



TORONTO WATERFRONT
REVITALIZATION CORPORATION

REPORT

**Constructability, Structural Engineering
Feasibility and Cost Study for the
Gardiner Expressway/
Lakeshore Boulevard Options**

Toronto, Ontario

December, 2004

MH
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REPORT

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Gardiner Expressway/Lake Shore
Boulevard Options**

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Presented to:

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Gardiner Expressway Under Construction, 1960's

1. INTRODUCTION

The revitalization of the Toronto Waterfront will transform it into world-class, new and attractive communities within the City with excellent access, parks and public spaces, where people desire to live, and where businesses desire to establish and grow. Established in November 2001 jointly by the Government of Canada, Province of Ontario, and the City of Toronto, the Toronto Waterfront Revitalization Corporation (TWRC) will oversee and lead the challenging task of the waterfront renewal.

It is acknowledged in the publication “Making Waves: Principles for Building Toronto’s Waterfront”, that the redesign of the Gardiner Expressway/Lake Shore Boulevard corridor and replacement with a modified road network is one of the most important ingredients in revitalizing Toronto’s central waterfront. The redesign would reunite the city with the lake, produce strong pedestrian corridors between Lake Ontario and downtown, as well as accelerate the transformation of an underutilized part of Toronto into a mixed-use waterfront district.

The 6.2 km elevated portion of the 14 km long F.G. Gardiner Expressway, is a key element in the entire revitalization program, due to its prominence and size, its position at the Toronto Waterfront running along the north shore of Lake Ontario, and as a prime vehicle access route for downtown Toronto. The existing elevated Gardiner Expressway comprises over 500 slab-on-girder bridge decks totaling 200,000 square metres in area, supported primarily on concrete piers. Construction began in the 1950’s with the final section of the viaduct completed in 1966. Much of the elevated expressway was built along and above Lake Shore Boulevard.

Maintenance of the Expressway structure, to keep it operating in a safe and secure condition, has been a major and expensive exercise undertaken by the City for the last 20 plus years, and is likely to continue in the future. In 2001, the lightly used section of the Gardiner Expressway east of the Don River to Leslie Street was decommissioned with new ramps built to access the truncated Expressway from Lake Shore Boulevard.



The F.G. Gardiner Expressway, Toronto.

The preferred approach to deal with the Gardiner Expressway/Lake Shore Boulevard corridor is a critical issue that will have a major impact on other proposed developments and improvements at the waterfront.

The purpose of this study is to review the feasibility, constructability and cost estimates for 3 selected options prepared by TWRC to deal with the Gardiner/Lake Shore corridor reconfiguration. All initial plans were provided by TWRC. A number of meetings were held to clarify intentions and make revisions to the original plans based on issues discussed. All recommendations are conceptual and schematic only. Detailed analyses will have to be conducted in future and subsequent design stages.

Issues related to traffic and capacity are not dealt with in the report. A separate parallel study is being undertaken to deal with these issues.

2. DESCRIPTION OF THE OPTIONS

The Corporation has conducted studies of many available options to determine the proposed approach to the Gardiner/Lake Shore corridor. Three possible scenarios between Dufferin Street and the DVP were identified for this study, namely:

1. A “Replace” Option, to remove the existing elevated structure between Strachan Avenue and Don Roadway and replace this by a new network of at-grade and below-grade links (tunnels);
2. A “Retain” Option to keep the existing elevated structure throughout, but remove or relocate some ramps, and remove a major portion of Lake Shore Boulevard from below the Expressway; and
3. A “Remove” Option to remove the elevated structure and construct a continuous at grade boulevard (Lake Shore) and other surface streets. Two sub-options were considered under the “Remove” option:
 - Full removal
 - Staged removal - removing only the section of the Expressway between Spadina Avenue and the DVP. Construction of a new surface road network between Spadina Avenue and the DVP, with a transition connecting the remaining Gardiner structure west of Bathurst Street with the new surface road.

Costs were estimated for the demolition/modification of the existing roadway and the construction of new roadways.

3. THE “REPLACE” OPTION

3.1 Description of Option

A drawing of the “Replace” Option is in Appendix 1 of this report. The plan was prepared based on information provided by TWRC and incorporated provisions recommended by MH to facilitate the construction of the proposed work, such as those to assist in traffic detours.

The Front Street Extension (FSE) would have been completed and operational at the time of construction of the Gardiner/Lake Shore schemes. Ramps via tunnels and bridges under and over the rail corridor will connect the newly built FSE to the elevated Gardiner somewhere between Strachan Avenue and Dufferin Street. The cost for these structures are assumed to be part of the FSE.

The main features of the “Replace” Option comprises the following:

1. Demolition of the existing elevated Gardiner from the Don Valley Parkway (DVP) to Strachan Avenue, including the ramps connecting Gardiner to DVP. At the conclusion of the construction, only a short section of the existing elevated Gardiner from the west abutment at Exhibition Place to approximately 530 m west of Strachan Avenue, will remain to retain the FSE connections, and pedestrian access to Exhibition Place and the GO Station.
2. A new twin tunnel will be built between Strachan Avenue to Portland Street. At Portland Street the tunnel will split into one westbound and one eastbound tube. The eastbound tunnel will end between Spadina Avenue and Rees Street, while the east portal of the westbound tube will be located east of York Street. The total length of the tunnel is over 2 km and follows a reverse curve alignment, traversing lands very close to the north side of Historic Fort York (including its cemetery). Local connections and split exits at the downtown section of the tunnel require local widening of the box sections, multiple portals, and the like, as shown on the drawing in Appendix 1. A total of 5 portals will be required for entry and exit traffic.
3. The Gardiner/Lake Shore “combo” at the demolished Gardiner location between the DVP and Jarvis Street will be converted into an at-grade road. Comprised of express route sections and an urban section, which will become part of the urban road system along the lake front. The express route will be located at more or less the elevation of the rail



Historic Fort York.

corridor with the urban section located below at the level of existing Lake Shore Boulevard. This combined road system will be connected through various roads to the tunnel sections mentioned above at York Street and at Spadina Avenue.

4. Grade separated crossings at Cherry Street, Parliament Street, Sherbourne Street and Jarvis Street with the new express section of the new Lake Shore Boulevard westbound lanes.

5. The central downtown portion of the new road system, from York Street to Spadina Avenue, will comprise a number of two level roads with on-grade road running on top of the new tunnels. The on-grade road system will include intersections at Spadina Avenue, Rees Street, Simcoe Street, York Street, Bay Street and Yonge Street, which are all at-grade intersections controlled by traffic signals.



Toronto Rail Corridor and the Future Express Road Location.



Mouth of the Don River.



The D.V.P. Interchange at Richmond Street.

6. New pedestrian bridge crossings between Simcoe Street and Spadina Avenue will be built to carry pedestrians from downtown to the waterfront.

7. New ramp structures will be built to connect the west end of the tunnels to the remaining elevated section of Gardiner near the Exhibition Place. Similarly, new low-level ramps will be needed to connect the DVP with the new Lake Shore and Gardiner. It is noted that existing Lake Shore east will connect to the new express lanes, with a bridge over the relocated Don River and under the DVP ramps.

8. As part of a separate initiative, a plan is being developed to realign the Don River Channel south of the railway mainline. This will necessitate a number of new crossings at the east end of the new Lake Shore to link up with the Lake Shore road system east of river. Two twin bridges as well as

the WB Lake Shore bridge will be included. These bridges are long bridges to be able to straddle the entire flood plain and provide the necessary hydraulic opening. Columns in the flood plain are thought to be acceptable.

9. As a common element to all 3 options, the existing DVP interchange at Richmond Street/Eastern Avenue will be improved to provide 2 lane ramps and to resolve existing weaving. The cost of this interchange modification is included as part of the cost estimate of this study.
10. Typical cross-sectional dimension of roads and expressways, as provided by TWRC or as proposed by MH, are shown in Appendix 5 to this report.

3.2 MH Review and Recommendations on Structural Feasibility and Constructability Issues

Of the three options, the Replace Option is unarguably the most complicated. There are many challenges associated with the constructability of this option, mainly because of the overlapping of existing and proposed works, the complex connections between the newly built roads and structures to existing facilities at the ends, as well as crossing and connection between these new facilities. There are also requirements to maintain the maximum number of East-West lanes during all stages of the construction.

The following are recommendations of MH for the “Replace” Option:

3.2.1 Construction Sequence and Traffic Management

There are apparently a number of similar but slightly different alternatives where traffic disruption will be minimized during the construction of the Replace Option facilities. The following is one feasible solution, comprising a total of 4 stages. Only the concept of the operation is illustrated. More details including lane provision and actual transition and connections, will be developed further in future design stages.

Stage 1: Pre-Building Stage

(Gardiner 100%, Lake Shore 100%, FSE 100%, Queens Quay <100%)*

* Note: Indication of the approximate percentage of capacity that would be maintained during this stage of construction, and is similar for all other locations in this report

From the proposed layout and the overlaying of new facilities onto the existing road system, it is evident that some facilities can be pre-built, without significantly impacting the existing road network. During this stage the existing capacity of both the elevated Gardiner Expressway and Lake Shore Boulevard (LSB) remains almost fully operational other than intermittent disruptions due to their proximity to the new works. The following will be built, starting from the west:

1. Front Street Extension
2. DVP/Richmond Street/Adelaide Street/Front Street Interchange Improvements
3. Tunnel:

The EB tunnel and WB tunnel from Strachan Avenue to east of Portland Street including the west portals and a 2-lane cross-over connections between the EB and WB tubes just east of Strachan Avenue and just east of Portland Street to maximize use of both tunnels in subsequent stages. A temporary portal and ramp will be built to allow traffic to return to the surface onto the Bremner Detour at Portland Street.

4. Bremner Detour

The use of Bremner Boulevard as a temporary detour route is proposed to provide a relief to both eastbound and westbound directions of traffic and to facilitate completion of the tunnel during subsequent stages. The Bremner Detour connects the temporary tunnel portal near Portland Street to the new Lake Shore Boulevard between York Street and Bay Street.

5. New Lake Shore outside the shadow of the elevated Gardiner, from York Street to the DVP, comprising:

- a. The bulk of the four-lane Express Road on the rail embankment (referred to as the “Express Road” for purposes of construction staging) from west of Jarvis Street to east of Cherry Street (including overpasses of Jarvis, Sherbourne, Parliament and Cherry Streets). The full width of the road cannot be built as the fill for the full embankment will spill over onto the existing and operating Lake Shore. Narrower lane widths could be used to accommodate 4 temporary lanes for subsequent construction stages. At the west end of the Express Road at Jarvis Street, traffic is either connected via a temporary ramp back onto the existing Lake Shore Boulevard



*Lake Shore Boulevard Emerging from Below the Gardiner
Towards the East End of Toronto.*

(see sketch and section in Appendix 2 for “Constructability Issues for Replace Options”). At the east end at DVP, build the N-W ramp from the DVP to the Express Road and the W-N ramp from the Express Road to the DVP to the point where they do not interfere with the existing DVP-Gardiner ramps. It is also recommended that the new Lake Shore between Cherry Street and Don Roadway, including new

bridges over the realigned Don River, be constructed as well as the connection from Lake Shore East.

The ramps currently on the north side of the elevated Gardiner at Sherbourne Street, Jarvis Street and Yonge Street will have to be demolished to facilitate the construction of the Express Road. Temporary connections from the elevated Expressway to the downtown streets will be disrupted because of this, but should be developed in subsequent design stages.

- b. New 5-lane eastbound Lake Shore (extension of Harbour Street) from Bay Street to west of Jarvis Street.
- c. Temporary WB (5-lanes) Lake Shore to south of elevated Gardiner, part of which may become the permanent roadwork. This would help to bring traffic from under the Gardiner to outside during subsequent construction stages.
- d. The EB Yonge/York/Bay Ramps would be removed to facilitate construction of part of the new Lake Shore urban section through the complex stretch of road between Spadina Avenue and York Street.
- e. Other miscellaneous roads and connections including: temporary EB Lake Shore detour around the Gardiner at Cherry Street; WB ramp connection between the Express Road and Lake Shore east of Cherry Street; Queens Quay Extension to Cherry Street; and a temporary connection from Cherry Street to the new Lake Shore alignment. All these will be used to spread out the traffic during Stages 2 and 3 to bypass the work zone where necessary, in order to minimize the major impact to traffic, when part of the Gardiner and the Lake Shore will be shutdown.

Stage 2: Completion of West Tunnel

(Gardiner 75%, Lake Shore 50% (varies), FSE 100%, Queens Quay 100%)

This stage will complete the tunnel and its connections at both ends (west of Strachan Avenue to the elevated FSE and east to surface Lake Shore Boulevard). At the conclusion of Stage 2, the new Lake Shore will be partially open from DVP to Dufferin. During Stage 2, the elevated portion of the Gardiner remains in operation while some detours are put in place for EB and WB Lake Shore traffic in order to build the transition road network pieces. These transition road network pieces will maximize the use of the pre-built sections to maintain as many lanes as possible in operation on the lake front road system during construction.

The items of work will include:

1. Complete the tunnel from Portland Street to York Street and all Portals. This section of the tunnels is directly under the existing Lake Shore, and from Spadina Avenue to York Street all or, part of Lake Shore is under the Gardiner. As a result the existing Lake Shore will be shut down during tunnel construction at this location for some period of time. There are 2 proposed mitigating measures to minimize this interruption:

- i. To enable the capacity of Lake Shore to be re-established as quickly as possible, construction of the tunnel could be carried out using a temporary decking and shoring system (see sketch in Appendix 2). The tunnels are therefore not recommended to be undertaken at the same time as activity 2 (Gardiner and DVP connections) below, when the Gardiner traffic will be disrupted. Once decked, and with minor realignments, Lake Shore could be fully reinstated.
- ii. The new tunnel at this section will be impacted by the existing foundations of the elevated Gardiner. In order to keep the elevated Gardiner fully operational, some bents will have to be wholly removed. The deck will be supported by temporary steel bents offset from the existing columns until Stage 3, when the Gardiner will be demolished (see sketch in Appendix 2).

After decking, some temporary access shafts will be necessary to reach the tunneling area to permit excavation, earth removal, and concreting the structure. An area adjacent to the tunneling site shall be made available for this purpose.

2. Construction of the west connection from north tube of tunnel portal to the Gardiner west of Strachan Avenue. This will involve diverting all Gardiner traffic toward the south half of the elevated expressway west of Strachan Avenue. A convenient section of the north elevated Gardiner at this location will then be demolished, simultaneously with the construction of a new ramp structure to connect the north tube portal to the northern half of the Gardiner. All connecting structures can then be properly rebuilt, especially the permanent ramp/Gardiner junction deck. To plan for Stage 3 work, it is suggested that the rebuilding of the junction deck and the associated north half of the Gardiner be widened to accommodate at least one more lane, or through the use of temporary decks, to facilitate Stage 3 work, as it has to accommodate 4 lanes of traffic under Stage 3 (currently only 3 lanes on the northern half), to maintain the current number of lanes.
3. Construction of the east connection from the east end of the Express Road to DVP. One existing DVP ramp (preferably the N-W ramp) will be demolished, and a new low level ramp will be built to connect DVP onto the new Express Road of the new Lake Shore pre-built under Stage 1. During this time, the other ramp (W-N) will be converted to accommodate 2-way traffic to maintain a continuous connection between DVP and Gardiner. This method was used in 1993, and the new ramps were rebuilt wider than the original and should be able to meet the challenge under Stage 2 of this work.

During activities 1 and 2, a number of lanes available on the Gardiner will be affected because of restrictions at the two ends. However, traffic can be significantly relieved by traffic diversions



The Don Valley Parkway Ramps.

to the system pre-built during Stage 1, with the following in operation:

- a. At Spadina: it is necessary to close and remove the westbound on-ramp to FGE at Spadina Avenue and the westbound off-ramp to Lake Shore and Spadina. Traffic will be able to use the Front Street extension to access Gardiner westbound. Part of the on-grade roads can be reinstated for use, and areas where excavation for the tunnel are proceeding will be again be available for traffic once decked, including the existing Lake Shore.
 - b. Some of the traffic (westbound) can be diverted from Lake Shore Boulevard to the Bremner Detour, which will provide at least two westbound lanes during the stages when the Lake Shore is being decked or during later completion of the portals. After the decking, most of the on grade road can be reinstated.
 - c. Other miscellaneous road links, such as the Queens Quay extension, and the temporary portions of the Lake Shore, will remain open and generally free of construction.
4. Reinstatement of On-Grade Road at completion of tunnels and portals. All temporary deck will be removed, and backfilling and paving will reinstate as much the existing road system as possible, especially that of the existing Lake Shore, although a major portion of that will have already been moved outside the shadow of the elevated Gardiner.

Now that the bulk of the on-grade road network, as well as the new westbound tunnel and Express Road are complete, the project is ready for re-routing of traffic off the elevated Gardiner, enabling its demolition.

Stage 3: Removal of the Gardiner Expressway

(Gardiner 0%, Lake Shore Tunnels 75%, Lake Shore Urban 50%, FSE 100%)

The Gardiner will be removed in one single operation. All connections to the Gardiner will be closed. Traffic to and from the DVP will be using the newly completed Express Road connection, partially completed Lake Shore urban section, and other connections such as the Don Roadway and the Front Street Extension. Traffic to and from the west will be using the newly completed West Tunnel, temporarily operating in two directions, and the remaining elevated Gardiner at Dufferin Street. Traffic traversing the lake front and accessing the downtown areas will use the partially completed Lake Shore and Queens Quay system, and the many at grade and grade separated connections, and the intermediate portals and branches of the West Tunnel.

The following will be involved:

1. Shift 4-lanes (2 lanes EB and 2 lanes WB) on Gardiner to the north section of the elevated structure, which, with the ramp and temporary cross-over section between the tunnels east of Strachan, now allows two way operation (EB and WB) in the North Tunnel from Strachan Avenue to York Street.

2. At the east end at the DVP, use the newly completed N-W ramp to connect the traffic to DVP, using the ramp for two way traffic, to access the Express Road. The partially completed Express Road will be temporarily operating to accommodate both directions of traffic. The southern portion of the lower urban section of the Lake Shore will also be used to carry E-W traffic.
3. Complete all necessary connecting roads and surface roads linking the lake front and downtown roads.
4. Demolish elevated Gardiner from Strachan to DVP including all remaining ramps. The elevated Gardiner hovers over the completed at grade Lake Shore, approximately between Spadina Avenue and Jarvis Street, and from the DVP ramp connections to the Gardiner East. From Jarvis Street to Cherry Street, the Gardiner is sandwiched between the completed Express Road and partially completed Lake Shore south of and outside the elevated Gardiner. For the removal of the first listed sections, care should be exercised to remove the deck in such a pattern that the structural integrity of the bridge is addressed at all stages of work, and that traffic below is properly protected from falling debris. For the removal of the latter section, similar care should be exercised although perhaps not to such a high level. Free dropping of any elements should be strictly forbidden. Most of the piers obstructing the construction of the tunnel should have been removed in previous stages. The remaining piers will only be taken down to approximately 1000 mm below ground with footings likely to remain buried. All temporary piers erected under Stage 2 will be removed.

A staged removal procedure could be implemented to mitigate the impact to the road system, and to allow some connections to the detour system to be built more easily, particularly for the section between Spadina Avenue and Jarvis Street. The details of this procedure can be found in Chapter 5 and will not be reiterated here.

The arrangement and the ability to remove the elevated Gardiner in one operation, without the use of a “half and half” approach will be extremely useful to shorten construction timing as well as to minimize the cost of temporary supports to reinforce the supporting bents.

Stage 4: Completion Works

(At Conclusion, All Elements to be 100% Operational)

With the Gardiner removed, this stage will complete all outstanding construction elements to enable the system to operate fully. These construction activities include:

1. West tunnel south (EB) connecting ramp structure west of Strachan Avenue. This ramp structure will enable the designated EB tunnel to be properly connected to the EB Gardiner, which continues to be elevated west of Strachan Avenue. After completion, the temporary vehicular cross-over between the tunnels can be removed or converted to other uses.

2. EB Lake Shore structure from urban to Express Road, west of Jarvis Street. The bridge cannot be built in earlier stages as it will be going between the elevated Gardiner deck and the on-grade Lake Shore.
3. Construct remaining portion of Lake Shore from Portland Street to York Street. This section of the surface Lake Shore, partly over the tunnel, could not be built to its full width in earlier stages because of interference of piers of the elevated Gardiner.
4. Proper road dimension of on-grade “urban” section of the Lake Shore (York Street to DVP). This section of Lake Shore could not be built to its full width previously, because of obstruction by the Gardiner. Only the southern section (approximately 5 lanes) would have been pre-built under Stage 1.
5. W-N Ramp Structure that carries the Express Road EB traffic to DVP over the Don River. This connection cannot be built until after the Gardiner deck, including the original high level ramp, is removed.
6. Other miscellaneous connections, minor structures, removals and the like, including the reinstatement of Bremner Boulevard as a normal two way city street.

The above staging scenario is illustrated via sketches in Appendix 2.

3.2.2 Emergency Services During Construction

From the above discussion it is obvious that there would be situations when extended operation using narrow lanes will be involved. This has to be discussed and agreed with various Emergency Services, such as fire, EMS and police.

One of the critical areas is the DVP ramps when one of the 2 ramps may be required to operate as a 2-way road. The ramps on a curved alignment, will require special attention during design to ensure the large trucks can navigate the alignment. Any widenings will need to be constructed as an advance contract to this project. The cost of doing this is not included in the estimate prepared by MH.

Another disruption is the extensive closure of ramps during construction and the many new connections being built to improve linkages to the lakefront from downtown. The public and the Emergency Services providers must be constantly informed of changes in advance to avoid driver confusion and unnecessarily long response times.

