

APPENDIX Q

SUBWAY OPERATIONS REPORT



Background

As part of the 1994 Yonge-Spadina Subway Loop Environmental Assessment (EA), the long-term plan was to connect the northern termini of the two aforementioned subways, in order to reduce headway and thereby increase carrying capacity for the Yonge Subway. In 2001 the RTES revisited this need and determined that the capacity constraints could be addressed through:

- Terminal improvements
- Signaling system improvements
- Transfer Station (Bloor-Yonge) improvements

In order to determine the environmental impacts of the Project, the Spadina Subway Extension EA study needs to identify all of the major facilities required for the Spadina Subway Extension, including any new or expanded train maintenance and storage facilities. The purpose of this report is to document the supporting operational analysis and the key decisions made as they pertain to the subway operations along the proposed extension from Downsview Station to Steeles West Station.

Operating Design Criteria

In order to efficiently and cost-effectively operate the proposed extension, TTC has identified the following requirements (See Attachment 3)

- 1) Double-crossover south of Finch West Station;
- 2) A 200m long tail track north of Steeles Station with provision for double-ending this storage track when the subway is extended further north;
- 3) No unbalanced super elevation and achieving two-minute headway;
- 4) Sufficient fleet additions and associated improvements to Wilson Yard;
- 5) A double-ended three track cross-over to allow the scheduled short-turn operation to be transferred from St. Clair West Station, north; and
- 6) No humped track profile (as per DM-0204-02, Alignment Section 2.3.8)

Additional details are provided below.

Finch West Station Double Cross-over

At the south end of Finch West Station, a double cross-over is required. This is to allow trains to change direction (i.e. NB train that is redirected southbound) at this station. As indicated in TTC Standards DM-0206-01, a cross over consists of two turnouts in which the track between the frogs is arranged to form a continuous passage for vehicles. A double crossover consists of two intersecting crossovers with a crossing between the turnouts. Since the proposed alignment runs tangent along Keele Street, implementation of the double cross-over south of Finch West Station is relatively simple. This cross-over

is required for operating flexibility, and would be required if the initial stage of the project is from Downsview Station to Finch West Station.

Steeles West Station Tail Track and Cross-over

For Steeles West station, a 200m long trail track north of the station is required. The tail track provides two operating features:

1. It allows overrun of the station, which is a safety feature that is required to allow trains to enter the terminal station at full speed.
2. It can provide temporary storage for a train on each track.

Similar to Downsview station, the tail track has to provide provision for a double-ending track for future extension further north into York Region. The cross-over immediately to the south of Steeles West Station allows the arriving northbound trains to use either platform edge and return via the south bound track. This is essential for terminal station operations.

Two-Minute Headway:

The track layout must permit trains to operate at headways of 2 minutes. The headway (interval between trains) depends on the train dwell time at the stations, train acceleration and deceleration performance, track layout and location of wayside signals.

One of the ways to maintain this criterion is to maintain high speeds for trains. In order to do this, the alignment must be as straight as possible. Any curvature should also be designed to accommodate for such. The TTC wishes to operate through curvature in a 'equilibrium' condition. This is when the centrifugal force of a train negotiating a curve is balanced by the Superelevation of the track. This Superelevation is limited to 100mm and for a maximum speed of 80 km/hr a minimum curve of 750 metres radius is required, which is the desirable minimum radius for this project. When this radius is not possible a speed restriction will be necessary.

All switches on this section will be the TTC Standard #9 switch. These have a diverting angle of approximately 6.4 degrees and the maximum speed in the diverging direction is 33 km/hr.

The signal system will be designed according to TTC signaling practice and will be similar and compatible with the signaling on the rest of the Yonge - University - Spadina Subway route. This is a block signaling system and only one train is allowed in each signaling block, which is the distance between two stop signals. The signaling uses 'stop' and 'approach' indications and drivers operate trains manually in accordance with the indications provided by the signaling system.

If a train should pass a signal indicating 'stop' a trackside trip arm contacts a trip valve on the train which initiates an emergency brake application. An overlap is provided beyond the stop signal so that the train will come to a stand before it would contact a preceding train, pass through a switch not set for the movement or contact a fouling train movement.

TTC uses simulation software for the signaling and run times for proposed track configurations. As part of this study, the recommended alignment was tested. It was confirmed by TTC that the 2 minute headway was achievable for the proposed alignment and station placement on this proposed extension.

Sufficient Fleet additions and associated improvements (Storage Space)

The addition of 6.2 km of new subway line requires an increase in fleet, storage and maintenance facilities. The additions to the Wilson Yard are approved under the 1994 New Subway Storage and Maintenance Facility EA (See Attachment #2) and with the re-opening of Davisville Yard in late 2002, and reallocation of approximately 90 subway cars to Davisville from Wilson yard, there should be sufficient train storage capacity already constructed at Wilson yard.

No Humped Track Profile

Within TTC Standard (DM-0204-02), a humped track profile should be used whenever possible. This design, which permits trains to accelerate out of stations and deceleration into stations, is achieved by introducing a short length (200 to 300m) of 3% up-and-down gradients before and after every station. This system increases average speeds, reduce wear and tear and reduces maintenance on motors and breaks. It also enables trains to coast, which produces energy savings.

Recognizing that this is an extension of an existing line with driver control in line of sight signaling, TTC Operations asked that this D.C. be removed citing line-of-sight requirements as paramount.

Scheduled Short Turns

Notwithstanding the entire Spadina Subway Extension has been designed for two-minute headway, the demand for line capacity are driven by the peak loads which occur south of Bloor street on the Yonge line. In response TTC has scheduled short turns, which means northbound trains on the Spadina Subway line are returned southbound before reaching the end of the line. At present, this occurs at St. Clair West Station. With the extension of the Spadina Subway, TTC service planning have determined that the scheduled short turn location should be moved further north.

As part of the 1994 EA, TTC identified that scheduled short turns should occur at Downsview station. Under construction at that time, the tail tracks for Downsview station were designed and structural provisions made for the eventual implementation.

The proposed short turn facility must be configured as a centre track in order to achieve the maximum operation benefit. The desired configuration should emulate the St. Clair West Centre track which is comprised of three switches at the south end, four switches at the north end and a bumper for small piece of "overlap" track extending north of the northern switches. For detailed information, please refer to Attachment 3.

The double ended three-track structure requires three closely spaced tracks, with high speed switches at each end. The structure within which this specialized trackwork is accommodated has a variable structural configuration and includes structural spans of various lengths (even short sections where there are no columns in between the three tracks). Due to the complex nature of this underground structure and shallow depths, construction using exclusively TBM is not possible. It may be technically feasible to mine portions of the three track structure. However, this significantly increases the complexity of the construction, which will increase the overall construction cost, critical features such as the structural box at the switches would still need to be constructed by cut and cover.

The detailed requirements for the Turnaround track geometry which includes the three track structure were presented on August 29, 2005 (Attachment 4). This memo includes the calculations for the length required to accommodate a three track structure north of Downsview Station. A critical component of the three track structure is that all switch work must be on tangent track. This was in conflict with the recommended alignment (South #2 West) which included curve that extended well beyond (>400m) Downsview station. In response, a number of alignment refinements were generated including two variations of South #2 West. (see Attachment 5). South 2 Option A and Option B are various compound curves designed to minimize property impacts while still adhering to the requirement where switches must be on tangent sections.

These options were analyzed and South 2 option A was selected as the preferred for the following reasons.

