



Report

*Detroit River International Crossing
Proposed Highway 401 along Talbot /
Huron Church Road Corridor*

Windsor GreenLink

*Constructability and Construction
Cost Estimating Review*

March 20, 2008

Submitted to:

The City of Windsor

Submitted by:

PB Americas, Inc.

A handwritten signature in black ink, appearing to read 'N. Munfah'.

Nasri Munfah, P.E.
Project Manager
Senior Vice President
National Tunnelling Practice Leader
Parsons Brinckerhoff
New York, N.Y.



**City of Windsor
Detroit River International Crossing**

**Proposed Highway 401 along Talbot / Huron Church Road Corridor
GreenLink**

Constructability and Construction Cost Estimate Evaluation

March 2008

Introduction

In August, 2007 the Detroit River International Crossing Project (DRIC) published a “Parkway” design alternative for building the Highway 401 extension to the location of DRIC’s proposed new international bridge crossing between Windsor and Detroit. The DRIC Parkway cost estimate was \$1.5 Billion. DRIC’s stated intention was “to identify a solution to Windsor’s border transportation issues that protects the community and improves the quality of life.”

The Parkway concept is a depressed six-lane controlled access roadway (and four-lane service road at street level), with a relatively conventional cross-section and 10 crossings, labelled “land bridges”, that would have some landscaping associated with them, as well as along the edges of the right-of-way in between the two directional pavement portions. These land bridges represent approximately 25% of the Parkway length.

Following its review of the Parkway concept, Windsor City Council retained Parson Brinckerhoff (PB), a major international engineering firm headquartered in New York, and Sam Schwartz PLLC, a firm specializing in transportation planning, to determine if DRIC’s objectives could be more effectively achieved, and negative impacts more effectively mitigated, by an alternative design for this access road.

The City’s consultants developed the GreenLink Windsor proposal, which was presented publicly in October, 2007. The GreenLink alignment extends from Highway 401 to the EC Row Expressway along the Talbot/Huron Church Road corridor. It has 6 covered highway segments or tunnels, ranging in length from 120 m to 1,220 m, with 3 tunnels longer than 1 km, with the result that GreenLink has tunnels covering about 65% of the new access road, with landscaping on these longer tunnel roofs. The tunnel portals (entrances and exits) are located away from adjacent sensitive areas such as residential or institutional communities. In presenting GreenLink in October, 2007 PB estimated the construction cost at \$1.67 Billion (2007 dollars). This estimate was based on estimated quantities take off and unit pricing approach. An in-house database of unit prices was used with suitable adjustments for the Windsor marketplace and exchange rate. DRIC subsequently questioned the GreenLink cost estimate, suggesting GreenLink’s cost would be substantially higher.



The Independent Peer Review Team

In order to respond to these questions, the City of Windsor requested that PB arrange for an independent constructibility and cost estimate peer review of GreenLink.

An independent GreenLink peer review team was assembled comprised of two professional engineers with many years specialized experience in major infrastructure project construction and costing. They are

- Don Hilton, P.E., Boise, Idaho. Mr. Hilton is an independent consultant with more than 35 years experience in many aspects of heavy civil and underground construction including bridge, tunnel and cut and cover projects in the U.S. and internationally. He has worked as a tunnel construction manager, field engineer, quality control engineer, construction cost estimator and project engineer for underground as well as surface construction projects and has applied that experience to estimating, corporate cost control systems and constructability reviews for tunnel engineering firms. Some examples include preparing bids for cut and cover subway projects in Washington, D.C., Atlanta, Boston and Los Angeles; preliminary engineering level cost estimates for tunnel and underground stations on the New York Subway system; and cost estimates and constructability reviews for preliminary engineering of "THE Tunnel", a new passenger rail tunnel for service from Newark, New Jersey to Penn Station, New York for New Jersey Transit. He is a member of the American Society of Civil Engineers. His CV is attached in Appendix A.
- John Doody, P.E., of G. C. Solutions Inc. Franklin, Massachusetts, specializes in heavy civil projects and has over 28 years heavy civil and tunnel construction experience throughout the United States. His firm specializes in assisting contractors, surety firms, owners, law firms and engineering firms with complex construction issues in the following areas: estimate manager; project management; construction means and methods; schedule development and analysis; claim/change order development. His experience as an estimate manager includes projects such as heavy highway, rapid transit, and large bridge structures. Other project experience includes the I-5 Tacoma Viaduct, the MBTA Wonderland Station and Boston Engine Terminal. He is a member of the American Society of Civil Engineers. His CV is attached in Appendix A.

Peer Review Process and Report

The peer review process was initiated using a workshop setting in which a presentation of the GreenLink design concept, photographs, drawings, a geotechnical report, the constructability issues, and the PB cost estimate were provided by the PB GreenLink project team. The workshop was carried out on February 7 and 8, 2008.

The peer review workshop began with a review of background information about the design and cost estimate, including findings to date with regard to geotechnical conditions, construction techniques, and constructability. The goal of the peer review was to solicit the peer reviewers' expert opinions on the following aspects of GreenLink for the new depressed roadway and tunnels associated with this project:



- Constructability of the project
- Construction staging required
- Validity of the conceptual cost estimate
- Estimated project duration
- Recommendations to improve the project constructibility and potential cost reduction.

The peer reviewers analyzed the presented data, identified technical and construction issues, assessed the constructability and risk issues, performed an independent evaluation of the cost estimate and identified potential modifications and improvements. The peer review team produced a summary report of their findings, which is provided in Appendix B.

The peer reviewers deemed that the GreenLink constructability is typical to similar types of cut and cover tunnel work with only minimal areas of Contractor risk or unknowns. The peer review team did not discover any “high risk” work areas or work that was not quantifiable. Review of the proposed means and methods of constructing the Grand Marais Drain demonstrated that the work is constructable based on the proposed sequence of work. The Grand Marais Drain would be constructed top-down as previously indicated on the drawing, with the tunnel roof being the underside of an aqueduct replacing the existing drain.

The peer review team considered that the service road would be built first to allow traffic to be shifted off the current mainline road to the new 4-lane service road and thereby allow the depressed roadways and tunnels to be constructed in one phase. The GreenLink construction design would allow traffic on Huron Church Road to continue, using the service road.

In the opinion of the peer review team, 18 at-grade temporary diversions or temporary bridges would be required to stage the construction. They recommended that a preliminary alignment plan be prepared with overlays of existing roadways so that construction staging and detours etc. can be refined.

The peer review team estimated the construction duration to be 5 to 6 years, accounting for minimal winter construction activities.

The peer review team identified the following items requiring cost adjustments:

Item	PB Cost Estimate Rate	Peer Review Proposed Rate
Temporary bridge or detour (18 total)	Included	\$2M each
Water pressure relief system	Included	\$2.1M
Surface water control	Included	\$4.9M
Drainage pipe	\$33-\$49/m	\$66/m
Excavation	\$20-\$39/m	\$33
Tie-down anchors	\$328/m	\$656/m
Base slab concrete	\$523/m ³	\$959/m ³
Wall concrete	\$785/m ³	\$1,019/m ³
Roof concrete	\$785/m ³	\$1,019/m ³
Wall finishes	\$54/m ²	\$0/m ² (included in Concrete)



Waterproofing	\$6-\$8/m ²	\$26/m ²
Backfill	\$20/m ³	\$26/m ³
Contingency	35%	35%

The peer review team also made recommendations to reduce the cost and improve the design and constructability:

- Prepare a preliminary alignment plan with overlays of existing roadways so that the construction staging and detours etc. can be evaluated.
- The preparation of engineering drawings allows for preliminary optimization of the initial layout over the use of only photographs and prints.
- Evaluate the possibility of reducing the invert slab thickness by increasing the number of invert tie-downs.
- Evaluate the elimination of the slurry walls by using a combination of invert jet grouting, soldier-pile and lagging initial support and a fully cast in place box structure.

PB Design Team Assessment

Following the comments from the peer review team, and in order to validate the peer review team recommendations regarding design improvements, PB conducted an in-depth analysis of the major differences in the cost estimate unit prices to confirm the validity of the peer reviewers' proposed unit prices for the project specific requirements. The analysis focused on establishing project specific unit prices for certain high cost items using the estimated quantities and developing project specific unit prices. The unit prices were calculated using costs of material, labour, equipment, supplies, Contractor and subcontractors' field and home office overheads, performance bond, and Contractor's anticipated profit. This process is usually used for projects at an advanced design level and is based on a similar approach as used by contractors in bidding projects. The main cost items that were re-evaluated were base slab concrete, wall concrete, top slab concrete and top and bottom excavation. The analysis is attached in Appendix C.

Based on this analysis PB and consideration of the peer review recommendations, PB concluded that the following unit prices are appropriate to be used for the GreenLink:

Item	PB original Cost Estimate Rate	Peer Review Proposed Rate	PB 2nd Review Rate	Rate Adopted
Temporary bridge or detour (18 total)	Incl.	\$2M each	Added	\$2M each
Pressure relief system	Incl.	\$2.1M	Added	\$2.1M
Surface water control	Incl.	\$4.9M	Added	\$4.9M
Drainage pipe	\$33-\$49/m	\$66/m	Unchanged	\$33-\$49/m
Excavation	\$20-\$39/m	\$33	\$31-\$40/m	\$31-\$40/m
Tie-down anchors	\$328/m	\$656/m	Unchanged	\$328/m



Base slab concrete	\$523/m ³	\$959/m ³	\$522/m ³	\$522/m ³
Wall concrete	\$785/m ³	\$1,019/m ³	\$980/m ³	\$980/m ³
Roof concrete	\$785/m ³	\$1,019/m ³	\$795/m ³	\$795/m ³
Wall finishes	\$54/m ²	\$0	Unchanged	\$54/m ²
Waterproofing	\$6-\$8/m ²	\$26/m ²	Unchanged	\$6-\$8/m ²
Backfill	\$20/m ³	\$26/m ³	Unchanged	\$20/m ³
Contingency	35%	35%	30%	30%

Based on refined development of the cost estimate unit prices in this latest evaluation, PB concluded that the contingency can be reduced from 35% to 30% consistent with other projects in the conceptual design level. PB performed a revised cost estimate using the adopted rates shown above. Using the “Rate Adopted” adjustments, the project cost rises from \$1.672B to \$1.753B, a 4.8% increase. Furthermore, if the peer review proposed changes of the drainage pipe, tie down anchors, wall finishes, waterproofing and backfilling costs were accepted, the revised construction cost would be \$1.77B, an additional increase of only 0.97%. All estimates are in 2007 dollars and exclude soft costs such as owner’s cost, engineering, construction management, insurance, real estate etc. The revised cost estimates are provided in Appendix D.

PB believes that further reduction of the construction cost can be achieved by adopting some of the potential cost saving ideas proposed in the peer review workshop such as reduction of the invert slab thickness by increasing the tie downs, changes in the wall finishes, use of jet grouting, etc. In addition, during the original cost estimate a number of conservative simplifying assumptions were made that if investigated further would undoubtedly further reduce the cost. At this stage these further cost saving ideas or re-investigating of the assumptions were not included.

Conclusion

The peer review confirmed the constructability of GreenLink. With respect to cost, the peer review and PB’s further evaluation demonstrates that the GreenLink cost will be in the range of \$1.75 to \$1.77B (in 2007 dollars), that is, within 6% of the original estimated GreenLink cost PB provided in October, 2007, and that further reductions of construction cost can be achieved.



Appendix A
Peer Reviewers CVs

RESUME

DONALD E. HILTON P.E.

Donald Hilton & Associates Inc.
195 E. Rush Dr.
Eagle, ID 83703
Ph.: 208-939-4798
E-mail DEHilton@AOL.COM

EDUCATIONAL BACKGROUND

May 1963 Graduate Public High School - Pine Bluff Arkansas
May 1972 Graduate BSCE University of Arkansas

PROFESSIONAL LICENSES

Professional Engineer - State of New York - #59875
Professional Engineer - State of Georgia - #15149

PROFESSIONAL ORGANIZATIONS

American Society of Civil Engineers
National Society of Professional Engineers
American Underground-Construction Association
Society for Mining Engineering
Disputes Review Board Foundation
Executive Committee Rapid Excavation and Tunneling Conference

PUBLICATIONS

Economics - When to go Trenchless {Recipient of AUA- Ken Lane Award.}
Editor 1999 RETC Proceedings

EXPERIENCE SUMMARY

Mr. Hilton has more than 35 years of experience in many aspects of heavy civil and underground construction. The varied nature of this experience gives a broad knowledge of different construction and management methods to apply to a particular project. His construction, engineering management and estimating experience includes mine development, lock and dam, bridge, tunnel and cut and cover projects in the United States as well as foreign assignments. He has worked as a field engineer, quality control inspector and project engineer for underground as well as surface construction projects. The knowledge of construction methods gained from these projects has been applied to estimating, corporate cost control systems and constructibility reviews for tunnel engineering firms. His corporate management experience includes responsibilities of Chief Estimator, Assistant Division Engineer Area Engineer and Chief Engineer.