3.2.3 Utilities

Many utilities will be encountered at all parts of the site, some buried, some installed on poles as overhead wires, some mounted on the structures, together with numerous installations such as maintenance facilities, power supply chambers, etc. which are associated with individual utilities. These could also include overhead HEPC wires, oil and gas pipelines, railway signals and steam lines, fibre optic cables, sewers and water mains. Proper

and timely arrangement for temporary and permanent diversion is a crucial activity that must not be overlooked and could be tricky because of the many stages involved in the construction. An additional complication is that many facilities must remain operational (illumination for example) as long as the Gardiner is operational. A special project team may need to be designated to handle this activity alone throughout the entire design and construction stage.

3.2.4 Temporary Structures

From the discussion above it is evident that temporary construction will be necessary to build the proposed work and to maintain safe traffic across the city. This includes the temporary supporting bents for a 1.2 km section of the elevated Gardiner in order to build the tunnel, the temporary retaining structure between the Express Road and the urban section of the new Lake Shore, temporary widening of the remaining elevated Gardiner west of Strachan Avenue, temporary cross-overs at tunnels, the extensive temporary decking and shoring system of the tunnel construction, temporary connecting roads, the Bremner Boulevard Detour, and the like. All these have been allowed for in the estimate for this option prepared by MH.



Typical 3-Legged Piers.



Typical 2-Legged Piers.

3.2.5 Properties

Although most lands affected by this option are owned by the City of Toronto, including the future park land (SE quadrant of Portland Street/Bremner Boulevard), some minor properties issues would still need to be clarified at this location. They may include:

1. Rail corridor right of way for the Express Road, although the track will unlikely be affected by the proposed work.
2. The property south of the existing Gardiner should also be addressed, particularly where necessary to move the Lake Shore towards the south.
3. The Fort York area including the cemetery lands.

4. Other minor areas encroached onto by the footprint and future maintenance areas. This has to be finalized in subsequent design stages.

Cost associated with property acquisition do not form part of this estimate.

3.2.6 The West Tunnels

The West Tunnels comprising a twin tube section and a “branched-out” single tube sections. Portals are located near Strachan Avenue and between Spadina Avenue and York Street, approximately. Despite the feasibility of this tunnel, the following are concerns that should be addressed in subsequent design stages:

- a. Localized conflict with the foundations of the existing Gardiner should be carefully reviewed. It is noted that the situation is particularly significant between Spadina Avenue and Simcoe Street. This problem has been discussed in detail above, and is illustrated in Appendix 2.
- b. Tunnel dimensions should include sidewalks with high curbs above which exhaust fans could be installed. There may be some opportunities for local parking bays for service and maintenance vehicles or stranded cars, depending on the spacing of the fans. Additionally, the twin tunnel should include an utilidor and provisions for frequent pedestrian connections from one tunnel to another. The utilidor is essential for the maintenance of the tunnels, running of utilities, ventilation, storage, etc. For the single tunnels, sidewalks with curbs are also needed (currently assumed on both sides of each tunnel), but this may change during the final design. Other facilities should also be allowed for, and should be included in the cost estimates:
 - Ventilation shafts/structures. Three of these structures are assumed for estimation purposes;
 - Emergency escape structures. Three are assumed for estimation purposes and could be combined with the ventilation structures;
 - Electrical and mechanical system, for lighting, ventilation, power supply, pumping, transformer houses, and the like.
 - Other services such as drainage and sumps, pumping stations, water supply, etc.

Costs for these facilities have been included in the cost estimate for this option. However, costs to operate these facilities have not been included.

- c. The tunnel passing under lands at the west end of the Historic Fort York site will be a concern, particularly in view of the archaeological value of the potential artifacts buried within the compound. To avoid possible dispute and complications, it is recommended that a “bored tunnel” situated within the shale bedrock be considered to avoid any excavation inside the Fort York Cemetery. There would be additional costs for choosing

bored rather than cut and cover tunnels. MH has reviewed both costs for comparison purposes as part of this study.

3.2.7 Existing Sections of Gardiner Expressway to Remain

The section of the elevated Expressway from the Front Street connections to the west abutment at Exhibition Place is in poor condition and should be at least re-decked. Based on the knowledge and proposed strategic rehabilitation solutions, the deck should be slated for replacement at this time due to limited repair in the 80's and the 90's. This is considered as part of the City's maintenance liabilities and the cost has not been included in the estimate prepared by MH.

3.3 Geotechnical Comments

The vertical profile for the tunneling under the cemetery at Fort York is only tentative, but adequate cover to the tunnel will be required to minimize potential for ground settlement. The preferred profile would provide for the tunnel to be fully within the shale bedrock; the bedrock surface is at about Elevation 73 m to 76 m in this area and is overlain by silty clay till. The groundwater level is at about Elevation 180 m; groundwater inflow should be expected through fractured zones within the bedrock.

There are variable extensive fill materials present in some portions of the alignment – these fills can contain significant rubble and previous shoreline structures which will present difficulties for caisson or soldier pile installation and/or excavations. In addition, there is potential for significant water inflow to excavations made through these fills as well as sands/silts (present also at some locations in the eastern portion of the study area) unless groundwater control measures are implemented.

The presence of a deep buried bedrock valley at the eastern study limits near the Don Valley Parkway will require the use of long driven piles for bridges proposed in this area.

The excavated soils in some parts of the alignment (particularly the fills, sands and organics east of Strachan Avenue) may require disposal at licensed landfills.

3.4 Recommendations

MH suggests that the “Replace” Option is feasible provided the above-stated issues are addressed and the construction follows the above-mentioned staging plan (or other feasible alternatives).

A drawing illustrating the proposed layout is shown in Appendix 1 of this report.

4. THE “RETAIN” OPTION

4.1 Description of Option

A drawing showing the “Retain” Option is shown in Appendix 1 of this report. The plan was prepared based on information provided by TWRC and incorporated provisions recommended by MH to facilitate the construction of the proposed work, such as those to improve vehicular and pedestrian access across the Gardiner Expressway corridor.

This option was originally called the “Transform” Option, and will basically maintain the existing condition of the elevated expressway. However, it will totally revamp the areas below the deck by relocating the existing Lake Shore most of which is now running below the expressway, towards the south, and allow for development of the space vacated by the move.

The main features of the “Retain” Option include the following:

1. The main deck of the existing elevated structure will be retained throughout. Some ramps will be removed. The ramps to be removed include the Yonge Street WB Off Ramp, the Bay Street EB On Ramp, the Yonge/York/Bay EB Off Ramps, and the Spadina Avenue WB Off Ramp.
2. Relocate some of the remaining ramps to improve the road intersections whereby the N-S roads could join the new Lake Shore with proper curves and safe sight distances, etc. The result will be three (3) On Ramps and three (3) Off Ramps, namely, WB Off Ramp at Sherbourne Street, EB On-Ramp at Sherbourne Street, EB Off Ramp at Jarvis Street, WB On Ramp at Jarvis Street, WB Off Ramp at York Street, and the WB On Ramp at Spadina Avenue. The final layout of the elevated expressway and the new ramp system is shown in Appendix 1.
3. Relocate Lake Shore Boulevard from below the existing Gardiner to form a 2-way road as part of the lake front road system. The relocated road would be a 6 lane urban road, 3 lanes in both WB and EB directions. Between Jarvis Street and York Street the new Lake Shore will be split into a pair of one-way streets following separate alignments. New bridges will have to be built over the realigned Don River. Similar to the previous option, these bridges should be long enough to clear the proposed flood plain.
4. The areas below the Gardiner will be re-developed into a boulevard style zone, with a variety of uses that could include landscaped areas, parks, businesses and



Opportunities Below the Gardiner Expressway.

covered structures. The details and costing of these does not form part of the scope of this study.

5. Modify the Richmond Street/Eastern Avenue/DVP Interchange, as in the “Replace” Option.

4.2 MH Review and Recommendations

For the Retain Option the major objective is the concept of opening up the waterfront by creating convenient and inviting accesses connecting the downtown to the lake, both for vehicles and pedestrians, with a wide boulevard created by the new Lake Shore, despite the continuous presence of the viaduct structure. Vehicles would pass below the Gardiner with smoothly aligned urban roads and safe sight distances, and pedestrians would not have to pass below multiple layers of ramps and decks. Areas below the existing Gardiner would be turned into brightly lit business and recreational areas and street fronts that would be attractive to pedestrians. These issues are to be addressed and affect the recommendations provided by MH.

The following are recommendations of MH for the “Retain” Option:

4.2.1 The Existing Gardiner Deck

The existing deck of the elevated structure has been in service since the Gardiner Expressway was first constructed in the early 1960’s. Except for the two connecting ramps to the Don Valley Parkway and the section between Jarvis and York, where the deck was replaced in 1993 and 1985 respectively, the original deck structure is very close to or has already passed the end of its service life and is in need of replacement. Rehabilitation was originally planned strategically based on a proposal presented in 1986, including a total deck replacement in the early 2000’s. The rehabilitation projects carried out so far have not been for the purpose of reinstating the original strength of the structure or for long term performance, but to extend its life by a finite amount so as to allow a more systematic and financially controlled rehabilitation and deck replacement program to be carried out.



Deck Replacement Will Be Necessary to Prolong the Life of the Existing Structure.

It is known from concrete core analysis that increased use of deicing salt over the years has resulted in chloride penetration of the deck concrete to varying extents. Over a period of time the embedded chlorides will continue to cause corrosion of the reinforcing steel that will manifest itself as concrete spalling and potholed asphalt which are indicators of structural problems in the deck. With the proposed changed usage of land below the deck, for boulevard, parkland, recreational or commercial, there is a potential of damage and

deterioration being hidden behind new structures or landscaping works. As a result, it will be more important to replace the contaminated deck with a new deck meeting the current bridge code, before, or as part of the work of this option, but no later. Additionally, piers should be fully refaced and/or cathodically protected, and girders repaired and coated to ensure durability and proper performance over a period of at least 50 to 75 years. This is important as falling concrete debris and partial collapse of the structure could result in loss of property and serious personal injuries.



The Poor Condition of the Existing Gardiner Must Be Addressed.

The cost of deck replacement is significant but is not included in the cost estimates for this option as presented later in this report. It is currently considered to be a maintenance project to be included as part of the regular capital budget of the City.

4.2.2 Ramp Removal and Partial Reconstruction of Gardiner Main Deck

Other than the removal of some ramps required to provide room for the new Lake Shore and connecting road system, as proposed by the TWRC, works are required as follows:

1. Relocation of some ramps in order to create normalized urban intersections which balance vehicular access with pedestrian and cyclist access. This work, which is located primarily at major intersection/crossing areas, is also identified due to some ramps' interference with connections with major N-S streets, either because of lack of headroom, or as impedance to projected pedestrian flow. The following four (4) locations have been identified, as shown in the drawings enclosed in Appendix 3:
 - (i) Crossing #1 near Spadina Avenue: remove and reconstruct Spadina EB Off Ramp, approximately 200 m long, and rebuild WB On Ramp, approximately 350 m in length;
 - (ii) Crossing #2 near Simcoe Street: remove WB On Ramp and build new WB Off Ramp, 450 m long approximately;
 - (iii) Crossing #3 at Jarvis: remove and reconstruct WB On Ramp, 230 m long, approximately, and remove and reconstruct EB Off Ramp, 300 m long, approximately, remove EB On Ramp east of Jarvis Street; and
 - (iv) Crossing #4 at Sherbourne Street: remove and reconstruct WB Off Ramp, approximately 200 m long, and build new EB On Ramp, east of Shourborne Street, about 250 m in length.

As these are “limbs” of the main deck, construction will have more impact on the Lake Shore below than on the main deck, where one lane of traffic will likely be affected during construction of these works. During construction, the affected ramp will be closed. This can be constructed as part of the main deck replacement, or as standalone projects carried out consecutively to minimize disruption.

2. There will be problems in threading connecting roads in between the existing columns of the Expressway, as identified in the proposed plan at 6 locations shown on the drawing enclosed in Appendix 3. These crossings occur where Lake Shore Blvd is moved out from under the Expressway, where a low level “ramp-type” road would be required to connect N-S streets with the new Lake Shore, and where the new Lake Shore weaves across below the elevated Gardiner. Given the existing column arrangement, and the oblique angles these intersections would make with each other, the supporting structure and the deck of the entire section of the elevated Gardiner at these locations should be re-constructed so as to put the new piers and columns in line with the alignments of the connecting roads. Removal will include the deck, girders as well as the substructures up to approximately 1000 mm below ground level. The sections affected will be rebuilt with the substructure relocated at an appropriate location to suit the new access road alignments.



Some Ramps are Impediments to Accessing the Lake Front.

To achieve this, major traffic management issues would have to be addressed during construction both above and below the deck. There will also be permanent impacts to the traffic and layout of the “boulevard” created when Lake Shore is moved southwards. In the cost estimates calculated by MH, these works have been taken into consideration. A more detailed review will be required in subsequent design stages.

By slightly shifting of the position of the piers, the structure replacement, can be constructed in three (3) stages to reduce impact to traffic. Four (4) lanes of traffic would be maintained on the Gardiner deck at any one time, an approach which has been used for all previous main deck rehabilitation work. This could be done in conjunction with the deck replacement work, which MH considers a mandatory requirement for this option irrespective of other changes. Traffic on Lake Shore would be affected and reduced to two lanes in each direction, to make way for the work zones during the reconstruction of the piers.

The location and extent of the replacement proposed as described above is shown on the drawing attached to Appendix 1, and is listed as follows:

- (i) Lake Shore and Gardiner at Spadina Avenue (Crossing #1, as described above), 150 m.

- (ii) Gardiner/Lake Shore at Simcoe Street (Crossing #2, as described above), 300 m;
- (iii) Jarvis Street Crossing (Crossing #3, as described above), 150m;
- (iv) Sherbourne Street Crossing (Crossing #4, as described above), 120m;
- (v) Cherry Street Crossing (Crossing #5), 200m;
- (vi) Lake Shore with DVP Ramps (Crossing #6), 150m;

All dimensions are tentative for preliminary costing purposes, and should be refined in subsequent design stages.

Additionally these new “gates” into the city may provide opportunities for the City to install signature features to improve the aesthetics of the new lake front.

4.2.3 Interference Between Ramps and Construction Sequence

Specific attention should be paid to potential problems with ramp reconstruction. Some of the reconstructed ramps appear too short in length in relation to the existing height of the Expressway at the locations indicated. This implies that the slopes may be in excess of the allowable 6% and the ramp lengths may have to be increased. The length of the ramp should be established with maximum permitted grade and incorporation of vertical curves at the bottom and at the top, and to ensure proper sight distances and merge distances particularly for the on-ramps.

There are also concerns with dimensions and clearances of these new ramps, which may impact the final position and lengths of the ramps. One example is the new WB off ramp at Simcoe Street, having to cross both Simcoe Street and York Street, although the Expressway is at a relatively high level at this location.

These should be addressed in more detail in subsequent design stages.

The sequence of construction of the ramps should be reviewed. At some of the locations indicated, the removal of the existing ramp is necessary before the new ramp can be constructed, because of the interference between the existing and new works.

4.2.4 The New Don River Bridges

The new twin Lake Shore Bridges over the Don River would be low-level structures but have to be long enough to go over the entire flood plain as stipulated. There is no significant concern in both construction and staging of this work. The cost of this main structure is included in the estimate.

4.2.5 Properties

No property issue is identified for the structural works for this option.

4.2.6 Impacts to Services During Construction

Impacts to Essential Services, City Services, Construction access, and other environmental and social issue arising from the implementation of this scheme is expected to be similar, but perhaps to a lesser degree than the other options. Proper notifications and meetings will be necessary to ensure impact is kept to a minimum. Existing utilities will be affected and need to be identified and relocated in advance, or during the construction work of this option.

4.3 Geotechnical Comments

The foundations for the new structure at the bottom of the DVP may be impacted by the presence of deep buried bedrock valley and long driven piles will be required for both structures, and perhaps at the new Richmond Street/Eastern Avenue interchange structures.

The excavated soils in some parts of the alignment (particularly the fills, sands, and organics east of Strachan Avenue) may require disposal at licensed landfills.

4.4 Recommendations

MH suggests that the “Retain” Option is feasible provided the above-stated issues are addressed.

A drawing illustrating the propose layout is shown in Appendix 1 of this report.

5. THE “REMOVE” OPTION

5.1 Description of Option

A drawing showing the “Remove” Option is shown in Appendix 1 of this report. This approach of this Option is to take down the entire elevated structure of the Gardiner Expressway from the east end east of the Don River to Spadina Avenue. This will accomplish the Corporation’s intention to “open” up the lakefront by removing the elevated Gardiner that separates the lakefront from the downtown district of the City.

Morrison Hershfield has also reviewed an option called the “Full” Remove Option where the entire elevated Gardiner will be removed from DVP to Dufferin Street including the approach embankments west of the west abutment. In this report, this option is also called “Remove Option B”.

Two (2) plans are included in Appendix 1, one for each of the two removal schemes. The plan was prepared based on information provided by TWRC and incorporated provisions recommended by MH.



Gardiner Perceived as Barrier Between Downtown and the Waterfront.

The main features of the “Remove” Option are as follows:

- Demolish the existing elevated Gardiner from west of Spadina on the west to the east end including the two ramp connections with the DVP. For the Remove Option B, removal would extend to beyond the west abutment at Dufferin Street.
- Within approximately the same alignment of the Gardiner build the new Lake Shore as a wide divided 10-lane road, 5 lanes in each direction, with at grade intersections at major streets including Cherry Street, Parliament Street, Sherbourne Street, Jarvis Street, Yonge Street, Bay Street, York Street, Simcoe Street, and Rees Street.



Removal of the Gardiner Will Open Up the Entire Lake Shore Area.

- For the Full Remove Option, widening the Lake Shore to 10 lanes from Spadina Avenue to Bathurst Street, and to 8 lanes from Bathurst Street to the Jameson Avenue/Gardiner Interchange. Extend the 4-lane Fort York Boulevard in the Gardiner alignment to west of Strachan Avenue with connecting ramps to the

elevated section north of Exhibition Place, and reconstruct the Lake Shore bridges and ramps at the Jameson interchange.

- Upgrade Cherry Street as a major N-S through road, with a grade separated intersection with the new Lake Shore, perhaps via a tunnel, connecting Richmond Street to the upgrade Queens Quay. In fact, this corridor (the Cherry Street Bypass) is the topic of a separate study, but for the purpose of this study, MH will assume that the Cherry Street/Lake Shore intersection will be an at-grade intersection controlled by traffic signals.
- Construct two new bridges (low level) to carry the realigned Lake Shore over the realigned Don River, each 125 m long to span the entire flood plan, and two new ramps to connect with the DVP, one of which is an elevated ramp structure, approximately 210 m long.
- For the Remove Option, build new west connections with the remaining elevated Expressway west of Spadina Avenue via 2 new long ramps starting between Rees Street and Spadina Avenue. These ramps are approximately 780 m and 600 m long for the north and south structures, respectively, and are multi-span ramp structures bringing the at-grade new Lake Shore onto the elevated Gardiner west of Spadina Avenue. For the Remove Option B, these bridges are not required.
- Modify the Richmond Street/DVP Interchange, including the Eastern Avenue connections, similar to other Options.

5.2 MH Review and Recommendations

The Remove, or the Remove B options will have different impact on the connections with the Front Street Extension. However, this is not part of this assignment, nor will it significantly affect the cost estimates prepared for this study.

The Remove Options, when completed, will not provide the same number and type of lanes as provided by the current Gardiner/Lake Shore system. An analysis of the capacity of this system is being undertaken in a separate study.

The following are recommendations of MH for the “Remove” Option:

5.2.1 Traffic Management and Construction Staging

The staging of the demolition of existing Gardiner and constructing the new Lake Shore Boulevard, while maintaining traffic across the city lakefront is a major issue. The new Lake Shore Boulevard would follow more or less the alignment of the existing Gardiner. Closure and demolition of the existing expressway would be necessary before the new at grade alternative could be constructed in the same alignment. A proper construction sequence is required to minimize the impact, and additional lanes on Lake Shore, temporary roadways and detour roads will be required. However, some reduction of service would appear to be

unavoidable. The Front Street Extension, and the DVP that the Eastern Avenue interchange must be constructed in advance of the main Gardiner/Lake Shore work (as in other options).

Unlike other Options, this option does not have other relief road networks, such as the relocated Lake Shore for the “Retain” Option, or the Express Road for the “Replace Option. Unless a special detour route is provided, the staging to manage the traffic would be quite difficult. The following is one suggestion:

Stage 1: Pre-Building of Detours

Similar to the Replace Option, a temporary road and a detouring plan is essential to maintain as much E-W capacity as possible during the removal of the elevated Gardiner. This may include:

1. The Bremner Boulevard Detour, similar to the Replace Option, which connects to Lake Shore Boulevard east of York Street at the east, and to Fort York Boulevard at Bathurst Street on the west. This would relieve the congestion at the potentially worst section between Spadina Avenue and York Street, where no other relief roads, as described below, can be built.
2. East of York, pre-build the section of the new Lake Shore outside the shadow of the elevated Gardiner. This will include the 5 lane EB section all the way to DVP, though at some sections, particularly between Jarvis Street and Cherry Street, some southward expansion of the proposed road may be necessary to build all the lanes. Some property issues may have to be addressed.
3. From York west to Spadina, the new Lake Shore EB lanes could continue by removing the York-Bay-Yonge EB Off Ramps and using the on-grade footprint of this ramp to pre-build part of the new Lake Shore.
4. Build new lanes along the north edge of the Gardiner from Simcoe Street to west of Spadina Avenue after removal of the Spadina Avenue WB on and off ramps.
5. Use part of the new Queens Quay extension east of Sherbourne Street to east of Cherry Street to temporarily carry eastbound Lake Shore.



The Yonge/York/Bay Ramp and Bremner Boulevard Area.

