required to construct the project. This comprises land for new right-of-way, for widening or outright purchase of existing rights-of-way, for constructing grade separations, and for stations. The acquisition costs include the cost of compensation that will have to be paid for loss of property value and loss of business revenue resulting from the acquisition. It also encompasses land which may have to be purchased or other expenses necessary to acquire or extinguish crossing rights. It does not include any cost for sharing of existing rights-of-way. Legal and professional fees associated with the acquisition process are also included.

This sub-system excludes all track and roadbed items.

2.2.2. Earthworks and Drainage

This sub-system comprises all work required to construct the roadbed to the bottom of the ballast layer for the high speed rail lines, except for bridge structures, tunnels, and/or grade separations as covered in other sub-systems.

It includes the cost of clearing land, excavating cuts, hauling fill and spoil materials, compaction, providing culverts, ditches, and fencing, and treating interferences caused by pipe and wire crossings. It also encompasses the cost of capping the earthwork with a layer of superior quality material to serve as a sub-ballast.

In terms of civil structures, this sub-system will include retaining walls for earthwork and noise attenuation barriers. On existing rights-of-way, it will include the costs associated with improving the quality of embankments where required. This might involve the removal of fouled or incompetent materials and the use of special earth reinforcement or other treatments.

Costs associated with technical feasibility studies and the environmental evaluation of the project are also included here, as well as the cost of implementing measures to mitigate most environmental impacts.

Earth moving and drainage works for stations are included in the Stations sub-system.

2.2.3. Bridges, Viaducts, and Tunnels

These structures are naturally included with earthworks to produce a "Roadway" sub-system as both these elements are often awarded for construction under a common contract. However, they are treated separately here in order to conform to past practice associated with this project and allow easy comparisons. The fact that they encompass a significant portion of the total project cost also justifies a separate sub-system.

Therefore, this includes all costs associated with providing all new and reconstructed bridges over streams and waterways, building viaducts across valleys, and constructing tunnels if required.

This sub-system does not include bridge structures, either over- or underpasses, required for grade separating the railway from roadways.

2.2.4. Grade Separations

This sub-system includes all costs associated with maintaining the high speed right-of-way free of potential vehicular or animal obstruction. In addition to grade separations, this will include grade separated farm crossings where required and the costs for closing and/or diverting roads to avoid grade separation.

Where existing grade separations must be modified to allow for additional tracks, the cost of such work will be included here. Again, in terms of contracting for construction, all of these items would typically be included with earthworks and bridges.

Where level crossings with automatic crossing protection have been considered for the project, the costs for crossing protection has been included in this sub-system. These costs are traditionally included with signalling costs. However, they have been included here so that the full costs for treating the crossing issue (separation or protection) can be easily compared irrespective of the solution adopted.

2.2.5. Other Accommodation Works

In developing the cost items the consultant identified some which did not readily fall within the categories already defined. Although it may have been possible to make some of the items to fit under trackwork, earthwork, or grade separations, there were reasons for not including them there. In addition, it was thought easier to evaluate the overall impact of these items as a single unit than to provide for them under two or three sub-systems.

Therefore, the removal of rail lines, the construction of new tracks to maintain existing rail traffic during construction and allow continued service to the clients of the freight railways, and the provision of rail/rail grade separations are all addressed here.

2.2.6. Track

All costs associated with providing the new high speed track structure from the bottom of the ballast to the top of rail fall under this sub-system. This encompasses provision of new main track and passing and maintenance sidings. The cost of providing access and yard tracks at maintenance shops are included with the shop costs developed under another study. Where the rehabilitation of existing track is considered or required to support the new passenger service, these costs are included here.

In terms of track materials, this sub-system includes rails, ties, ballast, fastenings, other track materials, special track materials for turnouts, switch machines, switch heaters, and bumping posts.

2.2.7. Electrification

This sub-system comprises all costs associated with the electrification of the proposed high speed services. These facilities include the catenary and support structures, electrical sub-stations, and feeder lines from the electrical utilities. Other costs to be included here are any modifications to overhead structures to obtain necessary electrical clearances for the catenary and protection of adjacent signalling and telecommunications systems against electrical interferences.

2.2.8. Stations

This sub-system includes all costs associated with the construction or modification of stations for the high speed rail system. This includes the station building itself as well as providing track-side platforms and their access ways, services and utilities, associated roadways, parking areas, and landscaping. The cost of land, station tracks, and catenary are included in other sub-systems.

The costs presented do not include the provision of equipment or furniture required for railways operations.

2.3. DEFINITION OF SECTORS

The term "sector" is used to designate a category of expenditure within the context of the project. These categories are generally common to all sub-systems. However, some sectors are not applicable to some sub-systems or the level of detail of the estimate has not allowed the particular costs for a sector to be identified separately. This cost estimate has identified the following 5 work sectors[1]:

- Professional Services/Project Management
- Equipment/Material
- Transportation/Distribution
- Construction/Installation
- Start-up

Each of the cost items in each sub-system will be allocated to one of the above sectors.

2.3.1. Professional Services/Project Management

This sector covers costs for preliminary engineering, design, construction supervision, and procurement services applicable to each of the sub-systems. In addition, it will cover other specialized services such as legal and professional services for land acquisition and the environmental approval process.

The costs for overall project management are also included in this sector.

2.3.2. Equipment/Material

This would cover the cost of any equipment or materials that could be procured for the project under individual contracts. An example of this is track materials - rail, ties, ballast, etc. - which would likely be purchased directly from the manufacturer. Other examples are materials required for electrification, furnishings for station buildings,

[1] It should be noted that these sectors must not only suit the sub-systems which fall under the terms of reference for this study, but also those of other studies in order that the individual capital cost estimates can be combined into a single comprehensive project estimate.

and/or standard bridge girders that the project might decide to procure from a single fabricator for installation by other contractors.

The level of detail for and approach to this cost estimate developed in a manner that Equipment/Material costs were identified separately for the Right-of-Way Acquisition and Track Sub-systems only.

2.3.3. Transportation/Distribution

The transportation costs for separately purchased equipment and materials should be addressed here and can involve significant amounts of money. An example would be ballast which is purchased in large quantities and can involve transport over long distances.

The development of the cost estimate has resulted in all transportation and distribution costs being included in the cost of the material or its installation.

2.3.4. Construction/Installation

This sector covers the cost of construction contracts using materials purchased as part of the contract (e.g. stations, earthworks) or materials purchased under other contracts (e.g. trackwork).

2.3.5. Start-up

This sector covers additional costs that must be incurred in order to convert the physical assets that have been constructed and put in place into an viable operating transportation system. For example, this might include training of personnel, marketing of the service, and provision of working capital.

These costs do not fall within the scope of the current study.

2.4. GEOGRAPHICAL SEGMENTS

The terms of reference require that the cost estimates present the cost of each of the main city pairs Québec-Montréal, Montréal-Toronto, and Toronto-Windsor and the value of the project constructed in each province. Further instruction from the Project Manager has indicated that the two end segments of the project be evaluated in such a manner that it be possible to treat them as incremental to a core Montréal-Toronto project.

The cost estimates have been further broken down into smaller sub-segments in order to facilitate the development of quantities by each project office involved in the study and to permit flexibility in the analysis of the project by allowing for recombination of sub-segments to evaluate various routing options. The following conditions and/or features along the length of the route have been used as endpoints for geographical sub-segments in developing the quantities for the cost estimates:

- terminal stations,
- the point defining facilities east of Montréal,
- the point defining facilities west of Toronto,
- the Ontario/Québec boundary,
- junctions between new and existing alignments,
- junctions between alternate route options, and
- the points separating the territory covered by each of the project (study) offices.

Each of the station locations has also been treated as a separate geographical sub-segment in order to allow for each station site to be easily included or excluded in the calculation of a total project cost.

Therefore, at the level of greatest detail, the cost estimates comprise the quantities and the associated extensions for all cost items broken down by sub-segment. However, all presentation of costs has been done at the level of the 3 major corridor segments.

2.5. UNIT COSTS AND QUANTITIES

2.5.1. Unit Costs

The unit costs for each of the cost items defined in Appendix A have been developed by the specialists amongst the consultant's team most familiar with that particular element of the overall cost estimate. Appendix B presents, in its first sub-section, a listing of all the unit costs for each of the speed/routing combinations. The second part of Appendix B presents the development of each of the unit costs used in the estimate. This information is in a standardized format, using 1 or 2 pages per unit cost. The pages are ordered according to sub-system, sector, and item number.

The unit costs are based on recent work that has gone to construction or has been designed and estimated by the consultant. In the case of track structure, where there are certain elements that are not typically common to North America (tolerances for rail straightness, use of high speed turnouts, high productivity track construction on account of the great distances, etc.), the consultant has undertaken discussions with potential suppliers to the project.

Although provision was made for varying unit costs amongst the 3 speed/routing combinations, this was only required for tunnels where the cross-sectional area is dependant on train operating speed. All other unit costs are identical between options. Therefore, differences in project costs between these options are almost entirely the result of the different quantities required to provide a functional right-of-way for the speed option being considered.

Unit costs for each cost item are generally identical, regardless of geographical segment, although prudence has been used in applying this generalization. Sub-ballast unit costs for several sub-segments have been modified to be lower than the standard to reflect the availability of surplus rock from cuts which would be used for sub-ballast. Also costs were reduced for some tunnels on the 300 kph alignments where it would be impractical to consider operating trains at their maximum speed.

2.5.2. Quantities

The quantities associated with each of the route and speed options have been developed in the manner described in great detail in the consultant's Interim Report

No. 2. The total quantities calculated for each cost item for each of the project segments are presented in the Detailed Estimates included in Appendices C, D, and E. Detailed estimates by sub-segment are on file with the Consultant as they are too voluminous to include in this report.

Differences in project costs amongst the speed/routing options are, to a large extent, due to gross differences in project lengths, quantities of new/re-used subgrade, etc. However, these differences are also a result of different technical requirements of the two speed options and, consequently, in the way that the quantities were calculated for some of the cost items, such as:

- Acceptance of level crossings,
- Tie and ballast quantities for trackwork, and
- The lengths of noise barriers required.

2.6. CONTINGENCY

The issues of contingency and accuracy are closely related in the development of a cost estimate and in the analysis of potential variations to the cost. How they are treated is often a source of confusion when trying to understand a cost estimate. To avoid this situation, the Consultant presents the following explanation of the approach used by the team in applying contingency to the cost estimates.

Contingency can be defined as a provision in the cost estimate for those variations which are likely to occur but which cannot be specifically identified at the time the estimate is prepared. This is true for a fully detailed budget approval estimate. In the case of a "preliminary" estimate for a project, as has been prepared here, the contingency amount must also cover items which can be identified, but whose small relative cost does not warrant their being addressed on an individual basis.

In terms of a mathematical definition, contingency is the amount of money that should be added to the cost estimate in order to provide the Project Manager with a 50/50 probability of having the final project cost being above or below the cost estimate.

To apply the above approach "de rigueur", however, requires a large statistical data base of previous estimates with comparisons to actual constructed costs. As the study does not support such an analysis, we have relied on the judgement of the

consultants to estimate appropriate contingencies. However, to facilitate the task, we have provided for contingency estimates within each of the sub-systems. We feel that this approach has allowed specialists to estimate a contingency relative to a specific area of work with which they are familiar and, therefore, has produced an overall contingency which is far more pertinent than a single figure estimated for the project as a whole.

The percentages used for contingency for each sub-system are shown in the detailed estimates. These percentages are the best estimates of the amounts needed to allow for probable variations to the costs estimated by those consultants involved in the development of the unit costs and quantities.

As a last point regarding contingencies, one should note the term probable variations and the definition provided above. These amounts for contingencies are not included to address the question of estimate accuracy. They are provided to give the estimate an equal chance of being overrun as underrun. As such, they represent real costs - though undefined. They must not be excluded in performing the financial or economic analysis.

Although contingencies applied to various sub-systems range from 5 to 30%, a review of the contingency reserve included in the total project costs provided indicates that they represent less than 10%.

3. KEY ASSUMPTIONS

3.1. BASIC CONDITIONS

Any cost estimate is only valid for the particular conditions under which it was developed. Where the conditions which will apply at the time of implementation are not or can not be known, it is necessary to make assumptions. The basic assumptions relating to this cost estimate are stated clearly in the following paragraphs.

i) The estimate is based on prices valid in the 1st quarter of 1993 in Canadian dollars. Where prices have been obtained in foreign currencies the rates of exchange used to convert these to Canadian dollars have been indicated in the development of unit costs.

ii) No allowance has been made for escalation in prices over the period of project implementation. The time required for implementation of the various line segments is discussed in Interim Report N° 4.

iii) The unit prices developed do not include any federal or provincial taxes, nor import duties.

iv) The estimate includes identified contingency amounts for physical contingencies, both known and un-known. These contingencies have been estimated for each sub-system/sector combination and are identified as line items in the estimate. As noted in Section 2.6, they represent real costs and must not be excluded in performing the financial or economic analysis.

v) The estimate assumes that all work - project management, design, construction - will be contracted to outside parties.

vi) No allowances have been included for owner-related costs, other than those related to personnel assigned to project management of construction. Costs not addressed might typically include those

associated with maintaining an organization, training, financing charges, insurance during construction, legal fees, etc.

vii) Where unit prices include costs for specialized track construction equipment, it is assumed that this equipment will be written off over a complete project from Windsor to Québec.

viii) Although the estimate includes costs for commissioning the track and electrification sub-systems, no costs are included for hiring and training the operating staff required to run the system.

3.2. POTENTIAL AREAS OF RISK

The basic assumptions above establish certain limits around the cost estimate provided in this report. Although some of the basic assumptions carry large cost implications, they most often establish an understanding as to where a cost will be captured, not whether it need be addressed by the study or not.

However, there are a further set of assumptions that have been made in progressing this study which establish criteria about the type and scope of costs to be included in this estimate. These have such a large potential impact on costs that an incorrect assumption would be equivalent to implementing a major change in the scope of the project and the estimate could no longer be considered valid.

These assumptions which have the potential for leading to major scope variations in the project are described in the paragraphs which follow.

3.2.1. Existing Rights-of-Way

The estimate assumes that the project will be able to use existing railway rights-of-way for the purpose of constructing some segments of the line. This includes situations where the high speed project would completely take over an existing right-of-way and/or where the project would share an existing right-of-way with the current owner.

These assumptions have been based on preliminary discussions with the two national railways. For some segments of lines, the railways' intentions for abandonment have been made evident. However, outright acquisition of other line segments would

require that a settlement be negotiated that is acceptable to the railway and that the railway be able to negotiate a track sharing agreement for its traffic to move over the lines of the other national carrier. Although there has recently been some movement towards track sharing by the railways and a publically announced desire to merge their operations in Eastern Canada, there is still some risk involved in assuming that these rights-of-way will be available. This estimate does not include any allowance for cost variations that may result from these rights-of-way not being available.

It should also be noted that this estimate includes no payment to the railways for occupying portions of their land at locations assuming shared ROW. These payments for land rental will be an operating expense.

3.2.2. Level Crossings

The assumptions regarding level crossings in the estimate are that they will be permitted at speeds up to 200 kph, provided that the automated crossing protection used at crossings above 160 kph incorporate safety measures additional to those currently in use in Canada.[2] This assumption is based on discussions that have taken place between the Technology Consultant and Transport Canada.

However, there are two areas of risk here. The first is in being able to find a technological solution that fully meets the desired safety objectives of the new regulations that will be developed. The second is that this can be achieved at a reasonable cost. Potential consequences range from higher costs than estimated for crossing protection to the project being faced with the cost of grade separating the planned level crossings.

Comparison of cost figures on sections of the 200+ and 300+ existing rights-of-way options indicate that the additional cost for grade separations could be in the order of $800 million over the length of the project. Although there is a relatively low risk that a level crossing solution will not be found, the fact that there is a potentially high cost penalty requires that this item be identified as a potential scope variation to the project as estimated.

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[2] These security requirements are discussed in the Technology Assessment Report.

It should also be noted that the estimate includes costs for the grade separations to be constructed under the initial project implementation. And, although there is an acceptance of level crossings at speeds up to 200 km/h in some national jurisdictions, these situations often include plans for the future grade separation and elimination of some or all of these level crossings. In addition, the growth of urban areas can lead to conditions which will require grade separation at locations which are initially accepted as level crossings.

Therefore, it is highly probable that some of the level crossings which remain after the initial construction will be grade separated during the life of the projet addressed by the financial evaluation. The cost of this future work has not been included in these estimates. To address this issue, it may be desirable for the financial evaluation to include an amount of $52 million in the first year of operation for the 200 km/h option as representing the net present value of additional grade separations to be built over the life of the project. This amount would allow for separation of 10% of remaining level crossings over 20 years.

3.2.3. Grade Separations

In assessing the roadways crossing the alignments of the new high speed rail routes, the Consultant has costed all provincial highways as being grade separated. In the case of all other roadways, attempts have been made to identify individual opportunities where lessor roadways might be closed in order to reduce the cost.

However, it has been proposed that it may be possible to close more crossings than identified in this study by applying criteria for closing roads similar to those used in the construction of new highways. The potential for applying such a policy is not clear. Where the new line is constructed along an existing ROW and the public is accustomed to its existing right to pass from one side of the line to the other, it may be difficult to obtain road closures. Also, the benefits accruing to individuals in rural areas are not as readily identifiable for a railway project as for a highway. However, should it be possible to implement this more aggressive strategy for closing roads, the cost savings to the project would be significant.

In addition, funds are included in the estimate to provide grade separated farm crossings for the project. Potential for reducing costs also exists here if it is possible to purchase farmers' rights to crossings for less than the cost of grade separations.

3.2.4. Urban Zones

Quantities and costs within the urban zones along the length of the project have been developed on the basis of trying to obtain the shortest possible travel time for each of the technologies. As such, feasible technical solutions have been applied at all locations to obtain the best running times possible.

However, there are several other factors associated with the question of speed in urban areas which could have an impact on what can be achieved. These are discussed in the following paragraphs.

i) Noise

Assumptions have been made regarding current noise levels and the perception of the noise created by any new service.[3] The result is that there are no noise-imposed speed restrictions on the system in the operations analysis. The costing has included some noise attenuation barriers in particularly sensitive locations, however, it has not been possible to evaluate the requirement for additional barriers within the context of this study.

This issue of noise and speed in urban areas, and the public perception of both, requires further study, including identification of local conditions. Although there may be some resistance to trains travelling at high speed in urban areas, it should be noted that the SNCF now penetrate to within 10 km of the center of Paris at maximum TGV speeds. Therefore, the consultant is confident in the potential to achieve the speed conditions projected, although there is a degree of uncertainty with respect to the level of expenditure required for noise mitigation.

ii) Track Sharing

A basic assumption of the study is that safety requirements will allow the high speed trains to use existing tracks with existing traffic up to speeds of 160 kph without restrictions and up to 200 kph with probable application of special conditions concerning track construction, maintenance, and train control.

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[3] see Interim Report #2 and Technology Assessment Report

However, for the reasons set out in Interim Report #2, the study has provided for building dedicated tracks to the cores of the large urban centers. This has required procurement of land in the urban areas and realignment of existing tracks. These costs are reflected in the estimates.

iii) Cost/Revenue

The cost of the approach used in the urban areas can be a significant portion of the cost of constructing the overall project. To reduce these costs implies an impact on train speed, on overall travel time, and, consequently, ridership and revenue.

Therefore, in summary, this cost estimate represents one of a multiple of possible solutions in the urban areas that offer combinations of noise mitigation measures, track sharing, cost, and revenue. There are very strong probabilities that the optimum solution could be other than that presented here. However, maximizing revenues was a strong priority in this study and the consultant feels that the solutions provided meet this goal. The key point of this discussion, however, is that there is potential for variations in the scope of the work to be done in urban areas. The Consultant has performed an initial evaluation of the potential cost reductions that can be achieved by accepting speed restrictions at certain locations. The results of this evaluation will be included in the Consultant's Interim Report No. 4.

3.2.5. Double Track

The terms of reference require that the main thrust of the study be toward analyzing the construction of a double track high speed railway from one end of the Québec - Windsor corridor to the other. This has been the basis of the estimates presented.

However, a combination of high implementation costs with insufficient ridership and revenue projections may lead to a project which is not financially interesting for one or more of the speed/routing options. Under such conditions, and provided that the operations analysis points to a feasible solution, it may be desirable to construct a single track railway over one or more of the corridor segments.

Such a solution would constitute a major change in scope from the three projects that have been estimated in this report. Section 8 of this report addresses the technical and cost implications of constructing a single track line.

3.2.6. Contaminated Soils and Disposal of Materials

Railway lands have the potential to contain soils contaminated as a result of conditions associated with their historical use. Pollutants may take the form of fuels or toxic chemicals that have entered the soil through leakage in regular use or accidental spills. Although the contamination is usually associated with yard sites, it might have also occurred along the rail lines as well.

In view of this condition, the cost estimate has included an item for performing an audit of railway lands that are assumed to be included in the projet. However, no specific costs have been included to perform a clean-up at contaminated sites. This approach has been used for the following reasons:

- a clear consensus on the probability of finding a contaminated site is not available,
- the potential cost for cleaning up a site is highly variable, depending on contaminants and quantities and therefore very difficult to estimate, and
- the potential liability associated with owning such a site may frustrate negotiations for the transfer of land ownership and require an alternate location be used.

For these reasons, the occurrence of contaminated soils must be considered as a change of scope to the project which could impose costs in the millions of dollars if they must be treated. It should be noted that the potential for encountering such conditions is of course greater on the alignments maximizing use of existing rights-of-way.

In addition to contaminated soils, there has been some indication, particularly by the Province of Ontario, that the off-site removal of certain excess excavated materials may require disposal at "managed sites". Such a condition, which has not been considered in this estimate, could have a significant impact on project costs, particularly in view of disposal costs which were suggested to be as high as $60/ton for "managed materials". Therefore, the current estimate includes the implicit assumption that, through careful design, it will be possible to dispose of these materials near to their point of excavation or within the confines of the project.

3.2.7. Economics Conditions

The unit prices for general civil construction work have been developed using an overview of the progression of prices over the last five years in order to produce prices which reflect normal economics conditions. To provide an insight into the type of impact that these conditions can have, the Ontario Ministry of Transport indicated that it has experienced a drop of 25% in prices quoted between the time of the construction boom in Ontario and the current recession.

As the prices provided in this report attempt to reflect "typical" conditions, it is evident that there could be a considerable saving in construction costs if the project were constructed under current economic conditions. On the other hand there could be a premium to pay if the awaited economic recovery has brought the construction industry to near-capacity levels of work.

3.2.8. Contracting Strategy

On a project of this magnitude, a key element in limiting the cost of the project will be the application of sound contract management principles. These include:

- ensuring that the design effort is thorough to identify all potential problem areas, ensure that feasible solutions are found during the design stage, and limit costly design changes and delays during construction,

- packaging of contracts to accommodate the capacities of contractors, minimize the amount of coordination required at interfaces, and obtain the maximum amount of standardization of common elements (bridge girders, catenary poles, etc.) throughout the length of the project, and

- close supervision of the work to ensure that it is proceeding in accordance with the schedule, budget, and specifications at all times and that modifications required to put the project back "on plan" are implemented in a timely manner.

Failure to follow these principles closely can easily lead to an escalating condition of project delays and cost overruns. This estimate does not include any allowance for this risk.

4. 200+ km/hr - EXISTING RIGHTS-OF-WAY

The total cost for a 200+ kph high speed railway project covering 1,249 km from Windsor to Québec City and using existing rights-of-way to the greatest extent possible is estimated to be $6.864 billion. This results in an average cost of $5.50 million per kilometre. A breakdown of this cost by sub-system and sector is provided in Table 4.1.

The percentage of the total cost allocated to each sub-system is presented in the pie chart in Figure 4.i.

Figure 4.i - 200+ km/hr on Existing R/W
Breakdown of Costs by Sub-system

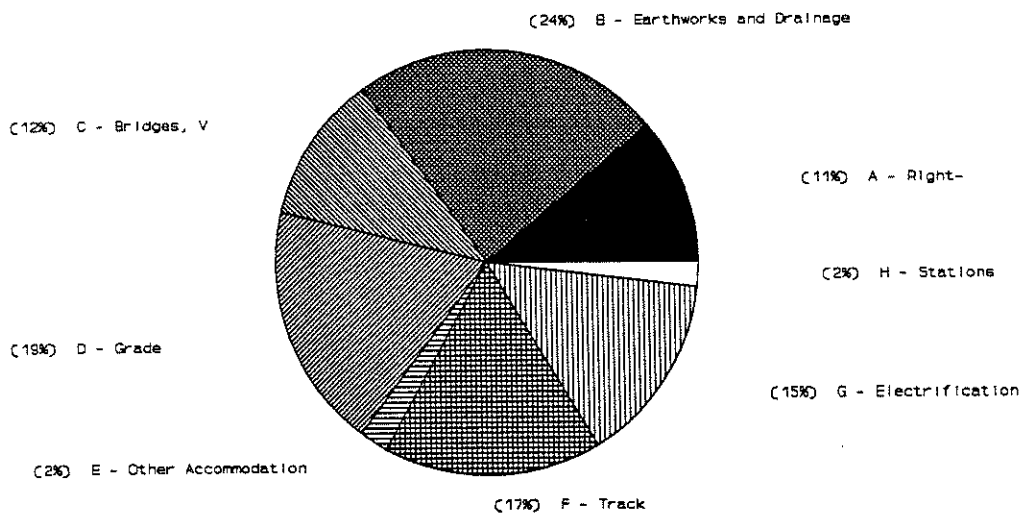

Table 4.1

QUEBEC – WINDSOR CORRIDOR TOTAL — SUMMARY OF TOTAL COSTS

technology:

200+, TILTING

Sector / Subsystem	Prof. Services / Proj. Management	Equipment / Material	Transportation / distribution	Construction / Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$51,884,925	$540,467,973	N/A	N/A	see note c	$592,352,899	$57,780,940
B – Earthworks and Drainage	$289,969,071	N/A	N/A	$1,309,430,624	see note c	$1,599,399,694	$170,795,299
C – Bridges, Viaducts, and Tunnels	$157,972,204	N/A	N/A	$959,325,950	see note c	$1,117,298,154	$87,211,450
D – Grade Separations	$158,495,204	N/A	N/A	$962,502,000	see note c	$1,120,997,204	$160,417,000
E – Other Accom– modation works	$15,545,361	see note a	see note a	$94,403,116	see note c	$109,948,477	$21,785,334
F – Track	$139,180,782	$771,736,908	see note b	$185,955,402	see note c	$1,096,873,092	$47,275,154
G – Electrification	$137,783,131	see note a	see note a	$836,722,721	see note c	$974,505,852	$109,137,746
H – Stations	$35,810,785	see note a	see note a	$217,470,000	see note c	$253,280,785	$19,770,000
Totals	$986,641,463	$1,312,204,881	$0	$4,565,809,813	$0	$6,864,656,157	$674,172,923

NOTES: a) Included in Construction / Installation
b) Included in Equipment / Material
c) Included in Other Studies

The average costs for the major infrastructure components are as follows:

Table 4.2

Component	Units	#	Average Cost	Total Cost ($ 000)	% of Total
Land	lump sum	N/A	N/A	592,353	9
Roadway	route-km	1,248.6	2,264,000	2,826,646	41
Road Crossings	each	736	1,523,000	1,120,997	16
Track & Power Supply	route-km	1,248.6	1,659,000	2,071,379	30
Stations[4]	each	14	18,091,000	253,281	4

The above component costs include $98,6 million for environmental impact mitigation measures and studies[5].

4 includes the cost of people mover to access Dorval Airport ($ 100 million)

5 Measures include environmental storm water controls, noise-attenuations structures, wildlife-passages, and EMI Mitigation Measures. Environmental Impact Assessment Studies and contaminated soils audits also included.

4.1. WINDSOR - TORONTO

The total cost for a 200+ kph high speed railway project using existing rights-of-way to the greatest extent possible is estimated to be $2.030 billion. A breakdown of this cost by sub-system and sector is provided in Table 4.4.

The total length of the alignment studied and costed between Windsor and Toronto is 360 km. This comprises 29% of the length of the line between Québec and Windsor. The cost of this segment is also 29% of the project cost. The average costs for the major infrastructure components are as follows:

Table 4.3

Component	Units	#	Average Cost	Total Cost ($ 000)	% of Total
Land	lump sum	N/A	N/A	279,635	14
Roadway	route-km	360	2,260,000	813,470	40
Road Crossings	each	264	1,270,000	335,211	17
Track & Power Supply	route-km	360	1,601,000	576,402	28
Stations	each	3	8,412,800	25,238	1

Table 4.4

SUBSYSTEM/SECTOR COST SUMMARY

WINDSOR – TORONTO CORRIDOR **200+, TILTING**

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$24,493,603	$255,141,700	N/A	N/A	see note c	$279,635,303	$27,276,967
B – Earthworks and Drainage	$72,494,731	N/A	N/A	$306,325,270	see note c	$378,820,001	$39,955,470
C – Bridges, Viaducts, and Tunnels	$50,461,961	N/A	N/A	$306,442,950	see note c	$356,904,911	$27,858,450
D – Grade Separations	$47,394,727	N/A	N/A	$287,816,400	see note c	$335,211,127	$47,969,400
E – Other Accom–modation works	$10,992,170	see note a	see note a	$66,752,719	see note c	$77,744,890	$15,404,474
F – Track	$39,292,144	$217,507,098	see note b	$52,742,498	see note c	$309,541,741	$13,342,905
G – Electrification	$37,730,822	see note a	see note a	$229,129,910	see note c	$266,860,732	$29,886,510
H – Stations	$3,568,399	see note a	see note a	$21,670,000	see note c	$25,238,399	$1,970,000
Totals	$286,428,558	$472,648,798	$0	$1,270,879,748	see note c	$2,029,957,104	$203,664,176

NOTES: a) included in Construction / Installation
b) included in Equipment / Material
c) included in Other Studies

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4.2. TORONTO - MONTRÉAL

The total cost for a 200+ kph high speed railway project, using existing rights-of-way to the greatest extent possible, is estimated to be $3.403 billion. A breakdown of this cost by sub-system and sector is provided in Table 4.6.

The total length of the alignment studied and costed between Toronto and Montréal is 616.1 km. This comprises 48% of the length of the line between Québec and Windsor, whereas the cost of this segment is 50% of the project cost. The average costs for the major infrastructure components are as follows:

Table 4.5

Component	Units	#	Average Cost	Total Cost ($ 000)	% of Total
Land	lump sum	N/A	N/A	239,210	7
Roadway	route-km	616.1	2,094,000	1,331,829	39
Road Crossings	each	352	1,740,000	612,430	18
Track & Power Supply	route-km	616.1	1,618,000	1,029,468	30
Stations[6]	each	7	27,178,000	190,249	6

6 total cost includes $100 million people mover to serve Dorval Airport

Table 4.6

SUBSYSTEM/SECTOR COST SUMMARY

TORONTO – MONTRÉAL ALIGNMENT **200+, TILTING** TORONTO – MONTRÉAL

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$20,952,695	$218,257,243	N/A	N/A	see note c	$239,209,938	$23,333,683
B – Earthworks and Drainage	$154,422,587	N/A	N/A	$714,165,134	see note c	$868,587,721	$93,151,974
C – Bridges, Viaducts, and Tunnels	$62,417,093	N/A	N/A	$379,043,500	see note c	$441,460,593	$34,458,500
D – Grade Separations	$86,590,073	N/A	N/A	$525,840,000	see note c	$612,430,073	$87,640,000
E – Other Accom–modation works	$3,079,464	see note a	see note a	$18,700,819	see note c	$21,780,283	$4,315,574
F – Track	$69,407,733	$385,103,211	see note b	$92,565,850	see note c	$547,076,794	$23,577,825
G – Electrification	$68,204,110	see note a	see note a	$414,186,616	see note c	$482,390,726	$54,024,341
H – Stations	$26,898,845	see note a	see note a	$163,350,000	see note c	$190,248,845	$14,850,000
Totals	$491,972,599	$603,360,453	$0	$2,307,851,920	see note c	$3,403,184,972	$335,351,897

NOTES: a) included in Construction / Installation
b) included in Equipment / Material
c) included in Other Studies

4.3. MONTRÉAL - QUÉBEC

The total cost for a 200+ kph high speed railway project using existing rights-of-way to the greatest extent possible is estimated to be $1.432 billion. A breakdown of this cost by sub-system and sector is provided in Table 4.8.

The total length of the alignment studied and costed between Montréal and Québec is 272.5 km. This comprises 22% of the length of the line between Québec and Windsor, whereas the cost of this segment is 21% of the project cost. The average costs for the major infrastructure components are as follows:

Table 4.7

Component	Units	#	Average Cost	Total Cost ($ 000)	% of Total
Land	lump sum	N/A	N/A	73,508	5
Roadway	route-km	272.5	2,500,000	681,348	48
Road Crossings	each	120	1,445,000	173,356	12
Track & Power Supply	route-km	272.5	1,708,000	465,509	33
Stations	each	4	9,448,000	37,794	2

Table 4.8

SUBSYSTEM/SECTOR COST SUMMARY

MONTREAL – QUÉBEC CORRIDOR 200+, TILTING

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$6,438,627	$67,069,031	N/A	N/A	see note c	$73,507,658	$7,170,289
B – Earthworks and Drainage	$63,051,753	N/A	N/A	$288,940,220	see note c	$351,991,972	$37,687,855
C – Bridges, Viaducts, and Tunnels	$45,093,150	N/A	N/A	$273,839,500	see note c	$318,932,650	$24,894,500
D – Grade Separations	$24,510,405	N/A	N/A	$148,845,600	see note c	$173,356,005	$24,807,600
E – Other Accom–modation works	$1,473,727	see note a	see note a	$8,949,577	see note c	$10,423,304	$2,065,287
F – Track	$30,480,904	$169,126,599	see note b	$40,647,053	see note c	$240,254,557	$10,354,424
G – Electrification	$31,848,198	see note a	see note a	$193,406,195	see note c	$225,254,393	$25,226,895
H – Stations	$5,343,542	see note a	see note a	$32,450,000	see note c	$37,793,542	$2,950,000
Totals	$208,240,306	$236,195,630	$0	$987,078,146	see note c	$1,431,514,081	$135,156,850

NOTES : a) Included in Construction / Installation
b) Included in Equipment / Material
c) Included in Other Studies

4.4. PROVINCIAL TOTALS

Tables 4.9 and 4.10 present summary cost estimates for the work to be carried out in Ontario and Québec respectively.

They show that $2.166 billion or 32% of the total cost of $6.865 billion for the 200+ km/hr high speed rail project, using existing rights-of-way to the greatest extent possible, covers the cost of infrastructure constructed in the Province of Québec. The balance of $4.698 billion required for the infrastructure in the Province of Ontario represents 68% of the total cost.

Table 4.9

QUEBEC – WINDSOR CORRIDOR TOTAL

SUMMARY OF TOTAL COSTS

technology:

200+, TILTING

PROVINCE OF QUÉBEC

Sector / Subsystem	Prof. Services / Proj. Management	Equipment / Material	Transportation / distribution	Construction / Installation	Start -- up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$6,663,309	$69,409,473	N/A	N/A	see note c	$76,072,783	$7,420,504
B – Earthworks and Drainage	$89,724,641	N/A	N/A	$402,873,146	see note c	$492,597,787	$52,548,671
C – Bridges, Viaducts, and Tunnels	$80,501,811	N/A	N/A	$488,867,500	see note c	$569,369,311	$44,442,500
D – Grade Separations	$34,570,820	N/A	N/A	$209,940,000	see note c	$244,510,820	$34,990,000
E – Other Accom– modation works	$1,654,468	see note a	see note a	$10,047,172	see note c	$11,701,639	$2,318,578
F – Track	$40,069,183	$222,788,090	see note b	$53,121,543	see note c	$315,978,817	$13,615,836
G – Electrification	$40,689,130	see note a	see note a	$247,094,980	see note c	$287,784,110	$32,229,780
H – Stations	$23,819,516	see note a	see note a	$144,650,000	see note c	$168,469,516	$13,150,000
Totals	$317,692,878	$292,197,563	$0	$1,556,594,341	$0	$2,166,484,783	$200,715,869

NOTES: a) Included in Construction / Installation

b) Included in Equipment / Material

c) Included in Other Studies

Table 4.10

QUEBEC – WINDSOR CORRIDOR TOTAL

SUMMARY OF TOTAL COSTS

technology:
200+, TILTING

PROVINCE OF ONTARIO

Sector / Subsystem	Prof. Services / Proj. Management	Equipment / Material	Transportation / distribution	Construction / Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$45,221,616	$471,058,500	N/A	N/A	see note c	$516,280,116	$50,360,436
B – Earthworks and Drainage	$200,244,430	N/A	N/A	$906,557,478	see note c	$1,106,801,907	$118,246,628
C – Bridges, Viaducts, and Tunnels	$77,470,393	N/A	N/A	$470,458,450	see note c	$547,928,843	$42,768,950
D – Grade Separations	$123,924,385	N/A	N/A	$752,562,000	see note c	$876,486,385	$125,427,000
E – Other Accom– modation works	$13,890,893	see note a	see note a	$84,355,944	see note c	$98,246,838	$19,466,756
F – Track	$99,111,598	$548,948,818	see note b	$132,833,859	see note c	$780,894,275	$33,659,318
G – Electrification	$97,094,000	see note a	see note a	$589,627,741	see note c	$686,721,741	$76,907,966
H – Stations	$11,991,269	see note a	see note a	$72,820,000	see note c	$84,811,269	$6,620,000
Totals	$668,948,584	$1,020,007,318	$0	$3,009,215,472	$0	$4,698,171,374	$473,457,054

NOTES: a) Included in Construction / Installation
b) Included in Equipment / Material
c) Included in Other Studies

5. 300+ km/hr - EXISTING RIGHTS-OF-WAY

The total cost for a 300+ kph high speed railway project covering 1,211 km from Windsor to Québec City and using existing rights-of-way to the greatest extent possible is estimated to be $7.824 billion. This results in an average cost of $ 6.46 million per kilometre. A breakdown of this cost by sub-system and sector is provided in Table 5.1.

The percentage of the total cost allocated to each sub-system is presented in the pie chart in Figure 5.i.

Figure 5.i - 300+ km/hr on Existing R/W
Breakdown of Costs by Sub-system

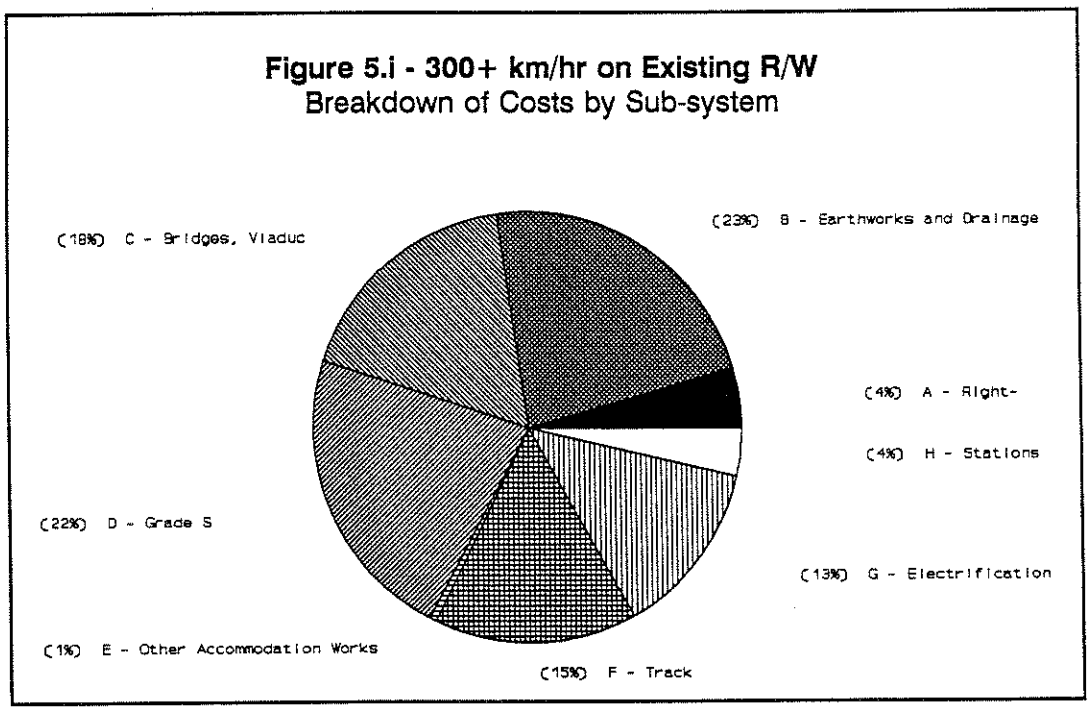

Table 5.1

QUEBEC – WINDSOR CORRIDOR TOTAL — **SUMMARY OF TOTAL COSTS**

technology:

300+, EXISTING ROW

Sector / Subsystem	Prof. Services / Proj. Management	Equipment / Material	Transportation / distribution	Construction / Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$57,672,772	$600,758,046	N/A	N/A	see note c	$658,430,818	$64,226,497
B – Earthworks and Drainage	$315,680,170	N/A	N/A	$1,402,737,030	see note c	$1,718,417,200	$182,965,700
C – Bridges, Viaducts, and Tunnels	$175,077,152	N/A	N/A	$1,063,200,050	see note c	$1,238,277,202	$96,654,550
D – Grade Separations	$271,506,735	N/A	N/A	$1,648,792,950	see note c	$1,920,299,685	$215,059,950
E – Other Accom–modation works	$16,861,718	see note a	see note a	$102,397,023	see note c	$119,258,741	$23,630,082
F – Track	$137,384,985	$767,721,877	see note b	$179,528,196	see note c	$1,084,635,058	$46,720,158
G – Electrification	$130,884,794	see note a	see note a	$794,830,838	see note c	$925,715,632	$103,673,588
H – Stations	$22,406,647	see note a	see note a	$136,070,000	see note c	$158,476,647	$12,370,000
Totals	$1,127,474,974	$1,368,479,923	$0	$5,327,556,085	$0	$7,823,510,982	$745,300,524

NOTES: a) Included in Construction / Installation
b) Included in Equipment / Material
c) Included in Other Studies

The average costs for the major infrastructure components are as follows:

Table 5.2

Component	Units	#	Average Cost	Total Cost ($ 000)	% of Total
Land	lump sum	N/A	N/A	658,430	8
Roadway	route-km	1,211	2,540,000	3,075,953	39
Road Crossings	each	668	2,875,000	1,920,300	25
Track & Power Supply	route-km	1,211	1,660,000	2,010,351	26
Stations	each	14	11,320,000	158,477	2

The above component costs include $130 million for environmental impact mitigation measures and studies.

5.1. WINDSOR - TORONTO

The total cost for a 300+ kph high speed railway project using existing rights-of-way to the greatest extent possible is estimated to be $2.424 billion. A breakdown of this cost by sub-system and sector is provided in Table 5.4.

The total length of the alignment studied and costed between Windsor and Toronto is 365 km. This comprises 30% of the length of the line between Québec and Windsor, whereas the cost of this segment is 31% of the project cost. The average costs for the major infrastructure components are as follows:

Table 5.3

Component	Units	#	Average Cost	Total Cost ($ 000)	% of Total
Land	lump sum	N/A	N/A	322,670	13
Roadway	route-km	365	2,590,000	945,220	39
Road Crossings	each	189	2,892,000	546,539	23
Track & Power Supply	route-km	365	1,602,000	584,593	24
Stations	each	3	8,413,000	25,238	1

Table 5.4

SUBSYSTEM/SECTOR COST SUMMARY

WINDSOR – TORONTO CORRIDOR **300+, EXISTING ROW**

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$28,263,101	$294,407,300	N/A	N/A	see note c	$322,670,401	$31,474,817
B – Earthworks and Drainage	$84,428,418	N/A	N/A	$352,880,950	see note c	$437,309,368	$46,027,950
C – Bridges, Viaducts, and Tunnels	$60,727,628	N/A	N/A	$368,783,800	see note c	$429,511,428	$33,525,800
D – Grade Separations	$77,273,958	N/A	N/A	$469,265,550	see note c	$546,539,508	$61,208,550
E – Other Accom–modation works	$11,084,670	see note a	see note a	$67,314,447	see note c	$78,399,118	$15,534,103
F – Track	$40,285,248	$224,663,613	see note b	$52,951,011	see note c	$317,899,872	$13,695,494
G – Electrification	$37,707,151	see note a	see note a	$228,986,160	see note c	$266,693,311	$29,867,760
H – Stations	$3,568,399	see note a	see note a	$21,670,000	see note c	$25,238,399	$1,970,000
Totals	$343,338,573	$519,070,913	$0	$1,561,851,919	see note c	$2,424,261,404	$233,304,474

NOTES: a) included in Construction / Installation
b) included in Equipment / Material
c) included in Other Studies

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5.2. TORONTO - MONTRÉAL

The total cost for a 300+ kph high speed railway project using existing rights-of-way, is estimated to be $3.996 billion. A breakdown of this cost by sub-system and sector is provided in Table 5.6.

The total length of the alignment studied and costed between Toronto and Montréal is 591.1 km. This comprises 49% of the length of the line between Québec and Windsor, whereas the cost of this segment is 51% of the project cost. The average costs for the major infrastructure components are as follows:

Table 5.5

Component	Units	#	Average Cost	Total Cost ($ 000)	% of Total
Land	lump sum	N/A	N/A	271,224	7
Roadway	route-km	591.1	2,692,000	1,591,217	40
Road Crossings	each	366	2,775,000	1,015,678	25
Track & Power Supply	route-km	591.1	1,715,000	1,013,678	25
Stations	each	8	12,972,000	103,772	3

Table 5.6

SUBSYSTEM/SECTOR COST SUMMARY

TORONTO – MONTRÉAL ALIGNMENT **300+, EXISTING ROW** TORONTO – MONTRÉAL

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$23,756,855	$247,467,243	N/A	N/A	see note c	$271,224,098	$26,456,498
B – Earthworks and Drainage	$170,418,455	N/A	N/A	$772,515,818	see note c	$942,934,273	$100,762,933
C – Bridges, Viaducts, and Tunnels	$87,284,033	N/A	N/A	$530,054,250	see note c	$617,338,283	$48,186,750
D – Grade Separations	$143,604,384	N/A	N/A	$872,073,750	see note c	$1,015,678,134	$113,748,750
E – Other Accom–modation works	$4,375,171	see note a	see note a	$26,569,324	see note c	$30,944,495	$6,131,382
F – Track	$69,089,825	$387,099,143	see note b	$89,593,375	see note c	$545,782,342	$23,504,616
G – Electrification	$66,154,714	see note a	see note a	$401,741,144	see note c	$467,895,858	$52,401,019
H – Stations	$14,672,097	see note a	see note a	$89,100,000	see note c	$103,772,097	$8,100,000
Totals	$579,355,534	$634,566,386	$0	$2,781,647,660	see note c	$3,995,569,581	$379,291,948

NOTES: a) included in Construction / Installation
b) included in Equipment / Material
c) included in Other Studies

5.3. MONTRÉAL - QUÉBEC

The total cost for a 300+ kph high speed railway project using existing rights-of-way to the greatest extent possible is estimated to be $1.404 billion. A breakdown of this cost by sub-system and sector is provided in Table 5.8.

The total length of the alignment studied and costed between Montréal and Québec is 255.1 km. This comprises 21% of the length of the line between Québec and Windsor, whereas the cost of this segment is 18% of the project cost. The average costs for the major infrastructure components are as follows:

Table 5.7

Component	Units	#	Average Cost	Total Cost ($ 000)	% of Total
Land	lump sum	N/A	N/A	49,729	5
Roadway	route-km	255.1	2,115,000	539,516	38
Road Crossings	each	113	3,169,000	358,082	26
Track & Power Supply	route-km	255.1	1,615,000	412,079	29
Stations	each	3	9,822,000	29,466	2

As the Toronto-Montréal and Montréal-Québec segments of this option use the identical alignment between Central Station and St. Martin Jct., the costs presented here only cover the territory between St. Martin Jct. and Québec City. The line between Central Station and St. Martin Jct. is assumed to have been constructed as part of the Toronto-Montréal segment. This shared portion of line is 16.2 km long and costs $212 million. It includes a 2.6 km long tunnel costing $91 million.

Table 5.8

SUBSYSTEM/SECTOR COST SUMMARY

MONTREAL – QUÉBEC CORRIDOR 300+, EXISTING ROW

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$5,652,816	$58,883,503	N/A	N/A	see note c	$64,536,319	$6,295,182
B – Earthworks and Drainage	$60,833,297	N/A	N/A	$277,340,262	see note c	$338,173,559	$36,174,817
C – Bridges, Viaducts, and Tunnels	$27,065,491	N/A	N/A	$164,362,000	see note c	$191,427,491	$14,942,000
D – Grade Separations	$50,628,393	N/A	N/A	$307,453,650	see note c	$358,082,043	$40,102,650
E – Other Accom–modation works	$1,401,877	see note a	see note a	$8,513,251	see note c	$9,915,128	$1,964,596
F – Track	$28,009,913	$155,959,121	see note b	$36,983,810	see note c	$220,952,843	$9,520,048
G – Electrification	$27,022,929	see note a	see note a	$164,103,534	see note c	$191,126,463	$21,404,809
H – Stations	$4,166,151	see note a	see note a	$25,300,000	see note c	$29,466,151	$2,300,000
Totals	$204,780,866	$214,842,624	$0	$984,056,506	see note c	$1,403,679,996	$132,704,102

NOTES : a) Included in Construction / Installation
b) Included in Equipment / Material
c) Included in Other Studies

5.4. PROVINCIAL TOTALS

Tables 5.9 and 5.10 present summary cost estimates for the work to be carried out in Ontario and Québec respectively.

They show that $2.061 billion or 26% of the total cost of $7.824 billion for the 300+ km/hr high speed rail project, using existing rights-of-way, covers the cost of infrastructure constructed in the Province of Québec. The balance of $5.763 billion required for the infrastructure in the Province of Ontario represents 74% of the total cost.

Table 5.9

QUEBEC – WINDSOR CORRIDOR TOTAL

SUMMARY OF TOTAL COSTS

technology:

300+, EXISTING ROW

PROVINCE OF QUÉBEC

Sector / Subsystem	Prof. Services / Proj. Management	Equipment / Material	Transportation / distribution	Construction / Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$7,701,137	$80,220,177	N/A	N/A	see note c	$87,921,314	$8,576,266
B – Earthworks and Drainage	$85,704,378	N/A	N/A	$385,310,300	see note c	$471,014,678	$50,257,865
C – Bridges, Viaducts, and Tunnels	$52,101,341	N/A	N/A	$316,398,500	see note c	$368,499,841	$28,763,500
D – Grade Separations	$65,485,834	N/A	N/A	$397,679,200	see note c	$463,165,034	$51,871,200
E – Other Accom– modation works	$1,510,955	see note a	see note a	$9,175,654	see note c	$10,686,609	$2,117,459
F – Track	$39,312,642	$220,221,061	see note b	$51,007,335	see note c	$310,541,038	$13,373,925
G – Electrification	$38,916,570	see note a	see note a	$236,330,664	see note c	$275,247,234	$30,825,739
H – Stations	$10,415,378	see note a	see note a	$63,250,000	see note c	$73,665,378	$5,750,000
Totals	$301,148,235	$300,441,238	$0	$1,459,151,653	$0	$2,060,741,126	$191,535,954

NOTES: a) Included in Construction / Installation

b) Included in Equipment / Material

c) Included in Other Studies

Table 5.10

QUEBEC – WINDSOR CORRIDOR TOTAL — **SUMMARY OF TOTAL COSTS**

technology:

300+, EXISTING ROW — **PROVINCE OF ONTARIO**

Sector / Subsystem	Prof. Services / Proj. Management	Equipment / Material	Transportation / distribution	Construction / Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$49,971,635	$520,537,868	N/A	N/A	see note c	$570,509,504	$55,650,230
B – Earthworks and Drainage	$229,975,792	N/A	N/A	$1,017,426,729	see note c	$1,247,402,521	$132,707,834
C – Bridges, Viaducts, and Tunnels	$122,975,811	N/A	N/A	$746,801,550	see note c	$869,777,361	$67,891,050
D – Grade Separations	$206,020,901	N/A	N/A	$1,251,113,750	see note c	$1,457,134,651	$163,188,750
E – Other Accom–modation works	$15,350,763	see note a	see note a	$93,221,369	see note c	$108,572,131	$21,512,624
F – Track	$98,072,343	$547,500,816	see note b	$128,520,860	see note c	$774,094,019	$33,346,233
G – Electrification	$91,968,224	see note a	see note a	$558,500,174	see note c	$650,468,397	$72,847,849
H – Stations	$11,991,269	see note a	see note a	$72,820,000	see note c	$84,811,269	$6,620,000
Totals	$826,326,739	$1,068,038,684	$0	$3,868,404,432	$0	$5,762,769,855	$553,764,570

NOTES: a) Included in Construction / Installation
b) Included in Equipment / Material
c) Included in Other Studies

6. 300+ km/hr - NEW RIGHTS-OF-WAY

The total cost for a 300+ kph high speed railway project covering 1,245 km from Windsor to Québec City and using new rights-of-way to the greatest extent possible is estimated to be $9.506 billion. This results in an average cost of $7.63 million per kilometre. A breakdown of this cost by sub-system and sector is provided in Table 6.1.

The percentage of the total cost allocated to each sub-system is presented in the pie chart in Figure 6.i.

Figure 6.i - 300+ km/hr on New R/W
Breakdown of Costs by Sub-system

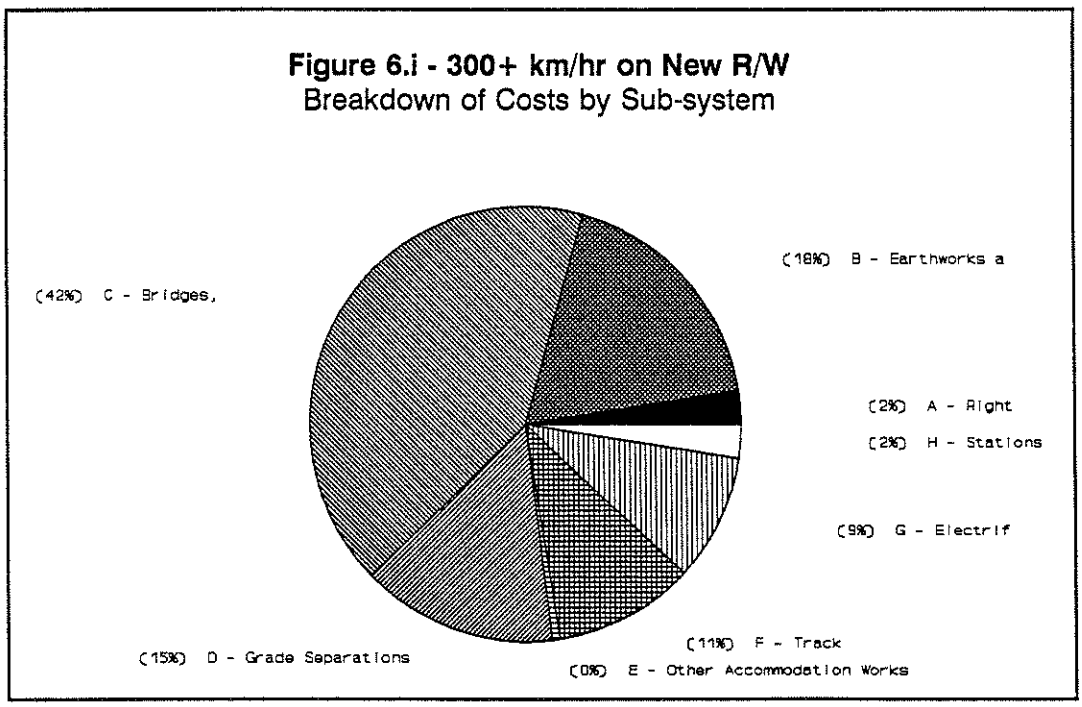

Table 6.1

QUEBEC – WINDSOR CORRIDOR TOTAL — **SUMMARY OF TOTAL COSTS**

technology:

300+, NEW ROW

Sector / Subsystem	Prof. Services / Proj. Management	Equipment / Material	Transportation / distribution	Construction / Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$41,590,906	$433,238,603	N/A	N/A	see note c	$474,829,509	$46,317,145
B – Earthworks and Drainage	$363,385,073	N/A	N/A	$1,583,393,594	see note c	$1,946,778,667	$206,529,599
C – Bridges, Viaducts, and Tunnels	$357,896,824	N/A	N/A	$2,173,418,500	see note c	$2,531,315,324	$197,583,500
D – Grade Separations	$273,852,089	N/A	N/A	$1,663,035,700	see note c	$1,936,887,789	$216,917,700
E – Other Accom– modation works	$21,881,523	see note a	see note a	$132,881,054	see note c	$154,762,577	$30,664,859
F – Track	$141,603,249	$791,740,254	see note b	$184,737,929	see note c	$1,118,081,433	$48,158,781
G – Electrification	$133,811,865	see note a	see note a	$812,606,215	see note c	$946,418,080	$105,992,115
H – Stations	$56,098,129	see note a	see note a	$340,670,000	see note c	$396,768,129	$30,970,000
Totals	$1,390,119,659	$1,224,978,858	$0	$6,890,742,992	$0	$9,505,841,509	$883,133,699

NOTES: a) Included in Construction / Installation
b) Included in Equipment / Material
c) Included in Other Studies

The average costs for the major infrastructure components are as follows:

Table 6.2

Component	Units	#	Average Cost	Total Cost ($ 000)	% of Total
Land	lump sum	N/A	N/A	474,830	4
Roadway	route-km	1,245.4	3,720,000	4,632,857	51
Road Crossings	each	645	3,003,000	1,936,888	21
Track & Power Supply	route-km	1,245.4	1,658,000	2,064,500	22
Stations[7]	each	15	26,451,000	396,768	2

The above component costs include $111.8 million for environmental impact mitigation measures and studies.

7 includes $230 million for a people mover at Pearson Airport

6.1. WINDSOR - TORONTO

The total cost for a 300+ kph high speed railway project using new rights-of-way to the greatest extent possible is estimated to be $2.634 billion. A breakdown of this cost by sub-system and sector is provided in Table 6.4.

The total length of the alignment studied and costed between Windsor and Toronto is 375 km. This comprises 30% of the length of the line between Québec and Windsor, whereas the cost of this segment is 28% of the project cost. The average costs for the major infrastructure components are as follows:

Table 6.3

Component	Units	#	Average Cost	Total Cost ($ 000)	% of Total
Land	lump sum	N/A	N/A	207,958	8
Roadway	route-km	375	2,405,000	901,970	34
Road Crossings	each	208	3,172,000	659,724	25
Track & Power Supply	route-km	375	1,603,000	601,310	23
Stations[8]	each	4	65,882,000	263,530	10

[8] includes $230 million for a people mover at Pearson Airport

Table 6.4

SUBSYSTEM/SECTOR COST SUMMARY

WINDSOR – TORONTO CORRIDOR **300+, NEW ROW**

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$18,215,261	$189,742,300	N/A	N/A	see note c	$207,957,561	$20,285,177
B – Earthworks and Drainage	$96,299,595	N/A	N/A	$411,708,165	see note c	$508,007,760	$53,701,065
C – Bridges, Viaducts, and Tunnels	$42,626,517	N/A	N/A	$258,860,250	see note c	$301,486,767	$23,532,750
D – Grade Separations	$93,276,902	N/A	N/A	$566,447,450	see note c	$659,724,352	$73,884,450
E – Other Accom–modation works	$13,074,833	see note a	see note a	$79,400,211	see note c	$92,475,043	$18,323,126
F – Track	$42,061,242	$234,967,397	see note b	$55,014,672	see note c	$332,043,312	$14,302,962
G – Electrification	$38,071,007	see note a	see note a	$231,195,770	see note c	$269,266,777	$30,155,970
H – Stations	$37,259,881	see note a	see note a	$226,270,000	see note c	$263,529,881	$20,570,000
Totals	$380,885,238	$424,709,697	$0	$1,828,896,518	see note c	$2,634,491,453	$254,755,499

NOTES: a) included in Construction / Installation
b) included in Equipment / Material
c) included in Other Studies

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6.2. TORONTO - MONTRÉAL

The total cost for a 300+ kph high speed railway project using new rights-of-way to the greatest extent possible is estimated to be $5.431 billion. A breakdown of this cost by sub-system and sector is provided in Table 6.6.

The total length of the alignment studied and costed between Toronto and Montréal is 613.0 km. This comprises 49% of the length of the line between Québec and Windsor, whereas the cost of this segment is 57% of the project cost. The average costs for the major infrastructure components are as follows:

Table 6.5

Component	Units	#	Average Cost	Total Cost ($ 000)	% of Total
Land	lump sum	N/A	N/A	213,084	4
Roadway	route-km	613.0	5,100,000	3,126,595	58
Road Crossings	each	334	2,821,000	942,117	17
Track & Power Supply	route-km	613.0	1,705,000	1,045,124	19
Stations	each	8	12,972,000	103,772	2

Table 6.6

SUBSYSTEM/SECTOR COST SUMMARY

TORONTO – MONTRÉAL ALIGNMENT **300+, NEW ROW** TORONTO – MONTRÉAL

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$18,664,318	$194,419,975	N/A	N/A	see note c	$213,084,292	$20,785,263
B – Earthworks and Drainage	$203,304,073	N/A	N/A	$878,814,814	see note c	$1,082,118,887	$114,628,019
C – Bridges, Viaducts, and Tunnels	$281,538,975	N/A	N/A	$1,709,716,250	see note c	$1,991,255,225	$155,428,750
D – Grade Separations	$133,203,778	N/A	N/A	$808,913,450	see note c	$942,117,228	$105,510,450
E – Other Accom–modation works	$7,524,806	see note a	see note a	$45,696,280	see note c	$53,221,086	$10,545,295
F – Track	$71,120,904	$398,311,251	see note b	$92,340,882	see note c	$561,773,037	$24,194,045
G – Electrification	$68,339,927	see note a	see note a	$415,011,396	see note c	$483,351,323	$54,131,921
H – Stations	$14,672,097	see note a	see note a	$89,100,000	see note c	$103,772,097	$8,100,000
Totals	$798,368,877	$592,731,226	$0	$4,039,593,072	see note c	$5,430,693,175	$493,323,743

NOTES: a) included in Construction / Installation
b) included in Equipment / Material
c) included in Other Studies

6.3. MONTRÉAL - QUÉBEC

The total cost for a 300+ kph high speed railway project using new rights-of-way to the greatest extent possible is estimated to be $1.441 billion. A breakdown of this cost by sub-system and sector is provided in Table 6.8.