EXPERIENCE DETAIL

ENGINEERING AND MANAGEMENT

- ❖ Mr. Hilton's engineering and management experiences have been both for owner and contractor. He has served as the owner's representative for the construction of The Entrenchment Creek Tunnel in Atlanta, Georgia. He was responsible for the oversight of inspection staff assuring compliance with contract specifications. The duties included approval of pay estimates, coordination of submittal reviews, negotiation of change orders with the contractor and maintenance of project progress records.
- ❖ His positions as Assistant Division Engineer and Area Engineer for the Morrison Knudsen Corporation required the management of estimating functions as well as support of engineering staff on tunnel construction projects in the Southwestern United States.
- ❖ As Chief Estimator for both Walsh Northwest and Frontier-Kemper Constructors he managed a diversified staff of estimators and consultants in the bidding efforts for various projects. He also coordinated the efforts of Joint Venture Partners.
- ❖ As an independent consultant he has prepared bid level estimates for both contractors and engineering firms. He assisted in change order preparation for the Hudson Bergen Light Rail project in North East New Jersey. He provided constructibility reviews and cost estimates for various alternatives for the 6.4 billion dollar East Side Access Project in New York City, water tunnel repair projects for New York City as well as various options for the New Croton water treatment system in New York City. He also provided constructibility review and engineers estimate for outlet tunnels and shafts for a water supply dam and lake in Denver, sewer tunnels in Seattle and post bid alternative evaluations Sound Transit tunnels in Seattle as well as Preliminary Engineering estimates for the future North Link Transit Tunnels in Seattle Washington.

DOMESTIC CONSTRUCTION

- ❖ Mr. Hilton has been involved in the construction of lock and dam projects with positions of Draftsman, Field Engineer as well as Quality Control Inspector. These projects were part of the Arkansas River Navigation System the De Gray Re-regulating Dam on the Quachita River in Arkansas and the Little Sunflower River Dam in Mississippi. He was involved field operation for both the excavation and concrete construction portion of the projects.
- ❖ Experience in construction of highways and bridges was gained as Project Engineer for the building of two concurrent interstate highway projects in Birmingham, Alabama. The projects involved the construction of 29 Bridges. Earthwork involved moving of four million CY of embankment using truck haul across town on one project, the second project required the cut and fill of over six million CY of soil, using scrapers. Both projects included the construction of numerous smaller structures such as retaining walls and culverts. Duties included formwork design, purchasing and cost engineering.
- ❖ Additional bridge construction experience was gained during construction of 19 interstate bridges north of Atlanta, Georgia. The project included building reinforced earth retaining walls. His duties were the same as above with the addition of surveying.
- ❖ Mr. Hilton's underground construction experience includes several projects: He has acted as Project Manager / Engineer for a small pipe jacking project in East St. Louis, Illinois. This assignment required that he perform a wide variety of functions including purchasing, payroll,

cost accounting as well as normal engineering duties.

During the construction of Buffalo Subway project his initial position was Field Engineer with subsequent promotion to Project Engineer. His duties included supervision of surveying and engineering staff, management of subcontractor's staff and coordination of engineering functions with field supervisory personnel. The project was the construction of twin ten thousand-foot rock tunnels. Excavation was accomplished with two Robbins TBM's.

INTERNATIONAL CONSTRUCTION

- ❖ Mr. Hilton has international construction experience in two countries. The first is Kuwait. The project was the construction of a cooling water intake plant. The facilities built included an Intake Structure built in a dry dock and floated into position, four 10 ft Diameter Pipe Lines 2000 lf into the Gulf, and an On-Shore Pumping Plant and Discharge Lines. His position was originally Area Engineer and later Project Engineer. The construction included on-sight fabrication of rebar, casting of the concrete intake pipes, fabrication of all formwork and batching of concrete. He was also Project Engineer for a concurrent project for the discharge of spent cooling water.
- ❖ The second location was Taipei, Taiwan. The work here involved the initial phase of a soft-ground subway project. He developed CPM schedule for submittal to the owner and assisted in the selection of subcontractors and basic construction methods.

ESTIMATING

- ❖ A varied background of estimating and building heavy civil projects provides an excellent base for cost estimates for both contractors and owners. More than 35 years of experience provides a solid base to draw on in determining cost and production rates for a wide range of projects. Estimating experience includes Bridges, Tunnels of all types, Cut and Cover Subway Line and Station Projects as well as Mine Development Projects such as Conventional Shafts, Raise Bore Shafts and Drill-Shoot Slopes. The estimating required the tracking of projects to bid, evaluation of the probability of being successful. The responsibilities included leading of teams in the development of technical as well as commercial proposals to the owners.
- ❖ Tunnel Projects include a wide spectrum of those requiring excavation and support methods varying from soft ground compressed air or EPB shields to rock tunnels excavated using conventional drill & blast methods or TBM's. These projects were located throughout North America and the Far East. They incorporated innovative methods such as temporary precast segments for preliminary support on successful bids in Houston Texas and Tucson Arizona. The use of continuous conveyors for muck removal was used on other successful bids in Milwaukee Wisconsin, Colorado Springs Colorado and Tucson Arizona. The list of successful bids include Tunnels for Subways for the City of Los Angeles, California and Design Build Interceptor Sewers in Toronto, Canada.
- ❖ Preparation of bids for Cut and Cover Subway Projects include work in Washington, D.C., Atlanta, Boston and Los Angeles. The bidding required the preliminary design of excavation support systems, street decking as well as underpinning of existing structures. The projects were simple line sections, basic station structure as well as fully finished stations. Cut and Cover Projects were not limited to those for Subways. Mr. Hilton also successfully bid the very large cut and cover "Experimental Halls" for the Super Collider Project near Dallas Texas.
- ❖ Bids for Mine Development Projects encompassed a wide range of minerals including Coal,

Limestone, Lead, Salt as well as precious metals such as Gold and Platinum. The scopes of these jobs varied from simple unlined raise bore shafts to those requiring multiple shafts, underground processing facilities as well as surface product packaging and shipping facilities.

- ❖ Bids for bridges construction projects were located in Alabama, Georgia, Missouri, Illinois and Idaho. The types of bridges were simple precast concrete or steel beams with cast-in-place decks as well as complex river crossing bridges with steel truss superstructures. The construction sites were rural, urban and those in environmentally sensitive areas.
- ❖ As an independent consultant estimates Mr. Hilton has prepared cost estimates for several projects including:
 1. Underground storage caverns for liquefied natural gas storage.
 2. Cut and cover station and line excavation and support for a Boston subway project.
 3. A highway enlargement project in Phoenix.
 4. Change order for the Hudson-Bergen Light Rail project in Northeast New Jersey.
 5. Tunnel enlargement and station construction in Wehawken NJ for the Hudson -Bergen Light Rail Project.
 6. Cost estimates based on conceptual design thru final design for the East Side Access Project in NY City.
 7. Preliminary engineering level cost estimates for tunnel and underground stations #7 Line Subway extension New York City.
 8. Repair of Delaware Aqueduct NY State
 9. Intake tunnels, shafts and outlet tunnels for an existing water supply lake in Denver, Co.
 10. Various tunnel and shaft options for the Croton Water Treatment Facilities in New York City.
 11. Repair and stabilization of collapsed water supply tunnel north of Denver Co.
 12. Large diameter sewer tunnel Milwaukee Wisconsin
 13. Conceptual Estimates for National Engineering Labs for underground experimental facilities requiring tunnels and shafts at various locations in the United States.
 14. Cost estimates and Constructability reviews for preliminary engineering of “THE Tunnel”, a new passenger rail tunnel for service from Newark New Jersey to Pen Station New York City for New Jersey Transit

CONSTRUCTABILITY REVIEWS & VALUE ENGINEERING

- ❖ He has provided constructability reviews for the Hudson-Bergen Light Rail project. This involved review of 30% design drawings to determine possible problems with sequencing and construction methods proposed or a major change order significantly changing the scope of the project.
- ❖ Constructability review input was provided for various configurations proposed in the preliminary design phases of the East Side Access project. These reviews were for several different areas of the project including, underpinning of existing rail facilities, construction of underground station and tunnels, excavation of mixed face tunnels and cut and cover excavation.
- ❖ Reviewed proposed construction methods #7 Line Subway extension New York City.
- ❖ Reviews of the proposed construction methods for repairs to be proposed for one of the Delaware Aqueduct Tunnels in New York State were provided along with the cost and schedule analysis.
- ❖ Participated in peer review panel and value engineering panel for the bright water sewer tunnels in Seattle.

- ❖ Value engineering team member block 39 subway project Chicago Illinois
- ❖ Contract packaging peer review Seattle North Link Subway project.

DISPUTES REVIEW BOARDS

He has as served as a member of the following DRB panels on these completed projects.

- ❖ Chattahoochee Sewer Tunnel in Atlanta GA
- ❖ Capital Peak Tunnel Complex in New Mexico
- ❖ Idaho Transportation Department I84-Hw93 Intersection Upgrade at Twin Falls, Idaho
- ❖ Tom Cat Hill Highway project for the Idaho Transportation Department

Mr. Hilton is currently a DRB member for the

- ❖ Big Walnut Interceptor sewer project in Columbus Ohio
- ❖ Riverbank Tunnel project Louisville, KY.
- ❖ Topaz to Lava Springs project for Idaho Transportation Department

He is an alternate member for standing disputes advisory board to Chief Engineer Idaho Highway Department

DRB Training Completed

1. DRB Foundation administration and practice workshop March 17, 2001
2. Completed DRB Foundation chairing workshop March 18, 2001
3. DRBF practice & procedures update training May 23,2006

Resume



John Doody

Construction Consultant

Specializing in heavy civil projects

Dedicated professional with over 28 years of heavy civil construction experience throughout the United States. After 17 years with Kiewit Construction, formed G.C. Solutions, Inc. (GCS) in 1996 to assist contractors, surety firms, owners, law firms and engineering firms with complex construction issues in the following areas of expertise:

- Schedule Development and Analysis
- Claim/Change Order Development
- Training
- Estimate Manager
- Project Management
- Construction Means and Methods

Combines common sense management style with strong communication skills. Reputation for implementing innovative ideas for complex construction issues. Ability to quickly identify and resolve problems.

Career Experience and Achievements

G.C. Solutions, Inc. - 1996 to Present

- Formed GCS in 1996 after a successful 17-year career with Kiewit Construction. Implemented company estimating programs and procedures, developed and instituted a company marketing plan and performed oversight of company's financial records.
- Prepared a complex, 20 million dollar claim that our client successfully negotiated with the owner.
- Provided key estimate input for 1.5 billion dollar successful low bid by American Bridge/Fluor team.
- Assigned a lead role by St. Paul Travelers to manage more than 500 million dollars of active work in which the contractor was terminated. Consulted surety executive management team and proposed cost saving options to complete the work. The work was successfully completed under budget with no assessment of liquidated damages.

Kiewit Construction – 1979 to 1996

- **Area Manager** – Profitably managed over 100 million dollars of work in the Northeast for two years. Assisted in the preparation and successful negotiation of multi-million dollar change orders. Instituted project training programs for engineers and superintendents.
- **Project Manager** – Was the project manager on a 248 million dollar Central Artery project. Supervised 50 engineers and coordinated a team of 300 craftspeople and 25 subcontractors. Project turned in record profits for the Northeast District of Kiewit.
- **Estimate Manager** – Led a team of seasoned estimators and submitted over two billion dollars of bids for various types of projects including heavy highway, rapid transit, large bridge structures and water treatment facilities. Developed pre-bid value engineering ideas that lead to successful low bids. Initiated estimating procedures to minimize pre-bid mistakes.
- **Other Projects** – 3rd Lake Washington Floating Bridge, MBTA Boston Engine Terminal, New Bedford Swing Bridge, I-5 Tacoma Viaduct, MBTA Wonderland Station, Naselle River Bridge, Yakima River Bridges.

Education

- B.S. Civil Engineering Technology – Fairleigh Dickinson University

Memberships/Organizations

- Member, American Society of Civil Engineers



Appendix B
Peer Review Report

DONALD HILTON & ASSOCIATES INC.
195 East Rush Drive
Eagle Idaho 83616

TO: Nasri Munfah

PB Americas

DATE: 8 March 2008

FROM:

Donald Hilton PE, Donald Hilton & Associates Inc

John Doody, GC Solutions

PROJECT: Green Link Windsor Tunnel

SUBJECT: Estimate Review

February 7 & 8 2008 John Doody and Donald Hilton were given the task to review the conceptual drawings and cost estimate prepared by PB Americas. We were tasked with reviewing the constructability of the project, the staging required, the validity of the conceptual cost estimate, providing expected construction duration of the project and providing recommendations to improve these items.

1) Constructability

Construction of the depressed section of highway is approximately 7km in length. Based on our review, the work is typical to other depressed highways built throughout the United States and Canada with only minimal areas of contractor risk or unknowns. Construction means and methods would also be typical to similar types of cut and cover tunnel work. In our review we did not discover any "high risk" work areas or work that was not quantifiable.

In our analysis an assumption was made that the "service road" would be built first. This would allow the traffic to be shifted off the current mainline artery to the new service road, which would allow for complete construction of the new depressed tunnel section in one phase. Phasing the project in this manner improves the schedule and minimizes the cost for traffic detours and congestion.

Some concern was raised relative to the Constructability of the Grand Marais Drain. A review of the proposed means and methods demonstrated the work is constructible based on a predetermined sequence of work. This sequence is as follows; construct finished roadway slurry wall in the “dry” season, install a pile bent at centerline of future tunnel, excavate flume in sections, cast thickened roadway tunnel roof and flume sidewalks, once complete, mine under the flume and complete the tunnel construction.

2) **Staging**

Assuming that the permanent surface access road is built 1st there are 18 locations that will require temporary bridges or at grade detours to allow construction of the depressed highways or tunnel structures.

3) **Cost Estimate**

The current cost estimate is for direct construction costs only in 2007 dollars. Soft costs such as engineering, construction management, property acquisition owner costs and escalation are not included.

