



**ALTERNATE ROUTE FOUNDATION ASSESSMENT REPORT  
HIGHWAY 17 SUDBURY SOUTHWEST BYPASS FOUR-LANING  
FROM SUDBURY MUNICIPAL ROAD 55 (MIDDLE JUNCTION)  
TO HIGHWAY 69 FOR 13.3 KM  
GWP 5825-05-00  
DISTRICT 54, SUDBURY**

PETO MacCALLUM LTD.  
165 CARTWRIGHT AVENUE  
TORONTO, ONTARIO  
M6A 1V5  
Phone: (416) 785-5110  
Fax: (416) 785-5120  
Email: [Toronto@petomaccallum.com](mailto:Toronto@petomaccallum.com)

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PML Ref.: 06TF002  
Index No.: 057FFR  
Geocres No.: 41I-219  
January 9, 2008



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# ***Peto MacCallum Ltd.***

**C O N S U L T I N G   E N G I N E E R S**

## **ALTERNATE ROUTE FOUNDATION ASSESSMENT REPORT**

for

Highway 17 Sudbury Southwest Bypass Four-Laning

From Sudbury Municipal Road 55 (Middle Junction)

to Highway 69 for 13.3 Km

GWP 5825-05-00

District 54, Sudbury

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### **1. INTRODUCTION**

This report provides the foundation assessment of five alternative routes for a four-lane Highway 17 Southwest Bypass of the City of Sudbury that extends from the Middle Junction of Highway 17 and Sudbury Municipal Road 55 (SMR 55) to Highway 69 for 13.3 km, in Sudbury. The study was carried out for the Ministry of Transportation of Ontario (MTO) on behalf of Stantec Consulting Ltd. (Stantec).

The Preferred Corridor extends from about Sta. 15+220 Township of Waters (at SMR 55) to Sta. 19+260 Township of Broder (at Highway 69). A chainage equation of the existing highway alignment occurs at the following Stations:

Sta. 19+258.827 Twp Waters = Sta. 10+000.000 Twp Broder

The proposed construction will involve the four-laning of Highway 17, construction of new embankments, interchanges, grade separation structures and bridges.

MTO has previously studied, approved and designed the new interchange at Long Lake Road (SMR 80) located at about Sta. 15+750 Twp Broder, new S-E ramp at Highway 69 and the north twinning of the Highway 17 section between Sta. 14+890 and Highway 69 and therefore these interchange and section of the highway were not considered in detail for the present study.

Stantec selected five alternative routes for consideration between SMR 55 and Long Lake Road:

- Alternative 1a – North Side Twinning
- Alternative 1b – North Side Twinning 1700 m Radius Curve
- Alternative 2a – South Side Twinning
- Alternative 2b – South Side Twinning 1700 m Radius Curve
- Alternative 3 – New Alignment South of Existing Highway 1700 m Radius Curve

*165 Cartwright Avenue, Toronto, Ontario M6A 1V5*

*Tel: (416) 785-5110 Fax: (416) 785-5120*

*E-mail: [toronto@petomacallum.com](mailto:toronto@petomacallum.com)*

*BARRIE, BRAMPTON, HAMILTON, KITCHENER, TORONTO*





Stantec provided drawings of the Preferred Corridor and the alternative routes.

The purpose of this alternate route foundation assessment was to identify the geologic features and hydrogeology along the four-laning corridor to assess the potential impact of these features on the five alternative routes selected for new four-lane highway.

## **2. SITE DESCRIPTION**

The study area is located to the south west of Sudbury and includes parts of the Townships of Broder and Waters. The alternate alignments start at the SMR 55 interchange and end at Highway 69. Currently the Highway 17 at-grade intersections along the study corridor include the following:

ROAD	STATION / TWP	ROAD	STATION / TWP
Kantola Road/Fielding Road	17+100 / Waters	Middle Lake Road	13+750/ Broder
Southview Drive	11+750 / Broder	Long Lake Road	15+800/ Broder
Hannah Lake Road	12+800 / Broder		

Land use includes scattered small residential centres in the suburbs of the Greater Sudbury area, which are located near the intersecting roads listed above. Mining/industrial and recreational facilities exist near SMR 55, Fielding Road, Long Lake Road and Highway 69. A Key Plan is attached as Drawing A.

The study area is located on the Huronian Area of the Canadian Shield where bedrock outcrops alternating with swamps and glaciolacustrine deposits comprise the typical geology. As such, the highway corridor extends along undulating terrain in rock areas and over relatively level topography in swampy and glaciolacustrine deposit sections. Exposed rock outcrops and ridges are noted along the existing Highway 17 alignment, where numerous rock cuts up to 8 m high (west of Long Lake Road) were blasted to construct the existing road platform.



The western part of the existing highway corridor borders the south margin of Kelly Lake. The alignment crosses several swampy areas, some of which are associated with the filled lake beds of the Kelly, Hannah, Middle and Silver Lakes. Other swamps occur between rock outcrops and at the intersection of Kantola Road/Fielding Road and Southview Drive with Highway 17. The swampy sections are traversed by means of embankments up to about 12 m high with associated culverts.

The existing structure along the study section of Highway 17 is the two-lane bridge which currently spans the Junction Creek.

The corridor contains a few forested areas mostly with birch trees and a few evergreens and the low lands are covered with grasses, brush and alders. The drainage of the study corridor is influenced by the typically shallow rocky and undulating terrain of the Canadian Shield, exhibiting relatively good drainage characteristics in the hilly outcrop sections and poorly drained conditions in the swampy lowland sections.

### **3. INVESTIGATION PROCEDURES**

The foundation evaluation involved a review of the available geological, topographical and hydrogeological mapping, existing geotechnical reports, studies, aerial photographs and construction drawings for the existing highway. Field visual observations were carried out to verify the inferred data. Field drilling, in-situ testing and sampling were not carried out.

#### **3.1 Reference Documents and Literature Review**

The general physiographic conditions along the corridor and the five alternative route alignments were obtained primarily from existing geological maps and reports from MTO Geocres library for the proposed Long Lake Road and existing SMR 55 interchanges and a Preliminary report carried out by others in 1997 at the Kantola Road/Fielding Road and Southview Drive intersections. Well records obtained from the Ministry of Environment (MOE) supplemented the data.



The documents and literature reviewed in whole or in part for this study are listed in Appendix A. The list reflects the selected data that contains geotechnical content relevant to the assessment. The list of the wells considered for the project is included in Appendix B.

The delineation of swamps and water courses/bodies as well as the location of rock outcrops along the alternative routes were interpreted from the Ministry of Natural Resources Ontario Base Maps and 1989 aerial photographs.

### **3.2 Site Reconnaissance**

Reconnaissance visits of the existing alignment and the adjacent lands within the study corridor were carried out on July 5 and September 12, 2006. The site reconnaissance visits consisted of a drive-by and walk-through of selected sections of Highway 17 and adjacent lands. The ground-truth checks verified the surficial geology and drainage conditions inferred from the literature and map reviews. A comprehensive commentary and notes from the site reconnaissance visits including inferred swamp depths, rock knob/outcrop occurrences, geology at the creek crossings and topography is presented in Appendix C.

Relevant natural features in selected areas of the corridor were photographed. The locations of the photographs are indicated on Drawings 1 to 9 and eighty-five representative site photographs are included in Appendix C.

## **4. INFERRED SUBSURFACE CONDITIONS**

The alternative routes are located in the Canadian Shield which locally contains typical physiographic regions including the following:

- Ground moraine deposits made up typically of glacial sandy silt tills with boulders
- Glaciolacustrine/ice contact deposits of typical silty clays or silts with subordinate rock knobs and/or peat/muck wetlands



- Bedrock plains comprising exposed bedrock knobs, shallow drift veneer over bedrock and subordinate interspersed peat/muck wetlands

The presence of ground moraine deposits was inferred between SMR 55 and the Kantola Road/Fielding Road intersection where Highway 17 was constructed through several long earth cuts up to about 10 m high. The Junction Creek presently flows through the moraine deposits. The soils in the moraine typically comprise glacial tills of silts and fine sands with cobbles and boulders. These materials were previously used for earth borrow as shown in the MNR aggregate Resources Inventory Paper 170 for the local area.

The glaciolacustrine/ice contact deposits primarily occur along the portion of the alignment bordering Kelly Lake. These deposits likely comprise silty clays and/or silts associated within flat low wetlands where they are typically covered with organic peaty deposits.

The bedrock plain which comprises most of the easterly section of the alignment consists of the various types of metasedimentary rock of Precambrian Age associated with the Sudbury Basin, such as quartzites. The bedrock is exposed in numerous outcrops and up to 8 m high highway rock cuts. The bedrock is covered elsewhere by shallow drift or organic soils. Wetlands occur between rock outcrops, most notably within the inferred filled sections of the old extensions of Hannah and Middle Lakes, as well as Silver Lake.

Wetlands of organic deposits and floodplain alluvium have also been deposited and/or accumulated in poorly drained depressions on and between bedrock outcrops.

Local observation indicates that the mineral soil cover in bedrock plain areas is typically less than 1 m deep but may vary greatly over short distances. The depth of soil cover in swampy lands may extend to depths nearing 10 m.

The anticipated extent of the major physiographic units and geology along the study corridor is shown on the enclosed Inferred Geological Conditions, Drawings 1 to 9. The legends and symbols used are provided on the Legend Drawing B.



The approximate extent of these physiographic/geologic formations is generally summarized below with reference to the existing alignment chainage:

APPROXIMATE CHAINAGE	PREDOMINANT GEOLOGIC UNIT	LENGTH (m)		PERCENT OF TOTAL (%)
		TOTAL	SUB TOTAL	
Sta. 15+220 Twp Waters to 17+500 Twp Waters	Ground Moraine	2,280	2,280	17.1
Sta. 17+500 to Sta.19+260 Twp Waters and Sta.10+000 to Sta.10+900 Twp Broder	Glaciolacustrine/ Ice Contact	2,660	1,410	10.6
	Wetlands		1,250	9.4
Sta.10+900 Twp Broder to 19+260 Twp Broder (*)	Bedrock Plain	8,360	6,410	48.2
	Wetlands		1,950	14.7
TOTAL LENGTH			13,300	100

Note: (\*) – The highway section east of Sta. 14+890 Township of Broder including the new interchange at Long Lake Road was previously studied and designed.

The total length of the areas generally covered by wetlands is about 3,200 m and accounts for about 24.1% of the total alignment west of Long Lake Road.

Local areas with fill soils other than the highway embankments were inferred/observed at several locations, such as at the intersection of Hannah Lake Road. These fills were placed to construct access roads and platforms for the commercial, institutional and residential developments over low-lying areas near the lakes. A rock disposal area was also noted north of Middle Lake Road. At Southview Drive excess rock fill or a stabilizing berm appeared to have been placed at the toe of slope over the swampy terrain north of the highway.

Generally, surface water run-off along the study corridor drains into streams, swamps and scattered ponds. Groundwater is inferred typically near ground surface (less than 1 m deep) in the low-lying areas.



The existing water courses typically run between bedrock outcrops except the Junction Creek which is incised into the ground moraine till. The western section of the alignment is cut through the ground moraine tills and may present slope stability concerns. However the remaining terrain has a characteristic low relief and shallow soil cover over bedrock suggesting that these areas are not prone to landslides.

## **5. ALTERNATE ROUTE FOUNDATION ASSESSMENT AND RANKING**

Five route alternatives for a four-lane highway were developed by Stantec within the study corridor, as previously described in this Report.