The total length of the alignment studied and costed between Montréal and Québec is 257.4 km. This comprises 21% of the length of the line between Québec and Windsor, whereas the cost of this segment is 15% of the project cost. The average costs for the major infrastructure components are as follows:

Table 6.7

Component	Units	#	Average Cost	Total Cost ($ 000)	% of Total
Land	lump sum	N/A	N/A	53,788	4
Roadway	route-km	257.4	2,348,000	604,292	42
Road Crossings	each	103	3,253,000	335,046	23
Track & Power Supply	route-km	257.4	1,624,000	418,065	29
Stations	each	3	9,822,000	29,466	2

As the Toronto-Montréal and Montréal-Québec segments of this option use the identical alignment between Central Station and St. Martin Jct., the costs presented here only cover the territory between St. Martin Jct. and Québec City. The line between Central Station and St. Martin Jct. is assumed to have been constructed as part of the Toronto-Montréal segment. This shared portion of line is 16.2 km long and costs $212 million. It includes a 2.6 km long tunnel costing $91 million.

Table 6.8

SUBSYSTEM/SECTOR COST SUMMARY

MONTREAL – QUÉBEC CORRIDOR 300+, NEW ROW

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$4,711,328	$49,076,328	N/A	N/A	see note c	$53,787,656	$5,246,706
B – Earthworks and Drainage	$63,781,405	N/A	N/A	$292,870,615	see note c	$356,652,020	$38,200,515
C – Bridges, Viaducts, and Tunnels	$33,731,332	N/A	N/A	$204,842,000	see note c	$238,573,332	$18,622,000
D – Grade Separations	$47,371,409	N/A	N/A	$287,674,800	see note c	$335,046,209	$37,522,800
E – Other Accom–modation works	$1,281,884	see note a	see note a	$7,784,564	see note c	$9,066,448	$1,796,438
F – Track	$28,421,103	$158,461,606	see note b	$37,382,375	see note c	$224,265,084	$9,661,774
G – Electrification	$27,400,931	see note a	see note a	$166,399,049	see note c	$193,799,980	$21,704,224
H – Stations	$4,166,151	see note a	see note a	$25,300,000	see note c	$29,466,151	$2,300,000
Totals	$210,865,544	$207,537,934	$0	$1,022,253,403	see note c	$1,440,656,880	$135,054,456

NOTES : a) Included in Construction / Installation
b) Included in Equipment / Material
c) Included in Other Studies

6.4. PROVINCIAL TOTALS

Tables 6.9 and 6.10 present summary cost estimates for the work to be carried out in Ontario and Québec respectively.

They show that $3.786 billion or 40% of the total cost of $9.506 billion for the 300+ km/hr high speed rail project, using new rights-of-way to the greatest extent possible, covers the cost of infrastructure constructed in the Province of Québec. The balance of $5.720 billion required for the infrastructure in the Province of Ontario represents 60% of the total cost.

Table 6.9

QUEBEC – WINDSOR CORRIDOR TOTAL — **SUMMARY OF TOTAL COSTS**

technology:

300+, NEW ROW — **PROVINCE OF QUÉBEC**

Sector / Subsystem	Prof. Services / Proj. Management	Equipment / Material	Transportation / distribution	Construction / Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$7,654,177	$79,731,007	N/A	N/A	see note c	$87,385,184	$8,523,970
B – Earthworks and Drainage	$133,008,142	N/A	N/A	$559,890,719	see note c	$692,898,861	$73,029,224
C – Bridges, Viaducts, and Tunnels	$222,710,659	N/A	N/A	$1,352,466,500	see note c	$1,575,177,159	$122,951,500
D – Grade Separations	$78,476,082	N/A	N/A	$476,565,750	see note c	$555,041,832	$62,160,750
E – Other Accom– modation works	$2,075,989	see note a	see note a	$12,606,967	see note c	$14,682,956	$2,909,300
F – Track	$52,728,683	$295,416,645	see note b	$68,386,054	see note c	$416,531,382	$17,938,368
G – Electrification	$50,612,571	see note a	see note a	$307,357,568	see note c	$357,970,138	$40,090,118
H – Stations	$12,226,748	see note a	see note a	$74,250,000	see note c	$86,476,748	$6,750,000
Totals	$559,493,050	$375,147,652	$0	$2,851,523,557	$0	$3,786,164,259	$334,353,229

NOTES: a) Included in Construction / Installation
b) Included in Equipment / Material
c) Included in Other Studies

Table 6.10

QUEBEC – WINDSOR CORRIDOR TOTAL — **SUMMARY OF TOTAL COSTS**

technology:

300+, NEW ROW — **PROVINCE OF ONTARIO**

Sector / Subsystem	Prof. Services / Proj. Management	Equipment / Material	Transportation / distribution	Construction / Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$33,936,729	$353,507,596	N/A	N/A	see note c	$387,444,325	$37,793,176
B – Earthworks and Drainage	$230,376,931	N/A	N/A	$1,023,502,875	see note c	$1,253,879,806	$133,500,375
C – Bridges, Viaducts, and Tunnels	$135,186,166	N/A	N/A	$820,952,000	see note c	$956,138,166	$74,632,000
D – Grade Separations	$195,376,007	N/A	N/A	$1,186,469,950	see note c	$1,381,845,957	$154,756,950
E – Other Accom–modation works	$19,805,534	see note a	see note a	$120,274,087	see note c	$140,079,621	$27,755,559
F – Track	$88,874,566	$496,323,610	see note b	$116,351,875	see note c	$701,550,051	$30,220,413
G – Electrification	$83,199,295	see note a	see note a	$505,248,648	see note c	$588,447,942	$65,901,998
H – Stations	$43,871,381	see note a	see note a	$266,420,000	see note c	$310,291,381	$24,220,000
Totals	$830,626,609	$849,831,205	$0	$4,039,219,435	$0	$5,719,677,249	$548,780,470

NOTES: a) Included in Construction / Installation
b) Included in Equipment / Material
c) Included in Other Studies

7. ESTIMATE ACCURACY

7.1. GENERAL

This evaluation of the overall accuracy of this cost estimate is built up from assessments of the accuracy of the costs in each sub-system which are based on the experience and judgement of our individual consultants in each of their specializations.

When properly stated, an evaluation of the accuracy of a cost estimate should define a probability that the actual cost of the project will fall within a certain confidence limit of the estimated cost. (eg. there is a 90% probability that the final cost will be within ±30% of the estimate). However, it is more common to think of estimate accuracy in a manner which only addresses the confidence limit (possible range of the final cost) without specifying a probability (i.e. - a cost is accurate to ± X%).

The assessments of accuracy for each sub-system were formulated along the second approach. In order to take these individual assessments by sub-system and combine them into an assessment of the accuracy of the overall cost estimate (including a statement regarding the probability of achieving the confidence limits), we have elected to use a "Monte Carlo" type analysis.

In a Monte Carlo analysis a probability density function is used to randomly generate component costs for the estimate. The component costs are then combined to produce a "possible" total project cost. Through repetition of this process, the analysis generates a "population" of possible total project costs. This population can then be analyzed to obtain a mean value and the characteristics of its distribution. These characteristics then allow us to state the accuracy of the total cost as a probability that the actual cost will fall within a specified confidence limit.

Performing this Monte Carlo analysis has required that the Consultant make the following 3 assumptions:

- that the cost estimates produced for the individual sub-systems are independent of each other,

- that the probability density function for the actual costs with respect to the estimated cost for any sub-system and/or the overall project cost would follow a "normal" distribution about the base estimate, and
- that the probability of sub-system costs falling within the ranges estimated by the consultants is approximately 2 times in 3[8].

7.2. SUB-SYSTEM ACCURACY

The assessment of the overall accuracy of this cost estimate has been built upon the anticipated accuracy for the costs developed within each of the sub-systems. The following table presents the level of accuracy as estimated by the specialists developing the unit costs and quantities.

Table 7.1

Sub-system	Estimated Accuracy
A - Right-of-Way Acquisition	25 %
B - Earthworks and Drainage	35 %
C - Bridges, Viaducts, and Tunnels	15 %
D - Grade Separations	15 %
E - Other Accommodation Works	50 %
F - Track	10 %
G - Electrification	15 %
H - Stations	20 %

The accuracy of a cost estimate can be a function of several different factors. These may include the volatility of prices in the marketplace, the level of detail used in establishing quantities and unit costs, and whether the type of work being considered is common or rare.

To a certain extent, many of the potential sources for variation in this cost estimate have been limited through assumptions (Section 3) governing the costing process or in the approach to the study. Examples of this follow:

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8 This assumption establishes a probability density function for the confidence limits proposed by the consultants for each sub-system. It is considered to be fairly conservative as it accepts the possibility of the estimate falling outside the range estimated by the consultant as often as 1 time in 3. These conditions are equivalent to a "normalized" standard deviation of 1.

- The consultant has been directed to use 1993 costs with no allowance for escalation over the duration of the project. As a result, our assessment of estimate accuracy need not account for inaccuracies in the evaluation of future levels of inflation. Presumably, this will be addressed through sensitivity analyses in the financial and economic evaluations.
- The screening process used in the first phase of our work has helped to limit the potential for variation in the length of each of the alignments. There is a variation of 22.6 km between the three speed/routing options. This is equivalent to a variation of less than 2%. In view of this, the potential for variation within any of the three options must be less. This potential for variations in length has a direct and proportional impact on cost for many sub-systems - R/W Acquisition, Earthworks, Track, Electrification.

In addition to the factors which have an impact on the accuracy of all sub-systems, there are differences in how the costs and quantities have been developed within each. These differences have produced the different accuracies in the above table. The subsequent paragraphs provide a short description of these additional factors affecting accuracy.

7.2.1. Right-of-Way Acquisition

Land quantities have been determined from ROW widths projected from the design hypotheses used. These have been defined in Interim Report No. 2. There is potential for variation in these quantities on account of the necessity to make assumptions about ROW widths over long lengths of the line.

The wide variation in land costs according to location and additional allowances for buildings and disruption damages along the proposed routes precluded the use of a single set of unit costs for the various land types in this sub-system. Multiplication factors were applied to land costs to account for the costs of buildings which might exist on the land as well as for damages to be paid for disruption to existing land owners. In view of the above, Right-of-Way sub-system accuracy is judged to be in the order of ±25%.

7.2.2. Earthworks and Drainage

The two primary elements influencing the cost of sub-items falling under this sub-system are the quantities of each sub-item and the unit cost adopted for the cost calculation. The factors affecting the accuracy of the former, quantities, will be discussed first.

One of the major sub-items in the earthworks category is roadbed preparation, required prior to construction of embankments or sub-ballast layers in cuts. The various types of roadbed preparation assumed, have been based on practices adopted for high speed lines in Europe. Hence, they are considered to be a reasonably accurate representation of the extent of removal, replacement, and compaction required. Since the need for each type of preparation is a function of the existing ground condition over which the alignment passes, the accuracy of the quantities depends on an assessment of these ground conditions. For this feasibility study three categories of ground condition quality were defined and, using geological mapping, the extent of each condition along the route alignment was assessed. This mapping interpretation is the first area with potential for inaccuracy and given that the routes could only be plotted at large scale, the assessment can only be considered a reasonable approximation.

The second major earthworks sub-item is the construction of embankments and cuts themselves. Quantities of each are derived from the track profile developed for each route and a representation of the existing ground elevation along it. The latter could only be approximated from available contour mapping, most of which was based on a 10 metre contour interval requiring significant interpolation. Consequently some inaccuracy must be expected. The other area necessitating interpretation, is the breakdown of the total volume of earth excavated for cuts, into rock and soft material classifications. This breakdown also relied on the large scale geological mapping for depth to rock estimations. Thus, it was only possible to approximate the distribution of material type.

Drainage sub-items make up a smaller part of the total sub-system cost. To reflect a reasonable cost for general right-of-way drainage, a typical design was developed and costed for a 1 km length of route. Quantities of major drainage structures were estimated from interpretation of the large scale topographical mapping. While this approach to estimation of drainage requirements, can only be an approximation, it is believed to be accurate to within 25-30%.

The quantities for the selected sub-ballast layers can be determined with accuracy as they are based on a constant cross-section applied over a route length which can be measured reasonably accurately. Similarly, security fencing quantities are also derived from known route lengths.

As noted earlier, the other major element affecting the accuracy of the earthworks and drainage cost is the unit price assumed for each sub-item. The prices used are considered to be representative of the likely tender prices for contracts in a high speed rail project as they were obtained from actual contracts for large scale highway earthworks currently in progress. Further confirmation of the appropriateness of the unit prices was provided by a generally favourable review by the contract department of the Ontario Ministry of Transportation. One factor which could influence the accuracy of the unit prices is the very competitive pricing prevalent in the civil construction industry at the moment. A different pricing environment when high speed rail is implemented could increase prices.

Given the potential for significant variability in quantities and to some extent prices, the overall accuracy of the earthworks and drainage sub-system is assessed as plus or minus 35%.

7.2.3. Bridges, Viaducts, and Tunnels

As with the earthworks and drainage sub-system, the overall accuracy of the estimate for this structural subsystem is a function of the method for determining quantities and the use of realistic, current unit prices representative of the bridge and tunnel work for a megaproject such as the high speed rail system.

The mapping used to develop alignment has permitted a reasonably accurate assessment of the number of river bridges or viaducts required since most creeks and rivers of varying size are shown on the mapping used. It is in the estimation of the length and to a lesser extent, the height of the structures that uncertainty could occur in the quantity calculations. Although a track profile of each representative route was prepared, the lack of mapping with a small contour interval to define river valley topography necessitated some approximation in estimating bridge or viaduct lengths.

In the case of tunnels, the greatest uncertainty lies in the types of ground through which the tunnels are constructed. Detailed information is essential to estimate

tunnelling cost with precision, as unit costs vary considerably with different types of ground conditions. For the tunnelling locations identified, rock conditions were assumed, consequently costs may be under-estimated if soft or variable ground conditions actually occur at the proposed tunnel sites.

Unit prices for bridges and viaducts were estimated from prices obtained in contracts for bridges of a similar size and type to those required for high speed rail tracks. Since these prices do not fully reflect the benefits of large volume, standardized bridge building, as would be possible in a high speed rail project, they could be considered conservative. However, current structure costs are also very competitive due to the present recessionary environment. Taking into account the above quantity and cost variables and the estimating methodology used, the construction costs derived for the bridges, viaducts and tunnels sub-system are considered to have an accuracy of plus or minus 15%.

7.2.4. Grade Separations

It has been possible to determine the number of locations of potential grade separations reasonably, since most existing road and rail crossings of the representative routes are evident from the mapping used. The only uncertainty in estimating the number of grade separations lies in the assessment of the need for a grade separation versus closure or diversion of the intersecting road or rail facility.

In order to determine a representative cost for grade separating the high speed rail routes, categories of grade separation were established and the crossings shown on the mapping were allocated to the appropriate category reflecting either a rural or urban location and the size of road to be crossed. The total construction cost of each category of grade separation was derived from the quantities of the main components required for a typical grade separation contract and unit prices being tendered for current contracts. These total costs were assessed as being reasonably accurate, based on the assumptions, by the MTO Contract office during their review. As with bridges, some cost saving could arise from the large quantity and repetition associated with the grade separation sub-system. Recognizing all of the above factors, the accuracy of the overall costs is considered to be in the 15% range.

7.2.5. Other Accommodation Works

This sub-system includes works related to existing rail installations: the removal of existing tracks, the construction of new access tracks, and the grade separation of locations where the HSR line would cross existing tracks.

It was possible to establish quantities for both the removal of tracks and the number of rail/rail grade separations with a reasonable degree of accuracy. However, the length of new access tracks and other relocated trackwork was more difficult to establish without a more detailed investigation of current and future conditions, such as the continuing need for sidings in industrial locations.

The costs associated with the items involving trackwork (track removal and construction) are judged to be relatively accurate for the reasons outlined in the section on Track below, however, there is some potential for variation in the quantities of materials required per kilometer. The cost developed for rail/rail grade separations are less accurate as only two typical costs (rural and urban) were developed to address all situations.

Since the two items which involve uncertainty in either cost or quantity account for a significant portion of the total sub-system cost, the accuracy of the Other Accommodations Works sub-systems is estimated to be plus or minus 50%.

7.2.6. Track

Track has the lowest potential for variability of the 8 sub-systems evaluated. This is a result of several conditions.

One is that new budget prices have been obtained from suppliers of all major materials. This was done to ensure that prices addressed any impact that might result from higher standards than commonly used in North America. In addition, most of the unit costs for installation were developed particular to the project due to the very high and fairly uncommon production rates required for installation of trackwork. Again, these carry a lower potential for variation.

In terms of quantities of materials and installation effort required for trackwork, these are easily and accurately estimated for a given length of line and design standard.

Other than the variation in project length discussed above, the greatest potential for changes in track length are in the sidings. However, even a 50% variation here would have very little impact percentage-wise on the total length of track to be installed.

As a result of the above, the consultant estimates that the costs presented for the Track Sub-system reflect the final construction cost in 1993 dollars to within ±10%.

7.2.7. Electrification

In terms of approach to developing electrification costs, a preliminary design reflecting local particularities was made for the entire length of the three alignments under study rather that develop an all-inclusive per kilometre cost for power supply and distribution.

As with most track items, those related to catenary are for the most part driven by sub-segment length. Once a design standard is settled upon, the generation of quantities is straightforward. As catenary accounts for over 50% of electrification costs, this helps to reduce the estimate variability.

A high degree of detail was also used in establishing items for the power supply work. For example, preliminary designs for main supply stations were prepared and costed for each of the three supply voltages (120kV, 230kV, and 315 kV) encountered along the HSR alignments.

Furthermore, the costs were developed by the team responsible for the design of the Deux-Montagnes (Montréal) electrified suburban rail line modernisation project. The experience acquired in producing a design incorporating current technology for the equipment necessary to interface with utilities (sub-stations, supply lines), evaluating quantities required, and sourcing potential suppliers should also help to reduce variability.

Some uncertainty is associated with Electromagnetic Induction (EMI) Mitigation Measures. Costs can vary greatly depending on the presence of vulnerable infrastructure (particularly telecommunications) along the right-of-way, as well as, to a lesser extent, on the types of soil and sub-soil present. The unit cost retained reflects the predominantly rural nature of the alignments. However, this item forms only a small portion of the total electrification cost.

The accuracy of the Electrification sub-system is evaluated at plus or minus 15%.

7.2.8. Stations

The total capital cost for the stations sub-system is comprised of an estimate for the new, largely suburban, stations combined with the estimated cost for modifications to existing stations in the major cities such as Québec, Montréal, Ottawa and Toronto. The accuracy of the estimate is a function of firstly, the extent and type of facilities at each station and secondly, the unit costs adopted for each station element.

For the new stations, a typical station arrangement and size was assumed based on facilities provided for new high speed lines in France as well as those used for commuter rail passenger service in Toronto and Montréal. The extent of the infrastructure and the corresponding estimated costs are considered to be reasonably accurate.

Quantifying and estimating the work required to make the larger, existing stations suitable for high speed rail is more difficult at the feasibility level of this study. Based on the track requirements provided by the Technology Consultant, the platform and related access needs have been assessed in general terms for each location. Without a detailed study of the methods of modifying the existing buildings and ancillary facilities, the estimate for this work can only be considered an order-of-magnitude. In costing the conversion of the major stations to high speed rail, it has been assumed that the primary concourse structure can be retained. If this proved not to be the case in detailed planning the conversion cost could be considerably higher.

The combination of the relatively reliable cost of the new stations and the less accurate estimate for modifications is considered to have a 20% accuracy

7.3. OVERALL ACCURACY

The estimates of accuracy for each sub-system described in the previous sub-section have been incorporated into an assessment of the overall accuracy of the cost estimate. This assessment as described here applies to the cost estimate for the 300 kph Existing Right-of-Way alignment between Windsor and Québec City. As the

percentage of total costs appearing under each of the sub-systems is relatively constant, regardless of alignment or route segment, the projected overall accuracy of the estimate would be similar for all of the options costed.

Table 7.2 comprises the results of our analysis. The first four columns present the implications of the discussion in the previous sub-section in terms of the potential dollar variation in costs for each sub-system. The Total for the column presenting **Accuracy - ±$** represents the potential cost over-run (or under-run) if the budget for all sub-systems are all overspent (or all underspent) by the amount of the projected accuracy.

The Total figure in the **Accuracy - ±%** column is the result of dividing the total figure discussed above by the Total Estimated Cost. As such, it represents a weighting of the individual accuracy estimates to 20.2% of the total estimated cost of $7.833 billion or $1.578 billion.

However, it is evident that not all sub-systems will be overspent, or underspent, by amounts equal to the expected accuracy. Consequently, the consultant performed the Monte Carlo analysis as mentioned in 7.1 to evaluate the impact of differing cost variations in each sub-system. This consisted of statistically generating possible costs for each sub-system using the estimated costs, the anticipated accuracies, and the assumed probability density function. The cost population generated consisted of 1000 for each sub-system which were then added to produce 1000 total costs.

The last two columns of Table 7.2 present the results of the statistical analysis. The column **Statistical Cost Projection** is the mean cost of the 1000 sample costs generated for each sub-system. The **Standard Deviation** column presents the standard deviations of the same sets of numbers. The proximity of these costs and standard deviations to the original estimates and anticipated accuracies in dollars confirm the reliability of the cost generating function.

Again, the Total line of the **Statistical Cost Projection** column is the mean value of all the project total costs developed in the population and corresponds well with the total estimated project cost. The Total line for the **Standard Deviation** column presents the standard deviation for the population of Total Costs. This figure accounts for the expected statistical variation of costs above and below the estimated amounts and is consequently considerably lower than the figure presented as the total of the **Accuracy - ±$** column. Having developed this number as being one standard

Table 7.2

Cost Estimate Accuracy Evaluation

(dollars in thousands)

Sub–system	Estimated Cost	Accuracy (%)	Accuracy (±$)	Statistical Cost Projection	Standard Deviation
Land Acquisition	$658,430	25%	$164,608	$660,431	$162,429
Earthworks and Drainage	$1,718,417	35%	$601,446	$1,724,075	$604,716
Bridges and Viaducts	$1,238,277	15%	$185,742	$1,233,624	$185,583
Grade Separations	$1,920,300	15%	$288,045	$1,921,121	$295,220
Other Accom. Works	$119,259	50%	$59,630	$120,263	$60,743
Track	$1,084,635	10%	$108,464	$1,085,822	$108,053
Electrification	$925,715	15%	$138,857	$928,540	$138,424
Stations	$158,477	20%	$31,695	$159,116	$31,015
Total	$7,823,510	20.2%	$1,578,486[a]	$7,832,992	$750,377[b]
Standard deviation as % of total cost (probability = 2 times in 3)					9.6%
Two standard deviations as % of total cost (prob. = 19 times in 20)					19.2%

a – as the sum of the possible errors in each sub–system, this represents the maximum possible error that could result if the inaccuracy of every sub–system was of the maximum amount and same sign (+ or –)

b – This is the standard deviation of the generated "population" of "Total Costs". It indicates that the expected cost of the project should fall withn ± this value of the base cost **68%** of the time (or on approximately 7 occasions out of 10). The expected cost of the project should fall within ± twice this value **95%** of the time (or approx. 19 times out of 20).

deviation above and below the estimated cost, we can now express the accuracy of this cost estimate as a probability that the cost will fall within a certain confidence limit. As the confidence limit increases, the probability that the final cost will fall within the range also increases. The results based on the assumptions made in this Section are presented in Table 7.3. The probability of 95.4% shown in the second line of the table corresponds to 2 standard deviations which is equivalent to the "19 times out of 20" commonly heard in the reporting of opinion poll results.

Table 7.3

Confidence Interval	Dollar Range (000's)	Probability
± 9.6%	$750,377	68.4%
± 19.2%	$1,500,754	95.4%

8. SINGLE VS. DOUBLE TRACK

Under the Terms of Reference for the current study, the Consultant has been requested to evaluate the feasibility of constructing the line as a single track, the resulting impacts on costs, and the problems of subsequently building a second track. These questions of feasibility and problems associated with subsequent construction are addressed together in the following sub-section. The impact on costs are discussed in the second half of this Section of the report.

8.1. FEASIBILITY

8.1.1. General

The interest in these discussions about single track is to provide for delay of investment in certain capital expenditures until the facilities are required for capacity or operating reasons. However, the initial single track configuration must also be such that it does not impose extensive time delays on scheduled train times on account of waiting or slowing for meets. It appears that the consensus on this issue in Canada for the Québec-Windsor corridor is that a single track layout with long sidings that total one third of the overall track length would be necessary to meet the desired operating characteristics. Consequently, this analysis addresses a track layout[10] with 7.5 km long sidings using 160 km/hr turnouts and spaced at 21 km intervals.

In terms of staging the construction of such a track layout, there are a few different approaches that could be considered, such as:

- building the embankment for only one track and completing the balance when required,
- building a double embankment but constructing bridge foundations and spans for only one track, or
- building a double embankment and constructing bridge foundations for two tracks but only installing spans for one track where possible.

10 as recommended by the Technology and Operating Strategy Consultant

Regardless of the option chosen, the trackwork and electrification would only built for the configuration described above. The following paragraphs discuss some of the considerations involved in staging the various elements of the project.

8.1.2. Staging of the Work

The decision as to whether to use a staged construction approach should depend, to a great extent, on the length of time anticipated before the second track is required and the type of work being considered for staging. Deciding factors include the immediate savings and the increased total cost associated with the staging as well as the impact of future construction work on the rail service offered and how delays will be perceived by the travelling public.

8.1.2.1. Earthworks

The safety considerations associated with widening an embankment to accept a second track immediately adjacent to an existing line will require speed restrictions on train operations. These may arise from:

- a need to perform earthwork during the day and have equipment working adjacent to the track while trains pass, and/or
- a need to cut into the slope of the existing embankment (potentially reducing stability) to achieve homogeneity in the overall fill.

Both these conditions require on-going speed restrictions that could extend over a fair length of line. Speed restrictions on account of equipment working adjacent to the track could be as low as 50 km/hr. Those imposed for reasons of slope stability would more likely be in the range of 80-100 km/hr. Such delays within a few years of commencing service may be perceived as being inherent to the technology and discourage ridership. If these interruptions are delayed sufficiently, they will be accurately perceived by riders as delays associated with the major improvement to service that they are.

Construction of the earthwork in two phases also has a significant cost impact. Not only must mobilization and supervision costs be absorbed a second time, but the unit costs also increase substantially. Building embankment for a single track reduces the

efficiency of the earth-moving operations due to the restricted width available at the top of the embankment (8m compared to 13+m for a 2-lane highway and 14+m for a double track line). Other complications adding to cost are the need to construct the second phase over only half the embankment width (6m), the obstacles to earthmoving and compaction created by culverts built during the first phase, and the need to remove and re-install security fencing.

It should be noted that some of these issues are similar to those which led to the expectation that it may be more economical to completely reconstruct embankments where existing ROWs were assumed to be used and converted for use as double track, high speed alignments.

8.1.2.2. Bridges

Much of the bridge construction work to accommodate a second track could be done without imposing speed restrictions on train operations. Work that would require restrictions is the placement of the bridge spans, however, such a restriction is localized and for a very short period of time. As such, the staging of bridge work allows for 2 approaches:

- construction of single track bridges, including abutments and piers during the original construction with the construction of independent structures at the time of adding the second track, or

- construction of double track abutments and piers which carry only a single span with the addition of second[11] spans in conjunction with the second track.

Using the first approach can produce some difficulties at the time that the second track is added on account of the displacements that might be produced in the original foundations by the driving of new pile foundations for the second structure. Avoiding this might require locating the new structure away from the second which could produce undesirable track geometry.

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11 It should be noted that, for some major bridge structures, the most economical span construction may be a box girder supporting two tracks and, consequently, a single track span may not be an option.

With the second approach, the final 2-track abutments and piers are constructed at a marginal cost to what would be required for a single track only. Afterwards, the span for the second track can be added with very little disruption to train traffic and this for only a short period of time.

8.1.2.3. Trackwork and Electrification

In the case of track work and electrification, the effects on service on account of construction of the second track becomes less of an issue. This is because this work can be done either at night, with special safety precautions, and/or a few localised speed restrictions. As such, there is a minimal impact on travel time and, consequently, service.

There are two principle areas where staging would imply additional costs for track work and electrification. These are for the construction bases which would have to be re-established for construction of the second track and for facilities which are constructed for the single track operation which would no longer be required (at their original location, anyway) for double track.

On a per kilometre of track constructed basis, the cost of the construction bases would probably increase in the order of 25% for the initial construction. In addition, these bases would have to be re-established for construction of the second track. It is estimated that the unit cost per track kilometre would again be 25% higher than that for double track construction.

Installations from the single track alignment which would no longer be required for double track consist primarily of turnouts and their associated catenary and signalling. It should be noted that there could be potential for using some of the single track turnouts at their original location. If we consider that single track would use sidings spaced ≈ every 20 km and that double track would have double crossovers every 20 km, there is potential for using the turnout at one end of each siding, without re-locating it, in the double track configuration.

As a result of these conditions, the total cost (total of both stages including necessary removals) of the trackwork and electrification sub-systems would increase in a staged project by an amount that would be in the order of 5% of their respective costs for an initial double track project.

8.1.3. Selected Approach

As mentioned previously, the approach to be used in staging the work of a high speed line should depend on the impact that staging will have on train operations and the cost of the project and on the anticipated length of time that the work can be deferred.

It is evident that there are benefits in phasing track work and electrification as the work can be performed later with very little impact on operations or cost penalty. Bridges could also be extended for a second track without much disruption of operations. However, there is a larger cost penalty and potential structural problems involved in phasing which make it less desirable.

Phasing of earthworks does not produce cost savings proportional to the quantity of work postponed due to increases in unit costs. It also causes a considerable impact on train operations during the subsequent widening of the embankment. Discussions with representatives of the French National Railways indicate that they consider this type of phasing to be unrecommended unless the capacity requirements for the second track are more than 10-15 years away. This opinion was supported by VIA's comments during stakeholders' meetings. In addition to the financial considerations, this delay allows riders to become familiar with and adapted to the HSR service before experiencing the deterioration in service that would be associated with work to widen the subgrade.

In view of these impacts and our understanding that double track will be a necessity for almost all of the corridor within 15 years of the start of operations, the construction phasing that has been costed for single track operation is as follows:

- Construct all stations for double track operation;
- Construct all bridge foundations for double track but the superstructure for single track only;
- Construct all embankment for double track but the track structure for single track and sidings;

- Construct all electrification for single track and sidings but all substations for the ultimate facility;

In addition, all environmental mitigation measures would have to be in place for single track operation as would all of the common administrative and maintenance facilities.

8.2. COST IMPLICATIONS

As mentioned above, an implementation plan using a single track layout in the Québec - Windsor corridor should allow for construction of a second track within 15 years throughout most of its length. Therefore, in accordance with the construction phasing proposed in 8.1, the costs for the Land, Earthworks and Drainage, Grade Separation, Other Accommodation Works, and Station sub-systems will be identical to those required to construct a double track line. Cost savings for constructing a single track line would be obtained in the Track and Electrification sub-systems, obviously, and in the Bridges and Viaducts sub-system where installation of the bridge spans for the second track could be delayed at single track locations.

In order to estimate the dollar value of the cost reduction to be achieved through the above approach, the consultant has developed a cost for a single track installation on one of the line sub-segments analyzed during the study. The sub-segment used is from Oshawa to Kingston on the 300 kph New ROW alignment as it was considered to present characteristics that are most typical of the overall corridor.

Table 8.1 presents the estimated costs for this sub-segment under the double and single track options. The result of this analysis is a projected cost saving of $70.9 million over the 198.56 km length of this sub-segment. This equates to a saving of $357,071 per kilometre and can be attributed to the following sub-systems percentage-wise: 64% for Track, 20% for Electrification, and 16% for Bridges.

Based on this analysis, we have developed costs for alignments incorporating single track for each of the route segments evaluated during this study. They reflect a reduction in the original cost of each major line segment by $357,000 per kilometer of line which could be built in the single track with passing tracks configuration. These portions of the lines are considered to be those located outside the heavily urbanized areas. Table 8.2, Table 8.3, and Table 8.4 indicate the estimated rural route lengths where the single track configuration could be used and present the resulting cost for

Table 8.1
Comparison of Double vs. Single Track Costs
Oshawa - Kingston 300 kph New ROW
($ millions)

Sub-system	Double Track	Single Track
A - Right-of-Way Acquisition	23.5	23.5
B - Earthworks and Drainage	271.2	270.4
C - Bridges,Viaducts, and Tunnels	239.3	228.6
D - Grade Separations	359.7	359.7
E - Other Accommodation Works	4.9	4.9
F - Track	165.7	120.6
G - Electrification	147.1	132.8
H - Stations	0.0	0.0
TOTAL	1,211.4	1,140.5

each speed/routing combination.

Table 8.2
Cost Estimate incorporating Single Track
200 kph Existing ROW
($ millions)

Line Segment	Double Track Cost	Rural Route Length	Cost Saving	Single Track Cost
Windsor - Toronto	2,030	313	112	$ 1,918
Toronto - Montréal	3,403	501	179	$ 3,224
Montréal - Québec	1,432	233	83	$ 1,349
TOTALS	$ 6,865	1,047	$ 374	$ 6,491

Table 8.3
Cost Estimate incorporating Single Track
300 kph Existing ROW
($ millions)

Line Segment	Double Track Cost	Rural Route Length	Cost Saving	Single Track Cost
Windsor - Toronto	2,424	313	112	2,312
Toronto - Montréal	3,996	501	179	3,817
Montréal - Québec	1,404	233	83	1,321
TOTALS	$ 7,824	1,047	$ 374	$ 7,450

Table 8.4
Cost Estimate incorporating Single Track
300 kph New ROW
($ millions)

Line Segment	Double Track Cost	Rural Route Length	Cost Saving	Single Track Cost
Windsor - Toronto	2,634	313	112	2,522
Toronto - Montréal	5,431	501	179	5,252
Montréal - Québec	1,441	233	83	1,358
TOTALS	$ 9,506	1,047	$ 374	$ 9,132

The estimated cost for converting the single track configuration to a full double track railway is estimated to be $441,000 per kilometer. This includes the $357,000 of work per kilometer not performed during the initial single track phase plus allowances for lower efficiency in performing bridge and track work and the extra cost for dismantling track and catenary at the turnouts installed for the long sidings.

APPENDIX - A

COST ITEM DEFINITIONS

SUB-SYSTEM A: RIGHT-OF-WAY ACQUISITION Sector 1 - Professional Services / Project Management				
Item No.	**Description**	**Units**	**Elements Included**	**Measurement and Costing Methods**
1.1	Surveying.	%	All professional services related to land surveying.	The cost will be developed as a percentage of the acquisition cost for the land based on the Consultant's experience from similar projects undertaken recently on highways corridors. The costs have not been differentiated between the different specializations and are covered by only 1 percentage figure.
1.2	Appraisal.	%	All professional services related to land appraisal.	
1.3	Legal expertise.	%	All professional services related to purchase and legal transfer of properties.	
2	Project Management	%	This amount is intended to cover a portion of the cost of providing project management services for the Client. This includes the costs for contract management, cost, quality, and schedule control, establishing project procedures, and coordinating.	This amount will be estimated as a percentage of the total cost of the project by the consultant based on experience with previous projects and the level of effort anticipated for the particular sub-system.

SUB-SYSTEM A: RIGHT-OF-WAY ACQUISITION Sector 2 - Equipment/Materials				
Item No.	**Description**	**Units**	**Elements Included**	**Measurement and Costing Methods**
1.1	Land Acquisition in Residential Areas.	Lump sum	All costs associated with purchasing non-railway land (for completely new rights-of-way and additional land required adjacent to existing railway land for shared rights-of way) and making it available in a useable condition for the project. This includes severances, other injurious allocations, and demolition of structures and facilities.	Quantities and costs developed to be representative of the requirements for a high speed rail system. Final costs upon project implementation will be the result of individual negotiations for each parcel of land to be acquired.
1.2	Land Acquisition in Commercial Areas.	Lump sum	As per Item 1.1.	As per Item 1.1.
1.3	Land Acquisition in Industrial Areas.	Lump sum	As per Item 1.1.	As per Item 1.1.
2.1	Land Acquisition in Agricultural Areas.	Lump sum	As per Item 1.1.	As per Item 1.1.
2.2	Land Acquisition in Natural Areas (non-farming rural areas, forests...).	Lump sum	As per Item 1.1.	As per Item 1.1.
3	Disruption, Capital Improvement Removal, and Land Costs for Existing Rail Right-of-Ways	Lump sum	Costs for purchasing existing or abandoned RoW for exclusive use by the HSR system. Costs presented include disruption, capital improvement removal, and land costs. Does not include purchase of railway lands for shared rights-of-way. Does not include the cost for removing or relocating tracks.	Quantities and costs developed to be representative of the requirements for a high speed rail system. Final costs upon project implementation will be the result of individual negotiations for each parcel of land to be acquired.

SUB-SYSTEM : ALL (except Land Acquisition)
Sector 1 - Professional Services / Project Management

Item No.	Description	Units	Elements Included	Measurement and Costing Methods
1	Engineering	%	This covers costs for further studies and final design of each of the infrastructure sub-systems. This final design includes obtaining all information on site conditions and preparing the plans, specifications, and bidding documents for the execution of the work.	This amount will be estimated as a percentage of the cost of construction work by the consultant based on experience with previous projects and the level of effort anticipated for the particular sub-system.
2	Construction Supervision	%	This covers costs for overseeing the execution of the work in the field. It includes the monitoring and supervision of contractors, recommending payment of invoices, and acceptance of the completed work and as-built drawings.	This amount will be estimated as a percentage of the cost of construction work by the consultant based on experience with previous projects and the level of effort anticipated for the particular sub-system.
3	Materials Procurement	%	This covers costs for overseeing the procurement of materials to be used on the project. It includes the quality assessment of suppliers and manufacturers, inspection of delivered materials, and recommending payment of invoices.	This amount will be estimated as a percentage of the cost of construction work by the consultant based on experience with previous projects and the level of effort anticipated for the particular sub-system. (Only applied to track sub-system).
4	Project Management	%	This amount is intended to cover a portion of the cost of providing project management services for the Client. This includes the costs for contract management, cost, quality, and schedule control, establishing project procedures, and coordinating.	This amount will be estimated as a percentage of the total cost of the project by the consultant based on experience with previous projects and the level of effort anticipated for the particular sub-system.

SUB-SYSTEM B: EARTHWORKS AND DRAINAGE Sector 1 - Professional Services / Project Management				
Item No.	**Description**	**Units**	**Elements Included**	**Measurement and Costing Methods**
3	Environmental Assessment	%	This amount is intended to cover the cost of the environmental assessment, review, and approval process, including public hearings, required for implemetation of the project.	This amount has been estimated by the consultant as a percentage of the total construction cost (excluding professional fees) of the project based on experience with previous projects.
4	Feasibility Studies (Technical)	%	This amount is intended to cover the cost of the technical feasibility study whose objective will be to finalize the desired routing for the project, identify feasible solutions to all constraints on the construction and operation of the line, and refine the cost estimate.	This amount has been estimated by the consultant as a percentage of the total construction cost (excluding professional fees) of the project based on experience with previous projects.

SUB-SYSTEM B: EARTHWORKS AND DRAINAGE
Sector 4 - Construction/Installation

Item No.	Description	Units	Elements Included	Measurement and Costing Methods
1.1	Clearing and roadbed preparation in Type 1 soils.	Route-km.	Clearing of ROW vegetation, removal of existing buildings facilities, preparation and/or replacement of existing roadbed including geo-textiles etc. across rock or other solid material and restoration.	Geological mapping of routes. Unit price has been developed for all work for 1 km of route based on cross-sections recommended by Sofrerail from TGV experience.
1.2	Clearing and roadbed preparation in Type 2 soils.	Route-km.	As above for roadbed across till, sands, and clays.	Geological mapping of routes. Unit price has been developed for all work for 1 km of route based on cross-sections recommended by Sofrerail from TGV experience.
1.3	Clearing and roadbed preparation in Type 3 soils.	Route-km.	As above for roadbed across wetlands, marshy areas, and water-sensitive clays.	Geological mapping of routes. Unit price has been developed for all work for 1 km of route based on cross-sections recommended by Sofrerail from TGV experience.
2.1	Embankment constructed from ROW cut in soft material.	Thousand cubic-metres.	Excavation of general or rippable fill material from cuts in the ROW using scrapers and placing in embankment, including compaction (excludes selected sub-ballast layers).	Quantities determined from geological mapping and cut and fill calculations using profiles at 1:50000 scale and 10 metre contours. (Accuracy verified by typical sections with larger scale).
2.2	Embankment constructed from ROW cut material in rock.	Thousand cubic-material.	Excavation of rock using explosives from cuts in ROW and selection and placing of suitable material in embankment, including compaction. (excludes selected sub-ballast layers).	Quantities determined from geological mapping and cut and fill calculations using profiles at 1:50000 scale and 10 metre contours. (Accuracy verified by typical sections with larger scale).
2.3	Embankment constructed from borrow material.	Thousand cubic-metres.	Excavation of general fill material in borrow pit and placing in embankment including compaction (excludes selected sub-ballast layers).	Borrow material determined from cut and fill calculations using profiles at 1:50000 scale and 10 metre contours. (Accuracy verified by typical sections with larger scale).
2.4	Disposal of unsuitable material.	Thousand cubic metres.	Loading, hauling and dumping of excavated material found to be unsuitable for embankment construction.	Geological mapping of routes has been used to assess percentage of excavation likely to be unsuitable.
3	Haulage of fill material (from borrow or excavation).	Thousand Cubic metre-km.	Loading, hauling and tipping of material suitable for general embankment fill or selected sub-ballast layers. Hauled either from borrow pits or along ROW from cuts.	**The cost implications for haul of excavated fill or borrow have been included in the unit costs developed for Item 2, Embankment Construction.**
4.1	Sub-ballast layers; new ROW.	Route-km.	Placing and compaction of selected material in two layers above general roadbed fill.	Quantities from typical cross-sections provided by Technology Consultant from European experience. Unit prices from current contracts for similar work items.

SUB-SYSTEM B: EARTHWORKS AND DRAINAGE Sector 4 - Construction/Installation				
Item No.	**Description**	**Units**	**Elements Included**	**Measurement and Costing Methods**
4.2	Sub-ballast layers; exist ROW.	Route-km.	Placing and compaction of selected material in two layers above general roadbed fill.	Quantities from typical cross-sections provided by Technology Consultant from European experience. Unit prices from current contracts for similar work items.
5.1	Normal ROW drainage system.	Route-km.	Minor culverts, parallel ditches, (including lining if required) sub-drainage systems.	Quantities from a typical 1 km section of ROW. Unit prices from current highway contracts for similar work items.
5.2	Major watercourse culverts.	Each.	Culvert across ROW complete, including headwalls, outlet works, grading and structure.	Unit cost developed from current contract prices for a representative major culvert approximately 6-10 metres across.
5.3	Environmental stormwater controls.	Route-km.	Provision of facilities such as settling ponds to mitigate transport of silts and debris into sensitive water courses.	Quantities to be identified by environmental specialists. Representative price to be developed for a typical facility.
6	Upgrade of existing roadbed on existing ROW.	Route-km.	Removal of unsuitable material, placing of selected sub-ballast layers, drainage improvement, minor widening if required.	Roadbed standards from Technical Consultant and European experience. Quantities based on data from railways on condition of existing roadbeds.
7.1	Retaining structures up to 3 metres height.	Km.	Retaining walls, including foundations, to support embankments or sides of cuts.	Urban area mapping, aerial photographs for quantities. Unit prices from current contracts for similar structures.
7.2	Retaining structures over 3 metres height.	Km.	Retaining Walls, including foundations, to support embankments or sides of cuts.	Urban area mapping, aerial photographs for quantities. Unit prices from current contracts for similar structures.
8	Intrusion Barriers	Km.	Concrete barrier or berm designed to prevent derailed trains on shared right-of-ways from interfering with the high speed tracks.	Final assumptions for track configuration and operating regulation eliminated requirement for solid barriers. Consequently, costs and quantities not assessed.
9.1	Noise attenuation structures - barriers.	Km.	Complete noise attenuation structure including foundations, manufacture and installation.	Configuration and materials to be developed from European experience and local applications. Unit price from potential local suppliers and similar highway/rail applications. Measured per side of ROW.
9.2	Noise attenuation structures - Berms.	Km.	Complete noise attenuation berm including placement of material, compaction and drainage.	Configuration to be developed from European experience and local applications. Unit price from similar highway/rail applications.
10	ROW security fencing (2 sided).	Route-km.	Complete security fencing of the ROW.	Configuration and materials from European experience. Unit prices from potential suppliers and European contracts applied to local conditions.

SUB-SYSTEM B: EARTHWORKS AND DRAINAGE Sector 4 - Construction/Installation				
Item No.	**Description**	**Units**	**Elements Included**	**Measurement and Costing Methods**
11	Snow control measures.	Km.	Manufacture and installation of snow control barriers.	**This is a minor cost with difficult to estimate quantities. Cost implications have been covered by contingencies.**
12.1	Utilities - Major Hydro relocation.	Each.	Representative allowance for relocation of Hydro lines and towers.	Cost implications included in contingencies.
12.2	Utilities - Major Oil/gas line relocation.	Each.	Representative allowance for relocation or crossing of oil/gas lines.	Cost implications included in contingencies.
12.3	Minor pipe or wire crossings.	Route-km.	Representative allowance for minor pipe and wire crossings including all works required.	Cost implications included in contingencies.
13	Other items.	Lump sum.	These items are intended to address any particular cases which have not been covered by the standard cost items elsewhere. They have been defined specifically for each case and may differ from one geographical segment to the next.	These items have been identified on a individual basis as situations which must be addressed during construction, but which do not fall into any other category. A lump sum has been developed representing the cost of all work required to accomodate the particular situation.
13.1	Audit for Contaminated Soil	Route-km.	This item is to cover the cost of site and lab investigations required to assess the presence of contaminated soils on railway lands.	Quantities based on length of railway right-of-way to be acquired. Unit costs are typical costs encoutered by MTO for similar investigations.
13.2	Audit for Contaminated Rail Yards	ea.	This item is to cover the cost of site and lab investigations required to assess the presence of contaminated soils on railway lands.	Quantities based on number of railway yard sites associated with railway lands to be acquired. Unit costs are typical costs encoutered by MTO for similar investigations.

SUB-SYSTEM C: BRIDGES, VIADUCTS AND TUNNELS Sector 4 - Construction/Installation				
Item No.	**Description**	**Units**	**Elements Included**	**Measurement and Costing Methods**
1.1	Small river crossings (up to 30 metres in length).	Each.	Complete bridge including associated earthworks, river protection works, but excluding track structure.	Rivers, creeks identified on 1:50,000 and 1:10,000 or 1:20,000 plans. Unit cost for a typical bridge of an assumed length from local contracts for similar multi-structure projects.
1.2	Extra over 1.1 for height over 10 metres.	Each.	Effect of sub-structure height on cost of all bridge components.	Additional cost per linear metre of bridge to be applied to small but high river bridges. Cost to be based on past local experience.
1.3	Intermediate river crossings (30 - 100 metres in length).	Linear metre.	Complete bridge including associated earthworks, river protection works, but excluding track structure.	Rivers identified on 1:10,000 and 1:20,000 plans. Bridge lengths estimated from plans and profiles. Unit cost per metre length of bridge from local contracts for similar multi-structure projects.
1.4	Extra over 1.2 for height over 10 metres.	Linear metre.	Effect of sub-structure height on cost of all bridge components.	Additional cost per linear metre of bridge to be applied to intermediate but high river bridges. Cost to be based on past local experience.
1.5	Large river crossings (100-250 metres in length).	Linear metre.	Complete bridge including associated earthworks, river protection works, but excluding track structure.	Rivers identified on 1:10,000 and 1:20,000 plans. Bridge lengths estimated from plans and profiles. Unit cost per metre length of bridge from local contracts for similar multi-structure projects.
1.6	Extra over 1.3 for height over 10 metres.	Linear metre.	Effect of sub-structure height on cost of all bridge components.	Additional cost per linear metre of bridge to be applied to large but high river bridges. Cost to be based on past local experience.
1.7	Major river crossings (over 250 metres).	Linear metre.	Complete bridge including associated earthworks, river protection works, but excluding track structure.	Rivers identified on 1:10,000 and 1:20,000 plans. Bridge lengths estimated from plans and profiles. Unit cost per metre length of bridge from local contracts for similar large bridge projects.
1.8	Extra-over items 1.1, 1.3, 1.5 and 1.7 for difficult foundation conditions.	Linear metre.	Effect of poor soil conditions or complex foundation requirements on the cost of bridges of each size.	Additional cost per linear metre of bridge to be applied to each size of bridge if location is known to involve poor soil conditions. Geological mapping, past experience to be used to identify complexity of foundations.
1.9	Modifications to existing bridges (new deck).	Linear metre.	Replacement or modification of existing bridge deck to accommodate HSR track structure. As most existing corridor bridges are single track, this includes the cost for constructing an additional single track span adjacent to the existing bridge.	Railway databases, 1:10,000 or larger scale plans of existing bridges. Unit cost developed from local experience applied to deck configuration specified by Technology Consultant.

SUB-SYSTEM C: BRIDGES, VIADUCTS AND TUNNELS Sector 4 - Construction/Installation				
Item No.	**Description**	**Units**	**Elements Included**	**Measurement and Costing Methods**
2.1	Viaducts exceeding 250 metres in length.	Linear metre.	Complete viaduct (elevated ROW) including temporary works, slope protection at abutments, any channelization or protection works if waterways under viaduct.	Locations identified on 1:50,000 or 1:10,000 plans. Lengths from track profiles. Unit costs per metre of viaduct from European experience applied to local construction industry.
2.2	Extra over 2.0 for height over 10 metres.	Linear metre.	Effect of sub-structure height on cost of all viaduct components.	Additional cost per linear metre of bridge to be applied to small but high viaducts. Cost to be based on past local experience.
2.3	Extra-over items 2.1 for difficult foundation conditions.	Linear metre.	Effect of poor soil conditions or complex foundation requirements on the cost of a viaduct.	Additional cost per linear metre of viaduct to be applied if location is known to involve poor soil conditions. Geological mapping, past experience to be used to identify complexity of foundations.
3.1	Double track tunnelling in soft ground.	Metre.	Complete tunnel in soft ground including all equipment, materials and labour for excavation, dewatering, lining and portal works.	Size and configuration from European experience. Lengths from track profiles. Ground conditions from geological mapping. Unit cost from European experience and local tunnelling contract records.
3.2	Double track tunnelling in rock.	Metre.	Complete tunnel in rock including all equipment materials and labour for excavation, dewatering, lining and portal works.	Size and configuration from European experience. Lengths from track profiles. Ground conditions from geological mapping. Unit cost from European experience and local tunnelling contract records.
3.3	Modifications to existing tunnels.	Lump sum.	Any modifications works to accommodate HSR trains in existing tunnels.	Prior studies or plans of existing tunnels (e.g. Mont Royal, Montreal; Dows Lake, Ottawa) Cost from local experience for similar works.
3.4	Noise Mitigation Measures.	Lump sum.	Special tunnel entrance hoods or ballast mats to mitigate noise and vibration.	Prior studies or plans of existing tunnels (e.g. Mont Royal, Montreal; Dows Lake, Ottawa) Cost from local and European experience for similar works.

SUB-SYSTEM D: GRADE SEPARATIONS Sector 4 - Construction/Installation				
Item No.	**Description**	**Units**	**Elements Included**	**Measurement and Costing Methods**
1.1	2 lane rural highway crossing.	ea.	All works to grade separate HSR from highway including bridge, approach earthworks, drainage, paving, signing, land, detours, traffic accommodation.	Quantities from 1:50,000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local contracts (MTO, MTQ).
1.2	2 lane rural highway crossing, dual ROW	ea.	All works to grade separate HSR plus an adjacent railway line from highway including bridge, approach earthworks, drainage, paving, signing, land, detours, traffic accommodation.	Quantities from 1:50,000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local contracts (MTO, MTQ).
1.3	4 lane rural highway crossing.	ea.	All works to grade separate HSR from highway including bridge, approach earthworks, drainage, paving, signing, land, detours, traffic accommodation.	Quantities from 1:50,000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local contracts (MTO, MTQ).
1.4	4 lane rural highway crossing, dual ROW.	ea.	All works to grade separate HSR plus an adjacent railway line from highway including bridge, approach earthworks, drainage, paving, signing, land, detours, traffic accommodation.	Quantities from 1:50,000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local contracts (MTO, MTQ).
1.5	Major rural highway crossing.	ea.	All works to grade separate HSR from freeways (401, 40 etc.) including bridge, approach earthworks, drainage, paving, signing, land, detours, traffic accommodation.	Quantities from 1:50,000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local contracts (MTO, MTQ).
1.6	Extra-over items 1.1 to 1.3 for difficult foundation conditions.	ea.	Effect of poor soil conditions or complex foundation requirements on the cost of bridges of each size.	Additional cost per linear metre of bridge to be applied to each size of bridge if location is known to involve poor soil conditions. Geological mapping, past experience to be used to identify complexity of foundations.
2.1	Secondary urban highway (2-4 lanes) crossing.	ea.	All works to grade separate HSR from urban highway including bridges, retaining walls earthworks, drainage, paving, signing, land, detours, traffic accommodation.	Quantities from 1:50,000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local municipal contracts.
2.2	Secondary urban highway (2-4 lanes) crossing, dual ROW.	ea.	All works to grade separate HSR plus an adjacent railway line from urban highway including bridges, retaining walls earthworks, drainage, paving, signing, land, detours, traffic accommodation.	Quantities from 1:50,000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local municipal contracts.

SUB-SYSTEM D: GRADE SEPARATIONS Sector 4 - Construction/Installation				
Item No.	**Description**	**Units**	**Elements Included**	**Measurement and Costing Methods**
2.3	Major urban highway (over 4 lanes).	ea.	All works to grade separate HSR from urban highway including bridges, retaining walls earthworks, drainage, paving, signing, land, detours, traffic accommodation.	Quantities from 1:50,000, 1:20,000 or 1:10,000 plans. Unit costs of complete works from typical similar local municipal contracts.
2.4	Extra-over items 2.1 to 2.3 for difficult foundation conditions.	ea.	Effect of poor soil conditions or complex foundation requirements on the cost of bridges of each size.	Additional cost per linear metre of bridge to be applied to each size of bridge if location is known to involve poor soil conditions. Geological mapping, past experience to be used to identify complexity of foundations.
3.1	Modification of existing urban grade separations.	ea.	Works to increase horizontal or vertical clearances through existing grade separations including earthworks and structural modifications.	A lump sum will be developed representing the cost of all works for a typical modification.
3.2	Modification of existing rural grade separations.	ea.	Works to increase horizontal or vertical clearances through existing grade separations including earthworks and structural modifications.	A lump sum will be developed representing the cost of all works for a typical modification.
4	Automatic Crossing Protection	ea.	Fixed barriers, gates, fencing, highway surfacing, railway drainage, electronic detection equipment, and signalling modifications.	A lump sum will be developed representing the cost of all works for a typical crossing. Quantities from 1:50,000 and 1:20,000 mapping and criteria established in conjunction with the technology consultant. Signalling portion of the work included here to allow comparison of the total cost for treating road crossings.
5	Closure and Diversion of roads.	km of road.	Roadworks to link roads cut off by HSR ROW to other grade separated roads.	1:50,000 and 1:20,000 mapping. Unit costs from typical provincial road contract records.
6	Private farm crossing.	ea.	All works to provide a grade separated crossing structure for private property owners adjacent to ROW. (approx 5 metre square opening).	Quantities from assessment of land use adjacent to ROWs. Frequency based on precedents from other limited access corridors. Unit costs from similar local contract works.
7	Wildlife passages.	ea.	All works to provide a grade separated crossing structure for wildlife moving from one side of the ROW to the other.	Quantities from assessment of land use to adjacent to ROWs and from environmental assessment. Frequencies based on precedents from other limited access corridors. Unit costs from similar local contract works.

SUB-SYSTEM E: OTHER ACCOMMODATION WORKS Sector 4 - Construction/Installation				
Item No.	**Description**	**Units**	**Elements Included**	**Measurement and Costing Methods**
1	Removal of Rail Lines.	Km.	The removal of rail, ties, OTM, and other railway plant to make an existing line available for construction works or due relocation of rail services to another subdivision.	Quantities will be identified from topographic and railway maps and requirements to either perform work on existing subgrade or to remove existing infrastructure due to relocation of railway services to another subdivision. Costs will be estimated from the work effort associated with removal of typical railway track.
2	Construction of New Rail Lines.	Km.	The provision a subgrade and construction of railway track and associated facilities.	This item will be used where existing rail lines must be relocated to accomodate the larger radius curves of adjacent high speed lines or where new tracks are required to provide access to railway customers. Quantities will be identified from topographic and railway maps. A unit cost will be developed to represent the cost of all works required for a typical rail line.
3	Rail/Rail Grade Separation.	ea.	All works required to grade separate HSR from other railways lines that it may cross. These include structures to pass over or beneath intersecting lines and/or tracks providing paralleling lines with access to the other side of the right-of-way.	Quantities from locations of existing railway lines and railway operating and service requirements. A lump sum will be developed representing the cost of all works for a typical rail/rail grade separation.
4	Other Particular Items.	Lum sum.	These items are intended to address any particular cases which have not been covered by the standard cost items elsewhere. They will be defined specifically for each case and may differ from one geographical segment to the next.	These items will be identified on a individual basis as situations which must be addressed during construction, but which do not fall into any other category. A lump sum will be developed representing the cost of all work required to accomodate the particular situation.

SUB-SYSTEM F: TRACK
Sector 2 - Equipment/Materials

Item No.	Description	Units	Elements Included	Measurement and Costing Methods
1	Rail (main line and siding)	tonnes	Procurement, welding into CWR strings, and delivery of rail for main line and siding tracks	Quantities from trackage required according to operations consultant. Prices from suppliers.
2	Ties	ea.	Procurement and delivery of concrete track ties. Shoulders to be provided by project.	Quantities from trackage required and design tie spacing. Prices from manufacturer or supplier.
3	Ballast	$m.^3$	Procurement, crushing, and delivery of ballast.	Quantities from trackage required and design ballast section. Potential sources and costs to be identified through discussion with railways.
4	Turnouts	ea.	Supply and delivery of switch points, stock rails, frogs, other track materials, switch ties, and switch machines.	Quantities of main line and siding/yard turnouts from operations consultant. Costs from European experience and discussion with local suppliers.
5.1	Rail Fastening Assemblies	sets	Supply and delivery of tie inserts, elastic fasteners, and rail pads for concrete ties.	Quantities as a function of the number of ties. Prices from suppliers.
5.2	Bonded Insulated Joints	ea.	Supply and delivery of bonded insulated rail joints.	Included in signalling costs.
5.3	Bumping Posts	ea.	Supply, delivery, and installation of bumping posts required for stub end tracks.	Quantities developed from preliminary track layouts. Costs from suppliers.
6	Switch Heaters/Snow Blowers	ea.	Supply, delivery, and installation of equipment to prevent build-up of snow between switch points and stock rails and at moveable point frogs.	Quantities developed in accordance with the requirements of the operations consultant. Prices from European experience and discussion with local suppliers.
7	Ballast Mats for Noise Attenuation	m^2	Supply, delivery, and installation of rubber mats to be installed beneath the track ballast to reduce train-induced vibrations.	Quantities developed in accordance with vibration/noise levels and limits specified by technology consultant and environmental specialists on team. Costs from European experience.

SUB-SYSTEM F: TRACK
Sector 4 - Construction/Installation

Item No.	Description	Units	Elements Included	Measurement and Costing Methods
1.1	Main Line Track Construction	km.	Labour and equipment required for high production construction of the basic track structure (rail, ties, and fastenings).	Length will include total main line identified within a segment, including lengths through turnouts. Costs based on estimated production rates and construction industry wages.
1.2	Siding Track Construction	km.	Labour and equipment required for construction of the basic track structure (rail, ties, and fastenings) using traditional methods.	Length will include total siding and auxilliary trackage identified within a segment, including lengths through turnouts. Costs based on estimated production rates and construction industry wages.
2	Field Welding Joints	ea.	All field welding required to join CWR strings into continuous rail and to weld turnouts.	Quantities have been based on total track length, the length of rail strings, and the number of turnouts. Costs based on estimated production rates and construction industry wages.
3.1	Main Line Turnout Construction	ea.	Work required to assemble and install a main line turnout.	Quantities as per Sector 2 - Item 4.1 plus 4.2. Costs based on estimated production rates and construction industry wages.
3.2	Yard Turnout Construction	ea.	Work required to assemble and install a yard turnout.	Quantities as per Sector 2 - Item 4.3. Costs based on estimated production rates and construction industry wages.
4	Ballasting and Surfacing	$m.^3$	Work required to distribute ballast on the track structure and lift, line, and surface the track to its final position.	Quantities correspond to ballast purchased. Costs based on estimated production rates and construction industry wages.
5	Rail Grinding	track-km.	Pre-operation rail grinding program to remove rail surface irregularities for ride comfort, noise, and track maintenance reasons.	Costs based on European experience. Quantities corresponding to Item 1.1.
6	Construction Bases	route-km.	Land, trackage, and facilities required to provide a base for track, catenary, and signalling construction activities.	A lump sum cost for a typical base has been developed and apportioned over the length of line which would be built from such a base.

SUB-SYSTEM G: ELECTRIFICATION
Sector 4 - Construction/Installation

Item No.	Description	Units	Elements Included	Measurement and Costing Methods
1.1	Single track - Independent structures.	Km.	Supply, delivery and installation of catenary conductors, grounding conductors, grounding rods, tensioning equipment clamps, fittings, catenary posts including arms and insulators, shield wire, foundations.	Length based on track layout, with typical span for catenary structure. Cost will be based on Deux-Montagnes experience and suppliers' data. Structures and foundations will be estimated from steel weight.
1.2	Double track - Independent structures.	Km.	Supply, delivery and installation of catenary conductors, grounding conductors, grounding rods, tensioning equipment clamps, fittings, catenary posts including arms and insulators, shield wire, foundations.	Length based on track layout, with typical span for catenary structure. Cost will be based on Deux-Montagnes experience and suppliers' data. Structures and foundations will be estimated from steel weight.
1.3	Double track - Portal structures.	Km.	Supply, delivery and installation of conductors, clamps, fittings, catenary posts, foundation, catenary supports, tensioning equipment, grounding rods, or counterweight.	Length based on track layout, with typical span for catenary structure. Cost will be based on Deux-Montagnes experience and suppliers' data. Structures and foundations will be estimated from steel weight.
1.4	Triple track - Portal structures.	Km.	Supply, delivery and installation of conductors, clamps, fittings, catenary posts, foundation, catenary supports, tensioning equipment, grounding rods, or counterweight.	Length based on track layout, with typical span for catenary structure. Cost will be based on Deux-Montagnes experience and suppliers' data. Structures and foundations will be estimated from steel weight.
1.5	Yard catenary.	100 m.	Supply, delivery and installation of catenary conductors, grounding conductors, grounding rods, tensioning equipment clamps, fittings, catenary posts including arms and insulators, shield wire, foundations.	Length based on track layout, with typical span for catenary structure. Cost will be based on Deux-Montagnes experience and suppliers' data. Structures and foundations will be estimated from steel weight.
1.6	Siding catenary.	100 m.	Supply, delivery and installation of catenary conductors, grounding conductors, grounding rods, tensioning equipment clamps, fittings, catenary posts including arms and insulators, shield wire, foundations.	Length based on track layout, with typical span for catenary structure. Cost will be based on Deux-Montagnes experience and suppliers' data. Structures and foundations will be estimated from steel weight.
1.7	Garage area catenary.	100 m.	Supply, delivery and installation of catenary conductors, grounding conductors, grounding rods, tensioning equipment clamps, fittings, catenary posts including arms and insulators, shield wire, foundations.	Length based on track layout, with typical span for catenary structure. Cost will be based on Deux-Montagnes experience and suppliers' data. Structures and foundations will be estimated from steel weight.