1. Add cost of detours or temporary bridges. 18 ea @ \$2 Million = \$36 million.
2. Construction surface water control and dewatering.
Instillation of a pressure relief system for 1050m at \$2,000 / m = \$2.1 million
Surface water control for protection of existing drainage ditches, control of surface runoff in the excavation, settling basins, pumping and other treatment required. Allow \$700 / meter = 700 x 7000 = \$4.9 million
3. Permanent drainage for drainage pipe and inlets increase allowed cost from \$33/m to \$66 / m = \$33/m increase = 18,377 x \$33 = \$0.6 million
4. Due to soft properties of the clay to be excavated the cost should be increased from \$20 / m³ to \$33 / m³ = \$13 x 3,115,138 = \$40.5 million.
5. Tie down anchors to resist up lift will be drilled in to rock with water under high artesian pressure the unit cost of \$ 328 / m will not be sufficient to cover these costs increase the cost to \$ 656 / m = \$328 x 20,198 = \$ 6.6 million
6. Increase unit cost of base slab concrete from \$523 / m³ to \$959 / m³ = \$436 x 462,461 = \$201.6 million
7. Increase unit cost for wall and roof concrete from \$785 / m³ to \$1,019 / m³ = \$234 x 272,118 = \$63.7 million

8. Delete the cost for wall finishes (\$5 Million)
9. Increase waterproofing costs from average \$7/ m² to \$26 / m² = \$19 x 446,727 = \$8.5 million
10. Increase backfill cost from \$20 / m³ to \$26 / m³ = \$6 x 365,917 = \$2.2 million

Total cost increase = \$361.7 million with 35% contingency = \$488.3 million cost adjustment

4) **Construction Duration**

The estimated construction duration is 5 to 6 years accounting for minimal winter construction activities.

5) **Recommendations**

- ❖ Prepare a preliminary alignment plan with overlays of existing roadways so that the construction staging and detours etc. can be evaluated.
- ❖ The preparation of an engineering drawing may allow for preliminary optimization of the initial layout over the use of only photographs and prints.
- ❖ The geotechnical reports mention the presence of Hydrogen Sulfide gas in the groundwater. The presence of this poisonous gas needs to be evaluated.
- ❖ Evaluate the possibility of reducing the invert slab thickness by increasing the number of invert tie-downs. A reduction of 0.3 m would result in a savings of \$63.4 million in invert concrete costs.
- ❖ Evaluate the elimination of the slurry walls by using a combination of invert jet grouting, soldier-pile and lagging initial support and a fully cast in place box structure.
- ❖ The contingency for comparison of the two options should be the same i.e. the contingency for this option should be reduced to the same as the full open cut option. The contingency in the final budget should be the 35% presented for this conceptual design. The contingency would then be reduced as the alignment and staging is refined.



Appendix C
Unit Prices Estimate



PB AMERICAS, Inc COMPUTATION SHEET

Page 1 of 45
 Made by LCF Ingerslev
 Date Nov 8, 2007
 Checked by
 Date

File Ref GreenLink3+3NarrowShoulders15Nov07Rev1b Quantities & Cost #2

Subject Short Tunnels Quantities Rev 1a splits wall and roof quantities
 Alignment raised 1 m, minimum shoulders and outside walls Rev 1b revises cost of excavation and concrete, adds 4 items at
 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Excavation Support System Zone	Section	Approx. Length, m	Approximate Excavation Depth, m	Remark	Actual Start	Apparent Start	Apparent Finish	Lanes	Length	
1	Surface Roadway	272.8	0 to 4 m	3+3 lane roadway on slab, minor depression	10+489.2	19+570.0	19+842.8	3+3	272.8	
	Eastern Approach Ramp - depressed roadway	400	4 to 10 m	3+3 lane roadway on slab, Sloped cut 1.5H:1V temporary; 2.5H:1V permanent	10+332.0	19+412.8	19+570.0	3+3	157.2	
	Depressed Roadway, Ramp 10 enters N side			4+3 lane roadway on slab, ditto	10+300.0	19+380.8	19+412.8	4+3	32	
2	Depressed Roadway, Entry Lane 10 on N side			4+3 lanes U-section, Soldier Pile and Lagging or Sheeting, laid back upper 7 m (max)	10+189.2	19+270.0	19+380.8	4+3	110.8	
	Depressed Roadway, Entry lane 10 on N side and Ramp 9 exits on S side			4+4 lanes U-section, ditto, laid back upper 7 m N side	10+089.2	19+170.0	19+270.0	4+4	100	
									<u>4380</u>	<u>672.8</u>

Excavation

Apparent Start	Length	Start PGL Depth	Ext wall min.ht	Excav Depth	Width	Exc End area	Excav Volume	Volume for Ramp Entry/Exit	% Laid back	Extra for Sloped Excav
19+570.0	272.8	3	0	4.0	29.560	118	20,160		100%	3,069
19+412.8	157.2	4	0	5.0	29.560	148	20,911		100%	8,057
19+380.8	32	4.8	0	5.8	33.310	193	5,456	1,276	100%	2,346
19+270.0	110.8	8	1.0	9.3	36.570	340	29,545		100%	9,978
19+170.0	100	8.7	1.7	10.3	40.320	415	37,770	3,245	50%	6,125
	<u>673</u>						<u>113,841</u>	<u>4,521</u>		<u>29,574</u>



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Subject	Short Tunnels Quantities	Rev 1a splits wall and roof quantities
	Alignment raised 1 m, minimum shoulders and outside walls	Rev 1b revises cost of excavation and concrete, adds 4 items at
	DRIC Windsor Tunnels, PB Option	end and contingency reduced to 30%

Excavation Support Eastern Approach Ramp

Apparent Start	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
19+570.0	-	-	-	-	-	-
19+412.8	-	-	-	-	-	-
19+380.8	-	-	-	-	-	-
19+270.0	255	-	-	15	-	-
19+170.0	1,260	2	132	27.5	-	-
	<u>1,515</u>			<u>3,630</u>		<u>-</u>

Concrete and Finishes

Apparent Start	Mud slab	Base Slab	Walls	W/proof (not U walls)	Barrier & Walkway Plan SM	Wall Finishes
19+570.0	-	8,064	-	0	1,015	-
19+412.8	-	4,647	-	0	585	-
19+380.8	-	1,006	-	0	119	-
19+270.0	3,871	4,479	111	3,871	412	55
19+170.0	3,845	5,603	270	3,845	372	135
	<u>7,716</u>	<u>23,799</u>	<u>381</u>	<u>7,716</u>	<u>2,503</u>	<u>190</u>
Thickness	<u>0.075</u>			Height	<u>0.8</u>	
Volume	<u>579</u>			Volume	<u>2,002</u>	

Base stability

Apparent Start	Soil & Concrete weight/m	Uplift, tonnes/m	Weight/m central half, T	Uplift center	Tiedown Length, m	160T tiedowns center, m	160T tiedowns outside m
19+570.0	81.3	29.6	43.9	14.8	37	-	-
19+412.8	81.3	29.6	43.9	14.8	37	-	-
19+380.8	86.0	33.3	48.6	16.7	37	-	-
19+270.0	111.0	84.1	66.3	42.1	33	-	165
19+170.0	154.3	133.1	87.6	66.5	28	-	252
						-	<u>417</u>



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Cost Estimate Eastern Approach Ramp

	Unit	Rate	Quantity	Min Cost \$M	Max Cost \$M
<u>Excavation and Fill: Depressed Roadway and Ramp Entrances</u>					
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	147,935	5	
	CM, max	\$40	147,935		6
Soldier-pile & lagging, exposed	SM, min	\$538	1,515	1	
	SM, max	\$646	1,515		1
Tieback anchors	LM	\$328	3,630	1	1
Secant piles 3 ft dia or slurry walls	SM	\$1,957	-	0	0
<u>Structure: Depressed Roadway and Ramp Entrances</u>					
Concrete mud slab	CM, min	\$262	579	0	
	CM, max	\$262	579		0
Base slab	CM	\$522	23,799	12	12
Tie-down anchors, center, 160T	LM	\$328	-	0	0
Tie-down anchors, outside, 160T	LM	\$328	417	0	0
Walls	CM, min	\$980	381	0	
	CM, max	\$980	381		0
Finishes walls (ceiling none)	SM	\$54	190	0	0
Barrier & walkway concrete	CM	\$450	2,002	1	1
Permanent tiebacks T, 45°			incl		
Waterproofing	SM, min	\$6	7,716	0	
	SM, max	\$8	7,716		0
				21	22
Contingency		30%		6	7
Estimated Section Cost				<u>\$27,810,000.00</u>	
	Cost/m			\$41,000	
	Cost/lane-m			\$6,300	



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Excavation Support System Zone	Section	Approx. Length, m	Approximate Excavation Depth, m	Remark	Actual Start	Apparent Start	Apparent Finish	Lanes	Length
2	Howard Ave Tunnel, Entry Lane 10 starts on N side and Entry/Exit Lane 7/9 on S side	120	10 to 10.5 m	4+4 lane box, Soldier Pile and Lagging or Sheeting	13+749.0	19+050.0	19+170.0	4+4	120
									<u>960</u>

Apparent Start	Length	Start PGL Depth	Excav Depth	Width	Exc End area	Excav Volume	Volume for Ramp Entry/Exit	Backfill
19+050.0	120	8.3	10.3	38.620	398	48,785		6,488
	<u>120</u>					<u>48,785</u>	-	<u>6,488</u>

Excavation Support

Apparent Start	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
19+050.0	2,472	3	240	30		-
	<u>2,472</u>			<u>7,200</u>		<u>-</u>

Concrete and Finishes

Apparent Start	Mud slab	Base Slab	Walls	Roof	W/proof (not U walls)	Barrier & Walkway Plan SM	Wall Finishes
19+050.0	4,736	8,505	1,908	8,526	11,657	446	2,544
	<u>4,736</u>	<u>8,505</u>	<u>1,908</u>	<u>8,526</u>	<u>11,657</u>	<u>446</u>	<u>2,544</u>
Thickness	0.075				Height	0.8	
Volume	<u>355</u>				Volume	<u>357</u>	

Base stability

Apparent Start	Soil & Concrete weight/m	Uplift, tonnes/m	No. of tiedown	Tiedown Length, m	160T tiedowns outside m	
19+050.0	394.6	351.4	21	28	588	-
					<u>588</u>	



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 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Cost Estimate For Howard Ave Tunnel

	Unit	Rate	Quantity	Min Cost \$M	Max Cost \$M
Excavation and Fill: Tunnel and Ramp Entrances					
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	48,785	2	
	CM, max	\$40	48,785		2
Soldier-pile & lagging, exposed	SM, min	\$538	2,472	1	
	SM, max	\$646	2,472		2
Tieback anchors	LM	\$328	7,200	2	2
Secant piles 3 ft dia or slurry walls	SM	\$1,957	-	0	0
Backfill	CM, min	\$20	6,488	0	
	CM, max	\$20	6,488		0
Structure: Tunnel and Ramp Entrances					
Concrete mud slab	CM, min	\$262	355	0	
	CM, max	\$262	355		0
Base slab	CM	\$522	8,505	4	4
Tie-down anchors, outside, 160T	LM	\$328	588	0	0
Walls	CM, min	\$980	1,908	2	
	CM, max	\$980	1,908		2
Roof	CM, min	\$795	8,526	7	
	CM, max	\$795	8,526		7
Finishes walls (ceiling none)	SM	\$54	2,544	0	0
Barrier & walkway concrete	CM	\$450	357	0	0
Permanent tiebacks T, 45°			incl		
Waterproofing	SM, min	\$6	11,657	0	
	SM, max	\$8	11,657		0
				19	20
				6	6
Contingency		30%			
Estimated Section Cost				\$25,270,000.00	
			Cost/m	\$211,000	
			Cost/lane-m	\$26,300	



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DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Excavation Support System Zone	Section	Approx. Length, m	Approximate Excavation Depth, m	Remark	Actual Start	Apparent Start	Apparent Finish	Lanes	Length
2	Depressed Roadway between Howard Ave and Villa Paradiso, Entry/Exit Lane 7/9 on S side	880	8 to 10.5 m	3+4 lanes U-section, Soldier Pile and Lagging or Sheeting, laid back upper 7 m	13+500.0	18+801.0	19+050.0	3+4	249
	Depressed roadway, Ramp 7 enters S side			Ditto, say 75% laid back	13+229.0	18+530.0	18+801.0	3+4	271
	Depressed roadway			3+3 lanes, ditto, say 75% laid back	12+869.0	18+170.0	18+530.0	3+3	360
								<u>3+3</u>	<u>5800</u>

Excavation and backfill

Apparent Start	Length	Start PGL Depth	Ext wall min.ht	Excav Depth	Width	Exc End	Excav Volume	Volume for Ramp Entry/Exit	% Laid back	Extra for Sloped Excav
18+801.0	249	6.7	0.0	7.7	36.570	282	84,582		100%	29,223
18+530.0	271	7.8	0.8	9.1	36.570	333	83,248	2,867	75%	23,854
18+170.0	360	8.9	1.9	10.5	32.820	345	121,931		75%	33,075
	<u>880</u>						<u>289,762</u>	<u>2,867</u>		<u>86,152</u>

Excavation Support

Apparent Start	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
18+801.0	1,071	0	-	20	-	-
18+530.0	1,789	0.75	135	30.0	-	-
18+170.0	3,276	1.5	360	25.0	-	-
	<u>6,135</u>			<u>13,050</u>		<u>-</u>