- Adherence to requirement of having switches on tangent tracks
- Met 2 minute headway operations (as tested by TTC)
- Least number of property impacts
- Lower capital cost

Recognizing that the recommended option still required the cut and cover construction which would displace the buildings on the surface, each of the affected property owners were notified by registered mail and were given the opportunity to comment at the

November 28, 2005 Toronto Transit Commission meeting. In response to opposition by the local businesses, TTC staff were directed to assess alternative locations for the three track structure.

A variety of options were considered (See Attachment #7). The original EA option proposed that the 3-track structure be placed directly north of Downsview station. This is an extension of the 3-track until there are tangent sections available for the placement of crossovers.

Option 1 involves the placement of crossover just before the Sheppard West station within Downsview Park lands. The alignment, however, will remain the same while the construction methodology will differ due to this placement.

Option 2 places the 3-track structure south of the Downsview Station, close to Wilson yard. The advantage of this is that TTC already operates at the site and that major modifications are not required.

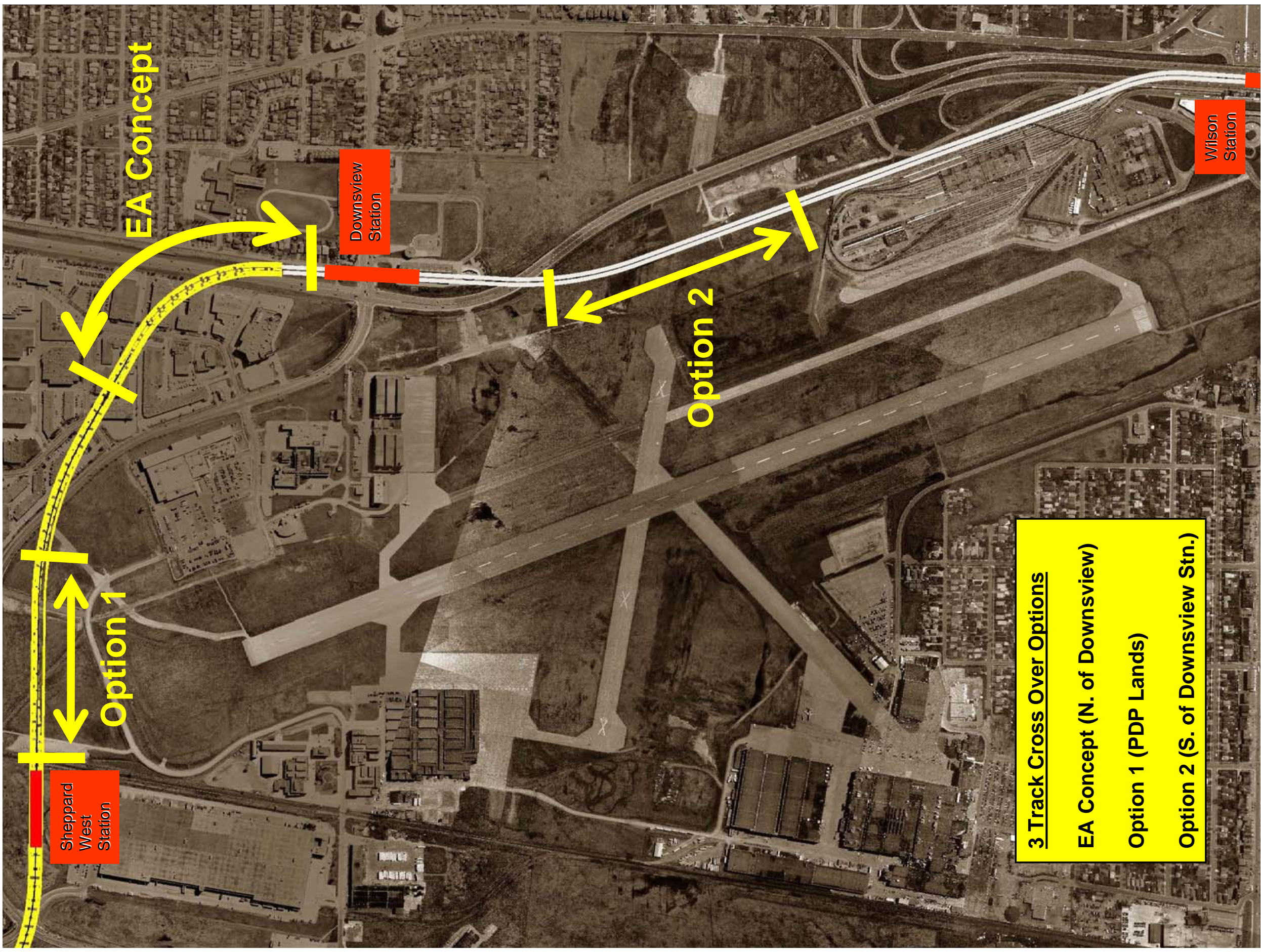
Option 2 was selected as preferred as it provides the most capital and operating savings and avoids the impacts to the businesses on Kodiak Crescent.

The Commission was advised that the three-track structure will be relocated to south of Downsview station, thus avoiding construction impacts on the Kodiak industrial subdivision properties verbally at its December 16, 2005 meeting, and in writing at its January 20, 2006 meeting (See Attachment 6).

The three-track structure, to be located south of Downsview station, is necessary for:

1. High speed turn back of trains at Wilson Station for the operation of short-turn service from Finch Station to Wilson Station;
2. Efficient restoration of scheduled subway service in the event of incidents or emergencies; and
3. Temporary storage of subway trains and workcars.

The location of this three track configuration was incorporated as part of the Wilson Yard EA and is not part of this EA (See Attachment 7)



Sheppard West Station

Option 1

EA Concept

Downsview Station

Option 2

Wilson Station

3 Track Cross Over Options
EA Concept (N. of Downsview)
Option 1 (PDP Lands)
Option 2 (S. of Downsview Stn.)

TORONTO TRANSIT COMMISSION

TO Geoff Marinoff
 FROM Tom Middlebrook
 DATE November 3, 2004
 SUBJECT Spadina and Sheppard Subway Extensions
 Train Fleet Storage and Maintenance Facilities Requirements

Further to your October 6, 2004 meeting with Pierre Laurin and Stephanie Rice, we are writing to request information on train storage and maintenance facility capacity to accommodate extensions of Spadina Subway (from Downsview Station to Steeles Avenue) and the Sheppard Subway (from Don Mills Station to Scarborough Centre Station).

Background

During the early 1990's Environmental Assessments (EA's) were conducted for the Yonge-Spadina Subway Loop Phase 1 (from Downsview Station to York University and Sheppard Subway (from Yonge Street to Scarborough City Centre) projects. The former Minister of the Environment and Energy approved the EA's in 1994. Subsequently, due to lack of funding, only the Yonge to Don Mills section of the Sheppard Subway was constructed.

In 2001, the Rapid Transit Expansion Study identified the Spadina Subway Extension (from Downsview Station to Steeles) and the Sheppard Subway Extension (from Victoria Park to Scarborough City Centre) as TTC's highest priorities for Rapid Transit Expansion.