SUB-SYSTEM G: ELECTRIFICATION
Sector 4 - Construction/Installation

Item No.	Description	Units	Elements Included	Measurement and Costing Methods
1.8	In-station catenary.	100 m.	Supply, delivery and installation of catenary conductors, grounding conductors, grounding rods, tensioning equipment clamps, fittings, catenary posts including arms and insulators, shield wire, foundations.	Length based on track layout, with typical span for catenary structure. Cost has been based on Deux-Montagnes experience and suppliers' data. Structures and foundations have been estimated from steel weight.
2.1	Crossover single (with section breaks).	Unit.	Supply, delivery and installation of section breaks, insulators, tensioning equipment, section insulators, conductors, potential transformers.	Quantities estimated from track layout (number of crossovers).
2.2	Crossover double (with section breaks).	Unit.	Supply, delivery and installation of section breaks, insulators, tensioning equipment, section insulators, conductors, potential transformers.	Quantities estimated from track layout (number of crossovers).
2.3	Phase break.	Unit.	Supply, delivery and installation of section breaks, insulators, tensioning equipment, section insulators, conductors, potential transformers.	Calculated from the number of traction stations. Prices based on manufacturer's catalog.
3.1	Underbridge.	100 m.	Supply of special supports, delivery and installation.	Quantities taken from civil group (number of underbridges).
3.2	Overbridge.	100 m.	Supply of special supports, delivery and installation.	Quantities taken from civil group (number of overbridges).
4.1	Main supply station - 230 kV.	ea.	Civil works, delivery, transport and installation of the equipment as defined in the single line diagrams.	Quantities determined from single line diagram.
4.2	Main supply station - 120 kV.	ea.	Civil works, delivery, transport and installation of the equipment as defined in the single line diagrams.	Quantities determined from single line diagram.
4.3	Paralleling and autotransformer station.	ea.	Civil works, delivery, transport and installation of the equipment as defined in the single line diagrams.	Quantities determined from single line diagram.
4.4	Interface station: 2x25kV - 1x25kV w/ autotransformer.	ea.	Civil works, delivery, transport and installation of the equipment as defined in the single line diagrams.	Quantities determined from single line diagram.
4.5	not used			

SUB-SYSTEM G: ELECTRIFICATION Sector 4 - Construction/Installation				
Item No.	**Description**	**Units**	**Elements Included**	**Measurement and Costing Methods**
4.6	Main supply station - 315 kV.	ea.	Civil works, delivery, transport and installation of the equipment as defined in the single line diagrams.	Quantities determined from single line diagram.
4.7	315 kV supply line from O.H. or H.Q.	Km.	Supply, delivery, and installation of a 315 kV line including structures, conductors, insulators, clamps, etc.	Lengths estimated based on desired location of the feeder stations for traction purposes and adjacent power lines.
4.8	230 kV supply line from O.H. or H.Q.	Km.	Supply, delivery, and installation of a 230 kV line including structures, conductors, insulators, clamps, etc.	Lengths estimated based on desired location of the feeder stations for traction purposes and adjacent power lines.
4.9	120 kV supply line from O.H. or H.Q.	Km.	Supply, delivery, and installation of a 120 kV line including structures, conductors, insulators, clamps, etc.	Lengths estimated based on desired location of the feeder stations for traction purposes and adjacent power lines.
4.10	Control center.	Unit.	Includes supervisory controls, telecommunications, multiplex, RTU's etc.	Lump sum to include all SCADA equipment.
5	EMI mitigation measures.	route-km.	Includes installations and special measures required to reduce interference of the 25 kV catenary on adjacent communications systems.	A typical cost has been developed based on European experience.

SUB-SYSTEM H: STATIONS
Sector 4 - Construction/Installation

Item No.	Description	Units	Elements Included	Measurement and Costing Methods
1	Modifications to Gare du Palais, Quebec.	Lump sum.	Platforms, Concourse, Parking, Service Facilities.	Prior studies, European experience.
2	New station at Trois Rivières.	Lump sum.	Platforms, Buildings, Parking, Auto and Access Bus.	European HSR and local commuter rail station experience. Contract costs for similar work items.
3	Modifications to Central Station, Montreal.	Lump sum.	Platforms, Concourse, Parking, Services Facilities.	Prior studies, European experience.
4	Modifications to Ottawa Station.	Lump sum.	Platforms, Concourse, Parking, Services Facilities.	Prior studies, European experience.
5	New station at Kingston.	Lump sum.	Platforms, Buildings, Parking, Auto and Bus Access.	European HSR and local commuter rail station experience. Contract costs for similar work items.
6	Modifications to Union Station.	Lump sum.	Platforms, Concourse, Parking, Services Facilities and Intermodal connections.	Prior studies, European experience.
7	New Station at Yonge St/CP.	Lump sum.	Platforms, Concourse, Parking, Service Facilities, Intermodal Connections.	European HSR and local commuter rail station experience. Contract costs for similar work items.
8	New station at Hamilton/Burlington.	Lump sum.	Platforms, Buildings, Parking, Auto and Bus Access.	European HSR and local commuter rail station experience. Contract costs for similar work items.
9	New station at Kitchener/Cambridge.	Lump sum.	Platforms, Buildings, Parking, Auto and Bus Access.	European HSR and local commuter rail station experience. Contract costs for similar work items.
10	New station at Suburban London.	Lump sum.	Platforms, Buildings, Parking, Auto and Bus Access.	European HSR and local commuter rail station experience. Contract costs for similar work items.
11	New station at Downtown London.	Lump sum.	Platforms, Buildings, Parking, Auto and Bus Access.	European HSR and local commuter rail station experience. Contract costs for similar work items.
12	New station at Windsor.	Lump sum.	Platforms, Buildings, Parking, Auto and Bus Access.	European HSR and local commuter rail station experience. Contract costs for similar work items.
13	New Mirabel Airport station.	Lump sum.	Platforms, intermodal connections.	Provision in airport plan, European HSR experience, typical local unit costs.
14	New Pearson Airport station.	Lump sum.	Platforms, intermodal connections, parking, auto and bus access.	Prior studies, European HSR experience, typical local unit costs for similar work e.g. suburban commuter rail stations.

APPENDIX - B

PRESENTATION OF UNIT COSTS

PRESENTATION OF UNIT COSTS

B1 - UNIT COST LISTING

ALL CORRIDORS — MASTER UNIT COST FILE

technology:
ALL TECHNOLOGIES — 10-Feb-94

ITEM NUMBER	ITEM	UNITS	300 NEW LOT / UNIT PRICE	300 EXIST LOT / UNIT PRICE	200 TILT. LOT / UNIT PRICE	SOURCE / REMARKS

ALL CORRIDORS — MASTER UNIT COST FILE

technology:
ALL TECHNOLOGIES — 10-Feb-94

ITEM NUMBER	ITEM	UNITS	300 NEW LOT / UNIT PRICE	300 EXIST LOT / UNIT PRICE	200 TILT. LOT / UNIT PRICE	SOURCE / REMARKS
	SUBSYSTEM	**A – RIGHT-OF-WAY ACQUISITION**				
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Professional Services					
1 1.1	– Surveying	%	8%	8%	8%	As a % of total cost of Sector 2
1 1.2	– Appraisal	%	0%	0%	0%	included in Item 1.1
1 1.3	– Legal Expertise	%	0%	0%	0%	included in Item 1.1
1 Item 2	Project Management	%	0%	0%	0%	As % of Sector 2 total + item 1.1
1 Item X	Contingencies	%	20%	20%	20%	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
2 SECTOR 2	EQUIPMENT / MATERIALS					
2 Item 1	Urban Land					
2 1.1	– Residential	hectare				
2 1.2	– Commercial	hectare				
2 1.3	– Industrial	hectare				
2 Item 2	Rural Land					
2 2.1	– Agricultural	hectare				
2 2.2	– Natural	hectare				
2 Item 3	Purchase of Existing Rail ROW					
2 3.1	– CN	hectare				
2 3.2	– CP	hectare				
2 3.3	– VIA	hectare				
2 Item X	Contingencies	%	10%	10%	10%	
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS					
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Not Applicable		$0	$0	$0	
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION					
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Not Applicable		$0	$0	$0	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION					
5 SECTOR 5	START-UP					
5	Included in Other Studies		$0	$0	$0	
5						
5 SECTOR 5	TOTAL: START-UP					

ALL CORRIDORS — MASTER UNIT COST FILE

technology:
ALL TECHNOLOGIES — 10-Feb-94

SUBSYSTEM — B - EARTHWORKS AND DRAINAGE

	ITEM NUMBER	ITEM	UNITS	300 NEW LOT / UNIT PRICE	300 EXIST LOT / UNIT PRICE	200 TILT. LOT / UNIT PRICE	SOURCE / REMARKS
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	5.5%	5.5%	5.5%	As a % of total cost of Sector 2
1	Item 2	Construction Supervision	%	5.0%	5.0%	5.0%	As a % of total cost of Sector 2
1	Item 3	Environmental Assessment	%	0.2%	0.2%	0.2%	Items 3 and 4 are %'s of entire
1	Item 4	Feasibility Studies (Technical)	%	1%	1%	1%	project's cost less profes. fees
1	Item 5	Project Management	%	5.4%	5.4%	5.4%	% of sector 2 total plus items 1-4
1	Item X	Contingencies	%	0%	0%	0%	
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
2	SECTOR 2	EQUIPMENT / MATERIALS					
2		Not Applicable		$0	$0	$0	
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS					
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Not Applicable		$0	$0	$0	
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION					
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	Clearing and Roadbed Preparation					
4	1.1	- Type 1 Soils	route-km	$142,000	$142,000	$142,000	$104,000 used in TM0-B1
4	1.2	- Type 2 Soils	route-km	$627,000	$627,000	$627,000	$437,000 used in TM0-B1
4	1.3	- Type 3 Soils	route-km	$1,035,000	$1,035,000	$1,035,000	$695,000 used in TM0-B1
4	Item 2	Embankment Construction					
4	2.1	- Soft Excavated Material	1000 m^3	$3,000	$3,000	$3,000	
4	2.2	- Hard Excavated Material (Rock)	1000 m^3	$18,000	$18,000	$18,000	
4	2.3	- Borrow Material	1000 m^3	$8,000	$8,000	$8,000	
4	2.4	- Disposal of Unsuitable Material	1000 m^3	$5,500	$5,500	$5,500	
4	Item 3	Haulage of Fill Material					
4		(from Borrow or Excavation)	1000 m^3-km	$0	$0	$0	Cost included in items B4-2.X
4	Item 4	Sub-Ballast Layers					For TM2-B0,TM2-D0,TM1-B0,
4	4.1	- New ROW	route-km	$228,000	$228,000	$228,000	TM1-D0,TM0-B0,TM0-B1,
4	4.2	- Existing ROW	route-km	$228,000	$228,000	$228,000	TM0-C0,and TM0-D0, $152,000
4	Item 5	Drainage Systems					used for cost of sub-ballast(it. 4)
4	5.1	- Normal ROW	route-km	$25,000	$25,000	$25,000	
4	5.2	- Major Watercourse Culverts	ea.	$35,000	$35,000	$35,000	
4	5.3	- Environment. Stormwater Controls	ea.	$7,000	$7,000	$7,000	
4	Item 6	Roadbed Upgrade on Existing ROW	route-km	$600,000	$600,000	$600,000	
4	Item 7	Retaining Structures					
4	7.1	- Up to 3 metres in Height	km.	$2,500,000	$2,500,000	$2,500,000	
4	7.2	- Over 3 metres in Height	km.	$5,000,000	$5,000,000	$5,000,000	
4	Item 8	Intrusion Barriers	km.	$0	$0	$0	Intrusion Barriers not required
4	Item 9	Noise Attenuation Structures					
4	9.1	- Barriers	km.	$660,000	$660,000	$660,000	
4	9.2	- Berms	km.	$165,000	$165,000	$165,000	
4	Item 10	ROW Security Fencing (on both sides)	route-km	$56,000	$56,000	$56,000	
4	Item 11	Snow Control Measures	km.	$0	$0	$0	Accounted for in Contingencies
4	Item 12	Utility Interferences					
4	12.1	- Major Hydro Relocation	ea.	$0	$0	$0	Accounted for in Contingencies
4	12.2	- Major Oil/Gas Relocation	ea.	$0	$0	$0	Accounted for in Contingencies
4	12.3	- Minor Pipe or Wire Crossings	route-km	$0	$0	$0	Accounted for in Contingencies
4	Item 13	Other Items					
4	13.1	- Audit for Contaminated Soil	route-km	$2,000	$2,000	$2,000	
4	13.2	- Audit for Contaminated Rail Yards	lump sum	$500,000	$500,000	$500,000	
4	13.3	- Minor Wildlife Passages (Culverts)	ea.	$100,000	$100,000	$100,000	
4	Item X	Contingencies	%	15%	15%	15%	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION					
5	SECTOR 5	START-UP					
5		Included in Other Studies		$0	$0	$0	
5							
5	SECTOR 5	TOTAL: START-UP					

ALL CORRIDORS — MASTER UNIT COST FILE

technology:
ALL TECHNOLOGIES — 10-Feb-94

SUBSYSTEM — C – BRIDGES, VIADUCTS, AND TUNNELS

ITEM NUMBER		ITEM	UNITS	300 NEW LOT / UNIT PRICE	300 EXIST LOT / UNIT PRICE	200 TILT. LOT / UNIT PRICE	SOURCE / REMARKS
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	5.5%	5.5%	5.5%	As a % of total cost of Sector 2
1	Item 2	Construction Supervision	%	5.0%	5.0%	5.0%	As a % of total cost of Sector 2
1	Item 3	Project Management	%	5.4%	5.4%	5.4%	% of sector 2 total plus items 1-2
1	Item X	Contingencies	%	0%	0%	0%	
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
2	SECTOR 2	EQUIPMENT / MATERIALS					
2		Not Applicable		$0	$0	$0	
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS					
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Not Applicable		$0	$0	$0	
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION					
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	Bridges					
4	1.1	– Small Rivers (< 30 metres)	ea.	$340,000	$340,000	$340,000	
4	1.2	– Extra at 1.1 for Height Over 10 m.	ea.	$85,000	$85,000	$85,000	
4	1.3	– Interm. Rivers (30 – 100 metres)	lin. m.	$23,500	$23,500	$23,500	
4	1.4	– Extra at 1.3 for Height Over 10 m.	lin. m.	$6,000	$6,000	$6,000	
4	1.5	– Large Rivers (100 – 250 metres)	lin. m.	$42,000	$42,000	$42,000	
4	1.6	– Extra at 1.5 for Height Over 10 m.	lin. m.	$10,500	$10,500	$10,500	
4	1.7	– Major Rivers (over 250 m.)	lin. m.	$50,000	$50,000	$50,000	
4	1.8	– Extra for Difficult Foundation Cond.	lin. m.	$5,000	$5,000	$5,000	
4	1.9	– Modif. to Exist. Bridges (new deck)	lin. m.	$13,000	$13,000	$13,000	
4	Item 2	Viaducts					
4	2.1	– Viaducts over 250 metres in Length	lin. m.	$27,000	$27,000	$27,000	
4	2.2	– Extra for Height Over XX metres	lin. m.	$8,000	$8,000	$8,000	
4	2.3	– Extra for Difficult Foundation Cond.	lin. m.	$4,000	$4,000	$4,000	
4	Item 3	Tunnels (Double Track)					
4	3.1	– In Soft Ground	lin. m.	$70,000	$70,000	$70,000	For 300+ technology, Rock
4	3.2	– In Rock	lin. m.	$50,000	$50,000	$35,000	Tunnels speed restricted by local
4	3.3	– Modifications to Existing Tunnels	lump sum	$0	$0	$0	conditions are $35,000/lin m.
4	3.4	– Noise Mitigation Measures	lump sum	$0	$0	$0	Accounted for in Contingencies
4	Item X	Contingencies	%	10%	10%	10%	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION					
5	SECTOR 5	START-UP					
5		Included in Other Studies		$0	$0	$0	
5							
5	SECTOR 5	TOTAL: START-UP					

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SUBSYSTEM — D - GRADE SEPARATIONS

	ITEM NUMBER		ITEM	UNITS	300 NEW LOT / UNIT PRICE	300 EXIST LOT / UNIT PRICE	200 TILT. LOT / UNIT PRICE	SOURCE / REMARKS
1	SECTOR 1		PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1		Engineering	%	5.5%	5.5%	5.5%	As a % of total cost of Sector 2
1	Item 2		Construction Supervision	%	5.0%	5.0%	5.0%	As a % of total cost of Sector 2
1	Item 3		Project Management	%	5.4%	5.4%	5.4%	% of sector 2 total plus items 1-2
1	Item X		Contingencies	%	0%	0%	0%	
1								
1	SECTOR 1		TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
2	SECTOR 2		EQUIPMENT / MATERIALS					
2			Not Applicable		$0	$0	$0	
2								
2	SECTOR 2		TOTAL: EQUIPMENT / MATERIALS					
3	SECTOR 3		TRANSPORTATION / DISTRIBUTION					
3			Not Applicable		$0	$0	$0	
3								
3	SECTOR 3		TOTAL: TRANSPORTATION / DISTRIBUTION					
4	SECTOR 4		CONSTRUCTION / INSTALLATION					
4	Item 1		New Grade Separations, Rural					
4		1.1	- 2 Lane Highways	ea.	$2,200,000	$2,200,000	$2,200,000	
4		1.2	- 2 Lane Highways, Dual ROW	ea.	$2,800,000	$2,800,000	$2,800,000	
4		1.3	- 4 Lane Highways	ea.	$3,100,000	$3,100,000	$3,100,000	
4		1.4	- 4 Lane Highways, Dual ROW	ea.	$3,565,000	$3,565,000	$3,565,000	
4		1.5	- Major Highways (401, 20, etc)	ea.	$4,450,000	$4,450,000	$4,450,000	
4		1.6	- Extra for Difficult Foundation Cond.	ea.	$180,000	$180,000	$180,000	
4	Item 2		New Grade Separations, Urban					
4		2.1	- Secondary Highways (2-4 lanes)	ea.	$4,068,000	$4,068,000	$4,068,000	
4		2.2	- Second. Hwys (2-4 l.) Dual ROW	ea.	$4,456,000	$4,456,000	$4,456,000	
4		2.3	- Major Highways (over 4 lanes)	ea.	$5,300,000	$5,300,000	$5,300,000	
4		2.4	- Extra for Difficult Foundation Cond.	ea.	$200,000	$200,000	$200,000	
4	Item 3		Modification of Exist. Grade Separations					
4		3.1	- Urban	ea.	$830,000	$830,000	$830,000	
4		3.2	- Rural	ea.	$627,000	$627,000	$627,000	
4	Item 4		Automatic Crossing Protection	ea.	$270,000	$270,000	$270,000	
4	Item 5		Closure and Diversion of Roads	km. of road	$280,000	$280,000	$280,000	
4	Item 6		Private Farm Crossings	ea.	$300,000	$300,000	$300,000	
4	Item 7		Major Wildlife Passages	ea.	$500,000	$500,000	$500,000	
4	Item X		Contingencies	%	15%	15%	20%	
4								
4	SECTOR 4		TOTAL: CONSTRUCTION / INSTALLATION					
5	SECTOR 5		START-UP					
5			Included in Other Studies		$0	$0	$0	
5								
5	SECTOR 5		TOTAL: START-UP					

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SUBSYSTEM — E – OTHER ACCOMODATION WORKS

ITEM NUMBER	ITEM	UNITS	300 NEW LOT / UNIT PRICE	300 EXIST LOT / UNIT PRICE	200 TILT. LOT / UNIT PRICE	SOURCE / REMARKS
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	5.5%	5.5%	5.5%	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	5.0%	5.0%	5.0%	As a % of total cost of Sector 2
1 Item 3	Project Management	%	5.4%	5.4%	5.4%	% of sector 2 total plus items 1 – 2
1 Item X	Contingencies	%	0%	0%	0%	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
2 SECTOR 2	EQUIPMENT / MATERIALS					
2	Included in Construction / Installation		$0	$0	$0	
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS					
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Included in Construction / Installation		$0	$0	$0	
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION					
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Removal of Rail Lines	km.	$21,134	$21,134	$21,134	
4 Item 2	Construction of New Access Tracks	km.	$644,750	$644,750	$644,750	
4 Item 3	Rail/Rail Grade Separation	ea.				
4 3.1	– Rural	ea.	$800,000	$800,000	$800,000	
4 3.2	– Urban	ea.	$1,000,000	$1,000,000	$1,000,000	
4 Item 4	Other Particular Items:					
4 4.1	– Sub-Item	lump sum				
4 4.2	– Sub-Item	lump sum				
4 4.3	– Sub-Item	lump sum				
4 4.4	– Sub-Item	lump sum				
4 Item X	Contingencies	%	30%	30%	30%	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION					
5 SECTOR 5	START-UP					
5	Included in Other Studies		$0	$0	$0	
5						
5 SECTOR 5	TOTAL: START-UP					

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SUBSYSTEM — F - TRACK

ITEM NUMBER		ITEM	UNITS	300 NEW LOT / UNIT PRICE	300 EXIST LOT / UNIT PRICE	200 TILT. LOT / UNIT PRICE	SOURCE / REMARKS
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	3.5%	3.5%	3.5%	As % of total for Sectors 2 and 4
1	Item 2	Construction Supervision	%	10%	10%	10%	As % of total for Sector 4
1	Item 3	Materials Procurement	%	4%	4%	4%	As % of total for Sector 2
1	Item 4	Project Management	%	5.4%	5.4%	5.4%	As % of Sectors 2,4 totals plus
1	Item X	Contingencies	%	0%	0%	0%	items 1 - 3
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
2	SECTOR 2	EQUIPMENT / MATERIALS					
2	Item 1	Rail					
2	1.1	- Main Line	t.	$773	$773	$773	
2	1.2	- Siding	t.	$773	$773	$773	
2	Item 2	Ties	ea.	$45	$45	$45	
2	Item 3	Ballast	m ^ 3	$21	$21	$21	
2	Item 4	Turnouts					
2	4.1	- High Speed	ea.	$280,000	$280,000	$280,000	
2	4.2	- Medium Speed	ea.	$135,000	$135,000	$135,000	
2	4.3	- Yard	ea.	$46,000	$46,000	$46,000	
2	Item 5	Other Track Material					
2	5.1	- Rail Fastening Assemblies	set	$27	$27	$27	
2	5.2	- Bonded Insulated Joints	ea.	$0	$0	$0	Included in Signalling costs
2	5.3	- Bumping Posts	ea.	$3,120	$3,120	$3,120	
2	Item 6	Switch Heaters/ Snow Blowers	ea.				
2	6.1	- Main Line	ea.	$105,000	$105,000	$105,000	
2	6.2	- Siding	ea.	$11,800	$11,800	$11,800	
2	Item 7	Ballast Mats for Noise Attenuation	m ^ 2	$63	$63	$63	
2	Item X	Contingencies	%	5%	5%	5%	
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS					
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		(included in Equipment / Materials)		$0	$0	$0	
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION					
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	Track Construction					
4	1.1	- Main Line	km.	$18,212	$18,212	$18,212	
4	1.2	- Yard	km.	$44,175	$44,175	$44,175	
4	Item 2	Field Welded Joints	ea.	$2,028	$2,028	$2,028	
4	Item 3	Turnout Construction					
4	3.1	- High and Med. Speed (Main Line)	ea.	$20,455	$20,455	$20,455	
4	3.2	- Yard	ea.	$4,680	$4,680	$4,680	
4	Item 4	Ballasting and Surfacing	m ^ 3	$8.47	$8.47	$8.47	
4	Item 5	Rail Grinding	track - km.	$4,545	$4,545	$4,545	
4	Item 6	Construction Bases	route-km	$24,372	$24,372	$24,372	
4	Item X	Contingencies	%	6%	6%	6%	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION					
5	SECTOR 5	START-UP					
5		Included in Other Studies					
5							
5	SECTOR 5	TOTAL: START-UP					

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SUBSYSTEM — G – ELECTRIFICATION

ITEM NUMBER	ITEM	UNITS	300 NEW LOT / UNIT PRICE	300 EXIST LOT / UNIT PRICE	200 TILT. LOT / UNIT PRICE	SOURCE / REMARKS
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	5.5%	5.5%	5.5%	As % of total for Sector 4
1 Item 2	Construction Supervision	%	5.0%	5.0%	5.0%	As % of total for Sector 4
1 Item 3	Project Management	%	5.4%	5.4%	5.4%	% of sector 4 total plus items 1–2
1 Item X	Contingencies	%	0%	0%	0%	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
2 SECTOR 2	EQUIPMENT / MATERIALS					
2	(included in Construction / Installation)		$0	$0	$0	
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS					
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	(included in Construction / Installation)		$0	$0	$0	
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION					
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Typical Catenary					
4 1.1	– Single Track – Independent Struct.	km.	$175,000	$175,000	$175,000	
4 1.2	– Double Track – Independ. Struct.	km.	$350,000	$350,000	$350,000	
4 1.3	– Double Track – Portal Structures	km.	$400,000	$400,000	$400,000	
4 1.4	– Triple Track – Portal Structures	km.	$460,000	$460,000	$460,000	
4 1.5	– Yard Catenary	100 m.	$13,500	$13,500	$13,500	
4 1.6	– Sidings Catenary	100 m.	$13,500	$13,500	$13,500	
4 1.7	– Garage Area Catenary	100 m.	$13,500	$13,500	$13,500	
4 1.8	– In-Station Catenary	100 m.	$17,500	$17,500	$17,500	
4 Item 2	Particular Catenary Installations					
4 2.1	– Xover Single (with section breaks)	ea.	$280,000	$280,000	$280,000	
4 2.2	– Xover Double (with section breaks)	ea.	$369,000	$369,000	$369,000	
4 2.3	– Phase Break	ea.	$1,052,000	$1,052,000	$1,052,000	
4 Item 3	Special Catenary Structures					
4 3.1	– Underbridge	100 m.	$10,000	$10,000	$10,000	
4 3.2	– Overbridge	100 m.	$15,000	$15,000	$15,000	
4 Item 4	Power Supply					
4 4.1	– Main Supply Station, 230 kV	ea.	$5,355,000	$5,355,000	$5,355,000	
4 4.2	– Main Supply Station, 138 – 120 kV	ea.	$4,075,000	$4,075,000	$4,075,000	
4 4.3	– Paralleling and Auto-transf. Stn	ea.	$730,000	$730,000	$730,000	
4 4.4	– 2x25 – 1x25 Interface Station	ea.	$925,000	$925,000	$925,000	
4 4.5	not used	ea.	$0	$0	$0	
4 4.6	– Main Supply Station, 315 kV	ea.	$6,380,000	$6,380,000	$6,380,000	
4 4.7	– 315 kV Supply Line	ea.	$252,500	$252,500	$252,500	
4 4.8	– 230 kV Supply Line	km.	$170,300	$170,300	$170,300	
4 4.9	– 120 kV Supply Line	km.	$132,200	$132,200	$132,200	
4 4.10	– Control Center	ea.	$200,000	$200,000	$200,000	
4 Item 5	EMI Mitigation Measures	route-km	$5,000	$5,000	$5,000	
4 Item X	Contingencies	%	15%	15%	15%	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION					
5 SECTOR 5	START-UP					
5	Included in Other Studies					
5						
5 SECTOR 5	TOTAL: START-UP					

ALL CORRIDORS — MASTER UNIT COST FILE

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ITEM NUMBER		ITEM	UNITS	300 NEW LOT / UNIT PRICE	300 EXIST LOT / UNIT PRICE	200 TILT. LOT / UNIT PRICE	SOURCE / REMARKS
		SUBSYSTEM — H – STATIONS					
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	5.5%	5.5%	5.5%	As a % of total for Sector 2
1	Item 2	Construction Supervision	%	5.0%	5.0%	5.0%	As a % of total for Sector 2
1	Item 3	Project Management	%	5.4%	5.4%	5.4%	% of sector 2 total plus items 1 – 2
1	Item X	Contingencies	%	0%	0%	0%	
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
2	SECTOR 2	EQUIPMENT / MATERIALS					
2		(included in Construction / Installation)		$0	$0	$0	
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS					
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		(included in Construction / Installation)		$0	$0	$0	
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION					
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	Individual Station (location, name)	lump sum	$0	$0	$0	
4	Item 2	Individual Station (location, name)	lump sum	$0	$0	$0	
4	Item 3	Individual Station (location, name)	lump sum	$0	$0	$0	
4	Item 4	Individual Station (location, name)	lump sum	$0	$0	$0	
4	Item X	Contingencies	%	10%	10%	10%	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION					
5	SECTOR 5	START-UP					
5		Included in Other Studies		$0	$0	$0	
5							
5	SECTOR 5	TOTAL: START-UP					

PRESENTATION OF UNIT COSTS

B2 - DEVELOPMENT OF INDIVIDUAL UNIT COSTS

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	Sub-system:	- B C D E G H
☑ 350 kph - new ROW	Sector:	1 - Prof. Services
☑ 350 kph - exist. ROW	Item:	-
☑ 250 kph - exist. ROW		

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable:

Percentages for professional services have been developed by the Consultant using information about similar costs for large transit projects throughout North America, costs from TGV experience in France, and additional consideration in view of the scope of the project and potential for economies of scale.

The percentages retained for use are:

Engineering	5.5%	applied to construction costs
Construction Supervision	5.0%	applied to construction costs
Project Management	5.4%	applied to construction + engineering costs

These equate to an amount of 16.5% on top of the construction cost of the project to cover professional services. They compare to figures of 20% and higher for North American transit projects, 19% for the "Let's Move" TTC expansion in Toronto, and 15% for the TGV, although it should be noted that much of the detailed engineering in Europe is performed by the Contractor.

In the case of Project Management shown above, the 5.4% applied to construction and engineering costs is equivalent to 6.0% applied to construction costs only (the more traditional approach).

In reviewing costs on other projects, it is noted that these percentages for "administration costs" generally include a minimum of 2% of agency or owner cost. A similar amount can be assumed to be included here.

Prepared by:	continued ☐

Date:		Page: 1 of 5

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

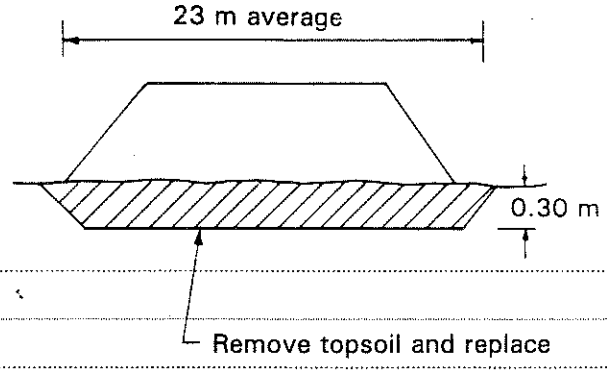
Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: 8 - EARTHWORKS Sector: 4 - CONSTRUCTION Item: 1 - CLEARING

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

1.1 - Type 1 Soils

Assume a 50 m wide corridor - (per/km)

1,000 m x 50 m = 50,000 m^2 = 5 ha



(1) Clearing - (scraper work):

5 ha @ $5,000/ha = $25,000/km

(2) Excavation of unsuitable material and backfill:

23 x 0.3 x 1,000 m/km = 6,900 m^3/km

Case 1 - 2a) Assuming 5 km haulage

(2.a1) Exc → 6,900 m^3/km @ $2.5/$m^3$ = $17,250/km

(2.a2) Disposal → assuming 5 km haulage @ $0.60 per m^3/km

$3.0/$m^3$ x 6,900 m^3/km = $20,700/km

Prepared by:	continued ☑

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology: ☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W

Sub-system: B - EARTHWORKS
Sector: 4 - CONSTRUCTION
Item: 1 - CLEARING

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:

Case 2 - 2b) If all backfill is borrow material, assuming 10 km avg. haulage

(2.b1) $17,250/km (same as in 2.a1)

(2.b2) $20,700/km (same as in 2.a2)

(2.b3) Excavation, placement and compaction of selected material:

6,900 m^3 @ $3/$m^3$ = $20,700/km

(2.b4) Haulage @ $0.50 per m^3/km

$5.0/$m^3$ x 6,900 m^3/km = $34,500/km

(3) Demolition of buildings and other structures

Lump sum $10,000/km (assuming an average of 2 houses/km)

Total Item 1.1

Case 1 - Total = [(1)+(2a)+(3)] + 10% allowance for misc. items

(No borrow. Free haulage) = $80,000/km

Case 2 - Total = [(1)+(2b)+(3)] + 10% allowance for misc. items

(All borrow. 10 km haulage) = $142,000/km

Case 3 - Average of Case 1 & Case 2 = $111,000/km

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology: ☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W

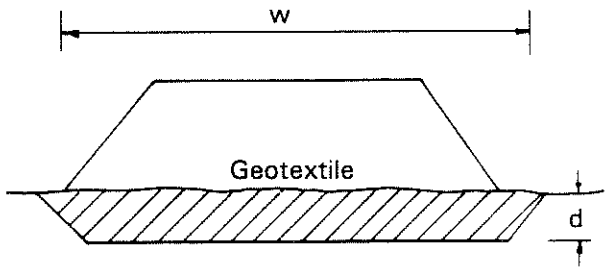
Sub-system: 3 - EARTHWORKS
Sector: 4 - CONSTRUCTION
Item: 1 - CLEARING

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

1.2 - Type 2 Soils; 1.3 - Type 3 Soils

Assume a 50 m wide corridor - (per km)

1,000 x 50 m = 50,000 m^2 = 5 ha



Item 1.2 : d = 1.5 m; w = 23 m

Item 1.3 : d = 2.0 m; w = 31 m

(1) Clearing (scraper) = $25,000/km (same as in 1.1)

(2) Excavation and backfill:

for Item 1.2 : 23 x 1.5 x 1,000 = 34,500 m^3/km

for Item 1.3 : 31 x 2 x 1,000 = 62,000 m^3/km

Case 1 - (2a) If backfill material is hauled from excavation item, free haulage

Item 1.2: (2.a1) Exc → 34,500 m^3/km @ $2.5/$m^3$ = $86,250/km

(2.a2) Disposal → assuming 5 km haulage @ $0.60 per m^3/km

0.60 x 5 x 34,500 = $103,500/km

Prepared by:

continued ☑

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology: ☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W

Sub-system: B - EARTHWORKS
Sector: 4 - CONSTRUCTION
Item: 1 - CLEARING

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable: _____

Item 1.3: (2.a1) Exc → 62,000 m^3/km @ \$2.5/m^3 = \$155,000/km

(2.a2) Disposal → assuming 5 km haulage @ \$0.60 per m^3/km

0.60 x 5 x 62,000 = \$186,000/km

Case 2 - (2b) If all backfill is borrow material, assuming 10 km avg. haulage

Item 1.3: (2.b1) \$155,000/km (same as in 2.a1)

(2.b2) \$186,000/km (same as in 2.a2)

(2.b3) Excavation, placement and compaction of selected material:

62,000 x 3 = \$186,000/km

(2.b4) Haulage @ \$0.50 per m^3/km

10 x 0.50 x 62,000 = \$310,000/km

Item 1.2: (2.b1) \$86,250/km (same as in 2.a1)

(2.b2) \$103,500/km (same as in 2.a2)

(2.b3) \$34,500 x 3 = \$103,500/km

(2.b4) \$10 x 0.50 x 34,500 = \$172,500 km

Date:		Page: 5 of 5

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: 3 - EARTHWORKS Sector: 4 - CONSTRUCTION Item: 1 - CLEARING

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable: _____

(3) Demolition of structures = lump sum = $10,000/km

(4) Geotextile @ $3/m^2

23 x 1000 x 3 = $69,000/km

Total Item 1.2

Case 1 : [(1)+(2a)+(3)+(4)] + 10% allowance for misc. items

(No borrow. Free haulage) = $323,000/km

Case 2 : [(1)+(2b)+(3)+(4)] + 10% allowance for misc. items

(All borrow. 10 km haulage) = $627,000/km

Case 3 : Average of Case 1 & Case 2 = $475,000/km

Total Item 1.3

Case 1 : [(1)+(2a)+(3)+(4)] + 10% allowance for misc. items

(No borrow. Free haulage) = $490,000/km

Case 2 : [(1)+(2b)+(3)+(4)] + 10% allowance for misc. items

(All borrow. 10 km haulage) = $1,035,000/km

Case 3 : Average of Case 1 & Case 2 = $763,000/km

Prepared by:	continued ☐

Date:		Page: 1 of 2

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: 8 - EARTHWORKS Sector: 4 - CONSTRUCTION Item: 2 - EMBANKMENT

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

ITEM 2 - EMBANKMENT CONSTRUCTION

Excavation (free haulage of 500 m in either direction of embankment, along R.O.W.); placement and compaction:

2.1 - Soft excavated material (scraper; small dozer work) = $3/m^3$

2.2.a - Soft rock (large dozer work) = $15/m^3$)

) Use $18/m^3$

2.2.b - Hard rock (blasting required) = $25/m^3$)

2.3 - Borrow material

(soil excavation) = $3/m^3$

Assuming 5 km avg. hauling @ $0.60/m^3/km = $3/m^3 + $3/m^3

= $6/m^3$

Assuming 10 km avg. hauling @ $0.50/m^3/km = $5/m^3 + $3/m^3

= $8/m^3$

Soft rock excavation = $15/m^3$

Assuming 10 km avg. hauling @ $0.50/m^3/km

= $5/m^3 + $15/m^3

= $20/m^3$

Prepared by:	continued ☑

Date:		Page: 2 of 2

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: 8 - EARTHWORKS Sector: 4 - CONSTRUCTION Item: 2 - EMBANKMENT

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable: _____

2.4 - Disposal of unsuitable material

Excavation = $2.5/m^3$

Disposal (assuming 5 km haulage @ $0.60/m^3/km)

= $0.6 x 5

= $3/m^3$

Total cost = $5.5/m^3$

Prepared by:	continued ☐

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

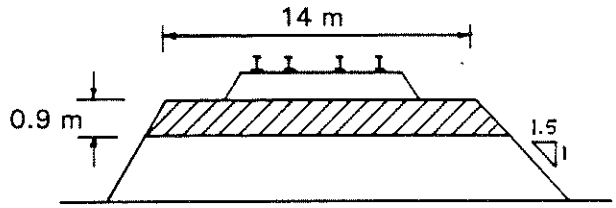
Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: 3 - EARTHWORKS Sector: 4 - CONSTRUCTION Item: 4 - SUB-BALLAST

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

ITEM 4 - SUB-BALLAST LAYER:

(i) @ $\$15/m^3$ with borrow material

Assuming a 0.9 m layer



$$\left[\left[\frac{(14 + 16.7)}{2} \times 0.9 \times 1000\right] + 10\% \text{ allowance}\right] \times \$15/m^3$$

= $228,000/km

(ii) With available material, rate to be adjusted to eliminate haulage @ $\$0.50/m^3/km$ for average length of 10 km, i.e., use a rate of $\$15-\$5 = \$10/m^3$

= $152,000/km

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Date:		Page: 1 of 1

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: 8 - EARTHWORKS Sector: 4 - CONSTRUCTION Item: 5 - DRAINAGE

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

5.1 Normal R.O.W:

(1) Assuming 4 no. 450 to 900 mm balancing culverts per km

$75/m x 25 m x 4 = $7,500/km

(2) Assuming 50% of the route requires 200 mm subdrains on both sides

$10/m x 1,000 m = $10,000/km

(3) Assuming $5,000/km for other drainage items

Total Item 5.1

= [(1)+(2)+(3)] +10% allowance for miscellaneous items

= $25,000/km

5.2 Major Watercourse Culverts

Assume a 40 m (4 m dia.) culvert including head walls

$875/m x 40 m = $35,000 each

5.3 Environmental Stormwater Controls

Cost of settlement pond = $70,000 including excavation for 50 x 30 x 2 m deep pond, one inlet, one outlet and restoration of site.

Assume provision of one settlement pond for every 10 km, use rate of $7,000 per route-km.

Prepared by:	continued ☐

Date:		Page: 1 of 1

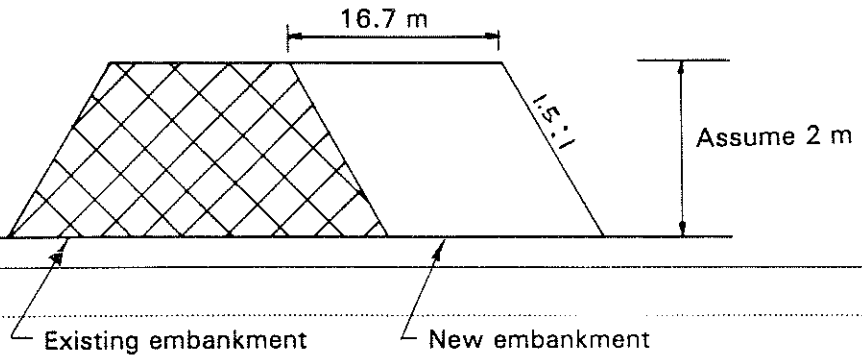
QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: 3 - EARTHWORKS Sector: 4 - CONSTRUCTION Item: 6 - ROADBED UPGRADE

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

ITEM 6 - ROADBED UPGRADE ON EXISTING R.O.W.



Benching of existing slope	= sqrt $2^2 + 3^2$
	= 3.61 m^2 @ \$40/m^2
	= \$145/m
Embankment construction	= 16.7 x 2
with borrow material	= 33.4 m^3 @ \$8/m^3
	= \$268/m
Add 50% for working in close proximity of operation	
	= \$402/m
Total cost	= (\$145 + \$402) + 10% allowance for misc. items
	= \$600/m say

Prepared by:	continued ☐

Date:		Page: 1 of 1

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☐ 300+ kph - new R/W
- ☐ 300+ kph - exist. R/W
- ☐ 200+ kph - exist. R/W

Sub-system: B - EARTHWORKS
Sector: 4 - CONSTRUCTION
Item: 7 - RET. WALLS

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable: _____

7.1 Up to 3 Metres in Height

Concrete	= $1,600/m
Excavation/backfill	= $100/m
Reinforcement	= $300/m
Total	= $2,000/m

Add 20% for difficult foundation and site constraints = $2,500/m say

7.2 Over 6 Metres in Height

Concrete	= $3,200/m
Excavation/backfill	= $200/m
Reinforcement	= $600/m
Total	= $4,000/m

Add 20% for difficult foundation and site constraints = $5,000/m say

Prepared by:

continued ☐

Date:		Page: 1 of 1

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: 8 - EARTHWORKS Sector: 4 - CONSTRUCTION Item: 9 - NOISE BARRIERS

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

ITEM 9 NOISE ATTENUATION STRUCTURES

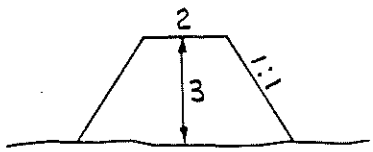
9.1 Barriers

Assuming 3 m in height:

from MTO Unit rates = $600/m

Add 10% allowance for miscellaneous items = $660,000/km

9.2 Berms



Assuming all borrow material, average hauling of 10 km @ $11/m^3

$15m^2 \times 1{,}000m \times 11/m^3 = \$165{,}000/km$

Prepared by:	continued ☐

Date:		Page: 1 of 1

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: 8 - EARTHWORKS Sector: 4 - CONSTRUCTION Item: 10 - FENCING

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable: _____

ITEM 10 ROW SECURITY FENCING (BOTH SIDES)

@ $28/m = $56,000/km

Prepared by:	continued ☐

Date:		Page: 1 of 4

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: C - BRIDGES Sector: 4 - CONSTRUCTION Item: 1.1 - SMALL RIVERS

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable: _____

Small River Bridges ± 20m

Based on bridges designed and estimated, cost of such a bridge is $\$1,300/m^2$

Assume width of bridge (2 tracks) = 13 m

$1,300 x 13 = $16,900/m

or, $16,900 x 20 = $340,000/each

Prepared by:	continued ☐

Date:		Page: 2 of 4

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: 2 - BRIDGES Sector: 4 - CONSTRUCTION Item: 1.3 - INTERM. RIVERS

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable: _____

Intermediate River Bridges 300 - 100 m

Based on bridges designed and estimated, cost of such a bridge is $1,800/m^2

Assume width of bridge (2 tracks) = 13 m

$1,800 x 13 = $23,400/m

Prepared by:	continued ☐

Date:		Page: 3 of 4

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: C - BRIDGES Sector: 4 - CONSTRUCTION Item: 1.5 - 1.7 LARGE RIVERS

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

Large River Bridges 100 - 250 m

Based on bridges designed and estimated, cost of such a bridge is $\$3,200/m^2$

Assume width of bridge (2 tracks) = 13 m

$\$3,200/m^2 \times 13 = \$41,600/m$

Same cost applies to the major river bridges.

Prepared by:	continued ☐

Date:		Page: 4 of 4

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☐ 300+ kph - new R/W
- ☐ 300+ kph - exist. R/W
- ☐ 200+ kph - exist. R/W

Sub-system: C - BRIDGES
Sector: 4 - CONSTRUCTION
Item: 1.9 - BRIDGE MODIF.

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

New deck for 1 track existing bridge of width 4 m

Concrete volume

4m x 0.3m x $400/m^3 = $480.00/m

Reinforcing steel

400 kg/m^3 x $1.25/kg = $500.00/m

$980.00/m

say $1,000/m

Provision shall be made to strengthen existing beam

say $800/m

$1,800/m

Provision for maintenance access $600/m

$2,400/m

For double track HSR

Add new bridge of width 8 m @ $1,300/m^2

$1,300 x 8 = $10,400/m

Total cost = $10,400 + $2,400

= $12,800

= $13,000/m say

Prepared by:

continued ☐

RURAL GRADE SEPARATIONS

TABLE 1

			Item 1.1		Item 1.2		Item 1.3		Item 1.4		Item 1.5	
			2 Lane Rural over 2 Trks		2 Lane Rural over 4 Trks		4 Lane Rural over 2 Trks		4 Lane Rural over 4 Trks		4 Lane Div. Freeway over 2 Tracks	
	Unit	Price	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
1. Excavation	m^3	5.0	1,760	8,800	1,760	8,800	2,140	10,700	2,140	10,700	3,590	17,950
2. Borrow	m^3	5.0	145,730	728,650	145,730	728,650	182,560	912,800	182,560	912,800	315,350	1,576,750
3. Hot Mix	t	60.0	2,265	135,900	2,365	141,900	4,680	280,800	4,850	291,000	6,670	400,200
4. Gran 'A'	t	10.0	6,820	68,200	6,820	68,200	9,340	93,400	9,340	93,400	14,350	143,500
5. Gran. 'B'	t	8.0	10,925	87,400	10,925	87,400	16,000	128,000	16,000	128,000	31,360	250,880
6. Guide Rail	m	75.0	1,540	115,500	1,540	115,500	1,540	115,500	1,540	115,500	840	63,000
Sub Total				1,144,450		1,150,450		1,541,200		1,551,400		2,452,280
7. Minor Items 10%				114,450		115,050		154,120		155,140		245,230
TOTAL ROADWORK				1,258,900		1,265,500		1,695,320		1,706,540		2,697,510
STRUCTURE												
8. Standard Conditions	m^2	1100	500	550,000	945	1,039,500	800	880,000	1,150	1,265,000	920	1,012,000
9. Diff.Fnd.Conditions	m^2	1265	500	632,500	945	1,195,430	800	1,012,000	1,150	1,454,750	920	1,163,800
TOTAL COST				2,200,000		2,800,000		3,100,000		3,565,000		[illegible]
Standard Conditions				1,808,900		2,305,000		2,575,320		2,971,540		3,709,510
Difficult Fnd. Conditions				1,891,400		2,460,930		2,707,320		3,161,290		3,861,310
				2,300,000		3,000,000		3,250,000		3,800,000		[illegible]

Note: 20% added to total cost to compensate for low borrow unit price

DRAFT

SUB-SYSTEM D

GRADE SEPARATIONS

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URBAN GRADE SEPARATIONS

TABLE 2

				Item 2.1		Item 2.2		Item 2.3a		Item 2.3b	
				4 Lane Road over 2 Trks		4 Lane Road over 4 Trks		6 Lane Road over 2 Trks		6 Lane Road over 4 Trks	
		Unit	Price	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
1.	Borrow	m^3	5.0	198,000	990,000	198,000	990,000	233,330	1,166,650	233,330	1,166,650
2.	Hot Mix	t	60.0	4,445	266,700	4,495	269,700	6,610	396,600	6,685	401,100
3.	Gran 'A'	t	10.0	5,640	56,400	5,640	56,400	8,670	86,700	8,670	86,700
4.	Gran. 'B'	t	8.0	14,100	112,800	14,100	112,800	25,000	200,000	25,000	200,000
5.	Guide Rail	m	75.0	1,540	115,500	1,540	115,500	1,540	115,500	1,540	115,500
6.	Curbs	m	32.0	1,880	60,160	1,880	60,160	3,760	120,320	3,760	120,320
7.	Sidewalks	m^2	35.0	2,820	98,700	2,820	98,700	2,820	98,700	2,820	98,700
	Sub Total				1,700,260		1,703,260		2,184,470		2,188,970
8.	Minor Items 30%				510,080		510,980		655,340		656,690
	TOTAL ROADWORK				2,210,340		2,214,240		2,839,810		2,845,660
	STRUCTURE										
9.	Standard Conditions	m^2	1100	800	880,000	1,090	1,199,000	1,160	1,276,000	1,580	1,738,000
10.	Diff.Fnd.Conditions	m^2	1265	800	1,012,000	1,090	1,378,850	1,160	1,467,400	1,580	1,998,700
11.	Traffic Maintenance				100,000		100,000		100,000		100,000
12.	Detours				150,000		150,000		150,000		150,000
13.	Mitigations - Private Property				50,000		50,000		50,000		50,000
TOTAL COST					4068,000		4456,000		5,300,000		5,961,000
Standard Conditions					3,390,340		3,713,240		4,415,810		4,883,660
Difficult Fnd. Conditions					3,522,340 +226,000		3,893,090 4,672,000		4,607,210 5,529,000		5,144,360 6,173,000

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Note: 20% added to total cost to compensate for low borrow unit price

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MODIFICATION OF EXISTING GRADE SEPARATION

TABLE 3

	Unit	Price	Item 3.2a 2 Lane Rural Road over 4 tracks Quantity	Cost	Item 3.2b Rural Minor Modification Quantity	Cost	Item 3.1a 4 Lane Urban Road over 4 tracks Quantity	Cost	Item 3.1b Urban Minor Modification Quantity	Cost
1. Roadway	L.S.		L.S.	100,000	L.S.	30,000	L.S.	200,000	L.S.	60,000
2. Detour	1 km	280,000	0.7	196,000			N/A			
Sub Total				296,000		30,000		200,000		60,000
Minor Items 30%				29,600		3,000		20,000		6,000
TOTAL ROADWORK				325,600		33,000		220,000		66,000
3. Structure	m^2	1,100	500	550,000			1,090	1,199,000	N/A	
							bridge removal	100,000		
4. Existing Bridge Rehabilitation	m^2	250	190	47,500	190	47,500	N/A		300	75,000
5. Crossing Protect. Signals, etc.	EA			250,000			N/A		N/A	
TOTAL COST				1,173,100		80,500		1,519,000		141,000

Assume using average

Assume using [illegible]

COST ESTIMATE - QUANTITIES
SUBSYSTEM D

1.1 2 Lane Rural Roadway Overpassing 2 Tracks

1.1.1 GRADING

Excavation - stripping only

l = 105 m w = 28.0 m

area 2 x (105 x 28) = 5880 m^2

depth 0.3 m

volume 1764 m^2 1760.0 m^3

Fill - bottom only

		Ht.	End Area		
Sta	1 + 020	9.5	312		
				301 x 70	21,070
	1 + 0990	9.0	289		
				231 x 116	26,796
	1 + 206	6.5	173		
				144 x 134	19,296
	1 + 340	5.0	114		
				57 x 100	5,700
					72, 862 m

x 2 = 145,724 m^3

1.1.2 PAVEMENT

Hot Mix

Roadway length - 470 x 2 = 940 m

width 7.50

area = 750 m^2

assuming 120 mm of asphalt

$\frac{7050 \times 12 \times 25.4}{1000} = 2148.84t$ 2.150t

on the bridge deck

90 mm

length = 40 m

width = 7.5 + 2 x 2.50 = 12.5

area = 40 x 12.5 = 500 m^2

$\frac{500 \times 9 \times 25.2}{1000} = 114.3t$ 115t

2,265t

GRANULAR 'A'

end area - 7.5 x 0.15 + 2(3.5 x 0.27)

= 1.13 + 1.89 = 3.02m^2

940 x 3.02 = 2839m^3x 2.4 = 6.813t

GRANULAR 'B'

$d = \frac{0.3 + 0.39}{2} = 0.35$

W = 16.6 m end area = 5.81m_2

5.81 x 940 = 5,461.4 x 2.0 10,923 t

1.1.3 GUIDE RAIL

l = 385 m x 4 = 1540 m

1.14 STRUCTURE

length = 40 m

w = 12.5 m

area = 500 m^2

1.2 2 lane roadway over 4 tracks

1.2.1 & 1.2.3 as for two track (see 1.1)

1.2.4 - STRUCTURE

l = 40+35.5 = 75.5 m

w = 12.5 m

area 75.5 x 12.5 = 943.75 m^2 say 945 m^2

1.2.2 PAVEMENT

Hot mix on the bridge

Area 945 m_2 90 mm

Asphalt $\frac{945 \times 9 \times 25.4}{1000}$ = 216t

Total Bridge	216
Roadway as for 2 track (see 1.1)	2150
	2366t

1.3 4 Lane Rural Roadway over 2 tracks

EXCAVATION - Stripping only

l = 105 m w = 34.0 m

area = 2 (105 x 34) = 7140 m^2

depth 0.3

7140 x 0.3 = 2140 m^3

Fill - bottom only

		Ht.	End Area		
Sta	1 + 020	9.5	383		
				369 x 70	25,830
	1 + 090	9.0	355		
				287 x 116	33,292
	1 + 206	6.5	218		

			184 x 134	24,656
1 + 340	5.0	150		
			75 x 100	7,500
1 + 440	0	0		
				91,278 m_2
			x 2 = 182,556 m^3	

1.3.2 PAVEMENT

Hot Mix

Roadway length - 940 m

width = 15.0 M

area = 14100 m^2 (120 mm H.M)

tonnage $\frac{14100 \times 12 \times 25.4}{100}$ = 4,298 t say 4,300 t

bridge deck d = 90 mm

l = 40 m w = 15 + (2.5 x 2) = 20 m - area 40 x 20 = 800 m^2

tonnage $\frac{800 \times 9 \times 25.4}{100}$ = 182.88 say 185 t

shoulder l = 940 w = 2 x 0.5

area 940 x 1.0 x 940 m^2 d = 80 mm

tonnage $\frac{940 \times 8 \times 25.4}{1000}$ = 191 t say 190 t

4,675 t

GRANULAR 'A'

end area - 15 x 0.15 + 2(3.5 x 0.27)

= 2.25 + 1.89 = 4.14 m^2

940 x 4.14 = 3891.6m^3 x 2.4 = 9,340 t

GRANULAR 'B'

$d = \frac{0.3 + 043}{2} = 0.37$

end area = 23 x 0.37 = $8.51m_2$

8.51 x 940 = 7,999.4 x 2.0 — 16,000 t

1.3.3 GUIDE RAIL

l = 385 m x 4 = — 1540 m

1.3.4 STRUCTURE

length = 40 m

w = 20.0 m

area = 800 m^2

1.4 4 lane roadway over 4 tracks (31.0 m offset)

1.4.1 As for 2 tracks

1.4.2 Pavement

Hot mix over bridge

l = 75.5 w = 20.0

area 75.5 x 20 = 1510 m^2

tonnage $\frac{1510 \times 9 \times 25.4}{1000}$ = — 345 t

on the road — 4,300 t

shoulders — 190

4,835 t

1.4.3 As for 2 tracks

1.4.4 Structure - area = 1510 m^2

1.5 4 Lane Rural Freeway Over 2 Tracks

1.5.1 GRADING

Excavation - stripping only

l = 105 m w = 57.0 m

area 2 x (105 x 57) = 11970 m^2

depth 0.3 m

volume 3591 m^2 say 3590 m^3

Fill -

		Ht.	End Area		
Sta	1 + 020	9.5	556		
				536 x 110	58,960
	1 + 130	9.0	515		
				422 x 155	65,410
	1 + 285	6.5	329		
				233 x 105	24,465
	1 + 390	3.5	136		
				68 x 130	8,840
	1 + 520	0	0		
					157,6752 m

x 2 = 315,350 m^3

1.5.2 Pavement

Hot Mix

Roadway length - 1120 m (120 mm)

Pavement width 2 x 7.50 = 15.0

1120 x 15 = 16800 m^2

$\frac{16,800 \times 13 \times 25.4}{1000}$ = 5547.3 t say 5550 t

Shoulders (80 mm)

Outer 1120 x 2 x 0.5 = 1120 m^2

Inner 1120 x 2 x 1.5 = 3360 m^2

4480 m^2

4480 x 8 x 25.4 = 910.33 t say 910 t

1000

On the bridge deck (90 mm)

2 bridges - l = 40 m w (7.5 + 2.5 +1.5) = 11.5

area 2 (40 x 11.5) = 920 m^2

920 x 9 x 25.4 = 210.3 say 210 t

100

6,670 t

Granular 'A'

End area 2 x (7.50 x 0.15 + 3.5 x 0.28 +

2.0 x 0.28) = 2 (1.13 + 0.98 = 0.56)

= 5.34 m^2

1120 x 5.34 = 5980.8 m^3 x 2.4 = 14,350 t

Granular 'B'

End area

Avg. d = 0.45 + 0.54 = 0.50

2

end area 2 (14 x 0.5) = 14.0 m^2

1120 x 14.0 = 15,680 m^2 x 2 = 31,360 t

1.5.3 Guide Rail

Assuming only on the outer edges

l = 420 m x 2 = 820 m

1.5.4 2 Bridges

l = 40 W - (2.5 + 7.5 + 1.5) = 11.5

area 2 x 40 x 11.5 = 920 m

Item 1.6 Extra for difficult foundation condition

- depends on bridge type
- depends on conditions site

For uniformity used 15% additional to standard bridge cost - using \$1100/m^2 for standard bridge cost - additional cost is \$165/m^2

Item 2.1 4 Lane Urban Roadway Over 2 Tracks

2.1.1 Grading

Excavation - negligible

Fill -

		Ht.	End Area		
Sta	1 + 020	9.5	412		
				396 x 70	27,720
	1 + 090	9.0	380		
				309 x 116	35,844
	1 + 206	6.5	238		
				202 x 134	27,068
	1 + 340	5.0	165		
				83 x 100	8,300
	1 + 440	0	0		
					98,9322 m
				x 2 =	197,864 m^3 say 198,000

2.1.2 Pavement

Hot Mix

Road: l = 940 m w = 15 m

area = 14100 m^2

tonnage $\frac{14100 \times 12 \times 25.4}{1000}$ = 4298 t say 4300 m

On the bridge deck d = 90 mm

Area: l = 40 m w = 15.6

area 40 x 15.6 = 624 m^2

tonnage $\frac{624 \times 9 \times 25.4}{1000}$ = 142.6 say 145 t

4,445 t

Granular 'A'

w = 16.6

End area 16.6 x 0.15 = 2.49 m^2 say 2.5m^2

l = 940 940 x 2.5 = 2350 m^3 x 2.4 5640 t

Granular 'B'

d = $\frac{0.45 + 0.53}{2}$ = 0.49

w = 16.6 m 16.6 x 0.49 = 7.47 m^2 say 7.5 m

l = 940 m 940 x 7.5 = 7050 m^3 x 2 = 14,000 t

2.1.3 Guide Rail

l = 3.85 x 4 = 1540 m

2.1.4 Curb - 940 x 2 = 1880 m

2.1.5 Sidewalk - 940 x 2 x 1.5 = 2820 m

2.1.6 Structure

w = 15 + 2 x 2.5 = 20 m

l = 40 m

area = 800 m^2

2.2 4 Lane Urban Roadway over 4 tracks

tracks (offset 10.0 m)

2.2.1 Grading as for 2 tracks

2.2.2 Pavement

Hot Mix

Roadway as for 2 tracks 4,300

On bridge deck

l = (20 + 7.25) x 2 = 54.5 m

w = 15.6 m

area 54.5 x 15.6 = 850.2 m^2

$\frac{850.2 \times 9 \times 25.4}{100}$ = 194.4 t say 195

4,495

Granulars as for 2 tracks

2.2.3 Guide Rail As for two tracks

2.2.4 Curb As for two tracks

2.2.5 Sidewalk As for two tracks

2.2.6 Structure

w = 20 l = 54.5 area = 1090 m^3

Item 2.3a 6 Lane Urban Roadway over 2 Tracks

2.3a.1 GRADING

Excavation - negligible

Fill -

		Ht.	End Area		
Sta	1 + 020	9.5	480		
				463 x 70	32,380
	1 + 190	9.0	445		

			364 x 116	42,225
1 + 206	6.5	283		
			240 x 134	32,160
1 + 340	5.0	198		
			99 x 100	9,900
1 + 440	0	0		
				116,6652 m
			x 2 = 233,330 m^3	

2.3a.2 Pavement

Hot Mix

Roadway length - 940 m

Pavement width = 22.0

area 940 x 22 = 20,680 m^2

tonnage $\frac{20,680 \times 12 \times 25.4}{1000}$ = 6,303.2 t say 6,300 m^2

On the bridge deck (90 mm)

l = 40 m w (11 +0.6) x 2 = 23.2 m

area = (40 x 23.2) = 92.8m^2

tonnage $\frac{928 \times 9 \times 25.4}{1000}$ = 212 t

on the median - 40 mm

l = 940 w = 2 - 2 x 0.5 = 1.0

area 940 m^2

$\frac{940 \times 4 \times 25.4}{1000}$ = 95.504 say 96.0 t

6,608.0 t

6,670 t

Granular 'A'

w = 25.6 End area 25.6 x 0.15 = 3.89 m^2

l = 940 x 3.84 = 3609.6 x 2.4 = 8.663 t 8665 t

Granular 'B'

d = $\frac{0.45 + 0.58}{2}$ = 0.52

w = 25.6 end area = 25.6 x 0.52 = 13.3 m^2

l = 940 940 x 13.3 = 12502 m^3 x 2 — 25,000 t

2.3a.3 Guide Rail

l = 385 m x 4 = — 1540 m

2.3a.4 Curbs: l = 940 x 4 = — 3760 m

2.3a.5 Sidewalk: 940 x 2 x 1.5 = — 2820 m^2

2.3a.6 Structure

w = 2 (11 + 1.0 + 2.5) = 29.0

l = 40

area 40 x 29 = 1160 m^2

2.3b 6 Lane Urban Roadway over 4 tracks (offset 10.0m)

2.3b.1 Grading - as for two tracks

2.3b.2 Pavement (hot mix)

Roadway as for 2 tracks — 6,300 t

On the bridge deck (90 mm)

l = (20+7.25) x 2 = 54.5 m

w = 23.2 m

area - 54.5 x 23.2 = 1264.0

tonnage $\frac{1264 \times 9 \times 25.4}{1000}$ = 288.95 t say — 289 t

in the median - as for 2 tracks — 96.0 t

6685 t

Granulars as for 2 tracks

2.3b.4 Guide Rail — As for 2 tracks

2.3b.4 Curbs — As for 2 tracks

2.3b.5	Sidewalk	As for 2 tracks
2.3b.6	Structure	
	w - (11+1.0 + 2.5) x 2 = 290	
	l = 54.5 m	
	area = 1580.5 say	1580 m^2

Item 2.4 Extra for difficult foundation condition as for rural grade separation added 15% to bridge structure - see item 1.6.