The corridor was subdivided into two subsections to evaluate the alternative routes and to identify a Preferred Route from a foundation perspective. We note that the most westerly 780 m from SMR 55 to the end of the existing highway transition from four to two lanes (Sta. 16+000) was considered to be uniformly common to all Alternatives and consequently was not considered for the computations for assessment of the favourability of the routes.

The subsections A-B and B-C used for the computations are about 6.5 and 3.3 km long respectively; the boundary between the two sections was strategically selected where the locations of the five alternative routes converge east of Southview Drive. The actual chainage limits of the subsections for the five alternative routes considered for the computations are listed in the following table.



ALTERNATIVE ROUTE	ROUTE SUBSECTION	SUBSECTION		
		LIMITS	LENGTH (m)	
			SUBTOTAL	TOTAL
ROUTE 1a North Side Twinning	1a A-B	Sta. 16+000 TW to 19+260 TW Sta. 10+000 TB to 12+440 TB	5,700	9,020
	1a B-C	Sta. 12+440 to 15+760 TB	3,320	
ROUTE 1b: North Side Twinning with 1700 m Radius Curve	1b A-B	Sta. 16+000 TW to 19+260 TW Sta. 10+000 TB to 12+290 TB	5,550	8,800
	1b B-C	Sta. 12+290 TB to 15+540 TB	3,250	
ROUTE 2a: South Side Twinning	2a A-B	Sta. 16+000 TW to 19+260 TW Sta. 10+000 TB to 12+380 TB	5,640	9,010
	2a B-C	Sta. 12+380 TB to 15+750 TB	3,370	
ROUTE 2b: South Side Twinning with 1700 m Radius Curve	2b A-B	Sta. 16+000 TW to 19+260 TW Sta. 10+000 TB to 12+220 TB	5,480	8,750
	2b B-C	Sta. 12+220 TB to 15+490 TB	3,270	
ROUTE 3: New Alignment South of Existing Highway 1700 m Radius Curve	3 A-B	Sta. 16+000 TW to 19+120 TW Sta. 10+000 TB to 12+190 TB	5,310	8,510
	3 B-C	Sta. 12+190 TB to 15+390 TB	3,200	

Notes: (TW) refers to Twp Waters and (TB) refers to Twp Broder.

The chainages in the Table refer to the alignment for each of the Alternative Routes. The variation of the lengths reflects the alignments of each of the alternatives through the Southview Drive horizontal curve. The route alignments located further south through the curve have the shorter route lengths.



## **5.1 Criteria Used In Assessing Alternatives**

The terms of reference for this project identified six criteria to be considered from a foundation perspective, as follows:

- Extent of Soft Ground
- Groundwater Conditions
- Structure Foundations
- Embankment Settlement
- Embankment Stability
- Construction Considerations

A rationale for what each criterion represents and a method for measuring and evaluating each criterion was developed. The results of the evaluation are provided in Tables F-1 to F-6. A discussion of the assessment criteria follows.

### **5.1.1 Extent of Soft Ground/Swamps (Table F-1)**

The potential impact of soft ground and/or swamps along each alternative route was evaluated on the basis of the total length of the route with inferred soft ground/swamps between 0 and 3 m deep; 3 and 10 m deep; and over 10 m deep.

Soft ground/swamps less than 3 m deep that may be excavated with conventional backhoe equipment were considered the most favourable. Soft ground/swamp ground that is between 3 and 10 m deep typically requires a long-stick excavator and is of intermediate favourability. The treatment of areas with soft ground/swamps over 10 m deep need special equipment such as drag lines or require non-conventional treatment (wick drains, preloading) and are the least favourable.





#### 5.1.2 Groundwater Conditions (Table F-2)

The extent of each route alternative with inferred groundwater at depths greater than 5 m (most favourable condition); between 1 and 5 m deep; and between 0 and 1 m deep (least favourable condition) were employed to assess the potential impact of this criterion.

The greater the groundwater depth the easier structures and embankments are to construct and the better the performance of embankments.

#### 5.1.3 Structure Foundations (Table F-3)

The type of foundation required to support bridges, interchange structures and major culverts was employed to assess the potential impact of this criterion. Shallow foundations were considered to be the most favourable and deep foundations the least favourable. The potential foundation type was estimated based on the inferred type and quality of founding subgrade materials along each route alternative.

#### 5.1.4 Embankment Settlement (Table F-4)

Evaluation of embankment settlement was based on the total length of route alternatives over compressible materials. For evaluation purposes, the compressible soils were grouped into less than 3 m deep areas; 3 to 10 m deep zones; and more than 10 m deep zones. Each of these groups was further divided into potentially sandy or clayey deposits.

The most favourable condition was defined as the swamp areas containing less than 3 m of compressible deposits of a sandy nature (for example, loose sand), and the least favourable conditions are in areas with compressible deposits of soft clayey soils deeper than 10 m.



#### 5.1.5 Embankment Stability (Table F-5)

The potential impact of embankment stability was evaluated on the basis of the total length of embankment and composition of the founding material. Conventional embankments that require little or no excavation and use conventional slope configurations were considered the most favourable, followed in decreasing favourability by embankments that require significant subexcavation, embankments that may require toe-stabilizing berms and (the least favourable) sections that may contain deeper than 10 m soft clays or sections with twinning of high embankments requiring pre-loading and wick drains.

#### 5.1.6 Construction Feasibility (Table F-6)

The impact of construction feasibility was assessed on the basis of the number and type of bridge and major culvert structures and number of major swamp sections, in conjunction with the inferred founding conditions. In addition, embankments in swamps requiring conventional construction were considered most favourable and those requiring special construction were considered least favourable.

### 5.2 Weighting of Evaluation Criteria (Tables F-1 to F-7)

A weighting system was developed to enable selection of the preferred subsections along each alternative route. The weighting system involved two factors:

- A favourability factor F to score the assessment for each evaluation criterion based on the foregoing discussion. The F values ranged from 5 for the most favourable to 1 for the least favourable.



- An impact weight  $B_i$  to reflect the significance of each of the six criteria on the design and construction of the highway. The impact weight for all criteria totals 1.00. The six evaluation criteria were compared in terms of relative importance and impact and assigned an individual impact weight as presented below:

EVALUATION CRITERION	IMPACT WEIGHT, $B_i$
Soft Ground/Swamp	0.15
Groundwater Conditions	0.10
Structure Foundations	0.30
Embankment Settlement	0.25
Embankment Stability	0.10
Construction Feasibility	0.10
<b>TOTAL</b>	<b>1.00</b>

The more important the individual evaluation criterion was considered for the design and/or construction of the highway, the higher the impact weight assigned. A value of 0 would be assigned if the criteria were deemed to have no impact on alternative route selection.



The favourability factors, F, used in Tables F-1 to F-6 and the impact weights, B<sub>i</sub>, used in the summary Table F-7 are summarized in the following table.

EVALUATION CRITERION	IMPACT WEIGHT, B <sub>i</sub>	FAVOURABILITY FACTOR, F						TABLE	
		MOST		AVERAGE		LEAST			
Soft Ground/ Swamps	0.15	Based on relative length and depth of soft ground (SG) and/or swamps (SWP):						F-1	
		SG or SWP 0 to 3 m Deep		SG or SWP 3 to 10 m Deep		SG or SWP Over 10 m Deep			
		F=5		F=3		F=1			
Groundwater Conditions	0.10	Based on inferred groundwater (G/W) depth:						F-2	
		G/W Deeper than 5 m		G/W 1 to 5 m		G/W 0 to 1 m			
		F=5		F=3		F=1			
Structure Foundations	0.30	Based on estimated type of foundation requirements:						F-3	
		Shallow Foundation			Deep Foundation				
		F=5			F=3				
Embankment Settlement	0.25	Based on length of sections with compressible soil with three depth ranges:						F-4	
		Less than 3 m deep		3 to 5 m deep		Deeper than 5 m			
		Silty	Clayey	Silty	Clayey	Silty	Clayey		
		F=5	F=4	F=4	F=3	F=2	F=1		
Embankment Stability	0.10	Based on estimated type of construction required to establish embankment on competent ground:						F-5	
		Conventional Embankment		Significant Subexcavation		Toe-Stabilizing Berms Required			Potential Pre-Loading/ Wick Drains
		F=5		F=3		F=2			F=1
Construction Feasibility	0.10	Based on combined assessment of structure foundations, and embankment construction over major swamps						F-6	
		Conventional Structure Foundation	Special Structure Foundation	Conventional Culvert	Special Culvert	Conventional Embankment Construction	Special Embankment Construction		
		F=5	F=1	F=5	F=1	F=5	F=1		



The computations provide Weighted Favourability Values  $A_i$  for each subsection. With reference to Table F-1, Soft Ground/Swamp Evaluation Criterion, the weighted favourability value  $A_3$  for the subsection 2a A-B was obtained by multiplying the Favourability factor  $F$  by the length of alignment for which the condition is applicable and dividing by the total length of the soft ground or swamp in the subsection, as presented below:

DEPTH RANGE (m)	LENGTH (m)	FAVOURABILITY FACTOR, $F$
0 - 3	480	5
3 - 10	2440	3
>10	0	1

$$A_3 = \text{Weighted Favourability Value} = \frac{(480 \times 5) + (2440 \times 3) + (0 \times 1)}{480 + 2440 + 0} = 3.33$$

The weighted favourability value,  $A_i$ , computed for each subsection is provided on Tables F-1 to F-6.

### 5.3 Scoring of Foundation Criteria (Table F-7)

For the scoring of the foundation criteria, each of the Favourability Values  $A_i$  was normalized to ratios of 1.0. The Normalized Favourability Values,  $N_i$ , shown next to each  $A_i$  on the Table eliminate the effect of unrelated  $A_i$  numbers on the Scores and provide a meaningful input of the Impact Weights on the final rankings. This is achieved by dividing each Weighted Favourability Value  $A_i$  by the highest  $A_i$  amongst all Alternatives for the criterion, and thus making all Normalized Favourability Values less than 1.00. The alternative route subsections were scored by adding the  $N_i$  for each of the evaluation criteria multiplied by the Impact Weight,  $B_i$  for the criterion. The Normalized Scores based on the  $N_i$  values (multiplied by 3 to produce values higher than 1.00 for ease of comparison) are shown on Table F-7.

An example of the computation of the Normalized Scores is provided below, for reference. The example is the calculation of the Normalized Score of **2.06** for the subsection 2a B-C which was obtained as follows.