At this time, capital funding for both projects is "below the line" and, therefore, the timing and phasing of implementation of the two projects is uncertain. However, the Commission has directed that staff commence with securing required Environmental Assessment approvals for the two projects. Because the Rapid Transit Expansion Study reaffirmed the original alignment for the Sheppard Subway Extension, only an update of the original EA study would be required. However, due to changes in the transportation and land use planning context during the 12 years since the original Yonge-Spadina Loop EA study was conducted, there is a need to review the alignment and station locations for the Spadina Subway Extension. Because the preferred alignment will likely vary significantly from the EA-approved alignment, the Ministry has directed TTC to conduct a new Environmental Assessment for the Project. The EA Study has now commenced and will be completed in late 2005.

In order to determine the environmental impacts of the Project, the Spadina Subway Extension EA study needs to identify all of the major facilities required for the Spadina Subway Extension, including any new or expanded train maintenance and storage facilities.

- 2 -

Service Levels for Spadina and Sheppard Extensions

As detailed in the attached Table One, Service Planning has developed several options for the two Subway Extensions:

- **Y-U-S Option 1** - This option shows the impact of extending the morning peak period short turn from St. Clair West Station to Glencairn Station, with the existing terminus at Downsview Station. Option 1 would result in an increase of 18 morning peak cars in service (compared to October 2004). We understand that implementation of this option is currently planned for 2006.
- **Y-U-S Option 2** - This option depicts the extension of the Y-U-S Subway to Steeles Avenue, with a morning peak period short turn at Glencairn Station. This would increase the number of morning peak cars in service by 48 cars compared to October 2004 service.
- **Y-U-S Option 3** - This option indicates that an increase of 90 morning peak cars (compared to October 2004) would be required for full subway service from Finch to Steeles West Station.
- **Sheppard Option 1** - This option indicates that 20 additional morning peak cars in service would be required to provide 6-minute service from Yonge to Scarborough City Centre.
- **Sheppard Option 2** - Lastly, this option shows an increase of 40 morning peak trains to provide increased service frequency on an extension to Scarborough City Centre.

The timing and phasing of both the proposed Sheppard Subway and Spadina Subway Extension projects are unknown at this time. We are assuming that implementation of Y-U-S Subway service improvements and the Subway extensions would occur in the following order:

- **Step 1** - Y-U-S Option 1 (plus 18 AM cars in service),
- **Step 2** - Y-U-S Option 2 (plus 48 AM cars in service), *30 new cars.*
- **Step 3** - Y-U-S Option 2/ Sheppard Option 1 (plus 68 AM cars in service),
- **Step 4** - Y-U-S Option 3/ Sheppard Option 2 (plus 110 AM cars in service),
- **Step 5** - Y-U-S Option 3/ Sheppard Option 2 (plus 130 AM cars in service).

We request that you advise us of the effect of Steps 2, 3, 4 and 5 on the overall train fleet size (including maintenance/spares). More importantly, please also advise whether the existing Wilson and Davisville Yards have sufficient capacity to accommodate the increases in the train fleet, and if not, what general improvements would be required.

Attachment 2

Table One
Subway Service Designs

	Present Service, October 2004	Possible New Service	Net Change
1 Yonge-University-Spadina Subway			
Option 1 - Downsview Station terminus, with short turn at Glencairn Station			
Morning peak trains	48	51	3
Morning peak cars	288	306	18
Afternoon peak trains	49	49	0
Afternoon peak cars	294	294	0
Weekly crew hours change			90
Weekly car miles change			5,850
Option 2 - Steeles West Station terminus, with short turn at Glencairn Station			
Morning peak trains	48	56	8
Morning peak cars	288	336	48
Afternoon peak trains	49	57	8
Afternoon peak cars	294	342	48
Weekly crew hours change			1430
Weekly car miles change			85,167
Option 3 - Steeles West Station terminus, no short turn			
Morning peak trains	48	63	15
Morning peak cars	288	378	90
Afternoon peak trains	49	57	8
Afternoon peak cars	294	342	48
Weekly crew hours change			1640
Weekly car miles change			100,112
4 - Sheppard Subway			
Option 1 Extension to Scarborough Centre Station; 6 min policy maximum headways			
Morning peak trains	4	9	5
Morning peak cars	16	36	20
Afternoon peak trains	4	9	5
Afternoon peak cars	16	36	20
Weekly crew hours change			1,300
Weekly car miles change			48,666
Option 2 - Extension to Scarborough Centre Station; 10,000 pphpd peaks, 6 min policy maximum headways off-peak			
Morning peak trains	4	14	10
Morning peak cars	16	56	40
Afternoon peak trains	4	14	10
Afternoon peak cars	16	56	40
Weekly crew hours change			1,650
Weekly car miles change			61,715

DEPARTMENT Rapid Transit Expansion Program

FROM D.R.
Callan DATE
December
7, 1993

TO Executive Committee

MOE SUBJECT
of Approval - New
Subway Storage
and Maintenance
Facility

COPY G.A. Smith
J.G. Ball
M. Rigney
T.G. Middlebrook
G.W. McNeil
D. Hammond
Corporate Records

On October 26, 1993 the Ministry of Environment and Energy (MOEE) E.A. Branch released its review of the New Subway Storage and Maintenance Facility Environmental Assessment Report. The public review period expired on November 30, 1993.

Since no requests for a hearing were received, the E.A. Branch will soon be forwarding its report to the Minister's Office recommending approval of the Environmental Assessment Report with the attached terms and conditions. In summary these conditions require the TTC to:

provide detailed building site plans for MOEE approval, prior to construction;

prepare a Material and Soil Management Strategy for MOEE approval, which shall include an analysis of excavated soil and material, and procedures for the appropriate disposal of these materials;

update the noise impact assessment based upon the actual design for the project, for MOEE Approval; and,



Order in Council
Décret

On the recommendation of the undersigned, the Lieutenant Governor, by and with the advice and concurrence of the Executive Council, orders that:

Sur la recommandation du soussigné, le lieutenant-gouverneur, sur l'avis et avec le consentement du Conseil des ministres, décrète ce qui suit :

WHEREAS section 14 of the Environmental Assessment Act provides that where the Minister of the Environment and Energy has accepted an environmental assessment of an undertaking, the Minister may with the approval of the Lieutenant Governor in Council, give approval to proceed with the undertaking subject to such terms and conditions as the Minister considers necessary, or refuse to give approval to proceed with the undertaking;

WHEREAS, having considered the purpose of the Act, the environmental assessment, as accepted, of the undertaking, which is the subject of the attached notice, the undersigned Minister of Environment and Energy is of the opinion that the undertaking should be given approval to proceed, subject to the terms and conditions specified in the attached notice; and

WHEREAS no notices requiring a hearing have been received by the undersigned Minister of Environment and Energy;

THEREFORE, pursuant to the provisions of the Environmental Assessment Act, the undertaking which is the subject of the attached notice, be given approval to proceed subject to the said terms and conditions.

Recommended Bud Weidman
Minister of Environment and Energy

Concurred Robert Speer
Chair of Cabinet

Approved and Ordered JAN 13 1994
Date

[Signature]
Lieutenant Governor

Certified to be a true copy.

[Signature]
Secretary of the Executive Council

ENVIRONMENTAL ASSESSMENT ACT
NOTICE OF ACCEPTANCE OF THE ENVIRONMENTAL ASSESSMENT AND
NOTICE OF APPROVAL TO PROCEED WITH THE UNDERTAKING

RE: An Environmental Assessment for the New Subway Storage and Maintenance Facility (Wilson Expansion 1993)

Proponent: The Municipality of Metropolitan Toronto, and the Toronto Transit Commission (TTC)

EA File No.: TP-TT-02

TAKE NOTICE that the date for receipt by me of submissions or requirements for a hearing on the above Environmental Assessment and/or its Review, provided for in the Notice of Completion of Environmental Assessment Review, dated October 26, 1993, expired on November 26, 1993. I received no requirements for a hearing by that date. I do not consider it advisable to require a hearing.