The goal of all these pre-building works is to ensure that a similar number of lanes can be provided during the removal of the elevated Gardiner.

5.2.2 Demolition Staging

The following proposed sequence will be able to minimize the impact of the work, as it would be extremely difficult to work safely for a “double-deck” highway situation like the Gardiner/Lake Shore system. The proposal relies on the provision of the capacity from the pre-built works.

(i) Tackle the most difficult section first – the Spadina Avenue to Jarvis Street section.

(ii) Optimize signalization and traffic flow on surrounding routes between Queens Quay and College Street and Jameson Avenue and Coxwell Avenue. Prepare designated detours around the Spadina-Jarvis area, including the use of temporary Lake Shore lanes and Queens Quay.



View of Spadina Avenue.

(iii) Channelize EB Gardiner traffic to exit onto Lake Shore Boulevard at Spadina Avenue, York /Bay and Jarvis Street. Close the EB Rees Street and Bay Street on-ramps. The EB Jarvis Street on-ramp can remain open. It is noted that FSE and the DVP/Richmond Street Interchange components will be operational at this time.

(iv) Channelize WB Gardiner traffic to exit on to Lake Shore Boulevard, Sherbourne Street and Yonge Street. Close the WB Jarvis Street on-ramp. The WB York Street and Spadina Avenue on-ramps can remain open. Also, it is noted that FSE will be operational at this time.

(v) Stage the closure of WB Lake Shore Boulevard between Jarvis Street to York Street, Rees Street, Spadina Avenue keeping the intervening north-south intersections open, but controlled, through the dismantling.

(vi) Close the elevated Gardiner in both directions between Jarvis Street and York Street. This is the full extent of the pre-cast box girder section.

(vii) Commence dismantling the deck from east to west beginning at Jarvis Street.

(viii) As deck removal progresses westward the EB Jarvis Street off ramp will be closed and as removal approaches Simcoe Street the WB York Street on ramp will also be closed.

(ix) As the deck removal progresses the bents and columns can be demolished to ground level progressively and street lighting installed as a follow up.

- (x) Staging for proposed construction work in the Spadina-Jarvis sector at Lake Shore should be implemented at this point.
- (xi) At this point in the dismantling work, the main deck and some ramps between Rees and Jarvis would be gone. Some traffic capacity on the remainder of the Gardiner can be maintained on ramps, as follows:
 - East of Jarvis Street, WB Gardiner traffic exits at Sherbourne Street and Yonge Street. EB Gardiner traffic enters at Jarvis Street.
 - West of Rees Street, WB Gardiner traffic enters at Spadina Avenue, EB Gardiner traffic exits at Spadina Avenue and York/Bay.
- (xii) The Lake Shore corridor between Rees and Jarvis could now be fully opened. The elevated expressway in this confined section is now removed along with the Jarvis WB on-ramp, WB Yonge/York on-ramp, EB Rees on-ramp, EB Jarvis off-ramp, EB Bay on-ramp. The EB York/Bay off-ramp or part of the ramp, can be maintained as long as is necessary to alleviate traffic congestion before being dismantled to make way for the eastbound at-grade arterial.

The connections to the Bremner Boulevard Detour are now fully accessible and operational. This will be important for the next stage of removal towards the 2 ends of the elevated Gardiner. With the Bremner Boulevard Detour and the completed Lake Shore and Queens Quay outside the Gardiner shadow, as built previously, the reduction in capacity could be reduced to a minimum.

- (xiii) With the removal of the EB Yonge/York/Bay off-ramp, the remaining elevated expressway from Spadina Avenue to Rees Street can be dismantled. This can be staged in half and half demolition where 3-legged bent configurations permit. Please see ensuing paragraphs for these works.

5.2.3 Connecting Bridges

As for the construction of the structures and connecting ramps at the west end (west of Spadina) for the Remove Option (not required for the Removal Option B), the staging of the construction would be by using a “half and half” method. As described above, the west ramps are long ramps and separate structures, and staging could follow a similar scheme used when the City demolishes the east end of the Gardiner. This has to be carried out carefully in order to maintain traffic using the remaining parts of the existing Gardiner. At this time, demolition would have been completed for the central portion of the viaduct, and the method of routing of EB and WB traffic onto a single ramp crossing the median should be developed carefully in subsequent design stages.

During demolition of the two DVP ramps, each of the ramps can be built independently, thereby maintaining two way connecting traffic on one ramp. This has been described in the “Replace Option” and will not be reiterated here.

For the construction of the new Don River structures at the east end, the alignment of the Don Overpasses as well as the Lake Shore can be slightly adjusted to provide some temporary detours. Therefore these structures can be built without much difficulty. It would be prudent to pre-build some substructure work wherever feasible prior to the realigning of the Don, which would speed up the subsequent deck work and reduce the duration of potential disruption of traffic at this complicated location.

A small retaining wall will likely be required between the high level ramp and the at grade ramp due to the proximity of the structures and the significant difference in elevations of these bridges. Its position is shown on the drawing enclosed in Appendix 1.

5.2.4 Other Construction

This includes the following:

1. The re-construction of the Eastern/Richmond/DVP Interchange will involve new bridge construction and modification of existing bridges, but conventional construction methods can be adopted to build the work. It is expected that one of these bridges would have to be closed during construction in turn, with some minor disruptions to the traffic.
2. The existing deck of the elevated Expressway from Bathurst Street to Dufferin Street which is to remain, for the Remove Option only, is in very poor condition and heavily contaminated, as discussed in the “Retain” Option. This problem should be addressed as part of this project to provide a new deck for this section of the Gardiner. For this cost estimate, this would be done as a separate rehabilitation project out of the City’s capital budgets.

5.2.5 Properties

Some properties will be required to carry out the work, along the south side of the existing Lake Shore Boulevard. Costs for property acquisition is not included in this estimate.

5.2.6 Other Considerations

Impacts to essential services, City services, construction access, tourism, sports and entertainment facilities, noise and dust problems, and public relations requirements, will be the same as that for other options.

5.3 Geotechnical Comments

The “Remove” Option will involve new structures at both east and west ends, excavation and temporary supports, as described in the above paragraphs.

There are variable extensive fill materials present in some portions of the site – these fills can contain significant rubble and previous shoreline structures which will present difficulties for

caisson or soldier pile installation and/or excavations. In addition, there is potential for significant water inflow to excavations made through these fills as well as the sands/silts (present also at some locations in the eastern portion of the study area) unless groundwater control measures are implemented.

The presence of a deep buried bedrock valley at the eastern study limits near the Don Valley Parkway will require the use of long driven piles for bridges proposed in this area.

The excavated soils in some parts of the alignment (particularly the fills, sands, and organics east of Strachan Avenue) may require disposal at licensed landfills.

5.4 Recommendations

MH suggests that the “Remove” Option and the “Remove Option B” are both feasible provided the above-stated issues are addressed.

Drawings illustrating the proposed layouts are shown in Appendix 1 of this report.

6. COST ESTIMATES

6.1 General

As part of the scope of this assignment, Morrison Hershfield conducted an independent exercise to evaluate the preliminary cost of each of the 3 Options identified by TWRC as described above. MH received information on cost estimates developed by Marshall Macklin Monaghan on the replacement option but has carried out the estimate based on a different approach in order to provide a comprehensive check.

The procedure of the estimation used, for each option, is as follows:

1. Determine scope of work involved and limits of estimation. Divide the limits into sections/zones for easy reference. Station 10+000 was assigned at the west portal as a reference point.
2. Identify and include all elements identified, including those not thoroughly discussed in the above chapters but perceived as necessary for the work.
3. Determine unit rates for typical elements, for acceptable scale of accuracies. For this exercise, unit rates such as cost per square metre of bridge deck, per metre length of twin tunnels, and the like, will be used. The following elements are covered:
 - Roadwork;
 - Structural Work;
 - Signals;
 - Tunnels;
 - Demolition; and
 - Others (Miscellaneous, including all staging and temporary for demolition and temporary supports).
4. Take off quantities for each element located within the limits of work.
5. Apply unit rate and extend all items to arrive at total estimate of actual work identified.
6. Apply percentage for contingencies and unforeseen expenses. The percentage adopted for these purposes is 30%.
7. Apply percentage to cover engineering, other soft costs such as utility diversions and permits, and taxes. The percentage adopted for these purposes is 32%.
8. Round up the estimate to the nearest \$millions.

6.2 Cost Estimates

The following are cost estimates derived by MH including all mark-up percentages, for the items of work identified and located within the limits prescribed. The breakdown of the estimates can be found in Appendix 7.

1a. Replace Option (Cut and Cover Tunnel)	\$1,395 Million
1b. Replace Option (Bored Tunnels under Fort York, 1.2km)	\$1,476 Million
2. Retain Option	\$415 Million
3a. Remove Option (Partial Remove)	\$437 Million
3b. Remove Option B (Full Remove)	\$457 Million

As discussed above, the following costs have not been included:

1. Properties
2. Hard and Soft Landscaping
3. Portal and Bridge Enhancement
4. Architectural Enhancement of the Retain Option
5. Life Cycle, Maintenance, and Operating Costs

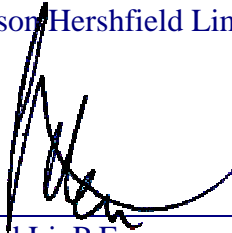
7. CONCLUSIONS

This report and its appendices summarize findings of Morrison Hershfield conducted on the three options to address the future of the Gardiner Expressway/Lake Shore Boulevard located at the lake front of the City of Toronto. The structural feasibility of all structures identified has been analyzed. The methods of construction of each of the three options have been reviewed including proposed methods to overcome or mitigate problems identified.

This report does not discuss merits of an individual option, nor criteria for selection of the most suitable option to be further developed.

It is concluded that, subject to additional work being undertaken as recommended, all three options are feasible each with various impacts on the traffic flow along this corridor. Although reductions in traffic service appear inevitable during the construction, it can be kept to a minimum by the proposed actions. Recognizing that this is a feasibility study, more study is required during subsequent design stages to review the problems more specifically to properly dimension and evaluate the works. Additionally many structural modification works should be subject to accurate dimensioning of stages, foundation conditions, extent of shoring and temporary protections, and the like.

Morrison Hershfield Limited



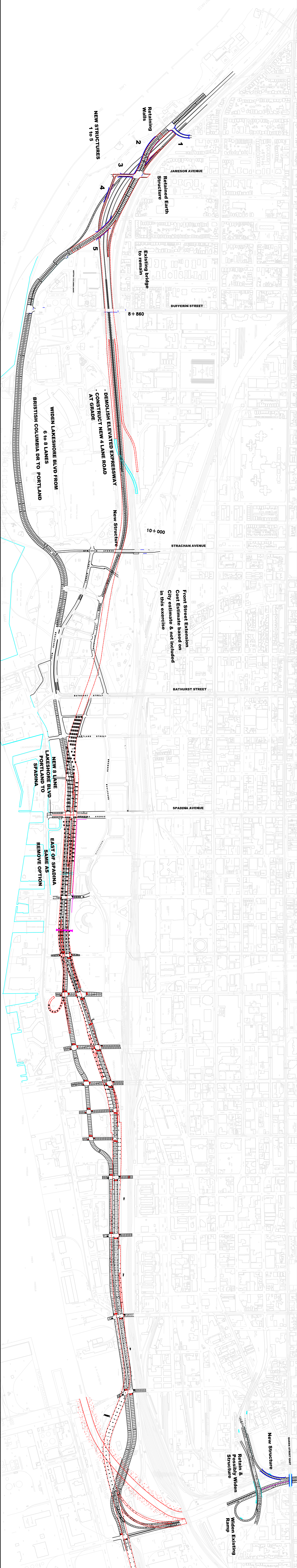
Edward Li, P.Eng.
Principal, Project Manager

8. APPENDICES

Appendix 1	Plans indicating each of the 3 Options, including proposed work by MH
Appendix 2:	Sketches Relating to Constructability Issues for the Replace Options
Appendix 3:	Sketches Relating to Constructability Issues for the Retain Option
Appendix 4:	Sketches Relating to Constructability Issues for the Remove Options
Appendix 5:	Typical Sections and Information provided by TWRC
Appendix 6:	Minutes of Review Meetings
Appendix 7:	Cost Estimates and Breakdowns
Appendix 8:	Subsurface Data Compilation, Lakefront Corridor, Golder Associates, December, 2000

APPENDIX 1

**Plans Indicating Each of the 3 Options
Including Proposed Work By MH**

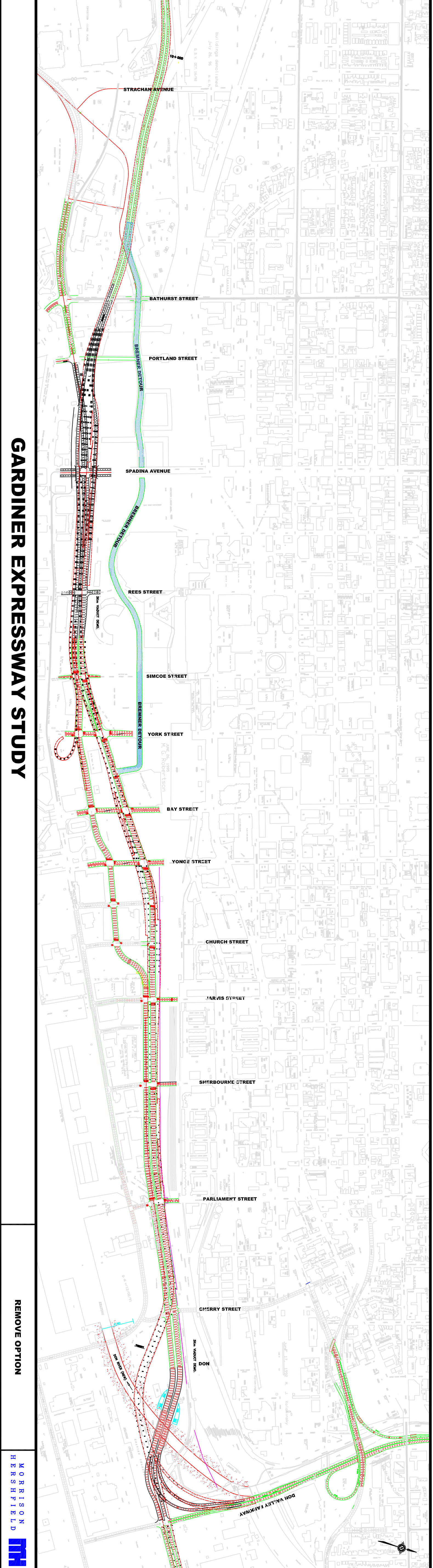


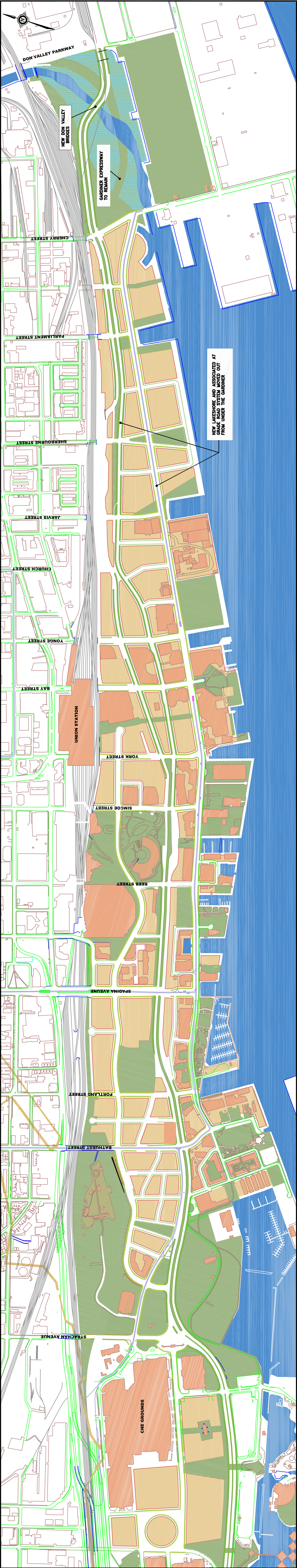
GARDINER EXPRESSWAY STUDY

FULL REMOVE OPTION

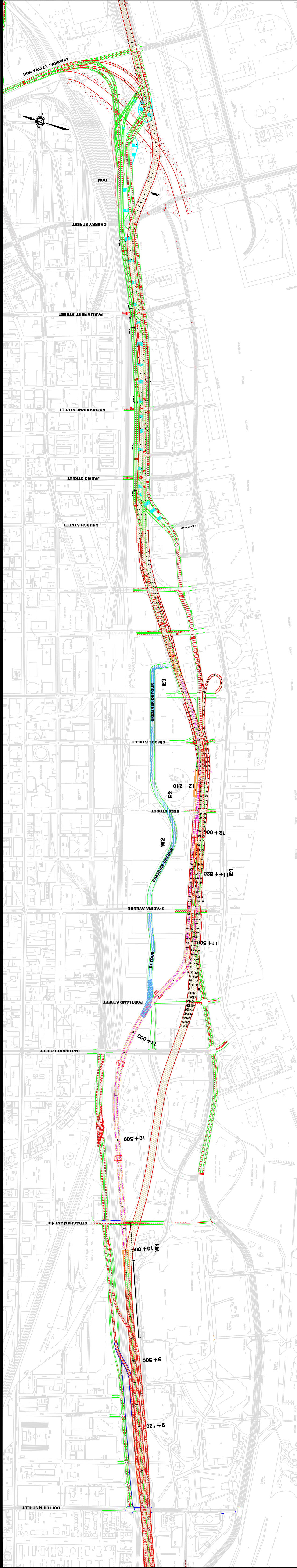
GARDINER EXPRESSWAY STUDY

REMOVE OPTION





GARDINER EXPRESSWAY STUDY

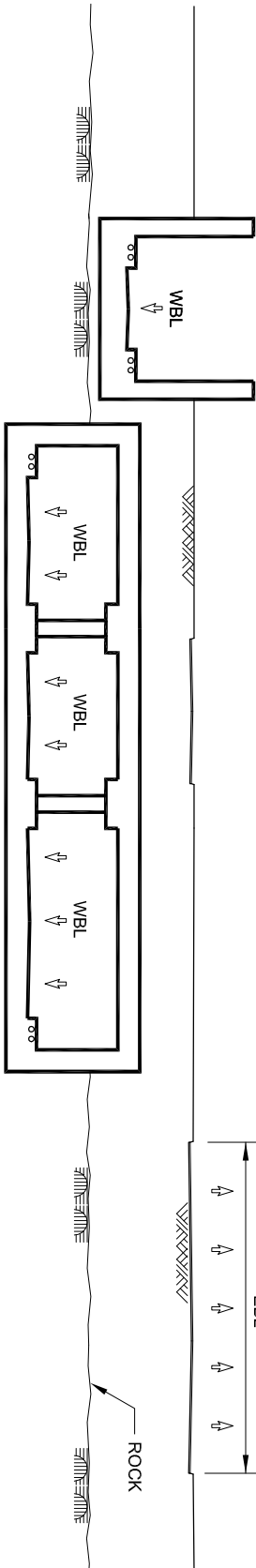


GARDINER EXPRESSWAY STUDY

APPENDIX 2

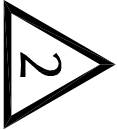
**Sketches Relating to Constructability Issues
For the Replace Options**

NORTH



SOUTH

CROSS-SECTION AT REES AVENUE



GARDINER EXPRESSWAY STUDY FOR TWRC - "REPLACE" OPTION
TYPICAL CROSS-SECTION - WEST TUNNEL AT YORK ST.