EVALUATION CRITERIA		SOFT GROUND/ SWAMPS	GROUNDWATER CONDITIONS	STRUCTURE FOUNDATIONS	EMBANKMENT SETTLEMENT	EMBANKMENT STABILITY	CONSTRUCTION FEASIBILITY
TABLE NO.		F-1	F-2	F-3	F-4	F-5	F-6
IMPACT WEIGHT, B <sub>i</sub>		0.15	0.10	0.30	0.25	0.10	0.10
2a B-C	A <sub>5</sub>	3.50	3.12	0.00	3.25	4.07	8.67
	N <sub>5</sub>	0.97	0.98	0.00	0.98	1.00	1.00

Notes:

Highest $A_i$	3.63	3.18	0.00	3.31	4.07	8.67
---------------	------	------	------	------	------	------

$$\text{Normalized Score 2a B-C} = 3[(3.50/3.63) \times 0.15 + (3.12/3.18) \times 0.10 + (N/A) + (3.25/3.31) \times 0.25 + (4.07/4.07) \times 0.10 + (8.67/8.67) \times 0.10]$$

**Normalized Score 2a B-C = 2.06**

[The ratios in brackets represent each of the  $N_i$  values, such as  $(3.12/3.18) = 0.98$ ]

The normalized scores and rankings of the foundation evaluation criterion for the 10 alternative route subsections are provided in Table F-7 and the results are summarized below:

SUB SECTION	NORMALIZED SCORE	NORMALIZED RANKING	SUB SECTION	NORMALIZED SCORE	NORMALIZED RANKING
1a A-B	2.86	2	1a B-C	2.03	2
1b A-B	2.74	3	1b B-C	2.01	5
2a A-B	2.78	4	2a B-C	2.06	1
2b A-B	2.57	5	2b B-C	2.01	5
3 A-B	2.88	1	3 B-C	2.03	2

The results indicated that the 2.86 and 2.88 normalized Scores of alternative route subsections 1a A-B and 3 A-B in the western A-B subsection of the corridor are similar and are practically equivalent in terms of foundation favourability. These alignments are preferred over those alternatives 1b A-B, 2a A-B and 2b A-B which have lower Normalized Scores of 2.74, 2.78 and 2.57, respectively.

All Normalized Scores for the eastern subsection B-C are considered similar however subsection 2a B-C has a higher score of 2.06 than the remaining eastern subsections 1a B-C,



1b B-C, 2b B-C and 3 B-C, which are 2.03, 2.01, 2.01 and 2.03, respectively. The subsection 2a B-C is therefore the most favourable.

The relatively small differences obtained for some of the subsections (such as, 1a A-B and 3 A-B) are generally consistent with the small variations of the geology within the study corridor.

## **6. ALIGNMENT REVIEW AND RECOMMENDATIONS**

### **6.1 General**

From an embankment and structures design perspective, the route alternative that incorporates the highest scoring subsections is preferred. For the selection of the preferred route alternatives, however, either one of the subsections with scores that are close, such as 3 A-B (2.88) and 1a A-B (2.86) is acceptable.

The preferred alignment should be selected to achieve bedrock or competent soil subgrades and avoid swamp areas, while minimizing the length of new construction that would be required for the four-laning of the highway. Embankments constructed over bedrock or competent soil subgrade will have better drainage conditions; will be more stable; and will be subjected to only minimal postconstruction settlements and therefore will require less maintenance.

To the north of the highway at Southview Drive there is a 200 m long swamp where the embankment would be placed for the north twining option 1a A-B. To the south there are rock ridges and the swamp appears shallower, more favourable. To locate the highway in the north swamp in this area will require extensive excavation of soft soils and/or preloading or wick drains since the highway embankment is about 5 m high and excavating in the area may induce instability on the existing embankment. Therefore along this 200 m long section, the alignment should be adjusted to follow the alternative route 2a A-B, South Side Twining and the North Side Twining option should be avoided.



The new structure foundations are typically similar at all alternative routes for the Junction Creek bridge and potential Kantola Road/Fielding Road grade separation or interchange. At Southview Drive, the alternatives that cross Highway 17 over the existing outcrops (1a A-B, 2a A-B and 3 A-B) instead of the swampy terrain (1b A-B, 2b A-B) would be preferred.

## **6.2 Embankment Design**

The embankments will likely comprise rockfill in sections requiring construction below the water table. Elsewhere embankments could be constructed of earth borrow, including the zones above the rockfill. Conventional embankment design and construction procedures for rockfill and earth fill embankments should be suitable. Embankment geometry through swamps should include a 2 m platform widening on both sides, according to Northern Region Directive 98-200.

The design of embankments through swamps should allow for subexcavation of soft compressible soils to depths of about 10 m for preliminary evaluation purposes. At these locations the slope of the rockfill below existing grade should be taken as 1.25H:1V for preliminary route evaluation purposes. Above grade, the embankments constructed with earth fill will be stable at 2H:1V slopes. As a guideline for preliminary design, the rockfill line should be carried at least 2.0 m above the water level in the swamps where earth fill is used in combination with rockfill to construct the embankments.

When twinning through wetland swamps such as the north side swamp at Southview Drive special consideration may be required to increase the median width, provide a temporary detour or use wick drain design (based on the actual depth of soft soils) or to ensure new construction does not impact negatively on the existing embankment.

The implications of constructing road embankments in swamps with soft soils are further highlighted in the following subsections.





### **6.3 Embankment Stability**

All alternative routes cross swamps that may contain very soft to firm clayey soils of varying depths, in the 5 to 10 m range. Typically, these weak soils will not provide adequately stable foundations for embankment construction. It is anticipated that subexcavation of soft soils will be required for construction of the road embankments.

The requirement to use non-standard slope configurations and wider median width such as toe-stabilizing berms or pre-loading with wick drains depends on the embankment height and depth of soft ground.

In particular, twinning options through the swamps at the Middle Lake and the swamp along the north side at Southview Drive may require wider than standard median widths to permit subexcavation of soft soils without affecting the existing embankment stability. The dimension of the wider medians will depend on the type(s) and quality of soils in the swamp and condition of existing embankments. The dimensions should be determined after site specific field investigations. Preloading or toe-stabilizing berms or lowering the vertical alignment to create shallower swamp sections are alternatives which may be considered to limit the excavation depths adjacent to the existing highway embankments.

### **6.4 Embankment Settlements**

It is anticipated that settlement of embankments founded on bedrock or competent non-swamp glaciolacustrine soil deposits will be minimal.

The swamp soils are typically not considered suitable for supporting the highway embankments due to their high compressibility and low strength. The magnitude and rate of the settlements will depend on the thickness and nature of the soils in each of the swamps and may exceed MTO criteria if placed on very soft to firm clayey soils to depths exceeding 15 m and/or may affect existing embankments/structures which are in proximity.



Non-conventional construction procedures may be required to reduce postconstruction settlements to tolerable levels or to twin embankments through deep soft deposits without negative effects on the existing embankment. Special construction methods may include the use of lightweight fill, wick drains and/or preloading.

## **6.5 Structure Foundations**

A new bridge structure is planned on the north twinning of the highway at Junction Creek, the location of the structure has been established and the foundations will likely be established on driven steel piles. The grade separation flyover or potential interchange structure at the Kantola Road/Fielding Road location will be also established on driven steel piles based on the expected subsurface conditions.

The foundations at the Junction Creek and Kantola Road/Fielding Road structures are expected to be of similar types for all alternative routes and therefore have no significant influence on the alternative route selection.

The grade separation structure(s) at the Southview Drive location for Routes north of the existing highway would be located over the anticipated swamp and would require a pile foundation. The location of the structure(s) to the south of the highway would be over bedrock outcrops and these structures would be founded on spread footings.

The type of foundation (shallow and/or deep) for the Southview Drive structure(s) will depend ultimately on the road grades at the structures and structural design concepts. However, foundation material for both spread footings or pile foundations is expected to comprise bedrock.

Foundations for culverts are expected to comprise rock or rockfill. Foundation design considerations involving cambered foundations may be required where embankments crossing swamps are placed directly on the compressible materials and preloaded to reduce postconstruction settlements. This condition may occur with the twinning route alternatives at Middle Lake, for instance.



## **6.6 Construction Considerations**

It is anticipated that the typical embankment construction will be accomplished with conventional methods since the alignment is on rock plains and through relatively shallow swamps less than 10 m deep. All alternative routes cross this area at approximately the same angle and it is expected that the degree of difficulty will be similar for embankment construction.

The swamp crossings along the north twinning will run near open water bodies such as at Kelly, Hannah and Middle Lakes. Since the high embankment may extend into the lakes, the design should verify that excavations will be kept well away from these lakes. The grades may need to be lowered or non-conventional construction requiring long preloading periods (one to two years) may need to be considered. Without subexcavation of soft materials, construction of these embankments ahead of the remainder of other highway embankments would be required.

## **6.7 Preferred Alternative**

Based on the foregoing considerations the preferred alignment from the foundation engineering perspective is considered to comprise the North Side Twinning, Alternative 1a for the subsection A-B, except through Southview Drive where the alignment should be south of the existing highway.

For the subsection B-C, the preferred alignment is the South Side Twinning, Alternative 2a.

It is noted that the alternative alignments scores are relatively close. The selection of the preferred alternative is also subject to separate evaluations being carried out by Stantec.

Drawing 10 shows the Preferred Alternative alignment provided on August 28, 2007 which incorporates the above recommendations.



## 7. ADDITIONAL STUDIES

The preliminary assessments in this report are based on literature reviews and site reconnaissance only. The recommendations are intended for planning purposes only. Additional data should be obtained by conducting preliminary investigation(s) to confirm the data inferred during these studies. In particular, the depth and extent of organic/soft/wet soils in swamps and low-lying areas should be investigated.

The potential bridge and interchange structure locations, overpass/underpass structures and major culvert locations should also be investigated. The bedrock at each location should be proven with additional cores to confirm that the preferred sites are adequate for the construction of the structures.

A preliminary list of high fills, deep earth cuts, embankments over swamps and structures from the Preferred Route plan is compiled in Table 1.

## 8. CLOSURE

This report was prepared by Mr. C.M.P. Nascimento, P. Eng., Senior Project Engineer and reviewed by Mr. B. R. Gray, MEng, P. Eng., MTO Designated Principal Contact.

Yours very truly,

Peto MacCallum Ltd.

A handwritten signature in black ink, appearing to read 'C. M. P. Nascimento'.

Carlos M. P. Nascimento, P. Eng.  
Senior Project Engineer

A handwritten signature in black ink, appearing to read 'Brian R. Gray'.

Brian R. Gray, MEng, P. Eng.  
MTO Designated Principal Contact  
CN-cn-mi





**TABLE 1**  
**RECOMMENDED LOCATIONS FOR FOUNDATION MAINLINE INVESTIGATIONS**  
**PREFERRED ROUTE**

		EXISTING DATA	
STATIONS	PROPOSED WORKS	NO. OF HOLES	REFUSAL DEPTH RANGE (m)
High Fill, Deep Cuts, Swamp Crossings - Highway 17, Township of Waters			
16+180 to 16+380 (WBL)	Deep earth cut up to 6.0 m depth	None	Not established
16+500 to 16+640 (WBL)	Embankment fill up to 10.0 high	None	Not established
16+640 to 16+940 (WBL)	Deep earth cut up to 7.0 m depth	None	Not established
17+700 to 18+460 (WBL)	Embankment fill up to 2.0 m high, swamp area	7	> 17.3
High Fill, Deep Cuts, Swamp Crossings - Highway 17, Township of Broder			
10+100 to 10+460 (WBL)	Embankment fill up to 1.5 m high, swamp area	5	(2 holes) 8.4 to 18.1
12+450 to 13+040 (EBL)	Embankment fill up to 5.0 m high, swamp area	7	3.1 to 7.9
13+220 to 13+320 (WBL)	Deep earth cut up to 4.0 m depth	3	0.8 to 6.9
13+500 to 13+600 (EBL)	Embankment fill up to 9.0 m high	None	Not established
14+240 to 14+750	Embankment fill up to 10.0 m high, swamp area	9	0.9 to 12.2
14+950 to 15+180 (WBL)	Embankment fill up to 4.0 m high, swamp area	6	0.0 to 9.9
Structures - Township of Waters			
16+450	Junction Creek Bridge Westbound	Note 3	Note 3
17+030	Kantola Road/Fielding Road Underpass	Note 3	Note 3
Structures - Township of Broder			
11+900 (WBL)	Southview Drive Overpass Westbound	Note 3	Note 3
11+900 (EBL)	Southview Drive Overpass Eastbound	Note 3	Note 3
14+430 (WBL)	Culvert at Middle Lake	2	1.7 to 3.4

- Notes:
1. Swamp limits were not established during current preliminary studies.
  2. Chainages are approximate, may vary for eastbound and westbound lanes and are to be confirmed during detail design.
  3. Refer to the separate preliminary foundation investigations for existing data on future structure sites.