3. Modification of Existing Grade Separations

Existing rural grade separations cost of modification was estimated with following assumptions:

Rural

- existing roadway will be maintained
- proposed railway will be lower than existing ±1.3 m
- road will be closed during construction - traffic will be on the temporary at grade crossing
- cost of railway is not included
- with offset 31.0 m existing bridge will be maintained for existing tracks new bridge will be built as separate structure
- for minor modification existing clearance ±6.8 m may require lowering of tracks.

Urban

- existing roadway will be maintained (see page 38)
- proposed railway will be lower than existing ±1.3m
- road will be closed during construction, local streets in the vicinity will be used to detour traffic
- cost of railway is not included
- with offset 10.0 m existing bridge will partially be demolished and lengthen to accommodate new tracks

3.1a Urban - 4 lane roadway over 4 tracks

3.1a.1 Roadway - allowance for restoration, signals and traffic diversion - Lump Sum

3.1a.2 Structure - ~~see~~ new ~~crossing~~ structure area 1090 m^2

3.1b Minor Modification

Rehabilitation of deck etc. assumed

w = 20.0 m l = 15.0 m

area = 300 m^2

3.2a 2 Lane Rural Roadway over 4 tracks - 2 existing; 2 proposed

3.2a.1 Roadway - allowance for restoration - L.S.

3.2a.2 Structure: l - 40 m; w = 7.5+2x2.5 = 12.5

area = 500.0 m^2

3.2a.3 Existing bridge rehabilitation

area = 15 x 12.5 = 187.5 m^2 say 200 m^2

3.1.4 Detour - 700 m

3.2b Minor Modification

Rehabilitation of deck, etc. assumed deck area - 190 m^2

w = 12.5 l = 15.0 m

Item 4. Automatic Crossing Protection

Item 5. ~~**Detours**~~ Diversion of Roads

Cost for 1.0 km

Excavation - assuming roadway at grade - excavation required to place base coat for ditching

Used 10m^2 end area

10 x 1000 = 10,000 x \$5.0/m^3 = \$50,000

Hot mix 7500m^2 d = 80 mm

$\frac{7500 \times 8 \times 25.4}{1000}$ = 1524 \$60/t = \$91,500

Granular 'A'

w = 12.5 d = 0.15 l = 1000

12.5 x 0.15 x 1000 = 1875 m^{3}x 2.4

= 4500 t @ \$10/t = \$45,000

Granular 'B'

w = 12.5 d = 0.35 l = 1000

12.5 x 0.35 x 1000 = 4375 m^3 x 2 = 8750 t @ \$8/t = 70,000

Removal of detour L.S. 20,000

Total 276,500

Used 280,000

Fenco / MS / Apr 93

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	Sub-system: D - GRADE SEPARATIONS
☐ 300+ kph - new R/W	Sector: 4 - CONSTR / INSTAL.
☐ 300+ kph - exist. R/W	Item: 4 -
☑ 200+ kph - exist. R/W	

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable:

AUTOMATIC CROSSING PROTECTION

Using preliminary data furnished by ABB, CIGGT developped the following cost for automatic crossing protection suitable for track speeds of 160 to 200 kph. Swederail subsequently reviewed and approved the cost developed.

The cost includes:

- occupancy detection circuits linked to train control,
- full-width barriers with vehicle intrusion detection,
- improved roadway signage.

Total cost for 1 crossing: $270,000.

Prepared by:	continued ☐

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- [x] 300+ kph - new R/W
- [x] 300+ kph - exist. R/W
- [x] 200+ kph - exist. R/W

Sub-system: E - Other Accom. Work
Sector: 4 - Construction
Item: 1 - Track Removal

Geographical Variation ? [x] no [ ] yes If yes, indicate segments applicable: _____

Price developed by CANARAIL

Work consists of 3 steps - picking up other track material, picking up rail, and picking up ties. Each has been estimated separately on the assumption of lifting track built with 115 lb/yd rail and are presented below:

Other Track Materials: (tie plates, spikes, rail anchors, joint bars)

40 tonnes/km @ $143/tonne		$ 5,720
Rail:		
115 tonnes/km @ $43.40/tonne		$ 4,991
Ties:		
2000 ties/km @ $2.65/tie		$ 5,300
Contractor's overhead and profit:	@ 32% of above cost	$ 5,123
	TOTAL (/km)	**$ 21,134**

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continued [ ]

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☑ 300+ kph - new R/W
- ☑ 300+ kph - exist. R/W
- ☑ 200+ kph - exist. R/W

Sub-system: E - Other Accom. Works
Sector: 4 - Construction
Item: 2 - New Access Tracks

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable: _____

Price developed by SNC-Lavalin + DELCAN + CANARAIL

Subgrade:

Grading @ 40,000 cu.m/km @ $ 5.00/cu.m.	$ 200,000	
Sub-ballast @ 1,600 cu.m/km @ $ 15.00/cu.m.	24,000	
Other costs @ 15%	33,600	
Total		$ 257,600

Track Materials:

Rail @ 120 tonnes/km @ $680/tonne	$ 81,600	
Fastenings @ 40 tonnes/km @ $850/tonne	34,000	
Wood ties @ 2,000/km @ $32.00/tie	64,000	
Ballast @ 2080 m^3/km @ $21.37/$m^3$	44,400	
Turnouts - assume 2/km @ $46,000/turnout	92,000	
Total		$ 316,000

Track Construction: (overhead and profit already included in unit prices)

Build 1 km of track @ $44,171/km	$ 44,170	
Install turnouts - 2 @ $4,680/turnout	9,360	
Ballast and surface 2080 m^3/km @ $8.47/$m^3$	17,620	
Total		$ 71,150

TOTAL (/km) **$ 644,750**

Prepared by:

continued ☐

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: E - OTHER ACC. WORKS Sector: 4 - CONSTRUCTION Item: 3 - RAIL/RAIL G/S

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

i) Rail/Rail Grade Separation in Rural Area

At crossings with existing rail tracks, the HSR tracks will be carried over or under the existing tracks with earthworks to be covered by linear measurement under Sub-system B.

Assume an average bridge length of 30m and a width of 13 m for 2 tracks,

cost of bridge structure = 13 x 30 @ $1,800/m^2

= $702,000

Allow 15% for rail diversions, miscellaneous temporary works, etc.

= $800,000 say

ii) Rail/Rail Grade Separation in Urban Area

Assume an average bridge length of 36m and a width of 13 m for 2 tracks,

cost of bridge structure = 13 x 36 @ $1,800/m^2

= $842,400

Allow 20% for rail diversions, retaining structures in constrained areas, miscellaneous temporary works, etc. = $1,000,000 say

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- [x] 300+ kph - new R/W
- [x] 300+ kph - exist. R/W
- [x] 200+ kph - exist. R/W

Sub-system: F - TRACK
Sector: 2 - MATERIALS
Item: 1.1 - RAIL

Geographical Variation ? [x] no [ ] yes If yes, indicate segments applicable: _____

Price quoted by supplier:

Price for rail meeting HSR specs	600.00	
Freight costs to Kingston	51.50	
TOTAL	$Can 651.50 /Ton	
@ 1.1 Tons/tonne = $Can/tonne		716.65

Price to weld into 400m strings:

Quote by contractor (including handling from gondolas to rail train)		
	$US 45.00 /weld	
	x 15. welds/string	
= Cost of welding/string	675.00	
	+ 24. tonnes/string	
TOTAL	$US 28.125 /tonne	
@ 1.2 $Can/$US = $Can/tonne		33.75

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continued [x]

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☐ 300+ kph - new R/W
- ☐ 300+ kph - exist. R/W
- ☐ 200+ kph - exist. R/W

Sub-system: F -
Sector: 2 -
Item: 1.1 -

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:

Land and trackage required @ welding plant:

Land required = 2 hectares @ $2,500/hectare	$ 5,000
Track required = 1,500m @ $286/m	429,000
= Total additional costs for rail welding	434,000
	+ 300,000. tonnes
Total	$ 1.45 /tonne

Cost to transport welded rail to rail head:

Includes avg. 300 km main line rail haul and ownership of three 28-car rail trains

$Can 21.57 /tonne

TOTAL COST

Rail	716.65
Welding	33.75
Land + Trackage	1.45
Transport	21.57
TOTAL (/tonne)	**773.42**

Prepared by:

continued ☐

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☑ 300+ kph - new R/W
- ☑ 300+ kph - exist. R/W
- ☑ 200+ kph - exist. R/W

Sub-system: F - TRACK
Sector: 2 - MATERIALS
Item: 2 - TIES

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable: _____

Price quoted by supplier:

Concrete track ties manufactured @ plant in Kingston
- inserts to be supplied by the project

Total	$ 42.00 /tie

Land and trackage required @ tie plant:

Land required = 16.2 hectares @ $2,500/hectare	$ 40,500
Track required = 1,830m @ $286/m	$523,380
= Total additional costs for tie manufacture	563,880
	+ 4,000,000. ties
Total	$ 0.14 /tie

Cost to transport to rail head:

Includes avg. 300 km main line rail haul and ownership of 140 special tie cars

$Can 4.12 /tie

TOTAL COST

Ties	42.00
Land + Trackage	0.14
Transport	2.65
TOTAL (/tie)	**44.79**

Prepared by:

continued ☐

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- [x] 300+ kph - new R/W
- [x] 300+ kph - exist. R/W
- [x] 200+ kph - exist. R/W

Sub-system: F - TRACK
Sector: 2 - MATERIAL
Item: 3 - BALLAST

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:

Price quoted by suppliers:

Granite ballast from Ottawa region

- avg. price loaded in rail hoppers	$ 4.90 /tonne
- density of ballast in track	x 1.72 tonnes/cu.m.
Total	$ 8.43 /cu.m.

Cost to transport to rail head:

Includes avg. 300 km main line rail haul @ 2¢/t-km and ownership of 322 ballast hoppers

$Can 12.94 /cu.m.

TOTAL COST

Ballast	8.43
Transport	12.94
TOTAL (/m^3)	**21.37**

Prepared by:

continued ☐

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- [x] 300+ kph - new R/W
- [x] 300+ kph - exist. R/W
- [x] 200+ kph - exist. R/W

Sub-system: F - TRACK
Sector: 2 - MATERIALS
Item: 4 - TURNOUTS

Geographical Variation ? [x] no [ ] yes If yes, indicate segments applicable: _____

Price provided in discussion with supplier (European/N.A. joint venture):

Prices include:
- complete turnout,
- concrete switch ties,
- rods and levers for remote throw points,
- locking devices on points, and
- delivery to project.

Prices do not include switch machines. Therefore, prices shown include an additional $30,000 (2 x $15,000) for switch machines to drive the switch and frog points on the high speed turnouts and an additional $15,000 for switch machines on the intermediate and low speed turnouts.

The basic speeds and turnouts being considered under each classification are as follows including a corresponding price:

Classification	Frog No.	Speed (kph)	Cost
High Speed	46	160	**$280,000**
Medium Speed	15.3	80	**$135,000**
Low Speed	10	25	**$ 46,000**

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☑ 300+ kph - new R/W
- ☑ 300+ kph - exist. R/W
- ☑ 200+ kph - exist. R/W

Sub-system: E - TRACK
Sector: 2 - MATERIALS
Item: 5.1 - FASTENINGS

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable: _____

Price quoted by suppliers:

Complete fastener sets per tie include:

- 4 inserts into the concrete tie,
- 2 rubber tie pads,
- 4 nylon insulators, and
- 4 elastic fastening systems fixing to the inserts.

Replies received from European and N.A. suppliers. Accounting for exchange rates and differential shipping charges, both provided prices within a few percentage points of each other. Resulting price to be used:

TOTAL (/tie set) **$ 26.50**

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continued ☐

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- [x] 300+ kph - new R/W
- [x] 300+ kph - exist. R/W
- [x] 200+ kph - exist. R/W

Sub-system: F - TRACK
Sector: 2 - MATERIAL
Item: 5.3 - BUMPING POSTS

Geographical Variation ? [x] no [ ] yes If yes, indicate segments applicable: _____

Material costs developed through discussion with supplier:

Cost of bumping post from supplier	$ 1920	
Shipping and handling for above @ 15%	288	
Total		$ 2210

Installation costs developed by consultant:

Labour	$ 550	
Equipment	140	
Overheads and profit @ 32% of installation cost	220	
Total		$ 910

TOTAL (/bumping post) **$ 3120**

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology: ☑ 300+ kph - new R/W ☑ 300+ kph - exist. R/W ☑ 200+ kph - exist. R/W

Sub-system: F - TRACK
Sector: 2 - MATERIAL
Item: 6.1 - SWITCH HEATER - MAIN

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable: _____

Price for equipment developed from discussions with supplier:

Switch heater for switch points up to 100'	$ 30,000	
Switch heater for moveable point frog	12,500	
Possible drainage protection for switch and frog	15,000	
Transportation for above @ 5%	2,875	
Total	say	$ 60,000

Prices for installation costs developed from discussion with railway:

Cost of typical power service to a turnout:		
Labour	$ 15,000	
Materials	14,000	
Total	$ 29,000	
Reduce cost account most turnouts being in pairs	x 0.75	
	$ 21,750	
Fuel Tank [2x typical account extra energy consump.]	20,000	
Miscellaneous Other Costs	3,000	
Total	say	$ 45,000

TOTAL **$ 105,000**

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continued ☐

SWTCHT-M.PRC

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology: ☑ 300+ kph - new R/W ☑ 300+ kph - exist. R/W ☑ 200+ kph - exist. R/W

Sub-system: E - TRACK
Sector: 2 - MATERIAL
Item: 6.2 - SWITCH HEATER - YARD

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable: _____

Price for equipment developed from discussions with supplier:

Horizontal air curtain for switch points up to 22'	$ 5,000	
Transportation for above @ 10%	500	
Total		$ 5,500

Installation costs developed from discussion with railway:

Cost of typical power service to a turnout:		
Labour	$ 15,000	
Materials	14,000	
Total	$ 29,000	
Reduce cost account grouping of turnouts in yards	x 0.2	
	$ 5,800	
Miscellaneous Other Costs	500	
Total		$ 6,300

TOTAL	**$ 11,800**

Prepared by:

continued ☐

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- [x] 300+ kph - new R/W
- [x] 300+ kph - exist. R/W
- [x] 200+ kph - exist. R/W

Sub-system: E - TRACK
Sector: 2 - MATERIALS
Item: 7 - BALLAST MATS

Geographical Variation ? [x] no [ ] yes If yes, indicate segments applicable: _____

Material costs developed in consultation with European consultant:

Cost of ballast mat in France (185 FF/m^2 ÷ 4.4 FF/$)	$ 41.00
Shipping and handling for above @ 20%	8.20
Total	$ 49.20

Installation costs developed by consultant:

Labour	$ 7.50
Equipment	2.70
Overheads and profit @ 32% of installation	3.25
Total	$ 13.45

TOTAL (/m^2) **$ 62.65**

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- [x] 300+ kph - new R/W
- [x] 300+ kph - exist. R/W
- [x] 200+ kph - exist. R/W

Sub-system: F - TRACK
Sector: 4 - CONSTRUCTION
Item: 1.1 - MAIN TRACKS.

Geographical Variation ? [x] no [ ] yes If yes, indicate segments applicable: _____

Price developed by CANARAIL

Assumes using track construction train to lay ties and afix continuously welded rail to them

Gang size as below:

1	Supervisor
12	Foremen
13	Operators
25	Labourers
1	Flagman
52	Total

working 9 hour days for total daily labour cost of: $ 14,230

Avg. daily meal & accomodation costs @ $ 20 per person: $ 1,040

Daily equipment cost

- based on use of a track construction train plus assorted work equipment to fasten rail, transport crews, and service men and equipment $ 7,725

Contractor's overhead and profit @ 32% of above costs 7,358

Total Daily Cost $ 30,345

Prepared by:

continued [x]

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: E - Sector: 4 - Item: L1 -

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:

Production

- assumes daily production of 2 km of track laying and a weekly output of 10 km, but in a 6-day week to allow for possible downtime due to weather, machine repairs, etc. Therefore,

daily production = 10km/6 days = 1-2/3 km/day

TOTAL (/ track-km.) **$ 18,212**

Prepared by:

continued ☐

Date: 93.04.02 | Page: 1 of 1

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology: ☑ 300+ kph - new R/W ☑ 300+ kph - exist. R/W ☑ 200+ kph - exist. R/W

Sub-system: F - Track Work
Sector: 4 - Construction
Item: 1.2 - Yard Tracks

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable: _____

Price developed by CANARAIL:

Assumes using small gang with Burro crane and loader to lay ties and afix jointed rail to them

Gang size as follows:	1	Supervisor
	3	Foremen
	7	Operators
	27	Labourers
	2	Flagman
	40	Total

working 9 hour days for total daily labour cost of:	$ 10,193
Daily accomodation costs for crew @ $ 20 per person:	800
Daily equipment cost	2,393
Contractor's overhead and profit @ 32% of above costs	4,284
Total Daily Cost	$ 17,670

Production

- assumes production of 400m of track laying

TOTAL (/ track-km.) **$ 44,175**

Prepared by:

continued ☐

Date: 93.04.02 | Page: 1 of 2

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- [x] 300+ kph - new R/W
- [x] 300+ kph - exist. R/W
- [x] 200+ kph - exist. R/W

Sub-system: F - TRACK
Sector: 4 - CONSTRUCTION
Item: 2 - RESTRESSING & WELDING

Geographical Variation ? [x] no [ ] yes If yes, indicate segments applicable: _____

Price developed by CANARAIL:

Assumes using a mobile flash butt rail welder to weld strings together in the field. The operation will also include unclipping the rail, heating it to its desired laying temperature, and reapplying the clips.

Gang size as below:

1	Supervisor
4	Foremen
7	Operators
12	Labourers
2	Flagman
26	Total

working 10 hour days for total daily labour cost of:	$ 8,062
Avg. daily accomodation costs for crew @ $ 20 per person:	$ 520
Daily equipment cost	
- based on lease of a mobile rail welder (including 2 operators) and work equipment to unfasten/fasten and restress the rail	$ 9,856
Contractor's overhead and profit @ 32% of above costs	$ 5,900
Total Daily Cost	$ 24,338

Prepared by:

continued [x]

Date:		Page: 2 of 2

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	Sub-system: F -
☐ 300+ kph - new R/W	Sector: 4 -
☐ 300+ kph - exist. R/W	Item: 2 -
☐ 200+ kph - exist. R/W	

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable: _____

Production	
- assumes production of 2 welds per hour and 6 hours of working time in the field per day =	12 welds/day
TOTAL (/joint welded)	**$ 2,028**

Prepared by:	continued ☐

Date: 93.04.06 | Page: 1 of 1

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☑ 300+ kph - new R/W
- ☑ 300+ kph - exist. R/W
- ☑ 200+ kph - exist. R/W

Sub-system: F - TRACK
Sector: 4 - CONSTRUCTION
Item: 3.1 - MAIN LINE & TURNOUTS

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable: _____

Price developed by CANARAIL:

Assumes using 2 gangs to pre-assemble long (up to 150m) main line turnouts at a central site and one gang to install in the field. All gangs require heavy mechanization, especially with cranes and loaders to be able to lift the heavy panels and concrete switch ties.

Gang size as follows:		
	1	Supervisor
	3	Foremen
	5	Operator
	34	Labourers
	2	Flagman
	45	Total

working 8.5 hour days for total daily labour cost of:	$ 10,394
Daily accomodation costs for crew @ $ 20 per person:	900
Daily equipment cost	4,202
Contractor's overhead and profit @ 32% of above costs	4,959
TOTAL (/ main line turnout installed)	**$ 20,455**

Prepared by:

continued ☐

Date: 93.04.06 | Page: 1 of 1

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☑ 300+ kph - new R/W
- ☑ 300+ kph - exist. R/W
- ☑ 200+ kph - exist. R/W

Sub-system: F - TRACK
Sector: 4 - CONSTRUCTION
Item: 3.2 - YARD TURNOUTS

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable: _____

Price developed by CANARAIL:

Assumes using a small gang with a speed swing and small machines to install 1 switch (ties and steel) per day in yards with no interference from other traffic

Gang size as follows:	1	Foremen
	1	Operator
	10	Labourers
	2	Flagman
	14	Total

working 8 hour days for total daily labour cost of:	$ 2,840
Daily accomodation costs for crew @ $ 20 per person:	280
Daily equipment cost	425
Contractor's overhead and profit @ 32% of above costs	1,135
TOTAL (/ yard turnout installed)	**$ 4,680**

Prepared by:

continued ☐

Date: 93.04.02 | Page: 1 of 2

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- [x] 300+ kph - new R/W
- [x] 300+ kph - exist. R/W
- [x] 200+ kph - exist. R/W

Sub-system: F - TRACK
Sector: 4 - CONSTRUCTION
Item: 4 - BALLASTING & SURFACING

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

Price developed by CANARAIL:

Assumes 1 high production surfacing gang + 1 intermediate production surfacing gang + 1 intermediate production gang shared with the second track. Also includes costs for dumping ballast.

Gang size as below:

1	Supervisor
7	Foremen
12	Operators
18	Labourers
8	Flagman
46	Total

working 9 hour days for total daily labour cost of:	$ 11,808
Avg. daily accomodation costs for crew @ $ 20 per person:	$ 920
Daily equipment cost	
- to cover cost of providing tampers, ballast regulators, ballast compactors, and a spreader for distributing ballast	$ 9,535
Contractor's overhead and profit @ 32% of above costs	$ 7,124
Total Daily Cost	$ 29,387

Prepared by:

continued ☑

Date:		Page: 2 of 2

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: F - Sector: 4 - Item: 4 -

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

Production

- Assumes 5 track lifts from skeleton track to final position. ∴ , 2 km/day of track laying requires 10 km/day of surfacing, but with lifts installing ≈ 20% of the total ballast section. This reconverts to a daily production of installing ballast at a rate of 2 km x 2080 m^3/km. However, as for track construction, we have assumed that it will take 6 days of work to ensure 5 days of full production at the above rates. Therefore, the average daily production is 5/6 of the above = 3,467 m^3/day

TOTAL (/m^3) **$ 8.47**

Prepared by:

continued ☐

Date: 93.04.02 | Page: 1 of 1

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☐ 300+ kph - new R/W
- ☐ 300+ kph - exist. R/W
- ☐ 200+ kph - exist. R/W

Sub-system: F - TRACK
Sector: 4 - CONSTRUCTION
Item: 5 & 6 - RAIL GRINDING

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable: _____

Cost based on European experience:

- SNCF contracts for grinding of newly installed rail on TGV lines to remove damage due to construction trains and provide the required rail surface. Cost for this service, including all ccahrges from the contractor, is approximately 20,000 FF/km ÷ 4.4 FF/$ ≈

TOTAL (/km.) **$ 4,545**

Prepared by:

continued ☐

Date: 93.04.20 | Page: 1 of 1

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☑ 300+ kph - new R/W
- ☑ 300+ kph - exist. R/W
- ☑ 200+ kph - exist. R/W

Sub-system: F - TRACK
Sector: 4 - CONSTRUCTION
Item: 6 - CONSTRUCTION BASES

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable: _____

Developed in consultation with European consultant:

Although, at 10 km/week, a typical base would support track construction activities for only 12-15 weeks + 2-3 week lag for the second track, it is also required for catenary and signalling construction. Allowing for the time to grade and construct trackage and then clear the site, it will probably be necessary to possess the land for a period of 3 years.

Land, trackage, and facilities required for construction base:

Grading = 66,500 cu.m @ $ 5/cu.m. + 15%	$ 382,370
Land required = 13.3 hectares @ $2,500/hectare	33,250
Track required = 12,500 m @ $286/m.	3,575,000
Turnouts required = 41 @ $ 34,680/turnout	1,421,880
Salvage of track materials @ 75% (on $180/m and $30,000/switch)	-2,610,000
Office space:	
- 20 ATCO trailers @ $ 400/month for 18 months	144,000
Services - lump sum	100,000
Total cost to establish a construction base	$ 3,046,500

Length of average segment served by base: 125 km

TOTAL (/route-km) **$ 24,372**

Prepared by:

continued ☐

Date:		Page: 1 of 2

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:		Sub-system: 6 - ELECTRIFICATION
☑	300+ kph - new R/W	Sector: 4 - CONSTR./INSTAL.
☑	300+ kph - exist. R/W	Item: 1 -
☑	200+ kph - exist. R/W	

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable:_____

TYPICAL CATENARY

Costs derived from european experience, with adjustments to reflect north american materials and labour costs.

Item 1.1 Single Track - Independent Structure:

-Catenary: $137,400.

-Feeder: $ 37,600.

Total: $175,000. per kilometre.

Item 1.2 Double Track - Independent Structure:

-Catenary: $274,900.

-Feeder: $ 75,100.

Total: $350,000. per kilometre.

Item 1.3 Double Track - Portal Structure:

-Catenary: $324,900.

-Feeder: $ 75,100.

Total: $400,000. per kilometre.

Prepared by:	continued ☑

Date:		Page: 2 of 2

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	Sub-system: G - ELECTRIFICATION
☑ 300+ kph - new R/W	Sector: 4 - CONSTR./INSTAL.
☑ 300+ kph - exist. R/W	Item: 1 -
☑ 200+ kph - exist. R/W	

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable: _____

TYPICAL CATENARY (continued)

Item 1.4 Triple Track - Portal Structure:

-Catenary: $384,900.

-Feeder: $ 75,100.

Total: $460,000. per kilometre.

Items 1.5, 1.6, 1.7 Yard, Sidings, and Garage Area Catenary:

Total Cost: $13,500. per 100 metres.

Item 1.8 Station Catenary:

Total Cost: $17,500. per 100 metres.

Prepared by:	continued ☐

Date: 93.05.07		Page: 1 of 2

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☑ 300+ kph - new R/W
- ☑ 300+ kph - exist. R/W
- ☑ 200+ kph - exist. R/W

Sub-system: 6 - ELECTRIFICATION
Sector: 4 - CONSTRUCTION
Item: 2.1 - SINGLE X-OVER

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable: _____

Prepared by:	continued ☑

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: TRACK SECTION STATION		SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: SINGLE X-OVER DISCONNECT CONTROL		ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S. ACCOUNT:	SHEET NO.: 1 OF 1

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT cost	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT cost	AMOUNT	UNIT cost	AMOUNT	UNIT cost	AMOUNT
Section break:																
25kV manual disc. 2poles, 1200A outdoor	4	un	45	180	50.00	2 250.00	9 000.00	45	180	10.00	450.00	1 800.00	7 000.00	28 000.00	9 700.00	38 800.00
25kV mot. disc. 2poles, 1200A outdoor	2	un	50	100	50.00	2 500.00	5 000.00	50	100	10.00	500.00	1 000.00	8 500.00	17 000.00	11 500.00	23 000.00
25kV potential transformer, 1ph., outdoor	3	un	25	75	50.00	1 250.00	3 750.00	25	75	10.00	250.00	750.00	4 000.00	12 000.00	5 500.00	16 500.00
Structures & insulators	6	un	40	240	50.00	2 000.00	12 000.00	40	240	10.00	400.00	2 400.00	1 500.00	9 000.00	3 900.00	23 400.00
Bus work 25kV	1	l.s.	75	75	50.00	3 750.00	3 750.00	75	75	10.00	750.00	750.00	3 500.00	3 500.00	8 000.00	8 000.00
Catenary section break (see ITEM #2)																
25kV/240-120V, 1ph., transformer 10kVA	1	un	50	50	50.00	2 500.00	2 500.00	50	50	10.00	500.00	500.00	12 000.00	12 000.00	15 000.00	15 000.00
Distribution panel 120/240V 1ph. 24cct	1	un	15	15	50.00	750.00	750.00	15	15	10.00	150.00	150.00	1 500.00	1 500.00	2 400.00	2 400.00
Transformer 240V/240-120V 1ph. 5 kVA	1	un	10	10	50.00	500.00	500.00	10	10	10.00	100.00	100.00	1 800.00	1 800.00	2 400.00	2 400.00
129V c.c.System (UPS) 12.5kVA	1	un	30	30	50.00	1 500.00	1 500.00	30	30	10.00	300.00	300.00	15 000.00	15 000.00	16 800.00	16 800.00
Control and relays panels	1	l.s.	85	85	50.00	4 250.00	4 250.00	85	85	10.00	850.00	850.00	30 000.00	30 000.00	35 100.00	35 100.00
Power and control cabling	1	l.s.	50	50	50.00	2 500.00	2 500	50	50	10.00	500.00	500.00	1 500.00	1 500.00	4 500.00	4 500.00
Misc (electrical works) 10%	1	lot	91	91	50.00	4 550.00	4 550.00	91	91	10.00	910.00	910.00	13 130.00	13 130.00	18 590.00	18 590.00
Sous-Total				1001			50 050		1001			10 010		$144 430		$204 490
Total				1001			50 050		1001			10 010		$144 430		$204 490

Date: 93.05.07 | Page: 1 of 2

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☑ 300+ kph - new R/W
- ☑ 300+ kph - exist. R/W
- ☑ 200+ kph - exist. R/W

Sub-system: 6 - ELECTRIFICATION
Sector: 4 - CONSTRUCTION
Item: 2.2 - DOUBLE X-OVER.

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable: _____

Prepared by:

continued ☑

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: TRACK SECTION STATION			SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: DOUBLE X-OVER DISCONNECT CONTROL			ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S.	ACCOUNT:	SHEET NO.: 1 OF 1

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT COST	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT
Section break:																
25kV manual disc. 2poles, 1200A outdoor	6	un	45	270	50.00	2 250.00	13 500.00	45	270	10.00	450.00	2 700.00	7 000.00	42 000.00	9 700.00	58 200.00
25kV mot. disc. 2poles, 1200A outdoor	3	un	50	150	50.00	2 500.00	7 500.00	50	150	10.00	500.00	1 500.00	8 500.00	25 500.00	11 500.00	34 500.00
25kV potential transformer, 1ph., outdoor	3	un	25	75	50.00	1 250.00	3 750.00	25	75	10.00	250.00	750.00	4 000.00	12 000.00	5 500.00	16 500.00
Structures & insulators	9	un	40	360	50.00	2 000.00	18 000.00	40	360	10.00	400.00	3 600.00	1 500.00	13 500.00	3 900.00	35 100.00
Bus work 25kV	1	l.s.	100	100	50.00	5 000.00	5 000.00	100	100	10.00	1 000.00	1 000.00	4 500.00	4 500.00	10 500.00	10 500.00
Catenary section break (see ITEM #2)																
25kV/240-120V, 1ph., transformer 10kVA	1	un	50	50	50.00	2 500.00	2 500.00	50	50	10.00	500.00	500.00	12 000.00	12 000.00	15 000.00	15 000.00
Distribution panel 120/240V 1ph. 24cct	1	un	15	15	50.00	750.00	750.00	15	15	10.00	150.00	150.00	1 500.00	1 500.00	2 400.00	2 400.00
Transformer 240V/240-120V 1ph. 5 kVA	1	un	10	10	50.00	500.00	500.00	10	10	10.00	100.00	100.00	1 800.00	1 800.00	2 400.00	2 400.00
129V c.c.System (UPS) 12.5kVA	1	un	30	30	50.00	1 500.00	1 500.00	30	30	10.00	300.00	300.00	15 000.00	15 000.00	16 800.00	16 800.00
Control and relays panels	1	l.s.	85	85	50.00	4 250.00	4 250.00	85	85	10.00	850.00	850.00	30 000.00	30 000.00	35 100.00	35 100.00
Power and control cabling	1	l.s.	50	50	50.00	2 500.00	2 500	50	50	10.00	500.00	500.00	1 500.00	1 500.00	4 500.00	4 500.00
Misc (electrical works) 10%	1	lot	120	120	50.00	6 000.00	6 000.00	120	120	10.00	1 200.00	1 200.00	15 930.00	15 930.00	23 130.00	23 130.00
Sous-Total				1315			65 750		1315			13 150		$175 230		$254 130
Total				1315			65 750		1315			13 150		$175 230		$254 130

Date: 93.05.07 | Page: 1 of 2

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- [x] 300+ kph - new R/W
- [x] 300+ kph - exist. R/W
- [x] 200+ kph - exist. R/W

Sub-system: 6 - ELECTRIFICATION
Sector: 4 - CONSTRUCTION
Item: 2.3 - PHASE BREAK

Geographical Variation ? [x] no [ ] yes If yes, indicate segments applicable: _____

Prepared by:

continued [x]

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: PHASE BREAK STATION		SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: 25kV SUBSTATION - 2 x 25kV		ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S. ACCOUNT:	SHEET NO.: 1 OF 1

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT cost	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT cost	AMOUNT	UNIT cost	AMOUNT	UNIT cost	AMOUNT
25kV metalclad switchgear including:	1	un	200	200	50.00	10 000.00	10 000.00	200	200	10.00	2 000.00	2 000.00	27 000.00	27 000.00	39 000.00	39 000.00
(rated 46kV)																
-load break mot. disc., 1pole, 1200A	N/A	un	incl.					incl.					20 000.00			
-load break mot. disc., 2poles, 1200A	5	un	incl.					incl.					25 000.00	125 000.00	25 000.00	125 000.00
-motorised disconnect, 1pole, 1200A	N/A	un	incl.					incl.					16 000.00			
-motorised disconnect, 2poles, 1200A	N/A	un	incl.					incl.					20 000.00			
-manual disconnect, 1pole, 1200A	N/A	un	incl.					incl.					12 000.00			
-manual disconnect, 2poles, 1200A	8	un	incl.					incl.					15 000.00	120 000.00	15 000.00	120 000.00
-potential transformer, 1ph., 25kV:120V	4	un	incl.					incl.					4 500.00	18 000.00	4 500.00	18 000.00
-outdoor bushing, 1pole	8	un	incl.					incl.					3 500.00	28 000.00	3 500.00	28 000.00
-bus work, 1pole, 1200A (per cell)	N/A	un	incl.					incl.					3 000.00			
-bus work, 2poles, 1200A (per cell)	13	un	incl.					incl.					5 000.00	65 000.00	5 000.00	65 000.00
-neutral bus and links, 1pole, 1200A	6	un	incl.					incl.					1 500.00	9 000.00	1 500.00	9 000.00
-25kV auto transformer 10MVA	2	un	225	450	50.00	11 250.00	22 500.00	225	450				170 000	340 000.00	181 250.00	362 500.00
Phase break:																
25kV mot. disc. 1pole, 1200A outdoor	2	un	40	80	50.00	2 000.00	4 000.00	40	80	10.00	400.00	800.00	6 500.00	13 000.00	8 900.00	17 800.00
25kV mot. disc. 2poles, 1200A outdoor	2	un	50	100	50.00	2 500.00	5 000.00	50	100	10.00	500.00	1 000.00	8 500.00	17 000.00	11 500.00	23 000.00
Structures & insulators	5	un	40	200	50.00	2 000.00	10 000.00	40	200	10.00	400.00	2 000.00	1 500.00	7 500.00	3 900.00	19 500.00
Bus work 25kV	1	l.s.	60	60	50.00	3 000.00	3 000.00	60	60	10.00	600.00	600.00	2 500.00	2 500.00	6 100.00	6 100.00
Catenary section break (see ITEM #2)																
25kV/240-120V, 1ph., transformer 10kVA	2	un	50	100	50.00	2 500.00	5 000.00	50	100	10.00	500.00	1 000.00	12 000.00	24 000.00	15 000.00	30 000.00
Distribution panel 120/240V 1ph. 24cct	1	un	15	15	50.00	750.00	750.00	15	15	10.00	150.00	150.00	1 500.00	1 500.00	2 400.00	2 400.00
Transformer 240V/240-120V 1ph. 5 kVA	1	un	10	10	50.00	500.00	500.00	10	10	10.00	100.00	100.00	1 800.00	1 800.00	2 400.00	2 400.00
129V c.c.System (UPS) 12.5kVA	1	un	30	30	50.00	1 500.00	1 500.00	30	30	10.00	300.00	300.00	15 000.00	15 000.00	16 800.00	16 800.00
Control and relays panels	1	l.s.	85	85	50.00	4 250.00	4 250.00	85	85	10.00	850.00	850.00	30 000.00	30 000.00	35 100.00	35 100.00
Power and control cabling	1	l.s.	100	100	50.00	5 000.00	5 000	100	100	10.00	1 000.00	1 000.00	3 000.00	3 000.00	9 000.00	9 000.00
Misc (electrical works) 10%	1	lot	143	143	50.00	7 150.00	7 150.00	143	143	10.00	1 430.00	1 430.00	84 730.00	84 730.00	93 310.00	93 310.00
Sous-Total				1573			78 650		1573			11 230		$932 030		$1 021 910
Total				1573			78 650		1573			11 230		$932 030		$1 021 910

Date:		Page: __ of __

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: 6 - ELECTRIFICATION Sector: 4 - CONSTR./INSTAL. Item: 3 - _____

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

SPECIAL CATENARY STRUCTURES

Costs derived from european experience, with adjustments to reflect north american materials and labour costs.

Item 3.1 Underbridge catenary:

Total Cost: $10,000. per 100 metres.

Item 3.2 Overbridge catenary:

Total Cost: $15,000. per 100 metres.

Prepared by:

continued ☐

Date: 93.05.07 | Page: 1 of 7

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- [x] 300+ kph - new R/W
- [x] 300+ kph - exist. R/W
- [x] 200+ kph - exist. R/W

Sub-system: 6 - ELECTRIFICATION
Sector: 4 - CONSTRUCTION
Item: 4.1 - 230 kV SUB-STATION

Geographical Variation ? [x] no [ ] yes If yes, indicate segments applicable:_____

Prepared by:

continued [x]

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 230kV SUBSTATION - 2 INCOMMING LINES			SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: 230kV - ELECTRICAL EQUIPMENT			ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S.	ACCOUNT:	SHEET NO.: 1 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT COST	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT
230kV Disconnect, 3ph., 1200A,c/w grnd.sw.	2	un	170	340	50.00	8 500.00	17 000.00	170	340	10.00	1 700.00	3 400.00	46 200.00	92 400.00	56 400.00	112 800.00
230kV current transf., 1ph., 2 windings	6	un	UTILI					UTILI					UTILITY			
230kV potential transf., 1ph., 120/120V	2	un	UTILI					UTILI					UTILITY			
230kV current transf., 1ph., 3 windings	6	un	45	270	50.00	2 250.00	13 500.00	45	270	10.00	450.00	2 700.00	23 500.00	141 000.00	26 200.00	157 200.00
230kV potential transf., 1ph., 120/120V	2	un	50	100	50.00	2 500.00	5 000.00	50	100	10.00	500.00	1 000.00	13 600.00	27 200.00	16 600.00	33 200.00
230kV circuit breaker, 3ph., 1200A SF6	3	un	390	1170	50.00	19 500.00	58 500.00	390	1170	10.00	3 900.00	11 700.00	220 000	660 000.00	243 400.00	730 200.00
230kV disconnect, 3ph., 1200A, manual	2	un	140	280	50.00	7 000.00	14 000.00	140	280	10.00	1 400.00	2 800.00	40 000.00	80 000.00	48 400.00	96 800.00
230kV disconnect, 2ph., 1200A, motorised	2	un	120	240	50.00	6 000.00	12 000.00	120	240	10.00	1 200.00	2 400.00	38 000.00	76 000.00	45 200.00	90 400.00
230kV station post insulators, 1ph.	16	un	15	240	50.00	750.00	12 000.00	15	240	10.00	150.00	2 400.00	1 200.00	19 200.00	2 100.00	33 600.00
25kV disconnect, 2ph., 2000A motorised	2	un	80	160	50.00	4 000.00	8 000.00	80	160	10.00	800.00	1 600.00	14 300.00	28 600.00	19 100.00	38 200.00
Flexible bus work 1250kcm ACSR	300	m	0.8	240	50.00	40.00	12 000.00	0.8	240	10.00	8.00	2 400.00	10.00	3 000.00	58.00	17 400.00
Tubular rigid aluminum bus work 75mm dia.	360	m	1	360	50.00	50.00	18 000	1	360	10.00	10.00	3 600.00	95.00	34 200.00	155.00	55 800.00
230 / 25kV Transformer, 2ph., 30MVA	2	un	1190	2380	50.00	59 500.00	119 000.00	1190	2380	25.00	29 750	59 500.00	750 000	1 500 000	839 250.00	1 678 500
4-current transf. 230kV, bushing type																
4-current transf. 25kV, bushing type																
2-lightning arresters 230kV, 1 ph.,																
2-lightning arresters 25kV, 1 ph.,																
Line protection panel	2	un	75	150	50.00	3 750.00	7 500.00	75	150	10.00	750.00	1 500.00	80 000.00	160 000.00	84 500.00	169 000.00
Circuit breaker control panel	3	un	60	180	50.00	3 000.00	9 000.00	60	180	10.00	600.00	1 800.00	40 000.00	120 000.00	43 600.00	130 800.00
Transformer control panel	2	un	30	60	50.00	1 500.00	3 000.00	30	60	10.00	300.00	600.00	15 000.00	30 000.00	16 800.00	33 600.00
Power and control cabling	1	l.s.	250	250	50.00	12 500.00	12 500.00	250	250	10.00	2 500.00	2 500.00	12 000.00	12 000.00	27 000.00	27 000.00
Misc. (brackets, supports, etc...) 10%	1	l.s.	642	642	50.00	32 100.00	32 100.00	642	642	10.00	6 420.00	6 420.00	298 360	298 360.00	336 880.00	336 880.00
Sub-Total				7062			353 100		7062			106 320		$3 281 960		$3 741 380
Total																

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 230kV SUBSTATION - 2 INCOMMING LINES			SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: 25kV MAIN SUBSTATION - 2 x 25kV			ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S.	ACCOUNT:	SHEET NO.: 2 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT COST	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT
25kV metalclad switchgear including:	1	un	200	200	50.00	10 000.00	10 000.00	200	200	10.00	2 000.00	2 000.00	40 500.00	40 500.00	52 500.00	52 500.00
(rated 46kV)																
-circuit breaker, 1poles, 1200A c/w CT's	N/A	un	incl.					incl.					36 000.00			
-circuit breaker, 2poles, 1200A c/w CT's	5	un	incl.					incl.					40 000.00	200 000.00	40 000.00	200 000.00
-motorised disconnect, 1pole, 1200A	N/A	un	incl.					incl.					16 000.00			
-motorised disconnect, 2poles, 1200A	2	un	incl.					incl.					20 000.00	40 000.00	20 000.00	40 000.00
-manual disconnect, 1pole, 1200A	N/A	un	incl.					incl.					12 000.00			
-manual disconnect, 2poles, 1200A	12	un	incl.					incl.					15 000.00	180 000.00	15 000.00	180 000.00
-potential transformer, 1ph., 25kV:120V	12	un	incl.					incl.					4 500.00	54 000.00	4 500.00	54 000.00
-outdoor bushing, 1pole	12	un	incl.					incl.					3 500.00	42 000.00	3 500.00	42 000.00
-bus work, 1pole, 1200A (per cell)	N/A	un	incl.					incl.					3 000.00			
-bus work, 2poles, 1200A (per cell)	19	un	incl.					incl.					5 000.00	95 000.00	5 000.00	95 000.00
-neutral bus and links, 1pole, 1200A	7	un	incl.					incl.					1 500.00	10 500.00	1 500.00	10 500.00
Section break:																
25kV mot. disc. 1pole, 1200A outdoor	2	un	40	80	50.00	2 000.00	4 000.00	40	80	10.00	400.00	800.00	6 500.00	13 000.00	8 900.00	17 800.00
25kV mot. disc. 2poles, 1200A outdoor	2	un	50	100	50.00	2 500.00	5 000.00	50	100	10.00	500.00	1 000.00	8 500.00	17 000.00	11 500.00	23 000.00
Structures & insulators	5	un	40	200	50.00	2 000.00	10 000.00	40	200	10.00	400.00	2 000.00	1 500.00	7 500.00	3 900.00	19 500.00
Bus work 25kV	1	l.s.	60	60	50.00	3 000.00	3 000.00	60	60	10.00	600.00	600.00	2 500.00	2 500.00	6 100.00	6 100.00
Catenary section break (see ITEM #2)																
25kV/240-120V, 1ph., transformer 50kVA	2	un	50	100	50.00	2 500.00	5 000.00	50	100	10.00	500.00	1 000.00	20 000.00	40 000.00	23 000.00	46 000.00
Distribution panel 120/240V 1ph. 24cct	1	un	15	15	50.00	750.00	750.00	15	15	10.00	150.00	150.00	1 500.00	1 500.00	2 400.00	2 400.00
Transformer 240V/240-120V 1ph. 5 kVA	1	un	10	10	50.00	500.00	500.00	10	10	10.00	100.00	100.00	1 800.00	1 800	2 400.00	2 400.00
129V c.c.System (UPS) 12.5kVA	1	un	30	30	50.00	1 500.00	1 500.00	30	30	10.00	300.00	300.00	15 000.00	15 000.00	16 800.00	16 800.00
Control and relays panels	1	l.s.	85	85	50.00	4 250.00	4 250.00	85	85	10.00	850.00	850.00	30 000.00	30 000.00	35 100.00	35 100.00
Power and control cabling	1	l.s.	100	100	50.00	5 000.00	5 000	100	100	10.00	1 000.00	1 000.00	3 000.00	3 000.00	9 000.00	9 000.00
Misc (electrical works) 10%	1	lot	98	98	50.00	4 900.00	4 900.00	98	98	10.00	980.00	980.00	79 330.00	79 330.00	85 210.00	85 210.00
Sous-Total				**1078**			**53 900**		**1078**			**10 780**		**$872 630**		$937 310
Total																

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 230kV SUBSTATION - 2 INCOMMING LINES	SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: CIVIL WORKS AND EQUIPMENT FOUNDATIONS	ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G. CHECK BY: H.S. ACCOUNT:	SHEET NO.: 3 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT COST	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT
230kV circuit breaker foundations	3	un	140	420	46.00	6 440.00	19 320.00	140	420	8.60	1 204.00	3 612.00	3 770.00	11 310.00	11 414.00	34 242.00
230kV motorised disconnect foundations	4	un	90	360	46.00	4 140.00	16 560.00	90	360	8.60	774.00	3 096.00	4 390.00	17 560.00	9 304.00	37 216.00
230kV manual disconnect foundations	4	un	90	360	46.00	4 140.00	16 560.00	90	360	8.60	774.00	3 096.00	4 390.00	17 560.00	9 304.00	37 216.00
230/25kV power transformer foundations	2	un	675	1350	46.00	31 050.00	62 100.00	675	1350	8.60	5 805.00	11 610.00	16 200.00	32 400.00	53 055.00	106 110.00
230kV potential transformer foundations	4	un	30	120	46.00	1 380.00	5 520.00	30	120	8.60	258.00	1 032.00	1 315.00	5 260.00	2 953.00	11 812.00
230kV current transformer foundations	18	un	30	540	46.00	1 380.00	24 840.00	30	540	8.60	258.00	4 644.00	1 290.00	23 220.00	2 928.00	52 704.00
230kV station post insulator foundations	12	un	35	420	46.00	1 610.00	19 320.00	35	420	8.60	301.00	3 612.00	1 550.00	18 600.00	3 461.00	41 532.00
230kV incomming line structure foundations	2	un	135	270	46.00	6 210.00	12 420.00	135	270	8.60	1 161.00	2 322.00	9 300.00	18 600.00	16 671.00	33 342.00
25kV switchgear foundation	1	un	300	300	46.00	13 800.00	13 800.00	300	300	8.60	2 580.00	2 580.00	7 200.00	7 200.00	23 580.00	23 580.00
Oil recuperator and accessories	1	un	280	280	46.00	12 880.00	12 880.00	280	280	8.60	2 408.00	2 408.00	15 000.00	15 000.00	30 288.00	30 288.00
Site preparation and transport	5600	m3	0.01	56	46.00	0.46	2 576.00	0.01	56	130.00	1.30	7 280.00	N/A		1.76	9 856.00
Fences and gates	340	m	0.8	272	46.00	36.80	12 512.00	0.8	272	8.60	6.88	2 339.20	30.00	10 200.00	73.68	25 051.20
Control bulding 15' x 40'	1	un	600	600	46.00	27 600.00	27 600.00	600	600	8.60	5 160.00	5 160.00	25 000.00	25 000.00	57 760.00	57 760.00
Grounding loop and shieldwire	5600	m2	0.25	1400	50.00	12.50	70 000.00	0.25	1400	10.00	2.50	14 000.00	10.60	59 360.00	25.60	143 360.00
Substation gravel topping (500mm)	5600	m2	0.04	224	40.00	1.60	8 960.00	0.04	224	8.60	0.34	1 926.40	9.65	54 040	11.59	64 926.40
Cable trenching and manholes	140	m	1.5	210	46.00	69.00	9 660.00	1.5	210	8.60	12.90	1 806.00	250.00	35 000.00	331.90	46 466.00
Misc. (civil works, etc...) 10%	1	l.s.	718	718	50.00	35 900.00	35 900.00	718	718	10.00	7 180.00	7 180.00	35 031.00	35 031.00	78 111.00	78 111.00
Sub-Total				7900			$370 528		7900			$77 704		$385 341		$833 573
Total				14962			$723 628		14962			$194 804		$4 539 931		$5 512 263

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 230kV SUBSTATION - 2 INCOMMING LINES			SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: 230kV - ELECTRICAL EQUIPMENT			ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S.	ACCOUNT:	SHEET NO.: 1 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT COST	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT
230kV Disconnect, 3ph., 1200A,c/w grnd.sw.	2	un	170	340	50.00	8 500.00	17 000.00	170	340	10.00	1 700.00	3 400.00	46 200.00	92 400.00	56 400.00	112 800.00
230kV current transf., 1ph., 2 windings	6	un	UTILI					UTILI					UTILITY			
230kV potential transf., 1ph., 120/120V	2	un	UTILI					UTILI					UTILITY			
230kV current transf., 1ph., 3 windings	6	un	45	270	50.00	2 250.00	13 500.00	45	270	10.00	450.00	2 700.00	23 500.00	141 000.00	26 200.00	157 200.00
230kV potential transf., 1ph., 120/120V	2	un	50	100	50.00	2 500.00	5 000.00	50	100	10.00	500.00	1 000.00	13 600.00	27 200.00	16 600.00	33 200.00
230kV circuit breaker, 3ph., 1200A SF6	3	un	390	1170	50.00	19 500.00	58 500.00	390	1170	10.00	3 900.00	11 700.00	220 000	660 000.00	243 400.00	730 200.00
230kV disconnect, 3ph., 1200A, manual	2	un	140	280	50.00	7 000.00	14 000.00	140	280	10.00	1 400.00	2 800.00	40 000.00	80 000.00	48 400.00	96 800.00
230kV disconnect, 2ph., 1200A, motorised	2	un	120	240	50.00	6 000.00	12 000.00	120	240	10.00	1 200.00	2 400.00	38 000.00	76 000.00	45 200.00	90 400.00
230kV station post insulators, 1ph.	16	un	15	240	50.00	750.00	12 000.00	15	240	10.00	150.00	2 400.00	1 200.00	19 200.00	2 100.00	33 600.00
25kV disconnect, 2ph., 2000A motorised	2	un	80	160	50.00	4 000.00	8 000.00	80	160	10.00	800.00	1 600.00	14 300.00	28 600.00	19 100.00	38 200.00
Flexible bus work 1250kcm ACSR	300	m	0.8	240	50.00	40.00	12 000.00	0.8	240	10.00	8.00	2 400.00	10.00	3 000.00	58.00	17 400.00
Tubular rigid aluminum bus work 75mm dia.	360	m	1	360	50.00	50.00	18 000	1	360	10.00	10.00	3 600.00	95.00	34 200.00	155.00	55 800.00
230 / 25kV Transformer, 2ph., 30MVA	2	un	1190	2380	50.00	59 500.00	119 000.00	1190	2380	25.00	29 750	59 500.00	750 000	1 500 000	839 250.00	1 678 500
4-current transf. 230kV, bushing type																
4-current transf. 25kV, bushing type																
2-lightning arresters 230kV, 1 ph.,																
2-lightning arresters 25kV, 1 ph.,																
Line protection panel	2	un	75	150	50.00	3 750.00	7 500.00	75	150	10.00	750.00	1 500.00	80 000.00	160 000.00	84 500.00	169 000.00
Circuit breaker control panel	3	un	60	180	50.00	3 000.00	9 000.00	60	180	10.00	600.00	1 800.00	40 000.00	120 000.00	43 600.00	130 800.00
Transformer control panel	2	un	30	60	50.00	1 500.00	3 000.00	30	60	10.00	300.00	600.00	15 000.00	30 000.00	16 800.00	33 600.00
Power and control cabling	1	l.s.	250	250	50.00	12 500.00	12 500.00	250	250	10.00	2 500.00	2 500.00	12 000.00	12 000.00	27 000.00	27 000.00
Misc. (brackets, supports, etc...) 10%	1	l.s.	642	642	50.00	32 100.00	32 100.00	642	642	10.00	6 420.00	6 420.00	298 360	298 360.00	336 880.00	336 880.00
Sub-Total				7062			353 100		7062			106 320		$3 281 960		$3 741 380
Total																

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 230kV SUBSTATION - 2 INCOMMING LINES			SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: 25kV MAIN SUBSTATION - 1 x 25kV			ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S.	ACCOUNT:	SHEET NO.: 2 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT cost	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT cost	AMOUNT	UNIT cost	AMOUNT	UNIT cost	AMOUNT
25kV metalclad switchgear including: (rated 46kV)	1	un	200	200	50.00	10 000.00	10 000.00	200	200	10.00	2 000.00	2 000.00	27 000.00	27 000.00	39 000.00	39 000.00
-circuit breaker, 1poles, 1200A c/w CT's	5	un	incl.					incl.					36 000.00	180 000.00	36 000.00	180 000.00
-circuit breaker, 2poles, 1200A c/w CT's	N/A	un	incl.					incl.					40 000.00			
-motorised disconnect, 1pole, 1200A	2	un	incl.					incl.					16 000.00	32 000.00	16 000.00	32 000.00
-motorised disconnect, 2poles, 1200A	N/A	un	incl.					incl.					20 000.00			
-manual disconnect, 1pole, 1200A	12	un	incl.					incl.					12 000.00	144 000.00	12 000.00	144 000.00
-manual disconnect, 2poles, 1200A	N/A	un	incl.					incl.					15 000.00			
-potential transformer, 1ph., 25kV:120V	6	un	incl.					incl.					4 500.00	27 000.00	4 500.00	27 000.00
-outdoor bushing, 1pole	6	un	incl.					incl.					3 500.00	21 000.00	3 500.00	21 000.00
-bus work, 1pole, 1200A (per cell)	19	un	incl.					incl.					3 000.00	57 000.00	3 000.00	57 000.00
-bus work, 2poles, 1200A (per cell)	N/A	un	incl.					incl.					5 000.00			
-neutral bus and links, 1pole, 1200A	7	un	incl.					incl.					1 500.00	10 500.00	1 500.00	10 500.00
Section break:																
25kV mot. disc. 1pole, 1200A outdoor	N/A	un	40		50.00			40		10.00			6 500.00			
25kV mot. disc. 2poles, 1200A outdoor	N/A	un	50		50.00			50		10.00			8 500.00			
Structures & insulators	N/A	un	40		50.00			40		10.00			1 500.00			
Bus work 25kV	N/A	l.s.	60		50.00			60		10.00			2 500.00			
Catenary section break (see ITEM #2)																
25kV/240-120V, 1ph., transformer 50kVA	2	un	50	100	50.00	2 500.00	5 000.00	50	100	10.00	500.00	1 000.00	20 000.00	40 000.00	23 000.00	46 000.00
Distribution panel 120/240V 1ph. 24cct	1	un	15	15	50.00	750.00	750.00	15	15	10.00	150.00	150.00	1 500.00	1 500.00	2 400.00	2 400.00
Transformer 240V/240-120V 1ph. 5 kVA	1	un	10	10	50.00	500.00	500.00	10	10	10.00	100.00	100.00	1 800.00	1 800	2 400.00	2 400.00
129V c.c.System (UPS) 12.5kVA	1	un	30	30	50.00	1 500.00	1 500.00	30	30	10.00	300.00	300.00	15 000.00	15 000.00	16 800.00	16 800.00
Control and relays panels	1	l.s.	85	85	50.00	4 250.00	4 250.00	85	85	10.00	850.00	850.00	30 000.00	30 000.00	35 100.00	35 100.00
Power and control cabling	1	l.s.	100	100	50.00	5 000.00	5 000	100	100	10.00	1 000.00	1 000.00	3 000.00	3 000.00	9 000.00	9 000.00
Misc (electrical works) 10%	1	lot	54	54	50.00	2 700.00	2 700.00	54	54	10.00	540.00	540.00	58 980.00	58 980.00	62 220.00	62 220.00
Sous-Total				**594**			**29 700**		**594**			**5 940**		**$648 780**		$684 420
Total																

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 230kV SUBSTATION - 2 INCOMMING LINES		SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: CIVIL WORKS AND EQUIPMENT FOUNDATIONS		ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S. ACCOUNT:	SHEET NO.: 3 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT COST	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT
230kV circuit breaker foundations	3	un	140	420	46.00	6 440.00	19 320.00	140	420	8.60	1 204.00	3 612.00	3 770.00	11 310.00	11 414.00	34 242.00
230kV motorised disconnect foundations	4	un	90	360	46.00	4 140.00	16 560.00	90	360	8.60	774.00	3 096.00	4 390.00	17 560.00	9 304.00	37 216.00
230kV manual disconnect foundations	4	un	90	360	46.00	4 140.00	16 560.00	90	360	8.60	774.00	3 096.00	4 390.00	17 560.00	9 304.00	37 216.00
230/25kV power transformer foundations	2	un	675	1350	46.00	31 050.00	62 100.00	675	1350	8.60	5 805.00	11 610.00	16 200.00	32 400.00	53 055.00	106 110.00
230kV potential transformer foundations	4	un	30	120	46.00	1 380.00	5 520.00	30	120	8.60	258.00	1 032.00	1 315.00	5 260.00	2 953.00	11 812.00
230kV current transformer foundations	18	un	30	540	46.00	1 380.00	24 840.00	30	540	8.60	258.00	4 644.00	1 290.00	23 220.00	2 928.00	52 704.00
230kV station post insulator foundations	12	un	35	420	46.00	1 610.00	19 320.00	35	420	8.60	301.00	3 612.00	1 550.00	18 600.00	3 461.00	41 532.00
230kV incomming line structure foundations	2	un	135	270	46.00	6 210.00	12 420.00	135	270	8.60	1 161.00	2 322.00	9 300.00	18 600.00	16 671.00	33 342.00
25kV switchgear foundation	1	un	300	300	46.00	13 800.00	13 800.00	300	300	8.60	2 580.00	2 580.00	7 200.00	7 200.00	23 580.00	23 580.00
Oil recuperator and accessories	1	un	280	280	46.00	12 880.00	12 880.00	280	280	8.60	2 408.00	2 408.00	15 000.00	15 000.00	30 288.00	30 288.00
Site preparation and transport	5600	m3	0.01	56	46.00	0.46	2 576.00	0.01	56	130.00	1.30	7 280.00	N/A		1.76	9 856.00
Fences and gates	340	m	0.8	272	46.00	36.80	12 512.00	0.8	272	8.60	6.88	2 339.20	30.00	10 200.00	73.68	25 051.20
Control bulding 15' x 40'	1	un	600	600	46.00	27 600.00	27 600.00	600	600	8.60	5 160.00	5 160.00	25 000.00	25 000.00	57 760.00	57 760.00
Grounding loop and shieldwire	5600	m2	0.25	1400	50.00	12.50	70 000.00	0.25	1400	10.00	2.50	14 000.00	10.60	59 360.00	25.60	143 360.00
Substation gravel topping (500mm)	5600	m2	0.04	224	40.00	1.60	8 960.00	0.04	224	8.60	0.34	1 926.40	9.65	54 040	11.59	64 926.40
Cable trenching and manholes	140	m	1.5	210	46.00	69.00	9 660.00	1.5	210	8.60	12.90	1 806.00	250.00	35 000.00	331.90	46 466.00
Misc. (civil works, etc...) 10%	1	l.s.	718	718	50.00	35 900.00	35 900.00	718	718	10.00	7 180.00	7 180.00	35 031.00	35 031.00	78 111.00	78 111.00
Sub-Total				**7900**			**$370 528**		**7900**			**$77 704**		**$385 341**		$833 573
Total				**14962**			**$723 628**		**14962**			**$189 964**		**$4 316 081**		$5 259 373

Date: 93.05.07		Page: 1 of 7

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	Sub-system: 6 - ELECTRIFICATION
☑ 300+ kph - new R/W	Sector: 4 - CONSTRUCTION
☑ 300+ kph - exist. R/W	Item: 4.2 - 120kV SUB-STATION
☑ 200+ kph - exist. R/W	