MORRISON
HERSHFIELD

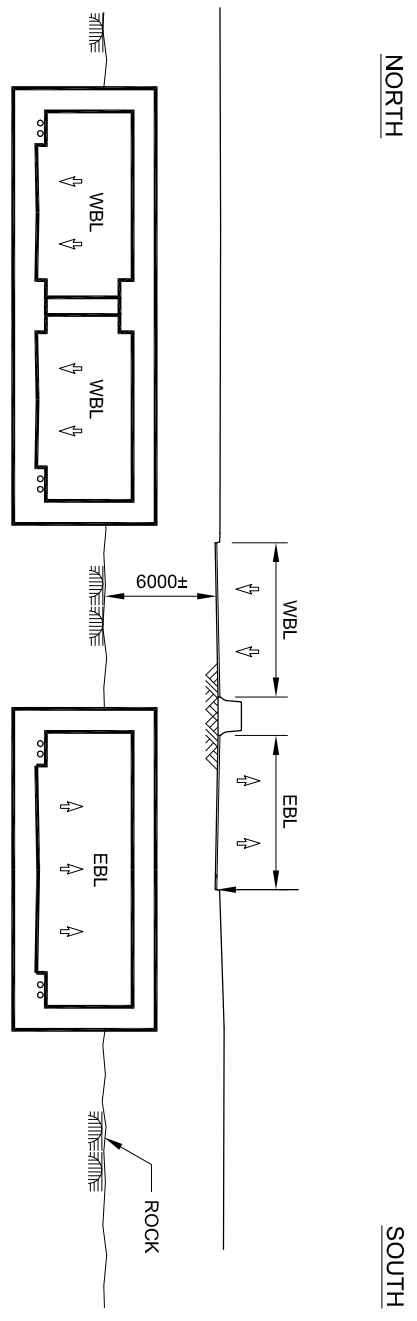
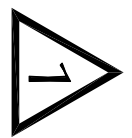


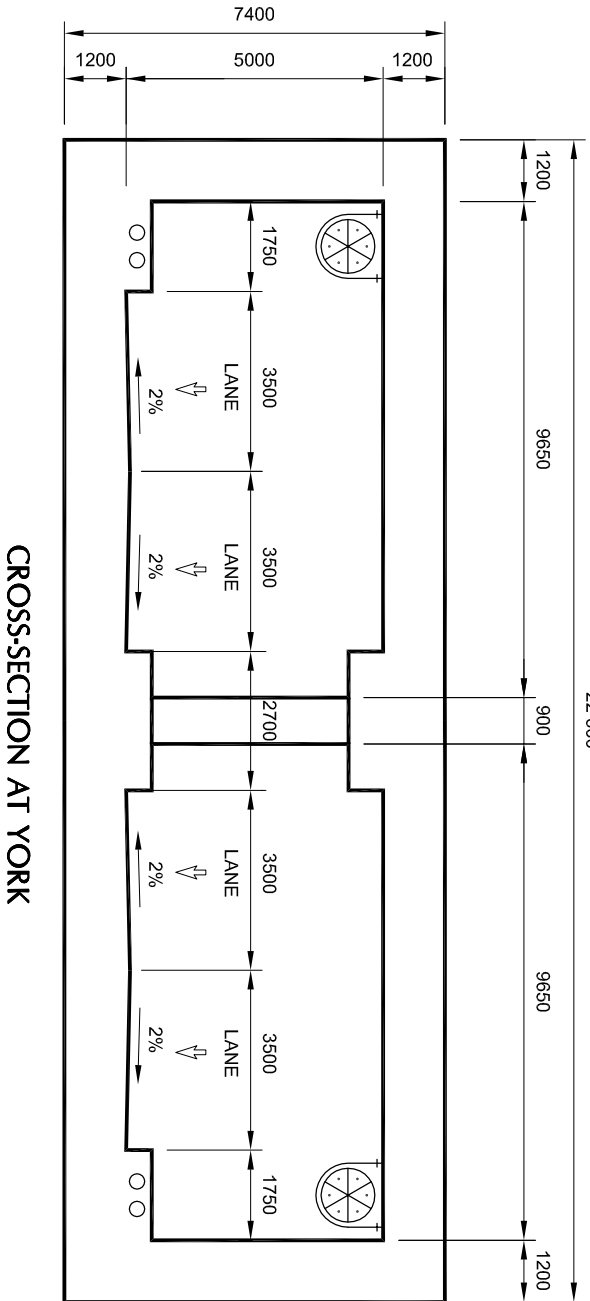
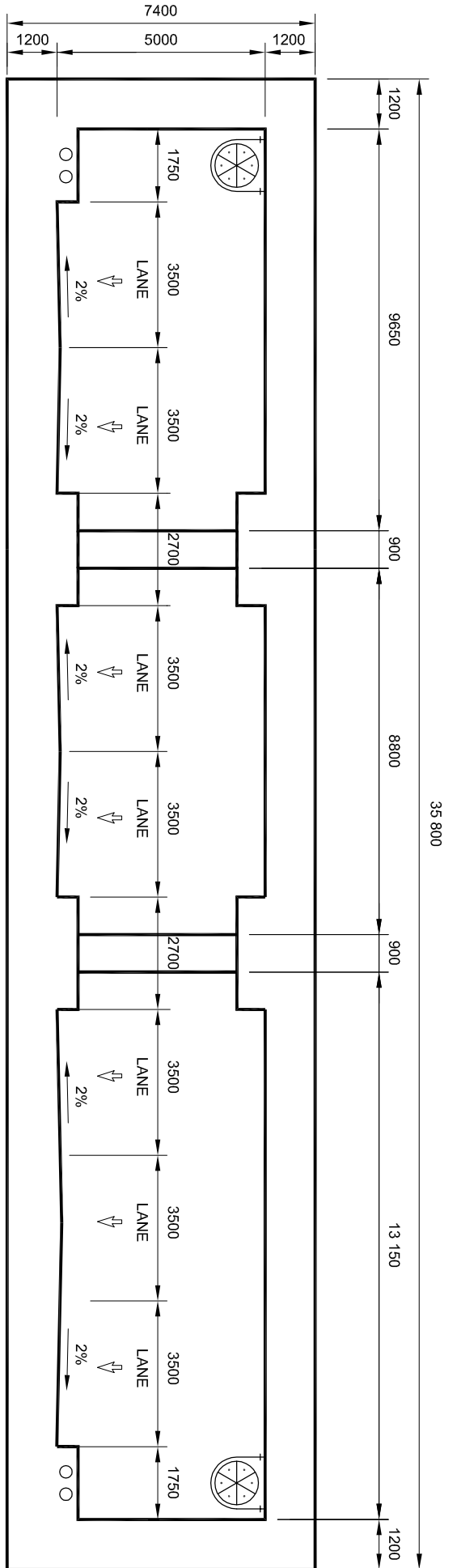
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FIG. 5

GARDINER EXPRESSWAY STUDY FOR TWRC - "REPLACE" OPTION
TYPICAL CROSS-SECTION - WEST TUNNEL AT SPADINA

CROSS-SECTION AT SPADINA AVENUE





GARDINER EXPRESSWAY STUDY FOR TWRC - "REPLACE" OPTION
TUNNEL CROSS-SECTIONS - AT DOWNTOWN CORE

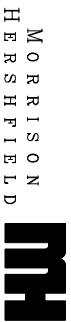
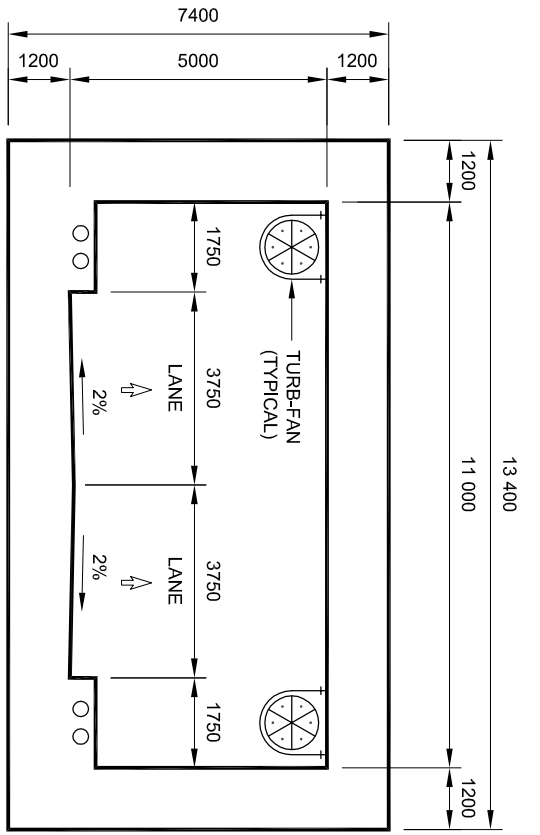
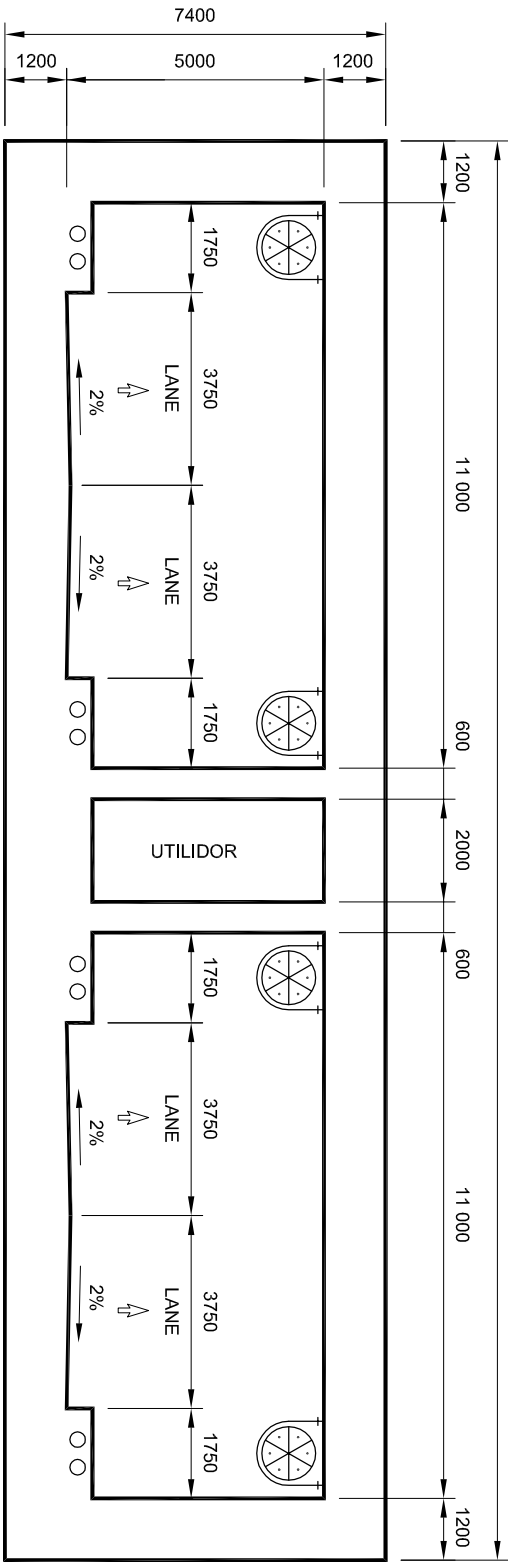


FIG. 3

DRAWING No.:



TYPICAL CROSS-SECTION - SINGLE TUNNEL CONFIG.



TYPICAL CROSS-SECTION - TWIN TUNNEL CONFIG.

GARDINER EXPRESSWAY STUDY FOR TWRC - "REPLACE" OPTION

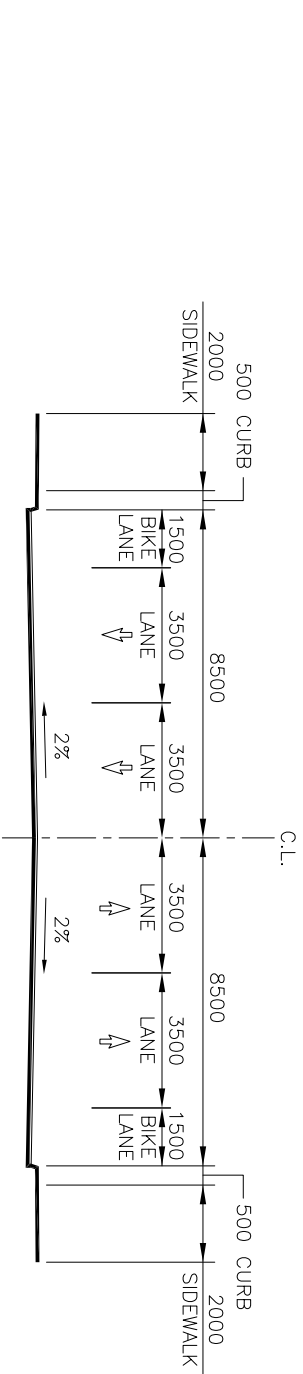
TYPICAL TUNNEL CROSS-SECTIONS - WEST OF SPADINA

MORRISON
HERSHFIELD

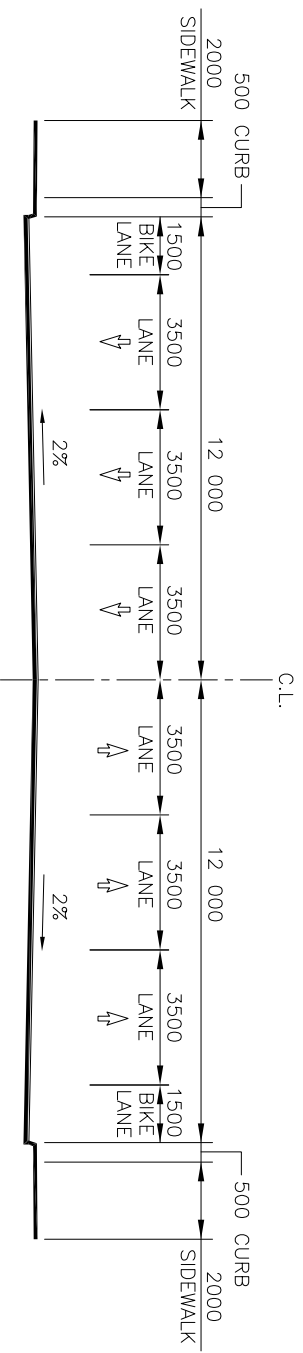


DRAWING No.:

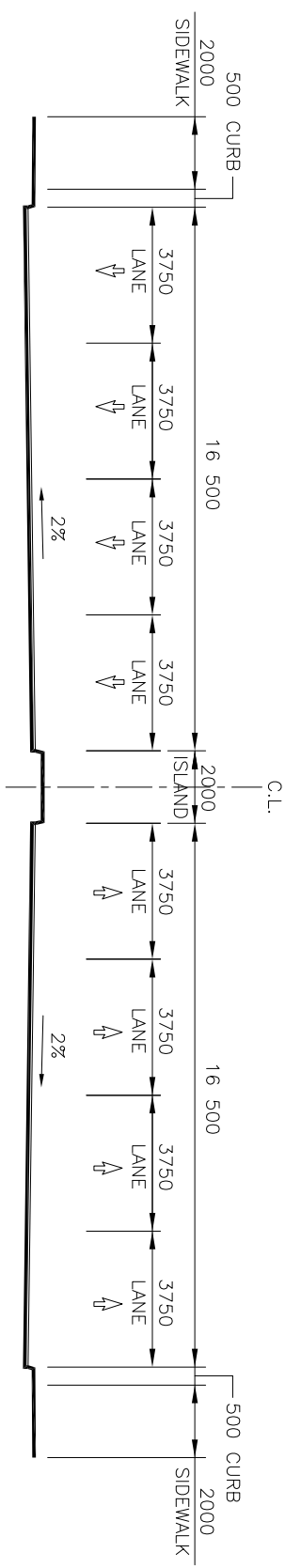
FIG. 2



2-LANE EACH WAY



3-LANE EACH WAY



4-LANE EACH WAY

GARDINER EXPRESSWAY STUDY FOR TWRC

TYPICAL ROAD CROSS-SECTIONS

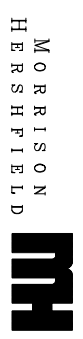
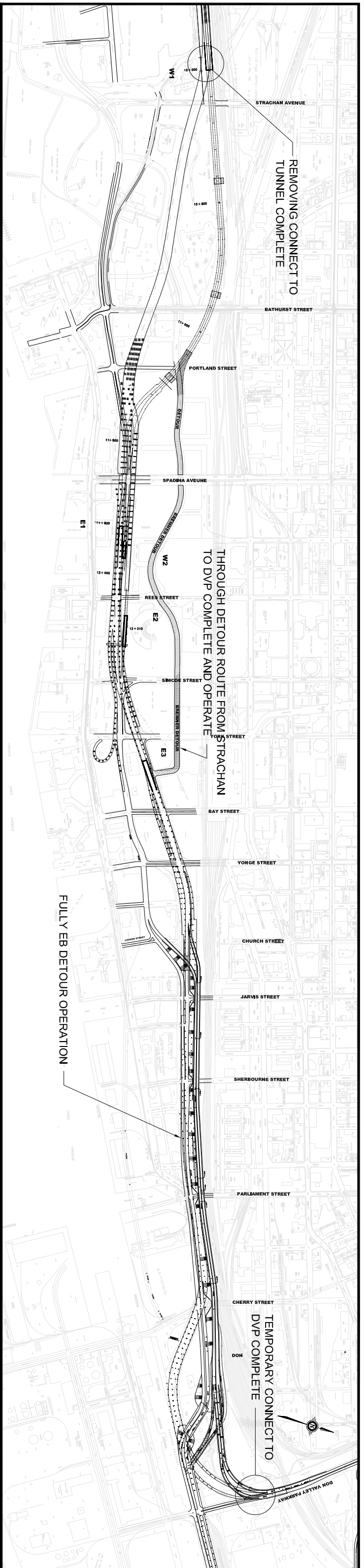


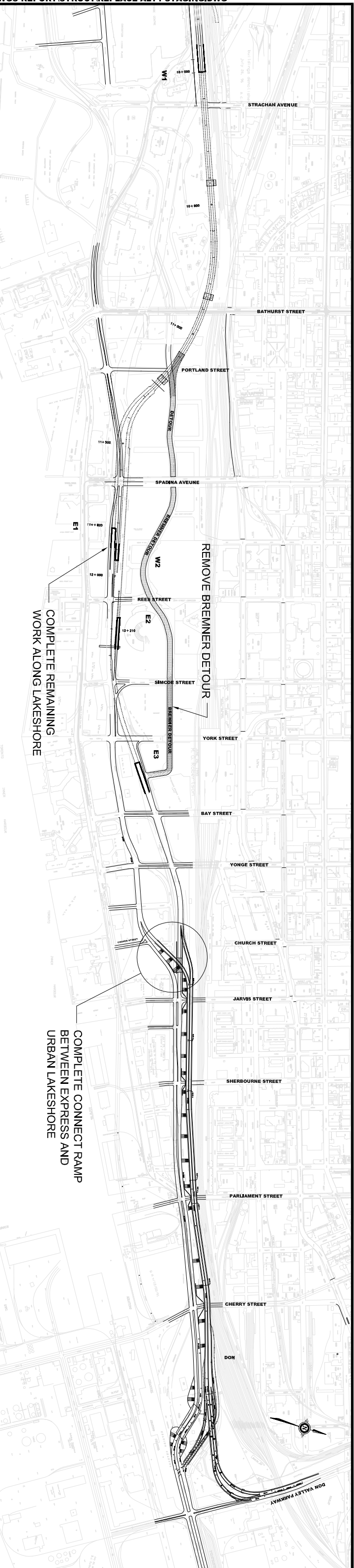
FIG. 1

DRAWING No.:



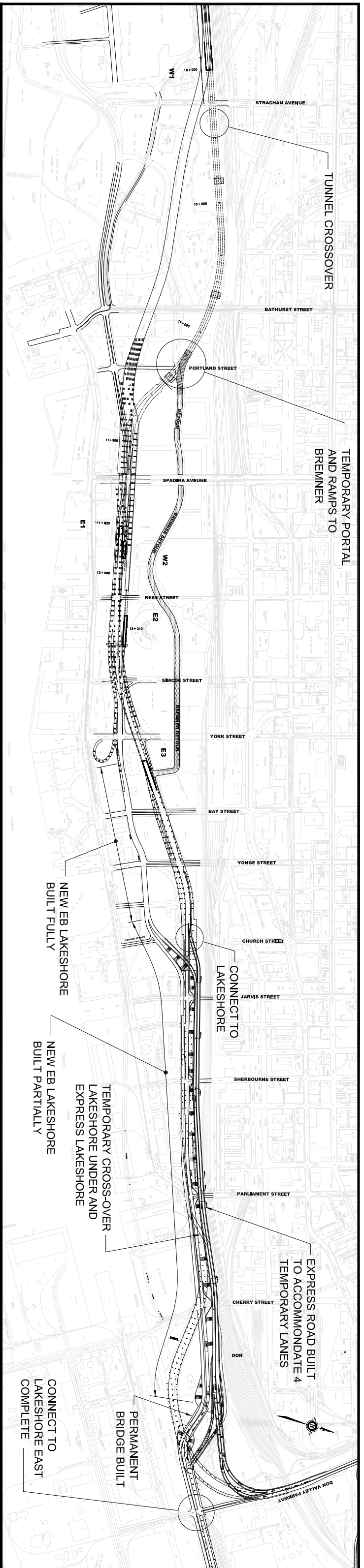
STAGE 3 - REMOVAL OF THE GARDINER EXPRESSWAY