TABLE F-1 – SOFT GROUND/SWAMPS

ALTERNATE ROUTE		ALTERNATE ROUTE SECTION	SOFT GROUND/SWAMPS DEPTHS AND FAVOURABILITY							WEIGHTED FAVOURABILITY VALUE(A <sub>i</sub> )		
			L1		F1	L2		F2	L4		F3	
			Depth Range ( 0 - 3m )	Depth Range ( 3 - 10m )		Depth Range (>10 m )						
1a	North Side Twinning	A - B	520	5	1420	3	-	1	3.54	A <sub>1</sub>		
1b	North Side Twinning with 1700 m Radius Curves	A - B	520	5	860	3	-	1	3.75	A <sub>2</sub>		
2a	South Side Twinning	A - B	480	5	2440	3	-	1	3.33	A <sub>3</sub>		
2b	South Side Twinning with 1700 m Radius Curves	A - B	580	5	2420	3	-	1	3.39	A <sub>4</sub>		
3	New Alignment South of Existing Highway 1700 m Radius Curves	A - B	880	5	1880	3	-	1	3.64	A <sub>5</sub>		
1a	North Side Twinning	B - C	520	5	1140	3	-	1	3.63	A <sub>6</sub>		
1b	North Side Twinning with 1700 m Radius Curves	B - C	620	5	1500	3	-	1	3.58	A <sub>7</sub>		
2a	South Side Twinning	B - C	520	5	1550	3	-	1	3.50	A <sub>8</sub>		
2b	South Side Twinning with 1700 m Radius Curves	B - C	560	5	2440	3	-	1	3.37	A <sub>9</sub>		
3	New Alignment South of Existing Highway 1700 m Radius Curves	B - C	440	5	2000	3	-	1	3.36	A <sub>10</sub>		

NOTE: Enter weighted favourability value A<sub>i</sub> in Table F-7.



TABLE F-2 – GROUNDWATER CONDITIONS

ALTERNATE ROUTE		ALTERNATE ROUTE SECTION	GROUNDWATER DEPTHS AND FAVOURABILITY							WEIGHTED FAVOURABILITY VALUE(A <sub>i</sub> )			
			L1(m) Depth Range ( >5m )		F1	L2(m) Depth Range ( 1 - 5m )		F2	L3(m) Depth Range ( 0 - 1 m )			F3	
1a	North Side Twinning	A - B	1190	5	4330	3	2040	1	2.78	A <sub>1</sub>			
1b	North Side Twinning with 1700 m Radius Curves	A - B	2500	5	4380	3	1680	1	3.19	A <sub>2</sub>			
2a	South Side Twinning	A - B	1260	5	3080	3	3080	1	2.51	A <sub>3</sub>			
2b	South Side Twinning with 1700 m Radius Curves	A - B	2840	5	2920	3	3160	1	2.93	A <sub>4</sub>			
3	New Alignment South of Existing Highway 1700 m Radius Curves	A - B	3280	5	3360	3	3420	1	2.97	A <sub>5</sub>			
1a	North Side Twinning	B - C	1020	5	640	3	1660	1	2.61	A <sub>6</sub>			
1b	North Side Twinning with 1700 m Radius Curves	B - C	1260	5	460	3	2140	1	2.54	A <sub>7</sub>			
2a	South Side Twinning	B - C	2380	5	640	3	2070	1	3.12	A <sub>8</sub>			
2b	South Side Twinning with 1700 m Radius Curves	B - C	2900	5	500	3	3000	1	2.97	A <sub>9</sub>			
3	New Alignment South of Existing Highway 1700 m Radius Curves	B - C	2980	5	540	3	2440	1	3.18	A <sub>10</sub>			

NOTE: Enter weighted favourability value A<sub>i</sub> in Table F-7.



TABLE F-3 – STRUCTURE FOUNDATIONS

ALTERNATE ROUTE		ALTERNATE ROUTE SECTION	CONTEMPLATED STRUCTURE/INTERCHANGE SITE							WEIGHTED FAVOURABILITY VALUE(A <sub>i</sub> )	
			JUNCTION CREEK BRIDGE		KANTOLA/FIELDING ROADS I/C		SOUTHVIEW DRIVE I/C				
Type	F1	Type	F2	Type	F3						
1a	North Side Twinning	A - B	B	3	B	3	A	5	3.67	A <sub>1</sub>	
1b	North Side Twinning with 1700 m Radius Curves	A - B	B	3	B	3	B	3	3.00	A <sub>2</sub>	
2a	South Side Twinning	A - B	B	3	B	3	A	5	3.67	A <sub>3</sub>	
2b	South Side Twinning with 1700 m Radius Curves	A - B	B	3	B	3	B	3	3.00	A <sub>4</sub>	
3	Existing Highway 1700 m Radius Curves	A - B	B	3	B	3	A	5	3.67	A <sub>5</sub>	
1a	North Side Twinning	B - C	-	-	-	-	-	-	0.00	A <sub>6</sub>	
1b	North Side Twinning with 1700 m Radius Curves	B - C	-	-	-	-	-	-	0.00	A <sub>7</sub>	
2a	South Side Twinning	B - C	-	-	-	-	-	-	0.00	A <sub>8</sub>	
2b	South Side Twinning with 1700 m Radius Curves	B - C	-	-	-	-	-	-	0.00	A <sub>9</sub>	
3	New Alignment South of Existing Highway 1700 m Radius Curves	B - C	-	-	-	-	-	-	0.00	A <sub>10</sub>	

NOTE:

A: Shallow Foundation, F = 5

B: Deep Foundation, F = 3

I/C: Denotes Interchange Location

Enter weighted favourability value A<sub>i</sub> in Table F-7.



TABLE F-4 – EMBANKMENT SETTLEMENT

ALTERNATE ROUTE		ALTERNATE ROUTE SECTION	SUBSOIL TYPE AND FAVOURABILITY FACTOR						WEIGHTED FAVOURABILITY VALUE(A <sub>i</sub> )	
			Less than 3m Deep		3m to 10m Deep		Deeper than 10m			
			L1	L2	L3	L4	L5	L6		
			Silty (F1=5)	Clayey (F2 =4)	Silty (F3=4)	Clayey (F4 =3)	Silty (F5=2)	Clayey (F6 =1)		
1a	North Side Twinning	A -B	3390	520	1040	1420	-	-	4.31	A <sub>1</sub>
1b	North Side Twinning with 1700 m Radius Curves	A -B	2840	520	1000	860	-	-	4.38	A <sub>2</sub>
2a	South Side Twinning	A -B	2080	480	1120	2440	-	-	3.94	A <sub>3</sub>
2b	South Side Twinning with 1700 m Radius Curves	A -B	1920	580	1120	2420	-	-	3.92	A <sub>4</sub>
3	New Alignment South of Existing Highway 1700 m Radius Curves	A -B	3570	880	310	1880	-	-	4.25	A <sub>5</sub>
1a	North Side Twinning	B -C	-	520	-	1140	-	-	3.31	A <sub>6</sub>
1b	North Side Twinning with 1700 m Radius Curves	B -C	-	620	-	1500	-	-	3.29	A <sub>7</sub>
2a	South Side Twinning	B -C	-	520	-	1550	-	-	3.25	A <sub>8</sub>
2b	South Side Twinning with 1700 m Radius Curves	B -C	-	560	-	2440	-	-	3.19	A <sub>9</sub>
3	New Alignment South of Existing Highway 1700 m Radius Curves	B -C	-	440	-	2000	-	-	3.18	A <sub>10</sub>

NOTE: Enter weighted favourability value A<sub>i</sub> in Table F-7.



TABLE F-5- EMBANKMENT STABILITY

ALTERNATE ROUTE	ALTERNATE ROUTE SECTION	CONVENTIONAL OR SPECIAL DESIGN REQUIREMENTS				WEIGHTED FAVOURABILITY VALUE(A <sub>i</sub> )
		L1	L2	L3	L4	
		Conventional Embankment (F1 = 5)	Embankment Requiring Subexcavation (F2 = 3)	Embankment Requiring Toe-Stabilizing Berms (F3 = 2)	Embankment Requiring pre-loading/ Wick Drains (F4 = 1)	
1a	North Side Twinning	5620	1660		280	4.41 A <sub>1</sub>
1b	North Side Twinning with 1700 m Radius Curves	6940	1620			4.62 A <sub>2</sub>
2a	South Side Twinning	4460	2960			4.20 A <sub>3</sub>
2b	South Side Twinning with 1700 m Radius Curves	5880	3040			4.32 A <sub>4</sub>
3	New Alignment South of Existing Highway 1700 m Radius Curves	7260	2800			4.44 A <sub>5</sub>
1a	North Side Twinning	1660	1380		280	3.83 A <sub>6</sub>
1b	North Side Twinning with 1700 m Radius Curves	1860	1680		320	3.80 A <sub>7</sub>
2a	South Side Twinning	3020	1770		300	4.07 A <sub>8</sub>
2b	South Side Twinning with 1700 m Radius Curves	3400	2380		620	3.87 A <sub>9</sub>
3	New Alignment South of Existing Highway 1700 m Radius Curves	3520	1940		500	4.01 A <sub>10</sub>

NOTE: Enter weighted favourability value A<sub>i</sub> in Table F-7.

TABLE F-6 - CONSTRUCTION FEASIBILITY

ALTERNATE ROUTE		ALTERNATE ROUTE SECTION	STRUCTURE/EMBANKMENT REQUIRING SPECIAL CONSTRUCTION						WEIGHTED FAVOURABILITY VALUE(Ai)	
			No. of Structure Foundations		No. of Major Culvert Foundations		No. of Major Swamps			
			S1 Convent. (F1=5)	S2 Special (F2=1)	C1 Convent. (F1=5)	C2 Special. (F2=1)	L1 Convent. (F1=5)	L2 Special (F2=1)		
1a	North Side Twinning	A - B	1	2	1		2	1	7.67	A <sub>1</sub>
1b	North Side Twinning with 1700 m Radius Curves	A - B		3	1		2		6.00	A <sub>2</sub>
2a	South Side Twinning	A - B	1	2	1		3		9.00	A <sub>3</sub>
2b	South Side Twinning with 1700 m Radius Curves	A - B		3	1		2		6.00	A <sub>4</sub>
3	New Alignment South of Existing Highway 1700 m Radius Curves	A - B	1	2	1		2		7.33	A <sub>5</sub>
1a	North Side Twinning	B - C			3		2	1	8.67	A <sub>6</sub>
1b	North Side Twinning with 1700 m Radius Curves	B - C			3		2	1	8.67	A <sub>7</sub>
2a	South Side Twinning	B - C			3		2	1	8.67	A <sub>8</sub>
2b	South Side Twinning with 1700 m Radius Curves	B - C			3		2	1	8.67	A <sub>9</sub>
3	New Alignment South of Existing Highway 1700 m Radius Curves	B - C			3		2	1	8.67	A <sub>10</sub>

Special Designation Applied to Following Conditions

A - Foundations with piers in water or deep foundations

B - Culverts in Lakes

C - Embankments through deep (> 10 m) swamps

(Only the ratio of conventional length to the length considered for ranking).