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 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Concrete and Finishes Depressed Roadway between Howard Ave and Villa Paradiso

Apparent Start	Mud slab	Base Slab	Walls	W/proof (not U walls)	Barrier & Walkway Plan SM	Wall Finishes
18+801.0	9,361	14,169	324	9,361	926	162
18+530.0	9,910	11,397	217	9,910	1,008	108
18+170.0	12,490	18,010	972	12,490	1,339	486
	<u>31,762</u>	<u>43,576</u>	<u>1,513</u>	<u>31,762</u>	<u>3,274</u>	<u>756</u>
Thickness	<u>0.075</u>			Height	<u>0.8</u>	
Volume	<u>2,382</u>			Volume	<u>2,619</u>	

Base stability

Apparent Start	Soil & Concrete weight/m	Uplift, tonnes/m	Weight/m central half, T	Uplift center	Tiedown Length, m	160T tiedowns center, m	160T tiedowns outside m
18+801.0	153.0	36.6	52.6	18.3	29	-	-
18+530.0	114.6	76.8	66.3	38.4	29	-	-
18+170.0	139.3	114.9	72.6	57.4	27	-	162
						<u>-</u>	<u>162</u>



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 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Cost Estimate for Depressed Roadway between Howard Ave and Villa Paradiso

	Unit	Rate	Quantity	Min Cost \$M	Max Cost \$M
Excavation and Fill: Depressed Roadway and Ramp Entrances					
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	378,780	12	
	CM, max	\$40	378,780		15
Soldier-pile & lagging, exposed	SM, min	\$538	6,135	3	
	SM, max	\$646	6,135		4
Tieback anchors	LM	\$328	13,050	4	4
Secant piles 3 ft dia or slurry walls	SM	\$1,957	-	0	0
Structure: Depressed Roadway and Ramp Entrances					
Concrete mud slab	CM, min	\$262	2,382	1	
	CM, max	\$262	2,382		1
Base slab	CM	\$522	43,576	23	23
Tie-down anchors, center, 160T	LM	\$328	-	0	0
Tie-down anchors, outside, 160T	LM	\$328	162	0	0
Walls	CM, min	\$980	1,513	1	
	CM, max	\$980	1,513		1
Finishes walls (ceiling none)	SM	\$54	756	0	0
Barrier & walkway concrete	CM	\$450	2,619	1	1
Permanent tiebacks T, 45°			incl		
Waterproofing	SM, min	\$6	31,762	0	
	SM, max	\$8	31,762		0
				46	50
				14	15
				\$62,020,000.00	
				Cost/m	\$70,000
				Cost/lane-m	\$10,700



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Excavation Support System Zone	Section	Approx. Length, m	Approximate Excavation Depth, m	Remark	Actual Start	Apparent Start	Apparent Finish	Lanes	Length
2	Mt Carmel - Villa Paradiso Tunnel, Ramp 8 enters N side	1,000	11.5 to 12 m	4+3 lane box, Soldier Pile and Lagging or Sheeting	12+369.0	17+670.0	18+170.0	4+3	500
	Mt Carmel - Villa Paradiso Tunnel			3+3 lane box, ditto	12+300.0	17+601.0	17+670.0	3+3	69
	Mt Carmel - Villa Paradiso Tunnel			3+3 lane box, ditto	11+869.0	17+170.0	17+601.0	3+3	431
									<u>6500</u>

Excavation and backfill

Apparent Start	Length	Start PGL Depth	Excav Depth	Width	Exc End area	Excav Volume	Volume for Ramp Entry/Exit	Backfill
17+670.0	500	9.7	11.7	36.570	428	193,120	3,686	37,484
17+601.0	69	9.9	11.6	32.820	381	27,896		6,114
17+170.0	431	10.3	12.0	32.820	394	166,916		42,436
	<u>1,000</u>					<u>387,932</u>	<u>3,686</u>	<u>86,035</u>

Excavation Support

Apparent Start	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
17+670.0	11,100	3	1,002	30	-	-
17+601.0	1,608	3	138	30	-	-
17+170.0	10,172	3	864	30	-	-
	<u>22,879</u>			<u>60,120</u>		<u>-</u>

Concrete and Finishes

Apparent Start	Mud slab	Base Slab	Walls	Roof	W/proof (not U walls)	Barrier & Walkway Plan SM	Wall Finishes
17+670.0	17,348	31,413	8,400	28,623	43,795	1,860	11,200
17+601.0	2,394	4,448	1,159	3,591	6,023	257	1,546
17+170.0	14,145	24,047	7,241	21,218	36,006	1,603	9,654
	<u>33,887</u>	<u>59,908</u>	<u>16,800</u>	<u>53,432</u>	<u>85,824</u>	<u>3,720</u>	<u>22,400</u>
Thickness	0.075				Height	0.8	
Volume	<u>2,542</u>				Volume	<u>2,976</u>	



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	Alignment raised 1 m, minimum shoulders and outside walls	Rev 1b revises cost of excavation and concrete, adds 4 items at
	DRIC Windsor Tunnels, PB Option	end and contingency reduced to 30%

Base Stability Mt Carmel - Villa Paradiso Tunnel

Apparent Start	Soil & Concrete weight/m	Uplift, tonnes/m	No. of tiedown	Tiedown Length, m	160T tiedowns outside m
17+670.0	342.2	332.8	179	31	5,549
17+601.0	333.3	288.8	6	30	180
17+170.0	304.6	288.8	114	29	3,306
					<u>9,035</u>

Cost Estimate for Mt Carmel - Villa Paradiso Tunnel

	Unit	Rate	Quantity	Min Cost \$M	Max Cost \$M
<u>Excavation and Fill: Tunnel and Ramp Entrances</u>					
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	391,617	12	
	CM, max	\$40	391,617		16
Soldier-pile & lagging, exposed	SM, min	\$538	22,879	12	
	SM, max	\$646	22,879		15
Tieback anchors	LM	\$328	60,120	20	20
Secant piles 3 ft dia or slurry walls		\$1,957	-	0	0
Backfill	CM, min	\$20	86,035	2	
	CM, max	\$20	86,035		2
<u>Structure: Tunnel and Ramp Entrances</u>					
Concrete mud slab	CM, min	\$262	2,542	1	
	CM, max	\$262	2,542		1
Base slab	CM	\$522	59,908	31	31
Tie-down anchors, outside, T	LM	\$328	9,035	3	3
Walls	CM, min	\$980	16,800	16	
	CM, max	\$980	16,800		16
Roof	CM, min	\$795	53,432	42	
	CM, max	\$795	53,432		42
Finishes walls (ceiling none)	SM	\$54	22,400	1	1
Barrier & walkway concrete	CM	\$450	2,976	1	1
Permanent tiebacks T, 45°			incl		
Waterproofing	SM, min	\$6	85,824	1	
	SM, max	\$8	85,824		1
				143	149
				43	45
				<u>189,650,000.00</u>	
				Cost/m \$190,000	
				Contingency 30%	
				Estimated Section Cost	



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Cost/lane-m \$29,200



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Excavation Support System Zone	Section	Approx. Length, m	Approximate Excavation Depth, m	Remark	Actual Start	Apparent Start	Apparent Finish	Lanes	Length
2	Depressed Roadway between Mt Carmel and St Clair Tunnels, Exit Lane 5 starts on N side and Entry Lane 6 ends on S side	110	12 m	4+4 U-section, Soldier Pile and Lagging or Sheeting, with transverse struts, laid back	11+759.0	17+060.0	17+170.0	4+4	110

880

Apparent Start	Length	Start PGL Depth	Ext wall min.ht	Excav Depth	Width	Exc End area	Excav Volume	Volume for Ramp Entry/Exit	% Laid back	Extra for Sloped Excav
17+060.0	110	9.7	2.7	11.6	40.320	468	47,385	-	100%	14,680
	<u>110</u>						<u>47,385</u>	<u>-</u>		<u>14,680</u>

Excavation Support

Apparent Start	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
17+060.0	1,056	1	74	20	-	-
	<u>1,056</u>			<u>1,480</u>		<u>-</u>

Concrete and Finishes

Apparent Start	Mud slab	Base Slab	Walls	W/proof (not U walls)	Barrier & Walkway Plan SM	Wall Finishes
17+060.0	4,023	7,282	594	4,023	409	330
	<u>4,023</u>	<u>7,282</u>	<u>594</u>	<u>4,023</u>	<u>409</u>	<u>330</u>
Thickness	0.075			Height	0.8	
Volume	<u>302</u>			Volume	<u>327</u>	

Base stability

Apparent Start	Soil & Concrete weight/m	Uplift, tonnes/m	Weight/m central half, T	Uplift center	Tiedown Length, m	160T tiedowns center, m	160T tiedowns outside m
17+060.0	186.4	185.5	102.7	92.7	30	180	570
						<u>180</u>	<u>570</u>



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	DRIC Windsor Tunnels, PB Option	end and contingency reduced to 30%	

Cost Estimate For Depressed Roadway between Mt Carmel and St Clair Tunnels

	<u>Unit</u>	<u>Rate</u>	<u>Quantity</u>	<u>Min Cost \$M</u>	<u>Max Cost \$M</u>
<u>Excavation and Fill: Depressed Roadway and Ramp Entrances</u>					
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	62,065	2	
	CM, max	\$40	62,065		2
Soldier-pile & lagging, exposed	SM, min	\$538	1,056	1	
	SM, max	\$646	1,056		1
Tieback anchors	LM	\$328	1,480	0	0
Secant piles 3 ft dia or slurry walls	SM	\$1,957	-	0	0
<u>Structure: Depressed Roadway and Ramp Entrances</u>					
Concrete mud slab	CM, min	\$262	302	0	
	CM, max	\$262	302		0
Base slab	CM	\$522	7,282	4	4
Tie-down anchors, center, 160T	LM	\$328	180	0	0
Tie-down anchors, outside, 160T	LM	\$328	570	0	0
Walls	CM, min	\$980	594	1	
	CM, max	\$980	594		1
Finishes walls (ceiling none)	SM	\$54	330	0	0
Barrier & walkway concrete	CM	\$450	327	0	0
Permanent tiebacks T, 45°			incl		
Waterproofing	SM, min	\$6	4,023	0	
	SM, max	\$8	4,023		0
				8	9
			Contingency 30%	2	3
			Estimated Section Cost	\$10,680,000.00	
			Cost/m	\$97,000	
			Cost/lane-m	\$12,100	



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Subject Short Tunnels Quantities Rev 1a splits wall and roof quantities
 Alignment raised 1 m, minimum shoulders and outside walls Rev 1b revises cost of excavation and concrete, adds 4 items at
 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Excavation Support System Zone	Section	Approx. Length, m	Approximate Excavation Depth, m	Remark	Actual Start	Apparent Start	Apparent Finish	Lanes	Length
2	St. Clair Tunnel, Exit Lane 5 on N side and Entry Lane 6 on S side	240	10 to 12 m	4+4 lane box with ramps both sides, Soldier Pile and Lagging or Sheeting	11+639.0	16+940.0	17+060.0	4+4	120
	St. Clair Tunnel, Ramp 5 exits N side and Entry Lane 6 on S side			4+4 lane box with exit ramp and include Cahill Drain, Soldier Pile and Lagging or Sheeting	11+519.0	16+820.0	16+940.0	4+4	120
									1920

Excavation and backfill

Apparent Start	Length	Start PGL Depth	Excav Depth	Width	Exc End area	Excav Volume	Volume for Ramp Entry/Exit	Backfill
16+940.0	120	8.9	10.9	40.320	439	54,432		10,644
16+820.0	120	8.2	10.2	40.320	411	51,045	3,213	7,016
	240					105,477	3,213	17,660

Excavation Support

Apparent Start	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
16+940.0	2,700	3	240	30		-
16+820.0	2,532	3	240	30		-
	5,232			14,400		-

Concrete and Finishes

Apparent Start	Mud slab	Base Slab	Walls	Roof	W/proof (not U walls)	Barrier & Walkway Plan SM	Wall Finishes
16+940.0	4,838	9,435	2,016	8,709	11,861	446	2,544
16+820.0	4,838	9,677	2,016	8,709	11,861	446	2,544
	9,677	19,112	4,032	17,418	23,722	893	5,088
Thickness	0.075				Height	0.8	
Volume	726				Volume	714	



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Subject Short Tunnels Quantities Rev 1a splits wall and roof quantities
 Alignment raised 1 m, minimum shoulders and outside walls Rev 1b revises cost of excavation and concrete, adds 4 items at
 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Base Stability St. Clair Tunnel

Apparent Start	Soil & Concrete weight/m	Uplift, tonnes/m	No. of tiedown	Tiedown Length, m	160T tiedowns outside m
16+940.0	420.0	366.9	16	30	480
16+820.0	425.0	366.9	12	30	360
					840