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable: _____

Prepared by:	continued ☑

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 120kV SUBSTATION - 2 INCOMMING LINES			SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: 120kV - ELECTRICAL EQUIPMENT			ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S.	ACCOUNT:	SHEET NO.: 1 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT cost	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT cost	AMOUNT	UNIT cost	AMOUNT	UNIT cost	AMOUNT
120kV Disconnect, 3ph., 1200A,c/w grnd.sw.	2	un	130	260	50.00	6 500.00	13 000.00	130	260	10.00	1 300.00	2 600.00	34 500.00	69 000.00	42 300.00	84 600.00
120kV current transf., 1ph., 2 windings	6	un	UTILI					UTILI					UTILITY			
120kV potential transf., 1ph., 120/120V	2	un	UTILI					UTILI					UTILITY			
120kV current transf., 1ph., 3 windings	6	un	35	210	50.00	1 750.00	10 500.00	35	210	10.00	350.00	2 100.00	16 800.00	100 800.00	18 900.00	113 400.00
120kV potential transf., 1ph., 120/120V	2	un	40	80	50.00	2 000.00	4 000.00	40	80	10.00	400.00	800.00	7 250.00	14 500.00	9 650.00	19 300.00
120kV circuit breaker, 3ph., 1200A SF6	3	un	300	900	50.00	15 000.00	45 000.00	300	900	10.00	3 000.00	9 000.00	162 000	486 000.00	180 000.00	540 000.00
120kV disconnect, 3ph., 1200A, manual	2	un	110	220	50.00	5 500.00	11 000.00	110	220	10.00	1 100.00	2 200.00	27 100.00	54 200.00	33 700.00	67 400.00
120kV disconnect, 2ph., 1200A, motorised	2	un	90	180	50.00	4 500.00	9 000.00	90	180	10.00	900.00	1 800.00	26 000.00	52 000.00	31 400.00	62 800.00
120kV station post insulators, 1ph.	12	un	10	120	50.00	500.00	6 000.00	10	120	10.00	100.00	1 200.00	750.00	9 000.00	1 350.00	16 200.00
25kV disconnect, 2ph., 2000A motorised	2	un	60	120	50.00	3 000.00	6 000.00	60	120	10.00	600.00	1 200.00	14 300.00	28 600.00	17 900.00	35 800.00
Flexible bus work 1250kcm ACSR	250	m	0.8	200	50.00	40.00	10 000.00	0.8	200	10.00	8.00	2 000.00	10.00	2 500.00	58.00	14 500.00
Tubular rigid aluminum bus work 75mm dia.	300	m	1	300	50.00	50.00	15 000	1	300	10.00	10.00	3 000.00	95.00	28 500.00	155.00	46 500.00
120 / 25kV Transformer, 2ph., 30MVA	2	un	915	1830	50.00	45 750.00	91 500.00	915	1830	25.00	22 875	45 750.00	480 000	960 000.00	548 625.00	1 097 250
4-current transf. 120kV, bushing type																
4-current transf. 25kV, bushing type																
2-lightning arresters 120kV, 1 ph.,																
2-lightning arresters 25kV, 1 ph.,																
Line protection panel	2	un	75	150	50.00	3 750.00	7 500.00	75	150	10.00	750.00	1 500.00	60 000.00	120 000.00	64 500.00	129 000.00
Circuit breaker control panel	3	un	60	180	50.00	3 000.00	9 000.00	60	180	10.00	600.00	1 800.00	40 000.00	120 000.00	43 600.00	130 800.00
Transformer control panel	2	un	30	60	50.00	1 500.00	3 000.00	30	60	10.00	300.00	600.00	15 000.00	30 000.00	16 800.00	33 600.00
Power and control cabling	1	l.s.	200	200	50.00	10 000.00	10 000.00	200	200	10.00	2 000.00	2 000.00	10 000.00	10 000.00	22 000.00	22 000.00
Misc. (brackets, supports, etc...) 10%	1	l.s.	501	501	50.00	25 050.00	25 050.00	501	501	10.00	5 010.00	5 010.00	208 510	208 510.00	238 570.00	238 570.00
Sub-Total				5511			275 550		5511			82 560		$2 293 610		$2 651 720
Total																

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 120kV SUBSTATION - 2 INCOMMING LINES		SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: 25kV MAIN SUBSTATION - 2 x 25kV		ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S. ACCOUNT:	SHEET NO.: 2 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT COST	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT
25kV metalclad switchgear including:	1	un	200	200	50.00	10 000.00	10 000.00	200	200	10.00	2 000.00	2 000.00	40 500.00	40 500.00	52 500.00	52 500.00
(rated 46kV)																
-circuit breaker, 1poles, 1200A c/w CT's	N/A	un	incl.					incl.					36 000.00			
-circuit breaker, 2poles, 1200A c/w CT's	5	un	incl.					incl.					40 000.00	200 000.00	40 000.00	200 000.00
-motorised disconnect, 1pole, 1200A	N/A	un	incl.					incl.					16 000.00			
-motorised disconnect, 2poles, 1200A	2	un	incl.					incl.					20 000.00	40 000.00	20 000.00	40 000.00
-manual disconnect, 1pole, 1200A	N/A	un	incl.					incl.					12 000.00			
-manual disconnect, 2poles, 1200A	12	un	incl.					incl.					15 000.00	180 000.00	15 000.00	180 000.00
-potential transformer, 1ph., 25kV:120V	12	un	incl.					incl.					4 500.00	54 000.00	4 500.00	54 000.00
-outdoor bushing, 1pole	12	un	incl.					incl.					3 500.00	42 000.00	3 500.00	42 000.00
-bus work, 1pole, 1200A (per cell)	N/A	un	incl.					incl.					3 000.00			
-bus work, 2poles, 1200A (per cell)	19	un	incl.					incl.					5 000.00	95 000.00	5 000.00	95 000.00
-neutral bus and links, 1pole, 1200A	7	un	incl.					incl.					1 500.00	10 500.00	1 500.00	10 500.00
Section break:																
25kV mot. disc. 1pole, 1200A outdoor	2	un	40	80	50.00	2 000.00	4 000.00	40	80	10.00	400.00	800.00	6 500.00	13 000.00	8 900.00	17 800.00
25kV mot. disc. 2poles, 1200A outdoor	2	un	50	100	50.00	2 500.00	5 000.00	50	100	10.00	500.00	1 000.00	8 500.00	17 000.00	11 500.00	23 000.00
Structures & insulators	5	un	40	200	50.00	2 000.00	10 000.00	40	200	10.00	400.00	2 000.00	1 500.00	7 500.00	3 900.00	19 500.00
Bus work 25kV	1	l.s.	60	60	50.00	3 000.00	3 000.00	60	60	10.00	600.00	600.00	2 500.00	2 500.00	6 100.00	6 100.00
Catenary section break (see ITEM #2)																
25kV/240-120V, 1ph., transformer 50kVA	2	un	50	100	50.00	2 500.00	5 000.00	50	100	10.00	500.00	1 000.00	20 000.00	40 000.00	23 000.00	46 000.00
Distribution panel 120/240V 1ph. 24cct	1	un	15	15	50.00	750.00	750.00	15	15	10.00	150.00	150.00	1 500.00	1 500.00	2 400.00	2 400.00
Transformer 240V/240-120V 1ph. 5 kVA	1	un	10	10	50.00	500.00	500.00	10	10	10.00	100.00	100.00	1 800.00	1 800	2 400.00	2 400.00
129V c.c.System (UPS) 12.5kVA	1	un	30	30	50.00	1 500.00	1 500.00	30	30	10.00	300.00	300.00	15 000.00	15 000.00	16 800.00	16 800.00
Control and relays panels	1	l.s.	85	85	50.00	4 250.00	4 250.00	85	85	10.00	850.00	850.00	30 000.00	30 000.00	35 100.00	35 100.00
Power and control cabling	1	l.s.	100	100	50.00	5 000.00	5 000	100	100	10.00	1 000.00	1 000.00	3 000.00	3 000.00	9 000.00	9 000.00
Misc (electrical works) 10%	1	lot	98	98	50.00	4 900.00	4 900.00	98	98	10.00	980.00	980.00	79 330.00	79 330.00	85 210.00	85 210.00
Sous-Total				**1078**			**53 900**		**1078**			**10 780**		**$872 630**		$937 310
Total																

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 120kV SUBSTATION - 2 INCOMMING LINES		SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: CIVIL WORKS AND EQUIPMENT FOUNDATIONS		ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S. ACCOUNT:	SHEET NO.: 3 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT COST	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT
120kV circuit breaker foundations	3	un	105	315	46.00	4 830.00	14 490.00	105	315	8.60	903	2 709.00	2 790.00	8 370.00	8 523.00	25 569.00
120kV motorised disconnect foundations	4	un	65	260	46.00	2 990.00	11 960.00	65	260	8.60	559.00	2 236.00	3 250.00	13 000.00	6 799.00	27 196.00
120kV manual disconnect foundations	4	un	65	260	46.00	2 990.00	11 960.00	65	260	8.60	559.00	2 236.00	3 250.00	13 000.00	6 799.00	27 196.00
120/25kV power transformer foundations	2	un	500	1000	46.00	23 000	46 000.00	500	1000	8.60	4 300	8 600.00	12 000.00	24 000.00	39 300.00	78 600.00
120kV potential transformer foundations	4	un	20	80	46.00	920.00	3 680.00	20	80	8.60	172.00	688.00	975.00	3 900.00	2 067.00	8 268.00
120kV current transformer foundations	18	un	20	360	46.00	920.00	16 560.00	20	360	8.60	172.00	3 096.00	950.00	17 100.00	2 042.00	36 756.00
120kV station post insulator foundations	12	un	25	300	46.00	1 150.00	13 800.00	25	300	8.60	215.00	2 580.00	1 150.00	13 800.00	2 515.00	30 180.00
120kV incomming line structure foundations	2	un	100	200	46.00	4 600.00	9 200.00	100	200	8.60	860.00	1 720.00	6 850.00	13 700.00	12 310.00	24 620.00
25kV switchgear foundation	1	un	300	300	46.00	13 800.00	13 800.00	300	300	8.60	2 580.00	2 580.00	7 200.00	7 200.00	23 580.00	23 580.00
Oil recuperator and accessories	1	un	280	280	46.00	12 880	12 880.00	280	280	8.60	2 408	2 408.00	15 000.00	15 000.00	30 288.00	30 288.00
Site preparation and transport	4200	m3	0.01	42	46.00	0.46	1 932.00	0.01	42	130.00	1.30	5 460.00	N/A		1.76	7 392.00
Fences and gates	265	m	0.8	212	46.00	36.80	9 752.00	0.8	212	8.60	6.88	1 823.20	30.00	7 950.00	73.68	19 525.20
Control bulding 15' x 40'	1	un	600	600	46.00	27 600	27 600.00	600	600	8.60	5 160	5 160.00	25 000.00	25 000.00	57 760.00	57 760.00
Grounding loop and shieldwire	4200	m2	0.25	1050	50.00	12.50	52 500.00	0.25	1050	10.00	2.50	10 500.00	10.60	44 520.00	25.60	107 520.00
Substation gravel topping (500mm)	4200	m2	0.04	168	40.00	1.60	6 720.00	0.04	168	8.60	0.34	1 444.80	9.65	40 530	11.59	48 694.80
Cable trenching and manholes	100	m	1.5	150	46.00	69.00	6 900.00	1.5	150	8.60	12.90	1 290.00	250.00	25 000.00	331.90	33 190.00
Misc. (civil works, etc...) 10%	1	l.s.	558	558	50.00	27 900	27 900.00	558	558	10.00	5 580	5 580.00	27 207.00	27 207.00	60 687.00	60 687.00
Sub-Total				**6135**			**$287 634**		**6135**			**$60 111**		**$299 277**		$647 022
Total				**11646**			**$563 184**		**11646**			**$153 451**		**$3 465 517**		$4 236 052

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 120kV SUBSTATION - 2 INCOMMING LINES		SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: 120kV - ELECTRICAL EQUIPMENT		ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S. ACCOUNT:	SHEET NO.: 1 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT cost	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT cost	AMOUNT	UNIT cost	AMOUNT	UNIT cost	AMOUNT
120kV Disconnect, 3ph., 1200A,c/w grnd.sw.	2	un	130	260	50.00	6 500.00	13 000.00	130	260	10.00	1 300.00	2 600.00	34 500.00	69 000.00	42 300.00	84 600.00
120kV current transf., 1ph., 2 windings	6	un	UTILI					UTILI					UTILITY			
120kV potential transf., 1ph., 120/120V	2	un	UTILI					UTILI					UTILITY			
120kV current transf., 1ph., 3 windings	6	un	35	210	50.00	1 750.00	10 500.00	35	210	10.00	350.00	2 100.00	16 800.00	100 800.00	18 900.00	113 400.00
120kV potential transf., 1ph., 120/120V	2	un	40	80	50.00	2 000.00	4 000.00	40	80	10.00	400.00	800.00	7 250.00	14 500.00	9 650.00	19 300.00
120kV circuit breaker, 3ph., 1200A SF6	3	un	300	900	50.00	15 000.00	45 000.00	300	900	10.00	3 000.00	9 000.00	162 000	486 000.00	180 000.00	540 000.00
120kV disconnect, 3ph., 1200A, manual	2	un	110	220	50.00	5 500.00	11 000.00	110	220	10.00	1 100.00	2 200.00	27 100.00	54 200.00	33 700.00	67 400.00
120kV disconnect, 2ph., 1200A, motorised	2	un	90	180	50.00	4 500.00	9 000.00	90	180	10.00	900.00	1 800.00	26 000.00	52 000.00	31 400.00	62 800.00
120kV station post insulators, 1ph.	12	un	10	120	50.00	500.00	6 000.00	10	120	10.00	100.00	1 200.00	750.00	9 000.00	1 350.00	16 200.00
25kV disconnect, 2ph., 2000A motorised	2	un	60	120	50.00	3 000.00	6 000.00	60	120	10.00	600.00	1 200.00	14 300.00	28 600.00	17 900.00	35 800.00
Flexible bus work 1250kcm ACSR	250	m	0.8	200	50.00	40.00	10 000.00	0.8	200	10.00	8.00	2 000.00	10.00	2 500.00	58.00	14 500.00
Tubular rigid aluminum bus work 75mm dia.	300	m	1	300	50.00	50.00	15 000	1	300	10.00	10.00	3 000.00	95.00	28 500.00	155.00	46 500.00
120 / 25kV Transformer, 2ph., 30MVA	2	un	915	1830	50.00	45 750.00	91 500.00	915	1830	25.00	22 875	45 750.00	480 000	960 000.00	548 625.00	1 097 250
4-current transf. 120kV, bushing type																
4-current transf. 25kV, bushing type																
2-lightning arresters 120kV, 1 ph.,																
2-lightning arresters 25kV, 1 ph.,																
Line protection panel	2	un	75	150	50.00	3 750.00	7 500.00	75	150	10.00	750.00	1 500.00	60 000.00	120 000.00	64 500.00	129 000.00
Circuit breaker control panel	3	un	60	180	50.00	3 000.00	9 000.00	60	180	10.00	600.00	1 800.00	40 000.00	120 000.00	43 600.00	130 800.00
Transformer control panel	2	un	30	60	50.00	1 500.00	3 000.00	30	60	10.00	300.00	600.00	15 000.00	30 000.00	16 800.00	33 600.00
Power and control cabling	1	l.s.	200	200	50.00	10 000.00	10 000.00	200	200	10.00	2 000.00	2 000.00	10 000.00	10 000.00	22 000.00	22 000.00
Misc. (brackets, supports, etc...) 10%	1	l.s.	501	501	50.00	25 050.00	25 050.00	501	501	10.00	5 010.00	5 010.00	208 510	208 510.00	238 570.00	238 570.00
Sub-Total				5511			275 550		5511			82 560		$2 293 610		$2 651 720
Total																

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 120kV SUBSTATION - 2 INCOMMING LINES		SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: 25kV MAIN SUBSTATION - 1 x 25kV		ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S. ACCOUNT:	SHEET NO.: 2 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT COST	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT
25kV metalclad switchgear including:	1	un	200	200	50.00	10 000.00	10 000.00	200	200	10.00	2 000.00	2 000.00	27 000.00	27 000.00	39 000.00	39 000.00
(rated 46kV)																
-circuit breaker, 1poles, 1200A c/w CT's	5	un	incl.					incl.					36 000.00	180 000.00	36 000.00	180 000.00
-circuit breaker, 2poles, 1200A c/w CT's	N/A	un	incl.					incl.					40 000.00			
-motorised disconnect, 1pole, 1200A	2	un	incl.					incl.					16 000.00	32 000.00	16 000.00	32 000.00
-motorised disconnect, 2poles, 1200A	N/A	un	incl.					incl.					20 000.00			
-manual disconnect, 1pole, 1200A	12	un	incl.					incl.					12 000.00	144 000.00	12 000.00	144 000.00
-manual disconnect, 2poles, 1200A	N/A	un	incl.					incl.					15 000.00			
-potential transformer, 1ph., 25kV:120V	6	un	incl.					incl.					4 500.00	27 000.00	4 500.00	27 000.00
-outdoor bushing, 1pole	6	un	incl.					incl.					3 500.00	21 000.00	3 500.00	21 000.00
-bus work, 1pole, 1200A (per cell)	19	un	incl.					incl.					3 000.00	57 000.00	3 000.00	57 000.00
-bus work, 2poles, 1200A (per cell)	N/A	un	incl.					incl.					5 000.00			
-neutral bus and links, 1pole, 1200A	7	un	incl.					incl.					1 500.00	10 500.00	1 500.00	10 500.00
Section break:																
25kV mot. disc. 1pole, 1200A outdoor	N/A	un	40		50.00			40		10.00			6 500.00			
25kV mot. disc. 2poles, 1200A outdoor	N/A	un	50		50.00			50		10.00			8 500.00			
Structures & insulators	N/A	un	40		50.00			40		10.00			1 500.00			
Bus work 25kV	N/A	l.s.	60		50.00			60		10.00			2 500.00			
Catenary section break (see ITEM #2)																
25kV/240-120V, 1ph., transformer 50kVA	2	un	50	100	50.00	2 500.00	5 000.00	50	100	10.00	500.00	1 000.00	20 000.00	40 000.00	23 000.00	46 000.00
Distribution panel 120/240V 1ph. 24cct	1	un	15	15	50.00	750.00	750.00	15	15	10.00	150.00	150.00	1 500.00	1 500.00	2 400.00	2 400.00
Transformer 240V/240-120V 1ph. 5 kVA	1	un	10	10	50.00	500.00	500.00	10	10	10.00	100.00	100.00	1 800.00	1 800	2 400.00	2 400.00
129V c.c.System (UPS) 12.5kVA	1	un	30	30	50.00	1 500.00	1 500.00	30	30	10.00	300.00	300.00	15 000.00	15 000.00	16 800.00	16 800.00
Control and relays panels	1	l.s.	85	85	50.00	4 250.00	4 250.00	85	85	10.00	850.00	850.00	30 000.00	30 000.00	35 100.00	35 100.00
Power and control cabling	1	l.s.	100	100	50.00	5 000.00	5 000	100	100	10.00	1 000.00	1 000.00	3 000.00	3 000.00	9 000.00	9 000.00
Misc (electrical works) 10%	1	lot	54	54	50.00	2 700.00	2 700.00	54	54	10.00	540.00	540.00	58 980.00	58 980.00	62 220.00	62 220.00
Sous-Total				**594**			**29 700**		**594**			**5 940**		**$648 780**		$684 420
Total																

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 120kV SUBSTATION - 2 INCOMMING LINES		SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: CIVIL WORKS AND EQUIPMENT FOUNDATIONS		ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S. ACCOUNT:	SHEET NO.: 3 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT COST	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT
120kV circuit breaker foundations	3	un	105	315	46.00	4 830.00	14 490.00	105	315	8.60	903	2 709.00	2 790.00	8 370.00	8 523.00	25 569.00
120kV motorised disconnect foundations	4	un	65	260	46.00	2 990.00	11 960.00	65	260	8.60	559.00	2 236.00	3 250.00	13 000.00	6 799.00	27 196.00
120kV manual disconnect foundations	4	un	65	260	46.00	2 990.00	11 960.00	65	260	8.60	559.00	2 236.00	3 250.00	13 000.00	6 799.00	27 196.00
120/25kV power transformer foundations	2	un	500	1000	46.00	23 000	46 000.00	500	1000	8.60	4 300	8 600.00	12 000.00	24 000.00	39 300.00	78 600.00
120kV potential transformer foundations	4	un	20	80	46.00	920.00	3 680.00	20	80	8.60	172.00	688.00	975.00	3 900.00	2 067.00	8 268.00
120kV current transformer foundations	18	un	20	360	46.00	920.00	16 560.00	20	360	8.60	172.00	3 096.00	950.00	17 100.00	2 042.00	36 756.00
120kV station post insulator foundations	12	un	25	300	46.00	1 150.00	13 800.00	25	300	8.60	215.00	2 580.00	1 150.00	13 800.00	2 515.00	30 180.00
120kV incomming line structure foundations	2	un	100	200	46.00	4 600.00	9 200.00	100	200	8.60	860.00	1 720.00	6 850.00	13 700.00	12 310.00	24 620.00
25kV switchgear foundation	1	un	300	300	46.00	13 800.00	13 800.00	300	300	8.60	2 580.00	2 580.00	7 200.00	7 200.00	23 580.00	23 580.00
Oil recuperator and accessories	1	un	280	280	46.00	12 880	12 880.00	280	280	8.60	2 408	2 408.00	15 000.00	15 000.00	30 288.00	30 288.00
Site preparation and transport	4200	m3	0.01	42	46.00	0.46	1 932.00	0.01	42	130.00	1.30	5 460.00	N/A		1.76	7 392.00
Fences and gates	265	m	0.8	212	46.00	36.80	9 752.00	0.8	212	8.60	6.88	1 823.20	30.00	7 950.00	73.68	19 525.20
Control bulding 15' x 40'	1	un	600	600	46.00	27 600	27 600.00	600	600	8.60	5 160	5 160.00	25 000.00	25 000.00	57 760.00	57 760.00
Grounding loop and shieldwire	4200	m2	0.25	1050	50.00	12.50	52 500.00	0.25	1050	10.00	2.50	10 500.00	10.60	44 520.00	25.60	107 520.00
Substation gravel topping (500mm)	4200	m2	0.04	168	40.00	1.60	6 720.00	0.04	168	8.60	0.34	1 444.80	9.65	40 530	11.59	48 694.80
Cable trenching and manholes	100	m	1.5	150	46.00	69.00	6 900.00	1.5	150	8.60	12.90	1 290.00	250.00	25 000.00	331.90	33 190.00
Misc. (civil works, etc...) 10%	1	l.s.	558	558	50.00	27 900	27 900.00	558	558	10.00	5 580	5 580.00	27 207.00	27 207.00	60 687.00	60 687.00
Sub-Total				**6135**			**$287 634**		**6135**			**$60 111**		**$299 277**		$647 022
Total				**11646**			**$563 184**		**11646**			**$148 611**		**$3 241 667**		$3 983 162

Date: 93.05.07 | Page: 1 of 2

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☑ 300+ kph - new R/W
- ☑ 300+ kph - exist. R/W
- ☑ 200+ kph - exist. R/W

Sub-system: 6 - ELECTRIFICATION
Sector: 4 - CONSTRUCTION
Item: 4.3 - PARALLELING STATION

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable: _____

Prepared by:

continued ☑

WINDSOR - QUEBEC IIIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: PARALLELING & AUTO-TRANSFORMER STATION			SHAWINIGAN NO: 005556
PROJECT: IIIGH SPEED TRAIN STUDY	DESCRIPTION: 25kV SUBSTATION - 2 x 25kV			ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S.	ACCOUNT:	SHEET NO.: 1 OF 1

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT cost	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT cost	AMOUNT	UNIT cost	AMOUNT	UNIT cost	AMOUNT
25kV metalclad switchgear including:	1	un	200	200	50.00	10 000.00	10 000.00	200	200	10.00	2 000.00	2 000.00	27 000.00	27 000.00	39 000.00	39 000.00
(rated 46kV)																
-load break mot. disc., 1pole, 1200A	N/A	un	incl.					incl.					20 000.00			
-load break mot. disc., 2poles, 1200A	2	un	incl.					incl.					25 000.00	50 000.00	25 000.00	50 000.00
-motorised disconnect, 1pole, 1200A	N/A	un	incl.					incl.					16 000.00			
-motorised disconnect, 2poles, 1200A	2	un	incl.					incl.					20 000.00	40 000.00	20 000.00	40 000.00
-manual disconnect, 1pole, 1200A	N/A	un	incl.					incl.					12 000.00			
-manual disconnect, 2poles, 1200A	2	un	incl.					incl.					15 000.00	30 000.00	15 000.00	30 000.00
-potential transformer, 1ph., 25kV:120V	2	un	incl.					incl.					4 500.00	9 000.00	4 500.00	9 000.00
-outdoor bushing, 1pole	4	un	incl.					incl.					3 500.00	14 000.00	3 500.00	14 000.00
-bus work, 1pole, 1200A (per cell)	N/A	un	incl.					incl.					3 000.00			
-bus work, 2poles, 1200A (per cell)	6	un	incl.					incl.					5 000.00	30 000.00	5 000.00	30 000.00
-neutral bus and links, 1pole, 1200A	5	un	incl.					incl.					1 500.00	7 500.00	1 500.00	7 500.00
-25kV auto transformer 10MVA	2	un	225	450	50.00	11 250.00	22 500.00	225	450				170 000	340 000.00	181 250.00	362 500.00
Phase break:																
25kV mot. disc. 1pole, 1200A outdoor	N/A	un	50		50.00			50		10.00			6 500.00			
25kV mot. disc. 2poles, 1200A outdoor	N/A	un	40		50.00			40		10.00			8 500.00			
Structures & insulators	N/A	un	40		50.00			40		10.00			1 500.00			
Bus work 25kV	N/A	l.s.	60		50.00			60		10.00			2 500.00			
Catenary section break (see ITEM #2)																
25kV/240-120V, 1ph., transformer 10kVA	1	un	50	50	50.00	2 500.00	2 500.00	50	50	10.00	500.00	500.00	12 000.00	12 000.00	15 000.00	15 000.00
Distribution panel 120/240V 1ph. 24cct	1	un	15	15	50.00	750.00	750.00	15	15	10.00	150.00	150.00	1 500.00	1 500.00	2 400.00	2 400.00
Transformer 240V/240-120V 1ph. 5 kVA	1	un	10	10	50.00	500.00	500.00	10	10	10.00	100.00	100.00	1 800.00	1 800.00	2 400.00	2 400.00
129V c.c.System (UPS) 12.5kVA	1	un	30	30	50.00	1 500.00	1 500.00	30	30	10.00	300.00	300.00	15 000.00	15 000.00	16 800.00	16 800.00
Control and relays panels	1	l.s.	85	85	50.00	4 250.00	4 250.00	85	85	10.00	850.00	850.00	30 000.00	30 000.00	35 100.00	35 100.00
Power and control cabling	1	l.s.	100	100	50.00	5 000.00	5 000	100	100	10.00	1 000.00	1 000.00	3 000.00	3 000.00	9 000.00	9 000.00
Misc (electrical works) 10%	1	lot	94	94	50.00	4 700.00	4 700.00	94	94	10.00	940.00	940.00	61 080.00	61 080.00	66 720.00	66 720.00
Sous-Total				1034			51 700		1034			5 840		$671 880		$729 420
Total				1034			51 700		1034			5 840		$671 880		$729 420

Date: 93.05.07 | Page: 1 of 2

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- [x] 300+ kph - new R/W
- [x] 300+ kph - exist. R/W
- [x] 200+ kph - exist. R/W

Sub-system: 6 - ELECTRIFICATION
Sector: 4 - CONSTRUCTION
Item: 4.4 - INTERFACE STNS.

Geographical Variation ? [x] no [ ] yes If yes, indicate segments applicable: _____

Prepared by:

continued [x]

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: INTERFACE & AUTO-TRANSFORMER STATION		SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: 25kV SUBSTATION - 2 x 25kV TO 1 X 25kV		ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S. ACCOUNT:	SHEET NO.: 1 OF 1

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT COST	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT
25kV metalclad switchgear including:	1	un	200	200	50.00	10 000.00	10 000.00	200	200	10.00	2 000.00	2 000.00	27 000.00	27 000.00	39 000.00	39 000.00
(rated 46kV)																
-load break mot. disc., 1pole, 1200A	2	un	incl.					incl.					20 000.00	40 000.00	20 000.00	40 000.00
-load break mot. disc., 2poles, 1200A	3	un	incl.					incl.					25 000.00	75 000.00	25 000.00	75 000.00
-motorised disconnect, 1pole, 1200A	N/A	un	incl.					incl.					16 000.00			
-motorised disconnect, 2poles, 1200A	N/A	un	incl.					incl.					20 000.00			
-manual disconnect, 1pole, 1200A	4	un	incl.					incl.					12 000.00	48 000.00	12 000.00	48 000.00
-manual disconnect, 2poles, 1200A	6	un	incl.					incl.					15 000.00	90 000.00	15 000.00	90 000.00
-potential transformer, 1ph., 25kV:120V	4	un	incl.					incl.					4 500.00	18 000.00	4 500.00	18 000.00
-outdoor bushing, 1pole	6	un	incl.					incl.					3 500.00	21 000.00	3 500.00	21 000.00
-bus work, 1pole, 1200A (per cell)	4	un	incl.					incl.					3 000.00	12 000.00	3 000.00	12 000.00
-bus work, 2poles, 1200A (per cell)	9	un	incl.					incl.					5 000.00	45 000.00	5 000.00	45 000.00
-neutral bus and links, 1pole, 1200A	6	un	incl.					incl.					1 500.00	9 000.00	1 500.00	9 000.00
-25kV auto transformer 10MVA	2	un	225	450	50.00	11 250.00	22 500.00	225	450				170 000	340 000.00	181 250.00	362 500.00
Phase break:																
25kV mot. disc. 1pole, 1200A outdoor	N/A	un	40		50.00			40		10.00			6 500.00			
25kV mot. disc. 2poles, 1200A outdoor	N/A	un	50		50.00			50		10.00			8 500.00			
Structures & insulators	N/A	un	40		50.00			40		10.00			1 500.00			
Bus work 25kV	N/A	l.s.	60		50.00			60		10.00			2 500.00			
Catenary section break (see ITEM #2)																
25kV/240-120V, 1ph., transformer 10kVA	1	un	50	50	50.00	2 500.00	2 500.00	50	50	10.00	500.00	500.00	12 000.00	12 000.00	15 000.00	15 000.00
Distribution panel 120/240V 1ph. 24cct	1	un	15	15	50.00	750.00	750.00	15	15	10.00	150.00	150.00	1 500.00	1 500.00	2 400.00	2 400.00
Transformer 240V/240-120V 1ph. 5 kVA	1	un	10	10	50.00	500.00	500.00	10	10	10.00	100.00	100.00	1 800.00	1 800.00	2 400.00	2 400.00
129V c.c.System (UPS) 12.5kVA	1	un	30	30	50.00	1 500.00	1 500.00	30	30	10.00	300.00	300.00	15 000.00	15 000.00	16 800.00	16 800.00
Control and relays panels	1	l.s.	85	85	50.00	4 250.00	4 250.00	85	85	10.00	850.00	850.00	30 000.00	30 000.00	35 100.00	35 100.00
Power and control cabling	1	l.s.	100	100	50.00	5 000.00	5 000	100	100	10.00	1 000.00	1 000.00	3 000.00	3 000.00	9 000.00	9 000.00
Misc (electrical works) 10%	1	lot	94	94	50.00	4 700.00	4 700.00	94	94	10.00	940.00	940.00	78 830.00	78 830.00	84 470.00	84 470.00
Sous-Total				**1034**			**51 700**		**1034**			**5 840**		**$867 130**		$924 670
Total				**1034**			**51 700**		**1034**			**5 840**		**$867 130**		$924 670

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QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☑ 300+ kph - new R/W
- ☑ 300+ kph - exist. R/W
- ☑ 200+ kph - exist. R/W

Sub-system: 6 - ELECTRIFICATION
Sector: 4 - CONSTRUCTION
Item: 4.6 - 315 kV SUB-STATION

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable: _____

Prepared by:

continued ☑

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 315kV SUBSTATION - 2 INCOMMING LINES	SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: 315kV - ELECTRICAL EQUIPMENT	ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G. CHECK BY: H.S. ACCOUNT:	SHEET NO.: 1 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT COST	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT
315kV Disconnect, 3ph., 1200A,c/w grnd.sw.	2	un	200	400	50.00	10 000.00	20 000.00	200	400	10.00	2 000.00	4 000.00	61 500.00	123 000.00	73 500.00	147 000.00
315kV current transf., 1ph., 2 windings	6	un	UTILI					UTILI					UTILITY			
315kV potential transf., 1ph., 120/120V	2	un	UTILI					UTILI					UTILITY			
315kV current transf., 1ph., 3 windings	6	un	55	330	50.00	2 750.00	16 500.00	55	330	10.00	550.00	3 300.00	45 000.00	270 000.00	48 300.00	289 800.00
315kV potential transf., 1ph., 120/120V	2	un	60	120	50.00	3 000.00	6 000.00	60	120	10.00	600.00	1 200.00	22 000.00	44 000.00	25 600.00	51 200.00
315kV circuit breaker, 3ph., 1200A SF6	3	un	450	1350	50.00	22 500.00	67 500.00	450	1350	10.00	4 500.00	13 500.00	310 000	930 000.00	337 000.00	1 011 000
315kV disconnect, 3ph., 1200A, manual	2	un	165	330	50.00	8 250.00	16 500.00	165	330	10.00	1 650.00	3 300.00	52 000.00	104 000.00	61 900.00	123 800.00
315kV disconnect, 2ph., 1200A, motorised	2	un	120	240	50.00	6 000.00	12 000.00	120	240	10.00	1 200.00	2 400.00	48 000.00	96 000.00	55 200.00	110 400.00
315kV station post insulators, 1ph.	12	un	20	240	50.00	1 000.00	12 000.00	20	240	10.00	200.00	2 400.00	1 900.00	22 800.00	3 100.00	37 200.00
25kV disconnect, 2ph., 2000A motorised	2	un	60	120	50.00	3 000.00	6 000.00	60	120	10.00	600.00	1 200.00	14 300.00	28 600.00	17 900.00	35 800.00
Flexible bus work 1250kcm ACSR	250	m	0.8	200	50.00	40.00	10 000.00	0.8	200	10.00	8.00	2 000.00	10.00	2 500.00	58.00	14 500.00
Tubular rigid aluminum bus work 75mm dia.	300	m	1	300	50.00	50.00	15 000	1	300	10.00	10.00	3 000.00	95.00	28 500.00	155.00	46 500.00
315 / 25kV Transformer, 2ph., 30MVA	2	un	1450	2900	50.00	72 500.00	145 000.00	1450	2900	25.00	36 250	72 500.00	870 000	1 740 000	978 750.00	1 957 500
4-current transf. 315kV, bushing type																
4-current transf. 25kV, bushing type																
2-lightning arresters 315kV, 1 ph.,																
2-lightning arresters 25kV, 1 ph.,																
Line protection panel	2	un	75	150	50.00	3 750.00	7 500.00	75	150	10.00	750.00	1 500.00	90 000.00	180 000.00	94 500.00	189 000.00
Circuit breaker control panel	3	un	60	180	50.00	3 000.00	9 000.00	60	180	10.00	600.00	1 800.00	40 000.00	120 000.00	43 600.00	130 800.00
Transformer control panel	2	un	30	60	50.00	1 500.00	3 000.00	30	60	10.00	300.00	600.00	15 000.00	30 000.00	16 800.00	33 600.00
Power and control cabling	1	l.s.	300	300	50.00	15 000.00	15 000.00	300	300	10.00	3 000.00	3 000.00	15 000.00	15 000.00	33 000.00	33 000.00
Misc. (brackets, supports, etc...) 10%	1	l.s.	722	722	50.00	36 100.00	36 100.00	722	722	10.00	7 220.00	7 220.00	373 440	373 440.00	416 760.00	416 760.00
Sub-Total				7942			397 100		7942			122 920		$4 107 840		$4 627 860
Total																

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 230kV SUBSTATION - 2 INCOMMING LINES			SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: 25kV MAIN SUBSTATION - 2 x 25kV			ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S.	ACCOUNT:	SHEET NO.: 2 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT cost	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT cost	AMOUNT	UNIT cost	AMOUNT	UNIT cost	AMOUNT
25kV metalclad switchgear including:	1	un	200	200	50.00	10 000.00	10 000.00	200	200	10.00	2 000.00	2 000.00	40 500.00	40 500.00	52 500.00	52 500.00
(rated 46kV)																
-circuit breaker, 1poles, 1200A c/w CT's	N/A	un	incl.					incl.					36 000.00			
-circuit breaker, 2poles, 1200A c/w CT's	5	un	incl.					incl.					40 000.00	200 000.00	40 000.00	200 000.00
-motorised disconnect, 1pole, 1200A	N/A	un	incl.					incl.					16 000.00			
-motorised disconnect, 2poles, 1200A	2	un	incl.					incl.					20 000.00	40 000.00	20 000.00	40 000.00
-manual disconnect, 1pole, 1200A	N/A	un	incl.					incl.					12 000.00			
-manual disconnect, 2poles, 1200A	12	un	incl.					incl.					15 000.00	180 000.00	15 000.00	180 000.00
-potential transformer, 1ph., 25kV:120V	12	un	incl.					incl.					4 500.00	54 000.00	4 500.00	54 000.00
-outdoor bushing, 1pole	12	un	incl.					incl.					3 500.00	42 000.00	3 500.00	42 000.00
-bus work, 1pole, 1200A (per cell)	N/A	un	incl.					incl.					3 000.00			
-bus work, 2poles, 1200A (per cell)	19	un	incl.					incl.					5 000.00	95 000.00	5 000.00	95 000.00
-neutral bus and links, 1pole, 1200A	7	un	incl.					incl.					1 500.00	10 500.00	1 500.00	10 500.00
Section break:																
25kV mot. disc. 1pole, 1200A outdoor	2	un	40	80	50.00	2 000.00	4 000.00	40	80	10.00	400.00	800.00	6 500.00	13 000.00	8 900.00	17 800.00
25kV mot. disc. 2poles, 1200A outdoor	2	un	50	100	50.00	2 500.00	5 000.00	50	100	10.00	500.00	1 000.00	8 500.00	17 000.00	11 500.00	23 000.00
Structures & insulators	5	un	40	200	50.00	2 000.00	10 000.00	40	200	10.00	400.00	2 000.00	1 500.00	7 500.00	3 900.00	19 500.00
Bus work 25kV	1	l.s.	60	60	50.00	3 000.00	3 000.00	60	60	10.00	600.00	600.00	2 500.00	2 500.00	6 100.00	6 100.00
Catenary section break (see ITEM #2)																
25kV/240-120V, 1ph., transformer 50kVA	2	un	50	100	50.00	2 500.00	5 000.00	50	100	10.00	500.00	1 000.00	20 000.00	40 000.00	23 000.00	46 000.00
Distribution panel 120/240V 1ph. 24cct	1	un	15	15	50.00	750.00	750.00	15	15	10.00	150.00	150.00	1 500.00	1 500.00	2 400.00	2 400.00
Transformer 240V/240-120V 1ph. 5 kVA	1	un	10	10	50.00	500.00	500.00	10	10	10.00	100.00	100.00	1 800.00	1 800	2 400.00	2 400.00
129V c.c.System (UPS) 12.5kVA	1	un	30	30	50.00	1 500.00	1 500.00	30	30	10.00	300.00	300.00	15 000.00	15 000.00	16 800.00	16 800.00
Control and relays panels	1	l.s.	85	85	50.00	4 250.00	4 250.00	85	85	10.00	850.00	850.00	30 000.00	30 000.00	35 100.00	35 100.00
Power and control cabling	1	l.s.	100	100	50.00	5 000.00	5 000	100	100	10.00	1 000.00	1 000.00	3 000.00	3 000.00	9 000.00	9 000.00
Misc (electrical works) 10%	1	lot	98	98	50.00	4 900.00	4 900.00	98	98	10.00	980.00	980.00	79 330.00	79 330.00	85 210.00	85 210.00
Sous-Total				**1078**			53 900		**1078**			**10 780**		**$872 630**		$937 310
Total																

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 315kV SUBSTATION - 2 INCOMMING LINES	SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: CIVIL WORKS AND EQUIPMENT FOUNDATIONS	ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G. CHECK BY: H.S. ACCOUNT:	SHEET NO.: 3 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT COST	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT
315kV circuit breaker foundations	3	un	165	495	46.00	7 590.00	22 770.00	165	495	8.60	1 419.00	4 257.00	4 400.00	13 200.00	13 409.00	40 227.00
315kV motorised disconnect foundations	4	un	100	400	46.00	4 600.00	18 400.00	100	400	8.60	860.00	3 440.00	5 100.00	20 400.00	10 560.00	42 240.00
315kV manual disconnect foundations	4	un	100	400	46.00	4 600.00	18 400.00	100	400	8.60	860.00	3 440.00	5 100.00	20 400.00	10 560.00	42 240.00
120/25kV power transformer foundations	2	un	775	1550	46.00	35 650.00	71 300.00	775	1550	8.60	6 665.00	13 330.00	20 000.00	40 000.00	62 315.00	124 630.00
315kV potential transformer foundations	4	un	35	140	46.00	1 610.00	6 440.00	35	140	8.60	301.00	1 204.00	1 500.00	6 000.00	3 411.00	13 644.00
315kV current transformer foundations	18	un	35	630	46.00	1 610.00	28 980.00	35	630	8.60	301.00	5 418.00	1 400.00	25 200.00	3 311.00	59 598.00
315kV station post insulator foundations	12	un	40	480	46.00	1 840.00	22 080.00	40	480	8.60	344.00	4 128.00	1 800.00	21 600.00	3 984.00	47 808.00
315kV incomming line structure foundations	2	un	160	320	46.00	7 360.00	14 720.00	160	320	8.60	1 376.00	2 752.00	10 700.00	21 400.00	19 436.00	38 872.00
25kV switchgear foundation	1	un	300	300	46.00	13 800.00	13 800.00	300	300	8.60	2 580.00	2 580.00	7 200.00	7 200.00	23 580.00	23 580.00
Oil recuperator and accessories	1	un	280	280	46.00	12 880.00	12 880.00	280	280	8.60	2 408.00	2 408.00	15 000.00	15 000.00	30 288.00	30 288.00
Site preparation and transport	6400	m3	0.01	64	46.00	0.46	2 944.00	0.01	64	130.00	1.30	8 320.00	N/A		1.76	11 264.00
Fences and gates	400	m	0.8	320	46.00	36.80	14 720.00	0.8	320	8.60	6.88	2 752.00	30.00	12 000.00	73.68	29 472.00
Control bulding 15' x 40'	1	un	600	600	46.00	27 600.00	27 600.00	600	600	8.60	5 160.00	5 160.00	25 000.00	25 000.00	57 760.00	57 760.00
Grounding loop and shieldwire	6400	m2	0.25	1600	50.00	12.50	80 000.00	0.25	1600	10.00	2.50	16 000.00	10.60	67 840.00	25.60	163 840.00
Substation gravel topping (500mm)	6400	m2	0.04	256	40.00	1.60	10 240.00	0.04	256	8.60	0.34	2 201.60	9.65	61 760	11.59	74 201.60
Cable trenching and manholes	180	m	1.5	270	46.00	69.00	12 420.00	1.5	270	8.60	12.90	2 322.00	250.00	45 000.00	331.90	59 742.00
Misc. (civil works, etc...) 10%	1	l.s.	811	811	50.00	40 550.00	40 550.00	811	811	10.00	8 110.00	8 110.00	40 200.00	40 200.00	88 860.00	88 860.00
Sub-Total				**8916**			**$418 244**		**8916**			**$87 823**		**$442 200**		$948 267
Total				**16858**			**$815 344**		**16858**			**$221 523**		**$5 422 670**		$6 513 437

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 315kV SUBSTATION - 2 INCOMMING LINES			SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: 315kV - ELECTRICAL EQUIPMENT			ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S.	ACCOUNT:	SHEET NO.: 1 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT cost	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT cost	AMOUNT	UNIT cost	AMOUNT	UNIT cost	AMOUNT
315kV Disconnect, 3ph., 1200A,c/w grnd.sw.	2	un	200	400	50.00	10 000.00	20 000.00	200	400	10.00	2 000.00	4 000.00	61 500.00	123 000.00	73 500.00	147 000.00
315kV current transf., 1ph., 2 windings	6	un	UTILI					UTILI					UTILITY			
315kV potential transf., 1ph., 120/120V	2	un	UTILI					UTILI					UTILITY			
315kV current transf., 1ph., 3 windings	6	un	55	330	50.00	2 750.00	16 500.00	55	330	10.00	550.00	3 300.00	45 000.00	270 000.00	48 300.00	289 800.00
315kV potential transf., 1ph., 120/120V	2	un	60	120	50.00	3 000.00	6 000.00	60	120	10.00	600.00	1 200.00	22 000.00	44 000.00	25 600.00	51 200.00
315kV circuit breaker, 3ph., 1200A SF6	3	un	450	1350	50.00	22 500.00	67 500.00	450	1350	10.00	4 500.00	13 500.00	310 000	930 000.00	337 000.00	1 011 000
315kV disconnect, 3ph., 1200A, manual	2	un	165	330	50.00	8 250.00	16 500.00	165	330	10.00	1 650.00	3 300.00	52 000.00	104 000.00	61 900.00	123 800.00
315kV disconnect, 2ph., 1200A, motorised	2	un	120	240	50.00	6 000.00	12 000.00	120	240	10.00	1 200.00	2 400.00	48 000.00	96 000.00	55 200.00	110 400.00
315kV station post insulators, 1ph.	12	un	20	240	50.00	1 000.00	12 000.00	20	240	10.00	200.00	2 400.00	1 900.00	22 800.00	3 100.00	37 200.00
25kV disconnect, 2ph., 2000A motorised	2	un	60	120	50.00	3 000.00	6 000.00	60	120	10.00	600.00	1 200.00	14 300.00	28 600.00	17 900.00	35 800.00
Flexible bus work 1250kcm ACSR	250	m	0.8	200	50.00	40.00	10 000.00	0.8	200	10.00	8.00	2 000.00	10.00	2 500.00	58.00	14 500.00
Tubular rigid aluminum bus work 75mm dia.	300	m	1	300	50.00	50.00	15 000	1	300	10.00	10.00	3 000.00	95.00	28 500.00	155.00	46 500.00
315 / 25kV Transformer, 2ph., 30MVA	2	un	1450	2900	50.00	72 500.00	145 000.00	1450	2900	25.00	36 250	72 500.00	870 000	1 740 000	978 750.00	1 957 500
4-current transf. 315kV, bushing type																
4-current transf. 25kV, bushing type																
2-lightning arresters 315kV, 1 ph.,																
2-lightning arresters 25kV, 1 ph.,																
Line protection panel	2	un	75	150	50.00	3 750.00	7 500.00	75	150	10.00	750.00	1 500.00	90 000.00	180 000.00	94 500.00	189 000.00
Circuit breaker control panel	3	un	60	180	50.00	3 000.00	9 000.00	60	180	10.00	600.00	1 800.00	40 000.00	120 000.00	43 600.00	130 800.00
Transformer control panel	2	un	30	60	50.00	1 500.00	3 000.00	30	60	10.00	300.00	600.00	15 000.00	30 000.00	16 800.00	33 600.00
Power and control cabling	1	l.s.	300	300	50.00	15 000.00	15 000.00	300	300	10.00	3 000.00	3 000.00	15 000.00	15 000.00	33 000.00	33 000.00
Misc. (brackets, supports, etc...) 10%	1	l.s.	722	722	50.00	36 100.00	36 100.00	722	722	10.00	7 220.00	7 220.00	373 440	373 440.00	416 760.00	416 760.00
Sub-Total				**7942**			**397 100**		**7942**			**122 920**		**$4 107 840**		**$4 627 860**
Total																

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 230kV SUBSTATION - 2 INCOMMING LINES	SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: 25kV MAIN SUBSTATION - 1 x 25kV	ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G. CHECK BY: H.S. ACCOUNT:	SHEET NO.: 2 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT cost	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT cost	AMOUNT	UNIT cost	AMOUNT	UNIT cost	AMOUNT
25kV metalclad switchgear including:	1	un	200	200	50.00	10 000.00	10 000.00	200	200	10.00	2 000.00	2 000.00	27 000.00	27 000.00	39 000.00	39 000.00
(rated 46kV)																
-circuit breaker, 1poles, 1200A c/w CT's	5	un	incl.					incl.					36 000.00	180 000.00	36 000.00	180 000.00
-circuit breaker, 2poles, 1200A c/w CT's	N/A	un	incl.					incl.					40 000.00			
-motorised disconnect, 1pole, 1200A	2	un	incl.					incl.					16 000.00	32 000.00	16 000.00	32 000.00
-motorised disconnect, 2poles, 1200A	N/A	un	incl.					incl.					20 000.00			
-manual disconnect, 1pole, 1200A	12	un	incl.					incl.					12 000.00	144 000.00	12 000.00	144 000.00
-manual disconnect, 2poles, 1200A	N/A	un	incl.					incl.					15 000.00			
-potential transformer, 1ph., 25kV:120V	6	un	incl.					incl.					4 500.00	27 000.00	4 500.00	27 000.00
-outdoor bushing, 1pole	6	un	incl.					incl.					3 500.00	21 000.00	3 500.00	21 000.00
-bus work, 1pole, 1200A (per cell)	19	un	incl.					incl.					3 000.00	57 000.00	3 000.00	57 000.00
-bus work, 2poles, 1200A (per cell)	N/A	un	incl.					incl.					5 000.00			
-neutral bus and links, 1pole, 1200A	7	un	incl.					incl.					1 500.00	10 500.00	1 500.00	10 500.00
Section break:																
25kV mot. disc. 1pole, 1200A outdoor	N/A	un	40		50.00			40		10.00			6 500.00			
25kV mot. disc. 2poles, 1200A outdoor	N/A	un	50		50.00			50		10.00			8 500.00			
Structures & insulators	N/A	un	40		50.00			40		10.00			1 500.00			
Bus work 25kV	N/A	l.s.	60		50.00			60		10.00			2 500.00			
Catenary section break (see ITEM #2)																
25kV/240-120V, 1ph., transformer 50kVA	2	un	50	100	50.00	2 500.00	5 000.00	50	100	10.00	500.00	1 000.00	20 000.00	40 000.00	23 000.00	46 000.00
Distribution panel 120/240V 1ph. 24cct	1	un	15	15	50.00	750.00	750.00	15	15	10.00	150.00	150.00	1 500.00	1 500.00	2 400.00	2 400.00
Transformer 240V/240-120V 1ph. 5 kVA	1	un	10	10	50.00	500.00	500.00	10	10	10.00	100.00	100.00	1 800.00	1 800	2 400.00	2 400.00
129V c.c.System (UPS) 12.5kVA	1	un	30	30	50.00	1 500.00	1 500.00	30	30	10.00	300.00	300.00	15 000.00	15 000.00	16 800.00	16 800.00
Control and relays panels	1	l.s.	85	85	50.00	4 250.00	4 250.00	85	85	10.00	850.00	850.00	30 000.00	30 000.00	35 100.00	35 100.00
Power and control cabling	1	l.s.	100	100	50.00	5 000.00	5 000	100	100	10.00	1 000.00	1 000.00	3 000.00	3 000.00	9 000.00	9 000.00
Misc (electrical works) 10%	1	lot	54	54	50.00	2 700.00	2 700.00	54	54	10.00	540.00	540.00	58 980.00	58 980.00	62 220.00	62 220.00
Sous-Total				**594**			**29 700**		**594**			**5 940**		**$648 780**		$684 420
Total																

WINDSOR - QUEBEC HIGH SPEED RAIL PROJECT

CLIENT: CANARAIL CONSULTANTS	TITLE: 315kV SUBSTATION - 2 INCOMMING LINES			SHAWINIGAN NO: 005556
PROJECT: HIGH SPEED TRAIN STUDY	DESCRIPTION: CIVIL WORKS AND EQUIPMENT FOUNDATIONS			ESTIMATION DATE: APRIL 1993
LOCATION: ONTARIO - QUEBEC	MADE BY: R.G.	CHECK BY: H.S.	ACCOUNT:	SHEET NO.: 3 OF 3

DESCRIPTION	QTY	U	LABOR					EQUIPMENT					MATERIAL		TOTAL	
			UNIT MH	TOTAL MH	MH RATE	UNIT COST	AMOUNT	UNIT EH	TOTAL EH	EH RATE	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT
315kV circuit breaker foundations	3	un	165	495	46.00	7 590.00	22 770.00	165	495	8.60	1 419.00	4 257.00	4 400.00	13 200.00	13 409.00	40 227.00
315kV motorised disconnect foundations	4	un	100	400	46.00	4 600.00	18 400.00	100	400	8.60	860.00	3 440.00	5 100.00	20 400.00	10 560.00	42 240.00
315kV manual disconnect foundations	4	un	100	400	46.00	4 600.00	18 400.00	100	400	8.60	860.00	3 440.00	5 100.00	20 400.00	10 560.00	42 240.00
120/25kV power transformer foundations	2	un	775	1550	46.00	35 650.00	71 300.00	775	1550	8.60	6 665.00	13 330.00	20 000.00	40 000.00	62 315.00	124 630.00
315kV potential transformer foundations	4	un	35	140	46.00	1 610.00	6 440.00	35	140	8.60	301.00	1 204.00	1 500.00	6 000.00	3 411.00	13 644.00
315kV current transformer foundations	18	un	35	630	46.00	1 610.00	28 980.00	35	630	8.60	301.00	5 418.00	1 400.00	25 200.00	3 311.00	59 598.00
315kV station post insulator foundations	12	un	40	480	46.00	1 840.00	22 080.00	40	480	8.60	344.00	4 128.00	1 800.00	21 600.00	3 984.00	47 808.00
315kV incomming line structure foundations	2	un	160	320	46.00	7 360.00	14 720.00	160	320	8.60	1 376.00	2 752.00	10 700.00	21 400.00	19 436.00	38 872.00
25kV switchgear foundation	1	un	300	300	46.00	13 800.00	13 800.00	300	300	8.60	2 580.00	2 580.00	7 200.00	7 200.00	23 580.00	23 580.00
Oil recuperator and accessories	1	un	280	280	46.00	12 880.00	12 880.00	280	280	8.60	2 408.00	2 408.00	15 000.00	15 000.00	30 288.00	30 288.00
Site preparation and transport	6400	m3	0.01	64	46.00	0.46	2 944.00	0.01	64	130.00	1.30	8 320.00	N/A		1.76	11 264.00
Fences and gates	400	m	0.8	320	46.00	36.80	14 720.00	0.8	320	8.60	6.88	2 752.00	30.00	12 000.00	73.68	29 472.00
Control bulding 15' x 40'	1	un	600	600	46.00	27 600.00	27 600.00	600	600	8.60	5 160.00	5 160.00	25 000.00	25 000.00	57 760.00	57 760.00
Grounding loop and shieldwire	6400	m2	0.25	1600	50.00	12.50	80 000.00	0.25	1600	10.00	2.50	16 000.00	10.60	67 840.00	25.60	163 840.00
Substation gravel topping (500mm)	6400	m2	0.04	256	40.00	1.60	10 240.00	0.04	256	8.60	0.34	2 201.60	9.65	61 760	11.59	74 201.60
Cable trenching and manholes	180	m	1.5	270	46.00	69.00	12 420.00	1.5	270	8.60	12.90	2 322.00	250.00	45 000.00	331.90	59 742.00
Misc. (civil works, etc...) 10%	1	l.s.	811	811	50.00	40 550.00	40 550.00	811	811	10.00	8 110.00	8 110.00	40 200.00	40 200.00	88 860.00	88 860.00
Sub-Total				**8916**			**$418 244**		**8916**			**$87 823**		**$442 200**		$948 267
Total				**16858**			**$815 344**		**16858**			**$216 683**		**$5 198 820**		$6 260 547

Date: 93.10.28 | Page: 1 of 1

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☑ 300+ kph - new R/W
- ☑ 300+ kph - exist. R/W
- ☑ 200+ kph - exist. R/W

Sub-system: 4 - ELECTRIFICATION
Sector: 4 - CONSTR/INSTALL.
Item: 5 - _____

Geographical Variation ? ☑ no ☐ yes If yes, indicate segments applicable: _____

ELECTROMAGNETIC INDUCTION MITIGATION

Recent work on conventional and TGV Rail lines in France, for a 2 * 25 kV supply system, has varied in cost from 6,000 - 60,000 FrF per kilometre, depending on degree of urbanization.

Taking into account the predominance of rural trackage, a cost of

22,500 FrF/km * 1 $Cdn/4.5 FrF = 5,000 /km

to mitigate the effects of electromagnetic induction is retained.