Enter weighted favourability value  $A_i$  in Table F-7.

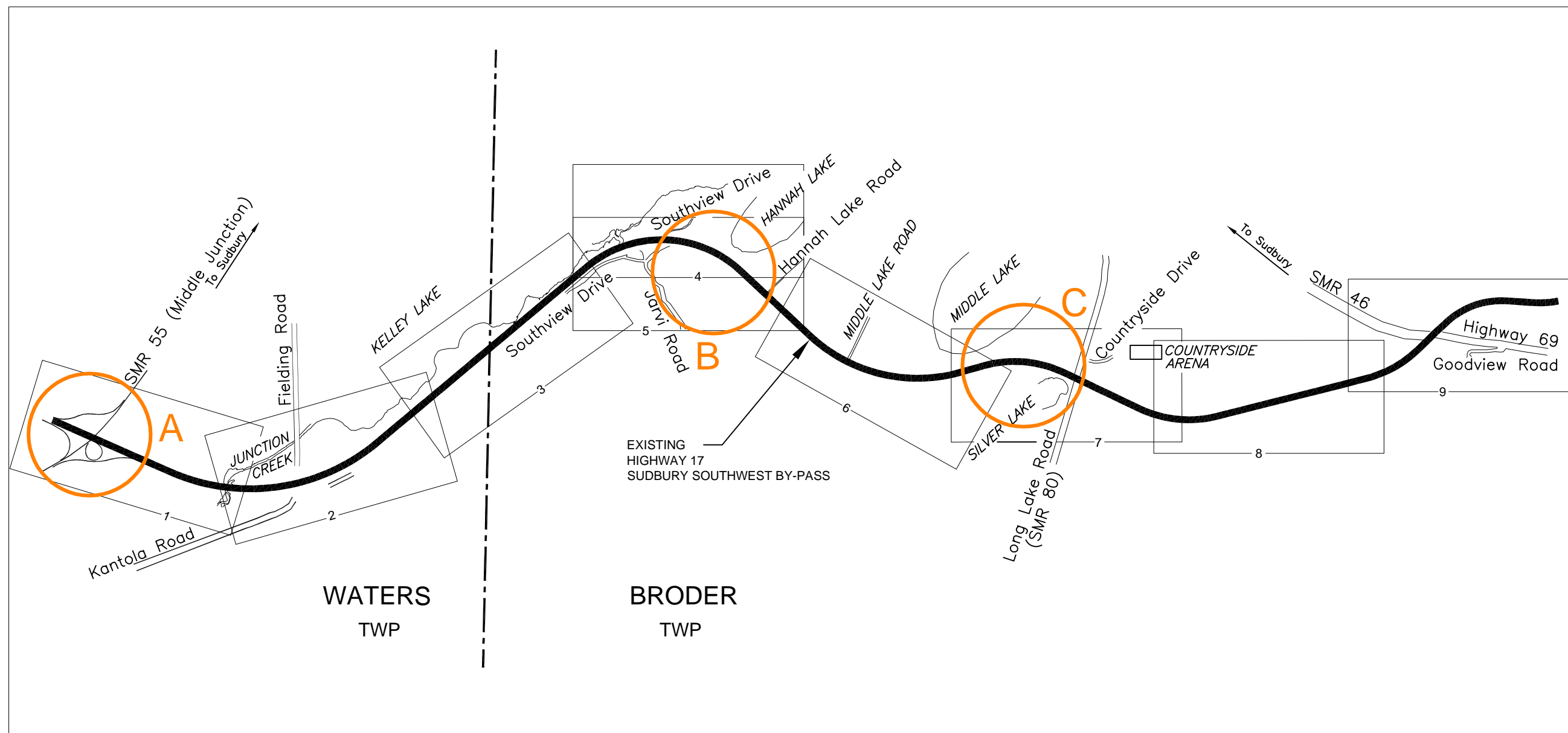


TABLE F-7 – SCORING OF FOUNDATION CRITERIA




EVALUATION CRITERIA		SOFT GROUND/ SWAMPS		GW CONDITIONS		STRUCTURE FOUNDATIONS		EMBANKMENT SETTLEMENT		EMBANKMENT STABILITY		CONSTRUCTION FEASIBILITY		NORMALIZED SCORE	NORMALIZED RANKING
TABLE No.		F1		F2		F3		F4		F5		F6			
IMPACT WEIGHT		0.15		0.10		0.30		0.25		0.10		0.10			
ALTERNATIVE	SECTION	Ai	Ni	Ai	Ni	Ai	Ni	Ai	Ni	Ai	Ni	Ai	Ni		
1a	North Side Twinning	3.54	0.94	2.78	0.87	3.67	1.00	4.31	0.98	4.41	0.95	7.67	0.85	2.86	2
1b	North Side Twinning with 1700 m Radius Curves	3.75	1.00	3.19	1.00	3.00	0.82	4.38	1.00	4.62	1.00	6.00	0.67	2.74	3
2a	South Side Twinning	3.33	0.89	2.51	0.79	3.67	1.00	3.94	0.90	4.20	0.91	9.00	1.00	2.78	4
2b	South Side Twinning with 1700 m Radius Curves	3.39	0.90	2.93	0.92	3.00	0.82	3.92	0.89	4.32	0.93	6.00	0.67	2.57	5
3	New Alignment South of Existing Highway 1700 m Radius Curves	3.64	0.97	2.97	0.93	3.67	1.00	4.25	0.97	4.44	0.96	7.33	0.81	2.88	1
1a	North Side Twinning	3.63	1.00	2.61	0.82	0.00	0.00	3.31	1.00	3.83	0.94	8.67	1.00	2.03	2
1b	North Side Twinning with 1700 m Radius Curves	3.58	0.99	2.54	0.80	0.00	0.00	3.29	0.99	3.80	0.93	8.67	1.00	2.01	5
2a	South Side Twinning	3.50	0.97	3.12	0.98	0.00	0.00	3.25	0.98	4.07	1.00	8.67	1.00	2.06	1
2b	South Side Twinning with 1700 m Radius Curves	3.37	0.93	2.97	0.93	0.00	0.00	3.19	0.96	3.87	0.95	8.67	1.00	2.01	5
3	New Alignment South of Existing Highway 1700 m Radius Curves	3.36	0.93	3.18	1.00	0.00	0.00	3.18	0.96	4.01	0.99	8.67	1.00	2.03	2

NOTES:

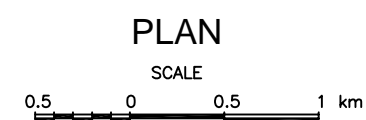
Ai - Weighted Favourability Value  
Ni - Normalized Favourability Value



# KEY PLAN LEGEND:

-  HWY 17 (EXISTING)
-  SHEET NUMBER
-  ASSESSMENT NODE

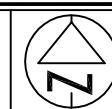
HIGHWAY 17 SUDBURY SOUTHWEST BY-PASS FOUR-LANING  
FROM SUDBURY MUNICIPALITY ROAD 55 (MIDDLE JUNCTION) EASTERLY  
TO HIGHWAY 69 FOR 13.3 KM  
DISTRICT 54, SUDBURY



**Peto MacCallum Ltd.**  
CONSULTING ENGINEERS

CONT No  
GWP No 5825-05-00

HIGHWAY 17  
SUDBURY SOUTHWEST BY-PASS FOUR-LANING  
KEY PLAN



SHEET  
A

**METRIC**

NOTES:

1. BEDROCK CUTS AND OUTCROPS SHOWN ON PLANS ARE BASED ON EXISTING CONSTRUCTION DATA, SITE RECONNAISSANCE AND AERIAL PHOTOGRAPHS. THE SYMBOLS ON THE PLANS INDICATE THE LOCAL PRESENCE OF THE BEDROCK UNIT AND DO NOT REPRESENT THE FULL EXTENT OF EACH ROCK OUTCROP.
2. THE EXTENT OF SWAMPS, WATER BODIES AND FILL AREAS IS AS INTERPRETED FROM SITE RECONNAISSANCE AND AERIAL PHOTOGRAPHS. THE AERIAL EXTENTS SHOWN ON THE PLANS REPRESENT ESTIMATES ONLY AND ACTUAL AREAS MAY VARY FROM THOSE SHOWN.
3. ESTIMATED DEPTH TO COMPETENT GROUND AND OR BEDROCK IN SWAMPS IS BASED ON GEOLOGICAL EVIDENCE, DESKTOP LITERATURE SEARCH DATA AND LIMITED SITE RECONNAISSANCE INFORMATION.
4. THE GEOLOGIC UNIT SYMBOLS SHOWN ON THE PLANS REPRODUCE THOSE SHOWN ON GEOLOGIC MAPPING OF THE AREA AND ARE ONLY A GENERAL REPRESENTATION OF BEDROCK AND SOIL UNITS.
5. THE PLANS ARE AN ENCLOSURE TO THE ROUTE SELECTION STUDY PREPARED BY PETO MACCALLUM LTD. THE DATA ON THESE PLANS MUST BE READ IN CONJUNCTION WITH THE REPORT.
6. THE DETAIL SHOWN ON THE PLAN IS CONSIDERED APPROPRIATE FOR ROUTE SELECTION PURPOSES. WHEN THE PREFERRED ROUTE HAS BEEN SELECTED, A SUBSURFACE INVESTIGATION SHOULD BE UNDERTAKEN TO DELINEATE THE STRATIGRAPHIC CONDITIONS ON A SITE SPECIFIC BASIS FOR PRELIMINARY AND DETAILED DESIGN PURPOSES.

LEGEND:


- ALTERNATE  
ROUTE
- 1A - NORTH SIDE TWINNING


1B - NORTH SIDE TWINNING  
1700m RADIUS CURVE


2A - SOUTH SIDE TWINNING


2B - SOUTH SIDE TWINNING  
1700m RADIUS CURVE


3 - NEW ALIGNMENT SOUTH OF  
EXISTING HIGHWAY  
1700m RADIUS CURVE


- 


ROCK CUT (R/C)
- 

4.5m R/C ROCK CUT HEIGHT FROM RECORDS
- 

BEDROCK OUTCROP (R O/C)
- 

SWAMP AREA
- 

ANTICIPATED RANGE OF DEPTH (m) TO  
COMPETENT MATERIAL/BEDROCK
- 

WATER BODY
- 


FILL AREA
- GM


-

GROUND MORaine (GLACIAL TILL)
- WL

WET LAND
- BR

BEDROCK PLAIN
- GL/IC

GLACIOLACUSTRINE/ICE CONTACT DEPOSITS
- 

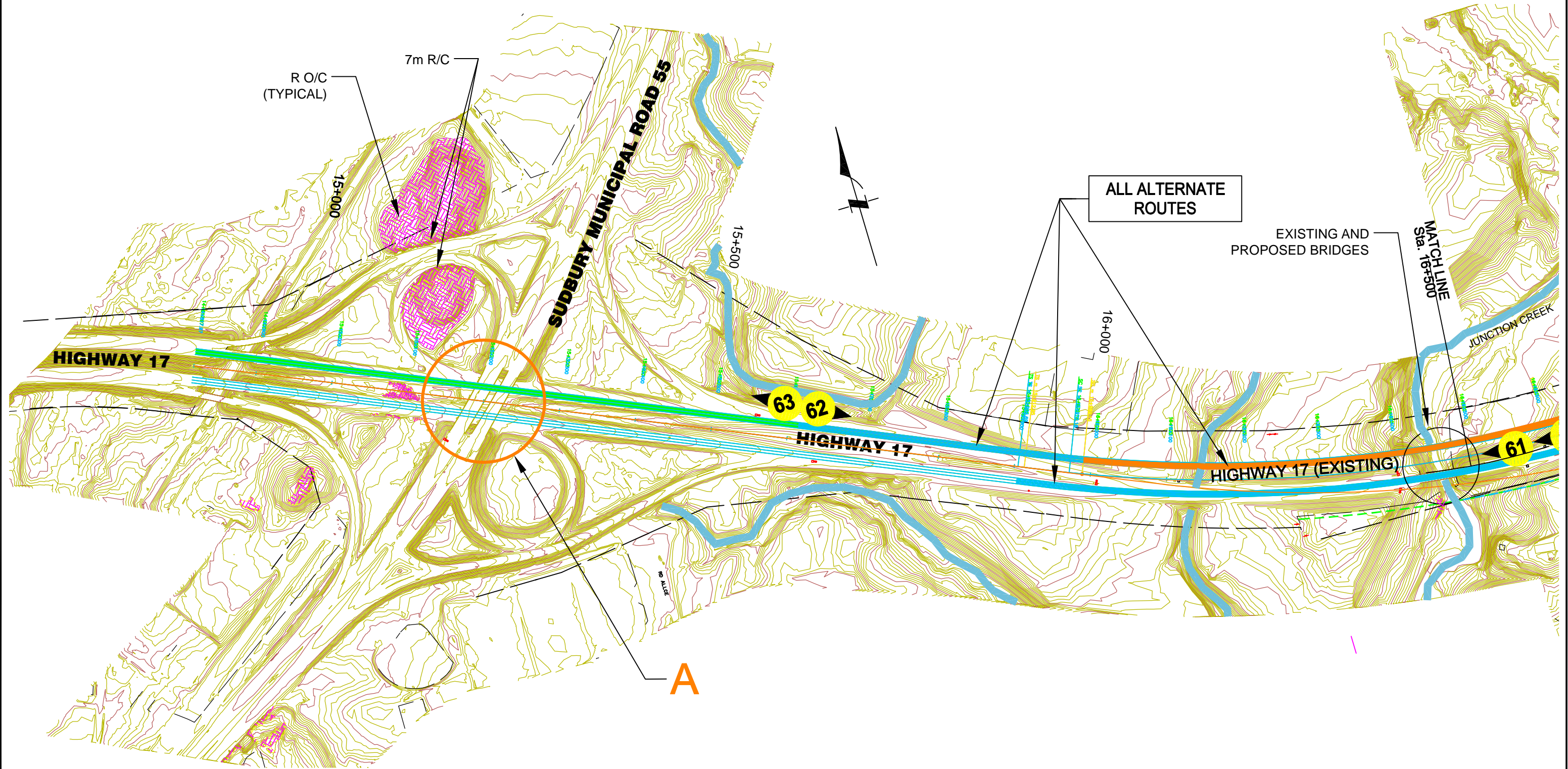
PHOTOGRAPH NUMBER  
(ARROW SHOWS DIRECTION OF VIEW)
- 

ASSESSMENT NODE



APPROXIMATE LIMIT OF STUDY  
STA. 15+220 TWP WATERS




GM STA 15+220 TO 17+500 TWP WATERS



STA. 15+220 TO 16+500 TWP WATERS (HIGHWAY 17 STUDY CORRIDOR)

METRIC

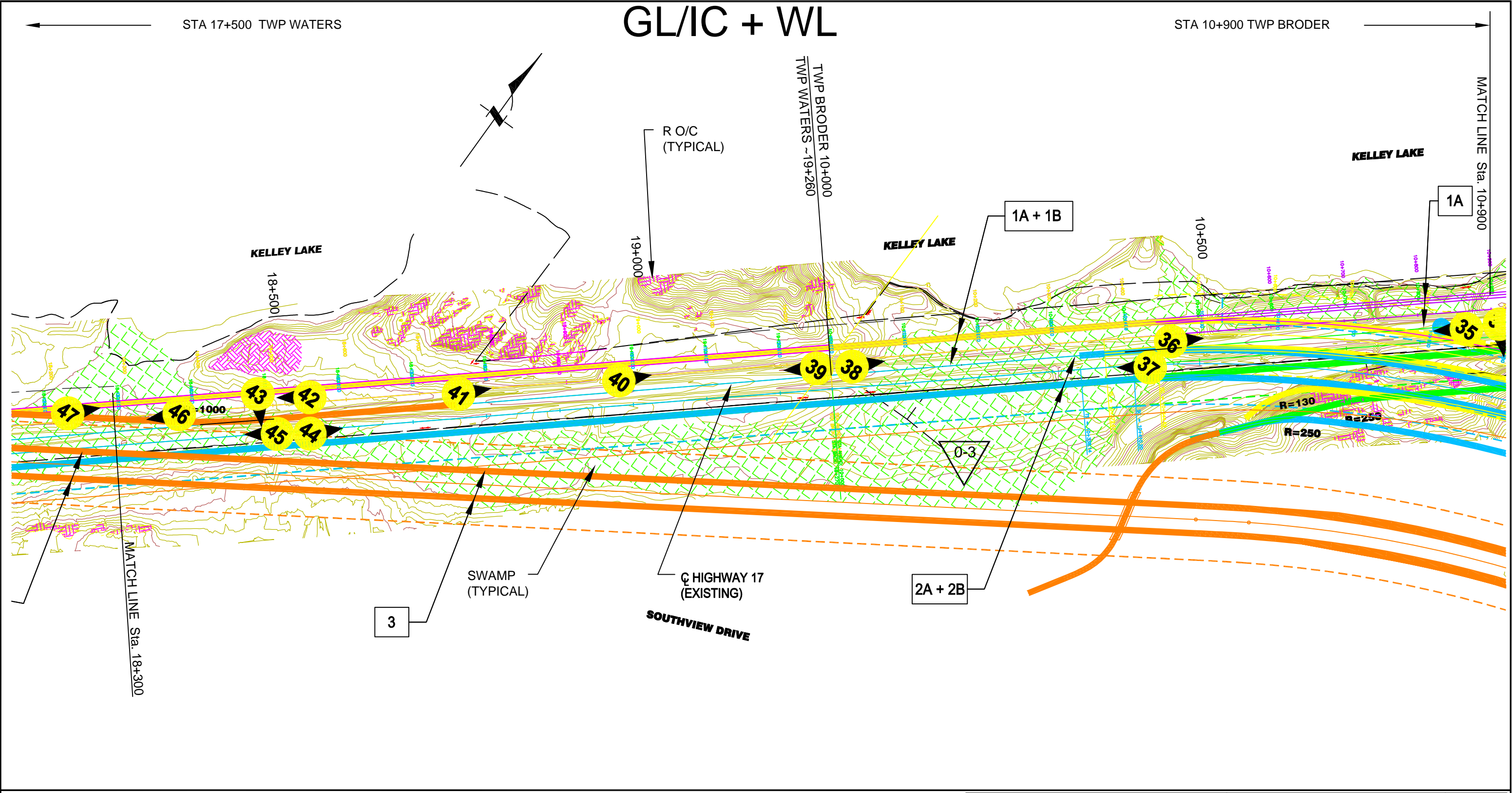


 Ministry of Transportation Ontario	CONT No GWP No 5825-05-00	
 <b>Peto MacCallum Ltd.</b> CONSULTING ENGINEERS	<b>HIGHWAY 17</b> SUDBURY SOUTHWEST BY-PASS FOUR-LANING FROM SUDBURY MUNICIPALITY ROAD 55 (MIDDLE JUNCTION) EASTERLY TO HIGHWAY 69 FOR 13.3km	SHEET 1











STA 10+900 TO 19+260 TWP BRODER



PLAN  
SCALE



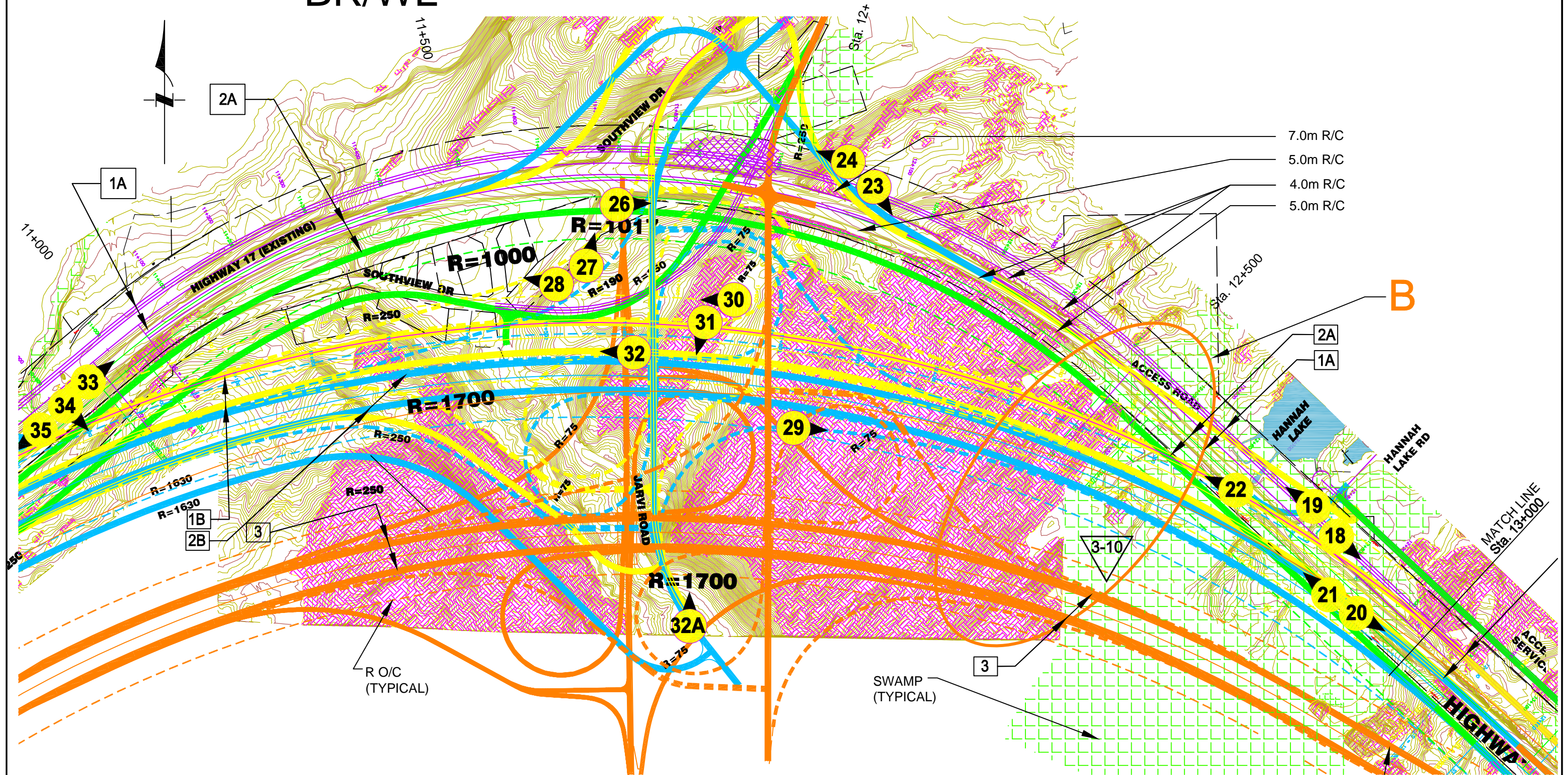
<p align="center"><u><b>HIGHWAY 17</b></u></p> <p align="center"><b>SUDBURY SOUTHWEST BY-PASS FOUR-LANING FROM SUDBURY MUNICIPALITY ROAD 55 (MIDDLE JUNCTION) EASTERLY TO HIGHWAY 69 FOR 13.3km</b></p>	
---	--





# BR/WL

STA 10+900 TO 19+260 TWP BRODER



STA. 11+000 TO 13+000 TWP BRODER (HIGHWAY 17 STUDY CORRIDOR)

METRIC



Ministry of  
Transportation  
Ontario



**Peto MacCallum Ltd.**  
CONSULTING ENGINEERS

CONT No  
GWP No 5825-05-00

HIGHWAY 17  
SUDBURY SOUTHWEST BY-PASS FOUR-LANING FROM  
SUDBURY MUNICIPALITY ROAD 55 (MIDDLE JUNCTION)  
EASTERLY TO HIGHWAY 69 FOR 13.3km



SHEET  
5



## STA 10+900 TO 19+260 TWP BRODER



PLAN  
SCALE

A horizontal scale bar with markings at 50, 0, 50, and 100m. The segment between 0 and 50 on the right is solid black, while the segment between 50 and 100 is also solid black. The segment to the left of 0 is divided into ten equal segments by vertical tick marks.