REPLACE OPTION - ALTERNATE 1



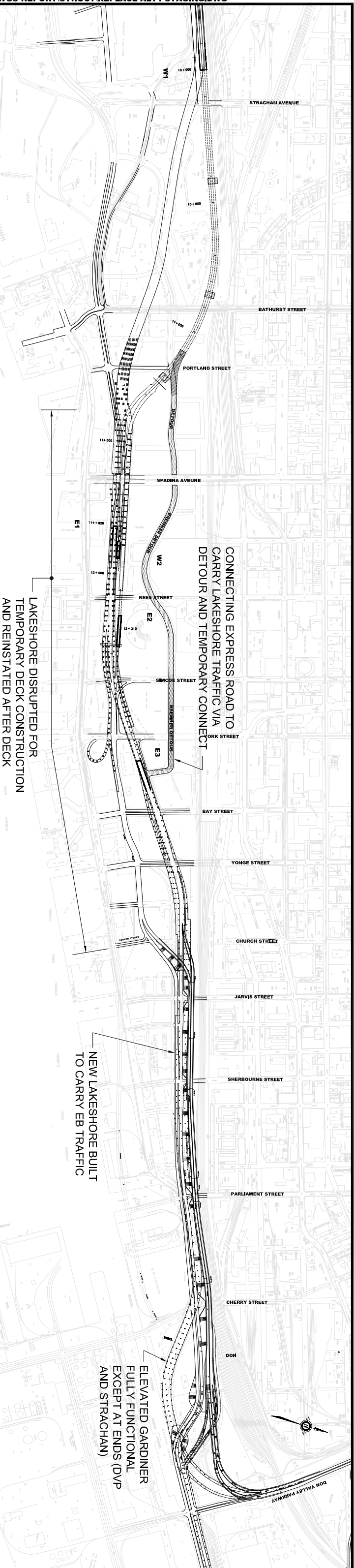
STAGE 4 - COMPLETION WORKS

REPLACE OPTION - ALTERNATE 1



STAGE 1 - PRE-BUILDING STAGE

REPLACE OPTION - ALTERNATE 1

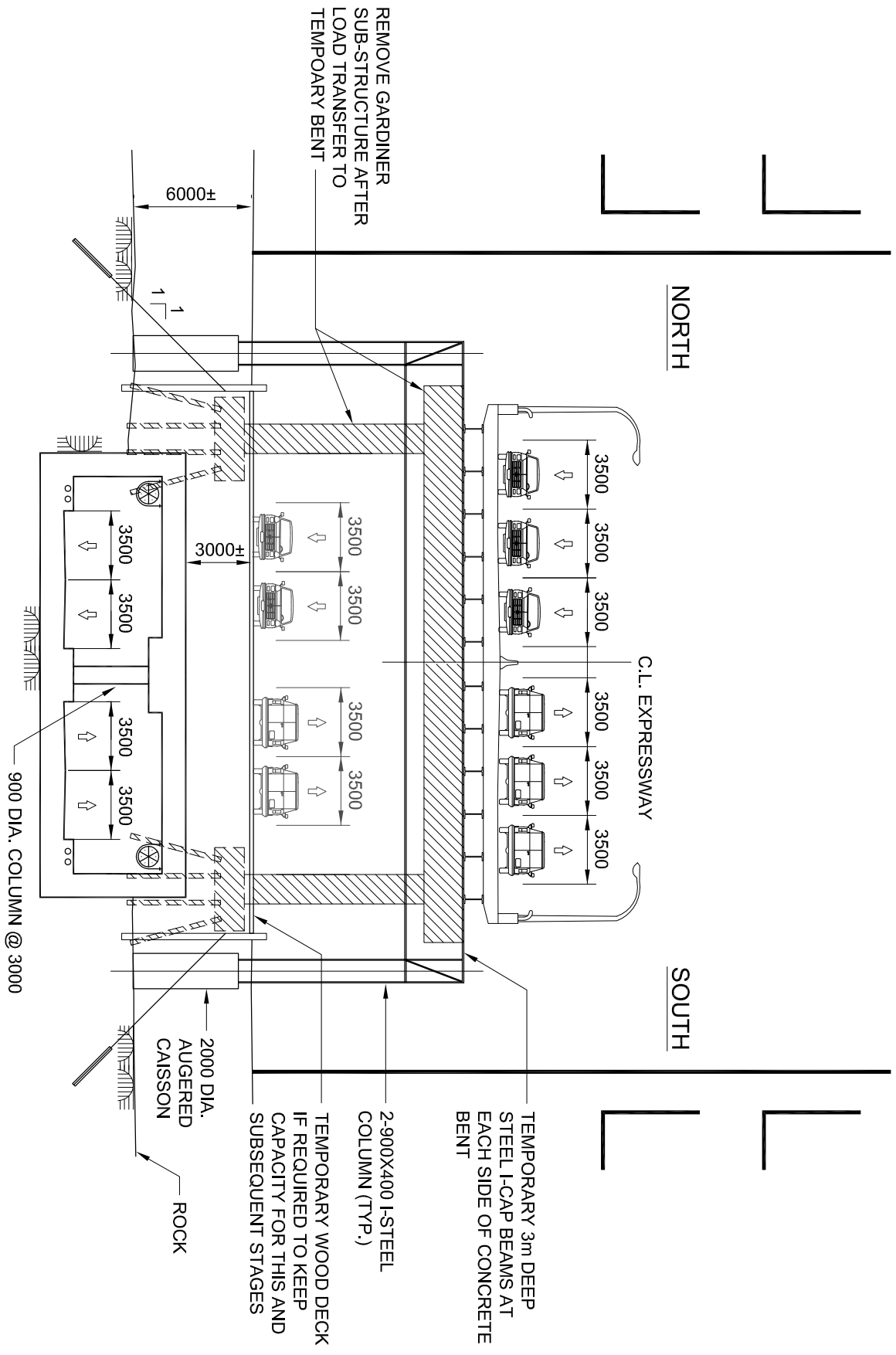


STAGE 2 - COMPLETION OF WEST TUNNEL

REPLACE OPTION - ALTERNATE 1



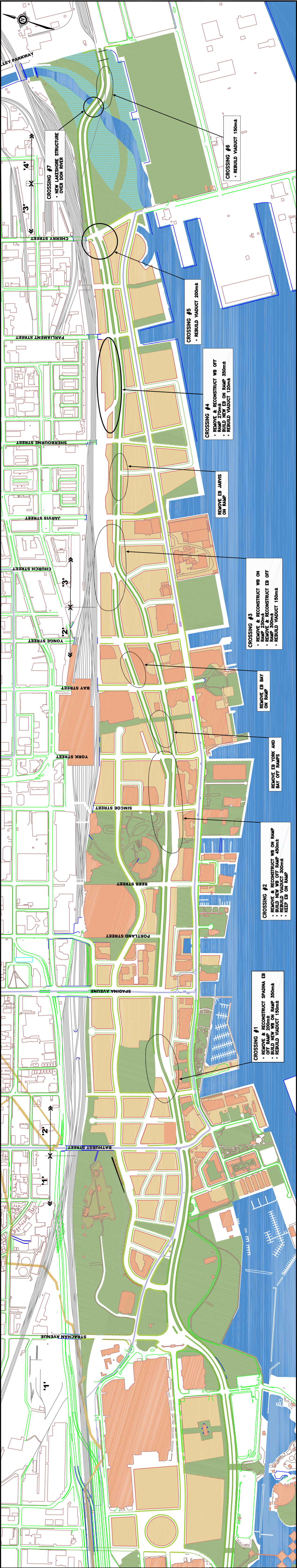
GARDINER EXPRESSWAY STUDY FOR TWRC - "REPLACE" OPTION
TYPICAL CROSS-SECTION
GARDINER TEMPORARY SUPPORT AND WEST TUNNEL CONSTRUCTION



DRAWING No.:

APPENDIX 3

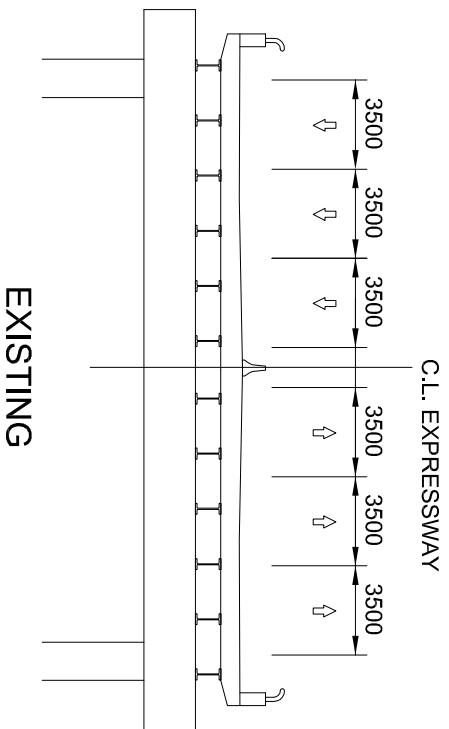
**Sketches Related to Constructability Issues
For the Retain Option**



GARDINER EXPRESSWAY STUDY

NORTH

SOUTH

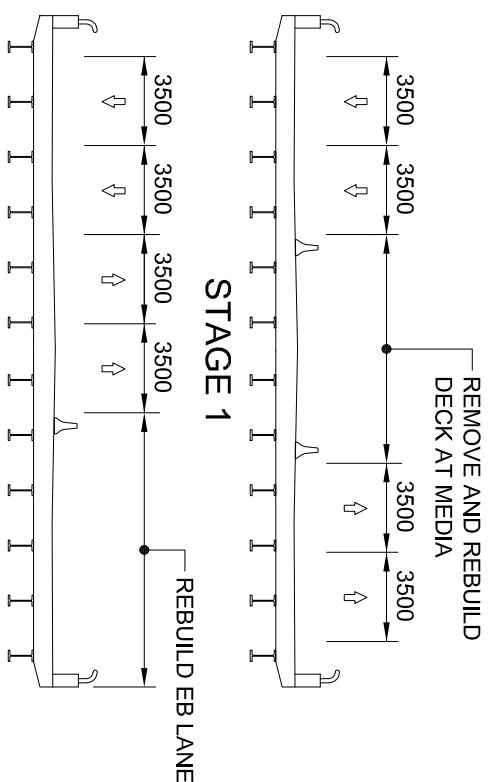


C.L. EXPRESSWAY

EXISTING

NORTH

SOUTH

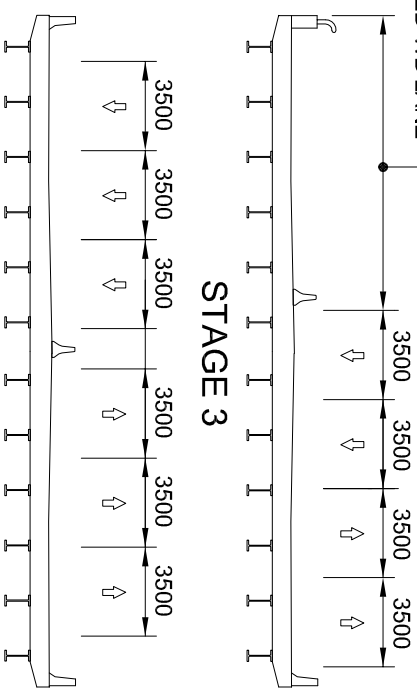


STAGE 1

REBUILD EB LANE

STAGE 2

REBUILD WB LANE



STAGE 3

FINAL

DECK REPLACEMENT

BUILT NEW PIER AND
 REMOVE EXISTING PIER
 WHILE SUPPORTING NEW DECK

GARDINER EXPRESSWAY STUDY FOR TWRC - "RETAIN" OPTION

METHOD OF DECK REPLACEMENT

MORRISON
 HERSHFIELD

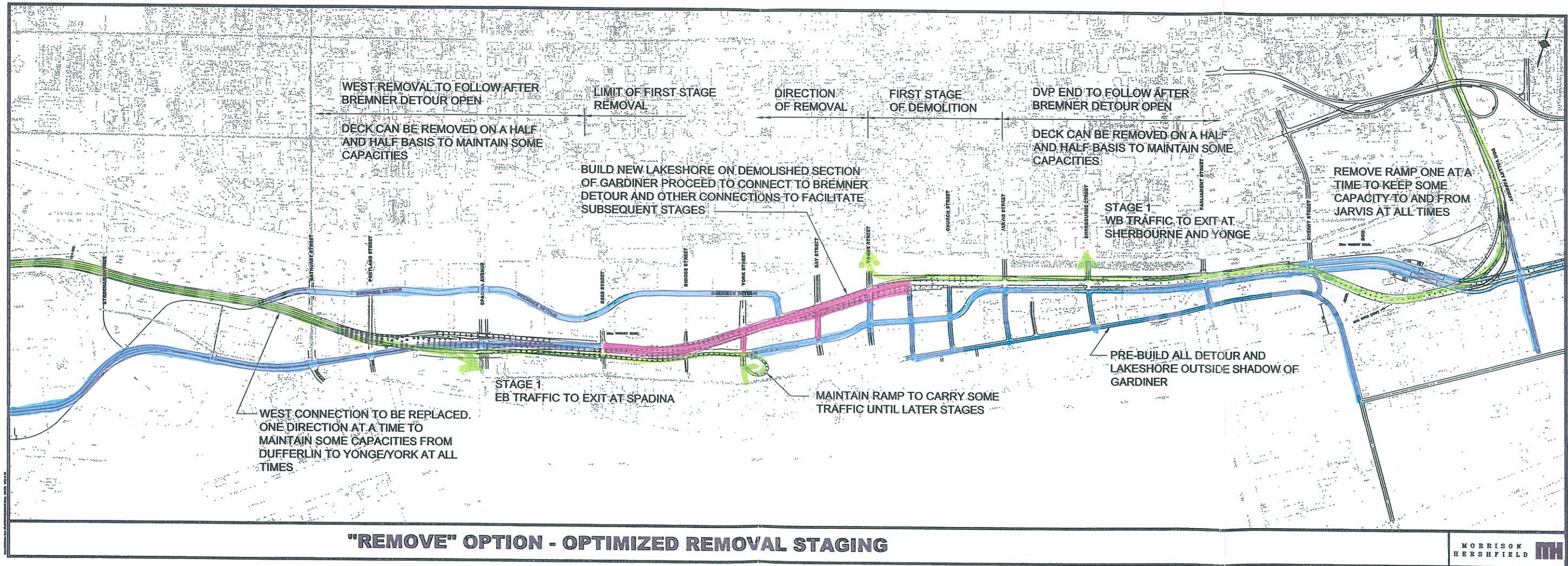


DRAWING No.:

FIG. 8

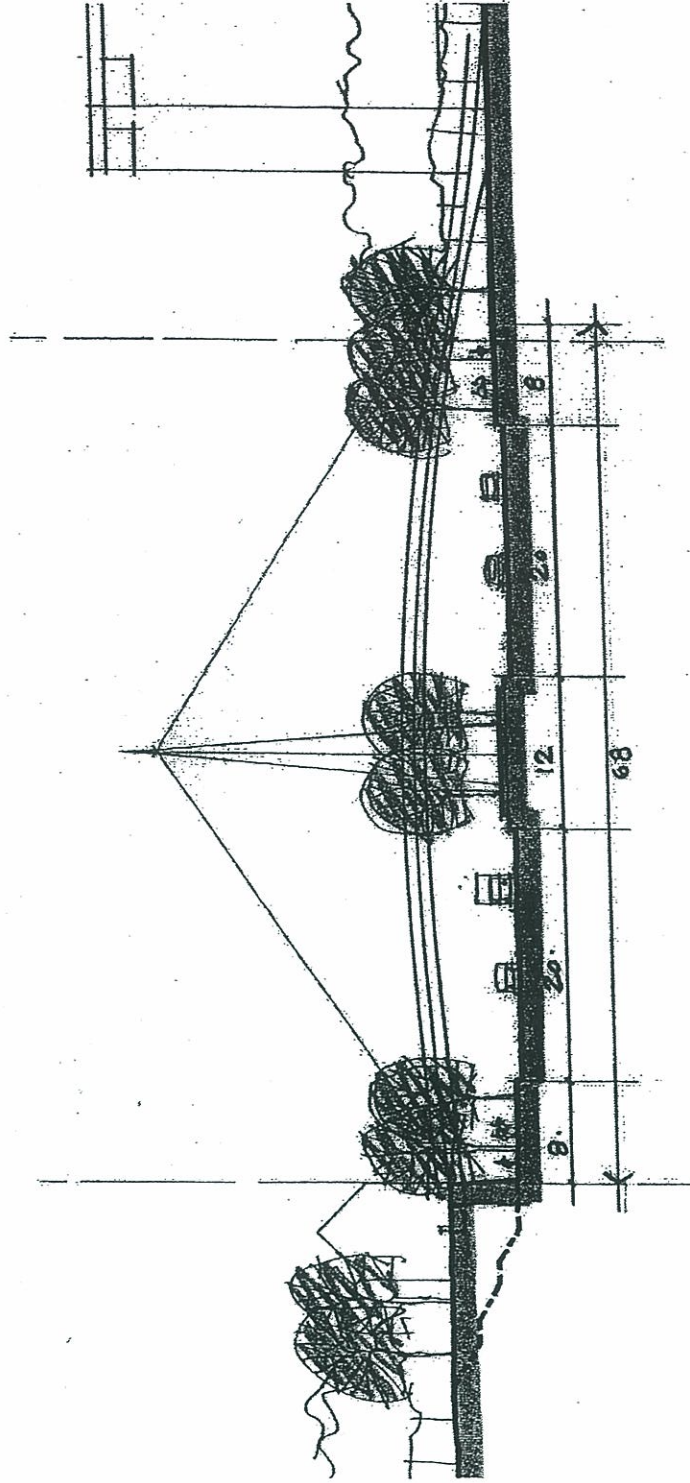
APPENDIX 4

**Sketches Relating to Constructability Issues
For the Remove Options**



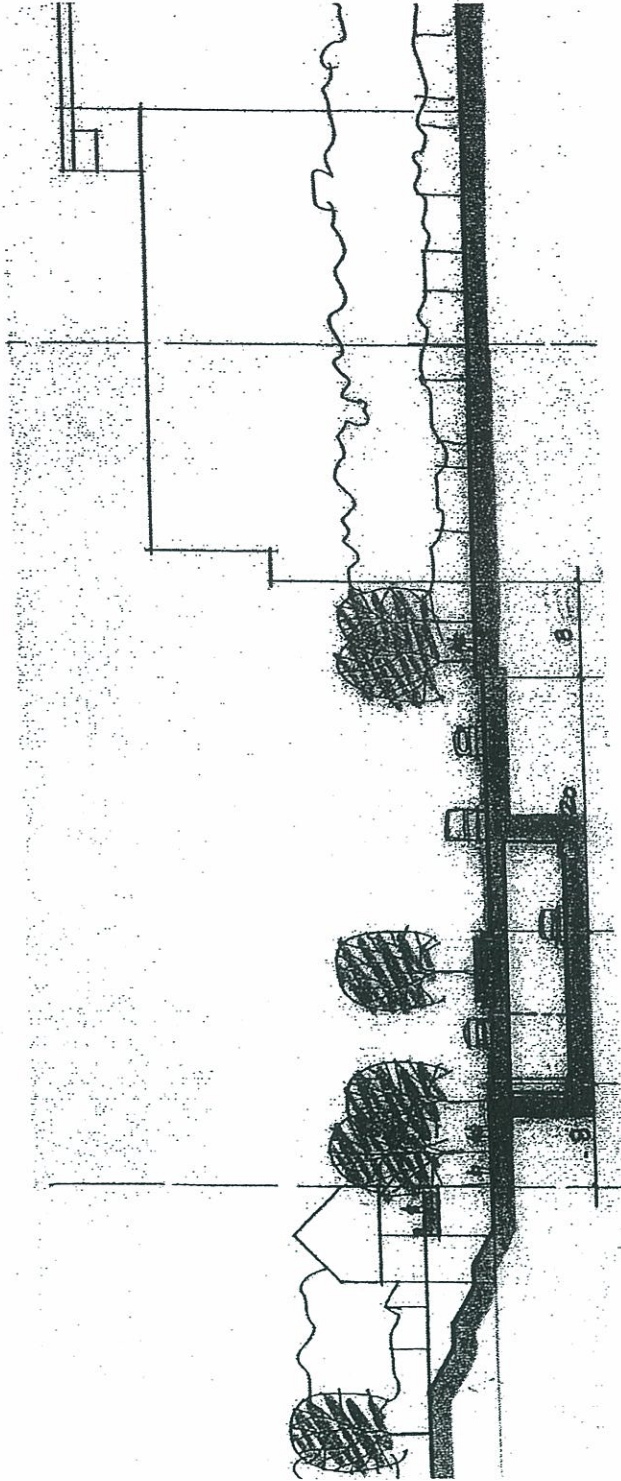
APPENDIX 5

**Typical Sections and Information
Provided by TWRC**



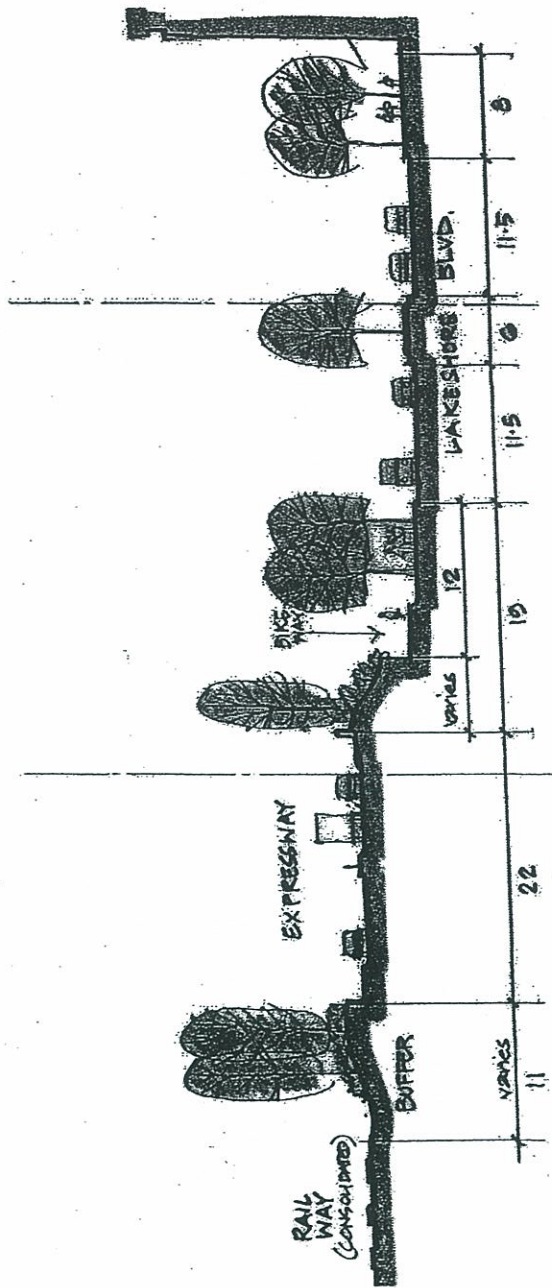
GARDINER/LAKESHORE CORRIDOR RECONFIGURATION
 du Tolt Allisopp - Hillier - Marshall Macklin Monaghan B.A. Consulting
 August 15, 2002