Cost Estimate for St Clair Tunnel

	Unit	Rate	Quantity	Min Cost \$M	Max Cost \$M
<u>Excavation and Fill: Tunnel and Ramp Entrances</u>					
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	108,690	3	
	CM, max	\$40	108,690		4
Soldier-pile & lagging, exposed	SM, min	\$538	5,232	3	
	SM, max	\$646	5,232		3
Tieback anchors	LM	\$328	14,400	5	5
Secant piles 3 ft dia or slurry walls	SM	\$1,957	-	0	0
Backfill	CM, min	\$20	17,660	0	
	CM, max	\$20	17,660		0
<u>Structure: Tunnel and Ramp Entrances</u>					
Concrete mud slab	CM, min	\$262	726	0	
	CM, max	\$262	726		0
Base slab	CM	\$522	19,112	10	10
Tie-down anchors, outside, T	LM	\$328	840	0	0
Walls	CM, min	\$980	4,032	4	
	CM, max	\$980	4,032		4
Roof	CM, min	\$795	17,418	14	
	CM, max	\$795	17,418		14
Finishes walls (ceiling none)	SM	\$54	5,088	0	0
Barrier & walkway concrete	CM	\$450	714	0	0
Permanent tiebacks T, 45°		\$0	incl		
Waterproofing	SM, min	\$6	23,722	0	
	SM, max	\$8	23,722		0
				40	42
Contingency 30%				12	13
Estimated Section Cost				\$53,350,000.00	

Cost/m \$222,000

Cost/lane-m \$27,800



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Excavation Support System Zone	Section	Approx. Length, m	Approximate Excavation Depth, m	Remark	Actual Start	Apparent Start	Apparent Finish	Lanes	Length
3	Depressed Roadway between St Clair and Oakwood Tunnels, Ramp 6 enters on west side	690	9.5 to 12 m	3+4 lane U-section, divert Cahill Drain, Soldier Pile and Lagging or Sheeting, say 50% laid back	11+379.0	16+680.0	16+820.0	3+4	140
	Depressed roadway			3+3 lane U-section, ditto, all laid back, with transverse struts	10+900.0	16+201.0	16+680.0	3+3	479
	Depressed roadway			3+3 lane U-section, Secant pile or Diaphragm Wall, laid back, with transverse struts	10+829.0	16+130.0	16+201.0	3+3	71
								<u>3+3</u>	<u>4280</u>

Excavation and backfill

Apparent Start	Length	Start PGL Depth	Ext wall min.ht	Excav Depth	Width	Exc End area	Excav Volume	Volume for Ramp Entry/Exit	% Laid back	Extra for Sloped Excav
16+680.0	140	7.5	0.5	8.7	36.570	318	51,060	2,741	50%	9,475
16+201.0	479	9.5	2.5	11.3	32.820	371	165,021		100%	58,678
16+130.0	71	9.8	2.8	11.7	31.120	364	26,091		100%	8,698
<u>690</u>							<u>242,173</u>	<u>2,741</u>		<u>76,850</u>

Excavation Support

Apparent Start	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
16+680.0	1,666	2	141	30.0	-	-
16+201.0	2,874	3	960	30	-	-
16+130.0		3	incl	30	10	2,059
<u>4,540</u>				<u>33,030</u>		<u>2,059</u>



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Concrete and Finishes Depressed Roadway between St Clair and Oakwood Tunnels

Apparent Start	Mud slab	Base Slab	Walls	W/proof (not)	Barrier & Walkway Plan SM	Wall Finishes
16+680.0	5,382	8,717	1,218	5,382	521	119
16+201.0	16,619	24,659	1,437	16,619	1,782	719
16+130.0	2,270	4,196	56	2,270	264	188
	<u>24,271</u>	<u>37,572</u>	<u>2,711</u>	<u>24,271</u>	<u>2,567</u>	<u>1,026</u>
Thickness	<u>0.075</u>			Height	<u>0.8</u>	
Volume	<u>1,820</u>			Volume	<u>2,053</u>	

Base stability

Apparent Start	Soil & Concrete weight/m	Uplift, tonnes/m	Weight/m central half, T	Uplift center	Tiedown Length, m	160T tiedowns center, m	160T tiedowns outside m
16+680.0	184.8	62.2	61.8	31.1	32	-	-
16+201.0	143.6	141.1	80.8	70.6	31	372	2,046
16+130.0	229.7	175.3	80.8	73.1	30	120	-
						<u>492</u>	<u>2,046</u>



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 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Cost Estimate for Depressed Roadway between St Clair and Oakwood Tunnels

	Unit	Rate	Quantity	Min Cost \$M	Max Cost \$M
<u>Excavation and Fill: Depressed Roadway and Ramp Entrances</u>					
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	321,763	10	
	CM, max	\$40	321,763		13
Soldier-pile & lagging, exposed	SM, min	\$538	4,540	2	
	SM, max	\$646	4,540		3
Tieback anchors	LM	\$328	33,030	11	11
Secant piles 3 ft dia or slurry walls	SM	\$1,957	2,059	4	4
<u>Structure: Depressed Roadway and Ramp Entrances</u>					
Concrete mud slab	CM, min	\$262	1,820	0	
	CM, max	\$262	1,820		0
Base slab	CM	\$522	37,572	20	20
Tie-down anchors, center, T	LM	\$328	492	0	0
Tie-down anchors, outside, T	LM	\$328	2,046	1	1
Walls	CM, min	\$980	2,711	3	
	CM, max	\$980	2,711		3
Finishes walls (ceiling none)	SM	\$54	1,026	0	0
Barrier & walkway concrete	CM	\$450	2,053	1	1
Permanent tiebacks T, 45°			incl		
Waterproofing	SM, min	\$6	24,271	0	
	SM, max	\$8	24,271		0
				52	55
Contingency			30%	16	17
Estimated Section Cost				<u>\$69,820,000.00</u>	
				Cost/m	\$101,000
				Cost/lane-m	\$16,300



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 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Excavation Support System Zone	Section	Approx. Length, m	Approximate Excavation Depth, m	Remark	Actual Start	Apparent Start	Apparent Finish	Lanes	Length
3	Oakwood Tunnel	1,220	11 to 12 m	3+3 lane box, crosses under Lennon Drain, Secant pile or Diaphragm Wall	15+080.0	15+080.0	16+130.0	3+3	1050
	OakwoodTunnel, Ramp 4 exits W side			3+4 lane box, Secant pile or Diaphragm Wall	14+910.0	14+910.0	15+080.0	3+4	170
									<u>7490</u>

Excavation and backfill

Apparent Start	Length	Start PGL Depth	Excav Depth	Width	Exc End area	Excav Volume	Volume for Ramp Entry/Exit	Backfill
15+080.0	1,050	9.7	11.4	31.120	355	377,408		86,591
14+910.0	170	9.3	11.3	34.870	394	63,648	3,591	13,338
	<u>1,220</u>					<u>441,056</u>	<u>3,591</u>	<u>99,929</u>

Excavation Support

Apparent Start	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
15+080.0		3	incl	30	10	45,255
14+910.0		3	incl	30	10	7,259
				<u>-</u>		<u>52,514</u>

Concrete and Finishes

Apparent Start	Mud slab	Base Slab	Walls	Roof	W/proof (not U walls)	Barrier & Walkway Plan SM	Wall Finishes
15+080.0	32,676	58,817	7,644	49,014	83,832	3,906	23,520
14+910.0	5,609	10,425	1,238	9,255	14,312	632	3,808
	<u>38,285</u>	<u>69,242</u>	<u>8,882</u>	<u>58,269</u>	<u>98,144</u>	<u>4,538</u>	<u>27,328</u>
Thickness	<u>0.075</u>				Height	<u>0.8</u>	
Volume	<u>2,871</u>				Volume	<u>3,631</u>	



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	Alignment raised 1 m, minimum shoulders and outside walls	Rev 1b revises cost of excavation and concrete, adds 4 items at
	DRIC Windsor Tunnels, PB Option	end and contingency reduced to 30%

Base Stability Oakwood Tunnel

Apparent Start	Soil & Concrete weight/m	Uplift, tonnes/m	No. of tiedown	Tiedown Length, m	160T tiedowns outside m
15+080.0	382.7	317.0	0	30	-
14+910.0	414.4	360.0	0	31	-
					-

Cost Estimate for Oakwood Tunnel

	Unit	Rate	Quantity	Min Cost \$M	Max Cost \$M
Excavation and Fill: Tunnel and Ramp Entrances					
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	444,647	14	
	CM, max	\$40	444,647		18
Soldier-pile & lagging, exposed	SM, min	\$538	-	0	
	SM, max	\$646	-		0
Tieback anchors	LM	\$328	-	0	0
Secant piles 3 ft dia or slurry walls	SM	\$1,957	52,514	103	103
Backfill	CM, min	\$20	99,929	2	
	CM, max	\$20	99,929		2
Structure: Tunnel and Ramp Entrances					
Concrete mud slab	CM, min	\$262	2,871	1	
	CM, max	\$262	2,871		1
Base slab	CM	\$522	69,242	36	36
Tie-down anchors, outside, T	LM	\$328	-	0	0
Walls	CM, min	\$980	8,882	9	
	CM, max	\$980	8,882		9
Roof	CM, min	\$795	58,269	46	
	CM, max	\$795	58,269		46
Finishes walls (ceiling none)	SM	\$54	27,328	1	1
Barrier & walkway concrete	CM	\$450	3,631	2	2
Permanent tiebacks T, 45°			incl		
Waterproofing	SM, min	\$6	98,144	1	
	SM, max	\$8	98,144		1
				214	218
				64	66
				Estimated Section Cost \$281,160,000.00	

Cost/m \$230,000
 Cost/lane-m \$37,500



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 Alignment raised 1 m, minimum shoulders and outside walls Rev 1b revises cost of excavation and concrete, adds 4 items at
 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Excavation Support System Zone	Section	Approx. Length, m	Approximate Excavation Depth, m	Remark	Actual Start	Apparent Start	Apparent Finish	Lanes	Length
3	Depressed Roadway between Pulford and Oakwood Tunnels, Entry/Exit Lane 4/1 on W side	160	11 m	3+4 lane U-section, Secant pile or Diaphragm Wall, with transverse struts, laid back	14+750.0	14+750.0	14+910.0	3+4	160
								1120	

Apparent Start	Length	Start PGL Depth	Ext wall min.ht	Excav Depth	Width	Exc End area	Excav Volume	Volume for Ramp Entry/Exit	% Laid back	Extra for Sloped Excav
14+750.0	160	9	2.0	10.7	34.870	373	61,371		100%	20,458
	160						61,371	-		20,458

Excavation Support

Apparent Start	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
14+750.0		1	incl	20	10	4,432
				-		4,432

Concrete and Finishes

Apparent Start	Mud slab	Base Slab	Walls	W/proof (not U walls)	Barrier & Walkway Plan SM	Wall Finishes
14+750.0	5,579	10,322	96	5,579	595	344
	5,579	10,322	96	5,579	595	344
Thickness	0.075			Height	0.8	
Volume	418			Volume	476	

Base stability

Apparent Start	Soil & Concrete weight/m	Uplift, tonnes/m	Weight/m central half, T	Uplift center	Tiedown Length, m	160T tiedowns center, m	160T tiedowns outside m
14+750.0	239.5	156.7	106.5	64.5	30	-	-
						-	-



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 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Cost Estimate For Depressed Roadway between Pulford and Oakwood Tunnels				<u>Min</u>	<u>Max</u>
	<u>Unit</u>	<u>Rate</u>	<u>Quantity</u>	<u>Cost \$M</u>	<u>Cost \$M</u>
Excavation and Fill: Depressed Roadway and Ramp Entrances					
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	81,829	3	
	CM, max	\$40	81,829		3
Soldier-pile & lagging, exposed	SM, min	\$538	-	0	
	SM, max	\$646	-		0
Tieback anchors	LM	\$328	-	0	0
Secant piles 3 ft dia or slurry walls	SM	\$1,957	4,432	9	9
Structure: Depressed Roadway and Ramp Entrances					
Concrete mud slab	CM, min	\$262	418	0	
	CM, max	\$262	418		0
Base slab	CM	\$522	10,322	5	5
Tie-down anchors, center, 160T	LM	\$328	-	0	0
Tie-down anchors, outside, 160T	LM	\$328	-	0	0
Walls	CM, min	\$980	96	0	
	CM, max	\$980	96		0
Finishes walls (ceiling none)	SM	\$54	344	0	0
Barrier & walkway concrete	CM	\$450	476	0	0
Permanent tiebacks T, 45°			incl		
Waterproofing	SM, min	\$6	5,579	0	
	SM, max	\$8	5,579		0
				17	18
				5	5
	Contingency	30%			
	Estimated Section Cost			\$22,670,000.00	
	Cost/m			\$142,000	
	Cost/lane-m			\$20,200	



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Excavation Support System Zone	Section	Approx. Length, m	Approximate Excavation Depth, m	Remark	Actual Start	Apparent Start	Apparent Finish	Lanes	Length
3	Pulford Tunnel, Entry/Exit Lane 4/1 on W side	230	12 to 13.5 m	3+4 lane box, Secant pile or Diaphragm Wall	14+680.0	14+680.0	14+750.0	3+4	70
	Pulford Tunnel, Entry/Exit Lane 4/1 on W side			Ditto	14+640.0	14+640.0	14+680.0	3+4	40
6	Pulford Tunnel, Entry/Exit Lane 4/1 on W side and Ramp 3 enters E side			4+4 lane box, Secant pile or Diaphragm Wall embedded 22 m	14+520.0	14+520.0	14+640.0	4+4	120
									<u>1730</u>

Excavation and backfill

Apparent Start	Length	Start PGL Depth	Excav Depth	Width	Exc End area	Excav Volume	Volume for Ramp Entry/Exit	Backfill
14+680.0	70	9.8	11.8	34.870	411	27,460		5,980
14+640.0	40	10.2	12.2	34.870	425	16,738		4,254
14+520.0	120	11.4	13.4	38.620	518	56,575	3,843	17,147
	<u>230</u>					<u>100,773</u>	<u>3,843</u>	<u>27,382</u>