ACCEPTANCE OF THE ENVIRONMENTAL ASSESSMENT

Having considered those matters set out in Section 8 and pursuant to Section 9, I accept the Environmental Assessment.

APPROVAL OF THE UNDERTAKING

Under Section 13 of the Act, before the decision on approval to proceed with the undertaking can be made, the proponent has the opportunity to require a hearing by the Environmental Assessment Board. The proponent has waived this right.

Having considered the purpose of the Act, the Environmental Assessment of the undertaking as accepted, and the submissions received, I hereby give approval to proceed with the undertaking subject to the following terms and conditions:

1. Except as otherwise provided by these conditions, the undertaking shall be carried out in accordance with the provisions of the Environmental Assessment (EA) which are incorporated herein by reference.

Soils Management, Decommissioning, and Stormwater Management

2. Prior to the commencement of the construction of any building associated with this undertaking, the proponent shall prepare and submit, to the satisfaction of the Director, Central Region, Ministry of the Environment and Energy (the Director), a detailed site plan showing the location and all other design aspects of the maintenance facilities normally shown on a site plan, including storage facilities for chemicals.
3. Prior to any site excavation the proponent shall obtain the approval of the Director for a Material and Soil Management Strategy, to be implemented with such changes as are approved from time to time by the Director. The Material and Soil Management Strategy (the Strategy) shall include the following components as a minimum.
 - a) A history of the site, an environmental audit of the site, and an analysis of the material and soil from each borehole and the borehole information to confirm that the material and soil are suitable for the method and location of disposal proposed.
 - b) The approval of the Director for the methods and locations of disposal.
 - c) If any material or soil is proposed to be disposed of at a Metropolitan Toronto and Regional Conservation Authority (the Authority) lakefill site the proponent shall provide the Director with written confirmation from the Authority before excavation that it is prepared to accept the soil.
 - d) The provision to the Director of copies of the waybills confirming receipt of the material and soil at any disposal site other than an Authority lakefill site.

Noise and Vibration

4. The noise impact for the undertaking shall be reassessed in detail at the design stage of the project. The reference document for the assessment shall be the

MOEE/TTC Noise Protocol for Noise and Vibration Assessment for the Proposed Yonge-Spadina Loop. The report of the assessment shall be submitted to the Director, MOEE Approvals Branch for approval.

Public Safety

5. The TTC will work with the Metropolitan Toronto Police during facility design, site plan approval and during the creation of operating (emergency response) plans to ensure public safety.

REASONS

The reasons for giving approval are:

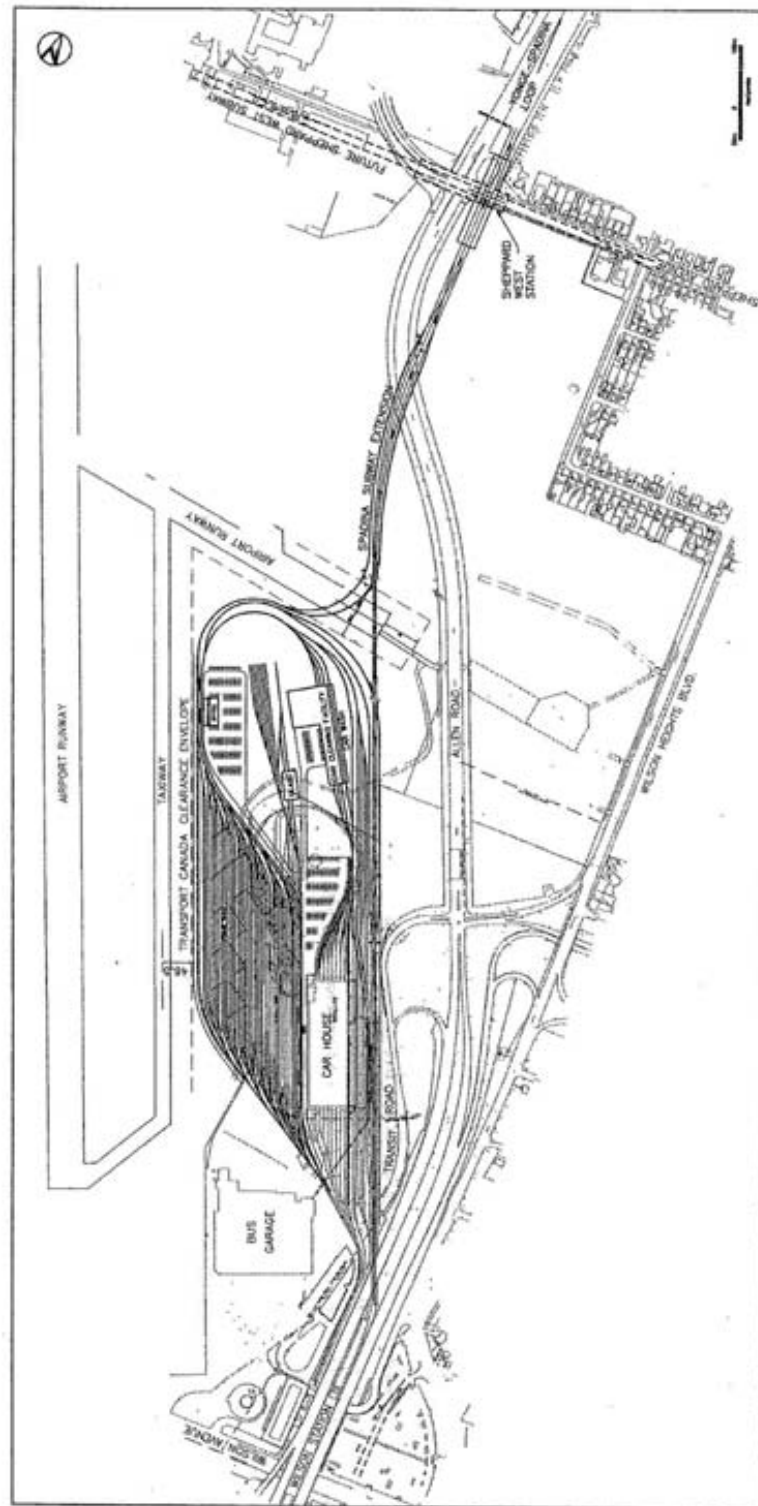
1. The Environmental Assessment document identifies a need for the proposed project, and the proponent has carried out the planning of the undertaking in accordance with the requirements of the Environmental Assessment Act.
2. The Government Review Team has indicated no outstanding concerns with this project. The concurrent public review of the environmental assessment did not identify any outstanding concerns.
3. I have not received any submissions on requirements for a hearing after giving the Notice of Completion dated October 26, 1993. I am not aware of any outstanding issues with respect to this undertaking which suggest that a hearing should be required.

Dated the 13 day of JAN, 1994 at
TORONTO.