**Peto MacCallum Ltd.**  
CONSULTING ENGINEERS

CONT No  
GWP No 5825-05-00

<p align="center"><u>HIGHWAY 17</u></p> <p>SUDBURY SOUTHWEST BY-PASS FOUR-LANING FROM SUDBURY MUNICIPALITY ROAD 55 (MIDDLE JUNCTION) EASTERLY TO HIGHWAY 69 FOR 13.3km</p>	
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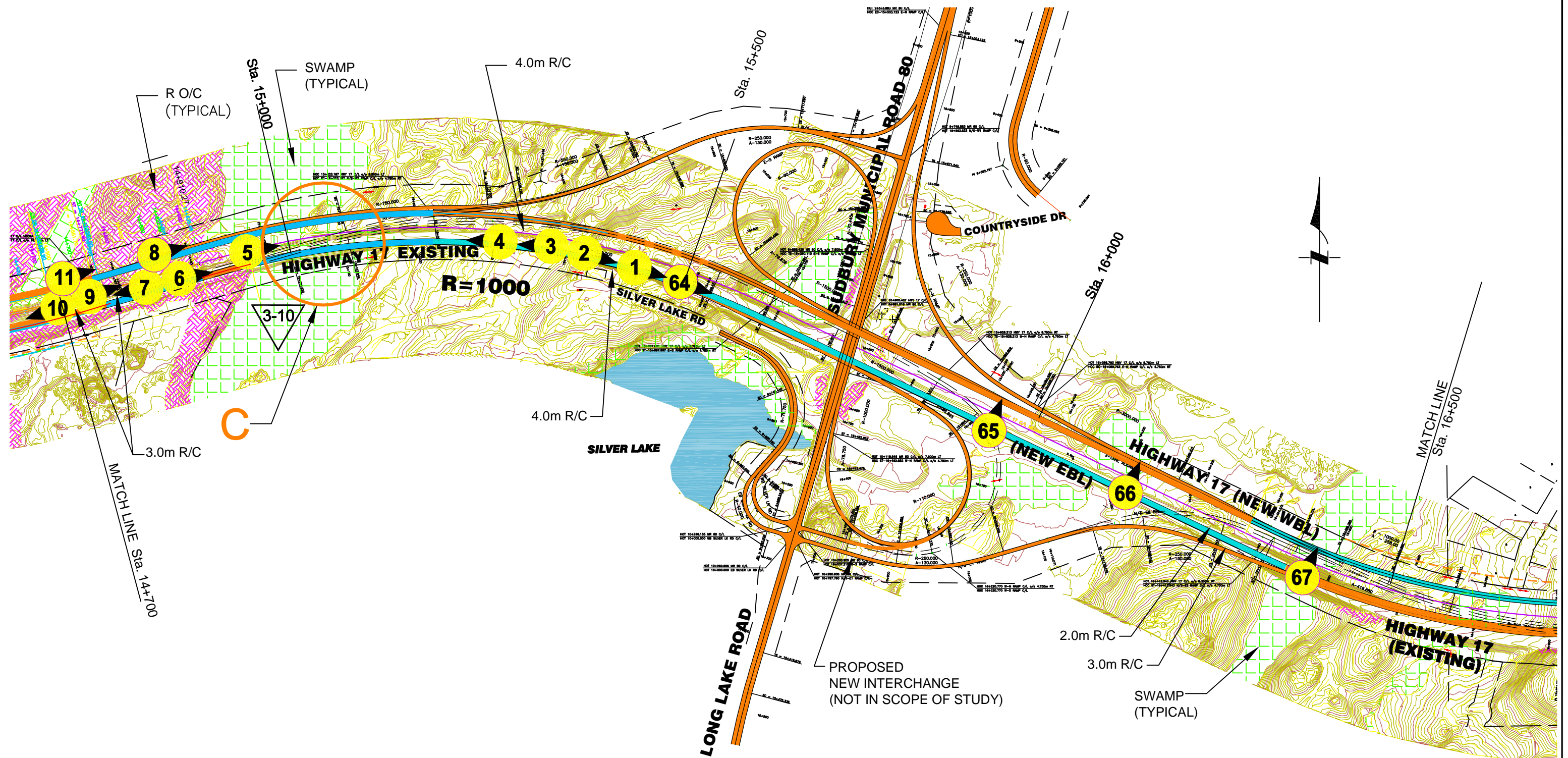


**SHEET**  
**6**



# BR/WL

STA 10+900 TO 19+260



STA. 14+700 TO 16+500 TWP BRODER (HIGHWAY 17 STUDY CORRIDOR)

METRIC



Ministry of  
Transportation  
Ontario



**Peto MacCallum Ltd.**  
CONSULTING ENGINEERS

CONT No  
GWP No 5825-05-00

HIGHWAY 17  
SUDBURY SOUTHWEST BY-PASS FOUR-LANING FROM  
SUDBURY MUNICIPALITY ROAD 55 (MIDDLE JUNCTION)  
EASTERLY TO HIGHWAY 69 FOR 13.3km

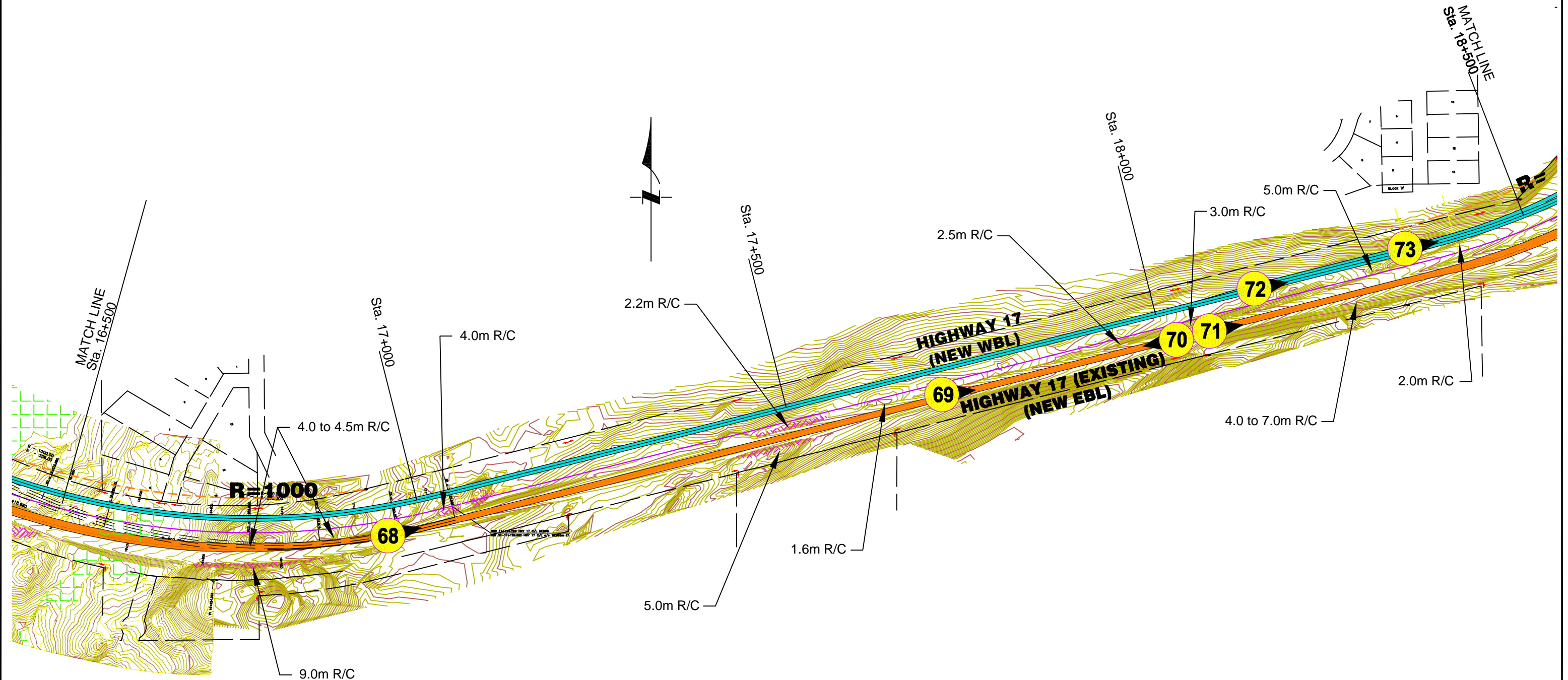


SHEET  
7



# BR/WL

STA 10+900 TO 19+260 TWP BRODER



STA. 16+500 TO 18+500 TWP BRODER (HIGHWAY 17 STUDY CORRIDOR)