Prepared by:

continued ☐

Date:		Page: 1 of 5

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☐ 300+ kph - new R/W
- ☐ 300+ kph - exist. R/W
- ☐ 200+ kph - exist. R/W

Sub-system: H - STATIONS
Sector: 4 - CONSTR./INSTALLATION
Item: 1 -

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

A) LINE STATIONS AT INTERMEDIATE CENTRES

i) Stations in this category:

a) London
b) Kitchener - Waterloo (new ROW only)
c) Hamilton - Burlington (ex ROW only)
d) Pickering - Whitby (ex ROW only)
e) Hwy 407/Markham E. (new ROW only)
f) Kingston
g) Ottawa - Merivale
h) Laval
i) Trois - Riviere
j) Ancienne - Lorette

ii) Primary components:

a) Property
b) Station Bldg.
c) Access Roads
d) Grading & Drainage
e) Parking Area/Bus Bays/Kiss & Ride
f) Platforms and canopies
g) Vertical circulation (Escalators/elevators)
h) Pedestrian Tunnels
i) Fencing

Prepared by:	continued ☑

Date:		Page: 2 of 5

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: H - STATIONS Sector: 4 - CONSTR/INSTALLATION Item: 1 -

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable: _____

iii) Development of unit costs for Line Stations

Item	Est. Cost
a) Property	
Area assumed: 200 metres x 100 metres = 2ha	
Land costs are included in sub-system A	-
b) Station Bldg.	
Passenger concourse containing:	
• Ticketing	
• Waiting Areas	
• Washrooms	
• Service Rooms	
• Concessions	
• Circulation	
Area assumed for above elements = 1,000m^2	
Based on GO Transit stat. costs, allow \$2,600/m^2	\$2,600,000
c) Access Roads	
Allow 200 m of 2 lane road to access parking/kiss & ride/bus bays etc	
Cost at \$400/m	\$80,000
d) Drainage	
• Allowance for storm sewers, sub-drains, surface ditches, manholes, catchbasins.	\$400,000

Prepared by:	continued ☑

Date:		Page: 3 of 5

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	Sub-system: H - STATIONS
☐ 300+ kph - new R/W	Sector: 4 - CONSTR./INSTALLATION
☐ 300+ kph - exist. R/W	Item: 1 -
☐ 200+ kph - exist. R/W	

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:

• Assume general site and station track grading earthworks	
averaging 1 metre over area required.	
i.e. (200 x 100) + (1,000 x 2 x 8) = 20,000 + 16,000 @ $5/m^3	$180,000
e) Parking/Bus pays	
• Assume 250 spaces at $1,600 ea.	$400,000
• Assume 6-bay bus terminal/loop	$100,000
• Kiss & Ride area (Approx. 30 spaces) + circ.lanes	$ 70,000
f) Platforms & Canopies/Shelters	
As per CIGGT Fax 13/4/93:	
2 single sided platforms required: - 400 m long (+300)	
- 300 m long (200 - 250)	
400 m platforms : 2 @ $160,000	$320,000
Canopies/Shelters : Allowance	$200,000
g) Vertical Circulation	
Escalators : 2 at $350,000 (mechanical and structures)	$700,000
Elevators : 2 at $150,000 (mechanical and structures)	$300,000
h) Pedestrian Tunnels	
Structure and finishes to provide access from concourse	
to platforms (under or over 4 tracks)	$600,000

Prepared by:

continued ☑

Date:		Page: 4 of 5

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: H - STATIONS Sector: 4 - CONSTR./INSTALLATION Item: 1 -

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable: _____

i) Fencing	
Assume 500 m @ $20/m	$10,000
j) Miscellaneous items (allow 10%)	540,000
TOTAL STATION COST (All components)	$6,500,000

Prepared by:

continued ☑

Date:		Page: 5 of 5

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:	☐ 300+ kph - new R/W ☐ 300+ kph - exist. R/W ☐ 200+ kph - exist. R/W	Sub-system: H - STATIONS Sector: 4 - CONSTR./INSTALLATION Item: 1 -

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

B) TERMINAL STATION AT WINDSOR

i) Primary components assumed to be as for Line Stations with additions as follows:

a) 2 side platforms replaced by 3 island platforms between 4 tracks i.e. equivalent to 4 side platforms.

b) Vert. Circulation:

Escalators - 2 for 3rd platform

Elevators - 1 for 3rd platform

c) Pedestrian Tunnels:

Additional stair/escalator structure for 3rd platform length as for Line Stations.

d) Station Bldg:

Assume 20% increase in Bldg. area.

ii) Summary of Unit Cost Components

a) Line station total cost	$ 6,500,000
b) Addition for platforms	$ 320,000
c) Allowance for additional canopies/shelters	$ 120,000
d) Vert. Circ.	$ 850,000
e) Pedestrian Tunnels	$ 20,000
f) Add for larger station bldg.	$ 260,000
g) Additional misc. items	$ 130,000
TOTAL STATION COST (All components)	$ 8,200,000

Prepared by:

continued ☐

Date:		Page: __ of __

QUEBEC-ONTARIO HIGH SPEED RAIL PROJECT

UNIT COSTS FOR PRELIMINARY ROUTING

Technology:
- ☐ 300+ kph - new R/W
- ☐ 300+ kph - exist. R/W
- ☐ 200+ kph - exist. R/W

Sub-system: H - STATIONS
Sector: 4 - CONSTR./INSTALLATION
Item: 1 -

Geographical Variation ? ☐ no ☐ yes If yes, indicate segments applicable:_____

C) MODIFICATIONS AT UNION STATION

i) Reconstruction of platform access tunnel and vertical circulation to platforms

Area of tunnel to be reconstructed = 2000m²

Total cost including new finishes = 2000 x 1250	=	$2,500,000
Assume 5 new elevators at $100,000 each	=	$ 500,000
Assume 5 x 2 new escalators at $225,000 each	=	$2,250,000
Total access modification direct cost	=	$5,250,000
Allowance for O/H and profit (15%)	=	$ 750,000
Total access modification cost		$6,000,000

ii)	Upgrading and alternations to Main Concourse area	allow	$5,000,000
iii)	Modification and upgrading of train services area	allow	$2,000,000
iv)	Expansion of parking structure 100 bays at $10,000		$1,000,000
v)	Modification to five HSR platforms 5 x 1,200,000		$6,000,000
	Total order-of-magnitude cost		$20,000,000

Prepared by:

continued ☐

APPENDIX - C

DETAILED ESTIMATES

WINDSOR-TORONTO

WINDSOR-TORONTO

C1. 200+ km/hr - EXISTING RIGHTS-OF-WAY

Segment Summary Cost Table

Segment Detailed Cost Report

Table 4.4

SUBSYSTEM/SECTOR COST SUMMARY

WINDSOR – TORONTO CORRIDOR 200+, TILTING

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$24,493,603	$255,141,700	N/A	N/A	see note c	$279,635,303	$27,276,967
B – Earthworks and Drainage	$72,494,731	N/A	N/A	$306,325,270	see note c	$378,820,001	$39,955,470
C – Bridges, Viaducts, and Tunnels	$50,461,961	N/A	N/A	$306,442,950	see note c	$356,904,911	$27,858,450
D – Grade Separations	$47,394,727	N/A	N/A	$287,816,400	see note c	$335,211,127	$47,969,400
E – Other Accom–modation works	$10,992,170	see note a	see note a	$66,752,719	see note c	$77,744,890	$15,404,474
F – Track	$39,292,144	$217,507,098	see note b	$52,742,498	see note c	$309,541,741	$13,342,905
G – Electrification	$37,730,822	see note a	see note a	$229,129,910	see note c	$266,860,732	$29,886,510
H – Stations	$3,568,399	see note a	see note a	$21,670,000	see note c	$25,238,399	$1,970,000
Totals	$286,428,558	$472,648,798	$0	$1,270,879,748	see note c	$2,029,957,104	$203,664,176

NOTES: a) included in Construction / Installation
b) included in Equipment / Material
c) included in Other Studies

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WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology: 200+, TILTING — 360.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM A – RIGHT–OF–WAY ACQUISITION					
	WINDSOR – TORONTO CORRIDOR 200+, TILTING					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Professional Services					
1 1.1	– Surveying	%	$255,141,700	8.0%	20,411,336	As a % of total cost of Sector 2
1 1.2	– Appraisal	%	$255,141,700	0%	0	included in Item 1.1
1 1.3	– Legal Expertise	%	$255,141,700	0%	0	included in Item 1.1
1 Item 2	Project Management	%	$275,553,036	0%	0	As % of Sector 2 total + item 1.1
1 Item X	Contingencies	%	$20,411,336	20%	4,082,267	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$24,493,603	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2 Item 1	Urban Land					
2 1.1	– Residential	lump sum			53,490,000	unit cost not applicable
2 1.2	– Commercial	lump sum			7,600,000	unit cost not applicable
2 1.3	– Industrial	lump sum			105,520,000	unit cost not applicable
2 Item 2	Rural Land					
2 2.1	– Agricultural	lump sum			20,729,000	unit cost not applicable
2 2.2	– Natural	lump sum			0	unit cost not applicable
2 Item 3	Purchase of Existing Rail ROW					
2 3.1	– CN	lump sum			13,245,000	unit cost not applicable
2 3.2	– CP	lump sum			31,363,000	unit cost not applicable
2 3.3	– VIA	lump sum			0	unit cost not applicable
2 Item X	Contingencies	%	$231,947,000	10%	23,194,700	
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$255,141,700	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Not Applicable				
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4		Not Applicable				
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$0	
5 SECTOR 5	START–UP					
5		Included in Other Studies				
5						
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology: 200+, TILTING — 360.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: B – EARTHWORKS AND DRAINAGE					
	WINDSOR – TORONTO CORRIDOR 200+, TILTING					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$306,325,270	5.5%	16,847,890	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$306,325,270	5.0%	15,316,264	As a % of total cost of Sector 2
1 Item 3	Environmental Assessment	%	$1,743,528,546	0.2%	3,487,057	Items 3 and 4 are %'s of entire
1 Item 4	Feasibility Studies (Technical)	%	$1,743,528,546	1.0%	17,435,285	project's cost less profes. fees
1 Item 5	Project Management	%	$359,411,766	5.4%	19,408,235	% of sector 2 total plus items 1–4
1 Item X	Contingencies	%	$72,494,731	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$72,494,731	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Clearing and Roadbed Preparation					
4 1.1	– Type 1 Soils	route–km	282.3	$142,000	40,086,600	
4 1.2	– Type 2 Soils	route–km	73.1	$627,000	45,833,700	
4 1.3	– Type 3 Soils	route–km	4.7	$1,035,000	4,864,500	
4 Item 2	Embankment Construction					
4 2.1	– Soft Excavated Material	1000 m^3	2937	$3,000	8,811,000	
4 2.2	– Hard Excavated Material (Rock)	1000 m^3	0	$0	0	
4 2.3	– Borrow Material	1000 m^3	677	$8,000	5,416,000	
4 2.4	– Disposal of Unsuitable Material	1000 m^3	4420	$5,500	24,310,000	
4 Item 3	Haulage of Fill Material (from Borrow or Excavation)	1000 m^3–	0	$0	0	Cost transferred to item B4–2
4 Item 4	Sub–Ballast Layers					For TM2–B0,TM2–D0,TM1–B0,
4 4.1	– New ROW	route–km	76.6	$180,178	13,801,600	TM1–D0,TM0–B0,TM0–B1,
4 4.2	– Existing ROW	route–km	283.4	$208,745	59,158,400	TM0–C0,and TM0–D0, $152,000
4 Item 5	Drainage Systems					used for cost of sub–ballast(it. 4)
4 5.1	– Normal ROW	route–km	351.2	$25,000	8,780,000	
4 5.2	– Major Watercourse Culverts	ea.	110	$35,000	3,850,000	
4 5.3	– Environment. Stormwater Controls	route–km	351.2	$7,000	2,458,400	
4 Item 6	Roadbed Upgrade on Existing ROW	route–km	13.3	$600,000	7,980,000	
4 Item 7	Retaining Structures					
4 7.1	– Up to 3 metres in Height	km.	0.3	$2,500,000	750,000	
4 7.2	– Over 3 metres in Height	km.	2	$5,000,000	10,000,000	
4 Item 8	Intrusion Barriers	km.	55.1	$0	0	Intrusion Barriers not required
4 Item 9	Noise Attenuation Structures					
4 9.1	– Barriers	km.	0	$0	0	
4 9.2	– Berms	km.	0	$0	0	
4 Item 10	ROW Security Fencing (on both sides)	route–km	351.2	$56,000	19,667,200	
4 Item 11	Snow Control Measures	km.	0	$0	0	Accounted for in Contingencies
4 Item 12	Utility Interferences					
4 12.1	– Major Hydro Relocation	ea.	15	$0	0	Accounted for in Contingencies
4 12.2	– Major Oil/Gas Relocation	ea.	4	$0	0	Accounted for in Contingencies
4 12.3	– Minor Pipe or Wire Crossings	route–km	355	$0	0	Accounted for in Contingencies
4 Item 13	Other Items					
4 13.1	– Audit for Contaminated Soil	route–km	351.2	$2,000	702,400	
4 13.2	– Audit for Contaminated Rail Yards	ea.	15	$500,000	7,500,000	
4 13.3	– Minor Wildlife Passages (Culverts)	ea.	24	$100,000	2,400,000	
4 Item X	Contingencies	%	$266,369,800	15%	39,955,470	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$306,325,270	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology: 200+, TILTING — 360.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM C – BRIDGES, VIADUCTS, AND TUNNELS					
	WINDSOR – TORONTO CORRIDOR 200+, TILTING					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$306,442,950	5.5%	16,854,362	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$306,442,950	5.0%	15,322,148	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$338,619,460	5.4%	18,285,451	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$50,461,961	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$50,461,961	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Bridges					
4 1.1	– Small Rivers (< 30 metres)	ea.	24	$340,000	8,160,000	
4 1.2	– Extra at 1.1 for Height Over 10 m.	ea.	0	$0	0	
4 1.3	– Interm. Rivers (30 – 100 metres)	lin. m.	1,055	$23,500	24,792,500	
4 1.4	– Extra at 1.3 for Height Over 10 m.	lin. m.	250	$6,000	1,500,000	
4 1.5	– Large Rivers (100 – 250 metres)	lin. m.	0	$0	0	
4 1.6	– Extra at 1.5 for Height Over 10 m.	lin. m.	0	$0	0	
4 1.7	– Major Rivers (over 250 m.)	lin. m.	0	$0	0	
4 1.8	– Extra for Difficult Foundation Cond.	lin. m.	0	$0	0	
4 1.9	– Modif. to Exist. Bridges (new deck)	lin. m.	14	$13,000	182,000	
4 Item 2	Viaducts					
4 2.1	– Viaducts over 250 metres in Length	lin. m.	4,200	$27,000	113,400,000	
4 2.2	– Extra for Height Over 10 metres	lin. m.	2,100	$8,000	16,800,000	
4 2.3	– Extra for Difficult Foundation Cond.	lin. m.	0	$0	0	
4 Item 3	Tunnels (Double Track)					
4 3.1	– In Soft Ground	lin. m.	0	$0	0	
4 3.2	– In Rock	lin. m.	3,250	$35,000	113,750,000	
4 3.3	– Modifications to Existing Tunnels	lump sum	0	$0	0	
4 3.4	– Noise Mitigation Measures	lump sum	0	$0	0	Accounted for in Contingencies
4 Item X	Contingencies	%	$278,584,500	10%	27,858,450	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$306,442,950	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology: 200+, TILTING — 360.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: D – GRADE SEPARATIONS					
	WINDSOR – TORONTO CORRIDOR 200+ TILTING					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$287,816,400	5.5%	15,829,902	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$287,816,400	5.0%	14,390,820	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$318,037,122	5.4%	17,174,005	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$47,394,727	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$47,394,727	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	New Grade Separations, Rural					
4 1.1	– 2 Lane Highways	ea.	19	$2,200,000	41,800,000	
4 1.2	– 2 Lane Highways, Dual ROW	ea.	0	$0	0	
4 1.3	– 4 Lane Highways	ea.	2	$3,100,000	6,200,000	
4 1.4	– 4 Lane Highways, Dual ROW	ea.	0	$0	0	
4 1.5	– Major Highways (401, 20, etc)	ea.	1	$4,450,000	4,450,000	
4 1.6	– Extra for Difficult Foundation Cond.	ea.	0	$0	0	
4 Item 2	New Grade Separations, Urban					
4 2.1	– Secondary Highways (2–4 lanes)	ea.	2	$4,068,000	8,136,000	
4 2.2	– Second. Hwys (2–4 l.) Dual ROW	ea.	14	$4,456,000	62,384,000	
4 2.3	– Major Highways (over 4 lanes)	ea.	0	$0	0	
4 2.4	– Extra for Difficult Foundation Cond.	ea.	0	$0	0	
4 Item 3	Modification of Exist. Grade Separations					
4 3.1	– Urban	ea.	57	$830,000	47,310,000	
4 3.2	– Rural	ea.	21	$627,000	13,167,000	
4 Item 4	Automatic Crossing Protection	ea.	148	$270,000	39,960,000	
4 Item 5	Closure and Diversion of Roads	km. of road	3.0	$280,000	840,000	
4 Item 6	Private Farm Crossings	ea.	52	$300,000	15,600,000	
4 Item 7	Major Wildlife Passages	ea.	0	$0	0	
4 Item X	Contingencies	%	$239,847,000	20%	47,969,400	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$287,816,400	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology: 200+, TILTING — 360.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	E – OTHER ACCOMODATION WORKS				
		WINDSOR – TORONTO CORRIDOR			200+, TILTING	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$66,752,719	5.5%	3,671,400	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$66,752,719	5.0%	3,337,636	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$73,761,755	5.4%	3,983,135	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$10,992,170	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$10,992,170	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2		Included in Construction / Installation				
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Construction / Installation				
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Removal of Rail Lines	km.	75.9	$21,134	1,604,071	
4 Item 2	Construction of New Access Tracks	km.	57.3	$644,750	36,944,175	
4 Item 3	Rail/Rail Grade Separation					
4 3.1	– Rural	ea.	16	$800,000	12,800,000	
4 3.2	– Urban	ea.	0	$0	0	
4 Item 4	Other Particular Items:					
4 4.1	– Sub–Item	lump sum	0		0	
4 4.2	– Sub–Item	lump sum	0		0	
4 4.3	– Sub–Item	lump sum	0		0	
4 4.4	– Sub–Item	lump sum	0		0	
4 Item X	Contingencies	%	$51,348,246	30%	15,404,474	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$66,752,719	
5 SECTOR 5	START–UP					
5		Included in Other Studies				
5						
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology:
200+, TILTING — 360.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM — F – TRACK					
	WINDSOR – TORONTO CORRIDOR — 200+, TILTING					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$270,249,597	3.5%	9,458,736	As % of total for Sectors 2 and 4
1 Item 2	Construction Supervision	%	$52,742,498	10.0%	5,274,250	As % of total for Sector 4
1 Item 3	Materials Procurement	%	$217,507,098	4.0%	8,700,284	As % of total for Sector 2
1 Item 4	Project Management	%	$293,682,867	5.4%	15,858,875	As % of Sectors 2,4 totals plus
1 Item X	Contingencies	%	$39,292,144	0%	0	items 1–3
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$39,292,144	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2 Item 1	Rail					
2 1.1	– Main Line	t.	88,140	$773	68,169,239	
2 1.2	– Siding	t.	1,640	$773	1,268,409	
2 Item 2	Ties	ea.	1,152,000	$45	51,598,080	
2 Item 3	Ballast	m^3	1,565,000	$21	33,444,050	
2 Item 4	Turnouts					
2 4.1	– High Speed	ea.	40	$280,000	11,200,000	
2 4.2	– Medium Speed	ea.	28	$135,000	3,780,000	
2 4.3	– Yard	ea.	0	$0	0	
2 Item 5	Other Track Material					
2 5.1	– Rail Fastening Assemblies	set	1,152,000	$27	30,528,000	
2 5.2	– Bonded Insulated Joints	ea.	0	$0	0	Included in Signalling costs
2 5.3	– Bumping Posts	ea.	7	$3,120	21,840	
2 Item 6	Switch Heaters/ Snow Blowers					
2 6.1	– Main Line	ea.	68	$105,000	7,140,000	
2 6.2	– Yard	ea.	0	$0	0	
2 Item 7	Ballast Mats for Noise Attenuation	m^2	0	$0	0	
2 Item X	Contingencies	%	$207,149,618	5%	10,357,481	
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$217,507,098	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Included in Equipment / Material					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Track Construction					
4 1.1	– Main Line	km.	720.0	$18,212	13,112,640	
4 1.2	– Siding	km.	13.2	$44,175	583,110	
4 Item 2	Field Welded Joints	ea.	4,590	$2,028	9,308,520	
4 Item 3	Turnout Construction					
4 3.1	– High and Med. Speed (Main Line)	ea.	68	$20,455	1,390,940	
4 3.2	– Yard	ea.	0	$0	0	
4 Item 4	Ballasting and Surfacing	m^3	1,565,000	$8.47	13,255,550	
4 Item 5	Rail Grinding	track – km	733.2	$4,545	3,332,394	
4 Item 6	Construction Bases	route–km	360.0	$24,372	8,773,920	
4 Item X	Contingencies	%	$49,757,074	6%	2,985,424	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$52,742,498	
5 SECTOR 5	START–UP					
5	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology: 200+, TILTING — 360.0 km. in length

ITEM NUMBER		ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
		SUBSYSTEM: G – ELECTRIFICATION					
		WINDSOR – TORONTO CORRIDOR 200+, TILTING					
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	$229,129,910	5.5%	12,602,145	As % of total for Sector 4
1	Item 2	Construction Supervision	%	$229,129,910	5.0%	11,456,496	As % of total for Sector 4
1	Item 3	Project Management	%	$253,188,551	5.4%	13,672,182	% of sector 4 total plus items 1–2
1	Item X	Contingencies	%	$37,730,822	0%	0	
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$37,730,822	
2	SECTOR 2	EQUIPMENT / MATERIALS					
2		Included in Construction / Installation					
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Construction / Installation					
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	Typical Catenary					
4	1.1	– Single Track – Independent Struct.	km.	0.0	$0	0	
4	1.2	– Double Track – Independ. Struct.	km.	360.0	$350,000	126,000,000	
4	1.3	– Double Track – Portal Structures	km.	0.0	$0	0	
4	1.4	– Triple Track – Portal Structures	km.	0.0	$0	0	
4	1.5	– Yard Catenary	100 m.	0	$0	0	
4	1.6	– Sidings Catenary	100 m.	40	$13,500	540,000	
4	1.7	– Garage Area Catenary	100 m.	0	$0	0	
4	1.8	– In–Station Catenary	100 m.	92	$17,500	1,610,000	
4	Item 2	Particular Catenary Installations					
4	2.1	– Xover Single (with section breaks)	ea.	22	$280,000	6,160,000	
4	2.2	– Xover Double (with section breaks)	ea.	6	$369,000	2,214,000	
4	2.3	– Phase Break	ea.	5	$1,052,000	5,260,000	
4	Item 3	Special Catenary Structures					
4	3.1	– Underbridge	100 m.	0	$0	0	
4	3.2	– Overbridge	100 m.	0	$0	0	
4	Item 4	Power Supply					
4	4.1	– Main Supply Station, 230 kV	ea.	3	$5,355,000	16,065,000	
4	4.2	– Main Supply Station, 138 – 120 kV	ea.	2	$4,075,000	8,150,000	
4	4.3	– Paralleling and Auto–transf. Stn	ea.	32	$730,000	23,360,000	
4	4.4	– 2x25 – 1x25 Interface Station	ea.	2	$925,000	1,850,000	
4	4.5	not used	ea.	0	$0	0	
4	4.6	– Main Supply Station, 315 kV	ea.	0	$0	0	
4	4.7	– 315 kV Supply Line	ea.	0	$0	0	
4	4.8	– 230 kV Supply Line	km.	30	$170,300	5,109,000	
4	4.9	– 120 kV Supply Line	km.	7	$132,200	925,400	
4	4.10	– Control Center	ea.	1	$200,000	200,000	
4	Item 5	EMI Mitigation Measures	route–km	360.0	$5,000	1,800,000	
4	Item X	Contingencies	%	$199,243,400	15%	29,886,510	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$229,129,910	
5	SECTOR 5	START–UP					
5		Included in Other Studies					
5							
5	SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology: 200+, TILTING — 360.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM H – STATIONS					
	WINDSOR – TORONTO CORRIDOR 200+, TILTING					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$21,670,000	5.5%	1,191,850	As a % of total for Sector 2
1 Item 2	Construction Supervision	%	$21,670,000	5.0%	1,083,500	As a % of total for Sector 2
1 Item 3	Project Management	%	$23,945,350	5.4%	1,293,049	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$3,568,399	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$3,568,399	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2	Included in Construction / Installation					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Included in Construction / Installation					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Individual Station (location, name)	lump sum		$19,700,000	19,700,000	
4 Item 2	Individual Station (location, name)	lump sum		$0	0	
4 Item 3	Individual Station (location, name)	lump sum		$0	0	
4 Item 4	Individual Station (location, name)	lump sum		$0	0	
4 Item X	Contingencies	%	$19,700,000	10%	1,970,000	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$21,670,000	
5 SECTOR 5	START–UP					
5	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

current costs on file

Windsor Toronto Corridor

200 Ex. ROW

segment	total cost
WT2–A0	$714,379,544
WT2–B0	$718,036,669
WT2–C0	$547,572,870
WT1–A0	$0
WT1–B0	$0
WT1–C0	$0
WT0–A0	$0
WT0–B0	$0
WT0–C0	$0
WT0–C1	$0
WTS–1	$16,135,838
WTS–2a	$0
WTS–2b	$20,706,614
WTS–3	$13,125,569
WTS–4	$0
WTS–5	$0
WTR–01	$0
WTR–02	$0

TOTAL $2,029,957,104

WINDSOR-TORONTO

C2. 300+ km/hr - EXISTING RIGHTS-OF-WAY

Segment Summary Cost Table

Segment Detailed Cost Report

Table 5.4

SUBSYSTEM/SECTOR COST SUMMARY

WINDSOR – TORONTO CORRIDOR **300+, EXISTING ROW**

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$28,263,101	$294,407,300	N/A	N/A	see note c	$322,670,401	$31,474,817
B – Earthworks and Drainage	$84,428,418	N/A	N/A	$352,880,950	see note c	$437,309,368	$46,027,950
C – Bridges, Viaducts, and Tunnels	$60,727,628	N/A	N/A	$368,783,800	see note c	$429,511,428	$33,525,800
D – Grade Separations	$77,273,958	N/A	N/A	$469,265,550	see note c	$546,539,508	$61,208,550
E – Other Accom–modation works	$11,084,670	see note a	see note a	$67,314,447	see note c	$78,399,118	$15,534,103
F – Track	$40,285,248	$224,663,613	see note b	$52,951,011	see note c	$317,899,872	$13,695,494
G – Electrification	$37,707,151	see note a	see note a	$228,986,160	see note c	$266,693,311	$29,867,760
H – Stations	$3,568,399	see note a	see note a	$21,670,000	see note c	$25,238,399	$1,970,000
Totals	$343,338,573	$519,070,913	$0	$1,561,851,919	see note c	$2,424,261,404	$233,304,474

NOTES: a) included in Construction / Installation
b) included in Equipment / Material
c) included in Other Studies

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WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology:
300+, EXISTING ROW — 365.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: A – RIGHT–OF–WAY ACQUISITION					
	WINDSOR – TORONTO CORRIDOR 300+, EXISTING ROW					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Professional Services					
1 1.1	– Surveying	%	$294,407,300	8.0%	23,552,584	As a % of total cost of Sector 2
1 1.2	– Appraisal	%	$294,407,300	0%	0	included in Item 1.1
1 1.3	– Legal Expertise	%	$294,407,300	0%	0	included in Item 1.1
1 Item 2	Project Management	%	$317,959,884	0%	0	As % of Sector 2 total + item 1.1
1 Item X	Contingencies	%	$23,552,584	20%	4,710,517	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$28,263,101	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2 Item 1	Urban Land					
2 1.1	– Residential	lump sum			57,690,000	unit cost not applicable
2 1.2	– Commercial	lump sum			7,600,000	unit cost not applicable
2 1.3	– Industrial	lump sum			116,020,000	unit cost not applicable
2 Item 2	Rural Land					
2 2.1	– Agricultural	lump sum			57,488,000	unit cost not applicable
2 2.2	– Natural	lump sum			0	unit cost not applicable
2 Item 3	Purchase of Existing Rail ROW					
2 3.1	– CN	lump sum			16,824,000	unit cost not applicable
2 3.2	– CP	lump sum			12,021,000	unit cost not applicable
2 3.3	– VIA	lump sum			0	unit cost not applicable
2 Item X	Contingencies	%	$267,643,000	10%	26,764,300	
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$294,407,300	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Not Applicable				
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4		Not Applicable				
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$0	
5 SECTOR 5	START–UP					
5		Included in Other Studies				
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology:
300+, EXISTING ROW — 365.0 km. in length

SUBSYSTEM: B – EARTHWORKS AND DRAINAGE

WINDSOR – TORONTO CORRIDOR — 300+, EXISTING ROW

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$352,880,950	5.5%	19,408,452	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$352,880,950	5.0%	17,644,048	As a % of total cost of Sector 2
1 Item 3	Environmental Assessment	%	$2,080,922,832	0.2%	4,161,846	Items 3 and 4 are %'s of entire
1 Item 4	Feasibility Studies (Technical)	%	$2,080,922,832	1.0%	20,809,228	project's cost less profes. fees
1 Item 5	Project Management	%	$414,904,524	5.4%	22,404,844	% of sector 2 total plus items 1–4
1 Item X	Contingencies	%	$84,428,418	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$84,428,418	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Clearing and Roadbed Preparation					
4 1.1	– Type 1 Soils	route–km	278	$142,000	39,476,000	
4 1.2	– Type 2 Soils	route–km	78.6	$627,000	49,282,200	
4 1.3	– Type 3 Soils	route–km	13.1	$1,035,000	13,558,500	
4 Item 2	Embankment Construction					
4 2.1	– Soft Excavated Material	1000 m^3	3500	$3,000	10,500,000	
4 2.2	– Hard Excavated Material (Rock)	1000 m^3	0	$0	0	
4 2.3	– Borrow Material	1000 m^3	3827	$8,000	30,616,000	
4 2.4	– Disposal of Unsuitable Material	1000 m^3	4987	$5,500	27,428,500	
4 Item 3	Haulage of Fill Material (from Borrow or Excavation)	1000 m^3–	0	$0	0	Cost transferred to item B4–2
4 Item 4	Sub–Ballast Layers					For TM2–B0,TM2–D0,TM1–B0,
4 4.1	– New ROW	route–km	124.9	$195,446	24,411,200	TM1–D0,TM0–B0,TM0–B1,
4 4.2	– Existing ROW	route–km	220.1	$206,764	45,508,800	TM0–C0,and TM0–D0, $152,000
4 Item 5	Drainage Systems					used for cost of sub–ballast(it. 4)
4 5.1	– Normal ROW	route–km	356.4	$25,000	8,910,000	
4 5.2	– Major Watercourse Culverts	ea.	123	$35,000	4,305,000	
4 5.3	– Environment. Stormwater Controls	route–km	356.4	$7,000	2,494,800	
4 Item 6	Roadbed Upgrade on Existing ROW	route–km	13.3	$600,000	7,980,000	
4 Item 7	Retaining Structures					
4 7.1	– Up to 3 metres in Height	km.	0.6	$2,500,000	1,500,000	
4 7.2	– Over 3 metres in Height	km.	2	$5,000,000	10,000,000	
4 Item 8	Intrusion Barriers	km.	42.8	$0	0	Intrusion Barriers not required
4 Item 9	Noise Attenuation Structures					
4 9.1	– Barriers	km.	0	$0	0	
4 9.2	– Berms	km.	0	$0	0	
4 Item 10	ROW Security Fencing (on both sides)	route–km	356.4	$56,000	19,958,400	
4 Item 11	Snow Control Measures	km.	0	$0	0	Accounted for in Contingencies
4 Item 12	Utility Interferences					
4 12.1	– Major Hydro Relocation	ea.	21	$0	0	Accounted for in Contingencies
4 12.2	– Major Oil/Gas Relocation	ea.	5	$0	0	Accounted for in Contingencies
4 12.3	– Minor Pipe or Wire Crossings	route–km	359.6	$0	0	Accounted for in Contingencies
4 Item 13	Other Items					
4 13.1	– Audit for Contaminated Soil	route–km	361.8	$2,000	723,600	
4 13.2	– Audit for Contaminated Rail Yards	ea.	15	$500,000	7,500,000	
4 13.3	– Minor Wildlife Passages (Culverts)	ea.	27	$100,000	2,700,000	
4 Item X	Contingencies	%	$306,853,000	15%	46,027,950	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$352,880,950	
5 SECTOR 5	START–UP					
5	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology: 300+, EXISTING ROW — 365.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: C – BRIDGES, VIADUCTS, AND TUNNELS					
	WINDSOR – TORONTO CORRIDOR 300+, EXISTING ROW					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$368,783,800	5.5%	20,283,109	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$368,783,800	5.0%	18,439,190	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$407,506,099	5.4%	22,005,329	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$60,727,628	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$60,727,628	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Bridges					
4 1.1	– Small Rivers (< 30 metres)	ea.	24	$340,000	8,160,000	
4 1.2	– Extra at 1.1 for Height Over 10 m.	ea.	0	$0	0	
4 1.3	– Interm. Rivers (30 – 100 metres)	lin. m.	1,180	$23,500	27,730,000	
4 1.4	– Extra at 1.3 for Height Over 10 m.	lin. m.	300	$6,000	1,800,000	
4 1.5	– Large Rivers (100 – 250 metres)	lin. m.	100	$42,000	4,200,000	
4 1.6	– Extra at 1.5 for Height Over 10 m.	lin. m.	50	$10,500	525,000	
4 1.7	– Major Rivers (over 250 m.)	lin. m.	0	$0	0	
4 1.8	– Extra for Difficult Foundation Cond.	lin. m.	0	$0	0	
4 1.9	– Modif. to Exist. Bridges (new deck)	lin. m.	11	$13,000	143,000	
4 Item 2	Viaducts					
4 2.1	– Viaducts over 250 metres in Length	lin. m.	4,200	$27,000	113,400,000	
4 2.2	– Extra for Height Over 10 metres	lin. m.	2,100	$8,000	16,800,000	
4 2.3	– Extra for Difficult Foundation Cond.	lin. m.	0	$0	0	
4 Item 3	Tunnels (Double Track)					
4 3.1	– In Soft Ground	lin. m.	0	$0	0	For 300+ technology, Rock Tunnels speed restricted by local conditions are $35,000/lin m. Accounted for in Contingencies
4 3.2	– In Rock	lin. m.	3,250	$50,000	162,500,000	
4 3.3	– Modifications to Existing Tunnels	lump sum	0	$0	0	
4 3.4	– Noise Mitigation Measures	lump sum	0	$0	0	
4 Item X	Contingencies	%	$335,258,000	10%	33,525,800	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$368,783,800	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology:
300+, EXISTING ROW — 365.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	**D – GRADE SEPARATIONS**				
		WINDSOR – TORONTO CORRIDOR			300+, EXISTING ROW	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$469,265,550	5.5%	25,809,605	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$469,265,550	5.0%	23,463,278	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$518,538,433	5.4%	28,001,075	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$77,273,958	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$77,273,958	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	New Grade Separations, Rural					
4 1.1	– 2 Lane Highways	ea.	91	$2,200,000	200,200,000	
4 1.2	– 2 Lane Highways, Dual ROW	ea.	11	$2,800,000	30,800,000	
4 1.3	– 4 Lane Highways	ea.	3	$3,100,000	9,300,000	
4 1.4	– 4 Lane Highways, Dual ROW	ea.	0	$0	0	
4 1.5	– Major Highways (401, 20, etc)	ea.	5	$4,450,000	22,250,000	
4 1.6	– Extra for Difficult Foundation Cond.	ea.	4	$180,000	720,000	
4 Item 2	New Grade Separations, Urban					
4 2.1	– Secondary Highways (2–4 lanes)	ea.	3	$4,068,000	12,204,000	
4 2.2	– Second. Hwys (2–4 l.) Dual ROW	ea.	13	$4,456,000	57,928,000	
4 2.3	– Major Highways (over 4 lanes)	ea.	0	$0	0	
4 2.4	– Extra for Difficult Foundation Cond.	ea.	0	$0	0	
4 Item 3	Modification of Exist. Grade Separations					
4 3.1	– Urban	ea.	46	$830,000	38,180,000	
4 3.2	– Rural	ea.	13	$627,000	8,151,000	
4 Item 4	Automatic Crossing Protection	ea.	0	$0	0	
4 Item 5	Closure and Diversion of Roads	km. of road	28.3	$280,000	7,924,000	
4 Item 6	Private Farm Crossings	ea.	68	$300,000	20,400,000	
4 Item 7	Major Wildlife Passages	ea.	0	$0	0	
4 Item X	Contingencies	%	$408,057,000	15%	61,208,550	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$469,265,550	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology:

300+, EXISTING ROW — 365.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: E – OTHER ACCOMODATION WORKS					
	WINDSOR – TORONTO CORRIDOR		300+, EXISTING ROW			
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$67,314,447	5.5%	3,702,295	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$67,314,447	5.0%	3,365,722	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$74,382,464	5.4%	4,016,653	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$11,084,670	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$11,084,670	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2	Included in Construction / Installation					
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Included in Construction / Installation					
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Removal of Rail Lines	km.	43.8	$21,134	925,669	
4 Item 2	Construction of New Access Tracks	km.	55.3	$644,750	35,654,675	
4 Item 3	Rail/Rail Grade Separation					
4 3.1	– Rural	ea.	19	$800,000	15,200,000	
4 3.2	– Urban	ea.	0	$0	0	
4 Item 4	Other Particular Items:					
4 4.1	– Sub–Item	lump sum	0		0	
4 4.2	– Sub–Item	lump sum	0		0	
4 4.3	– Sub–Item	lump sum	0		0	
4 4.4	– Sub–Item	lump sum	0		0	
4 Item X	Contingencies	%	$51,780,344	30%	15,534,103	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$67,314,447	
5 SECTOR 5	START–UP					
5	Included in Other Studies					
5						
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology:
300+, EXISTING ROW — 365.0 km. in length

SUBSYSTEM — F – TRACK

WINDSOR – TORONTO CORRIDOR — 300+, EXISTING ROW

	ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	$277,614,624	3.5%	9,716,512	As % of total for Sectors 2 and 4
1	Item 2	Construction Supervision	%	$52,951,011	10.0%	5,295,101	As % of total for Sector 4
1	Item 3	Materials Procurement	%	$224,663,613	4.0%	8,986,545	As % of total for Sector 2
1	Item 4	Project Management	%	$301,612,782	5.4%	16,287,090	As % of Sectors 2,4 totals plus
1	Item X	Contingencies	%	$40,285,248	0%	0	items 1–3
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$40,285,248	
2	SECTOR 2	EQUIPMENT / MATERIALS					
2	Item 1	Rail					
2	1.1	– Main Line	t.	89,370	$773	69,120,545	
2	1.2	– Siding	t.	1,520	$773	1,175,598	
2	Item 2	Ties	ea.	1,261,800	$45	56,516,022	
2	Item 3	Ballast	m^3	1,572,000	$21	33,593,640	
2	Item 4	Turnouts					
2	4.1	– High Speed	ea.	36	$280,000	10,080,000	
2	4.2	– Medium Speed	ea.	26	$135,000	3,510,000	
2	4.3	– Yard	ea.	0	$0	0	
2	Item 5	Other Track Material					
2	5.1	– Rail Fastening Assemblies	set	1,261,800	$27	33,437,700	
2	5.2	– Bonded Insulated Joints	ea.	0	$0	0	Included in Signalling costs
2	5.3	– Bumping Posts	ea.	7	$3,120	21,840	
2	Item 6	Switch Heaters/ Snow Blowers					
2	6.1	– Main Line	ea.	62	$105,000	6,510,000	
2	6.2	– Yard	ea.	0	$0	0	
2	Item 7	Ballast Mats for Noise Attenuation	m^2	0	$0	0	
2	Item X	Contingencies	%	$213,965,346	5%	10,698,267	
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$224,663,613	
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Equipment / Material					
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	Track Construction					
4	1.1	– Main Line	km.	730.0	$18,212	13,294,760	
4	1.2	– Siding	km.	12.2	$44,175	538,935	
4	Item 2	Field Welded Joints	ea.	4,570	$2,028	9,267,960	
4	Item 3	Turnout Construction					
4	3.1	– High and Med. Speed (Main Line)	ea.	62	$20,455	1,268,210	
4	3.2	– Yard	ea.	0	$0	0	
4	Item 4	Ballasting and Surfacing	m^3	1,572,000	$8.47	13,314,840	
4	Item 5	Rail Grinding	track – km	742.2	$4,545	3,373,299	
4	Item 6	Construction Bases	route–km	365.0	$24,372	8,895,780	
4	Item X	Contingencies	%	$49,953,784	6%	2,997,227	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$52,951,011	
5	SECTOR 5	START–UP					
5		Included in Other Studies					
5							
5	SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology:

300+, EXISTING ROW — 365.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	**G – ELECTRIFICATION**				
		WINDSOR – TORONTO CORRIDOR			300+, EXISTING ROW	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$228,986,160	5.5%	12,594,239	As % of total for Sector 4
1 Item 2	Construction Supervision	%	$228,986,160	5.0%	11,449,308	As % of total for Sector 4
1 Item 3	Project Management	%	$253,029,707	5.4%	13,663,604	% of sector 4 total plus items 1–2
1 Item X	Contingencies	%	$37,707,151	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$37,707,151	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2	Included in Construction / Installation					
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Included in Construction / Installation					
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Typical Catenary					
4 1.1	– Single Track – Independent Struct.	km.	0.0	$0	0	
4 1.2	– Double Track – Independ. Struct.	km.	365.0	$350,000	127,750,000	
4 1.3	– Double Track – Portal Structures	km.	0.0	$0	0	
4 1.4	– Triple Track – Portal Structures	km.	0.0	$0	0	
4 1.5	– Yard Catenary	100 m.	0	$0	0	
4 1.6	– Sidings Catenary	100 m.	30	$13,500	405,000	
4 1.7	– Garage Area Catenary	100 m.	0	$0	0	
4 1.8	– In–Station Catenary	100 m.	92	$17,500	1,610,000	
4 Item 2	Particular Catenary Installations					
4 2.1	– Xover Single (with section breaks)	ea.	19	$280,000	5,320,000	
4 2.2	– Xover Double (with section breaks)	ea.	6	$369,000	2,214,000	
4 2.3	– Phase Break	ea.	5	$1,052,000	5,260,000	
4 Item 3	Special Catenary Structures					
4 3.1	– Underbridge	100 m.	0	$0	0	
4 3.2	– Overbridge	100 m.	0	$0	0	
4 Item 4	Power Supply					
4 4.1	– Main Supply Station, 230 kV	ea.	3	$5,355,000	16,065,000	
4 4.2	– Main Supply Station, 138 – 120 kV	ea.	2	$4,075,000	8,150,000	
4 4.3	– Paralleling and Auto–transf. Stn	ea.	32	$730,000	23,360,000	
4 4.4	– 2x25 – 1x25 Interface Station	ea.	1	$925,000	925,000	
4 4.5	not used	ea.	0	$0	0	
4 4.6	– Main Supply Station, 315 kV	ea.	0	$0	0	
4 4.7	– 315 kV Supply Line	ea.	0	$0	0	
4 4.8	– 230 kV Supply Line	km.	30	$170,300	5,109,000	
4 4.9	– 120 kV Supply Line	km.	7	$132,200	925,400	
4 4.10	– Control Center	ea.	1	$200,000	200,000	
4 Item 5	EMI Mitigation Measures	route–km	365.0	$5,000	1,825,000	
4 Item X	Contingencies	%	$199,118,400	15%	29,867,760	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$228,986,160	
5 SECTOR 5	START–UP					
5	Included in Other Studies					
5						
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology:
300+, EXISTING ROW — 365.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: H – STATIONS					
	WINDSOR – TORONTO CORRIDOR				300+, EXISTING ROW	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$21,670,000	5.5%	1,191,850	As a % of total for Sector 2
1 Item 2	Construction Supervision	%	$21,670,000	5.0%	1,083,500	As a % of total for Sector 2
1 Item 3	Project Management	%	$23,945,350	5.4%	1,293,049	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$3,568,399	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$3,568,399	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2		Included in Construction / Installation				
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Construction / Installation				
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Individual Station (location, name)	lump sum		$19,700,000	19,700,000	
4 Item 2	Individual Station (location, name)	lump sum		$0	0	
4 Item 3	Individual Station (location, name)	lump sum		$0	0	
4 Item 4	Individual Station (location, name)	lump sum		$0	0	
4 Item X	Contingencies	%	$19,700,000	10%	1,970,000	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$21,670,000	
5 SECTOR 5	START–UP					
5		Included in Other Studies				
5						
5 SECTOR 5	TOTAL: START–UP				$0	

current costs on file

Windsor Toronto Corridor

300 Ex. ROW

segment	total cost
WT2–A0	$0
WT2–B0	$0
WT2–C0	$0
WT1–A0	$1,003,294,584
WT1–B0	$841,232,227
WT1–C0	$529,766,572
WT0–A0	$0
WT0–B0	$0
WT0–C0	$0
WT0–C1	$0
WTS–1	$16,135,838
WTS–2a	$0
WTS–2b	$20,706,614
WTS–3	$13,125,569
WTS–4	$0
WTS–5	$0
WTR–01	$0
WTR–02	$0

TOTAL $2,424,261,404

WINDSOR-TORONTO

C3. 300+ km/hr - NEW RIGHTS-OF-WAY

Segment Summary Cost Table

Segment Detailed Cost Report

SUBSYSTEM/SECTOR COST SUMMARY

WINDSOR – TORONTO CORRIDOR 300+, NEW ROW

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$18,215,261	$189,742,300	N/A	N/A	see note c	$207,957,561	$20,285,177
B – Earthworks and Drainage	$96,299,595	N/A	N/A	$411,708,165	see note c	$508,007,760	$53,701,065
C – Bridges, Viaducts, and Tunnels	$42,626,517	N/A	N/A	$258,860,250	see note c	$301,486,767	$23,532,750
D – Grade Separations	$93,276,902	N/A	N/A	$566,447,450	see note c	$659,724,352	$73,884,450
E – Other Accom–modation works	$13,074,833	see note a	see note a	$79,400,211	see note c	$92,475,043	$18,323,126
F – Track	$42,061,242	$234,967,397	see note b	$55,014,672	see note c	$332,043,312	$14,302,962
G – Electrification	$38,071,007	see note a	see note a	$231,195,770	see note c	$269,266,777	$30,155,970
H – Stations	$37,259,881	see note a	see note a	$226,270,000	see note c	$263,529,881	$20,570,000
Totals	$380,885,238	$424,709,697	$0	$1,828,896,518	see note c	$2,634,491,453	$254,755,499

NOTES: a) included in Construction / Installation
b) included in Equipment / Material
c) included in Other Studies

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WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology: 300+, NEW ROW — 375.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM A – RIGHT–OF–WAY ACQUISITION					
	WINDSOR – TORONTO CORRIDOR 300+, NEW ROW					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Professional Services					
1 1.1	– Surveying	%	$189,742,300	8.0%	15,179,384	As a % of total cost of Sector 2
1 1.2	– Appraisal	%	$189,742,300	0%	0	included in Item 1.1
1 1.3	– Legal Expertise	%	$189,742,300	0%	0	included in Item 1.1
1 Item 2	Project Management	%	$204,921,684	0%	0	As % of Sector 2 total + item 1.1
1 Item X	Contingencies	%	$15,179,384	20%	3,035,877	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$18,215,261	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2 Item 1	Urban Land					
2 1.1	– Residential	lump sum			5,940,000	unit cost not applicable
2 1.2	– Commercial	lump sum			20,490,000	unit cost not applicable
2 1.3	– Industrial	lump sum			28,300,000	unit cost not applicable
2 Item 2	Rural Land					
2 2.1	– Agricultural	lump sum			95,948,000	unit cost not applicable
2 2.2	– Natural	lump sum			0	unit cost not applicable
2 Item 3	Purchase of Existing Rail ROW					
2 3.1	– CN	lump sum			17,315,000	unit cost not applicable
2 3.2	– CP	lump sum			4,500,000	unit cost not applicable
2 3.3	– VIA	lump sum			0	unit cost not applicable
2 Item X	Contingencies	%	$172,493,000	10%	17,249,300	
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$189,742,300	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Not Applicable				
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4		Not Applicable				
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$0	
5 SECTOR 5	START–UP					
5		Included in Other Studies				
5						
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology:
300+, NEW ROW — 375.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	**B – EARTHWORKS AND DRAINAGE**				
		WINDSOR – TORONTO CORRIDOR		300+, NEW ROW		
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$411,708,165	5.5%	22,643,949	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$411,708,165	5.0%	20,585,408	As a % of total cost of Sector 2
1 Item 3	Environmental Assessment	%	$2,253,606,215	0.2%	4,507,212	Items 3 and 4 are %'s of entire
1 Item 4	Feasibility Studies (Technical)	%	$2,253,606,215	1.0%	22,536,062	project's cost less profes. fees
1 Item 5	Project Management	%	$481,980,797	5.4%	26,026,963	% of sector 2 total plus items 1–4
1 Item X	Contingencies	%	$96,299,595	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$96,299,595	
2 SECTOR 2	EQUIPMENT / MATERIALS					
		Not Applicable				
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
		Not Applicable				
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Clearing and Roadbed Preparation					
4 1.1	– Type 1 Soils	route–km	279.7	$142,000	39,717,400	
4 1.2	– Type 2 Soils	route–km	94	$627,000	58,938,000	
4 1.3	– Type 3 Soils	route–km	1.3	$1,035,000	1,345,500	
4 Item 2	Embankment Construction					
4 2.1	– Soft Excavated Material	1000 m^3	6070	$3,000	18,210,000	
4 2.2	– Hard Excavated Material (Rock)	1000 m^3	1104	$18,000	19,872,000	
4 2.3	– Borrow Material	1000 m^3	4234	$8,000	33,872,000	
4 2.4	– Disposal of Unsuitable Material	1000 m^3	983	$5,500	5,406,500	
4 Item 3	Haulage of Fill Material (from Borrow or Excavation)	1000 m^3–	0	$0	0	Cost transferred to item B4–2
4 Item 4	Sub–Ballast Layers					For TM2–B0,TM2–D0,TM1–B0,
4 4.1	– New ROW	route–km	336.8	$228,000	76,790,400	TM1–D0,TM0–B0,TM0–B1,
4 4.2	– Existing ROW	route–km	38.2	$228,000	8,709,600	TM0–C0,and TM0–D0, $152,000
4 Item 5	Drainage Systems					used for cost of sub–ballast(it. 4)
4 5.1	– Normal ROW	route–km	369.4	$25,000	9,235,000	
4 5.2	– Major Watercourse Culverts	ea.	156	$35,000	5,460,000	
4 5.3	– Environment. Stormwater Controls	route–km	180.5	$7,000	1,263,500	
4 Item 6	Roadbed Upgrade on Existing ROW	route–km	6.6	$600,000	3,960,000	
4 Item 7	Retaining Structures					
4 7.1	– Up to 3 metres in Height	km.	6.1	$2,500,000	15,250,000	
4 7.2	– Over 3 metres in Height	km.	3.9	$5,000,000	19,500,000	
4 Item 8	Intrusion Barriers	km.	13	$0	0	Intrusion Barriers not required
4 Item 9	Noise Attenuation Structures					
4 9.1	– Barriers	km.	17.2	$660,000	11,352,000	
4 9.2	– Berms	km.	0	$0	0	
4 Item 10	ROW Security Fencing (on both sides)	route–km	369.4	$56,000	20,686,400	
4 Item 11	Snow Control Measures	km.	0	$0	0	Accounted for in Contingencies
4 Item 12	Utility Interferences					
4 12.1	– Major Hydro Relocation	ea.	33	$0	0	Accounted for in Contingencies
4 12.2	– Major Oil/Gas Relocation	ea.	10	$0	0	Accounted for in Contingencies
4 12.3	– Minor Pipe or Wire Crossings	route–km	375	$0	0	Accounted for in Contingencies
4 Item 13	Other Items					
4 13.1	– Audit for Contaminated Soil	route–km	369.4	$2,000	738,800	
4 13.2	– Audit for Contaminated Rail Yards	ea.	9	$500,000	4,500,000	
4 13.3	– Minor Wildlife Passages (Culverts)	ea.	32	$100,000	3,200,000	
4 Item X	Contingencies	%	$358,007,100	15%	53,701,065	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$411,708,165	
5 SECTOR 5	START–UP					
		Included in Other Studies				
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology: 300+, NEW ROW — 375.0 km. in length

SUBSYSTEM: C – BRIDGES, VIADUCTS, AND TUNNELS

WINDSOR – TORONTO CORRIDOR — 300+, NEW ROW

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$258,860,250	5.5%	14,237,314	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$258,860,250	5.0%	12,943,013	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$286,040,576	5.4%	15,446,191	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$42,626,517	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$42,626,517	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Bridges					
4 1.1	– Small Rivers (< 30 metres)	ea.	65	$340,000	22,100,000	
4 1.2	– Extra at 1.1 for Height Over 10 m.	ea.	2	$85,000	170,000	
4 1.3	– Interm. Rivers (30 – 100 metres)	lin. m.	620	$23,500	14,570,000	
4 1.4	– Extra at 1.3 for Height Over 10 m.	lin. m.	0	$0	0	
4 1.5	– Large Rivers (100 – 250 metres)	lin. m.	450	$42,000	18,900,000	
4 1.6	– Extra at 1.5 for Height Over 10 m.	lin. m.	175	$10,500	1,837,500	
4 1.7	– Major Rivers (over 250 m.)	lin. m.	0	$0	0	
4 1.8	– Extra for Difficult Foundation Cond.	lin. m.	0	$0	0	
4 1.9	– Modif. to Exist. Bridges (new deck)	lin. m.	0	$0	0	
4 Item 2	Viaducts					
4 2.1	– Viaducts over 250 metres in Length	lin. m.	1,650	$27,000	44,550,000	
4 2.2	– Extra for Height Over 10 metres	lin. m.	1,650	$8,000	13,200,000	
4 2.3	– Extra for Difficult Foundation Cond.	lin. m.	0	$0	0	
4 Item 3	Tunnels (Double Track)					
4 3.1	– In Soft Ground	lin. m.	0	$0	0	For 300+ technology, Rock Tunnels speed restricted by local conditions are $35,000/lin m. Accounted for in Contingencies
4 3.2	– In Rock	lin. m.	2,400	$50,000	120,000,000	
4 3.3	– Modifications to Existing Tunnels	lump sum	0	$0	0	
4 3.4	– Noise Mitigation Measures	lump sum	0	$0	0	
4 Item X	Contingencies	%	$235,327,500	10%	23,532,750	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$258,860,250	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology:
300+, NEW ROW — 375.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: D – GRADE SEPARATIONS					
	WINDSOR – TORONTO CORRIDOR				300+, NEW ROW	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$566,447,450	5.5%	31,154,610	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$566,447,450	5.0%	28,322,373	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$625,924,432	5.4%	33,799,919	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$93,276,902	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$93,276,902	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	New Grade Separations, Rural					
4 1.1	– 2 Lane Highways	ea.	135	$2,200,000	297,000,000	
4 1.2	– 2 Lane Highways, Dual ROW	ea.	0	$0	0	
4 1.3	– 4 Lane Highways	ea.	5	$3,100,000	15,500,000	
4 1.4	– 4 Lane Highways, Dual ROW	ea.	0	$0	0	
4 1.5	– Major Highways (401, 20, etc)	ea.	6	$4,450,000	26,700,000	
4 1.6	– Extra for Difficult Foundation Cond.	ea.	0	$0	0	
4 Item 2	New Grade Separations, Urban					
4 2.1	– Secondary Highways (2–4 lanes)	ea.	15	$4,068,000	61,020,000	
4 2.2	– Second. Hwys (2–4 l.) Dual ROW	ea.	0	$0	0	
4 2.3	– Major Highways (over 4 lanes)	ea.	4	$5,300,000	21,200,000	
4 2.4	– Extra for Difficult Foundation Cond.	ea.	0	$0	0	
4 Item 3	Modification of Exist. Grade Separations					
4 3.1	– Urban	ea.	38	$830,000	31,540,000	
4 3.2	– Rural	ea.	5	$627,000	3,135,000	
4 Item 4	Automatic Crossing Protection	ea.	0	$0	0	
4 Item 5	Closure and Diversion of Roads	km. of road	30.6	$280,000	8,568,000	
4 Item 6	Private Farm Crossings	ea.	93	$300,000	27,900,000	
4 Item 7	Major Wildlife Passages	ea.	0	$0	0	
4 Item X	Contingencies	%	$492,563,000	15%	73,884,450	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$566,447,450	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology:

300+, NEW ROW — 375.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	**E – OTHER ACCOMODATION WORKS**				
		WINDSOR – TORONTO CORRIDOR			300+, NEW ROW	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$79,400,211	5.5%	4,367,012	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$79,400,211	5.0%	3,970,011	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$87,737,233	5.4%	4,737,811	% of sector 2 total plus items 1 – 2
1 Item X	Contingencies	%	$13,074,833	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$13,074,833	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2		Included in Construction / Installation				
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Construction / Installation				
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Removal of Rail Lines	km.	17.8	$21,134	376,185	
4 Item 2	Construction of New Access Tracks	km.	68.4	$644,750	44,100,900	
4 Item 3	Rail/Rail Grade Separation					
4 3.1	– Rural	ea.	17	$800,000	13,600,000	
4 3.2	– Urban	ea.	3	$1,000,000	3,000,000	
4 Item 4	Other Particular Items:					
4 4.1	– Sub–Item	lump sum	0		0	
4 4.2	– Sub–Item	lump sum	0		0	
4 4.3	– Sub–Item	lump sum	0		0	
4 4.4	– Sub–Item	lump sum	0		0	
4 Item X	Contingencies	%	$61,077,085	30%	18,323,126	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$79,400,211	
5 SECTOR 5	START–UP					
5		Included in Other Studies				
5						
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology:
300+, NEW ROW — 375.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: F – TRACK					
	WINDSOR – TORONTO CORRIDOR				300+, NEW ROW	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$289,982,070	3.5%	10,149,372	As % of total for Sectors 2 and 4
1 Item 2	Construction Supervision	%	$55,014,672	10.0%	5,501,467	As % of total for Sector 4
1 Item 3	Materials Procurement	%	$234,967,397	4.0%	9,398,696	As % of total for Sector 2
1 Item 4	Project Management	%	$315,031,605	5.4%	17,011,707	As % of Sectors 2,4 totals plus
1 Item X	Contingencies	%	$42,061,242	0%	0	items 1–3
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$42,061,242	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2 Item 1	Rail					
2 1.1	– Main Line	t.	91,820	$773	71,015,424	
2 1.2	– Siding	t.	1,770	$773	1,368,953	
2 Item 2	Ties	ea.	1,299,400	$45	58,200,126	
2 Item 3	Ballast	m^3	1,619,000	$21	34,598,030	
2 Item 4	Turnouts					
2 4.1	– High Speed	ea.	44	$280,000	12,320,000	
2 4.2	– Medium Speed	ea.	30	$135,000	4,050,000	
2 4.3	– Yard	ea.	0	$0	0	
2 Item 5	Other Track Material					
2 5.1	– Rail Fastening Assemblies	set	1,299,400	$27	34,434,100	
2 5.2	– Bonded Insulated Joints	ea.	0	$0	0	Included in Signalling costs
2 5.3	– Bumping Posts	ea.	7	$3,120	21,840	
2 Item 6	Switch Heaters/ Snow Blowers					
2 6.1	– Main Line	ea.	74	$105,000	7,770,000	
2 6.2	– Yard	ea.	0	$0	0	
2 Item 7	Ballast Mats for Noise Attenuation	m^2	0	$0	0	
2 Item X	Contingencies	%	$223,778,474	5%	11,188,924	
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$234,967,397	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Included in Equipment / Material					
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Track Construction					
4 1.1	– Main Line	km.	750.0	$18,212	13,659,000	
4 1.2	– Siding	km.	14.2	$44,175	627,285	
4 Item 2	Field Welded Joints	ea.	4,820	$2,028	9,774,960	
4 Item 3	Turnout Construction					
4 3.1	– High and Med. Speed (Main Line)	ea.	74	$20,455	1,513,670	
4 3.2	– Yard	ea.	0	$0	0	
4 Item 4	Ballasting and Surfacing	m^3	1,619,000	$8.47	13,712,930	
4 Item 5	Rail Grinding	track – km	764.2	$4,545	3,473,289	
4 Item 6	Construction Bases	route–km	375.0	$24,372	9,139,500	
4 Item X	Contingencies	%	$51,900,634	6%	3,114,038	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$55,014,672	
5 SECTOR 5	START–UP					
5	Included in Other Studies					
5						
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology:
300+, NEW ROW — 375.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: G – ELECTRIFICATION					
	WINDSOR – TORONTO CORRIDOR				300+, NEW ROW	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$231,195,770	5.5%	12,715,767	As % of total for Sector 4
1 Item 2	Construction Supervision	%	$231,195,770	5.0%	11,559,789	As % of total for Sector 4
1 Item 3	Project Management	%	$255,471,326	5.4%	13,795,452	% of sector 4 total plus items 1 – 2
1 Item X	Contingencies	%	$38,071,007	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$38,071,007	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Included in Construction / Installation					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Included in Construction / Installation					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Typical Catenary					
4 1.1	– Single Track – Independent Struct.	km.	0.0	$0	0	
4 1.2	– Double Track – Independ. Struct.	km.	375.0	$350,000	131,250,000	
4 1.3	– Double Track – Portal Structures	km.	0.0	$0	0	
4 1.4	– Triple Track – Portal Structures	km.	0.0	$0	0	
4 1.5	– Yard Catenary	100 m.	0	$0	0	
4 1.6	– Sidings Catenary	100 m.	30	$13,500	405,000	
4 1.7	– Garage Area Catenary	100 m.	0	$0	0	
4 1.8	– In–Station Catenary	100 m.	112	$17,500	1,960,000	
4 Item 2	Particular Catenary Installations					
4 2.1	– Xover Single (with section breaks)	ea.	21	$280,000	5,880,000	
4 2.2	– Xover Double (with section breaks)	ea.	8	$369,000	2,952,000	
4 2.3	– Phase Break	ea.	4	$1,052,000	4,208,000	
4 Item 3	Special Catenary Structures					
4 3.1	– Underbridge	100 m.	0	$0	0	
4 3.2	– Overbridge	100 m.	0	$0	0	
4 Item 4	Power Supply					
4 4.1	– Main Supply Station, 230 kV	ea.	4	$5,355,000	21,420,000	
4 4.2	– Main Supply Station, 138 – 120 kV	ea.	1	$4,075,000	4,075,000	
4 4.3	– Paralleling and Auto–transf. Stn	ea.	33	$730,000	24,090,000	
4 4.4	– 2x25 – 1x25 Interface Station	ea.	0	$0	0	
4 4.5	not used	ea.	0	$0	0	
4 4.6	– Main Supply Station, 315 kV	ea.	0	$0	0	
4 4.7	– 315 kV Supply Line	ea.	0	$0	0	
4 4.8	– 230 kV Supply Line	km.	16	$170,300	2,724,800	
4 4.9	– 120 kV Supply Line	km.	0	$0	0	
4 4.10	– Control Center	ea.	1	$200,000	200,000	
4 Item 5	EMI Mitigation Measures	route–km	375.0	$5,000	1,875,000	
4 Item X	Contingencies	%	$201,039,800	15%	30,155,970	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$231,195,770	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

WINDSOR – TORONTO CORRIDOR — SUMMARY SHEET

technology:
300+, NEW ROW — 375.0 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: H – STATIONS					
	WINDSOR – TORONTO CORRIDOR				300+, NEW ROW	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$226,270,000	5.5%	12,444,850	As a % of total for Sector 2
1 Item 2	Construction Supervision	%	$226,270,000	5.0%	11,313,500	As a % of total for Sector 2
1 Item 3	Project Management	%	$250,028,350	5.4%	13,501,531	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$37,259,881	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$37,259,881	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2	Included in Construction / Installation					
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Included in Construction / Installation					
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Individual Stations	lump sum		$27,700,000	27,700,000	
4 Item 2	People Movers	lump sum		$178,000,000	178,000,000	used at Pearson and Dorval only
4 Item 3	Not used	lump sum		$0	0	
4 Item 4	Not used	lump sum		$0	0	
4 Item X	Contingencies	%	$205,700,000	10%	20,570,000	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$226,270,000	
5 SECTOR 5	START–UP					
5	Included in Other Studies					
5						
5 SECTOR 5	TOTAL: START–UP				$0	

current costs on file

Windsor Toronto Corridor

300 New ROW

segment	total cost
WT2–A0	$0
WT2–B0	$0
WT2–C0	$0
WT1–A0	$0
WT1–B0	$0
WT1–C0	$0
WT0–A0	$886,630,624
WT0–B0	$1,163,674,373
WT0–C0	$0
WT0–C1	$287,176,656
WTS–1	$16,135,838
WTS–2a	$0
WTS–2b	$20,706,614
WTS–3	$0
WTS–4	$15,190,095
WTS–5	$244,977,252
WTR–01	$0
WTR–02	$0

TOTAL $2,634,491,453

WINDSOR-TORONTO

C4. TOTAL COSTS FOR SUB-SEGMENTS

		(000's $)
WT2-A0	Windsor - London	714,380
WT2-B0	London - Hamilton	718,037
WT2-C0	Hamilton - Union Station	547,573
WT1-A0	Windsor - London	1,003,295
WT1-B0	London - Hamilton	841,232
WT1-C0	Hamilton - Union Station	529,767
WT0-A0	Windsor - London	886,631
WT0-B0	London - Pearson Airport	1,163,674
WT0-C0	Pearson Airport - North Toronto Station	267,728
WT0-C1	Pearson Airport - Union Station	287,177
WTS-1	Windsor - New Station	16,136
WTS-2a	London - New Downtown Station	11,045
WTS-2b	London - New Suburban Station	20,707
WTS-3	Hamilton/Burlington - New Station	13,126
WTS-4	Kitchener/Cambridge - New Station	15,190
WTS-5	Pearson International Airport - New Station	244,977

APPENDIX - D

DETAILED ESTIMATES

TORONTO-MONTRÉAL

TORONTO-MONTRÉAL

D1. 200+ km/hr - EXISTING RIGHTS-OF-WAY

Segment Summary Cost Table

Segment Detailed Cost Report

Table 4.6

SUBSYSTEM/SECTOR COST SUMMARY

TORONTO – MONTRÉAL ALIGNMENT **200+, TILTING** TORONTO – MONTRÉAL

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$20,952,695	$218,257,243	N/A	N/A	see note c	$239,209,938	$23,333,683
B – Earthworks and Drainage	$154,422,587	N/A	N/A	$714,165,134	see note c	$868,587,721	$93,151,974
C – Bridges, Viaducts, and Tunnels	$62,417,093	N/A	N/A	$379,043,500	see note c	$441,460,593	$34,458,500
D – Grade Separations	$86,590,073	N/A	N/A	$525,840,000	see note c	$612,430,073	$87,640,000
E – Other Accom–modation works	$3,079,464	see note a	see note a	$18,700,819	see note c	$21,780,283	$4,315,574
F – Track	$69,407,733	$385,103,211	see note b	$92,565,850	see note c	$547,076,794	$23,577,825
G – Electrification	$68,204,110	see note a	see note a	$414,186,616	see note c	$482,390,726	$54,024,341
H – Stations	$26,898,845	see note a	see note a	$163,350,000	see note c	$190,248,845	$14,850,000
Totals	$491,972,599	$603,360,453	$0	$2,307,851,920	see note c	$3,403,184,972	$335,351,897

NOTES: a) included in Construction / Installation
b) included in Equipment / Material
c) included in Other Studies