Paul Shieldman
Minister of Environment and Energy
135 St. Clair Avenue West
12th Floor
Toronto, Ontario
M4V 1P5

Approved by O.C. No. 8/94

Figure 8.3
Wilson Yard Expansion



LET'S MOVE
ON

Morrison Herdfield Limited
Consulting Engineers
with Acera International Limited

Attachment 3

TORONTO TRANSIT COMMISSION

1081450
RECEIVED
A85-63

TO T.G. Middlebrook ✓
FROM R. Cornacchia
DATE September 13, 2005
SUBJECT Spadina Subway Extension – TTC Subway Operations Requirements

In response to your request, we are documenting the following requirements as discussed at the meetings with yourself and the Consultants:

- 1) Two-minute headway;
- 2) No unbalanced super elevation;
- 3) Wilson Yard north connection;
- 4) A double-ended three track centre track north of Downsview Station;
- 5) Double-crossover south of Keele Station; and
- 6) A single-ended three track storage track north of Steeles Station with provision for double-ending this storage track when the subway is extended further north.

Attached is a Position Paper describing the rationale and requirements for a double-ended three track north of Downsview Station.

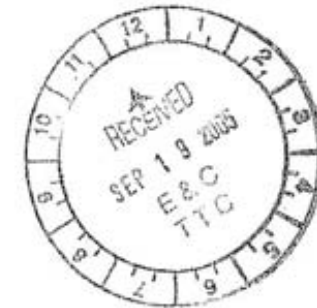
Further, we should update our Design Manual to incorporate the design requirements as noted in items 1, 4 and 6 (as item 2 is already incorporated).


If you have any comments or concerns regarding the attached, please do not hesitate to contact me.

Rublawach
Deputy General Manager
Subway Operations

6-183-59
Attachment

Copy: D. Finn B. Dawson
 W. Bartram S. McKay
 P. Millett



	Signalling Study	SLX 01
Toronto Transit Commission Signals Engineering	Spadina Line Extension Downsview Centre Track Requirement Position Paper	

(Minor changes to the previous edition are indicated by ♦ placed before the relevant paragraphs.)

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1 SCOPE

1.1 Concerns have been raised by Operations Branch regarding the proposed configuration of the storage track just north of Downsview Station. In particular, there is a concern that owing to construction costs, the storage track may be configured as a pocket track with access to the mainline at the south end only instead of the desired centre track configuration which would have access to the mainline at both north and south ends. Were that to happen, the operational flexibility of the Spadina Line will be negatively impacted during both the construction phase and the revenue service phase.

1.2 In this light, this report has been written to:

- 1.2.1 Delineate the requirements for the Downsview storage facility,
- 1.2.2 Delineate the reasons why a Centre Track is preferred over a Pocket Track for this storage facility,
- 1.2.3 Delineate concerns over a proposal to build the storage facility in open cut,
- 1.2.4 Raise concerns regarding the capacity/throughput of the northern end of the Wilson Yard Mainline area, and,
- 1.2.5 Obtain consensus of the foregoing among the affected TTC Operations Branch Departments.

1.3 Section 2 delineates the Downsview Centre Track requirements presented by Operations Branch.

1.4 Section 3 delineates the arguments supporting the centre track requirement.

1.5 Section 4 raises associated concerns regarding the:


- 1.5.1 The northern connection to Wilson yard, and,
- 1.5.2 The provision of a three track tail track structure at Steeles for a future centre track construction.

1.6 Section 5 lists conclusions and provides some recommendations.

2 DOWNSVIEW STORAGE FACILITY REQUIREMENTS

2.1 The proposed Downsview storage facility must be configured as a centre track in order to achieve the maximum operational benefit.

2.2 The desired configuration should emulate the St. Clair West Centre track which is comprised of three switches at the south end (1 left turnout, 1 right turnout, and 1 equilateral turnout), four switches at the north end (2 left turnouts and 2 right turn

	Signalling Study	SLX 01
Toronto Transit Commission Signals Engineering	Spadina Line Extension Downsview Centre Track Requirement Position Paper	

outs) and a bumper for the small piece of "overlap" track extending north of the northern switches.

2.3 The desired location for this centre track is just north of Downsview utilizing the existing tail track structure. This will afford four main functions:

- 2.3.1 Afford staging and sufficient isolation from the mainline to the new extension during the construction phase with a minimum of impact to revenue service to Downsview,
- 2.3.2 Afford the ability to turn service trains back at Downsview thus affording Downsview a higher frequency of service than the new extension as passenger loading warrants,
- 2.3.3 Afford the ability to stage work cars from Wilson Yard in the centre track in advance of the nightly end of service to maximize maintenance work time,
- 2.3.4 Afford the ability to "park" slower northbound and southbound service trains to allow the queue of backed up trains to bypass, and,
- 2.3.5 Afford the ability to stage "change-off" trains in the centre track as required during service to ease congestion at the Wilson Yard Mainline Interlocking.

2.4 The centre track must afford a two minute headway turn back.

2.5 The centre track must be situated in a covered (box or tunnel) structure to afford maximum reliability. Storage facilities which are situated in the open are subject to reliability problems due to adverse weather.

2.6 The use of unbalanced super elevation must be kept to a minimum.

3 CENTRE TRACK JUSTIFICATION


3.1 There are a number of key reasons why a centre track configuration is preferred over a pocket track configuration for the Downsview storage facility. They include:

3.1.1 Benefits During Construction.

Switches at the north end will allow construction trains to service both mainline tunnels from the storage track with a minimum of impact on revenue service into Downsview Station. Moreover, construction trains could be sent out from Wilson Yard and placed in the centre track at convenient periods during the day to support construction activities. A pocket track arrangement would not afford this flexibility. Trains stored in the existing tail tracks would impact the use of the associated platforms as trains arriving at the terminal would be forced to enter at a slower speed due to the reduced overlap. This slower speed is enforced by the Platform Blind Trainstop functionality. Briefly, this functionality causes the Blind Trainstops to be driven clear upon the establishment of a route into a given platform if the associated tail track is clear. If the associated tail track is not clear, the Blind Trainstops will remain in the trip position when a route into the platform is established and will only drive clear after their respective time once the platform track is occupied.

3.1.2 Testing and commissioning of the new extension.

Switches at the north end will allow dynamic testing to be conducted all day instead of during non-revenue hours. In a typical signal system test program, dynamic testing with test trains can commence once the static

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testing of the signalling and track has been completed. Test trains could work a centre track to Steeles loop thereby allowing testing to continue throughout the day. A pocket track arrangement would reduce dynamic testing to non-revenue hours due to the need to run into Downsview station and turn back using the switches south of Downsview station. This constraint could increase the dynamic testing window by a factor of as much as twelve. As above, test trains could be stored in the middle road when not in use thereby not foul of either "original" tail track and therefore not impacting revenue terminal operation at Downsview. During the Sheppard Line Test and Commissioning phase, dynamic testing was performed over two periods; the first being three weeks and the second being one week. The robust testing performed on the Sheppard Line allowed for numerous signal system faults to be found and corrected prior to the opening of the Line. Without the centre track this dynamic testing task could expand from a 3 to 4 week period to a 36 to 48 week period unless extended shutdowns of the Downsview Extension were approved.

3.1.3 **Operator Familiarization.** Prior to the opening of the Sheppard Line, Operators of the YUS Division were given approximately two hours of line familiarization. As above, a centre track configuration would support Operator familiarization all day long. This period of familiarization contributed to the successful opening of the Sheppard Line. As with §3.1.2, this task would be virtually impossible


to perform without a centre track. An extended shutdown north of Wilson would be required to perform this training.