Excavation Support

Apparent Start	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
14+680.0		3	incl	30	10	2,975
14+640.0		3	incl	30	10	1,760
14+520.0		4	incl	30	22	8,352
						<u>13,087</u>



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	DRIC Windsor Tunnels, PB Option	end and contingency reduced to 30%

Concrete and Finishes Pulford Tunnel

Apparent Start	Mud slab	Base Slab	Walls	Roof	W/proof (not U walls)	Barrier & Walkway Plan SM	Wall Finishes
14+680.0	2,441	4,516	482	4,027	6,114	260	1,484
14+640.0	1,395	2,790	276	2,301	3,494	149	848
14+520.0	4,409	8,819	827	7,937	11,003	446	2,544
	8,245	16,124	1,585	14,266	20,610	856	4,876
Thickness	0.075				Height	0.8	
Volume	618				Volume	684	

Base stability

Apparent Start	Soil & Concrete weight/m	Uplift, tonnes/m	No. of tiedown	Tiedown Length, m	160T tiedowns outside m
14+680.0	428.6	349.4	0	30	-
14+640.0	445.4	350.9	0	29	-
14+520.0	540.3	421.0	0	28	-
					-



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Subject Short Tunnels Quantities Rev 1a splits wall and roof quantities
 Alignment raised 1 m, minimum shoulders and outside walls Rev 1b revises cost of excavation and concrete, adds 4 items at
 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Cost Estimate for Pulford Tunnel

	Unit	Rate	Quantity	Min Cost \$M	Max Cost \$M
Excavation and Fill: Tunnel and Ramp Entrances					
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	104,616	3	
	CM, max	\$40	104,616		4
Soldier-pile & lagging, exposed	SM, min	\$538	-	0	
	SM, max	\$646	-		0
Tieback anchors	LM	\$328	-	0	0
Secant piles 3 ft dia or slurry walls		\$1,957	13,087	26	26
Backfill	CM, min	\$20	27,382	1	
	CM, max	\$20	27,382		1
Structure: Tunnel and Ramp Entrances					
Concrete mud slab	CM, min	\$262	618	0	
	CM, max	\$262	618		0
Base slab	CM	\$522	16,124	8	8
Tie-down anchors, outside, T	LM	\$328	-	0	0
Walls	CM, min	\$980	1,585	2	
	CM, max	\$980	1,585		2
Roof	CM, min	\$795	14,266	11	
	CM, max	\$795	14,266		11
Finishes walls (ceiling none)	SM	\$54	4,876	0	0
Barrier & walkway concrete	CM	\$450	684	0	0
Permanent tiebacks T, 45°			incl		
Waterproofing	SM, min	\$6	20,610	0	
	SM, max	\$8	20,610		0
				52	53
				15	16
				Estimated Section Cost \$67,680,000.00	
				Cost/m	\$294,000
				Cost/lane-m	\$39,100



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Subject Short Tunnels Quantities Rev 1a splits wall and roof quantities
 Alignment raised 1 m, minimum shoulders and outside walls Rev 1b revises cost of excavation and concrete, adds 4 items at
 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Excavation Support System Zone	Section	Approx. Length, m	Approximate Excavation Depth, m	Remark	Actual Start	Apparent Start	Apparent Finish	Lanes	Length
6	Depressed Roadway between Huron and Pulford Tunnels, entry/exit lanes both sides (4/1 & 2/3)	210	13.5 to 15.5 m	4+4 lane U-section, Secant pile or Diaphragm Wall embedded 20 m, laid back	14+430.0	14+430.0	14+520.0	4+4	90
7	Depressed roadway, entry/exit lanes both sides (4/1 & 2/3)			4+4 lane U-section, Secant pile or Diaphragm Wall embedded 20 m, laid back, excavate 15 m lengths	14+310.0	14+310.0	14+430.0	4+4	120
								<u>4+4</u>	<u>1680</u>

Excavation and backfill

Apparent Start	Length	Start PGL Depth	Ext wall min.ht	Excav Depth	Width	Exc End area	Excav Volume	Volume for Ramp Entry/Exit	% Laid back	Extra for Sloped Excav
14+430.0	90	12.6	5.6	14.6	38.620	564	48,661		100%	9,297
14+310.0	120	13.5	6.5	15.5	38.620	599	69,748		100%	14,700
	<u>210</u>						<u>118,409</u>	-		<u>23,997</u>

Excavation Support

Apparent Start	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
14+430.0		2	incl	30	20	4,968
14+310.0		3	incl	30	20	6,840
				-		<u>11,808</u>

Concrete and Finishes

Apparent Start	Mud slab	Base Slab	Walls	W/proof (not U walls)	Barrier & Walkway Plan SM	Wall Finishes
14+430.0	3,476	6,952	151	3,476	335	450
14+310.0	4,634	9,269	218	4,634	446	726
	<u>8,110</u>	<u>16,220</u>	<u>369</u>	<u>8,110</u>	<u>781</u>	<u>1,176</u>
Thickness	0.075			Height	0.8	
Volume	<u>608</u>			Volume	<u>625</u>	



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Subject	Short Tunnels Quantities	Rev 1a splits wall and roof quantities
	Alignment raised 1 m, minimum shoulders and outside walls	Rev 1b revises cost of excavation and concrete, adds 4 items at
	DRIC Windsor Tunnels, PB Option	end and contingency reduced to 30%

Base Stability Depressed Roadway between Huron and Pulford Tunnels

Apparent Start	Soil & Concrete weight/m	Uplift, tonnes/m	Weight/m central half, T	Uplift center	Tiedown Length, m	160T tiedowns center, m	160T tiedowns outside m
14+430.0	345.2	348.7	129.0	146.8	27	729	-
14+310.0	353.2	385.3	129.0	164.1	26	1,352	-
						<u>2,081</u>	<u>-</u>

Cost Estimate for Depressed Roadway between Huron and Pulford Tunnels

	Unit	Rate	Quantity	Min Cost \$M	Max Cost \$M
<u>Excavation and Fill: Depressed Roadway and Ramp Entrances</u>					
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	142,406	4	
	CM, max	\$40	142,406		6
Soldier-pile & lagging, exposed	SM, min	\$538	-	0	
	SM, max	\$646	-		0
Tieback anchors	LM	\$328	-	0	0
Secant piles 3 ft dia or slurry walls	SM	\$1,957	11,808	23	23
<u>Structure: Depressed Roadway and Ramp Entrances</u>					
Concrete mud slab	CM, min	\$262	608	0	
	CM, max	\$262	608		0
Base slab	CM	\$522	16,220	8	8
Tie-down anchors, center, T	LM	\$328	2,081	1	1
Tie-down anchors, outside, T	LM	\$328	-	0	0
Walls	CM, min	\$980	369	0	
	CM, max	\$980	369		0
Finishes walls (ceiling none)	SM	\$54	1,176	0	0
Barrier & walkway concrete	CM	\$450	625	0	0
Permanent tiebacks T, 45°			incl		
Waterproofing	SM, min	\$0	8,110	0	
	SM, max	\$0	8,110		0
				<u>38</u>	<u>39</u>
			Contingency 30%	<u>11</u>	<u>12</u>
			Estimated Section Cost	<u>\$49,630,000.00</u>	
			Cost/m	\$236,000	
			Cost/lane-m	\$29,500	



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 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Excavation Support System Zone	Section	Approx. Length, m	Approximate Excavation Depth, m	Remark	Actual Start	Apparent Start	Apparent Finish	Lanes	Length
7	Bellewood - Huron Tunnel, Ramp 1 enters W side and Ramp 2 exits E side	1020	10.5 to 15.5 m	4+4 lane box crosses under Grand Marais Drain, Secant pile or Diaphragm Wall embedded 22 m, excavate in 15 m lengths	14+020.0	14+020.0	14+310.0	4+4	290
8	Bellewood - Huron Tunnel			3+3 lane box, Secant pile or Diaphragm Wall embedded 12 m	13+710.0	13+710.0	14+020.0	3+3	310
9	Bellewood - Huron Tunnel			3+3 lane box, Soldier Pile and Lagging or Sheeting	13+600.0	13+600.0	13+710.0	3+3	110
	Bellewood - Huron Tunnel			3+3 lane box, Soldier Pile and Lagging or Sheeting	13+290.0	13+290.0	13+600.0	3+3	310
									<u>6700</u>

Excavation and backfill

Apparent Start	Length	Start PGL Depth	Excav Depth	Width	Exc End area	Excav Volume	Volume for Ramp Entry/Exit	Backfill
14+020.0	290	11.3	13.3	38.620	514	161,277	8,379	55,999
13+710.0	310	9.6	11.3	31.120	352	134,122		29,424
13+600.0	110	9.2	10.9	32.820	358	39,017		7,220
13+290.0	310	8.8	10.5	32.820	345	108,864		16,279
	<u>1,020</u>					<u>443,280</u>	<u>8,379</u>	<u>108,922</u>

Excavation Support

Apparent Start	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
14+020.0		4	incl	30	22	21,112
13+710.0		3	incl	30	12	15,066
13+600.0	2,442	3	222	30		-
13+290.0	6,634	3	618	30		-
	<u>9,076</u>			<u>25,200</u>		<u>36,178</u>



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Subject	Short Tunnels Quantities	Rev 1a splits wall and roof quantities
	Alignment raised 1 m, minimum shoulders and outside walls	Rev 1b revises cost of excavation and concrete, adds 4 items at
	DRIC Windsor Tunnels, PB Option	end and contingency reduced to 30%

Concrete and Finishes Bellewood - Huron Tunnel

Apparent Start	Mud slab	Base Slab	Walls	Roof	W/proof (not U walls)	Barrier & Walkway Plan SM	Wall Finishes
14+020.0	11,200	22,400	2,111	20,160	27,852	1,079	6,496
13+710.0	10,810	20,172	2,257	16,215	27,075	1,153	6,944
13+600.0	3,517	5,978	1,848	5,275	8,969	409	2,464
13+290.0	10,174	17,296	5,208	15,261	25,804	1,153	6,944
	<u>35,700</u>	<u>65,846</u>	<u>11,424</u>	<u>56,911</u>	<u>89,701</u>	<u>3,794</u>	<u>22,848</u>
Thickness	<u>0.075</u>				Height	<u>0.8</u>	
Volume	<u>2,678</u>				Volume	<u>3,036</u>	

Base stability

Apparent Start	Soil & Concrete weight/m	Uplift, tonnes/m	No. of tiedown	Tiedown Length, m	160T tiedowns outside m
14+020.0	567.1	435.8	0	27	-
13+710.0	433.1	322.5	0	28	-
13+600.0	297.8	288.8	34	29	986
13+290.0	304.6	288.8	82	30	2,460
					<u>3,446</u>



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 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Cost Estimate for Bellewood - Huron Tunnel

	Unit	Rate	Quantity	Min Cost \$M	Max Cost \$M
Excavation and Fill: Tunnel and Ramp Entrances					
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	451,659	14	
	CM, max	\$40	451,659		18
Soldier-pile & lagging, exposed	SM, min	\$538	9,076	5	
	SM, max	\$646	9,076		6
Tieback anchors	LM	\$328	25,200	8	8
Secant piles 3 ft dia or slurry walls		\$1,957	36,178	71	71
Backfill	CM, min	\$20	108,922	2	
	CM, max	\$20	108,922		2
Structure: Tunnel and Ramp Entrances					
Concrete mud slab	CM, min	\$262	2,678	1	
	CM, max	\$262	2,678		1
Base slab	CM	\$522	65,846	34	34
Tie-down anchors, outside, T	LM	\$328	3,446	1	1
Walls	CM, min	\$980	11,424	11	
	CM, max	\$980	11,424		11
Roof	CM, min	\$795	56,911	45	
	CM, max	\$795	56,911		45
Finishes walls (ceiling none)	SM	\$54	22,848	1	1
Barrier & walkway concrete	CM	\$450	3,036	1	1
Permanent tiebacks T, 45°			incl		
Waterproofing	SM, min	\$6	89,701	1	
	SM, max	\$8	89,701		1
				196	201
			Contingency 30%	59	60
			Estimated Section Cost	<u>\$258,090,000.00</u>	
			Cost/m	\$253,000	
			Cost/lane-m	\$38,500	



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Subject Short Tunnels Quantities Rev 1a splits wall and roof quantities
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DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Excavation Support System Zone	Section	Approx. Length, m	Approximate Excavation Depth, m	Remark	Actual Start	Apparent Start	Apparent Finish	Lanes	Length
9	Western Approach Ramp - depressed roadway	650	0 to 10.5 m	3+3 lane U-section, Soldier Pile and Lagging or Sheeting, laid back	13+030.0	13+030.0	13+290.0	3+3	260
	Western Approach Ramp - depressed roadway			3+3 lane U-section, Soldier Pile and Lagging or Sheeting, laid back	12+780.0	12+780.0	13+030.0	3+3	250
10	Western Approach Ramp - depressed roadway	26.5		3+3 lane U-section, Sloped cut 1.5H:1V temporary; 2.5H:1V permanent	12+700.0	12+700.0	12+780.0	3+3	80
	Surface Roadway			3+3 lane roadway on slab, Sloped cut 1.5H:1V temporary; 2.5H:1V permanent	12+613.5	12+613.5	12+700.0	3+3	86.5
Total Length									7,229.3
									4059