TYPICAL SECTION - SPADINA TO SIMCOE
 OPTION 6 - BOULEVARD



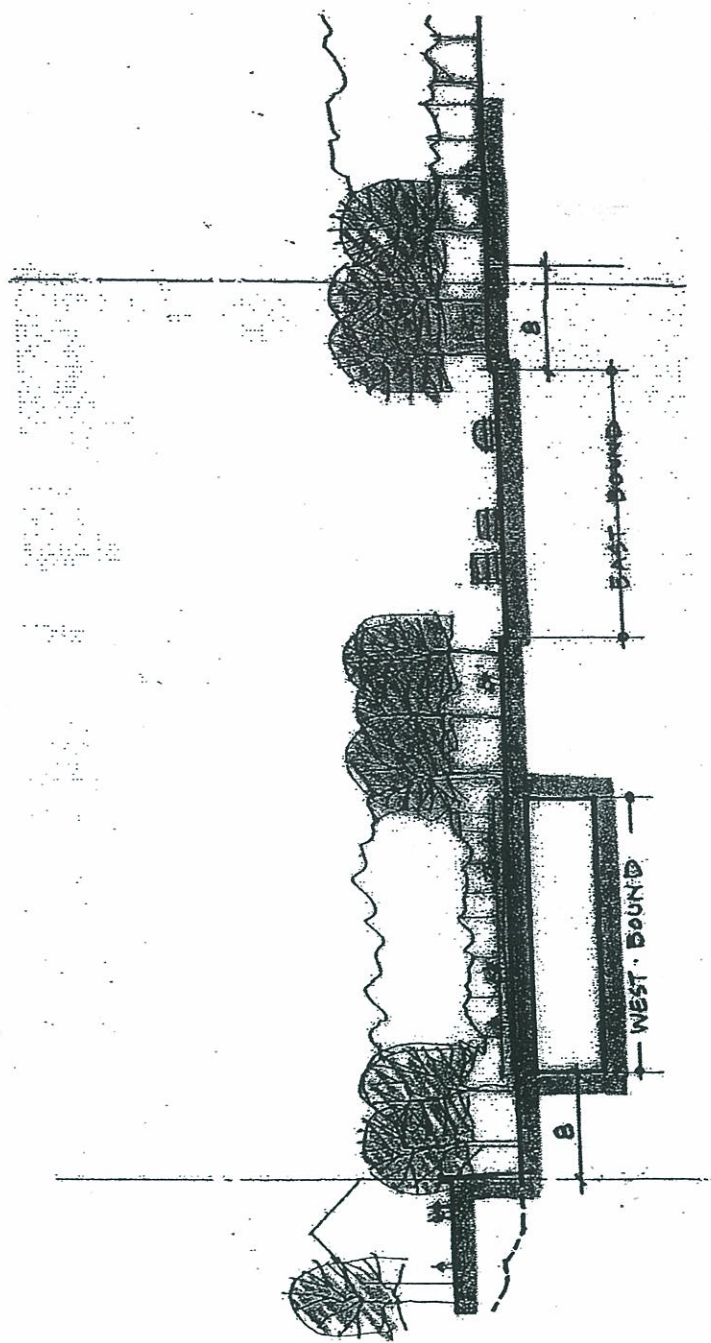
GARDINER/LAKESHORE CORRIDOR RECONFIGURATION
by Toit-Alleopp Hillier Marshall Macklin Monaghan B.A. Consulting
August 16, 2002

TYPICAL SECTION - SPADINA TO SIMCOE
OPTION 8 - WESTBOUND BELOW GRADE (COMPRESSED)



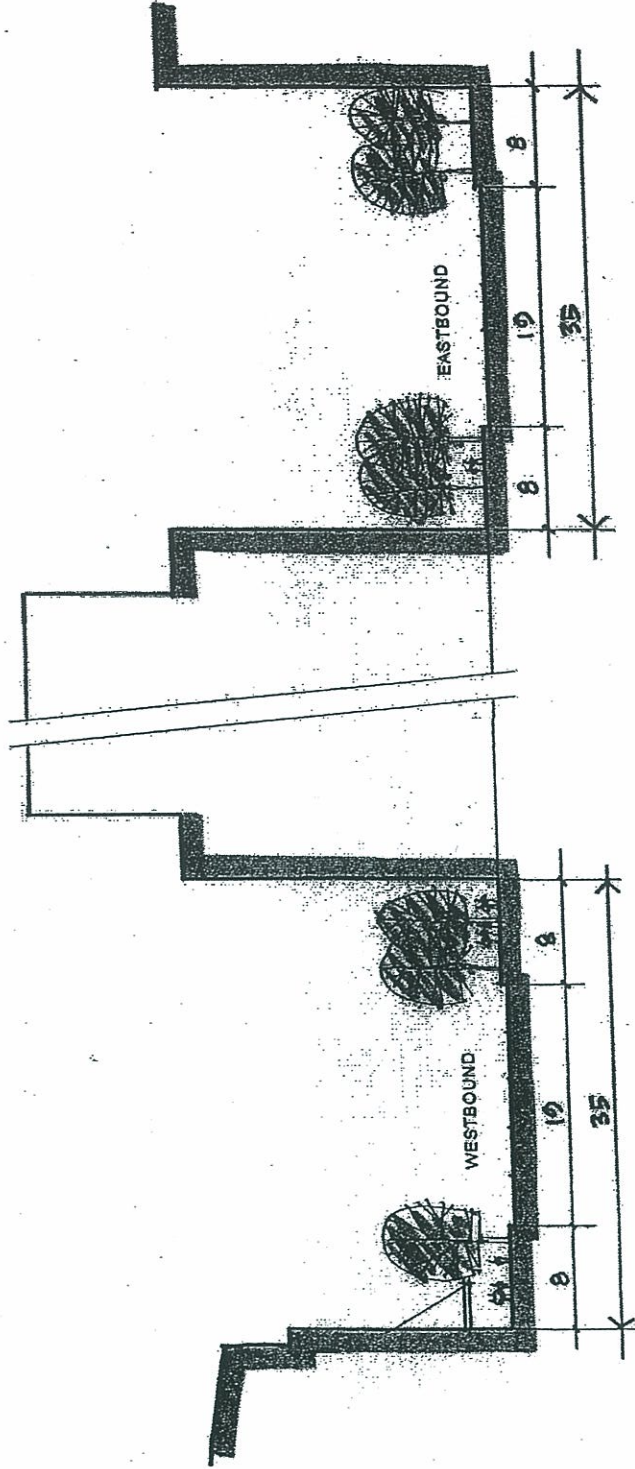
GARDINER/LAKESHORE CORRIDOR RECONFIGURATION
 du Toit-Alsopp Hillier Marshall Macklin Monaghan E.A. Consulting
 August 16, 2002

TYPICAL SECTION - JARVIS TO CHERRY
 OPTION 8 - BOULEVARD



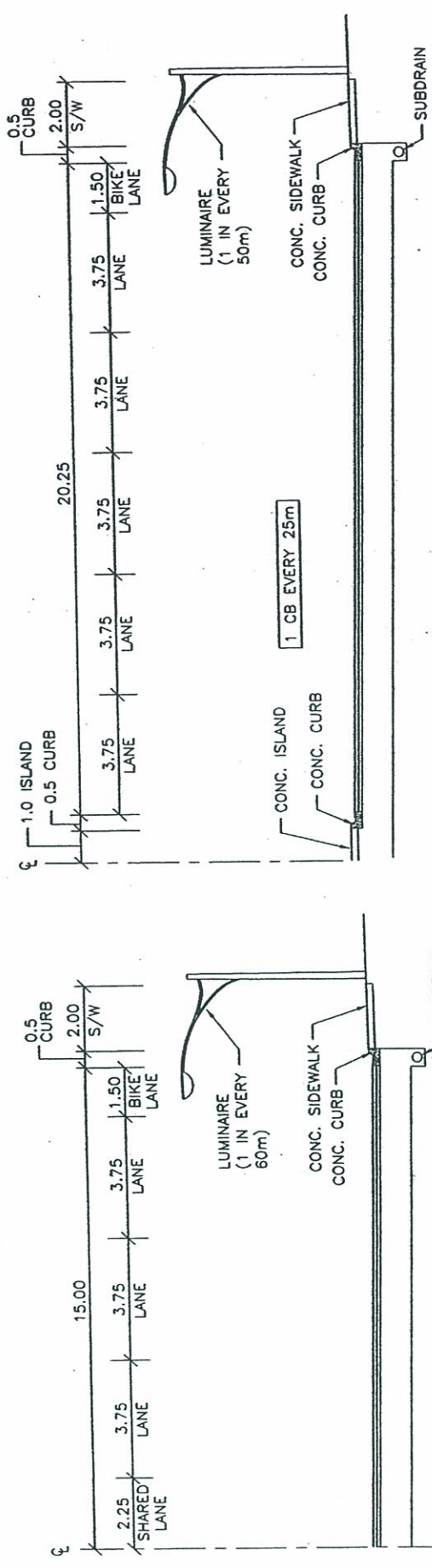
GARDINER/LAKESHORE CORRIDOR RECONFIGURATION
 dtv Toit: Allscopp Hillier Marshall Macklin Monaghan B A Consulting
 August 15, 2002

TYPICAL SECTION - SPADINA TO SIMCOE
 OPTION 8 - WESTBOUND BELOW GRADE (SEPARATED)



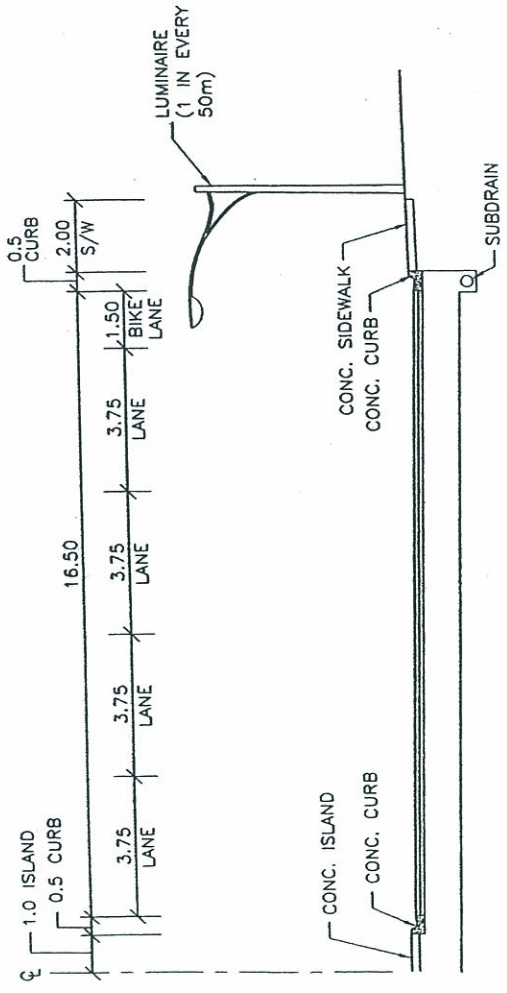
GARDINER/LAKESHORE CORRIDOR RECONFIGURATION
 dt-Tait-Alleopp -Hillier Marshall Macklin Monaghan - B+A Consulting
 August 15, 2002

TYPICAL SECTION - YORK TO COOPER
 OPTION 6 AND 8 - ONE-WAY PAIR



THREE AND A HALF LANE
URBAN ROAD

FIVE LANE URBAN ROAD



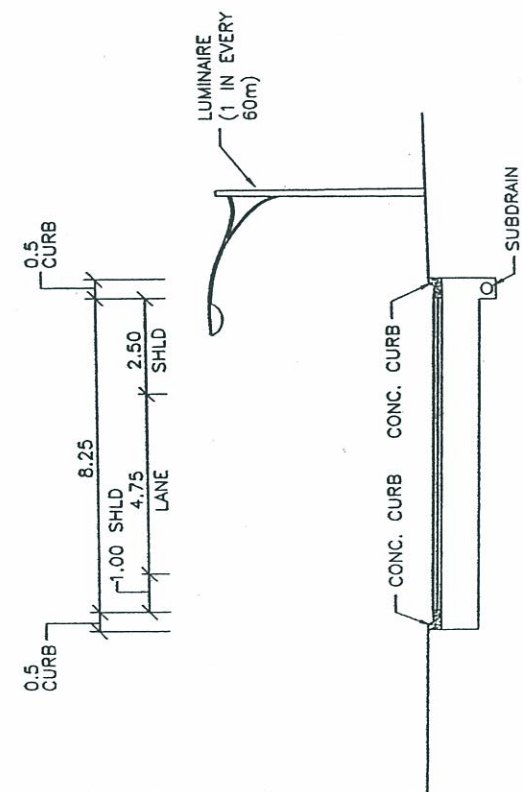
FOUR LANE URBAN ROAD

NOTES:

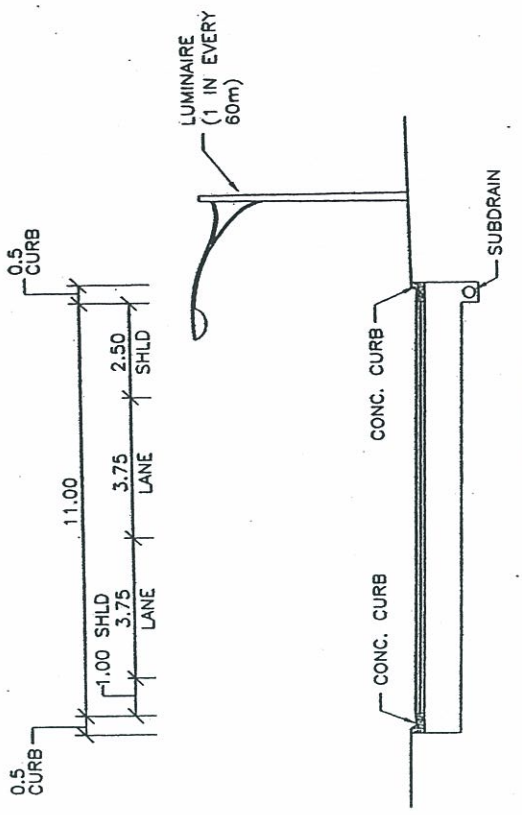
1. SECTIONS ALSO INCLUDE :
 - a. STORM SEWER PIPE (450mm ϕ)
 - b. 1 CB EVERY 50m (UNLESS OTHERWISE NOTED)
 - c. UTILITY RELOCATION
2. EB/NB LANES SHOWN ONLY. WB/SB LANES ARE MIRRORED ABOUT CENTRELINE WITH THE EXCEPTION OF SECTIONS LABELED "ONE WAY". "ONE WAY" SECTIONS ARE STAND ALONE.



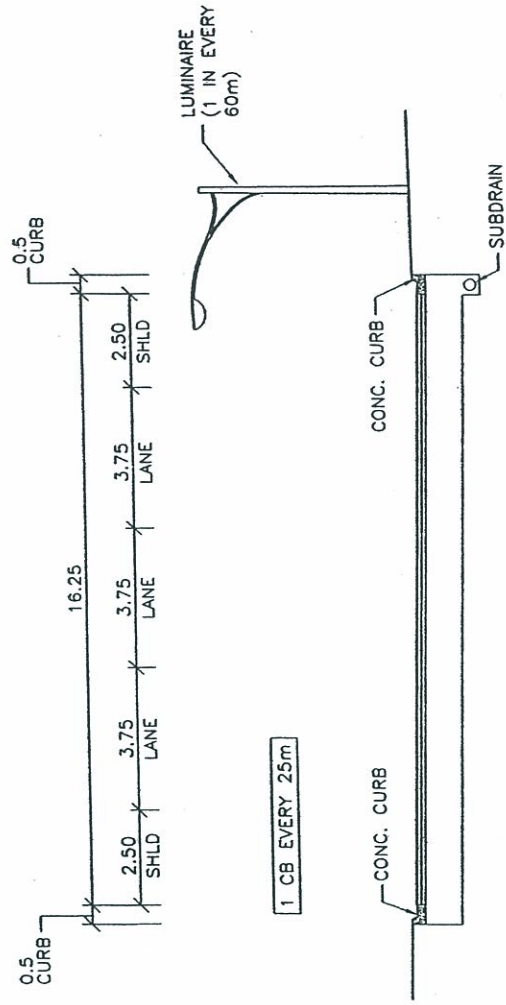
WATER FRONT - COST ESTIMATE
ASSUMED CROSS-SECTIONS
DATE : JUNE 28, 2002 DWG No.: SECT-2



ONE LANE RAMP



TWO LANE RAMP



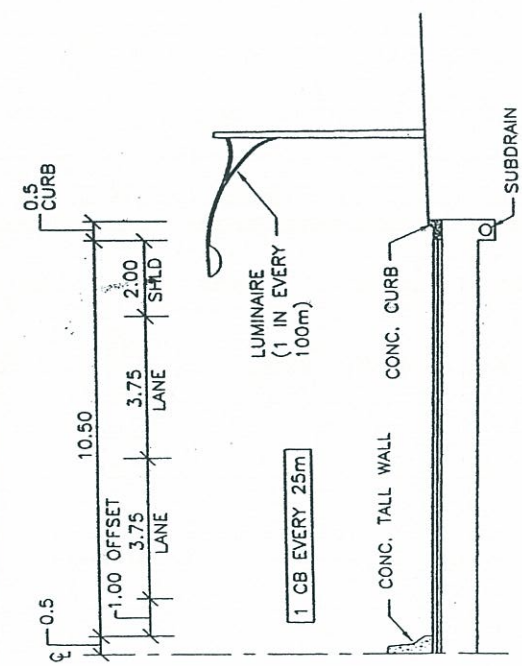
THREE LANE RAMP

NOTES:

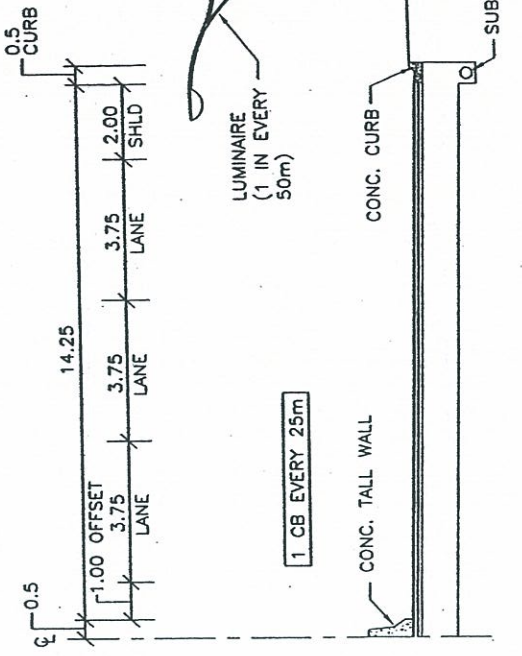
1. SECTIONS ALSO INCLUDE :
 - a. STORM SEWER PIPE (450mm ϕ)
 - b. 1 CB EVERY 50m (UNLESS OTHERWISE NOTED)
 - c. UTILITY RELOCATION
2. EB/NB LANES SHOWN ONLY. WB/SB LANES ARE MIRRORED ABOUT CENTRELINE WITH THE EXCEPTION OF SECTIONS LABELED "ONE WAY". "ONE WAY" SECTIONS ARE STAND ALONE.



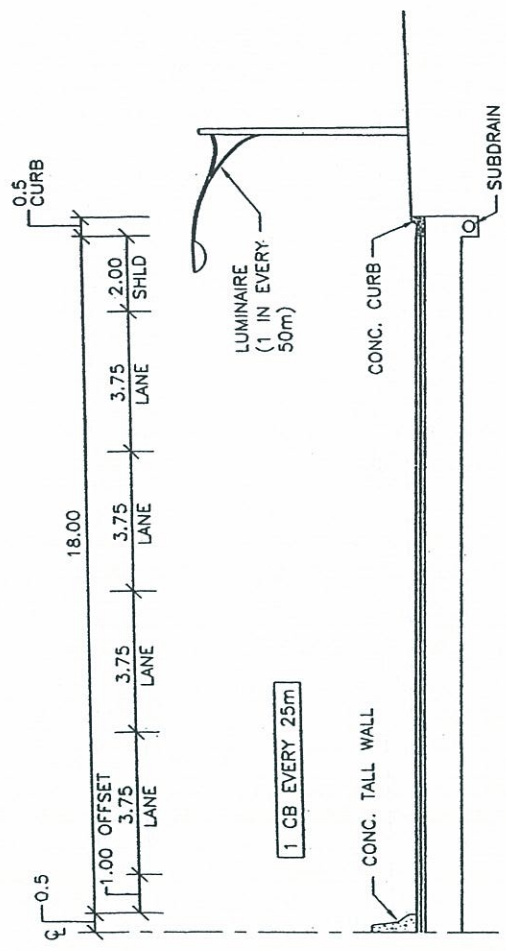
WATER FRONT - COST ESTIMATE	
ASSUMED CROSS-SECTIONS	
DATE : JUNE 28, 2002	DWG No.: SECT-4



TWO LANE HIGHWAY




THREE LANE HIGHWAY

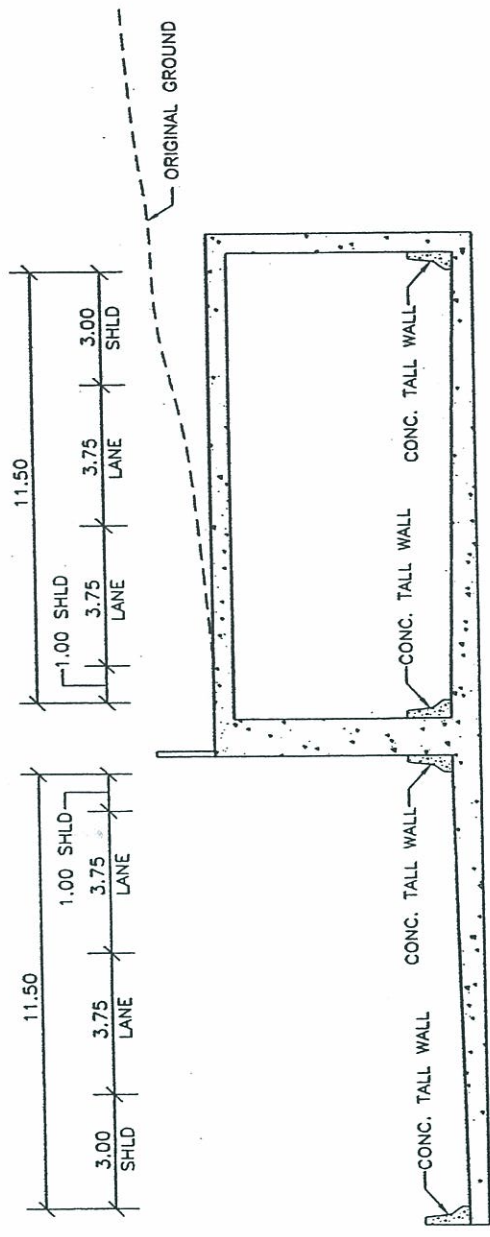


FOUR LANE HIGHWAY

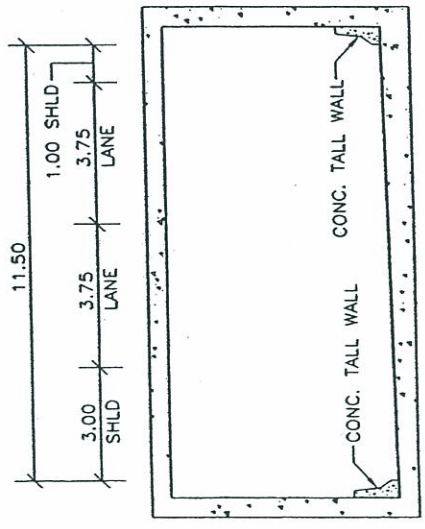
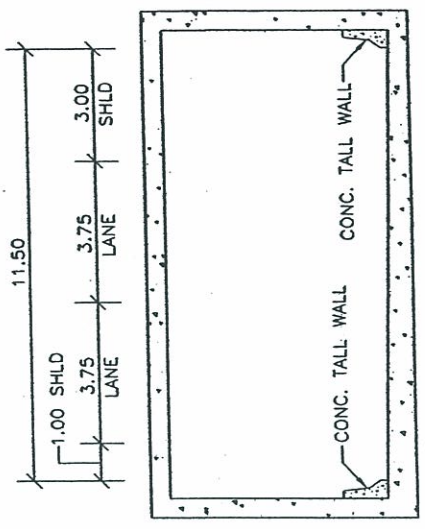
NOTES:

1. SECTIONS ALSO INCLUDE :
 - a. STORM SEWER PIPE (450mm ϕ)
 - b. 1 CB EVERY 50m (UNLESS OTHERWISE NOTED)
 - c. UTILITY RELOCATION
2. EB/NB LANES SHOWN ONLY. WB/SB LANES ARE MIRRORED ABOUT CENTRELINE WITH THE EXCEPTION OF SECTIONS LABELED "ONE WAY". SECTIONS ARE STAND ALONE.