3.1.4 **Temporary storage of short turning service trains.** During revenue operation, it is vital to have the ability to remove service trains, store them for a period of time, and then insert them back into service as required. A centre track arrangement would afford more flexibility for this requirement allowing southbound trains to enter the storage facility and to allow trains to rejoin the service northbound service. Moreover, southbound trains seeking entry into Wilson Yard could be temporarily stored in the centre track were the Wilson Yard Mainline Interlocking busy. Currently, when this happens, trains are sent to either Lawrence West or St. Clair West Centre Tracks for temporary storage. Finally, a centre track configuration allows slower northbound or southbound service trains to be "parked" in the centre track whilst following trains could be "advanced" past.

3.1.5 **Temporary storage and staging of workcar fleet.** A centre track operation is necessary to afford the needed flexibility in managing the nightly work car deployment and recovery. "Engineering hours" on the TTC are very short, typically affording a mere 200 minutes to Track and Structures to deploy the work cars, perform the work, and return to Wilson Yard. The ability to store work cars in a centre track would provide some flexibility in the management of the work car deployments.

3.1.6 **Temporary storage and staging of "change-off" trains.** Similar to §3.1.5, a centre track would afford increased

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flexibility to stage trains deployed from Wilson Yard for "change-off".

3.1.7 **Cold Storage.** During periods of extreme cold and/or snow and ice, a centre track will enhance the deployment and recovery of trains placed on the mainline for cold storage overnight. Switches at the north end would improve the ability to position and sequence trains.

3.2 In addition to the foregoing, it must be pointed out that, with the exception of the Eglinton pocket track, the TTC has only built centre tracks since the original Bloor-Danforth construction. The operational flexibility afforded by these centre tracks is immeasurable. The existing centre tracks are heavily used by Subway Operations whilst the two existing pocket tracks are rarely used. For example, the Islington Centre Track was utilized 317 times during the first 6 months of 2004.

3.3 Finally, given the development within Vaughan at present and proposed for the future, further extensions north into Vaughan should be expected. Without, a centre track in the Downsview area, the ability to manage service in these extensions will be constrained as the subsequent end terminals will be pushed farther away from the existing interim storage facility afforded by the Lawrence West Centre Track.

4 OTHER CONSIDERATIONS

4.1 Whilst the focus of this project is to build a subway extension to York University, consideration must be given to ensuring that service trains can get in and out of Wilson Yard in a timely fashion to build and reduce service as required. Similarly,

rapid ingress and egress of the work car fleet based at Wilson Yard is critical to maximizing the work performed during the non-revenue hours of operation by Maintenance and Engineering personnel.

4.2 The Wilson Yard Mainline area is already a bottleneck and it will only get worse with the proposed extension. The construction of an additional access road for improved access to Wilson Yard is a requirement that must be linked to the proposed extension to Steeles. Figure 1 depicts one option which would contribute towards improving the access to Wilson Yard.

4.3 Further to §3.1.5, the tail track structure at the proposed Steeles Terminal should be constructed to support a future centre track construction when the line is extended into Vaughan for the reasons delineated in §3.1.1, §3.1.2, and §3.1.3.

5 CONCLUSIONS


5.1 It is recommended that a centre track configuration be constructed for the proposed storage facility at Downsview. A centre track configuration is more desirable than a pocket track configuration both during construction of the new extension and when the extension is in revenue operation.

5.2 It is recommended that this centre track facility must be in a covered (box or tunnel) structure for maximum reliability of the asset.

5.3 The preferred location of this centre track is just north of Downsview utilizing the existing Downsview tail tracks structure.

5.4 It is recommended that this project facilitate improved access to Wilson Yard. The

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- Wilson Yard Mainline area is currently a bottleneck that will only get worse with the proposed extension.
- 5.5 It is recommended that this project facilitate a future centre track configuration at the proposed Steeles Terminal by constructing a three road tail track structure similar to Finch.
- 5.6 Finally, it is recommended that the TTC Design Standards be updated to ensure that for new subway construction precedence is given to the construction of:
- 5.6.1 Centre track storage facilities as opposed to pocket track storage facilities, and,
- 5.6.2 A three road tail track structure at future terminal stations.

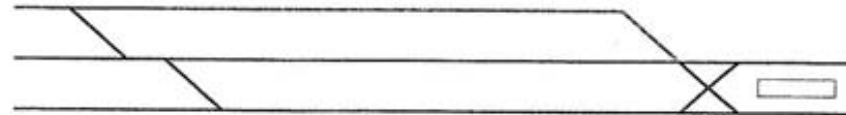


Figure 1: Proposed layout for improved access to Wilson Yard

Distribution

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Attachment 4

URS

Memorandum

Date: August 28, 2005
 To: Scott Thorburn
 From: David Perry
 c.c. Eugene Chen
 Reference: Spadina Subway EA - 33015347
 Subject: Downsview Turnaround Track Geometry

1. Introduction

This memo accompanies file 'Turnround track July 4 05.pdf'. This illustrates the length required for a single ended and a double ended turnaround track with provision for a train to enter the track from the south and clear the interlocking at the maximum speed allowed in the diverging direction on a #9 switch of 33 kph.

2. N end of platform to Point of Switch

The north end of Downsview Station platform is the zero point. From TTC drawings the distance from this point to the point of switch of the interlocking would be 33 metres.

3. Point of grade diversion

$33 + 37.8 = 70.8$ metres, based on geometry of #9 switch and DM - 0206 - 01, Fig. 2.3.C. If the turnaround track were to be constructed at minimal grade but it was desirable for the main lines to descend to allow tunnels to be bored, this is the point that the vertical curves on the main tracks could begin. Of course this would be inconsistent with a double ended turnaround track.

4. Length of South Interlocking

84.7 metres from DM - 0206 - 01, Fig. 2.6.B.

5. Signals allowance

10 metres from PS of equilateral according to DM - 0206 - 01, Fig. 2.3.C.

6. Start of horizontal curvature

12 metres from PS of equilateral according to DM - 0206 - 01, 2.2.2.2 (with approval). This

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point $33 + 84.7 + 12 = 129.7$ metres from N end of platform is the earliest point curvature can begin for alternative S1.

7. End of existing Structure

From TTC Drawing, 195.7 metres from N end of platform. For alternatives S2, S3 and S4 with a single ended turnaround track this represents the earliest point of potential curvature.

The main tracks and the double ended turnaround track, for alternatives S2, S3 and S4, could be curved from here to a point 12 metres from the nearest PS of the N interlocking.

8. Train length

150 metres for a six car train.

9. Deceleration Length

The objective is to turn trains around at Downsview while maintaining a 2 minute headway. To do this it is deemed necessary to run trains into the turnaround track at the maximum speed allowed by the #9 switches (33 kph) and allow an additional length for the train to decelerate once on the turnaround track in order to minimise the time occupying the interlocking.

- Calculation

TTC Have quoted a deceleration rate of 2.58 mphps, but this appears to be a maximum service braking rate. It is unlikely that such a high rate would be achieved under these circumstances (from the low speed of 33 kph) due to tapering of the brake on application and approaching the stop to avoid jerk. Therefore we have assumed a conservative figure of 1 mphps, or 1.6 kphps.

Using this figure the train would stop in 20.6 seconds and, assuming linear deceleration, cover 94.5 metres while decelerating. Therefore we would recommend an additional 100 metres for this deceleration, giving a total turnaround tunnel length of 280m from PS of the equilateral switch.

- Critical Condition

Note that according to this calculation the critical condition will be when exiting the turnaround track, rather than on entry. Assuming the 33m from end of platform to PS of the main line switch, i.e. 183 m from PS to far end of platform, then deceleration would need to begin $183 - 94.5$, i.e. 88.5 metres from PS. At this distance only half the train has crossed onto the main line and the switch is occupied during the first part of the train's deceleration.