Excavation

Apparent Start	Length	Start PGL Depth	Ext wall min.ht	Excav Depth	Width	Exc End area	Excav Volume	Volume for Ramp Entry/Exit	% Laid back	Extra for Sloped Excav
13+030.0	260	6.7	1.7	8.3	32.820	272	80,212		100%	24,508
12+780.0	250	4.6	0.0	5.6	32.820	184	57,025		100%	14,425
12+700.0	80	3	0	4.0	32.820	131	12,603		100%	3,016
12+613.5	86.5	0		1.0	32.820	33	7,097		100%	973
	<u>676.5</u>						<u>156,937</u>	-		<u>42,922</u>

Excavation Support

Apparent Start	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
13+030.0	2,288		-	30		-
12+780.0	975		-	20		-
12+700.0	-		-			-
12+613.5	-		-			-
	<u>3,263</u>			<u>-</u>		<u>-</u>



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Concrete and Finishes Western Approach Ramp

Apparent Start	Mud slab	Base Slab	Walls	W/proof (not U walls)	Barrier & Walkway Plan SM	Wall Finishes
13+030.0	8,533	14,080	1,430	8,533	967	455
12+780.0	8,205	10,667	425	8,205	930	213
12+700.0	2,626	2,626	-	2,626	298	-
12+613.5	-	2,839	-	-	322	-
	<u>19,364</u>	<u>30,211</u>	<u>1,855</u>	<u>19,364</u>	<u>2,517</u>	<u>668</u>
Thickness	<u>0.075</u>			Height	<u>0.8</u>	
Volume	<u>1,452</u>			Volume	<u>2,013</u>	

Base stability

Apparent Start	Soil & Concrete weight/m	Uplift, tonnes/m	Weight/m central half, T	Uplift center	Tiedown Length, m	T tiedowns center, m	T tiedowns outside m
13+030.0	156.6	108.3	98.0	54.2	31	-	341
12+780.0	118.4	32.8	73.4	16.4	33	-	-
12+700.0	89.5	32.8					
12+613.5	89.5	32.8					
						<u>-</u>	<u>341</u>



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Cost Estimate Western Approach Ramp

	Unit	Rate	Quantity	Min Cost \$M	Max Cost \$M
Excavation and Fill: Depressed Roadway and Ramp Entrances					
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	199,859	6	
	CM, max	\$40	199,859		8
Soldier-pile & lagging, exposed	SM, min	\$538	3,263	2	
	SM, max	\$646	3,263		2
Tieback anchors	LM	\$328	-	0	0
Secant piles 3 ft dia or slurry walls	SM	\$1,957	-	0	0
Structure: Depressed Roadway and Ramp Entrances					
Concrete mud slab	CM, min	\$262	1,452	0	
	CM, max	\$262	1,452		0
Base slab	CM	\$522	30,211	16	16
Tie-down anchors, center, T	LM	\$328	-	0	0
Tie-down anchors, outside, T	LM	\$328	341	0	0
Walls	CM, min	\$980	1,855	2	
	CM, max	\$980	1,855		2
Finishes walls (ceiling none)	SM	\$54	668	0	0
Barrier & walkway concrete	CM	\$450	2,013	1	1
Permanent tiebacks T, 45°			incl		
Waterproofing	SM, min	\$6	19,364	0	
	SM, max	\$8	19,364		0
				27	29
				8	9
	Contingency	30%			
	Estimated Section Cost			\$36,640,000.00	
	Cost/m			\$54,000	
	Cost/lane-m			\$9,000	



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Entry and Exit Ramps (7 m between walls)

	2006 PVI-PVI	Length scaled (now)	Height Change m	Ramp Max Gradient	Hwy 401 Surface VC Grade	Surface VC Length	Level Change	Lower VC Length	Level Change	Slope length	Min Ramp Length
Ramp 1, EB on, Marentette & Mangin Drain	246.081	265	11	-5.0%	-0.3%	174.782	4.367	152.122	3.859	55.5	382
Ramp 2, WB off, EC Row	266.954	210	11	5.0%	0.3%	174.782	4.367	152.122	3.859	55.5	382
Ramp 3, WB on, Pulford		320	11	-5.0%	-1.0%	174.782	4.367	129.507	2.797	76.7	381
Ramp 4, EB off, Todd Lane		250	10	5.0%	-0.3%	174.782	4.367	171.489	4.905	14.6	361
Ramp 5, EB on, St Clair		180	8	-4.5%	-0.5%	157.341	3.538	129.507	2.797	37.0	324
Ramp 6, WB off, St Clair	204.753	210	9	5.0%	0.5%	174.782	4.367	145.663	3.538	21.9	342
Ramp 7, WB on, Villa Paradiso	245.064	390	11	-4.6%	-0.3%	160.830	3.697	139.202	3.231	88.5	390
Ramp 8, EB on, Villa Paradiso	212.979	280	8	-4.0%	0.5%	139.888	2.797	145.663	3.538	41.6	327
Ramp 9, WB on, loop		270	4	-4.5%	-3.0%	157.341	3.538	48.600	0.394	1.5	270
Ramp 10, EB off, to Hwy 3	239.797	310	9	6.0%	3.0%	209.623	6.283	97.166	1.574	19.1	326
Hwy 401W WB off, to Howard (surface)		480	-								
Hwy 401S WB off, to Hwy 3 (bridge separate)	347	313	3								
length of bridge	34										
Hwy 3 EB to Hwy 401 (surface)		440	-								
		3,918									

Crest K = 35
 Sag K = 30

Excavation Ramp	Scaled Length	Start PGL Depth	Ext wall min.ht	Excav Depth	Excav Width	Excav Volume	% Laid back	Extra for Sloped Excav	Backfill
Ramp 1, EB or	265	11.3	6.3	12.5	11.4	18,881	50%	4,141	2,332
Ramp 2, WB o	210	11.3	6.3	12.5	11.4	14,963	50%	3,281	1,848
Ramp 3, WB o	320	10.2	3.2	11.4	11.4	20,794	50%	9,800	2,144
Ramp 4, EB of	250	9.3	2.3	10.5	11.4	14,963	50%	7,656	1,450
Ramp 5, EB or	180	8.2	1.2	9.4	11.4	9,644	50%	5,513	846
Ramp 6, WB o	210	7.5	0.5	8.7	11.4	10,414	50%	6,431	840
Ramp 7, WB o	390	7.8	0.8	9	11.4	20,007	50%	11,944	1,677
Ramp 8, EB or	280	9.7	2.7	10.9	11.4	17,396	50%	8,575	1,736
Ramp 9, WB o	270	8	1.0	9.2	11.4	14,159	50%	8,269	1,215
Ramp 10, EB c	310	4	0.0	5.2	11.4	9,188	50%	3,100	620
Hwy 401W WE	480	0	0.0	0.6	9.4	2,707			
Hwy 401S WB	313	-3.5	2.5	-3	9.4	6,179	100%		4,793
Hwy 3 EB to H	440	0	0.0	0.6	9.4	2,482			
	3,918					161,776		68,709	19,501



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	DRIC Windsor Tunnels, PB Option	end and contingency reduced to 30%

Excavation Support Entry and Exit Ramps

Ramp	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
Ramp 1, EB or	3,392	3	176	30		-
Ramp 2, WB o	2,688	3	140	30		-
Ramp 3, WB o	2,428	3	212	30		
Ramp 4, EB of	1,556	3	168	30		
Ramp 5, EB or	837	2	80	30		
Ramp 6, WB o	780	2	93	30		
Ramp 7, WB o	1,602	2	173	30		
Ramp 8, EB or	1,910	3	188	30		
Ramp 9, WB o	1,182	2	120	30		
Ramp 10, EB c	-					
Hwy 401W WE	-					
Hwy 401S WB	-					
Hwy 3 EB to H	-					
	<u>16,374</u>			<u>40,520</u>		<u>-</u>

Concrete and Finishes

Apparent Start	Mud slab	Base Slab	Walls	Roof	W/proof (not U walls)	Barrier & Walkway Plan SM	Wall Finishes	Base stability	
								Soil & Concrete weight/m	Uplift, tonnes/m
Ramp 1, EB of	4,731	5,677	3,007	272	1,813	265	259	109.4	96.4
Ramp 2, WB o	4,104	4,925	2,521	215	1,436	210	206	109.4	96.4
Ramp 3, WB o	3,648	4,378	1,110	328	2,189	320	50	92.9	76.7
Ramp 4, EB of	2,850	3,420	677	257	1,710	250	18	85.8	68.2
Ramp 5, EB or	2,052	2,462	334	0	1,231	180	2	77.1	57.9
Ramp 6, WB o	2,394	2,873	287	215	1,436	210	0	71.6	51.3
Ramp 7, WB o	4,446	5,335	612	0	2,668	390	2	74.0	54.1
Ramp 8, EB or	3,192	3,830	851	0	1,915	280	29	88.9	72.0
Ramp 9, WB o	3,078	3,694	461	0	1,847	270	2	75.6	56.0
Ramp 10, EB c	3,534	4,241	-	0	-	310	-	55.9	32.5
Hwy 401W WE	4,512	5,414			-				
Hwy 401S WB	2,942	3,531			-				
Hwy 3 EB to H	4,136	4,963			-				
	<u>45,619</u>	<u>54,743</u>	<u>9,859</u>	<u>1,288</u>	<u>16,245</u>	<u>2,685</u>	<u>569</u>		
Thickness	0.075				Height	0.8			
Volume	<u>3,421</u>				Volume	<u>2,148</u>			

Use heels on section to mobilize extra soil weight



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Subject Short Tunnels Quantities Rev 1a splits wall and roof quantities
 Alignment raised 1 m, minimum shoulders and outside walls Rev 1b revises cost of excavation and concrete, adds 4 items at
 DRIC Windsor Tunnels, PB Option end and contingency reduced to 30%

Cost Estimate Entry and Exit Ramps

	Unit	Rate	Quantity	Min Cost \$M	Max Cost \$M
<u>Excavation and Fill: Tunnel, Depressed Roadway and Ramps</u>					
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	230,486	7	
	CM, max	\$40	230,486		9
Soldier-pile & lagging, exposed	SM, min	\$538	16,374	9	
	SM, max	\$646	16,374		11
Tieback anchors	LM	\$328	40,520	13	13
Secant piles 3 ft dia or slurry walls	SM	\$1,957	-	0	0
Backfill	CM, min	\$20	19,501	0	
	CM, max	\$20	19,501		0
<u>Structure: Tunnel, Depressed Roadway and Ramps</u>					
Concrete mud slab	CM, min	\$262	3,421	1	
	CM, max	\$262	3,421		1
Base slab	CM	\$522	54,743	29	29
Tie-down anchors, outside, 160T	LM	\$328	-	0	0
Walls	CM, min	\$980	9,859	10	
	CM, max	\$980	9,859		10
Roof	CM, min	\$795	1,288	1	
	CM, max	\$795	1,288		1
Finishes walls (ceiling none)	SM	\$54	569	0	0
Barrier & walkway concrete	CM	\$450	2,148	1	1
Permanent tiebacks T, 45°			incl		
Waterproofing	SM, min	\$6	16,245	0	
	SM, max	\$8	16,245		0
				71	75
				21	22
Contingency		30%			
Estimated Section Cost				<u>\$94,680,000.00</u>	
			Cost/m	\$24,000	



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Depressing Surface Roads and Provide Tunnel (no shoulders)

	Lanes	Length scaled (now)
Oakwood - Villa Borghese (Huron Ramps)	2+2	320
Tunnel	2+2	120
		<u>440</u>
Mt Carmel - Villa Paradiso (Talbot Road)	2+2	310
Tunnel	2+2	240
		<u>550</u>

Excavation

Apparent Start	Length	Max depth	Ext wall min.ht	Excav Depth	Width	Excav Volume	% Laid back	Extra for Sloped Excav	Backfill
Oakwd Ramp	320	5.3	0	6.5	25.12	23,676	100%	11,236	
Oakwd Tun	120	6.2	5.3	7.5	25.12	21,101			3,014
	<u>440</u>					<u>44,776</u>		<u>11,236</u>	<u>3,014</u>
Carmel Ramp	310	5.3	0	6.5	25.12	23,676	100%	10,885	
Carmel Tun	240	6.2	5.3	7.5	25.12	42,202			6,029
	<u>550</u>					<u>65,877</u>		<u>10,885</u>	<u>6,029</u>

Excavation Support

Apparent Start	Exposed soldier pile & lagging	Anchor levels @ 3m c/c	Tieback anchors	Anchor length	Buried slurry wall length	Slurry wall vol
Oakwd Ramp						-
Oakwd Tun	1,680			30		-
	<u>1,680</u>			<u>-</u>		<u>-</u>
Carmel Ramp						-
Carmel Tun	3,360			30		-
	<u>3,360</u>			<u>-</u>		<u>-</u>



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Concrete and Finishes Depressing Surface Roads and Provide Tunnel

Apparent Start	Mud slab	Base Slab	Walls	Roof	W/proof (not U walls)	Barrier & Walkway Plan SM	Wall Finishes
Oakwd Ramp	8,038	9,646	2,035		8,038	1,043	
Oakwd Tun	3,014	3,919	1,781	3,919	7,925	446	2,544
	11,053	13,565	3,816	3,919	15,963	1,490	2,544
Thickness	0.075				Height	0.8	
Volume	829				Volume	1,192	
Carmel Ramp	7,787	9,345	1,972		7,787	1,011	
Carmel Tun	6,029	7,837	3,562	7,837	15,850	893	5,088
	13,816	17,182	5,533	7,837	23,637	1,903	5,088
Thickness	0.075						
Volume	1,036						



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Cost Estimate for Depressing Surface Roads and Provide Tunnel (no shoulders)