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology: 200+, TILTING — 636.135 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: A – RIGHT–OF–WAY ACQUISITION					
	TORONTO – MONTREAL ALIGNMENT 200+, TILTING					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Professional Services					
1 1.1	– Surveying	%	$218,257,243	8%	$17,460,579	As a % of total cost of Sector 2
1 1.2	– Appraisal	%	$218,257,243	0%	$0	included in Item 1.1
1 1.3	– Legal Expertise	%	$218,257,243	0%	$0	included in Item 1.1
1 Item 2	Project Management	%	$235,717,822	0%	$0	As % of Sector 2 total + item 1.1
1 Item X	Contingencies	%	$17,460,579	20%	$3,492,116	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$20,952,695	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2 Item 1	Urban Land					
2 1.1	– Residential	lump sum			78,732,250	unit cost not applicable
2 1.2	– Commercial	lump sum			1,500,000	unit cost not applicable
2 1.3	– Industrial	lump sum			35,886,000	unit cost not applicable
2 Item 2	Rural Land					
2 2.1	– Agricultural	lump sum			3,322,575	unit cost not applicable
2 2.2	– Natural	lump sum			710,250	unit cost not applicable
2 Item 3	Purchase of Existing Rail ROW					
2 3.1	– CN	lump sum			74,976,625	unit cost not applicable
2 3.2	– CP	lump sum			2,450,000	unit cost not applicable
2 3.3	– VIA	lump sum			837,975	unit cost not applicable
2 Item X	Contingencies	%	$198,415,675	10%	19,841,568	
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$218,257,243	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Not Applicable				
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4		Not Applicable				
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$0	
5 SECTOR 5	START–UP					
5		Included in Other Studies				
5						
5 SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology: 200+, TILTING — 636.135 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	**B – EARTHWORKS AND DRAINAGE**				
		TORONTO – MONTRÉAL ALIGNMENT 200+, TILTING				
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$714,165,134	5.5%	39,279,082	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$714,165,134	5.0%	35,708,257	As a % of total cost of Sector 2
1 Item 3	Environmental Assessment	%	$2,911,212,373	0.2%	5,822,425	Items 3 and 4 are %'s of entire
1 Item 4	Feasibility Studies (Technical)	%	$2,911,212,373	1.0%	29,112,124	project's cost less profes. fees
1 Item 5	Project Management	%	$824,087,022	5.4%	44,500,699	% of sector 2 total plus items 1–4
1 Item X	Contingencies	%	$154,422,587	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$154,422,587	
2 SECTOR 2	EQUIPMENT / MATERIALS					
		Not Applicable				
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
		Not Applicable				
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Clearing and Roadbed Preparation					
4 1.1	– Type 1 Soils	route–km	245.2	142,000	34,819,110	
4 1.2	– Type 2 Soils	route–km	305.6	627,000	191,586,120	
4 1.3	– Type 3 Soils	route–km	57.9	1,035,000	59,936,850	
4 Item 2	Embankment Construction					
4 2.1	– Soft Excavated Material	1000 m^3	5,079	3,000	15,238,200	
4 2.2	– Hard Excavated Material (Rock)	1000 m^3	1,639	18,000	29,502,000	
4 2.3	– Borrow Material	1000 m^3	645	8,000	5,157,920	
4 2.4	– Disposal of Unsuitable Material	1000 m^3	6,006	5,500	33,033,220	
4 Item 3	Haulage of Fill Material					
4	(from Borrow or Excavation)	1000 m^3–	0	0	0	Cost transferred to item B4–2
4 Item 4	Sub–Ballast Layers					For TM2–B0,TM2–D0,TM1–B0,
4 4.1	– New ROW	route–km	394.8	190,690	75,287,120	TM1–D0,TM0–B0,TM0–B1,
4 4.2	– Existing ROW	route–km	217.5	220,186	47,898,240	TM0–C0,and TM0–D0, $152,000
4 Item 5	Drainage Systems					used for cost of sub–ballast(it. 4)
4 5.1	– Normal ROW	route–km	607.0	25,000	15,174,375	
4 5.2	– Major Watercourse Culverts	ea.	269	35,000	9,415,000	
4 5.3	– Environment. Stormwater Controls	route–km	572.1	7,000	4,004,455	
4 Item 6	Roadbed Upgrade on Existing ROW	route–km	52.4	600,000	31,416,000	
4 Item 7	Retaining Structures					
4 7.1	– Up to 3 metres in Height	km.	2.6	2,500,000	6,500,000	
4 7.2	– Over 3 metres in Height	km.	0.7	5,000,000	3,500,000	
4 Item 8	Intrusion Barriers	km.	0.0	0	0	Intrusion Barriers not required
4 Item 9	Noise Attenuation Structures					
4 9.1	– Barriers	km.	19.9	660,000	13,134,000	
4 9.2	– Berms	km.	0.0	0	0	
4 Item 10	ROW Security Fencing (on both sides)	route–km	601.6	56,000	33,690,720	
4 Item 11	Snow Control Measures	km.	0.0	0	0	Accounted for in Contingencies
4 Item 12	Utility Interferences					
4 12.1	– Major Hydro Relocation	ea.	42	0	0	Accounted for in Contingencies
4 12.2	– Major Oil/Gas Relocation	ea.	13	0	0	Accounted for in Contingencies
4 12.3	– Minor Pipe or Wire Crossings	route–km	116.0	0	0	Accounted for in Contingencies
4 Item 13	Other items					
4 13.1	– Audit for Contaminated Soil	route–km	609.9	2,000	1,219,830	
4 13.2	– Audit for Existing Rail Yards	ea.	11	500,000	5,500,000	
4 13.3	– Minor Wildlife Passages (Culverts)	ea.	50	100,000	5,000,000	
4 Item X	Contingencies	%	$621,013,160	15%	93,151,974	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$714,165,134	
5 SECTOR 5	START–UP					
		Included in Other Studies				
5 SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology: 200+, TILTING — 636.135 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	**C – BRIDGES, VIADUCTS, AND TUNNELS**				
		TORONTO – MONTRÉAL ALIGNMENT 200+, TILTING				
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$379,043,500	5.5%	20,847,393	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$379,043,500	5.0%	18,952,175	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$418,843,068	5.4%	22,617,526	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$62,417,093	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$62,417,093	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Bridges					
4 1.1	– Small Rivers (< 30 metres)	ea.	17	340,000	5,780,000	
4 1.2	– Extra at 1.1 for Height Over 10 m.	ea.	0	0	0	
4 1.3	– Interm. Rivers (30 – 100 metres)	lin. m.	620	23,500	14,570,000	
4 1.4	– Extra at 1.3 for Height Over 10 m.	lin. m.	115	6,000	690,000	
4 1.5	– Large Rivers (100 – 250 metres)	lin. m.	860	42,000	36,120,000	
4 1.6	– Extra at 1.5 for Height Over 10 m.	lin. m.	0	0	0	
4 1.7	– Major Rivers (over 250 m.)	lin. m.	700	50,000	35,000,000	
4 1.8	– Extra for Difficult Foundation Cond.	lin. m.	725	5,000	3,625,000	
4 1.9	– Modif. to Exist. Bridges (new deck)	lin. m.	1,350	13,000	17,550,000	
4 Item 2	Viaducts					
4 2.1	– Viaducts over 250 metres in Length	lin. m.	3,250	27,000	87,750,000	
4 2.2	– Extra for Height Over XX metres	lin. m.	0	0	0	
4 2.3	– Extra for Difficult Foundation Cond.	lin. m.	0	0	0	
4 Item 3	Tunnels (Double Track)					
4 3.1	– In Soft Ground	lin. m.	2,050	70,000	143,500,000	
4 3.2	– In Rock	lin. m.	0	0	0	
4 3.3	– Modifications to Existing Tunnels	lump sum	0		0	
4 3.4	– Noise Mitigation Measures	lump sum	0		0	Accounted for in Contingencies
4 Item X	Contingencies	%	$344,585,000	10%	34,458,500	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$379,043,500	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology: 200+, TILTING — 636.135 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	**D – GRADE SEPARATIONS**				
		TORONTO – MONTRÉAL ALIGNMENT 200+, TILTING				
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$525,840,000	5.5%	28,921,200	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$525,840,000	5.0%	26,292,000	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$581,053,200	5.4%	31,376,873	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$86,590,073	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$86,590,073	
2 SECTOR 2	EQUIPMENT / MATERIALS					
		Not Applicable				
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
		Not Applicable				
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	New Grade Separations, Rural					
4 1.1	– 2 Lane Highways	ea.	22	$2,200,000	48,400,000	
4 1.2	– 2 Lane Highways, Dual ROW	ea.	29	$2,800,000	81,200,000	
4 1.3	– 4 Lane Highways	ea.	3	$3,100,000	9,300,000	
4 1.4	– 4 Lane Highways, Dual ROW	ea.	0	$0	0	
4 1.5	– Major Highways (401, 20, etc)	ea.	4	$4,450,000	17,800,000	
4 1.6	– Extra for Difficult Foundation Cond.	ea.	3	$180,000	540,000	
4 Item 2	New Grade Separations, Urban					
4 2.1	– Secondary Highways (2–4 lanes)	ea.	15	$4,068,000	61,020,000	
4 2.2	– Second. Hwys (2–4 l.) Dual ROW	ea.	9	$4,456,000	40,104,000	
4 2.3	– Major Highways (over 4 lanes)	ea.	6	$5,300,000	31,800,000	
4 2.4	– Extra for Difficult Foundation Cond.	ea.	0	$0	0	
4 Item 3	Modification of Exist. Grade Separations					
4 3.1	– Urban	ea.	56	$830,000	46,480,000	
4 3.2	– Rural	ea.	54	$627,000	33,858,000	
4 Item 4	Automatic Crossing Protection	ea.	151	$270,000	40,770,000	
4 Item 5	Closure and Diversion of Roads	km. of road	3	$280,000	728,000	
4 Item 6	Private Farm Crossings	ea.	84	$300,000	25,200,000	
4 Item 7	Wildlife Passages	ea.	2	$500,000	1,000,000	
4 Item X	Contingencies	%	$438,200,000	20%	87,640,000	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$525,840,000	
5 SECTOR 5	START–UP					
		Included in Other Studies				
5 SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology:
200+, TILTING — 636.135 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS

SUBSYSTEM — E – OTHER ACCOMODATION WORKS

TORONTO – MONTRÉAL ALIGNMENT 200+, TILTING

1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	$18,700,819	5.5%	1,028,545	As a % of total cost of Sector 2
1	Item 2	Construction Supervision	%	$18,700,819	5.0%	935,041	As a % of total cost of Sector 2
1	Item 3	Project Management	%	$20,664,405	5.4%	1,115,878	% of sector 2 total plus items 1–2
1	Item X	Contingencies	%	$3,079,464	0%	0	
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$3,079,464	
2	SECTOR 2	EQUIPMENT / MATERIALS					
2		Included in Construction / Installation					
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Construction / Installation					
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	Removal of Rail Lines	km.	86.5	$21,134	1,827,246	
4	Item 2	Construction of New Access Tracks	km.	8.0	$644,750	5,158,000	
4	Item 3	Rail/Rail Grade Separation					
4	3.1	– Rural	ea.	3	$800,000	2,400,000	
4	3.2	– Urban	ea.	5	$1,000,000	5,000,000	
4	Item 4	Other Particular Items:					
4	4.1	– Sub–Item	lump sum	0		0	
4	4.2	– Sub–Item	lump sum	0		0	
4	4.3	– Sub–Item	lump sum	0		0	
4	4.4	– Sub–Item	lump sum	0		0	
4	Item X	Contingencies	%	$14,385,246	30%	4,315,574	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$18,700,819	
5	SECTOR 5	START–UP					
5		Included in Other Studies					
5							
5	SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTRÉAL ALIGNMENT — SUMMARY SHEET

technology:
200+, TILTING — 636.135 km. in length

SUBSYSTEM: F – TRACK

TORONTO – MONTRÉAL ALIGNMENT 200+, TILTING

ITEM NUMBER		ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	$477,669,061	3.5%	16,718,417	As % of total for Sectors 2 and 4
1	Item 2	Construction Supervision	%	$92,565,850	10.0%	9,256,585	As % of total for Sector 4
1	Item 3	Materials Procurement	%	$385,103,211	4.0%	15,404,128	As % of total for Sector 2
1	Item 4	Project Management	%	$519,048,191	5.4%	28,028,602	As % of Sectors 2,4 totals plus
1	Item X	Contingencies	%	$69,407,733	0%	0	items 1–3
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$69,407,733	
2	SECTOR 2	EQUIPMENT / MATERIALS					
2	Item 1	Rail					
2	1.1	– Main Line	t.	150,870	$773	116,685,875	
2	1.2	– Siding	t.	4,060	$773	3,140,085	
2	Item 2	Ties	ea.	1,988,800	$45	89,078,352	
2	Item 3	Ballast	m^3	2,701,000	$21	57,720,370	
2	Item 4	Turnouts					
2	4.1	– High Speed	ea.	80	$280,000	22,400,000	
2	4.2	– Medium Speed	ea.	68	$135,000	9,180,000	
2	4.3	– Yard	ea.	5	$46,000	230,000	
2	Item 5	Other Track Material					
2	5.1	– Rail Fastening Assemblies	set	1,988,800	$27	52,703,200	
2	5.2	– Bonded Insulated Joints	ea.	0	$0	0	Included in Signalling costs
2	5.3	– Bumping Posts	ea.	9	$3,120	28,080	
2	Item 6	Switch Heaters/ Snow Blowers					
2	6.1	– Main Line	ea.	148	$105,000	15,540,000	
2	6.2	– Yard	ea.	5	$11,800	59,000	
2	Item 7	Ballast Mats for Noise Attenuation	m^2	0	$0	0	
2	Item X	Contingencies	%	$366,764,963	5%	18,338,248	
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$385,103,211	
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Equipment / Material					
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	Track Construction					
4	1.1	– Main Line	km.	1,232.3	18,212	22,441,737	
4	1.2	– Siding	km.	32.6	44,175	1,440,105	
4	Item 2	Field Welded Joints	ea.	8,260	2,028	16,751,280	
4	Item 3	Turnout Construction					
4	3.1	– High and Med. Speed (Main Line)	ea.	148	20,455	3,027,340	
4	3.2	– Yard	ea.	5	4,680	23,400	
4	Item 4	Ballasting and Surfacing	m^3	2,701,000	8	22,877,470	
4	Item 5	Rail Grinding	track – km.	1,264.9	4,545	5,748,743	
4	Item 6	Construction Bases	route–km	616.1	24,372	15,016,199	
4	Item X	Contingencies	%	$87,326,274	6%	5,239,576	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$92,565,850	
5	SECTOR 5	START–UP					
5		Included in Other Studies					
5							
5	SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology: 200+, TILTING — 636.135 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS

SUBSYSTEM: G – ELECTRIFICATION

TORONTO – MONTRÉAL ALIGNMENT 200+, TILTING

1	SECTOR 1		PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1		Item 1	Engineering	%	$414,186,616	5.5%	22,780,264	As % of total for Sector 4
1		Item 2	Construction Supervision	%	$414,186,616	5.0%	20,709,331	As % of total for Sector 4
1		Item 3	Project Management	%	$457,676,211	5.4%	24,714,515	% of sector 4 total plus items 1–2
1		Item X	Contingencies	%	$68,204,110	0%	0	
1								
1	SECTOR 1		TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$68,204,110	
2	SECTOR 2		EQUIPMENT / MATERIALS					
2			Included in Construction / Installation					
2								
2	SECTOR 2		TOTAL: EQUIPMENT / MATERIALS				$0	
3	SECTOR 3		TRANSPORTATION / DISTRIBUTION					
3			Included in Construction / Installation					
3								
3	SECTOR 3		TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4	SECTOR 4		CONSTRUCTION / INSTALLATION					
4		Item 1	Typical Catenary					
4		1.1	– Single Track – Independent Struct.	km.	0.0	0	0	
4		1.2	– Double Track – Independ. Struct.	km.	616.1	350,000	215,643,750	
4		1.3	– Double Track – Portal Structures	km.	0.0	0	0	
4		1.4	– Triple Track – Portal Structures	km.	0.0	0	0	
4		1.5	– Yard Catenary	100 m.	0	0	0	
4		1.6	– Sidings Catenary	100 m.	60	13,500	810,000	
4		1.7	– Garage Area Catenary	100 m.	0	0	0	
4		1.8	– In–Station Catenary	100 m.	266	17,500	4,655,000	
4		Item 2	Particular Catenary Installations					
4		2.1	– Xover Single (with section breaks)	ea.	44	280,000	12,320,000	
4		2.2	– Xover Double (with section breaks)	ea.	15	369,000	5,535,000	
4		2.3	– Phase Break	ea.	10	1,052,000	10,520,000	
4		Item 3	Special Catenary Structures					
4		3.1	– Underbridge	100 m.	0	0	0	
4		3.2	– Overbridge	100 m.	0	0	0	
4		Item 4	Power Supply					
4		4.1	– Main Supply Station, 230 kV	ea.	5	5,355,000	26,775,000	
4		4.2	– Main Supply Station, 138 – 120 kV	ea.	5	4,075,000	20,375,000	
4		4.3	– Paralleling and Auto–transf. Stn	ea.	58	730,000	42,340,000	
4		4.4	– 2x25 – 1x25 Interface Station	ea.	7	925,000	6,475,000	
4		4.5	not used	ea.	3	0	0	
4		4.6	– Main Supply Station, 315 kV	ea.	0	0	0	
4		4.7	– 315 kV Supply Line	ea.	0	0	0	
4		4.8	– 230 kV Supply Line	km.	45	170,300	7,663,500	
4		4.9	– 120 kV Supply Line	km.	27	132,200	3,569,400	
4		4.10	– Control Center	ea.	2	200,000	400,000	
4		Item 5	EMI Mitigation Measures	route–km	616.1	5,000	3,080,625	
4		Item X	Contingencies	%	$360,162,275	15%	54,024,341	
4								
4	SECTOR 4		TOTAL: CONSTRUCTION / INSTALLATION				$414,186,616	
5	SECTOR 5		START–UP					
5			Included in Other Studies					
5								
5	SECTOR 5		TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology:
200+, TILTING — 636.135 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM H – STATIONS					
	TORONTO – MONTRÉAL ALIGNMENT 200+, TILTING					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$163,350,000	5.5%	8,984,250	As a % of total for Sector 2
1 Item 2	Construction Supervision	%	$163,350,000	5.0%	8,167,500	As a % of total for Sector 2
1 Item 3	Project Management	%	$180,501,750	5.4%	9,747,095	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$26,898,845	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$26,898,845	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2	Included in Construction / Installation					
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Included in Construction / Installation					
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Individual Stations	lump sum		$0	71,500,000	
4 Item 2	People Movers	lump sum		$0	77,000,000	used at Pearson and Dorval only
4 Item 3	not used	lump sum		$0	0	
4 Item 4	not used	lump sum		$0	0	
4 Item X	Contingencies	%	$148,500,000	10%	14,850,000	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$163,350,000	
5 SECTOR 5	START–UP					
5	Included in Other Studies					
5						
5 SECTOR 5	TOTAL: START–UP				$0	

Toronto – Montréal Corridor		200+, TILTING	
segment	total cost	segment	total cost
TM2–A0	$505,756,142	TMS–3a	$19,239,160
TM2–B0	$849,270,351	TMS–3b	$26,939,577
TM2–C0	$528,080,137	TMS–DIV	
TM2–D0	$87,408,268	TM2–G0	$388,548,721
TM2–E0	$249,302,681	TM2–H0	$194,990,039
TM2–F0	$339,612,132	TM1–H0	$0
TM1–A0	$0	TM1–H1	$0
TM1–B0	$0	TM1–I0	$0
TM1–C0	$0	TM1–I1	$0
TM1–D0	$0	TM1–J0	$0
TM1–E0	$0	TM0–F0	$0
TM1–F0	$0	TM0–F1	$0
TM1–G0	$0	TM0–F2	$0
TM0–A0	$0		
TM0–A1	$0	TM0–G0	$0
TM0–A2	$0	TM0–G1	$0
TM0–B0	$0	TM0–H0	$0
TM0–B1	$0	TMS–3c	$0
TM0–C0	$0	TMS–4	$0
TM0–D0	$0	TMS–5a	$0
TM0–E0	$0	TMS–5b	$36,636,302
TMS–1a	$34,651,547	TMS–5c	$114,795,639
TMS–1b	$0	TMR–01	$0
TMS–1c	$12,515,813	TMR–02	$0
TMS–2	$15,438,462	TMR–03	$0
		TMR–04	$0
		WTR–02	$0
		WT0–C1	$0
		WTS–5	$0

TOTAL $3,403,184,972

10–Feb–94

TORONTO-MONTRÉAL

D2. 300+ km/hr - EXISTING RIGHTS-OF-WAY

Segment Summary Cost Table

Segment Detailed Cost Report

Table 5.6

SUBSYSTEM/SECTOR COST SUMMARY

TORONTO – MONTRÉAL ALIGNMENT **300+, EXISTING ROW** TORONTO – MONTRÉAL

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$23,756,855	$247,467,243	N/A	N/A	see note c	$271,224,098	$26,456,498
B – Earthworks and Drainage	$170,418,455	N/A	N/A	$772,515,818	see note c	$942,934,273	$100,762,933
C – Bridges, Viaducts, and Tunnels	$87,284,033	N/A	N/A	$530,054,250	see note c	$617,338,283	$48,186,750
D – Grade Separations	$143,604,384	N/A	N/A	$872,073,750	see note c	$1,015,678,134	$113,748,750
E – Other Accom–modation works	$4,375,171	see note a	see note a	$26,569,324	see note c	$30,944,495	$6,131,382
F – Track	$69,089,825	$387,099,143	see note b	$89,593,375	see note c	$545,782,342	$23,504,616
G – Electrification	$66,154,714	see note a	see note a	$401,741,144	see note c	$467,895,858	$52,401,019
H – Stations	$14,672,097	see note a	see note a	$89,100,000	see note c	$103,772,097	$8,100,000
Totals	$579,355,534	$634,566,386	$0	$2,781,647,660	see note c	$3,995,569,581	$379,291,948

NOTES: a) included in Construction / Installation
b) included in Equipment / Material
c) included in Other Studies

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology: 300+, EXISTING ROW — 591.065 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM A – RIGHT-OF-WAY ACQUISITION					
	TORONTO – MONTRÉAL ALIGNMENT 300+, EXISTING ROW					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Professional Services					
1 1.1	– Surveying	%	$247,467,243	8%	$19,797,379	As a % of total cost of Sector 2
1 1.2	– Appraisal	%	$247,467,243	0%	$0	included in Item 1.1
1 1.3	– Legal Expertise	%	$247,467,243	0%	$0	included in Item 1.1
1 Item 2	Project Management	%	$267,264,623	0%	$0	As % of Sector 2 total + item 1.1
1 Item X	Contingencies	%	$19,797,379	20%	$3,959,476	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$23,756,855	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2 Item 1	Urban Land					
2 1.1	– Residential	lump sum			100,034,534	unit cost not applicable
2 1.2	– Commercial	lump sum			1,251,200	unit cost not applicable
2 1.3	– Industrial	lump sum			94,760,500	unit cost not applicable
2 Item 2	Rural Land					
2 2.1	– Agricultural	lump sum			14,354,265	unit cost not applicable
2 2.2	– Natural	lump sum			542,508	unit cost not applicable
2 Item 3	Purchase of Existing Rail ROW					
2 3.1	– CN	lump sum			13,482,375	unit cost not applicable
2 3.2	– CP	lump sum			68,214	unit cost not applicable
2 3.3	– VIA	lump sum			476,625	unit cost not applicable
2 Item X	Contingencies	%	$224,970,221	10%	22,497,022	
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$247,467,243	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Not Applicable				
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4		Not Applicable				
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$0	
5 SECTOR 5	START-UP					
5		Included in Other Studies				
5						
5 SECTOR 5	TOTAL: START-UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology:
300+, EXISTING ROW — 591.065 km. in length

SUBSYSTEM: B – EARTHWORKS AND DRAINAGE

TORONTO – MONTRÉAL ALIGNMENT 300+, EXISTING ROW

ITEM NUMBER		ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	$772,515,818	5.5%	42,488,370	As a % of total cost of Sector 2
1	Item 2	Construction Supervision	%	$772,515,818	5.0%	38,625,791	As a % of total cost of Sector 2
1	Item 3	Environmental Assessment	%	$3,416,214,047	0.2%	6,832,428	Items 3 and 4 are %'s of entire
1	Item 4	Feasibility Studies (Technical)	%	$3,416,214,047	1.0%	34,162,140	project's cost less profes. fees
1	Item 5	Project Management	%	$894,624,547	5.4%	48,309,726	% of sector 2 total plus items 1–4
1	Item X	Contingencies	%	$170,418,455	0%	0	
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$170,418,455	
2	SECTOR 2	EQUIPMENT / MATERIALS					
2		Not Applicable					
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Not Applicable					
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	Clearing and Roadbed Preparation					
4	1.1	– Type 1 Soils	route–km	268.8	142,000	38,173,860	
4	1.2	– Type 2 Soils	route–km	256.5	627,000	160,806,690	
4	1.3	– Type 3 Soils	route–km	49.5	1,035,000	51,273,900	
4	Item 2	Embankment Construction					
4	2.1	– Soft Excavated Material	1000 m^3	7,003	3,000	21,008,430	
4	2.2	– Hard Excavated Material (Rock)	1000 m^3	4,653	18,000	83,754,000	
4	2.3	– Borrow Material	1000 m^3	2,374	8,000	18,992,080	
4	2.4	– Disposal of Unsuitable Material	1000 m^3	5,967	5,500	32,820,370	
4	Item 3	Haulage of Fill Material					
4		(from Borrow or Excavation)	1000 m^3–	0	0	0	Cost transferred to item B4–2
4	Item 4	Sub– Ballast Layers					For TM2–B0,TM2–D0,TM1–B0,
4	4.1	– New ROW	route–km	409.5	192,316	78,753,480	TM1–D0,TM0–B0,TM0–B1,
4	4.2	– Existing ROW	route–km	166.2	218,045	36,231,480	TM0–C0,and TM0–D0, $152,000
4	Item 5	Drainage Systems					used for cost of sub–ballast(it. 4)
4	5.1	– Normal ROW	route–km	571.2	25,000	14,281,000	
4	5.2	– Major Watercourse Culverts	ea.	271	35,000	9,485,000	
4	5.3	– Environment. Stormwater Controls	route–km	539.3	7,000	3,775,065	
4	Item 6	Roadbed Upgrade on Existing ROW	route–km	37.1	600,000	22,251,000	
4	Item 7	Retaining Structures					
4	7.1	– Up to 3 metres in Height	km.	3.0	2,500,000	7,575,000	
4	7.2	– Over 3 metres in Height	km.	3.4	5,000,000	17,050,000	
4	Item 8	Intrusion Barriers	km.	0.0	0	0	Intrusion Barriers not required
4	Item 9	Noise Attenuation Structures					
4	9.1	– Barriers	km.	52.4	660,000	34,584,000	
4	9.2	– Berms	km.	0.0	0	0	
4	Item 10	ROW Security Fencing (on both sides)	route–km	548.6	56,000	30,721,880	
4	Item 11	Snow Control Measures	km.	0.0	0	0	Accounted for in Contingencies
4	Item 12	Utility Interferences					
4	12.1	– Major Hydro Relocation	ea.	43	0	0	Accounted for in Contingencies
4	12.2	– Major Oil/Gas Relocation	ea.	9	0	0	Accounted for in Contingencies
4	12.3	– Minor Pipe or Wire Crossings	route–km	111.0	0	0	Accounted for in Contingencies
4	Item 13	Other Items					
4	13.1	– Audit for Contaminated Soil	route–km	557.8	2,000	1,115,650	
4	13.2	– Audit for Existing Rail Yards	ea.	9	500,000	4,500,000	
4	13.3	– Minor Wildlife Passages (Culverts)	ea.	46	100,000	4,600,000	
4	Item X	Contingencies	%	$671,752,885	15%	100,762,933	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$772,515,818	
5	SECTOR 5	START–UP					
5		Included in Other Studies					
5							
5	SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology:
300+, EXISTING ROW — 591.065 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: C – BRIDGES, VIADUCTS, AND TUNNELS					
	TORONTO – MONTRÉAL ALIGNMENT 300+, EXISTING ROW					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$530,054,250	5.5%	29,152,984	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$530,054,250	5.0%	26,502,713	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$585,709,946	5.4%	31,628,337	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$87,284,033	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$87,284,033	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Bridges					
4 1.1	– Small Rivers (< 30 metres)	ea.	17	340,000	5,780,000	
4 1.2	– Extra at 1.1 for Height Over 10 m.	ea.	0	0	0	
4 1.3	– Interm. Rivers (30 – 100 metres)	lin. m.	465	23,500	10,927,500	
4 1.4	– Extra at 1.3 for Height Over 10 m.	lin. m.	115	6,000	690,000	
4 1.5	– Large Rivers (100 – 250 metres)	lin. m.	860	42,000	36,120,000	
4 1.6	– Extra at 1.5 for Height Over 10 m.	lin. m.	150	10,500	1,575,000	
4 1.7	– Major Rivers (over 250 m.)	lin. m.	3,250	50,000	162,500,000	
4 1.8	– Extra for Difficult Foundation Cond.	lin. m.	1,100	5,000	5,500,000	
4 1.9	– Modif. to Exist. Bridges (new deck)	lin. m.	510	13,000	6,630,000	
4 Item 2	Viaducts					
4 2.1	– Viaducts over 250 metres in Length	lin. m.	3,100	27,000	83,700,000	
4 2.2	– Extra for Height Over XX metres	lin. m.	700	8,000	5,600,000	
4 2.3	– Extra for Difficult Foundation Cond.	lin. m.	2,900	4,000	11,600,000	
4 Item 3	Tunnels (Double Track)					
4 3.1	– In Soft Ground	lin. m.	0	0	0	For 300+ technology, Rock
4 3.2	– In Rock	lin. m.	3,807	39,728	151,245,000	Tunnels speed restricted by local
4 3.3	– Modifications to Existing Tunnels	lump sum	0		0	conditions are $35,000/lin m.
4 3.4	– Noise Mitigation Measures	lump sum	0		0	Accounted for in Contingencies
4 Item X	Contingencies	%	$481,867,500	10%	48,186,750	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$530,054,250	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology:
300+, EXISTING ROW — 591.065 km. in length

SUBSYSTEM: D – GRADE SEPARATIONS

TORONTO – MONTRÉAL ALIGNMENT 300+, EXISTING ROW

ITEM NUMBER		ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	$872,073,750	5.5%	47,964,056	As a % of total cost of Sector 2
1	Item 2	Construction Supervision	%	$872,073,750	5.0%	43,603,688	As a % of total cost of Sector 2
1	Item 3	Project Management	%	$963,641,494	5.4%	52,036,641	% of sector 2 total plus items 1–2
1	Item X	Contingencies	%	$143,604,384	0%	0	
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$143,604,384	
2	SECTOR 2	EQUIPMENT / MATERIALS					
2		Not Applicable					
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Not Applicable					
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	New Grade Separations, Rural					
4	1.1	– 2 Lane Highways	ea.	182	$2,200,000	400,400,000	
4	1.2	– 2 Lane Highways, Dual ROW	ea.	31	$2,800,000	86,800,000	
4	1.3	– 4 Lane Highways	ea.	5	$3,100,000	15,500,000	
4	1.4	– 4 Lane Highways, Dual ROW	ea.	0	$0	0	
4	1.5	– Major Highways (401, 20, etc)	ea.	6	$4,450,000	26,700,000	
4	1.6	– Extra for Difficult Foundation Cond.	ea.	11	$180,000	1,980,000	
4	Item 2	New Grade Separations, Urban					
4	2.1	– Secondary Highways (2–4 lanes)	ea.	16	$4,068,000	65,088,000	
4	2.2	– Second. Hwys (2–4 l.) Dual ROW	ea.	8	$4,456,000	35,648,000	
4	2.3	– Major Highways (over 4 lanes)	ea.	5	$5,300,000	26,500,000	
4	2.4	– Extra for Difficult Foundation Cond.	ea.	0	$0	0	
4	Item 3	Modification of Exist. Grade Separations					
4	3.1	– Urban	ea.	55	$830,000	45,650,000	
4	3.2	– Rural	ea.	19	$627,000	11,913,000	
4	Item 4	Automatic Crossing Protection	ea.	28	$270,000	7,560,000	
4	Item 5	Closure and Diversion of Roads	km. of road	15	$280,000	4,186,000	
4	Item 6	Private Farm Crossings	ea.	98	$300,000	29,400,000	
4	Item 7	Wildlife Passages	ea.	2	$500,000	1,000,000	
4	Item X	Contingencies	%	$758,325,000	15%	113,748,750	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$872,073,750	
5	SECTOR 5	START–UP					
5		Included in Other Studies					
5							
5	SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology:
300+, EXISTING ROW — 591.065 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	**E – OTHER ACCOMODATION WORKS**				
		TORONTO – MONTRÉAL ALIGNMENT			300+, EXISTING ROW	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$26,569,324	5.5%	1,461,313	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$26,569,324	5.0%	1,328,466	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$29,359,103	5.4%	1,585,392	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$4,375,171	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$4,375,171	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2		Included in Construction / Installation				
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Construction / Installation				
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Removal of Rail Lines	km.	79.5	$21,134	1,679,942	
4 Item 2	Construction of New Access Tracks	km.	8.0	$644,750	5,158,000	
4 Item 3	Rail/Rail Grade Separation					
4 3.1	– Rural	ea.	17	$800,000	13,600,000	
4 3.2	– Urban	ea.	0	$0	0	
4 Item 4	Other Particular Items:					
4 4.1	– Sub–Item	lump sum	0		0	
4 4.2	– Sub–Item	lump sum	0		0	
4 4.3	– Sub–Item	lump sum	0		0	
4 4.4	– Sub–Item	lump sum	0		0	
4 Item X	Contingencies	%	$20,437,942	30%	6,131,382	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$26,569,324	
5 SECTOR 5	START–UP					
5		Included in Other Studies				
5						
5 SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTRÉAL ALIGNMENT — SUMMARY SHEET

technology:
300+, EXISTING ROW — 591.065 km. in length

SUBSYSTEM — F – TRACK

TORONTO – MONTRÉAL ALIGNMENT 300+, EXISTING ROW

ITEM NUMBER		ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	$476,692,518	3.5%	16,684,238	As % of total for Sectors 2 and 4
1	Item 2	Construction Supervision	%	$89,593,375	10.0%	8,959,337	As % of total for Sector 4
1	Item 3	Materials Procurement	%	$387,099,143	4.0%	15,483,966	As % of total for Sector 2
1	Item 4	Project Management	%	$517,820,059	5.4%	27,962,283	As % of Sectors 2,4 totals plus
1	Item X	Contingencies	%	$69,089,825	0%	0	items 1–3
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$69,089,825	
2	SECTOR 2	EQUIPMENT / MATERIALS					
2	Item 1	Rail					
2	1.1	– Main Line	t.	144,740	$773	111,944,811	
2	1.2	– Siding	t.	4,180	$773	3,232,896	
2	Item 2	Ties	ea.	2,067,600	$45	92,607,804	
2	Item 3	Ballast	m ^ 3	2,578,000	$21	55,091,860	
2	Item 4	Turnouts					
2	4.1	– High Speed	ea.	88	$280,000	24,640,000	
2	4.2	– Medium Speed	ea.	70	$135,000	9,450,000	
2	4.3	– Yard	ea.	5	$46,000	230,000	
2	Item 5	Other Track Material					
2	5.1	– Rail Fastening Assemblies	set	2,067,600	$27	54,791,400	
2	5.2	– Bonded Insulated Joints	ea.	0	$0	0	Included in Signalling costs
2	5.3	– Bumping Posts	ea.	9	$3,120	28,080	
2	Item 6	Switch Heaters/ Snow Blowers					
2	6.1	– Main Line	ea.	158	$105,000	16,590,000	
2	6.2	– Yard	ea.	5	$11,800	59,000	
2	Item 7	Ballast Mats for Noise Attenuation	m ^ 2	0	$0	0	
2	Item X	Contingencies	%	$368,665,850	5%	18,433,293	
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$387,099,143	
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Equipment / Material					
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	Track Construction					
4	1.1	– Main Line	km.	1,182.1	18,212	21,528,587	
4	1.2	– Siding	km.	33.6	44,175	1,484,280	
4	Item 2	Field Welded Joints	ea.	8,130	2,028	16,487,640	
4	Item 3	Turnout Construction					
4	3.1	– High and Med. Speed (Main Line)	ea.	158	20,455	3,231,890	
4	3.2	– Yard	ea.	5	4,680	23,400	
4	Item 4	Ballasting and Surfacing	m ^ 3	2,578,000	8	21,835,660	
4	Item 5	Rail Grinding	track – km.	1,215.7	4,545	5,525,402	
4	Item 6	Construction Bases	route–km	591.1	24,372	14,405,192	
4	Item X	Contingencies	%	$84,522,052	6%	5,071,323	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$89,593,375	
5	SECTOR 5	START–UP					
5		Included in Other Studies					
5							
5	SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTRÉAL ALIGNMENT — SUMMARY SHEET

technology:
300+, EXISTING ROW — 591.065 km. in length

SUBSYSTEM: G – ELECTRIFICATION

TORONTO – MONTRÉAL ALIGNMENT 300+. EXISTING ROW

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$401,741,144	5.5%	22,095,763	As % of total for Sector 4
1 Item 2	Construction Supervision	%	$401,741,144	5.0%	20,087,057	As % of total for Sector 4
1 Item 3	Project Management	%	$443,923,964	5.4%	23,971,894	% of sector 4 total plus items 1–2
1 Item X	Contingencies	%	$66,154,714	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$66,154,714	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Included in Construction / Installation					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Included in Construction / Installation					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Typical Catenary					
4 1.1	– Single Track – Independent Struct.	km.	0.0	0	0	
4 1.2	– Double Track – Independ. Struct.	km.	591.1	350,000	206,869,250	
4 1.3	– Double Track – Portal Structures	km.	0.0	0	0	
4 1.4	– Triple Track – Portal Structures	km.	0.0	0	0	
4 1.5	– Yard Catenary	100 m.	0	0	0	
4 1.6	– Sidings Catenary	100 m.	50	13,500	675,000	
4 1.7	– Garage Area Catenary	100 m.	0	0	0	
4 1.8	– In–Station Catenary	100 m.	286	17,500	5,005,000	
4 Item 2	Particular Catenary Installations					
4 2.1	– Xover Single (with section breaks)	ea.	43	280,000	12,040,000	
4 2.2	– Xover Double (with section breaks)	ea.	18	369,000	6,642,000	
4 2.3	– Phase Break	ea.	10	1,052,000	10,520,000	
4 Item 3	Special Catenary Structures					
4 3.1	– Underbridge	100 m.	0	0	0	
4 3.2	– Overbridge	100 m.	0	0	0	
4 Item 4	Power Supply					
4 4.1	– Main Supply Station, 230 kV	ea.	4	5,355,000	21,420,000	
4 4.2	– Main Supply Station, 138 – 120 kV	ea.	5	4,075,000	20,375,000	
4 4.3	– Paralleling and Auto–transf. Stn	ea.	61	730,000	44,530,000	
4 4.4	– 2x25 – 1x25 Interface Station	ea.	4	925,000	3,700,000	
4 4.5	not used	ea.	0	0	0	
4 4.6	– Main Supply Station, 315 kV	ea.	1	6,380,000	6,380,000	
4 4.7	– 315 kV Supply Line	ea.	0	0	0	
4 4.8	– 230 kV Supply Line	km.	25	170,300	4,257,500	
4 4.9	– 120 kV Supply Line	km.	26	132,200	3,371,100	
4 4.10	– Control Center	ea.	3	200,000	600,000	
4 Item 5	EMI Mitigation Measures	route–km	591.1	5,000	2,955,275	
4 Item X	Contingencies	%	$349,340,125	15%	52,401,019	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$401,741,144	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology:
300+, EXISTING ROW — 591.065 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: H – STATIONS					
	TORONTO – MONTRÉAL ALIGNMENT 300+, EXISTING ROW					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$89,100,000	5.5%	4,900,500	As a % of total for Sector 2
1 Item 2	Construction Supervision	%	$89,100,000	5.0%	4,455,000	As a % of total for Sector 2
1 Item 3	Project Management	%	$98,455,500	5.4%	5,316,597	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$14,672,097	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$14,672,097	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2		Included in Construction / Installation				
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Construction / Installation				
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Individual Stations	lump sum		$0	81,000,000	
4 Item 2	People Movers	lump sum		$0	0	used at Pearson and Dorval only
4 Item 3	not used	lump sum		$0	0	
4 Item 4	not used	lump sum		$0	0	
4 Item X	Contingencies	%	$81,000,000	10%	8,100,000	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$89,100,000	
5 SECTOR 5	START–UP					
5		Included in Other Studies				
5						
5 SECTOR 5	TOTAL: START–UP				$0	

Toronto – Montréal Corridor		300+, EXISTING ROW	
segment	total cost	segment	total cost
TM2–A0	$0	TMS–3a	$19,239,160
TM2–B0	$0	TMS–3b	$26,939,577
TM2–C0	$0	TMS–DIV	
TM2–D0	$0	TM2–G0	$0
TM2–E0	$0	TM2–H0	$0
TM2–F0	$0	TM1–H0	$207,831,571
TM1–A0	$523,802,011	TM1–H1	$0
TM1–B0	$1,330,388,161	TM1–I0	$162,420,364
TM1–C0	$549,504,663	TM1–I1	$0
TM1–D0	$88,665,935	TM1–J0	$212,551,924
TM1–E0	$262,187,935	TM0–F0	$0
TM1–F0	$399,672,943	TM0–F1	$0
TM1–G0	$75,502,243	TM0–F2	$0
TM0–A0	$0		
TM0–A1	$0	TM0–G0	$0
TM0–A2	$0	TM0–G1	$0
TM0–B0	$0	TM0–H0	$0
TM0–B1	$0	TMS–3c	$0
TM0–C0	$0	TMS–4	$18,961,954
TM0–D0	$0	TMS–5a	$18,659,014
TM0–E0	$0	TMS–5b	$36,636,302
TMS–1a	$34,651,547	TMS–5c	$0
TMS–1b	$0	TMR–01	$0
TMS–1c	$12,515,813	TMR–02	$0
TMS–2	$15,438,462	TMR–03	$0
		TMR–04	$0
		WTR–02	$0
		WT0–C1	$0
		WTS–5	$0

TOTAL $3,995,569,581

TORONTO-MONTRÉAL

D3. 300+ km/hr - NEW RIGHTS-OF-WAY

Segment Summary Cost Table

Segment Detailed Cost Report

Table 6.6

SUBSYSTEM/SECTOR COST SUMMARY

TORONTO – MONTRÉAL ALIGNMENT **300+, NEW ROW** TORONTO – MONTRÉAL

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$18,664,318	$194,419,975	N/A	N/A	see note c	$213,084,292	$20,785,263
B – Earthworks and Drainage	$203,304,073	N/A	N/A	$878,814,814	see note c	$1,082,118,887	$114,628,019
C – Bridges, Viaducts, and Tunnels	$281,538,975	N/A	N/A	$1,709,716,250	see note c	$1,991,255,225	$155,428,750
D – Grade Separations	$133,203,778	N/A	N/A	$808,913,450	see note c	$942,117,228	$105,510,450
E – Other Accom–modation works	$7,524,806	see note a	see note a	$45,696,280	see note c	$53,221,086	$10,545,295
F – Track	$71,120,904	$398,311,251	see note b	$92,340,882	see note c	$561,773,037	$24,194,045
G – Electrification	$68,339,927	see note a	see note a	$415,011,396	see note c	$483,351,323	$54,131,921
H – Stations	$14,672,097	see note a	see note a	$89,100,000	see note c	$103,772,097	$8,100,000
Totals	$798,368,877	$592,731,226	$0	$4,039,593,072	see note c	$5,430,693,175	$493,323,743

NOTES: a) included in Construction / Installation
b) included in Equipment / Material
c) included in Other Studies

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology:
300+, NEW ROW — 613.015 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: A – RIGHT-OF-WAY ACQUISITION					
	TORONTO – MONTRÉAL ALIGNMENT 300+, NEW ROW					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Professional Services					
1 1.1	– Surveying	%	$194,419,975	8%	$15,553,598	As a % of total cost of Sector 2
1 1.2	– Appraisal	%	$194,419,975	0%	$0	included in Item 1.1
1 1.3	– Legal Expertise	%	$194,419,975	0%	$0	included in Item 1.1
1 Item 2	Project Management	%	$209,973,573	0%	$0	As % of Sector 2 total + item 1.1
1 Item X	Contingencies	%	$15,553,598	20%	$3,110,720	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$18,664,318	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2 Item 1	Urban Land					
2 1.1	– Residential	lump sum			77,656,185	unit cost not applicable
2 1.2	– Commercial	lump sum			9,051,200	unit cost not applicable
2 1.3	– Industrial	lump sum			47,546,917	unit cost not applicable
2 Item 2	Rural Land					
2 2.1	– Agricultural	lump sum			22,302,660	unit cost not applicable
2 2.2	– Natural	lump sum			1,222,010	unit cost not applicable
2 Item 3	Purchase of Existing Rail ROW					
2 3.1	– CN	lump sum			18,905,542	unit cost not applicable
2 3.2	– CP	lump sum			60,918	unit cost not applicable
2 3.3	– VIA	lump sum			0	unit cost not applicable
2 Item X	Contingencies	%	$176,745,432	10%	17,674,543	
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$194,419,975	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Not Applicable				
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4		Not Applicable				
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$0	
5 SECTOR 5	START-UP					
5		Included in Other Studies				
5 SECTOR 5	TOTAL: START-UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology: 300+, NEW ROW — 613.015 km. in length

SUBSYSTEM: B – EARTHWORKS AND DRAINAGE

TORONTO – MONTRÉAL ALIGNMENT 300+, NEW ROW

ITEM NUMBER	ITEM		UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT						
1 Item 1	Engineering		%	$878,814,814	5.5%	48,334,815	As a % of total cost of Sector 2
1 Item 2	Construction Supervision		%	$878,814,814	5.0%	43,940,741	As a % of total cost of Sector 2
1 Item 3	Environmental Assessment		%	$4,632,324,298	0.2%	9,264,649	Items 3 and 4 are %'s of entire
1 Item 4	Feasibility Studies (Technical)		%	$4,632,324,298	1.0%	46,323,243	project's cost less profes. fees
1 Item 5	Project Management		%	$1,026,678,261	5.4%	55,440,626	% of sector 2 total plus items 1–4
1 Item X	Contingencies		%	$203,304,073	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT					$203,304,073	
2 SECTOR 2	EQUIPMENT / MATERIALS						
			Not Applicable				
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS					$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION						
			Not Applicable				
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION					$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION						
4 Item 1	Clearing and Roadbed Preparation						
4	1.1	– Type 1 Soils	route–km	391.5	128,989	50,502,980	
4	1.2	– Type 2 Soils	route–km	147.6	556,403	82,136,240	
4	1.3	– Type 3 Soils	route–km	40.4	1,000,141	40,385,700	
4 Item 2	Embankment Construction						
4	2.1	– Soft Excavated Material	1000 m ^ 3	16,024	3,000	48,073,230	
4	2.2	– Hard Excavated Material (Rock)	1000 m ^ 3	10,676	18,000	192,168,000	
4	2.3	– Borrow Material	1000 m ^ 3	683	8,000	5,464,080	
4	2.4	– Disposal of Unsuitable Material	1000 m ^ 3	6,042	5,500	33,232,870	
4 Item 3	Haulage of Fill Material						
4		(from Borrow or Excavation)	1000 m ^ 3–	0	0	0	Cost transferred to item B4–2
4 Item 4	Sub– Ballast Layers						For TM2–B0,TM2–D0,TM1–B0,
4	4.1	– New ROW	route–km	511.2	185,751	94,962,380	TM1–D0,TM0–B0,TM0–B1,
4	4.2	– Existing ROW	route–km	84.0	205,666	17,272,900	TM0–C0,and TM0–D0, $152,000
4 Item 5	Drainage Systems						used for cost of sub–ballast(it. 4)
4	5.1	– Normal ROW	route–km	576.8	25,000	14,420,750	
4	5.2	– Major Watercourse Culverts	ea.	300	35,000	10,500,000	
4	5.3	– Environment. Stormwater Controls	route–km	561.9	7,000	3,933,615	
4 Item 6	Roadbed Upgrade on Existing ROW		route–km	45.2	600,000	27,111,000	
4 Item 7	Retaining Structures						
4	7.1	– Up to 3 metres in Height	km.	13.2	2,500,000	33,075,000	
4	7.2	– Over 3 metres in Height	km.	10.7	5,000,000	53,550,000	
4 Item 8	Intrusion Barriers		km.	0.0	0	0	Intrusion Barriers not required
4 Item 9	Noise Attenuation Structures						
4	9.1	– Barriers	km.	23.4	660,000	15,444,000	
4	9.2	– Berms	km.	0.0	0	0	
4 Item 10	ROW Security Fencing (on both sides)		route–km	583.8	56,000	32,693,080	
4 Item 11	Snow Control Measures		km.	0.0	0	0	Accounted for in Contingencies
4 Item 12	Utility Interferences						
4	12.1	– Major Hydro Relocation	ea.	47	0	0	Accounted for in Contingencies
4	12.2	– Major Oil/Gas Relocation	ea.	13	0	0	Accounted for in Contingencies
4	12.3	– Minor Pipe or Wire Crossings	route–km	82.0	0	0	Accounted for in Contingencies
4 Item 13	Other Items						
4	13.1	– Audit for Contaminated Soil	route–km	580.5	2,000	1,160,970	
4	13.2	– Audit for Existing Rail Yards	ea.	6	500,000	3,000,000	
4	13.3	– Minor Wildlife Passages (Culverts)	ea.	51	100,000	5,100,000	
4 Item X	Contingencies		%	$764,186,795	15%	114,628,019	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION					$878,814,814	
5 SECTOR 5	START–UP						
			Included in Other Studies				
5 SECTOR 5	TOTAL: START–UP					$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology: 300+, NEW ROW — 613.015 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: C – BRIDGES, VIADUCTS, AND TUNNELS					
	TORONTO – MONTRÉAL ALIGNMENT 300+, NEW ROW					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$1,709,716,250	5.5%	94,034,394	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$1,709,716,250	5.0%	85,485,813	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$1,889,236,456	5.4%	102,018,769	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$281,538,975	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$281,538,975	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Bridges					
4 1.1	– Small Rivers (< 30 metres)	ea.	18	340,000	6,120,000	
4 1.2	– Extra at 1.1 for Height Over 10 m.	ea.	5	85,000	425,000	
4 1.3	– Interm. Rivers (30 – 100 metres)	lin. m.	605	23,500	14,217,500	
4 1.4	– Extra at 1.3 for Height Over 10 m.	lin. m.	50	6,000	300,000	
4 1.5	– Large Rivers (100 – 250 metres)	lin. m.	1,350	42,000	56,700,000	
4 1.6	– Extra at 1.5 for Height Over 10 m.	lin. m.	500	10,500	5,250,000	
4 1.7	– Major Rivers (over 250 m.)	lin. m.	4,100	50,000	205,000,000	
4 1.8	– Extra for Difficult Foundation Cond.	lin. m.	1,160	5,000	5,800,000	
4 1.9	– Modif. to Exist. Bridges (new deck)	lin. m.	510	13,000	6,630,000	
4 Item 2	Viaducts					
4 2.1	– Viaducts over 250 metres in Length	lin. m.	5,700	27,000	153,900,000	
4 2.2	– Extra for Height Over XX metres	lin. m.	1,900	8,000	15,200,000	
4 2.3	– Extra for Difficult Foundation Cond.	lin. m.	0	0	0	
4 Item 3	Tunnels (Double Track)					
4 3.1	– In Soft Ground	lin. m.	3,400	70,000	238,000,000	For 300+ technology, Rock
4 3.2	– In Rock	lin. m.	17,357	47,747	828,745,000	Tunnels speed restricted by local
4 3.3	– Modifications to Existing Tunnels	lump sum	0		18,000,000	conditions are $35,000/lin m.
4 3.4	– Noise Mitigation Measures	lump sum	0		0	Accounted for in Contingencies
4 Item X	Contingencies	%	$1,554,287,500	10%	155,428,750	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$1,709,716,250	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology:
300+, NEW ROW — 613.015 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM D – GRADE SEPARATIONS					
	TORONTO – MONTRÉAL ALIGNMENT 300+, NEW ROW					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$808,913,450	5.5%	44,490,240	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$808,913,450	5.0%	40,445,673	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$893,849,362	5.4%	48,267,866	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$133,203,778	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$133,203,778	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	New Grade Separations, Rural					
4 1.1	– 2 Lane Highways	ea.	215	$2,200,000	473,000,000	
4 1.2	– 2 Lane Highways, Dual ROW	ea.	2	$2,800,000	5,600,000	
4 1.3	– 4 Lane Highways	ea.	4	$3,100,000	12,400,000	
4 1.4	– 4 Lane Highways, Dual ROW	ea.	0	$0	0	
4 1.5	– Major Highways (401, 20, etc)	ea.	3	$4,450,000	13,350,000	
4 1.6	– Extra for Difficult Foundation Cond.	ea.	9	$180,000	1,620,000	
4 Item 2	New Grade Separations, Urban					
4 2.1	– Secondary Highways (2–4 lanes)	ea.	15	$4,068,000	61,020,000	
4 2.2	– Second. Hwys (2–4 l.) Dual ROW	ea.	8	$4,456,000	35,648,000	
4 2.3	– Major Highways (over 4 lanes)	ea.	1	$5,300,000	5,300,000	
4 2.4	– Extra for Difficult Foundation Cond.	ea.	0	$0	0	
4 Item 3	Modification of Exist. Grade Separations					
4 3.1	– Urban	ea.	40	$830,000	33,200,000	
4 3.2	– Rural	ea.	13	$627,000	8,151,000	
4 Item 4	Automatic Crossing Protection	ea.	24	$270,000	6,480,000	
4 Item 5	Closure and Diversion of Roads	km. of road	17	$280,000	4,634,000	
4 Item 6	Private Farm Crossings	ea.	140	$300,000	42,000,000	
4 Item 7	Wildlife Passages	ea.	2	$500,000	1,000,000	
4 Item X	Contingencies	%	$703,403,000	15%	105,510,450	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$808,913,450	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT SUMMARY SHEET

technology:
300+, NEW ROW 613.015 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	**E – OTHER ACCOMODATION WORKS**				
		TORONTO – MONTRÉAL ALIGNMENT 300+, NEW ROW				
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$45,696,280	5.5%	2,513,295	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$45,696,280	5.0%	2,284,814	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$50,494,389	5.4%	2,726,697	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$7,524,806	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$7,524,806	
2 SECTOR 2	EQUIPMENT / MATERIALS					
		Included in Construction / Installation				
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
		Included in Construction / Installation				
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Removal of Rail Lines	km.	50.9	$21,134	1,075,509	
4 Item 2	Construction of New Access Tracks	km.	36.1	$644,750	23,275,475	
4 Item 3	Rail/Rail Grade Separation					
4 3.1	– Rural	ea.	11	$800,000	8,800,000	
4 3.2	– Urban	ea.	2	$1,000,000	2,000,000	
4 Item 4	Other Particular items:					
4 4.1	– Sub–Item	lump sum	0		0	
4 4.2	– Sub–Item	lump sum	0		0	
4 4.3	– Sub–Item	lump sum	0		0	
4 4.4	– Sub–Item	lump sum	0		0	
4 Item X	Contingencies	%	$35,150,984	30%	10,545,295	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$45,696,280	
5 SECTOR 5	START–UP					
		Included in Other Studies				
5 SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology:
300+, NEW ROW — 613.015 km. in length

SUBSYSTEM: F – TRACK

TORONTO – MONTRÉAL ALIGNMENT 300+, NEW ROW

	ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	$490,652,133	3.5%	17,172,825	As % of total for Sectors 2 and 4
1	Item 2	Construction Supervision	%	$92,340,882	10.0%	9,234,088	As % of total for Sector 4
1	Item 3	Materials Procurement	%	$398,311,251	4.0%	15,932,450	As % of total for Sector 2
1	Item 4	Project Management	%	$532,991,496	5.4%	28,781,541	As % of Sectors 2,4 totals plus
1	Item X	Contingencies	%	$71,120,904	0%	0	items 1–3
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$71,120,904	
2	SECTOR 2	EQUIPMENT / MATERIALS					
2	Item 1	Rail					
2	1.1	– Main Line	t.	150,100	$773	116,090,342	
2	1.2	– Siding	t.	4,050	$773	3,132,351	
2	Item 2	Ties	ea.	2,140,400	$45	95,868,516	
2	Item 3	Ballast	m^3	2,668,000	$21	57,015,160	
2	Item 4	Turnouts					
2	4.1	– High Speed	ea.	88	$280,000	24,640,000	
2	4.2	– Medium Speed	ea.	68	$135,000	9,180,000	
2	4.3	– Yard	ea.	5	$46,000	230,000	
2	Item 5	Other Track Material					
2	5.1	– Rail Fastening Assemblies	set	2,140,400	$27	56,720,600	
2	5.2	– Bonded Insulated Joints	ea.	0	$0	0	Included in Signalling costs
2	5.3	– Bumping Posts	ea.	9	$3,120	28,080	
2	Item 6	Switch Heaters/ Snow Blowers					
2	6.1	– Main Line	ea.	156	$105,000	16,380,000	
2	6.2	– Yard	ea.	5	$11,800	59,000	
2	Item 7	Ballast Mats for Noise Attenuation	m^2	0	$0	0	
2	Item X	Contingencies	%	$379,344,049	5%	18,967,202	
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$398,311,251	
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Equipment / Material					
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	Track Construction					
4	1.1	– Main Line	km.	1,226.0	18,212	22,328,094	
4	1.2	– Siding	km.	32.6	44,175	1,440,105	
4	Item 2	Field Welded Joints	ea.	8,320	2,028	16,872,960	
4	Item 3	Turnout Construction					
4	3.1	– High and Med. Speed (Main Line)	ea.	156	20,455	3,190,980	
4	3.2	– Yard	ea.	5	4,680	23,400	
4	Item 4	Ballasting and Surfacing	m^3	2,668,000	8	22,597,960	
4	Item 5	Rail Grinding	track – km.	1,258.6	4,545	5,720,382	
4	Item 6	Construction Bases	route–km	613.0	24,372	14,940,158	
4	Item X	Contingencies	%	$87,114,039	6%	5,226,842	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$92,340,882	
5	SECTOR 5	START–UP					
5		Included in Other Studies					
5							
5	SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology:
300+, NEW ROW — 613.015 km. in length

SUBSYSTEM — G – ELECTRIFICATION

TORONTO – MONTRÉAL ALIGNMENT 300+, NEW ROW

ITEM NUMBER		ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	$415,011,396	5.5%	22,825,627	As % of total for Sector 4
1	Item 2	Construction Supervision	%	$415,011,396	5.0%	20,750,570	As % of total for Sector 4
1	Item 3	Project Management	%	$458,587,593	5.4%	24,763,730	% of sector 4 total plus items 1–2
1	Item X	Contingencies	%	$68,339,927	0%	0	
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$68,339,927	
2	SECTOR 2	EQUIPMENT / MATERIALS					
2		Included in Construction / Installation					
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Construction / Installation					
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	Typical Catenary					
4	1.1	– Single Track – independent Struct.	km.	0.0	0	0	
4	1.2	– Double Track – independ. Struct.	km.	613.0	350,000	214,551,750	
4	1.3	– Double Track – Portal Structures	km.	0.0	0	0	
4	1.4	– Triple Track – Portal Structures	km.	0.0	0	0	
4	1.5	– Yard Catenary	100 m.	0	0	0	
4	1.6	– Sidings Catenary	100 m.	40	13,500	540,000	
4	1.7	– Garage Area Catenary	100 m.	0	0	0	
4	1.8	– In–Station Catenary	100 m.	286	17,500	5,005,000	
4	Item 2	Particular Catenary Installations					
4	2.1	– Xover Single (with section breaks)	ea.	40	280,000	11,200,000	
4	2.2	– Xover Double (with section breaks)	ea.	19	369,000	7,011,000	
4	2.3	– Phase Break	ea.	11	1,052,000	11,572,000	
4	Item 3	Special Catenary Structures					
4	3.1	– Underbridge	100 m.	0	0	0	
4	3.2	– Overbridge	100 m.	0	0	0	
4	Item 4	Power Supply					
4	4.1	– Main Supply Station, 230 kV	ea.	4	5,355,000	21,420,000	
4	4.2	– Main Supply Station, 138 – 120 kV	ea.	7	4,075,000	28,525,000	
4	4.3	– Paralleling and Auto–transf. Stn	ea.	56	730,000	40,880,000	
4	4.4	– 2x25 – 1x25 Interface Station	ea.	3	925,000	2,775,000	
4	4.5	not used	ea.	0	0	0	
4	4.6	– Main Supply Station, 315 kV	ea.	1	6,380,000	6,380,000	
4	4.7	– 315 kV Supply Line	ea.	0	0	0	
4	4.8	– 230 kV Supply Line	km.	30	170,300	5,109,000	
4	4.9	– 120 kV Supply Line	km.	19	132,200	2,445,700	
4	4.10	– Control Center	ea.	2	200,000	400,000	
4	Item 5	EMI Mitigation Measures	route–km	613.0	5,000	3,065,025	
4	Item X	Contingencies	%	$360,879,475	15%	54,131,921	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$415,011,396	
5	SECTOR 5	START–UP					
5		Included in Other Studies					
5							
5	SECTOR 5	TOTAL: START–UP				$0	

TORONTO – MONTREAL ALIGNMENT — SUMMARY SHEET

technology:
300+, NEW ROW — 613.015 km. in length

SUBSYSTEM: H – STATIONS

TORONTO – MONTRÉAL ALIGNMENT 300+, NEW ROW

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$89,100,000	5.5%	4,900,500	As a % of total for Sector 2
1 Item 2	Construction Supervision	%	$89,100,000	5.0%	4,455,000	As a % of total for Sector 2
1 Item 3	Project Management	%	$98,455,500	5.4%	5,316,597	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$14,672,097	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$14,672,097	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2		Included in Construction / Installation				
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Construction / Installation				
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Individual Stations	lump sum		$0	81,000,000	
4 Item 2	People Movers	lump sum		$0	0	used at Pearson and Dorval only
4 Item 3	not used	lump sum		$0	0	
4 Item 4	not used	lump sum		$0	0	
4 Item X	Contingencies	%	$81,000,000	10%	8,100,000	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$89,100,000	
5 SECTOR 5	START–UP					
5		Included in Other Studies				
5						
5 SECTOR 5	TOTAL: START–UP				$0	

Toronto – Montréal Corridor		300+, NEW ROW	
segment	total cost	segment	total cost
TM2–A0	$0	TMS–3a	$19,239,160
TM2–B0	$0	TMS–3b	$0
TM2–C0	$0	TMS–DIV	
TM2–D0	$0	TM2–G0	$0
TM2–E0	$0	TM2–H0	$0
TM2–F0	$0	TM1–H0	$0
TM1–A0	$0	TM1–H1	$0
TM1–B0	$0	TM1–I0	$0
TM1–C0	$0	TM1–I1	$0
TM1–D0	$0	TM1–J0	$0
TM1–E0	$0	TM0–F0	$1,867,505,348
TM1–F0	$0	TM0–F1	$0
TM1–G0	$0	TM0–F2	$0
TM0–A0	$0		
TM0–A1	$418,951,674	TM0–G0	$162,414,989
TM0–A2	$270,736,574	TM0–G1	$0
TM0–B0	$0	TM0–H0	$209,268,240
TM0–B1	$1,308,639,523	TMS–3c	$32,061,531
TM0–C0	$583,713,106	TMS–4	$18,961,954
TM0–D0	$88,673,382	TMS–5a	$18,659,014
TM0–E0	$332,626,555	TMS–5b	$36,636,302
TMS–1a	$34,651,547	TMS–5c	$0
TMS–1b	$0	TMR–01	$0
TMS–1c	$12,515,813	TMR–02	$0
TMS–2	$15,438,462	TMR–03	$0
		TMR–04	$0
		WTR–02	$0
		WT0–C1	$0
		WTS–5	$0