10. End of track and Tunnel Wall for single ended track

For single ended track, $1.8 + 11 + 7 + 2 = 21.8$ metres according to DM - 0206 - 01, Fig. 3.5. The last 25 metres of this track must be tangent. Note that this is 1.8 metres more than DM - 0206 - 01, Fig. 2.3.C. This gives a total distance from the N end of the platform of $33 + 84.7 + 10 + 150 + 100 + 21.8 = 399.5$ metres.

11. Signal allowance N end for double ended turnaround track

10 metres as for S end.

12. Length of North End Interlocking

$31.3 + 83.5 + 1.4 = 114.8$ metres according to DM - 0206 - 01, Fig. 2.2, 2.3A, 2.3.C, 2.4B. This defines the end of the three track structure at $33 + 84.7 + 10 + 150 + 10 + 114.8 = 402.5$ metres from N end of platform.

13. Deceleration Length for double ended turnaround track

Note that for this configuration a specific deceleration length is not necessary as the distance from the end of the train to the end of the three track structure $10 + 114.8 = 124.8$ metres exceeds that for deceleration and tunnel end of $100 + 21.8 = 121.8$ metres.

However the signaling system must allow a decelerating train to pass the signal protecting the N. end interlocking.

14. Begin vertical curvature for double ended turnaround track

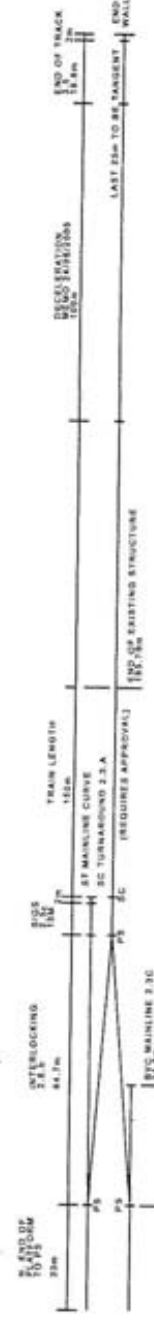
10 metres from northernmost PS or 412.5 metres from N end of platform according to DM - 0206 - 01, Fig. 2.3.C.

15. Begin horizontal curvature for double ended turnaround track

46 metres from northernmost PS or 448.5 metres from N end of platform according to DM - 0206 - 01, Fig. 2.3.B.

TTC SPADINA SUBWAY

TOTAL LENGTH OF 3 TRACK STRUCTURE FOR DEAD END TRACK 399.5m



TOTAL LENGTH OF 3 TRACK STRUCTURE FOR DOUBLE ENDED TRACK 403.1m



July 22, 2005

Attachment 5

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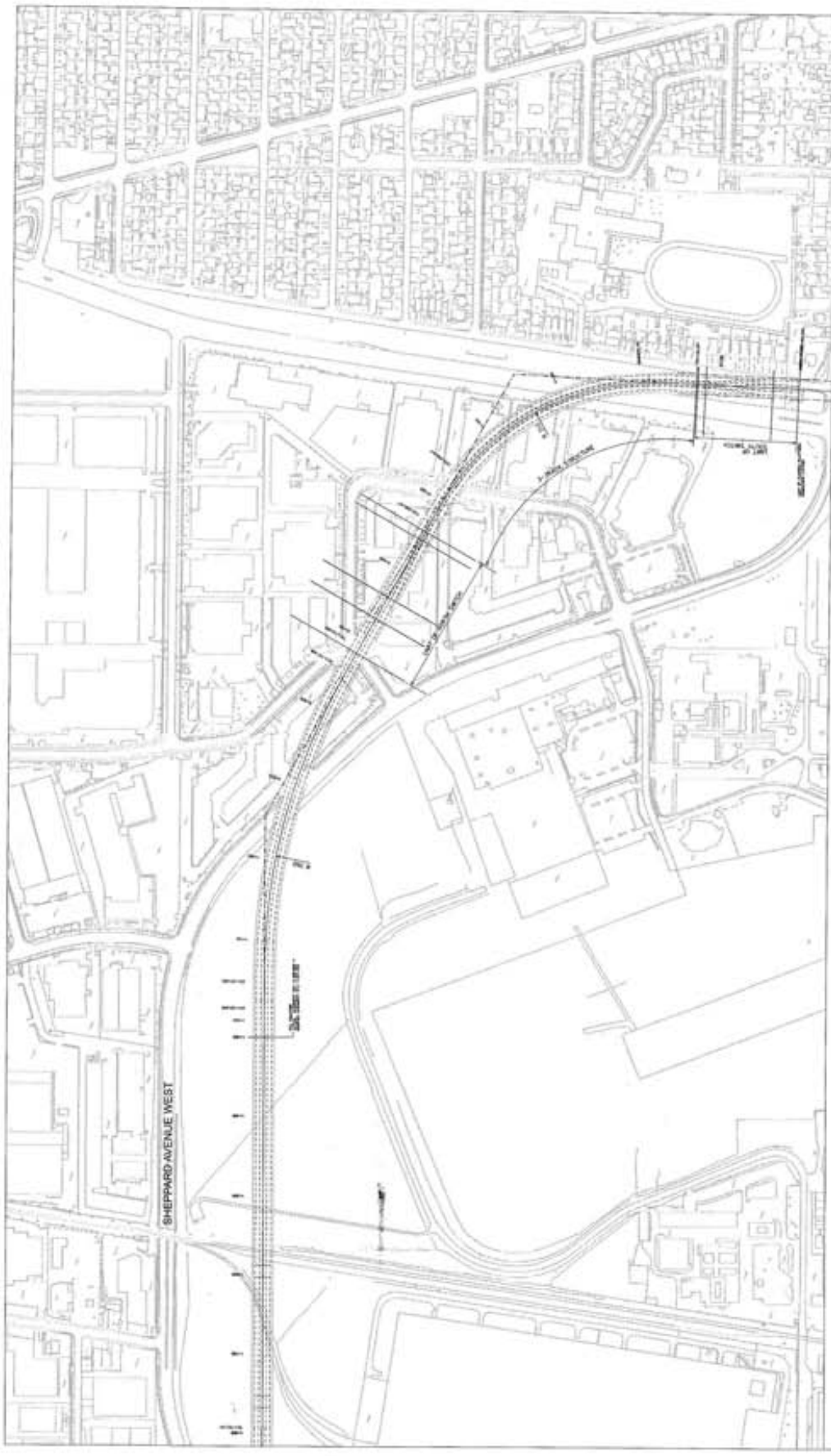
Operational