	Unit	Rate	Oakwood 440 m			Carmel 550 m			
			Quantity	Min Cost \$M	Max Cost \$M	Quantity	Min Cost \$M	Max Cost \$M	
<u>Excavation and Fill: Tunnel, Depressed Roadway and Ramps</u>									
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	56,012	2		76,762	2		
	CM, max	\$40	56,012		2	76,762		3	
Soldier-pile & lagging, exposed	SM, min	\$538	1,680	1		3,360	2		
	SM, max	\$646	1,680		1	3,360		2	
Tieback anchors	LM	\$328	-	0	0	-	0	0	
Secant piles 3 ft dia or slurry walls	SM	\$1,957	-	0	0	-	0	0	
Backfill	CM, min	\$20	3,014	0		6,029	0		
	CM, max	\$20	3,014		0	6,029		0	
<u>Structure: Tunnel, Depressed Roadway and Ramps</u>									
Concrete mud slab	CM, min	\$262	829	0		1,036	0		
	CM, max	\$262	829		0	1,036		0	
Base slab	CM	\$522	13,565	7	7	17,182	9	9	
Tie-down anchors, center, 160T	LM	\$328	-	0	0	-	0	0	
Tie-down anchors, outside, 160T	LM	\$328	-	0	0	-	0	0	
Walls	CM, min	\$980	3,816	4		5,533	5		
	CM, max	\$980	3,816		4	5,533		5	
Roof	CM, min	\$795	3,919	3		7,837	6		
	CM, max	\$795	3,919		3	7,837		6	
Finishes walls (ceiling none)	SM	\$54	2,544	0	0	5,088	0	0	
Barrier & walkway concrete	CM	\$450	1,192	1	1	1,523	1	1	
Permanent tiebacks T, 45°			incl			incl			
Waterproofing	SM, min	\$6	15,963	0		23,637	0		
	SM, max	\$8	15,963		0	23,637		0	
				18	18			26	27
Contingency 30%				5	6	30%		8	8
Estimated Section Cost				<u>\$23,380,000.00</u>				<u>\$34,910,000.00</u>	
				\$53,000		Cost/m	\$63,000		
				\$13,300		Cost/lane-m	\$15,900		



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Surface Access Rd, DRIC Aug 07 Plan Scaled	Lanes		Lane-m EB	Lanes WB		Lane-m WB	Lanes crossing		Lane-m crossing
	EB	m		m	WB		m	m	
West of Bethlehem Ave	3	330	990	3	330	990			
Bethlehem Ave	3	20	60	3	20	60	4	150	600
Bethlehem Ave to Grand Marais Road	2.5	260	650	3	245	735	2	40	80
Grand Marais Road	2	350	700	2	235	470			
Grand Marais Road	2	20	40	2	20	40	3	175	525
Grand Marais Road to Cabana Road West	2	1,320	2,640	2	1320	2640	4	85	340
Cabana Road West / Todd Lane	2	20	40	0.5	160	80	3	85	255
Cabana Road West to Huron Church Lane exit	2	20	40	2	20	40	3.5	230	805
Huron Church Line Road	2	345	690	2	345	690			
Huron Church Line Road to St Clair	2	20	40	2	20	40	4	180	720
St Clair	2	1,170	2,340	2	1170	2340			
St Clair to Cousineau Road	0.5	180	90	0.5	165	82.5			
Cousineau Road	2	20	40	2	20	40	4	115	460
Cousineau Road to Montgomery Drive	2	520	1,040	2	520	1040			
Moontgomery Drive to Howard Ave	2	20	40	2	20	40	3	200	600
Howard Ave	2	800	1,600	2	800	1600	2	40	80
Howard Ave to Outer Drive	2	790	1,580	2	790	1580			
Outer Drive to Highway 3	1	180	180	1	160	160			
Outer Drive to Highway 3	2	20	40	2	20	40	4	240	960
Outer Drive to Highway 3	2	980	1,960	2	980	1960			
Outer Drive to Highway 3	1	100	100	1	320	320			
Outer Drive to Highway 3	2	750	1,500	2	750	1500	2	140	280
Note: Depressed sections & tunnels ignored.		7,755	16,360		7,785	16,488		1,680	5,705

Paths and Footbridges, Scaled from Sam Schwartz GreenLink Plan	Paths	# Bridges			# Bridges
		2-lane	3-lane	4-lane	
Bellewood / Huron Tunnel area	3,210	1	2	6	
Extra on Pulford Tunnel area sheet	1,940			1	
Extra on Oakwood Tunnel Area sheet	2,660	2		2	
Extra on St Clair Tunnel sheet	2,790			2	
Extra to end Mt Carmel / Villa Paradiso Tunnel	750				
Villa Paradiso to eastern end	2,720			2	
LM	14,070	3	2	13	
Bridge length assumed		14	17	24	LM
Bridge areas, assuming width = 10 m		420	340	3,120	SM



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Surface Roads, Paths and Bridges				Base Cost
Surface access roads	Lane m	\$1,000	38,553	\$38,552,500
Westbound ramp over 401	SM	\$3,229	216	\$697,464
Route 3 over 401	SM	\$3,229	756	\$2,441,124
Bridge adj Shadetree Cres	SM	\$3,229	972	\$3,138,588
Bridge north of St Clair Drive	SM	\$3,229	792	\$2,557,368
Bridge over ramp at Pulford St	SM	\$3,229	420	\$1,356,180
Ditto at Grand Marais Road W	SM	\$3,229	240	\$774,960
Pedestrian bridges, 18 No	SM	\$872	3,880	\$3,383,360
Pedestrian paths parallel Rd	LM	\$250	14,070	\$3,517,500
				\$56,419,044
	Contingency	30%		\$16,925,713
	Estimated Section Cost			\$73,344,757

Surface Road Lighting	LM	\$1,500	9,090	\$13,635,000
	Contingency	30%		\$4,090,500
	Estimated Section Cost			\$17,725,500

M&E: Tunnel, Depressed Roadway and Ramps				
Jet fans	each	100000	126	\$12,600,000
Emission monitoring equipment	Sum	1500000	1	\$1,500,000
Firefighting 150 mm standpipe	LM	325	12000	\$3,900,000
Hose connections		1500	150	\$225,000
Siamese connections		5000	54	\$270,000
Tunnel Lighting	m-bore, r	3440	7660	\$26,350,400
Depressed	m-roadw:	590	5120	\$3,020,800
Power distribution	Sum	2.4E+07	1	\$24,000,000
Comm, surveill, VMS, SCADA	Sum	7000000	1	\$7,000,000
Provide power supply			excl.	
				\$78,866,200
	Contingency	30%		\$23,659,860
	Estimated Section Cost			\$102,526,060



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Utilities: Tunnel, Depressed Roadway and Ramps	Unit	Rate	Quantity	Min Cost \$M	Max Cost \$M
Drain underpinning	Sum	\$10,000,000	1	10	10
Utility Work	Sum	\$15,000,000	1	15	
	Sum	\$20,000,000	1		20
Drainage pipe and inlets	LM	\$33	18,377	1	
	LM	\$49	18,377		1
Drainage pump stations	No	\$1,000,000	8	8	8
Surface roadway & ramp lighting			excl.		
Lighting in parks			excl.		
MPT	Sum	\$10,000,000	1	10	
	Sum	\$15,000,000	1		15
		Subtotal		44	54
		Contingencies	30%	13	16
				57	70
		Estimated Section Cost		\$63,379,724	

Utilities: Depressed Surface Roadways

Tunnel Lighting	m-bore, min	\$3,440	360	1	1
Drainage pump stations	No	\$1,000,000	2	2	2
Drainage			incl		
Firefighting 150 mm standpipe			incl		
Comm, surveill, VMS, SCADA			incl		
		Subtotal		3	3
		Contingencies	30%	1	1
				4	4
		Estimated Section Cost		\$4,209,920	

Parks and other Amenities

Park, 350 acres, topsoil & seed	SM	\$5	1400000	incl	
Trees, one per 400 SY	each, min	\$100	4,235	incl	
	each, max	\$500	4,235	incl	
Brick paving in park, 1% area	Hectare	\$30,000	140	incl	
Trees and park	Sum	\$50,000,000	1	50	
Other park facilities, ball fields	Sum	\$20,000,000	1	20	
		Subtotal		70	
		Contingencies	30%	21	
				91	
		Estimated Section Cost		\$91,000,000	



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SUMMARY OF PRIMARY MAINLINE QUANTITIES

Excavation and Fill: Tunnel, Depressed Roadway and Ramps	Unit	Rate	Quantity			Min	Max
			Route 401	Ramps	Total	Cost \$M	Cost \$M
Open excavation, bottom with soldier-pile and lagging, remove and dispose	CM, min	\$31	2,884,652	230,486	3,115,138	97	
	CM, max	\$40	2,884,652	230,486	3,115,138		125
Soldier-pile & lagging, exposed	SM, min	\$538	56,168	16,374	72,543	39	
	SM, max	\$646	56,168	16,374	72,543		47
Tieback anchors	LM	\$328	158,110	40,520	198,630	65	65
Secant piles 3 ft dia or slurry walls	SM	\$1,957	120,078	-	120,078	235	235
Backfill	CM, min	\$20	346,416	19,501	365,917	7	
	CM, max	\$20	346,416	19,501	365,917		7
Structure: Tunnel, Depressed Roadway and Ramps							
Concrete mud slab	CM, min	\$262	17,352	3,421	20,773	5	
	CM, max	\$262	17,352	3,421	20,773		5
Base slab	CM	\$522	407,718	54,743	462,461	241	241
Tie-down anchors, center, 160T	LM	\$328	2,753		2,753	1	1
Tie-down anchors, outside, 160T	LM	\$328	17,445		17,445	6	6
Walls	CM, min	\$980	52,149	9,859	62,008	61	
	CM, max	\$980	52,149	9,859	62,008		61
Roof	CM, min	\$795	208,822	1,288	210,109	167	
	CM, max	\$795	208,822	1,288	210,109		167
Finishes walls (ceiling none)	SM	\$54	89,574	569	90,142	5	5
Barrier & walkway concrete	CM	\$450	21,514	2,148	23,662	11	11
Permanent tiebacks T, 45°				incl			
Waterproofing	SM, min	\$6	430,482	16,245	446,727	3	
	SM, max	\$8	430,482	16,245	446,727		4
						943	979
						283	294
						\$1,249,220,000.00	
			Contingency	30%			
			Estimated Section Cost				



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SUMMARY COST ESTIMATE BY SECTION

Depressed Mainline Roadway and Tunnel	Cost	Cost/m	\$/lane-m	Lane-m
Eastern Approach Ramp	\$27,810,000	\$41,000	\$6,300	4,414
Howard Ave Tunnel	\$25,270,000	\$211,000	\$26,300	961
Depressed roadway between Howard Ave and Villa Paradiso	\$62,020,000	\$70,000	\$10,700	5,796
Mt Carmel - Villa Paradiso Tunnel	\$189,650,000	\$190,000	\$29,200	6,495
Depressed Roadway between Mt Carmel and St Clair Tunnels	\$10,680,000	\$97,000	\$12,100	883
St. Clair Tunnel	\$53,350,000	\$222,000	\$27,800	1,919
Depressed roadway between St Clair and Oakwood Tunnels	\$69,820,000	\$101,000	\$16,300	4,283
Oakwood Tunnel	\$281,160,000	\$230,000	\$37,500	7,498
Depressed roadway between Pulford and Oakwood Tunnels	\$22,670,000	\$142,000	\$20,200	1,122
Pulford Tunnel	\$67,680,000	\$294,000	\$39,100	1,731
Depressed roadway between Huron and Pulford Tunnels	\$49,630,000	\$236,000	\$29,500	1,682
Bellewood - Huron Tunnel	\$258,090,000	\$253,000	\$38,500	6,704
Western Approach Ramp	\$36,640,000	\$54,000	\$9,000	4,071
Total Length = 7,229.3 m	\$1,154,470,000	\$159,693	\$24,274	47,559

Roads Associated with Mainline

Entry Exit Ramps (10) and Other Access Roads (3)	\$94,680,000	\$24,000	\$24,000	3,945
Oakwood Depressed & Tunnel Service Road	\$23,380,000	\$53,000	\$13,300	1,758
Carmel Depressed & Tunnel Service Road	\$34,910,000	\$63,000	\$15,900	2,196
	\$152,970,000		\$19,367	7,898

Additional Items (Rev 1b)

	Quantity	Rate		
Detours or Temporary Bridges (MPT)	18	\$2.M	\$36,000,000	
Constr. Pressure Relief System, m	1,050		\$2,100,000	\$2,000
Surface water control, m	7,000		\$4,900,000	\$700
Longer Ramps than shown, m	800		\$14,927,720	
		Subtotal	\$57,927,720	
		Contingency 30%	\$17,378,316	
		Total Additional	\$97,233,756	

Associated Mainline Costs

M&E: Tunnel, Depressed Roadway and Ramps	\$102,526,060		
Utilities: Tunnel, Depressed Roadway and Ramps	\$63,379,724		
Utilities: Depressed Surface Roadways	\$4,209,920		
	\$165,905,784	Total Mainline	\$1,570,579,539



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Surface Works

Surface Roads, Paths and Bridges	\$73,344,757		
Surface Road Lighting	\$17,725,500		
Parks and other Amenities	\$91,000,000		
	<u>\$182,070,257</u>	Total Surface	\$182,070,257

TOTAL PROJECT COST \$1,752,649,796



Appendix D
Revised Cost Estimates