TOTAL $5,430,693,175

TORONTO-MONTRÉAL

D4. TOTAL COSTS FOR SUB-SEGMENTS

		(000's $)
TM2-A0	Union Station - Oshawa	505,756
TM2-B0	Oshawa - Kingston	849,270
TM2-C0	Kingston - Smith Falls (via Brockville Sub)	528,080
TM2-D0	Smith Falls - Richmond	87,408
TM2-E0	Richmond - Ottawa	249,303
TM2-F0	Ottawa - Ontario/Québec border	339,612
TM2-G0	Ontario/Québec border - Dorion	388,549
TM2-H0	Dorion - Montréal (Central Station)	194,990
TM1-A0	Union Station - Oshawa	523,802
TM1-B0	Oshawa - Kingston	1,330,388
TM1-C0	Kingston - Smith Falls	549,505
TM1-D0	Smith Falls - Richmond	88,666
TM1-E0	Richmond - Ottawa	262,188
TM1-E1	Ottawa By-pass (developed only as a general alignment)	
TM1-F0	Ottawa - Van Kleek Hill	400,000
TM1-G0	Van Kleek Hill - Ottawa River (Ontario/Québec border)	75,502
TM1-H0	Ontario/Québec border - Mirabel	207,832
TM1-H1	Ont./Qué. border - Mirabel By-pass	201,170
TM1-I0	Mirabel - St. Martin Jct.	162,420
TM1-I1	Mirabel By-pass - St. Martin Jct.	151,656
TM1-J0	St. Martin Jct. - Montréal (Central Station)	212,552

TORONTO-MONTRÉAL

D4. TOTAL COSTS FOR SUB-SEGMENTS (Continued)

TM0-A0	North Toronto Station - East Toronto Station	459,706
TM0-A1	Union Station - East Toronto Station	418,952
TM0-A2	East Toronto Station - Oshawa	270,737
TM0-B0	Oshawa - Coburg (x-over to lakeshore route)	1,376,586
TM0-B1	Oshawa - Kingston	1,308,640
TM0-C0	Kingston - Smith Falls	583,713
TM0-D0	Smith Falls - Richmond	88,673
TM0-E0	Richmond - Hull (Ontario/Québec border)	332,627
TM0-F0	Hull - Mirabel	1,867,505
TM0-F1	Hull - Mirabel By-pass	1,862,001
TM0-F2	Hull - Mirabel (Lachute Alignment)	738,591
TM0-G0	Mirabel - St. Martin Jct.	162,415
TM0-G1	Mirabel By-pass - St. Martin Jct.	149,087
TM0-H0	St. Martin Jct. - Montréal (Central Station)	209,268
TMS-1a	Union Station - Modifications	34,652
TMS-1b	Yonge St. Station - New on North Toronto Sub.	47,602
TMS-1c	E. Toronto Suburban - New Station	12,516
TMS-2	Kingston - New Station	15,438
TMS-3a	Ottawa South - New Station	19,239
TMS-3b	Ottawa - Modifications	26,940
TMS-3c	Hull - New Station	32,061
TMS-4	Mirabel Airport - New Station	18,962
TMS-5a	Laval - New Station	18,659
TMS-5b	Central Station - Modifications	36,636
TMS-5c	Dorval Airport - Modifications	114,796

APPENDIX - E

DETAILED ESTIMATES

MONTRÉAL-QUÉBEC

MONTRÉAL-QUÉBEC

E1. 200+ km/hr - EXISTING RIGHTS-OF-WAY

Segment Summary Cost Table

Segment Detailed Cost Report

Table 4.8

SUBSYSTEM/SECTOR COST SUMMARY

MONTREAL – QUÉBEC CORRIDOR 200+, TILTING

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$6,438,627	$67,069,031	N/A	N/A	see note c	$73,507,658	$7,170,289
B – Earthworks and Drainage	$63,051,753	N/A	N/A	$288,940,220	see note c	$351,991,972	$37,687,855
C – Bridges, Viaducts, and Tunnels	$45,093,150	N/A	N/A	$273,839,500	see note c	$318,932,650	$24,894,500
D – Grade Separations	$24,510,405	N/A	N/A	$148,845,600	see note c	$173,356,005	$24,807,600
E – Other Accom–modation works	$1,473,727	see note a	see note a	$8,949,577	see note c	$10,423,304	$2,065,287
F – Track	$30,480,904	$169,126,599	see note b	$40,647,053	see note c	$240,254,557	$10,354,424
G – Electrification	$31,848,198	see note a	see note a	$193,406,195	see note c	$225,254,393	$25,226,895
H – Stations	$5,343,542	see note a	see note a	$32,450,000	see note c	$37,793,542	$2,950,000
Totals	$208,240,306	$236,195,630	$0	$987,078,146	see note c	$1,431,514,081	$135,156,850

NOTES : a) Included in Construction / Installation
b) Included in Equipment / Material
c) Included in Other Studies

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:
200+, TILTING — 272.51 km. in length

ITEM NUMBER		ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
		SUBSYSTEM — A – RIGHT–OF–WAY ACQUISITION					
		MONTREAL – QUÉBEC CORRIDOR — 200+, TILTING					
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Professional Services					
1	1.1	– Surveying	%	$67,069,031	8%	5,365,522	As a % of total cost of Sector 2
1	1.2	– Appraisal	%	$67,069,031	0%	0	included in Item 1.1
1	1.3	– Legal Expertise	%	$67,069,031	0%	0	included in Item 1.1
1	Item 2	Project Management	%	$72,434,553	0%	0	As % of Sector 2 total + item 1.1
1	Item X	Contingencies	%	$5,365,522	20%	1,073,104	
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$6,438,627	
2	SECTOR 2	EQUIPMENT / MATERIALS					
2	Item 1	Urban Land					
2	1.1	– Residential	hectare	120.1	$182,114	21,871,936	
2	1.2	– Commercial	hectare	7.5	$453,400	3,400,500	
2	1.3	– Industrial	hectare	37.5	$293,605	11,010,200	
2	Item 2	Rural Land					
2	2.1	– Agricultural	hectare	555	$17,688	9,816,902	
2	2.2	– Natural	hectare	138	$1,083	149,421	
2	Item 3	Purchase of Existing Rail ROW					
2	3.1	– CN	hectare	0	N/A	0	
2	3.2	– CP	hectare	283.4	$51,951	14,722,887	
2	3.3	– VIA	hectare	0	N/A	0	
2	Item X	Contingencies	%	$60,971,846	10%	6,097,185	
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$67,069,031	
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Not Applicable					
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				N/A	
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4		Not Applicable					
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$0	
5	SECTOR 5	START–UP					
5		Included in Other Studies					
5							
5	SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:
200+, TILTING — 272.51 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	**B – EARTHWORKS AND DRAINAGE**				
		MONTREAL – QUÉBEC CORRIDOR			200+, TILTING	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$288,940,220	5.5%	15,891,712	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$288,940,220	5.0%	14,447,011	As a % of total cost of Sector 2
1 Item 3	Environmental Assessment	%	$1,223,273,775	0.2%	2,446,548	Items 3 and 4 are %'s of entire
1 Item 4	Feasibility Studies (Technical)	%	$1,223,273,775	1%	12,232,738	project's cost less profes. fees
1 Item 5	Project Management	%	$333,958,228	5.4%	18,033,744	% of sector 2 total plus items 1–4
1 Item X	Contingencies	%	$63,051,753	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$63,051,753	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Clearing and Roadbed Preparation					
4 1.1	– Type 1 Soils	route–km	146.91	$142,000	20,861,220	
4 1.2	– Type 2 Soils	route–km	78.88	$627,000	49,457,760	
4 1.3	– Type 3 Soils	route–km	28.64	$1,035,000	29,642,400	
4 Item 2	Embankment Construction					
4 2.1	– Soft Excavated Material	1000 m^3	1422.03	$3,000	4,266,090	
4 2.2	– Hard Excavated Material (Rock)	1000 m^3	0	$0	0	
4 2.3	– Borrow Material	1000 m^3	1665.46	$8,000	13,323,680	
4 2.4	– Disposal of Unsuitable Material	1000 m^3	434.33	$5,500	2,388,815	
4 Item 3	Haulage of Fill Material					
4	(from Borrow or Excavation)	1000 m^3 -	0	$0	0	Cost transferred to item B4–2
4 Item 4	Sub– Ballast Layers					For TM2–B0,TM2–D0,TM1–B0,
4 4.1	– New ROW	route–km	95.79	$228,000	21,840,120	TM1–D0,TM0–B0,TM0–B1,
4 4.2	– Existing ROW	route–km	158.63	$228,000	36,167,640	TM0–C0,and TM0–D0, $152,000
4 Item 5	Drainage Systems					used for cost of sub–ballast(it. 4)
4 5.1	– Normal ROW	route–km	254.42	$25,000	6,360,500	
4 5.2	– Major Watercourse Culverts	ea.	32	$35,000	1,120,000	
4 5.3	– Environment. Stormwater Controls	route–km	0	$0	0	
4 Item 6	Roadbed Upgrade on Existing ROW	route–km	19.839	$600,000	11,903,400	
4 Item 7	Retaining Structures					
4 7.1	– Up to 3 metres in Height	km.	1.49	$2,500,000	3,725,000	
4 7.2	– Over 3 metres in Height	km.	3.59	$5,000,000	17,950,000	
4 Item 8	Intrusion Barriers	km.	0	$0	0	Intrusion Barriers not required
4 Item 9	Noise Attenuation Structures					
4 9.1	– Barriers	km.	22.6	$660,000	14,916,000	
4 9.2	– Berms	km.	0	$0	0	
4 Item 10	ROW Security Fencing (on both sides)	route–km	243.08	$56,000	13,612,480	
4 Item 11	Snow Control Measures	km.	0	$0	0	Accounted for in Contingencies
4 Item 12	Utility Interferences					
4 12.1	– Major Hydro Relocation	ea.	29	$0	0	Accounted for in Contingencies
4 12.2	– Major Oil/Gas Relocation	ea.	0	$0	0	Accounted for in Contingencies
4 12.3	– Minor Pipe or Wire Crossings	route–km	0	$0	0	Accounted for in Contingencies
4 Item 13	Other Items					
4 13.1	– Audit for Contaminated Soil	route–km	158.63	$2,000	317,260	
4 13.2	– Audit for Contaminated Rail Yards	ea.	2	$500,000	1,000,000	
4 13.3	– Minor Wildlife Passages (Culverts)	ea.	24	$100,000	2,400,000	
4 Item X	Contingencies	%	$251,252,365	15%	37,687,855	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$288,940,220	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:
200+, TILTING — 272.51 km. in length

SUBSYSTEM — C – BRIDGES, VIADUCTS, AND TUNNELS

MONTREAL – QUÉBEC CORRIDOR — 200+, TILTING

ITEM NUMBER		ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	$273,839,500	5.5%	15,061,173	As a % of total cost of Sector 2
1	Item 2	Construction Supervision	%	$273,839,500	5.0%	13,691,975	As a % of total cost of Sector 2
1	Item 3	Project Management	%	$302,592,648	5.4%	16,340,003	% of sector 2 total plus items 1 – 2
1	Item X	Contingencies	%	$45,093,150	0%	0	
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$45,093,150	
2	SECTOR 2	EQUIPMENT / MATERIALS					
2			Not Applicable				
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3			Not Applicable				
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	Bridges					
4	1.1	– Small Rivers (< 30 metres)	ea.	90	$340,000	30,600,000	
4	1.2	– Extra at 1.1 for Height Over 10 m.	ea.	0	$0	0	
4	1.3	– Interm. Rivers (30 – 100 metres)	lin. m.	40	$23,500	940,000	
4	1.4	– Extra at 1.3 for Height Over 10 m.	lin. m.	0	$0	0	
4	1.5	– Large Rivers (100 – 250 metres)	lin. m.	120	$42,000	5,040,000	
4	1.6	– Extra at 1.5 for Height Over 10 m.	lin. m.	0	$0	0	
4	1.7	– Major Rivers (over 250 m.)	lin. m.	280	$50,000	14,000,000	
4	1.8	– Extra for Difficult Foundation Cond.	lin. m.	0	$0	0	
4	1.9	– Modif. to Exist. Bridges (new deck)	ea.	2,290	$13,000	29,770,000	
4	Item 2	Viaducts					
4	2.1	– Viaducts over 250 metres in Length	lin. m.	0	$0	0	
4	2.2	– Extra for Height Over XX metres	lin. m.	0	$0	0	
4	2.3	– Extra for Difficult Foundation Cond.	lin. m.	0	$0	0	
4	Item 3	Tunnels (Double Track)					
4	3.1	– In Soft Ground	lin. m.	0	$0	0	
4	3.2	– In Rock	lin. m.	4,817	$35,000	168,595,000	
4	3.3	– Modifications to Existing Tunnels	lump sum	0		0	
4	3.4	– Noise Mitigation Measures	lump sum	0		0	Accounted for in Contingencies
4	Item X	Contingencies	%	$248,945,000	10%	24,894,500	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$273,839,500	
5	SECTOR 5	START–UP					
5			Included in Other Studies				
5							
5	SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology: 200+, TILTING — 272.51 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: D – GRADE SEPARATIONS					
	MONTREAL – QUÉBEC CORRIDOR: 200+, TILTING					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$148,845,600	5.5%	8,186,508	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$148,845,600	5.0%	7,442,280	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$164,474,388	5.4%	8,881,617	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$24,510,405	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$24,510,405	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	New Grade Separations, Rural					
4 1.1	– 2 Lane Highways	ea.	22	$2,200,000	48,400,000	
4 1.2	– 2 Lane Highways, Dual ROW	ea.	0	$0	0	
4 1.3	– 4 Lane Highways	ea.	2	$3,100,000	6,200,000	
4 1.4	– 4 Lane Highways, Dual ROW	ea.	0	$0	0	
4 1.5	– Major Highways (401, 20, etc)	ea.	0	$0	0	
4 1.6	– Extra for Difficult Foundation Cond.	ea.	0	$0	0	
4 Item 2	New Grade Separations, Urban					
4 2.1	– Secondary Highways (2–4 lanes)	ea.	0	$0	0	
4 2.2	– Second. Hwys (2–4 l.) Dual ROW	ea.	0	$0	0	
4 2.3	– Major Highways (over 4 lanes)	ea.	0	$0	0	
4 2.4	– Extra for Difficult Foundation Cond.	ea.	0	$0	0	
4 Item 3	Modification of Exist. Grade Separations					
4 3.1	– Urban	ea.	0	$0	0	
4 3.2	– Rural	ea.	24	$627,000	15,048,000	
4 Item 4	Automatic Crossing Protection	ea.	72	$270,000	19,440,000	
4 Item 5	Closure and Diversion of Roads	km. of road	49	$280,000	13,650,000	
4 Item 6	Private Farm Crossings	ea.	71	$300,000	21,300,000	
4 Item 7	Major Wildlife Passages	ea.	0	$0	0	
4 Item X	Contingencies	%	$124,038,000	20%	24,807,600	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$148,845,600	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:

200+, TILTING — 272.51 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	E – OTHER ACCOMODATION WORKS				
		MONTREAL – QUÉBEC CORRIDOR			200+, TILTING	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$8,949,577	5.5%	492,227	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$8,949,577	5.0%	447,479	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$9,889,283	5.4%	534,021	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$1,473,727	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$1,473,727	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2		Included in Construction / Installation				
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Construction / Installation				
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Removal of Rail Lines	km.	174	$21,134	3,684,290	
4 Item 2	Construction of New Access Tracks	km.	0	$0	0	
4 Item 3	Rail/Rail Grade Separation					
4 3.1	– Rural	ea.	4	$800,000	3,200,000	
4 3.2	– Urban	ea.	0	$0	0	
4 Item 4	Other Particular Items:					
4 4.1	– Sub–Item	lump sum	0		0	
4 4.2	– Sub–Item	lump sum	0		0	
4 4.3	– Sub–Item	lump sum	0		0	
4 4.4	– Sub–Item	lump sum	0		0	
4 Item X	Contingencies	%	$6,884,290	30%	2,065,287	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$8,949,577	
5 SECTOR 5	START–UP					
5		Included in Other Studies				
5						
5 SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology: 200+, TILTING — 272.51 km. in length

SUBSYSTEM: F – TRACK

MONTREAL – QUÉBEC CORRIDOR — 200+, TILTING

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$209,773,652	3.5%	7,342,078	As % of total for Sectors 2 and 4
1 Item 2	Construction Supervision	%	$40,647,053	10.0%	4,064,705	As % of total for Sector 4
1 Item 3	Materials Procurement	%	$169,126,599	4.0%	6,765,064	As % of total for Sector 2
1 Item 4	Project Management	%	$227,945,500	5.4%	12,309,057	As % of Sectors 2,4 totals plus
1 Item X	Contingencies	%	$30,480,904	0%	0	items 1 – 3
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$30,480,904	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2 Item 1	Rail					
2 1.1	– Main Line	t.	66,720	$773	51,602,582	
2 1.2	– Siding	t.	1,550	$773	1,198,801	
2 Item 2	Ties	ea.	876,200	$45	39,244,998	
2 Item 3	Ballast	m^3	1,191,000	$21	25,451,670	
2 Item 4	Turnouts					
2 4.1	– High Speed	ea.	36	$280,000	10,080,000	
2 4.2	– Medium Speed	ea.	27	$135,000	3,645,000	
2 4.3	– Yard	ea.	0	$0	0	
2 Item 5	Other Track Material					
2 5.1	– Rail Fastening Assemblies	set	876,200	$27	23,219,300	
2 5.2	– Bonded Insulated Joints	ea.	0	$0	0	Included in Signalling costs
2 5.3	– Bumping Posts	ea.	5	$3,120	15,600	
2 Item 6	Switch Heaters/ Snow Blowers					
2 6.1	– Main Line	ea.	63	$105,000	6,615,000	
2 6.2	– Yard	ea.	0	$0	0	
2 Item 7	Ballast Mats for Noise Attenuation	m^2	0	$0	0	
2 Item X	Contingencies	%	$161,072,951	5%	8,053,648	
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$169,126,599	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Included in Equipment / Material					
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Track Construction					
4 1.1	– Main Line	km.	545	$18,212	9,925,904	
4 1.2	– Siding	km.	12	$44,175	547,770	
4 Item 2	Field Welded Joints	ea.	3,610	$2,028	7,321,080	
4 Item 3	Turnout Construction					
4 3.1	– High and Med. Speed (Main Line)	ea.	63	$20,455	1,288,665	
4 3.2	– Yard	ea.	0	$0	0	
4 Item 4	Ballasting and Surfacing	m^3	1,191,000	$8.47	10,087,770	
4 Item 5	Rail Grinding	track–km	557	$4,545	2,533,474	
4 Item 6	Construction Bases	route–km	273	$24,372	6,641,614	
4 Item X	Contingencies	%	$38,346,277	6%	2,300,777	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$40,647,053	
5 SECTOR 5	START–UP					
5	Included in Other Studies					
5						
5 SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:

200+, TILTING — 272.51 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM: G – ELECTRIFICATION					
	MONTREAL – QUÉBEC CORRIDOR: 200+, TILTING					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$193,406,195	5.5%	10,637,341	As % of total for Sector 4
1 Item 2	Construction Supervision	%	$193,406,195	5.0%	9,670,310	As % of total for Sector 4
1 Item 3	Project Management	%	$213,713,845	5.4%	11,540,548	% of sector 4 total plus items 1–2
1 Item X	Contingencies	%	$31,848,198	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$31,848,198	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Included in Construction / Installation					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Included in Construction / Installation					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Typical Catenary					
4 1.1	– Single Track – Independent Struct.	km.	0	$0	0	
4 1.2	– Double Track – Independ. Struct.	km.	273	$350,000	95,378,500	
4 1.3	– Double Track – Portal Structures	km.	0	$0	0	
4 1.4	– Triple Track – Portal Structures	km.	0	$0	0	
4 1.5	– Yard Catenary	100 m.	0	$0	0	
4 1.6	– Sidings Catenary	100 m.	30	$13,500	405,000	
4 1.7	– Garage Area Catenary	100 m.	0	$0	0	
4 1.8	– In–Station Catenary	100 m.	94	$17,500	1,645,000	
4 Item 2	Particular Catenary Installations					
4 2.1	– Xover Single (with section breaks)	ea.	10	$280,000	2,800,000	
4 2.2	– Xover Double (with section breaks)	ea.	4	$369,000	1,476,000	
4 2.3	– Phase Break	ea.	5	$1,052,000	5,260,000	
4 Item 3	Special Catenary Structures					
4 3.1	– Underbridge	100 m.	0	$0	0	
4 3.2	– Overbridge	100 m.	0	$0	0	
4 Item 4	Power Supply					
4 4.1	– Main Supply Station, 230 kV	ea.	2	$5,355,000	10,710,000	
4 4.2	– Main Supply Station, 138 – 120 kV	ea.	1	$4,075,000	4,075,000	
4 4.3	– Paraileling and Auto–transf. Stn	ea.	24	$730,000	17,520,000	
4 4.4	– 2x25 – 1x25 Interface Station	ea.	4	$925,000	3,700,000	
4 4.5	not used	ea.	0	$0	0	
4 4.6	– Main Supply Station, 315 kV	ea.	3	$6,380,000	19,140,000	
4 4.7	– 315 kV Supply Line	ea.	12	$252,500	3,030,000	
4 4.8	– 230 kV Supply Line	km.	8	$170,300	1,277,250	
4 4.9	– 120 kV Supply Line	km.	0	$0	0	
4 4.10	– Control Center	ea.	2	$200,000	400,000	
4 Item 5	EMI Mitigation Measures	route–km	273	$5,000	1,362,550	
4 Item X	Contingencies	%	168,179,300	15%	25,226,895	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$193,406,195	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:
200+, TILTING — 272.51 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM — H – STATIONS					
	MONTREAL – QUÉBEC CORRIDOR — 200+, TILTING					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	32,450,000	5.5%	1,784,750	As a % of total for Sector 2
1 Item 2	Construction Supervision	%	32,450,000	5.0%	1,622,500	As a % of total for Sector 2
1 Item 3	Project Management	%	35,857,250	5.4%	1,936,292	% of sector 2 total plus items 1 – 2
1 Item X	Contingencies	%	5,343,542	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$5,343,542	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2		Included in Construction / Installation				
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Construction / Installation				
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Individual Stations	lump sum		$29,500,000	29,500,000	
4 Item 2	Not used	lump sum		$0	0	
4 Item 3	Not used	lump sum		$0	0	
4 Item 4	Not used	lump sum		$0	0	
4 Item X	Contingencies	%	29,500,000	10%	2,950,000	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$32,450,000	
5 SECTOR 5	START–UP					
5		Included in Other Studies				
5						
5 SECTOR 5	TOTAL: START–UP				$0	

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10–Feb–94 current costs on file

Montréal – Québec Corridor

200+, TILTING

segment	total cost
MQ2–A0	$799,443,552
MQ2–B0	$564,209,313
MQ1–A0	$0
MQ1–B0	$0
MQ1–C0	$0
MQ0–A0	$0
MQ0–B0	$0
MQ0–C0	$0
MQS–1	$18,659,014
MQS–2	$14,270,328
MQS–3a	$13,979,869
MQS–3b	$20,952,005
MQR–01	$0
MQR–02	$0
TMR–04	$0

$1,431,514,081

MONTRÉAL-QUÉBEC

E3. 300+ km/hr - EXISTING RIGHTS-OF-WAY

Segment Summary Cost Table

Segment Detailed Cost Report

Table 5.8

SUBSYSTEM/SECTOR COST SUMMARY

MONTREAL – QUÉBEC CORRIDOR 300+, EXISTING ROW

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$5,652,816	$58,883,503	N/A	N/A	see note c	$64,536,319	$6,295,182
B – Earthworks and Drainage	$60,833,297	N/A	N/A	$277,340,262	see note c	$338,173,559	$36,174,817
C – Bridges, Viaducts, and Tunnels	$27,065,491	N/A	N/A	$164,362,000	see note c	$191,427,491	$14,942,000
D – Grade Separations	$50,628,393	N/A	N/A	$307,453,650	see note c	$358,082,043	$40,102,650
E – Other Accom–modation works	$1,401,877	see note a	see note a	$8,513,251	see note c	$9,915,128	$1,964,596
F – Track	$28,009,913	$155,959,121	see note b	$36,983,810	see note c	$220,952,843	$9,520,048
G – Electrification	$27,022,929	see note a	see note a	$164,103,534	see note c	$191,126,463	$21,404,809
H – Stations	$4,166,151	see note a	see note a	$25,300,000	see note c	$29,466,151	$2,300,000
Totals	$204,780,866	$214,842,624	$0	$984,056,506	see note c	$1,403,679,996	$132,704,102

NOTES : a) Included in Construction / Installation
b) Included in Equipment / Material
c) Included in Other Studies

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:
300+, EXISTING ROW — 255.14 km. in length

SUBSYSTEM: A – RIGHT-OF-WAY ACQUISITION

MONTREAL – QUÉBEC CORRIDOR — 300+, EXISTING ROW

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Professional Services					
1 1.1	– Surveying	%	$58,883,503	8%	4,710,680	As a % of total cost of Sector 2
1 1.2	– Appraisal	%	$58,883,503	0%	0	included in Item 1.1
1 1.3	– Legal Expertise	%	$58,883,503	0%	0	included in Item 1.1
1 Item 2	Project Management	%	$63,594,183	0%	0	As % of Sector 2 total + item 1.1
1 Item X	Contingencies	%	$4,710,680	20%	942,136	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$5,652,816	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2 Item 1	Urban Land					
2 1.1	– Residential	hectare	124.1	$147,691	18,328,430	
2 1.2	– Commercial	hectare	7.5	$453,400	3,400,500	
2 1.3	– Industrial	hectare	41.5	$311,295	12,918,750	
2 Item 2	Rural Land					
2 2.1	– Agricultural	hectare	692.57	$12,063	8,354,729	
2 2.2	– Natural	hectare	200.5	$1,254	251,361	
2 Item 3	Purchase of Existing Rail ROW					
2 3.1	– CN	hectare	0	N/A	0	
2 3.2	– CP	hectare	231.58	$44,376	10,276,687	
2 3.3	– VIA	hectare	0	N/A	0	
2 Item X	Contingencies	%	$53,530,457	10%	5,353,046	
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$58,883,503	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Not Applicable				
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				N/A	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4		Not Applicable				
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$0	
5 SECTOR 5	START-UP					
5		Included in Other Studies				
5 SECTOR 5	TOTAL: START-UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:
300+, EXISTING ROW — 255.14 km. in length

SUBSYSTEM — B – EARTHWORKS AND DRAINAGE

MONTREAL – QUÉBEC CORRIDOR — 300+, EXISTING ROW

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$277,340,262	5.5%	15,253,714	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$277,340,262	5.0%	13,867,013	As a % of total cost of Sector 2
1 Item 3	Environmental Assessment	%	$1,198,899,130	0.2%	2,397,798	Items 3 and 4 are %'s of entire
1 Item 4	Feasibility Studies (Technical)	%	$1,198,899,130	1%	11,988,991	project's cost less profes. fees
1 Item 5	Project Management	%	$320,847,779	5.4%	17,325,780	% of sector 2 total plus items 1–4
1 Item X	Contingencies	%	$60,833,297	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$60,833,297	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2		Not Applicable				
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Not Applicable				
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Clearing and Roadbed Preparation					
4 1.1	– Type 1 Soils	route–km	129.58	$142,000	18,400,360	
4 1.2	– Type 2 Soils	route–km	89.585	$627,000	56,169,795	
4 1.3	– Type 3 Soils	route–km	27.42	$1,035,000	28,379,700	
4 Item 2	Embankment Construction					
4 2.1	– Soft Excavated Material	1000 m^3	1373.89	$3,000	4,121,670	
4 2.2	– Hard Excavated Material (Rock)	1000 m^3	0	$0	0	
4 2.3	– Borrow Material	1000 m^3	1718.325	$8,000	13,746,600	
4 2.4	– Disposal of Unsuitable Material	1000 m^3	476.19	$5,500	2,619,045	
4 Item 3	Haulage of Fill Material					
4	(from Borrow or Excavation)	1000 m^3–	0	$0	0	Cost transferred to item B4–2
4 Item 4	Sub–Ballast Layers					For TM2–B0,TM2–D0,TM1–B0,
4 4.1	– New ROW	route–km	128.55	$228,000	29,309,400	TM1–D0,TM0–B0,TM0–B1,
4 4.2	– Existing ROW	route–km	118.035	$228,000	26,911,980	TM0–C0,and TM0–D0, $152,000
4 Item 5	Drainage Systems					used for cost of sub–ballast(it. 4)
4 5.1	– Normal ROW	route–km	246.585	$25,000	6,164,625	
4 5.2	– Major Watercourse Culverts	ea.	28	$35,000	980,000	
4 5.3	– Environment. Stormwater Controls	route–km	0	$0	0	
4 Item 6	Roadbed Upgrade on Existing ROW	route–km	7.754	$600,000	4,652,400	
4 Item 7	Retaining Structures					
4 7.1	– Up to 3 metres in Height	km.	1.06	$2,500,000	2,650,000	
4 7.2	– Over 3 metres in Height	km.	2.38	$5,000,000	11,900,000	
4 Item 8	Intrusion Barriers	km.	0	$0	0	Intrusion Barriers not required
4 Item 9	Noise Attenuation Structures					
4 9.1	– Barriers	km.	28	$660,000	18,480,000	
4 9.2	– Berms	km.	0	$0	0	
4 Item 10	ROW Security Fencing (on both sides)	route–km	232.925	$56,000	13,043,800	
4 Item 11	Snow Control Measures	km.	0	$0	0	Accounted for in Contingencies
4 Item 12	Utility Interferences					
4 12.1	– Major Hydro Relocation	ea.	27	$0	0	Accounted for in Contingencies
4 12.2	– Major Oil/Gas Relocation	ea.	0	$0	0	Accounted for in Contingencies
4 12.3	– Minor Pipe or Wire Crossings	route–km	0	$0	0	Accounted for in Contingencies
4 Item 13	Other Items					
4 13.1	– Audit for Contaminated Soil	route–km	118.035	$2,000	236,070	
4 13.2	– Audit for Contaminated Rail Yards	ea.	2	$500,000	1,000,000	
4 13.3	– Minor Wildlife Passages (Culverts)	ea.	24	$100,000	2,400,000	
4 Item X	Contingencies	%	$241,165,445	15%	36,174,817	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$277,340,262	
5 SECTOR 5	START–UP					
5		Included in Other Studies				
5 SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:

300+, EXISTING ROW — 255.14 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	**C – BRIDGES, VIADUCTS, AND TUNNELS**				
		MONTREAL – QUÉBEC CORRIDOR			300+, EXISTING ROW	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$164,362,000	5.5%	9,039,910	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$164,362,000	5.0%	8,218,100	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$181,620,010	5.4%	9,807,481	% of sector 2 total plus items 1 – 2
1 Item X	Contingencies	%	$27,065,491	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$27,065,491	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Bridges					
1.1	– Small Rivers (< 30 metres)	ea.	82	$340,000	27,880,000	
1.2	– Extra at 1.1 for Height Over 10 m.	ea.	0	$0	0	
1.3	– Interm. Rivers (30 – 100 metres)	lin. m.	40	$23,500	940,000	
1.4	– Extra at 1.3 for Height Over 10 m.	lin. m.	0	$0	0	
1.5	– Large Rivers (100 – 250 metres)	lin. m.	325	$42,000	13,650,000	
1.6	– Extra at 1.5 for Height Over 10 m.	lin. m.	0	$0	0	
1.7	– Major Rivers (over 250 m.)	lin. m.	280	$50,000	14,000,000	
1.8	– Extra for Difficult Foundation Cond.	lin. m.	0	$0	0	
1.9	– Modif. to Exist. Bridges (new deck)	ea.	1,200	$13,000	15,600,000	
4 Item 2	Viaducts					
2.1	– Viaducts over 250 metres in Length	lin. m.	0	$0	0	
2.2	– Extra for Height Over XX metres	lin. m.	0	$0	0	
2.3	– Extra for Difficult Foundation Cond.	lin. m.	0	$0	0	
4 Item 3	Tunnels (Double Track)					
3.1	– In Soft Ground	lin. m.	0	$0	0	For 300+ technology, Rock
3.2	– In Rock	lin. m.	2,210	$35,000	77,350,000	Tunnels speed restricted by local
3.3	– Modifications to Existing Tunnels	lump sum	0		0	conditions are $35,000/lin m.
3.4	– Noise Mitigation Measures	lump sum	0		0	Accounted for in Contingencies
4 Item X	Contingencies	%	$149,420,000	10%	14,942,000	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$164,362,000	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:

300+, EXISTING ROW — 255.14 km. in length

SUBSYSTEM: D – GRADE SEPARATIONS

MONTREAL – QUÉBEC CORRIDOR — 300+, EXISTING ROW

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$307,453,650	5.5%	16,909,951	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$307,453,650	5.0%	15,372,683	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$339,736,283	5.4%	18,345,759	% of sector 2 total plus items 1 – 2
1 Item X	Contingencies	%	$50,628,393	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$50,628,393	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	New Grade Separations, Rural					
4 1.1	– 2 Lane Highways	ea.	90	$2,200,000	198,000,000	
4 1.2	– 2 Lane Highways, Dual ROW	ea.	0	$0	0	
4 1.3	– 4 Lane Highways	ea.	4	$3,100,000	12,400,000	
4 1.4	– 4 Lane Highways, Dual ROW	ea.	0	$0	0	
4 1.5	– Major Highways (401, 20, etc)	ea.	0	$0	0	
4 1.6	– Extra for Difficult Foundation Cond.	ea.	0	$0	0	
4 Item 2	New Grade Separations, Urban					
4 2.1	– Secondary Highways (2–4 lanes)	ea.	0	$0	0	
4 2.2	– Second. Hwys (2–4 l.) Dual ROW	ea.	0	$0	0	
4 2.3	– Major Highways (over 4 lanes)	ea.	0	$0	0	
4 2.4	– Extra for Difficult Foundation Cond.	ea.	0	$0	0	
4 Item 3	Modification of Exist. Grade Separations					
4 3.1	– Urban	ea.	0	$0	0	
4 3.2	– Rural	ea.	19	$627,000	11,913,000	
4 Item 4	Automatic Crossing Protection	ea.	0	$0	0	
4 Item 5	Closure and Diversion of Roads	km. of road	78	$280,000	21,938,000	
4 Item 6	Private Farm Crossings	ea.	77	$300,000	23,100,000	
4 Item 7	Major Wildlife Passages	ea.	0	$0	0	
4 Item X	Contingencies	%	$267,351,000	15%	40,102,650	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$307,453,650	
5 SECTOR 5	START–UP					
5	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:

300+, EXISTING ROW — 255.14 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	**E – OTHER ACCOMODATION WORKS**				
		MONTREAL – QUÉBEC CORRIDOR			300+, EXISTING ROW	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$8,513,251	5.5%	468,229	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$8,513,251	5.0%	425,663	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$9,407,143	5.4%	507,986	% of sector 2 total plus items 1 – 2
1 Item X	Contingencies	%	$1,401,877	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$1,401,877	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2	Included in Construction / Installation					
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Included in Construction / Installation					
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Removal of Rail Lines	km.	121	$21,134	2,548,655	
4 Item 2	Construction of New Access Tracks	km.	0	$0	0	
4 Item 3	Rail/Rail Grade Separation					
4 3.1	– Rural	ea.	5	$800,000	4,000,000	
4 3.2	– Urban	ea.	0	$0	0	
4 Item 4	Other Particular Items:					
4 4.1	– Sub–Item	lump sum	0		0	
4 4.2	– Sub–Item	lump sum	0		0	
4 4.3	– Sub–Item	lump sum	0		0	
4 4.4	– Sub–Item	lump sum	0		0	
4 Item X	Contingencies	%	$6,548,655	30%	1,964,596	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$8,513,251	
5 SECTOR 5	START–UP					
5	Included in Other Studies					
5						
5 SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:

300+, EXISTING ROW — 255.14 km. in length

SUBSYSTEM — F – TRACK

MONTREAL – QUÉBEC CORRIDOR — 300+, EXISTING ROW

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$192,942,930	3.5%	6,753,003	As % of total for Sectors 2 and 4
1 Item 2	Construction Supervision	%	$36,983,810	10.0%	3,698,381	As % of total for Sector 4
1 Item 3	Materials Procurement	%	$155,959,121	4.0%	6,238,365	As % of total for Sector 2
1 Item 4	Project Management	%	$209,632,679	5.4%	11,320,165	As % of Sectors 2,4 totals plus
1 Item X	Contingencies	%	$28,009,913	0%	0	items 1–3
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$28,009,913	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2 Item 1	Rail					
2 1.1	– Main Line	t.	62,470	$773	48,315,547	
2 1.2	– Siding	t.	1,180	$773	912,636	
2 Item 2	Ties	ea.	883,700	$45	39,580,923	
2 Item 3	Ballast	m ^ 3	1,102,000	$21	23,549,740	
2 Item 4	Turnouts					
2 4.1	– High Speed	ea.	20	$280,000	5,600,000	
2 4.2	– Medium Speed	ea.	21	$135,000	2,835,000	
2 4.3	– Yard	ea.	0	$0	0	
2 Item 5	Other Track Material					
2 5.1	– Rail Fastening Assemblies	set	883,700	$27	23,418,050	
2 5.2	– Bonded Insulated Joints	ea.	0	$0	0	Included in Signalling costs
2 5.3	– Bumping Posts	ea.	5	$3,120	15,600	
2 Item 6	Switch Heaters/ Snow Blowers					
2 6.1	– Main Line	ea.	41	$105,000	4,305,000	
2 6.2	– Yard	ea.	0	$0	0	
2 Item 7	Ballast Mats for Noise Attenuation	m ^ 2	0	$0	0	
2 Item X	Contingencies	%	$148,532,496	5%	7,426,625	
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$155,959,121	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Included in Equipment / Material					
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Track Construction					
4 1.1	– Main Line	km.	510	$18,212	9,293,401	
4 1.2	– Siding	km.	9	$44,175	415,245	
4 Item 2	Field Welded Joints	ea.	3,170	$2,028	6,428,760	
4 Item 3	Turnout Construction					
4 3.1	– High and Med. Speed (Main Line)	ea.	41	$20,455	838,655	
4 3.2	– Yard	ea.	0	$0	0	
4 Item 4	Ballasting and Surfacing	m ^ 3	1,102,000	$8.47	9,333,940	
4 Item 5	Rail Grinding	track–km	520	$4,545	2,361,991	
4 Item 6	Construction Bases	route–km	255	$24,372	6,218,394	
4 Item X	Contingencies	%	$34,890,386	6%	2,093,423	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$36,983,810	
5 SECTOR 5	START–UP					
5	Included in Other Studies					
5						
5 SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:

300+, EXISTING ROW — 255.14 km. in length

SUBSYSTEM — G – ELECTRIFICATION

MONTREAL – QUÉBEC CORRIDOR — 300+, EXISTING ROW

ITEM NUMBER		ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Engineering	%	$164,103,534	5.5%	9,025,694	As % of total for Sector 4
1	Item 2	Construction Supervision	%	$164,103,534	5.0%	8,205,177	As % of total for Sector 4
1	Item 3	Project Management	%	$181,334,405	5.4%	9,792,058	% of sector 4 total plus items 1–2
1	Item X	Contingencies	%	$27,022,929	0%	0	
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$27,022,929	
2	SECTOR 2	EQUIPMENT / MATERIALS					
2		Included in Construction / Installation					
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Construction / Installation					
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4	Item 1	Typical Catenary					
4	1.1	– Single Track – Independent Struct.	km.	0	$0	0	
4	1.2	– Double Track – Independ. Struct.	km.	255	$350,000	89,300,750	
4	1.3	– Double Track – Portal Structures	km.	0	$0	0	
4	1.4	– Triple Track – Portal Structures	km.	0	$0	0	
4	1.5	– Yard Catenary	100 m.	0	$0	0	
4	1.6	– Sidings Catenary	100 m.	20	$13,500	270,000	
4	1.7	– Garage Area Catenary	100 m.	0	$0	0	
4	1.8	– In–Station Catenary	100 m.	74	$17,500	1,295,000	
4	Item 2	Particular Catenary Installations					
4	2.1	– Xover Single (with section breaks)	ea.	6	$280,000	1,680,000	
4	2.2	– Xover Double (with section breaks)	ea.	1	$369,000	369,000	
4	2.3	– Phase Break	ea.	3	$1,052,000	3,156,000	
4	Item 3	Special Catenary Structures					
4	3.1	– Underbridge	100 m.	0	$0	0	
4	3.2	– Overbridge	100 m.	0	$0	0	
4	Item 4	Power Supply					
4	4.1	– Main Supply Station, 230 kV	ea.	2	$5,355,000	10,710,000	
4	4.2	– Main Supply Station, 138 – 120 kV	ea.	0	$0	0	
4	4.3	– Paralleling and Auto–transf. Stn	ea.	20	$730,000	14,600,000	
4	4.4	– 2x25 – 1x25 Interface Station	ea.	3	$925,000	2,775,000	
4	4.5	not used	ea.	0	$0	0	
4	4.6	– Main Supply Station, 315 kV	ea.	2	$6,380,000	12,760,000	
4	4.7	– 315 kV Supply Line	ea.	12	$252,500	3,030,000	
4	4.8	– 230 kV Supply Line	km.	8	$170,300	1,277,250	
4	4.9	– 120 kV Supply Line	km.	0	$0	0	
4	4.10	– Control Center	ea.	1	$200,000	200,000	
4	Item 5	EMI Mitigation Measures	route–km	255	$5,000	1,275,725	
4	Item X	Contingencies	%	142,698,725	15%	21,404,809	
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$164,103,534	
5	SECTOR 5	START–UP					
5		Included in Other Studies					
5							
5	SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:

300+, EXISTING ROW — 255.14 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM — H – STATIONS					
	MONTREAL – QUÉBEC CORRIDOR — 300+, EXISTING ROW					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	25,300,000	5.5%	1,391,500	As a % of total for Sector 2
1 Item 2	Construction Supervision	%	25,300,000	5.0%	1,265,000	As a % of total for Sector 2
1 Item 3	Project Management	%	27,956,500	5.4%	1,509,651	% of sector 2 total plus items 1 – 2
1 Item X	Contingencies	%	4,166,151	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$4,166,151	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2		Included in Construction / Installation				
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Included in Construction / Installation				
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Individual Stations	lump sum		$23,000,000	23,000,000	
4 Item 2	Not used	lump sum		$0	0	
4 Item 3	Not used	lump sum		$0	0	
4 Item 4	Not used	lump sum		$0	0	
4 Item X	Contingencies	%	23,000,000	10%	2,300,000	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$25,300,000	
5 SECTOR 5	START–UP					
5		Included in Other Studies				
5						
5 SECTOR 5	TOTAL: START–UP				$0	

10–Feb–94 current costs on file

Montréal – Québec Corridor

300+, EXISTING ROW

segment	total cost
MQ2–A0	$0
MQ2–B0	$0
MQ1–A0	$0
MQ1–B0	$667,086,507
MQ1–C0	$687,391,289
MQ0–A0	$0
MQ0–B0	$0
MQ0–C0	$0
MQS–1	$0
MQS–2	$14,270,328
MQS–3a	$13,979,869
MQS–3b	$20,952,005
MQR–01	$0
MQR–02	$0
TMR–04	$0

$1,403,679,996

MONTRÉAL-QUÉBEC

E3. 300+ km/hr - NEW RIGHTS-OF-WAY

Segment Summary Cost Table

Segment Detailed Cost Report

Table 6.8

SUBSYSTEM/SECTOR COST SUMMARY

MONTREAL – QUÉBEC CORRIDOR 300+, NEW ROW

Subsystem	Professional Serv./ Proj. Management	Equipment/ Material	Transportation/ distribution	Construction/ Installation	Start – up	TOTAL	Contingency reserve included in TOTAL
A – Right–of–way Aquisition	$4,711,328	$49,076,328	N/A	N/A	see note c	$53,787,656	$5,246,706
B – Earthworks and Drainage	$63,781,405	N/A	N/A	$292,870,615	see note c	$356,652,020	$38,200,515
C – Bridges, Viaducts, and Tunnels	$33,731,332	N/A	N/A	$204,842,000	see note c	$238,573,332	$18,622,000
D – Grade Separations	$47,371,409	N/A	N/A	$287,674,800	see note c	$335,046,209	$37,522,800
E – Other Accom–modation works	$1,281,884	see note a	see note a	$7,784,564	see note c	$9,066,448	$1,796,438
F – Track	$28,421,103	$158,461,606	see note b	$37,382,375	see note c	$224,265,084	$9,661,774
G – Electrification	$27,400,931	see note a	see note a	$166,399,049	see note c	$193,799,980	$21,704,224
H – Stations	$4,166,151	see note a	see note a	$25,300,000	see note c	$29,466,151	$2,300,000
Totals	$210,865,544	$207,537,934	$0	$1,022,253,403	see note c	$1,440,656,880	$135,054,456

NOTES : a) Included in Construction / Installation
b) Included in Equipment / Material
c) Included in Other Studies

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:

300+, NEW ROW — 257.39 km. in length

ITEM NUMBER		ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
		SUBSYSTEM: A – RIGHT-OF-WAY ACQUISITION					
		MONTREAL – QUÉBEC CORRIDOR: 300+, NEW ROW					
1	SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1	Item 1	Professional Services					
1	1.1	– Surveying	%	$49,076,328	8%	3,926,106	As a % of total cost of Sector 2
1	1.2	– Appraisal	%	$49,076,328	0%	0	included in Item 1.1
1	1.3	– Legal Expertise	%	$49,076,328	0%	0	included in Item 1.1
1	Item 2	Project Management	%	$53,002,435	0%	0	As % of Sector 2 total + item 1.1
1	Item X	Contingencies	%	$3,926,106	20%	785,221	
1							
1	SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$4,711,328	
2	SECTOR 2	EQUIPMENT / MATERIALS					
2	Item 1	Urban Land					
2	1.1	– Residential	hectare	88.6	$231,237	20,487,615	
2	1.2	– Commercial	hectare	5	$453,400	2,267,000	
2	1.3	– Industrial	hectare	20.5	$410,302	8,411,200	
2	Item 2	Rural Land					
2	2.1	– Agricultural	hectare	752.39	$11,845	8,912,429	
2	2.2	– Natural	hectare	372.5	$12,179	4,536,600	
2	Item 3	Purchase of Existing Rail ROW					
2	3.1	– CN	hectare	0	N/A	0	
2	3.2	– CP	hectare	0	N/A	0	
2	3.3	– VIA	hectare	0	N/A	0	
2	Item X	Contingencies	%	$44,614,844	10%	4,461,484	
2							
2	SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$49,076,328	
3	SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3		Not Applicable					
3							
3	SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				N/A	
4	SECTOR 4	CONSTRUCTION / INSTALLATION					
4		Not Applicable					
4							
4	SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$0	
5	SECTOR 5	START-UP					
5		Included in Other Studies					
5							
5	SECTOR 5	TOTAL: START-UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:

300+, NEW ROW — 257.39 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	B – EARTHWORKS AND DRAINAGE				
		MONTREAL – QUÉBEC CORRIDOR			300+, NEW ROW	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$292,870,615	5.5%	16,107,884	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$292,870,615	5.0%	14,643,531	As a % of total cost of Sector 2
1 Item 3	Environmental Assessment	%	$1,229,791,337	0.2%	2,459,583	Items 3 and 4 are %'s of entire
1 Item 4	Feasibility Studies (Technical)	%	$1,229,791,337	1%	12,297,913	project's cost less profes. fees
1 Item 5	Project Management	%	$338,379,526	5.4%	18,272,494	% of sector 2 total plus items 1–4
1 Item X	Contingencies	%	$63,781,405	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$63,781,405	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Clearing and Roadbed Preparation					
4 1.1	– Type 1 Soils	route–km	112.48	$142,000	15,972,160	
4 1.2	– Type 2 Soils	route–km	100.02	$627,000	62,712,540	
4 1.3	– Type 3 Soils	route–km	36.41	$1,035,000	37,684,350	
4 Item 2	Embankment Construction					
4 2.1	– Soft Excavated Material	1000 m ^ 3	1632.91	$3,000	4,898,730	
4 2.2	– Hard Excavated Material (Rock)	1000 m ^ 3	0	$0	0	
4 2.3	– Borrow Material	1000 m ^ 3	1935.445	$8,000	15,483,560	
4 2.4	– Disposal of Unsuitable Material	1000 m ^ 3	689.58	$5,500	3,792,690	
4 Item 3	Haulage of Fill Material					
4	(from Borrow or Excavation)	1000 m ^ 3 -	0	$0	0	Cost transferred to item B4–2
4 Item 4	Sub–Ballast Layers					For TM2–B0,TM2–D0,TM1–B0,
4 4.1	– New ROW	route–km	231.35	$228,000	52,747,800	TM1–D0,TM0–B0,TM0–B1,
4 4.2	– Existing ROW	route–km	17.56	$228,000	4,003,680	TM0–C0,and TM0–D0, $152,000
4 Item 5	Drainage Systems					used for cost of sub–ballast(it. 4)
4 5.1	– Normal ROW	route–km	248.91	$25,000	6,222,750	
4 5.2	– Major Watercourse Culverts	ea.	30	$35,000	1,050,000	
4 5.3	– Environment. Stormwater Controls	route–km	0	$0	0	
4 Item 6	Roadbed Upgrade on Existing ROW	route–km	7.754	$600,000	4,652,400	
4 Item 7	Retaining Structures					
4 7.1	– Up to 3 metres in Height	km.	1.06	$2,500,000	2,650,000	
4 7.2	– Over 3 metres in Height	km.	2.38	$5,000,000	11,900,000	
4 Item 8	Intrusion Barriers	km.	0	$0	0	Intrusion Barriers not required
4 Item 9	Noise Attenuation Structures					
4 9.1	– Barriers	km.	21.4	$660,000	14,124,000	
4 9.2	– Berms	km.	0	$0	0	
4 Item 10	ROW Security Fencing (on both sides)	route–km	238.22	$56,000	13,340,320	
4 Item 11	Snow Control Measures	km.	0	$0	0	Accounted for in Contingencies
4 Item 12	Utility Interferences					
4 12.1	– Major Hydro Relocation	ea.	26	$0	0	Accounted for in Contingencies
4 12.2	– Major Oil/Gas Relocation	ea.	0	$0	0	Accounted for in Contingencies
4 12.3	– Minor Pipe or Wire Crossings	route–km	0	$0	0	Accounted for in Contingencies
4 Item 13	Other Items					
4 13.1	– Audit for Contaminated Soil	route–km	17.56	$2,000	35,120	
4 13.2	– Audit for Contaminated Rail Yards	ea.	2	$500,000	1,000,000	
4 13.3	– Minor Wildlife Passages (Culverts)	ea.	24	$100,000	2,400,000	
4 Item X	Contingencies	%	$254,670,100	15%	38,200,515	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$292,870,615	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:

300+, NEW ROW — 257.39 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM	C – BRIDGES, VIADUCTS, AND TUNNELS				
		MONTREAL – QUÉBEC CORRIDOR			300+, NEW ROW	
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$204,842,000	5.5%	11,266,310	As a % of total cost of Sector 2
1 Item 2	Construction Supervision	%	$204,842,000	5.0%	10,242,100	As a % of total cost of Sector 2
1 Item 3	Project Management	%	$226,350,410	5.4%	12,222,922	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	$33,731,332	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$33,731,332	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Not Applicable					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Not Applicable					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Bridges					
4 1.1	– Small Rivers (< 30 metres)	ea.	92	$340,000	31,280,000	
4 1.2	– Extra at 1.1 for Height Over 10 m.	ea.	0	$0	0	
4 1.3	– Interm. Rivers (30 – 100 metres)	lin. m.	520	$23,500	12,220,000	
4 1.4	– Extra at 1.3 for Height Over 10 m.	lin. m.	0	$0	0	
4 1.5	– Large Rivers (100 – 250 metres)	lin. m.	610	$42,000	25,620,000	
4 1.6	– Extra at 1.5 for Height Over 10 m.	lin. m.	0	$0	0	
4 1.7	– Major Rivers (over 250 m.)	lin. m.	730	$50,000	36,500,000	
4 1.8	– Extra for Difficult Foundation Cond.	lin. m.	0	$0	0	
4 1.9	– Modif. to Exist. Bridges (new deck)	ea.	250	$13,000	3,250,000	
4 Item 2	Viaducts					
4 2.1	– Viaducts over 250 metres in Length	lin. m.	0	$0	0	
4 2.2	– Extra for Height Over XX metres	lin. m.	0	$0	0	
4 2.3	– Extra for Difficult Foundation Cond.	lin. m.	0	$0	0	
4 Item 3	Tunnels (Double Track)					
4 3.1	– In Soft Ground	lin. m.	0	$0	0	For 300+ technology, Rock
4 3.2	– In Rock	lin. m.	2,210	$35,000	77,350,000	Tunnels speed restricted by local
4 3.3	– Modifications to Existing Tunnels	lump sum	0		0	conditions are $35,000/lin m.
4 3.4	– Noise Mitigation Measures	lump sum	0		0	Accounted for in Contingencies
4 Item X	Contingencies	%	$186,220,000	10%	18,622,000	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$204,842,000	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:
300+, NEW ROW — 257.39 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM — F – TRACK					
	MONTREAL – QUÉBEC CORRIDOR — 300+, NEW ROW					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$195,843,981	3.5%	6,854,539	As % of total for Sectors 2 and 4
1 Item 2	Construction Supervision	%	$37,382,375	10.0%	3,738,238	As % of total for Sector 4
1 Item 3	Materials Procurement	%	$158,461,606	4.0%	6,338,464	As % of total for Sector 2
1 Item 4	Project Management	%	$212,775,222	5.4%	11,489,862	As % of Sectors 2,4 totals plus
1 Item X	Contingencies	%	$28,421,103	0%	0	items 1–3
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$28,421,103	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2 Item 1	Rail					
2 1.1	– Main Line	t.	62,860	$773	48,617,181	
2 1.2	– Siding	t.	1,180	$773	912,636	
2 Item 2	Ties	ea.	889,200	$45	39,827,268	
2 Item 3	Ballast	m^3	1,109,000	$21	23,699,330	
2 Item 4	Turnouts					
2 4.1	– High Speed	ea.	24	$280,000	6,720,000	
2 4.2	– Medium Speed	ea.	21	$135,000	2,835,000	
2 4.3	– Yard	ea.	0	$0	0	
2 Item 5	Other Track Material					
2 5.1	– Rail Fastening Assemblies	set	889,200	$27	23,563,800	
2 5.2	– Bonded Insulated Joints	ea.	0	$0	0	Included in Signalling costs
2 5.3	– Bumping Posts	ea.	5	$3,120	15,600	
2 Item 6	Switch Heaters/ Snow Blowers					
2 6.1	– Main Line	ea.	45	$105,000	4,725,000	
2 6.2	– Yard	ea.	0	$0	0	
2 Item 7	Ballast Mats for Noise Attenuation	m^2	0	$0	0	
2 Item X	Contingencies	%	$150,915,815	5%	7,545,791	
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$158,461,606	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Included in Equipment / Material					
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Track Construction					
4 1.1	– Main Line	km.	514	$18,212	9,352,408	
4 1.2	– Siding	km.	9	$44,175	415,245	
4 Item 2	Field Welded Joints	ea.	3,230	$2,028	6,550,440	
4 Item 3	Turnout Construction					
4 3.1	– High and Med. Speed (Main Line)	ea.	45	$20,455	920,475	
4 3.2	– Yard	ea.	0	$0	0	
4 Item 4	Ballasting and Surfacing	m^3	1,109,000	$8.47	9,393,230	
4 Item 5	Rail Grinding	track–km	523	$4,545	2,376,717	
4 Item 6	Construction Bases	route–km	257	$24,372	6,257,877	
4 Item X	Contingencies	%	$35,266,392	6%	2,115,984	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$37,382,375	
5 SECTOR 5	START–UP					
5	Included in Other Studies					
5						
5 SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:

300+, NEW ROW — 257.39 km. in length

SUBSYSTEM — G – ELECTRIFICATION

MONTREAL – QUÉBEC CORRIDOR — 300+, NEW ROW

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	$166,399,049	5.5%	9,151,948	As % of total for Sector 4
1 Item 2	Construction Supervision	%	$166,399,049	5.0%	8,319,952	As % of total for Sector 4
1 Item 3	Project Management	%	$183,870,949	5.4%	9,929,031	% of sector 4 total plus items 1–2
1 Item X	Contingencies	%	$27,400,931	0%	0	
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$27,400,931	
2 SECTOR 2	EQUIPMENT / MATERIALS					
	Included in Construction / Installation					
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
	Included in Construction / Installation					
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Typical Catenary					
4 1.1	– Single Track – Independent Struct.	km.	0	$0	0	
4 1.2	– Double Track – Independ. Struct.	km.	257	$350,000	89,867,750	
4 1.3	– Double Track – Portal Structures	km.	0	$0	0	
4 1.4	– Triple Track – Portal Structures	km.	0	$0	0	
4 1.5	– Yard Catenary	100 m.	0	$0	0	
4 1.6	– Sidings Catenary	100 m.	20	$13,500	270,000	
4 1.7	– Garage Area Catenary	100 m.	0	$0	0	
4 1.8	– In–Station Catenary	100 m.	74	$17,500	1,295,000	
4 Item 2	Particular Catenary Installations					
4 2.1	– Xover Single (with section breaks)	ea.	6	$280,000	1,680,000	
4 2.2	– Xover Double (with section breaks)	ea.	2	$369,000	738,000	
4 2.3	– Phase Break	ea.	4	$1,052,000	4,208,000	
4 Item 3	Special Catenary Structures					
4 3.1	– Underbridge	100 m.	0	$0	0	
4 3.2	– Overbridge	100 m.	0	$0	0	
4 Item 4	Power Supply					
4 4.1	– Main Supply Station, 230 kV	ea.	2	$5,355,000	10,710,000	
4 4.2	– Main Supply Station, 138 – 120 kV	ea.	0	$0	0	
4 4.3	– Paralleling and Auto–transf. Stn	ea.	20	$730,000	14,600,000	
4 4.4	– 2x25 – 1x25 Interface Station	ea.	3	$925,000	2,775,000	
4 4.5	not used	ea.	0	$0	0	
4 4.6	– Main Supply Station, 315 kV	ea.	2	$6,380,000	12,760,000	
4 4.7	– 315 kV Supply Line	ea.	12	$252,500	3,030,000	
4 4.8	– 230 kV Supply Line	km.	8	$170,300	1,277,250	
4 4.9	– 120 kV Supply Line	km.	0	$0	0	
4 4.10	– Control Center	ea.	1	$200,000	200,000	
4 Item 5	EMI Mitigation Measures	route–km	257	$5,000	1,283,825	
4 Item X	Contingencies	%	144,694,825	15%	21,704,224	
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$166,399,049	
5 SECTOR 5	START–UP					
	Included in Other Studies					
5 SECTOR 5	TOTAL: START–UP				$0	

MONTREAL – QUÉBEC CORRIDOR — SUMMARY SHEET

technology:
300+, NEW ROW — 257.39 km. in length

ITEM NUMBER	ITEM	UNITS	QUANTITY	LOT / UNIT PRICE	TOTAL COST	SOURCE / REMARKS
	SUBSYSTEM H – STATIONS					
	MONTREAL – QUÉBEC CORRIDOR 300+, NEW ROW					
1 SECTOR 1	PROFESSIONAL SERVICES / PROJECT MANAGEMENT					
1 Item 1	Engineering	%	25,300,000	5.5%	1,391,500	As a % of total for Sector 2
1 Item 2	Construction Supervision	%	25,300,000	5.0%	1,265,000	As a % of total for Sector 2
1 Item 3	Project Management	%	27,956,500	5.4%	1,509,651	% of sector 2 total plus items 1–2
1 Item X	Contingencies	%	4,166,151	0%	0	
1						
1 SECTOR 1	TOTAL: PROFESSIONAL SERVICES / PROJECT MANAGEMENT				$4,166,151	
2 SECTOR 2	EQUIPMENT / MATERIALS					
2	Included in Construction / Installation					
2						
2 SECTOR 2	TOTAL: EQUIPMENT / MATERIALS				$0	
3 SECTOR 3	TRANSPORTATION / DISTRIBUTION					
3	Included in Construction / Installation					
3						
3 SECTOR 3	TOTAL: TRANSPORTATION / DISTRIBUTION				$0	
4 SECTOR 4	CONSTRUCTION / INSTALLATION					
4 Item 1	Individual Stations	lump sum		$23,000,000	23,000,000	
4 Item 2	Not used	lump sum		$0	0	
4 Item 3	Not used	lump sum		$0	0	
4 Item 4	Not used	lump sum		$0	0	
4 Item X	Contingencies	%	23,000,000	10%	2,300,000	
4						
4 SECTOR 4	TOTAL: CONSTRUCTION / INSTALLATION				$25,300,000	
5 SECTOR 5	START–UP					
5	Included in Other Studies					
5						
5 SECTOR 5	TOTAL: START–UP				$0	

10–Feb–94 current costs on file

Montréal – Québec Corridor

300+, NEW ROW

segment	total cost
MQ2–A0	$0
MQ2–B0	$0
MQ1–A0	$0
MQ1–B0	$0
MQ1–C0	$0
MQ0–A0	$0
MQ0–B0	$708,975,021
MQ0–C0	$682,479,658
MQS–1	$0
MQS–2	$14,270,328
MQS–3a	$13,979,869
MQS–3b	$20,952,005
MQR–01	$0
MQR–02	$0
TMR–04	$0

$1,440,656,880

MONTRÉAL-QUÉBEC

E4. TOTAL COSTS FOR SUB-SEGMENTS

MQ2-A0	Montréal - Trois-Rivières	799,444
MQ2-B0	Trois-Rivières - Québec City (Gare du Palais)	564,209
MQ1-A0	Montréal - St. Martin Jct.*	210,775
MQ1-B0	St. Martin Jct. - Trois-Rivières	667,087
MQ1-C0	Trois-Rivières - Québec City (Gare du Palais)	687,391
MQ0-A0	Montréal - St. Martin Jct.*	210,781
MQ0-B0	St. Martin Jct. - Trois-Rivières	708,975
MQ0-C0	Trois-Rivières - Québec City (Gare du Palais)	682,480
MQS-1	Laval - New Station**	18,659
MQS-2	Trois-Rivières - New Station	14,270
MQS-3a	Ancienne Lorette - New Station	13,980
MQS-3b	Québec City/Gare du Palais - Modifications	20,952

* only required when considering Montréal - Québec alone

** only required for 300+ option when considering Montréal - Québec alone