TTC SPADINA SUBWAY EXTENSION

SOUTH OPTION-2
REFINEMENT ALTERNATIVES

31 OCT 2005



TTC SPADINA SUBWAY EXTENSION

MODIFIED SOUTH ALIGNMENT
COMPOUND CURVE OPTION - A

31 OCT 2005



TTC SPADINA SUBWAY EXTENSION

MODIFIED SOUTH ALIGNMENT
COMPOUND CURVE OPTION - B

31 OCT 2005

TTC Spadina Subway

**DOWNSVIEW TRACK WORK
DRAFT - FOR INTERNAL USE ONLY**

DATE: 10/31/2005

Indicators	Measures	Data by	S2		S2-Option A		S2-Option B	
			Double Ended Turnouts	0	Double Ended Turnouts	R=310@ L=275	Double Ended Turnouts	R=310@ L=190 R=310@ L=154
Speed and comfort for subway passengers.	<ul style="list-style-type: none"> Length of Curves with Radii less than 457m Length of curves with radii between 457m and 750 m. 	URS	0	R=485@ L=750	R=485@ L=750	R=485@ L=750	R=485@ L=750	
Number, type of employment properties that are directly affected.	<ul style="list-style-type: none"> Number of businesses 	URS	7		5	6		
Capital costs including underground and surface subway facilities, fleet and storage. (TTC, URS - P, Collins)	<ul style="list-style-type: none"> Capital costs estimated in 2005 dollars after GST Rebate \$(millions) 	URS	602	Manufacturing, Car Dealership	Manufacturing, Car Dealership	Manufacturing, Car Dealership	Manufacturing, Car Dealership	
	<ul style="list-style-type: none"> Length of alignments (curve) where construction by TBM may not be feasible 	TTC (Engineering)	1020		570	530	563	
E2.1) Total property cost. (JDA)	<ul style="list-style-type: none"> Estimated real estate costs in 2005 dollars. (million) Estimated real estate costs & Capital Costs. (million) Operating Cost/Operating Saving 	URS	38.2		25.7	31.0		
E3.2) Operations and maintenance cost of the subway extension, including feeder bus operations.		URS	640		594	594		
		TTC (Ops)						

O:\1-30015347 Spadina Subway EA\Documents\04 Analysis\Track work\Track Work Analysis Table-preferred south alternatives Oct31-05.xls\Summary Table

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TORONTO TRANSIT COMMISSION

TO Commissioners

FROM Richard C. Ducharme

MEETING DATE January 25, 2006

**SUBJECT Staff Response to Commission Inquiry
Spadina Subway Extension Environmental Assessment Study**

At its meeting of November 28, 2005, when considering the report "Spadina Subway Extension Environmental Assessment Study Final Recommendations", the Commission directed:

1. "That staff review the feasibility of making minor adjustments to the route and consider construction methods that will minimize the disruption to industrial properties in the Kodiak industrial subdivision.
2. That staff work with business owners and the administration of Downsview Park to assist with the relocation of these businesses on the nearby Downsview lands, and that this be part of the negotiations with the Park regarding the locating of a station on the Downsview Park lands.
3. That staff report on the possibility of building Fire Station #141 into the Finch West Subway Station.
4. That staff consult with the City Works Department and develop plans for the completion of the trunk sewer north from Sheppard towards Grandravine in conjunction with the construction of this subway.
5. That staff report on possible alternative names for the Finch West Station (Keele North Station) and Sheppard West Station (Park Station).
6. That staff report back on the rational of the three track system versus the two track system."

This memorandum responds to the Commission's requests.

Relocation of Three-Track Structure (Motions 1, 2 and 6)

At the December 16, 2005 Commission meeting, staff advised that the three-track structure will be relocated to south of Downsview Station (see Exhibit 1), thus avoiding construction impacts on the Kodiak industrial subdivision properties. Because these businesses will be maintained in their current location, further discussions about relocating the businesses to the Downsview Park lands (as detailed in Motion 2, above) are not necessary.

Following the December 16, 2005 Commission meeting, registered letters were sent to all affected property owners to advise that full acquisition will no longer be required and that the Spadina Subway Extension will be

constructed under their properties by tunnelling.

The three-track structure, to be located south of Downsview Station, is necessary for:

1. High speed turn back of trains at Wilson Station for the operation of short-turn service from Finch Station to Wilson Station;
2. Efficient restoration of scheduled subway service in the event of incidents or emergencies; and
3. Temporary storage of subway trains and workcars.

Integration of Fire Station #141 with Finch West Station (Motion 3)

The recommended location of the Finch West Station bus terminal will displace Fire Station #141 (located at 3965 Keele Street) (see attached Exhibit 2). In accordance with the Commission's motion, staff met with Toronto Fire Services to discuss potential integration of Fire Station #141 with Finch West Station. However, as detailed in Appendix A, opportunities for integration would be constrained due to impacts on existing properties and buildings and competing vehicle access/egress requirements for the bus terminal and the Fire Station.

Therefore, it is recommended that an alternate location be sought for Fire Station #141. TTC, City of Toronto Planning and City of Toronto Real Estate staff are working co-operatively with Toronto Fire Services to determine a suitable location for Fire Station #141. Opportunities to co-locate the Fire Station at an Emergency Exit Building site will also be investigated.

Future Black Creek Sanitary Trunk Sewer (Motion 4)

Staff will include commitments in the Environmental Assessment Study Final Report to co-ordinate construction of the Spadina Subway Extension with the City of Toronto Black Creek Sanitary Trunk Sewer System improvements within the Keele Street right-of-way, where practical.

Alternative Names for Sheppard West and Finch West Stations (Motion 5)

As detailed in the January 25, 2006 memorandum from Richard C. Ducharme to the Commission entitled "Staff Response to Commission Inquiry – Station Names on Spadina Subway Extension", staff recommend retaining the Sheppard West and Finch West Stations names, in accordance with Commission-approved policy.

Chief General Manager

1085513
80-2-100

Attachments: Exhibit 1 – Spadina Subway Extension Three-Track Structure
Exhibit 2 - Finch West Station Concept

APPENDIX A - INTEGRATION OF FIRE STATION #141 WITH FINCH WEST STATION

Possible alternatives to integrate Fire Station #141 with Finch West Station include:

1. **Option 1** - Integration of the existing Fire Station #141 building with the Finch West Station bus terminal and traction power sub-station;
2. **Option 2** - Reconstruction of the Fire Station within the area designated for the Finch West Station bus terminal and traction power sub-station;
3. **Option 3** - Relocation of the Fire Station and integration with one of the proposed station entrances (to be located at the south-east and north-west corners of the Keele/Finch intersection and on the west-side of Keele Street, south of Four Winds Drive; or
4. **Option 4** - Relocation of the Fire Station and integration with the passenger pick-up and drop-off or commuter parking lot within the Finch Hydro corridor.

However, each of these alternatives has drawbacks:

1. **Options 1 and 2** - Both the Fire Station and the bus terminal require similar traffic control and traffic signal priority measures for the efficient and safe delivery of services. As such, the co-location of the two facilities would result in compromised vehicle operations. Furthermore, additional property on the industrial condominium lands to the east would be required to accommodate both the Fire Station and the bus terminal. The potential property and business loss compensation costs are anticipated to exceed the cost of constructing a new Fire Station at an alternate location.
2. **Option 3** - Integration of the Fire Station with the proposed entrances at the Keele/Finch intersection would require full acquisition of properties at these locations. Both sites would be suitable for high-density, transit-oriented development due to their close proximity to Finch West Station and the major arterial roads. Opportunities for future redevelopment would be lost if the Fire Station is located at either of these sites.

The third entrance at Four Winds Drive is located within the landscaped area of a high-rise residential condominium (1 Four Winds Drive), adjacent to the ramp to the underground parking. Because the Fire Station would require an area of approximately one acre, there is insufficient space to accommodate the Fire Station within the landscaped area of the property, without affecting access to the underground parking.

3. **Option 4** - Toronto Fire Services do not support locating the Fire Station within the Hydro corridor under high voltage power lines due to staff health and safety concerns.

In view of the foregoing, it is recommended that Fire Station #141 be relocated to an alternate site.