 Meehall Construction <small>INCORPORATED IN THE STATE OF TEXAS</small>	
WATER FRONT - COST ESTIMATE	
ASSUMED CROSS-SECTIONS	
DATE : JUNE 28, 2002	DWG No.: SECT--5



FORK YORK



LAKE SHORE



WATER FRONT - COST ESTIMATE

ASSUMED CROSS-SECTIONS

DATE : JUNE 28, 2002 DWG No.: SECT-7

APPENDIX 6

Minutes of Review Meetings



Toronto Waterfront Revitalization Program - Gardiner Expressway and Lake Shore Blvd. Constructability and Cost Estimates – First Review Meeting

Project: Toronto Waterfront Revitalization Program - Gardiner Expressway and Lake Shore Blvd. Constructability and Cost Estimates

Project No.: 1041006.00

Place: TWRC Office, 207 Queens Quay West, Suite 822

Date: Friday, February 27, 2004

Time: 1:30 p.m. to 5:00 p.m.

Present:

Rod McPhail	City of Toronto (City)
John Niedra	City of Toronto (City)
Rob Wanless	Marshall Macklin Monaghan (MMM)
David Jull	Marshall Macklin Monaghan (MMM)
Roger Du Toit	Du Toit Allsopp Hillier (DTAH)
Kevin Pask	Morrison Hershfield Limited (MH)
Chak Lo	Morrison Hershfield Limited (MH)
Terry Choo-Kang	Morrison Hershfield Limited (MH)
Edward Li	Morrison Hershfield Limited (MH)

ITEM	MINUTES	ACTION BY
1.0	General	
1.1	Edward Li stated the purpose of the meeting was to present results of structural review of the 3 selected options completed to-date based on information received so far. Work began after a workshop conducted in MH on February 2, 2004 and one Work Meeting was held in the offices of MMM on February 11, 2004 where more information were provided.	Info
1.2	3 options were studied, namely the “Replace”, “Retain” and “Remove” Options, with specific attention paid to the constructability and feasibility of the proposed work. An estimate will be provided for each of the 3 options in due course.	Info
1.3	Edward distributed a number of tables in advance of the meeting summarizing MH’s preliminary findings and recommendations, which would be the theme of this	

ITEM	MINUTES	ACTION BY
	presentation and topics for subsequent discussions. Handouts including printed copies of these tables as well as proposed cross-sections of the Gardiner / Lake Shore road system prepared by MH were distributed in the meeting.	Info
1.4	The presentation will be conducted using a “Powerpoint” format.	Info
	(the distributed tables are enclosed to these minutes and will not be re-iterated).	
2.0	Discussions	
2.1	Option 1: Replace	
2.1.1	MMM advised that there are no grade-separated crossings at Spadina, York, and Simcoe. The WB Gardiner Expressway lanes are supposed to dive down into the Tunnel before York (location of east portal moved). The Architect’s impressions showing the signature cable-stayed bridges are for pedestrian only.	MH
2.1.2	MMM stated that there is a common concern about the left turn direction vehicles from EB arterial onto the side streets such as Jarvis, Sherbourne. Hence by using an arterial at a lower level it will enable vehicles to get onto the downtown under the express with bridges. Previous studies have shown the EB flow is much heavier than WB ones. This is the intention of providing grade-separated intersections at these locations.	Info
2.1.3	MMM noted the Lakeshore connections to the new express lanes, with a bridge going over the Don and under the DVP ramps, is to provide a smooth access from Lakeshore WB onto the express WB. In the EB direction, this may not be needed, and there may not have sufficient space to provide a curve bridge to carry the EB expressway traffic onto the Lakeshore EB east of the Don. This bridge has therefore been eliminated.	Info
2.1.4	The width of the west tunnel was discussed in detail. MH opined that high curb walkway is necessary to allow maintenance personnel to walk along the tunnel and for pedestrian whose cars are stranded. Moreover, the tunnel fans will be right above these narrow	

ITEM	MINUTES	ACTION BY
	<p>walkways, and will not be suitable for roadways, even used as shoulders. However, depending on the spacing of these fans, some recessed areas may be created for emergency parking of maintenance vehicles, etc. MH may have to find out what is the potential distance between consecutive ceiling exhaust fans. To locally increase the headroom above the fans throughout the entire tunnel may not be a good solution due to flow and cost considerations. There was a general acceptance of the utilidor proposed by MH and the provision of exhaust/ventilation shafts, as well as the emergency escape structures, but more details are likely to be involved in the future designs. Estimates for these structures, however, will be included in MH's estimates.</p>	Info
2.1.5	<p>For the WB tunnel beginning east of York, the intention is to build a parallel service road along the tunnel that would pick up the potential WB vehicles from York, run along Simcoe, and join the WB tunnel via a "merging lane" type arrangement west of Simcoe. As a result part of the tunnel here has to be widened to accommodate an extra lane and an additional portal and down ramp will be required.</p>	MH
2.1.6	<p>The condition at Fort York cemetery was discussed. There is concern that any excavation using cut and cover may run into archaeological findings that could have major impact to the feasibility of the project, and that a bored tunnel is more appropriate along this area. In this case the entire tunnel may be constructed using a hybrid method, mixing both boring as well as cut and cover. MH noted a bore tunnel will be located much deeper in the shale bedrock and that longer ramps will be needed to bring the traffic back to the surface, as well as potential water problem. MH is therefore reviewing both situations for evaluating the constructability of the West Tunnel.</p>	All
	<p>The City has to decide the details of circumventing the existing cemetery. From the property drawing, the City owns the land at the north side of Fort York between Strachan and Bathurst. However between Bathurst and Spadina the lower portion of land adjacent to the Gardiner is privately owned.</p>	City, MMM

ITEM	MINUTES	ACTION BY
2.1.7	It was recognized that traffic Staging is probably the most important issue. MH's ideas of using the pre-built high level express section of the future Lakeshore, and the creation of the temporary Bremner bypass is a good solution, but properties issue has to be reviewed carefully, particularly around the ACC area. The use of half and half type demolition of the Gardiner is also discussed. Roger said that his idea is always to build the high level express and takes all remaining traffic from Lakeshore and Gardiner after the Front Street Extension has been completed. MH's opinion was that a total of 14 lanes now use the existing corridor, and the 4 lanes plus the Bremner bypass cannot replace all 14 lanes at the same time. MMM said that traffic over that section of the Gardiner is low compared to the downtown section.	All
2.1.8	Between Jarvis and Cherry, there appears to have enough room to pre-build the full width of the 4 lane arterial on the rail embankment. It should not be divided, and should have neither shoulders nor barrier wall at least during the construction period. The 6 lane at-grade arterial south of the existing Gardiner ROW can be pre-built completely by acquiring frontage property on Lakeshore from Bonnycastle to Cherry St. The idea is that both arterials can be pre-built completely away from the elevated structure which can then be demolished completely in a single operation. If space is still a problem, the lanes can be squeezed or the arterials can be partially built then widened to ultimate once the Gardiner is down. TWRC sees this as more cost-effective.	MH
2.1.9	Spadina, Rees, Simcoe were intended as at-grade intersections to accommodate left turns from EB arterial. Lakeshore east of Strachan is supposed to be reduced from 6 to 4 lanes.	MH
2.1.10	For the construction of the west tunnel there is no major concerns for the staging but it is indicated that something similar to the East Demolition will be carried out because the situation is similar. The tunnels have to be completed first and the connecting ramps and corresponding demolition will have to be done one direction at a time to allow the traffic of Gardiner to have part of the Gardiner to exit the City.	Info

ITEM	MINUTES	ACTION BY
2.1.11	The Queens Quay bypass is not part of MH's work, but somehow the Queens Quay may be able to ease the traffic slightly.	MH
2.1.12	There are questions about the maintaining one of the 2 DVP ramps operational during construction. MH said it is possible, as it has been done before in the 1993 Ramp re-decking contract, but very narrow lanes have to be tolerated (10' or less). Some of the past experience could help if the work is going to be designed. Approvals from emergency services such as Fire, EMS and Police will be required particularly for long periods and over winter when snow accumulation will become a problem.	All to review
2.1.13	Property issues were discussed. TWRC said that most of the lands affected are city lands, including the golf course land adjacent to a residential development, belongs to the City. Some minor property issues would be resolved in the future.	City/MMM
2.1.14	Kevin asked about the traffic volumes along each section of the Expressway. MMM confirmed that these could be provided. <i>(the information was subsequently provided to MH)</i>	MMM
2.1.15	There are also some discussions on the overall width of the new roadways as depicted in MH's sketches, but MH opined that minor changing of the cross-sectional properties may not affect the constructability and feasibility review recommendations. In any case, MMM will provide typical cross section to MH for finalizing the study.	MMM
2.1.16	The implication of taking out all the ramps on the north side of the Expressway were re-stressed by MH in the meeting, this will be stated in the report.	MH
2.1.17	The remaining deck west of Strachan would still have to be replaced, but whether it should be included in the overall cost of this project, or just as the City's cost of maintenance, would have to be resolved by the TWRC.	Info
2.1.18	MMM advised the MH should include as part of <u>every</u> option the new Interchange at Eastern / Richmond and	

ITEM	MINUTES	ACTION BY
	DVP, although it is only shown in the “Retain” option plans.	MH
2.2	Option 2: Retain	
2.2.1	Roger confirmed that previously this option was call “Transform”.	Info
2.2.2	MH stated any retain option without replacement of the entire deck is considered dangerous and not recommended, irrespective of whether the work is costed as part of the waterfront project or as part of a regular maintenance by the City, and defined the deck for replacement as any thing supported on the top flange of the girders, but excludes girders, bearings, and supporting bents.	All to comment
2.2.3	It was however recognized that allocation of the cost of the deck replacement has to be resolved as it is essential that the cost of the 3 options be compared on an equal basis and not including something that the city should be doing anyway.	MH
2.2.4	MH recommended that a few sections of the Gardiner structure are to be completely reconstructed to accommodate new accesses from downtown. TWRC questioned how the reconstruction deck and substructure be done. MH said the any reconstruction of the sections should be carried out as part of the deck replacement contract and staged simultaneously, which has been done many times in the past using a 3 stage method. Substructure for the replaced decks, following the new alignment of the new downtown access roads, should be built in advance before any deck work should begin in order to minimize the disruption. The City may choose to install some sort of signature features to each connection by assignment characteristic shape, or inscription at the new piers.	Info
2.2.5	MH clarified that only the structural engineering part of the work would be evaluated in accordance with the terms of the assignment, but TWRC would have to consider all other soft costs such as landscaping, development and property costs.	MMM/City

ITEM	MINUTES	ACTION BY
2.2.6	MH also confirmed that not only the deck is to be replaced, the girders and the piers must be repaired properly, because once the land use below the deck was changed, and people starting to built enclosures, structures, planting, etc., as expected for a Boulevard type situation, the deck would not be easily inspected and no distress would be noticed until its too late, i.e. when something falls down. Safety to the new land users must not be overlooked.	Info
2.2.7	There was no comments to MH's suggestion to remove and reconstruct some ramps that obstruct pedestrian flow, and the reconstruction of part of the Expressway at the cross-overs.	Info
2.3	Option 3: Remove	
2.3.1	The main cost of this option appears to be the 2 long ramp accesses at the west end, each 800m in length. TWRC questioned whether some of the existing structure, especially the Spadina / Lakeshore structure can be reused. MH answered that the existing structure would have a different age than others, and will put significant restriction on the alignment and structural type to match it. It may also involve more frequent maintenance effort when compared to other parts of the new expressway. Aesthetically it would be very difficult to avoid a mismatch and will mar the appearance of the newly built road system.	All to review
2.3.2	Staging of the 2 new ramps would be pretty much the same as the tunnel connections, i.e. one at a time.	Info
2.3.3	The Don River is assumed at the same location as present.	Info
2..3.4	MH stated that the City would still have the same problem of determining what to do with the part of the Gardiner west of Bathurst that is to stay, regarding deck replacement, girders, and piers, etc.	Info
2.3.5	It was agreed that because of the missing high level road, and unless we deliberately built a 6km north bypass the work is very difficult to stage to maintain the capacity of the combined Gardiner / Lake Shore during the demolition and reconstruction work. It was	

ITEM	MINUTES	ACTION BY
	recognized that the it may be more appropriate to divert traffic towards the south, via a system of new network which may include the Queens Quay, the south widening of the Lakeshore (pre-built), and by doing the demolition half by half, keeping some capacity throughout the construction period.	Info
2.3.6	MMM confirmed that the Cherry Street Bypass is not part of this exercise and is being reviewed as a separate exercise. MH will treat this intersection as an at-grade one for the study.	MH
2.3.7	MMM will send MH revised drawings showing the most up-to-date layout of this option, and may be for other options as well.	MMM
2.3.8	MH indicated that in this option some property acquisition appear to be required south of the existing Lakeshore in order to widen towards that side; it was generally agreed by the meeting	Info
3.0	Other Issues	
3.1	MMM noted that the 3 river crossing structures at the Don River should assume a re-channeled river and a wider flood plain. In each Option, for cost comparison, MH is to assume the 3 structures at 120m (total length of bridge) as well as at 240m (total length of bridge).	Info
3.2	Roger emphasized the costing of the 3 Options must be such that they can be compared on an equal basis. Therefore the costing of items in each option has to be related.	MH
3.3	Kevin indicated that MHL would produce pure engineering costs. TWRC will direct MH how they want these costs to be priced, packaged and presented.	All
4.0	Next Meeting	
3.1	Edward Li said that the original schedule should be maintained, next meeting on March 22, 2004.	All

These minutes were prepared by Edward Li; please notify Edward of any mistakes and omissions.

ITEM	MINUTES	ACTION BY
Distribution:	All present Marc Hewitt, TWRC Jamie McEwan, TWRC	
Encl.	Summary Tables	



Toronto Waterfront Revitalization Program - Gardiner Expressway and Lake Shore Blvd. Constructability and Cost Estimates – Second Review Meeting

Project: Toronto Waterfront Revitalization Program - Gardiner Expressway and Lake Shore Blvd. Constructability and Cost Estimates

Project No.: 1041006.00

Place: TWRC Office, 207 Queens Quay West, Suite 822

Date: Monday, March 29, 2004

Time: 12:00 p.m. to 4:30 p.m.

Present:

Marc Hewitt	Toronto Waterfront Revitalization Corporation (TWRC)
Rod McPhail	City of Toronto (City)
Michael Kirkland	Principal, the Kirkland Partnership Inc.
Rob Wanless	Marshall Macklin Monaghan (MMM)
David Jull	Marshall Macklin Monaghan (MMM)
Kevin Pask	Morrison Hershfield Limited (MH)
Chak Lo	Morrison Hershfield Limited (MH)
Edward Li	Morrison Hershfield Limited (MH)

ITEM	MINUTES	ACTION BY
1.0	General	
1.1	Edward Li stated this is the second review meeting with the Steering Committee to present MH's cost estimates prepared for each of the 3 Gardiner options identified by TWRC. On February 27, MH presented its initial findings relating to constructability and structural issues of the options. A number of meetings were subsequently held between MH and MMM to clarify various intentions of the options and to define limits of the study.	Info
1.2	Edward recapped the scope of each of the 3 options with plans, and stated that one variation of the "Remove" option, called the "Extreme Remove" option, was added to the list to be evaluated by MH.	Info
1.3	Edward distributed summary of cost estimates together with breakdowns to the attendants, and stated that the	

ITEM	MINUTES	ACTION BY
	<p>work was carried out independent of the work previously done by MMM, using different approach and zoning method. However, after the basic estimates were reached the same percentages used by MMM representing contingencies and soft costs were applied to reach the final estimates, they were:</p> <p>30% for Contingencies, and 32% for Soft Costs, including engineering, financing and taxes.</p>	Info
1.4	<p>The following initial cost estimates were provided by MH, including all mark-ups:</p> <ul style="list-style-type: none">• Replace Option, Open Cut \$1,276M• Replace Option, Tunnel \$1,356M• Remove Option, \$438M• Extreme Remove Option \$458M• Retain Option \$439M	Info
1.5	<p>The following qualifications were also provided:</p> <ul style="list-style-type: none">• Staging and traffic management costs were not included. This may have impact on some of the options, the “Replace” option being the most affected. As discussed later in the meeting, MH would add cost to address the staging issues.• Landscaping and public arts were not considered in the calculations.• Properties were not allowed for in the estimates.	Info
2.0	Discussions	
2.1	General	
2.1.1	<p>Marc commented on the use of the mark up percentages and questioned whether the 30% and 32% used were appropriate. Rob stated that the 32% were made up of suitable percentages to account for soft costs and if those percentages were changed, such as when no taxes were required, and then the percentage can be adjusted. As for the 30% for contingencies, although it appears to</p>	

ITEM	MINUTES	ACTION BY
	be conservative, it is considered suitable for a study at the feasibility stage due to the large amount of unknowns. It was agreed that all parties should review these mark-up percentages and comment if needed.	All
2.1.2	Marc also questioned whether a construction time has been assessed for each option. Edward stated that construction scheduling and timing were not within the scope of MH's work. Rob indicated that general opinions put the construction time at around 8 years, although some other studies have assessed a construction period as short as 3 years.	Info
3.0	"Replace" Options	
3.1	Marc pointed out some incorrect information such as the details of the Queens Quay and the new Lake Shore Eastbound structure over the realigned Don. Edward indicated that these can be updated, but would unlikely affect the results of the cost estimates.	MH
3.2	Rod questioned whether railway lands will be required to build the high level express section of the new Lake Shore. MH and MMM stated that the existing tracks will not be affected but the railway ROW may be touched; this will need to be addressed in future studies.	Info
3.3	There were discussions about moving the express section of the new Lake Shore closer to the low level urban section, but it was considered not recommendable as this may impede the left turning traffic from the Lake Shore to the downtown connecting roads. The present layout should remain.	Info
3.4	The meeting continued to address some constructability issues relating to the "Replace" option, which is clearly the most complicated option considering the challenges to maintain traffic while building the new system.	Info
3.5	One major point of deliberation was at the west end when the Front Street Extension (FSE) is to connect to the Gardiner Expressway with ramps crossing over and under the rail corridor. The most up-to-date direction was to remove the entire elevated Gardiner and connect the FSE to Gardiner at a lower level with the elevated Gardiner totally removed including the west abutment	

ITEM	MINUTES	ACTION BY
	and the approach embankments. The meeting eventually agreed that it appeared more appropriate to keep the Gardiner up for the section west of Strachan so the FSE would connect Gardiner at the existing, higher level. This would significantly simplify the construction of the new Lake Shore tunnel connection in the future when the Replace option will be implemented. MH indicated that the difference in cost for either situations will not be significant.	All
3.6	MH agreed that the section of the new road system between Spadina and York will be the most difficult to construct and it appeared that a slurry wall and a temporary decking system will be required to maintain sufficient east-west traffic capacity while the elevated Gardiner is being removed. A separate meeting will be set up between MH and MMM to examine the staging more carefully before adding the cost to the overall estimate of this option.	MH/MMM
4.0	“Remove” Options	
4.1	MH indicated that the original Remove option (to Spadina) and the “Extreme” Remove option in fact cost almost the same, because although the original remove option has less work, it requires long ramp structures to connect the new Lake Shore back to the remaining part of the elevated Gardiner at Bathurst.	Info
4.2	Marc questioned why is Dowling Bridge included as part of this option. Rod indicated that Dowling Bridge is in poor condition and is destined to be replaced anyway, but in this case it should be rebuilt at a suitable position in proper relation to other new facilities based on the agreed scheme. The cost can be taken out from the overall estimate.	MH
4.3	Rob stated that MMM has conducted some traffic modeling which indicated that the Remove option only has about 50% of the capacity of the Gardiner prior to the removal.	Info
5.0	“Retain” Option	
5.1	The meeting recognized that the Retain Option does not come free as the name sounds. The removal and	

ITEM	MINUTES	ACTION BY
	replacement of ramps and the proper construction of the downtown connection crossovers, and the new Lake Shore outside the shadows of Gardiner, are all expensive undertakings, resulting in this option being almost the same cost as the Remove option.	Info
5.2	Edward stated that the estimate provided, as instructed from last meeting, did not include the full deck replacement, which is crucial for the proper functioning of the Retain Option.	Info
5.2	The concept of removing some ramps will put pressure on the local roads, and may result in some improvements required of these local roads.	Info
5.3	Lake Shore west of Strachan is not to be included as part of this assignment, and will not be costed, as noted on MH's drawings.	Info
6.0	Next Meeting	
6.1	To be announced.	All
	<i>(post-meeting note: the 3rd review meeting has tentatively been rescheduled on April 13, 2004 to be held at the offices of TWRC, more details will be provided once availability of members are obtained.)</i>	
	These minutes were prepared by Edward Li; please notify Edward of any mistakes and omissions.	
Distribution:	All present John Niedra, City of Toronto Jamie McEwan, City of Toronto Roger Du Toit Terry Choo-Kang, MH	
Encl.	Cost Tables (faxed separately to addressees not in attendance of the meeting)	

APPENDIX 8

**Subsurface Data Compilation, Lakefront Corridor
Golder Associates – December, 2000**

December 21, 2000

001-1164

McCormick Rankin Corporation
2655 North Sheridan Way
Mississauga, Ontario
L5K 2P8

ATTENTION: Mr. Martin Scott, P.Eng.

**RE: SUBSURFACE DATA COMPILATION
LAKEFRONT CORRIDOR**

Dear Sirs:

This report presents the results of compilation of the available subsurface information from previous geotechnical investigations carried out within the study area. The purpose of this study is to determine the subsurface soil, bedrock and groundwater conditions at the site. Based on our interpretation of the compiled data, recommendations are provided on the geotechnical aspects of design of the proposed works.

STUDY AREA AND PROJECT DESCRIPTION

The study area is located within the lakefront corridor in downtown Metropolitan Toronto, Ontario (see Figure). The study area extends westerly to Jameson Avenue, easterly to Don Valley Parkway including the Don Valley Parkway up to 0.5 km north of Queen Street, and from north is limited to Front Street and from south is bounded by the Lake Ontario. It is understood that the proposed work is comprised of the following items:

- Depressing a portion of the Gardiner Expressway between Yonge Street and Bathurst Street.

- Depressing a portion of the Gardiner Expressway between Yonge Street and Bathurst Street.
- Widening and/or remediation of the Don Valley Parkway, Lakeshore Boulevard and Front Street within the study area.

BACKGROUND INFORMATION

Total of 55 geotechnical and environmental investigation reports dating back to 1920 carried out in the study area were critically reviewed and studied in search of the key relevant information such as subsoil conditions, groundwater elevation, bedrock surface elevation and major environmental concerns. Sources used in this study are Golder Associates Library, GEOCRESS of Ministry of Transportation, Ontario and Metro Hall Technical Services Division of the City of Toronto. Bedrock topography map (1961) belonging to Ontario Department of Mines was also used to determine the bedrock surface elevation. The following table is a list of the reports used in this study:

Table 1: List of Reports used in Data Compilation

<i>No.</i>	<i>Title</i>	<i>Date</i>	<i>Source</i>
1	"Toronto Transportation Terminal, Geotechnical Investigation, Proposed Flyunder Rail Corridor Redevelopment, Bathurst Street Junction, Toronto, Ontario"; <i>Reference No. 771055</i>	November 1997	Golder Associates
2	"Compilation of Geotechnical Data, Rail Corridor Redevelopment, Bathurst Street Junction, Toronto, Ontario"; <i>Reference No.: 771265</i>	December 1997	Golder Associates
3	"Subsurface Investigation, Proposed Sewer Diversions, Bathurst Street and Spadina Avenue, Toronto, Ontario"; <i>Reference No.: 781051</i>	November 1998	Golder Associates
4	"Subsurface Investigation, Existing Concrete Floor, Atlas Alloy Building, 215 Lakeshore Boulevard East, Toronto, Ontario"; <i>Reference No.: 781172</i>	August 1978	Golder Associates
5	"Geotechnical Investigation, Slope Instability, T.T.R. Flyunder, Toronto, Ontario"; <i>Reference No.: 821-1287</i>	November 1982	Golder Associates
6	"Geotechnical Investigation, Proposed Hydraulic Tunnel, TTR Corridor Near John Street, Toronto, Ontario"; <i>Reference No.: 871-1416</i>	December 1987	Golder Associates
7	"Geotechnical Investigation, Canada Mailing Co. Limited, Parliament Street Plant, Toronto, Ontario"; <i>Reference No.: 871-1224</i>	June 1987	Golder Associates
8	"Preliminary Investigation for the Proposed Redevelopment of the Gooderham and Worts Limited Property, Toronto, Ontario"; <i>Reference No.: 881-1374</i>	August 1988	Golder Associates
9	"Geotechnical Investigation, Canada Mailing Co. Limited,	August 1988	Golder

No.	Title	Date	Source
	Parliament Street Plant, Toronto, Ontario"; <i>Reference No.: 881-1386</i>		Associates
10	"Geotechnical Investigation, Changeable Message Signs, F.G. Gardiner / Lakeshore Boulevard, Toronto, Ontario"; <i>Reference No.: 891-1335</i>	February 1990	Golder Associates
11	"Geotechnical Investigation, Union Station-Go Transit Access Improvement, Toronto, Ontario"; <i>Reference No. 891-1416</i>	January 1990	Golder Associates
12	"Geotechnical Investigation, Proposed Entrance to Queen's Quay Station, Harbourfront Light Rail Transit Line, Toronto, Ontario"; <i>Reference No. 901-1317</i>	March 1990	Golder Associates
13	"Geotechnical Investigation, Proposed Elevated Ramps and Gardiner Widening, Front Street Extension/Gardiner Expressway, Toronto, Ontario"; <i>Reference No. 901-1437</i>	October 1991	Golder Associates
14	"Hydrogeologic Investigation of the Gooderham and Worts Limited, Mill Street Property, Toronto, Ontario"; <i>Reference No.: 901-1908</i>	March 1991	Golder Associates
15	"Geotechnical Investigation, CTMS Gardiner-Lakeshore, Yonge to Leslie Plus DVP Like, Toronto, Ontario"; <i>Reference No.: 911-1302</i>	June 1991	Golder Associates
16	"Geotechnical Investigation for the Proposed Service Tunnel, Metro Toronto Convention Centre Expansion, Toronto, Ontario"; <i>Reference No.: 941-1709</i>	April 1994	Golder Associates
17	"Preliminary Geotechnical Investigation, Proposed Renovations to Exhibition Go Station, Toronto, Ontario"; <i>Reference No.: 951-1329</i>	August 1995	Golder Associates
18	"Geotechnical Investigation"; <i>Reference No.: 001-8353</i>	October 2000	Golder Associates
19	"Don Valley Parkway, Toronto, Ontario"; <i>Reference No. 26 a-z</i>	February 1957	Metro Hall
20	"Don Valley Parkway, Eastern Avenue and Duke-Duchess Connection, Toronto, Ontario"; <i>Reference No. 29</i>	August 1962	Metro Hall
21	"Queen Street East Bridge, Toronto, Ontario"; <i>Reference No. 44</i>	May 1962	Metro Hall
22	"Don Valley Parkway, 200 feet north of Eastern Avenue"; <i>Reference Nos. 54 (City of Toronto) and 6154 (Golder Associates)</i>	January 1962	Metro Hall & Golder Associates
23	"Lakeshore Expressway, Bathurst and Fleet Streets, Toronto, Ontario"; <i>Reference No.: 77</i>	March 1959	Metro Hall
24	"Gardiner Expressway, Keating Channel Area, Pile Driving and Loading Test, Toronto, Ontario"; <i>Reference No. 78</i>	March 1959	Metro Hall
25	"Additional Borings, York Interchange - Frederick G. Gardiner Expressway, Toronto, Ontario"; <i>Reference No.: 79</i>	October 1960	Metro Hall
26	"Rock Boring, Bent Nos. 106 to 119 Inclusive, Frederick G. Gardiner Expressway, Toronto, Ontario"; <i>Reference No.: 80</i>	October 1959	Metro Hall
27	"Soil Investigation For Gardiner Expressway, Don Channel to Parliament Street, Section C, Lakeshore Boulevard East and Cherry Street South, Toronto, Ontario"; <i>Reference No. 187 a-z</i>	February 1961	Metro Hall
28	"Soil Investigation For Gardiner Expressway, Don Channel to Parliament Street, Section B, Lakeshore Boulevard East	January 1961	Metro Hall

No.	Title	Date	Source
	and Cherry Street South, Toronto, Ontario"; <i>Reference No. 188 a-z</i>		
29	"Soil Investigation For Gardiner Expressway, Don Channel to Parliament Street, Section A, Don River to Cherry Street South, Toronto, Ontario"; <i>Reference No. 189 a-z</i>	January 1961	Metro Hall
30	"Geotechnical Investigation, Proposed Metro Toronto Convention Centre, Toronto, Ontario"; Shaheen & Peaker Limited; <i>Reference No.: SP446</i>	January 1994	Golder Associates
31	"Environmental Site Investigation, Block 10 Railway Lands, Toronto, Ontario"; Monenco Inc.	April 1992	Golder Associates
32	"Filtered Water Tunnel, Water Works Extension, Toronto, Ontario"; City of Toronto	September 1920	Golder Associates
33	"Foundation Investigation Report for the Proposed Relocation of the West Entrance to Ontario Place, District No. 6, Metropolitan Toronto, Ontario"; <i>Reference No. 30M11-101</i>	May 1972	GEOCRES MTO
34	"Preliminary Foundation Investigation Report for Proposed Intermediate Capacity Public Transit System, Canadian National Exhibition Grounds, Metropolitan Toronto, Ontario"; <i>Reference No.: 30M11-102</i>	September 1972	GEOCRES MTO
35	"Harbourfront Light Rail Transit, Metropolitan Toronto, Ontario"; TTC	September 1987	Golder Associates
36	"Soil Characterization and Contaminant Studies"; Geocon	June 1988	Golder Associates

SUBSURFACE CONDITIONS

Based on the subsurface information, five key areas were identified with respect to the following items:

1. Deep bedrock valley
2. Shallow bedrock surface elevation
3. Deep fill materials
4. Shallow fill materials
5. Glacial till over bedrock

The deep bedrock valley exists some 300 m west of Don Valley Parkway which a sudden drop of up to 25 m was noted in the bedrock surface elevation along the Gardiner Expressway Area. Having a breadth of about 200 m, the deep bedrock valley was found to be crossing the Gardiner Expressway and continuing southward. Bedrock surface was generally encountered at shallower depths (less than 10 m) in rest of the study area.

The deep fill material refers to areas in which assorted fill materials were encountered overlying the bedrock. The section between York Street and Spadina Avenue within the study area could be cited as deep fill material zone. Cinders, brick, wood fragments, nails, rubble, wharves, significant amount of organics and more unclassified materials were commonly noted within the fill materials. Thickness of the fill material was measured less than 4.1 m in all other investigations within the study area.

Glacial till overlying the bedrock commonly forms the stratigraphy on west of Strachan Avenue within the study area. The glacial till typically is a heterogeneous mixture of sand, silt and clay with variable quantities of gravel. Thickness of the glacial till varies from 3 m to 7.3 m. traces of organic materials were noted within the upper crust this deposit.

A more detailed stratigraphy including the groundwater conditions of the study area is given in the following table.

TABLE 2
SUMMARY OF SUBSURFACE CONDITIONS
LAKEFRONT CORRIDOR

Location	General Soil Stratigraphy (Listed from Ground Surface Down)	Detailed Soil / Bedrock Stratigraphy (Listed from Ground Surface Down)	Groundwater	Remarks
Don Valley Parkway (0.5 km north of Queen Street to Gardiner Expressway)	<ul style="list-style-type: none"> • Fill material • Silty sand to sandy silt / silt • Glacial till • Sand and clayey silt • Shale bedrock 	<ul style="list-style-type: none"> • Fill material: Loose to dense sand and gravel (stiff clayey silt at some locations), containing brick, wood and organic materials and peat; up to 4.1 m thick • Silty sand to sandy silt: Loose to dense; between 1.6 m to 6 m (5.2 ft. to 20 ft.) in thickness; grey to grey-brown; containing organic materials at some locations; top elevation varies from 75.1 m to 82 m; encountered in most of boreholes overlying bedrock or glacial till • Glacial till (silty clay till) Stiff to hard; ranging from 2.5 m to 7 m (8.2 ft. to 23 ft.) in thickness; brown and grey; mainly encountered near Queen Street and Eastern Avenue off-ramp; its thickness decreases southward • Sand and clayey silt: <ul style="list-style-type: none"> - clayey silt: soft; grey; up to 0.9 m (3 ft.) thick - sand: very loose; grey; up to 2 m (6.5 ft.) thick Encountered in some boreholes around Eastern Avenue overlying bedrock • bedrock: Shale bedrock (Dundas Formation); bedrock surface elevation north of Eastern Avenue gently decreases from 73.8 m to 70.4 m (242 ft. to 231 ft.) and varies between 61 m (200 ft.) to 70.4 m south of Eastern Avenue 	<ul style="list-style-type: none"> • Elevation 72.2 m to 77.4 m • Only one borehole immediately south of Eastern Avenue was noted dry upon completion of drilling 	<ul style="list-style-type: none"> • Soft zones were noted within the shale bedrock at some locations • Ground surface elevation varies from 75.2 m to 84.4 m
Gardiner Expressway (Don Valley Parkway to Parliament Street)	<ul style="list-style-type: none"> • Assorted fill material • Organic silt or silty sand • Sand • Glacial till • Shale bedrock 	<ul style="list-style-type: none"> • Assorted fill material: Loose; 3.65 m (12 ft.) average thickness; containing wood fragments, cinders, brick, sand and unclassified materials • Organic silt or silty sand: Loose; brown to grey-brown; top elevation ranges from 72.5 m (238 ft.) to 74.7 m (245 ft.); ranges from clayey silt to sandy silt; becomes denser and coarser with depth; average thickness of about 7.6 m (25 ft.) • Sand: Dense; becoming gravelly with depth; grey; between 4.5 m to 9 m (15 ft. to 30 ft.) in thickness; top elevation is variable • Glacial till (sand and gravel till): Dense; less than 1.5 m thick in most locations and up to 4.5 m around the deep bedrock valley area; not encountered in all boreholes (discontinuous) • Bedrock: Shale bedrock (Dundas Formation); bedrock surface generally between Elevations 65.5 m (215 ft.) and 68 m (223 ft.) between Parliament Street just east of Cherry Street. Major bedrock valley is present between Cherry Street and Don Valley Parkway. The bedrock surface is thought to be at about Elevations 41.5 m to 43.4 m at the deepest point within the valley. The subsoils within the bedrock valley generally consist of: <ul style="list-style-type: none"> - Ground surface Elevation 76.5 m - Elevation 76.5 m to 61.9 m: loose to dense sand, occasional organics - Elevation 61.9 m to 59.1 m: dense, grey clayey silt - Elevation 59.1 m to 47.5 m: dense coarse to medium sand with clayey silt seams - Elevation 47.5 m to 43.9 m (or 41.5 m): dense, grey glacial till (silty clay to sand and gravel) Thickness of weathered bedrock varies from 0 m to 1.2 m. 	Elevation 75.7 m to 74.7 m	<ul style="list-style-type: none"> • The assorted fill layer is oil-impregnated with leakage from various pipelines in the area • A loose layer of sand of varying thickness exists over the organic silt or silty sand layer at some places • Ground surface elevation varies from 76.4 m to 78.0 m

TABLE 2 (continued)
SUMMARY OF SUBSURFACE CONDITIONS
LAKEFRONT CORRIDOR

Location	General Soil Stratigraphy (Listed from Ground Surface Down)	Detailed Soil / Bedrock Stratigraphy (Listed from Ground Surface Down)	Groundwater	Remarks
Gardiner Expressway (Parliament Street to Yonge Street)	<ul style="list-style-type: none"> Assorted fill material Silty sand / sand / sandy silt Clayey silt Shale bedrock 	<ul style="list-style-type: none"> Assorted fill material: Soft clayey silt to compact sand and gravel, containing red brick and organic materials; thickness ranging from about 1 m to 3 m Silty sand / sand / sandy silt: Very loose to loose; containing high organic materials; thickness ranging from 6.3 m at Jarvis Street location to 8.0 m at Parliament Street Clayey silt: Soft; 2.0 m thick; containing organics Bedrock: Shale bedrock (Dundas Formation); bedrock surface generally encountered at Elevation 66.6 m to 67.7 m. 	Elevation 74.6 m at Jarvis Street to 73.8 m at Parliament Street	<ul style="list-style-type: none"> Ground surface elevation varies from Elevation 76.5 m at Jarvis Street to Elevation 77.0 m at a location close to Parliament Street
Gardiner Expressway (Yonge Street to Strachan Avenue)	<ul style="list-style-type: none"> Assorted fill Sand / silt / silty sand / sandy silt (at some locations) Clayey silt (at some locations) Peat Shale bedrock 	<ul style="list-style-type: none"> Assorted fill material: Almost entire overburden consists of various fill materials (i.e. generally only thin layers of native soils were encountered if present at all). The various fill materials encountered in boreholes are listed below: <ul style="list-style-type: none"> Loose to very dense sandy gravel to gravelly sand Very loose to very dense, grey brown to black, sandy silt to silty sand / sand some silt Very soft to very stiff mottled grey brown and black clayey silt to silty clay Timber cribs, old wharves, and other miscellaneous rubble known to be present within the fill particularly between Spadina and York. Materials such as wood and coal fragments, slag, brick, ceramic, shells and glass were commonly noted within the fill. The thickness of fill layer varies from 4.2 m to 9.1 m but generally greater than 7.5 m. Sand / silt / silty sand Deposits of fine sand to silt and /or silty sand generally encountered between Yonge Street and Spadina Avenue; generally very loose to loose (compact at few locations); thickness (sandy deposits together) ranges from 0.6 m to 6.4 m, these deposits tend to have greater thickness around Jarvis Street and they are replaced by fill materials moving approaching toward Yonge Street; organic materials frequently noted within the deposits Clayey silt A deposit of soft, grey clayey silt exists immediately below the sandy deposits; thickness of this stratum is about 1.5 m between Jarvis Street and Bay Street and declines to 0.9 m and less approaching Yonge Street and finally disappears; organic materials noted within this deposit Peat A deposit of peat up to 0.3 m thick was noted at some locations below the sandy deposits and within the subsoils generally between Bay Street and Simcoe Street Bedrock Shale bedrock (Dundas Formation); bedrock surface generally at about Elevation 66.5 m to 71.5 m between Jarvis Street and Bathurst Street Bedrock surface rises gently to about Elevations 75.5 m and 76.5 m between Bathurst Street and Strachan Avenue 	Generally at about lake level or higher; measured levels generally varied from Elevation 73 m to 79 m	<ul style="list-style-type: none"> Noticeable petroleum odour within the fill materials between Yonge Street and Spadina Avenue Ground surface elevation varies as below: <ul style="list-style-type: none"> Bay Street to Simcoe Street about Elevation 76.6 m Gentle increase from Elevation 76.6 m at about Simcoe Street to Elevation 80.6 m at Spadina Avenue and then gently decreases to about Elevation 74.6 m at Bathurst Street Gentle increase Elevation 84 m at Strachan Avenue
Gardiner Expressway (Strachan Avenue to Jameson Avenue)	<ul style="list-style-type: none"> Variable surficial fill Glacial till Shale bedrock 	<ul style="list-style-type: none"> Typically shallow variable fill materials less than 3 m deep Glacial till: Typically heterogeneous mixture of sand, silt and clay with variable quantities of gravel; stiff to hard; sand / silt interlayers common; thickness varying from 3 m to 7.3 m (10 ft. to 24 ft.); traces of organic material in upper crust Bedrock Shale bedrock (Dundas Formation) generally at about Elevation 76 m to 79 m 	Elevation 80.5 m to 83 m (some boreholes were noted dry upon completion of drilling)	<ul style="list-style-type: none"> Ground surface elevation varies from 82.7 m to 87.5 m

ENGINEERING RECOMMENDATIONS

The key areas of concern with respect to bridge foundations are

- the deep bedrock valley just west of Don Valley Parkway,
- the variable fill materials which typically occur between York and Spadina can contain significant rubble, old cribs and wharves
- the generally sandy nature of the fills / overburden and high groundwater level in the area east of Spadina.

The depressed corridor area will generally be within variable fill materials with bedrock typically at less than 10 m depth; the fill can contain significant rubble; the groundwater level is relatively high. Depending on the grades, construction within contiguous caisson wall or slurry wall may be required. These forms of excavation support would provide the groundwater control necessary for excavation through these variable waterbearing fills.

West of Strachan Avenue, the subsoils generally consist of competent till overlying the bedrock; driven H-piles or drilled caissons founded on / within the bedrock are generally suitable for support of bridges.

Along and immediately west of the Don Valley Parkway, within the area of the deep bedrock valley, steel H-piles driven to bedrock will generally be suitable; the key difficulty is that the bedrock surface varies significantly over short distances.

Yours truly,

GOLDER ASSOCIATES LTD.