METRIC



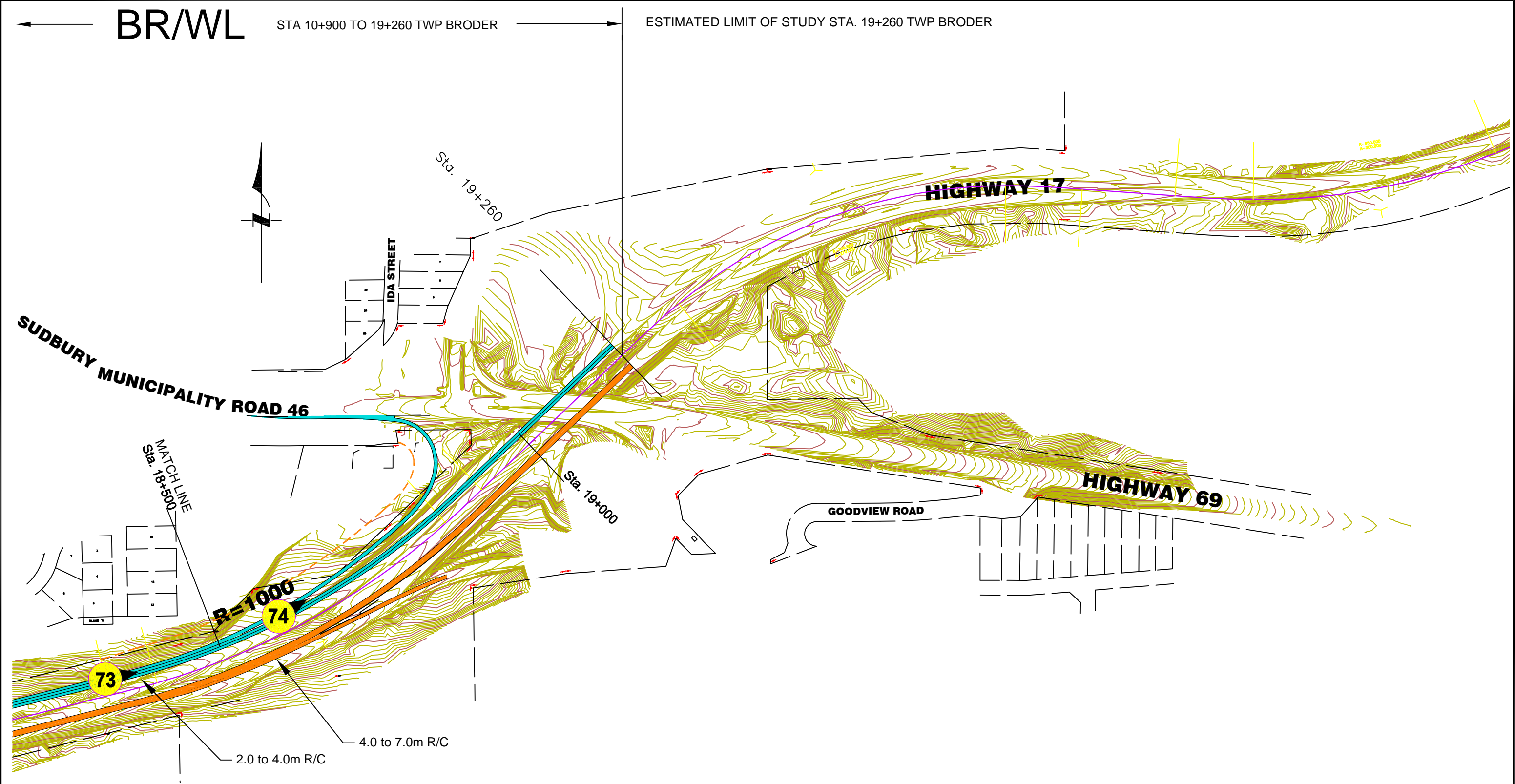
**Peto MacCallum Ltd.**  
CONSULTING ENGINEERS

CONT No  
GWP No 5825-05-00

HIGHWAY 17  
SUDBURY SOUTHWEST BY-PASS FOUR-LANING FROM  
SUDBURY MUNICIPALITY ROAD 55 (MIDDLE JUNCTION)  
EASTERLY TO HIGHWAY 69 FOR 13.3km

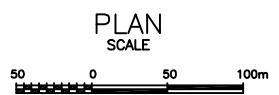





SHEET  
8

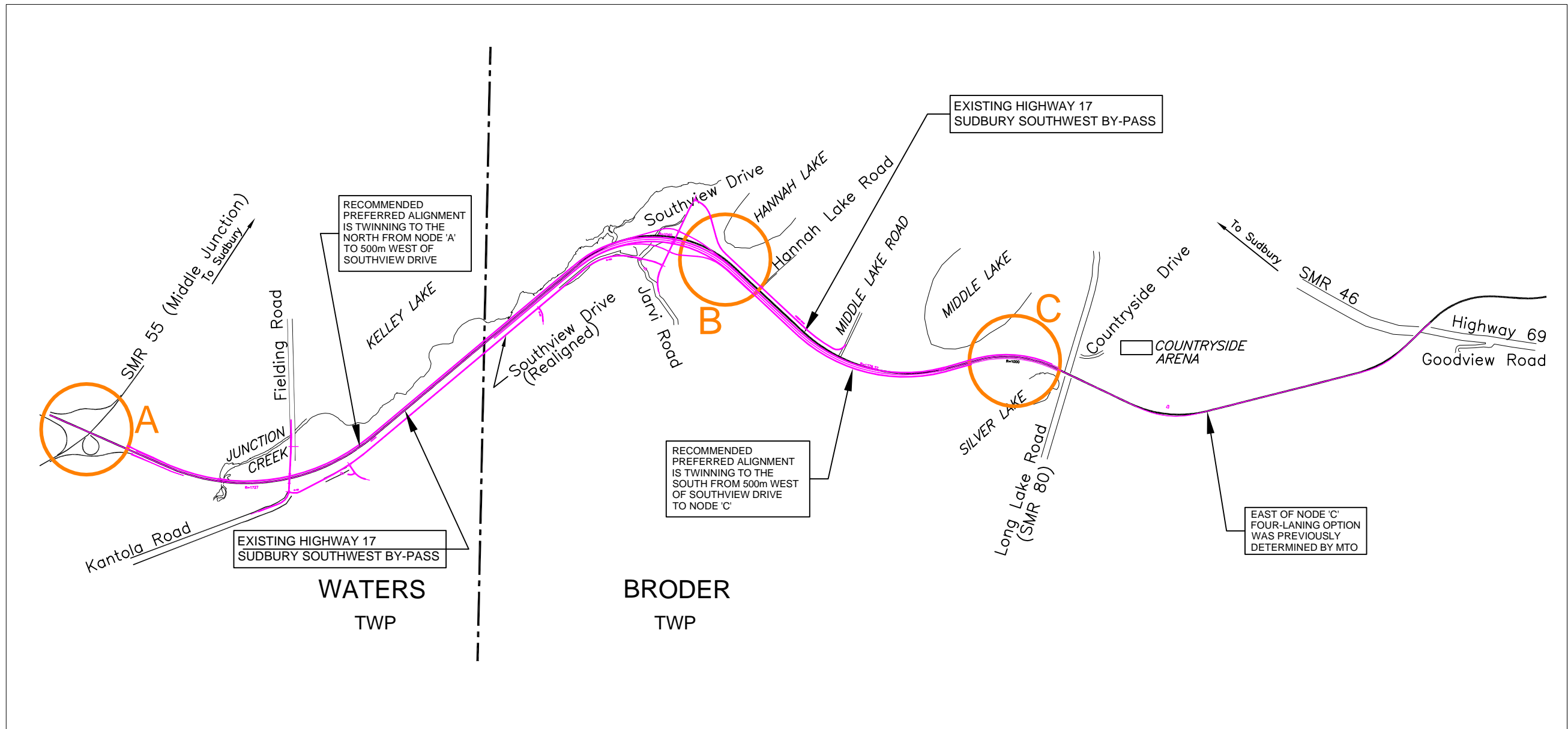
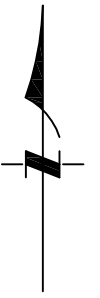


STA. 18+500 TO 19+260 TWP BRODER (HIGHWAY 17 STUDY CORRIDOR)

METRIC



 <p>Ministry of Transportation Ontario</p>	<p>CONT No GWP No 5825-05-00</p>	
 <p><b>Peto MacCallum Ltd.</b> CONSULTING ENGINEERS</p>	<p><b>HIGHWAY 17</b> SUDBURY SOUTHWEST BY-PASS FOUR-LANING FROM SUDBURY MUNICIPALITY ROAD 55 (MIDDLE JUNCTION) EASTERLY TO HIGHWAY 69 FOR 13.3km</p>	<p>SHEET 9</p>



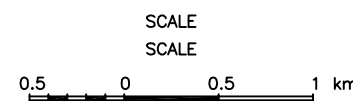
**NOTE:** PREFERRED ROUTE SHOWN IS BASED ON AUGUST 28, 2007 UPDATE FROM STANTEC CONSULTING LTD. THE DRAWING ILLUSTRATES THE FOUNDATION ASSESSMENT RECOMMENDED ALTERNATIVES.

**LEGEND:**

- HWY 17 ( EXISTING)
- HWY 17 ( PREFERRED ROUTE)
- <sup>C</sup> ASSESSMENT NODE

**METRIC**

**PREFERRED ROUTE (AUGUST 2007)**  
HIGHWAY 17 SUDBURY SOUTHWEST BY-PASS FOUR-LANING  
FROM SUDBURY MUNICIPALITY ROAD 55 (MIDDLE JUNCTION) EASTERLY  
TO HIGHWAY 69 FOR 13.3 KM  
DISTRICT 54, SUDBURY



	CONT No GWP No 5825-05-00
<b>Peto MacCallum Ltd.</b> CONSULTING ENGINEERS	HIGHWAY 17 PREFERRED ROUTE (AUGUST 2007)

SHEET 10





## **APPENDIX A**

### List of Reference Documents

## **APPENDIX A**

### **LIST OF REFERENCE DOCUMENTS**

**Highway 17, Sudbury Southwest By-Pass Four-Laning  
From Sudbury Municipal Road 55 (Middle Junction)  
Easterly to Highway 69 for 13.3 km  
GWP No. 5825-05-00  
P.O. No.: 5005-E-0003**

#### **A. GEOLOGICAL AND PHYSIOGRAPHIC MAPS**

- Surficial Geology of Northern Ontario, Map No. 2518 from Ministry of Northern Development and Mines Ontario Geological Survey, Printed 1987. Scale: 1:1,200,000.
- Surficial Geology of Algoma, Sudbury, Timiskaming and Nipissing, Map No. S465 from Ontario Department of Lands and Forests, dated 1965. Scale: 1:506,880 or 8 miles to 1 inch.
- Northern Ontario Engineering Geology Terrain Study, Data Base Map of Sudbury, Map No. 5003 from Ministry of Natural Resources Ontario Geological Survey, published 1978. Scale: 1:100,000.
- Sudbury Mining Area (Bedrock Geology) Map No. 2170 from the Ontario Department of Mines. Published 1969. Scale: 1 inch to 1 mile.
- Part of the Sudbury Basin Area, Map No. 1956-1 from the Department of Mines, published 1955. Scale: 1:63,360 or 1 mile to 1 inch.
- Stratigraphy, Sedimentology and Petrology of the Huronian Supergroup in the Sudbury - Espanola Area, Geoscience Study 16 from the Ministry of Natural Resources, dated 1977.
- Aggregate Resources Inventory of the East Half of the Regional Municipality of Sudbury, Paper No. 170, dated 1998.
- Sand and Gravel Resources, ARIM Map No. 170-1B from the Ontario Geological Survey Aggregate Resources Inventory, Issued 1998. Scale: 1:50,000.
- Geology of Panache Lake Area (East Part) Districts of Sudbury and Manitoulin, Preliminary Map No. P669 Geological Series from the Ontario Department of Mines and Northern Affairs dated 1971. Scale: 1 inch to 1 mile.

#### **B. ONTARIO BASE MAPS**

- Ontario Base Map from Ontario Ministry of Natural Resources Sheet 2017 4900 51400 published 1999. Scale 1:20,000.
- Ontario Base Map from Ontario Ministry of Natural Resources Sheet 2017 5000 51400 published 1980. Scale:1:20,000



### **C. PREVIOUS MTO REPORTS**

- Foundation Investigation Report for Highway 17/Municipal Road 80 Overpass, G.W.P. 99-98-00 prepared by Golder Associates Ltd. Report Reference 021-1147 dated June 2003. Geocres No. 41I-160.
- Supplemental Pavement Design Report for Highway 17, Sudbury Southwest Bypass Fielding/Kantola Road Intersection Townships of Waters, Sta. 16+700 to 17+400 and Southview Drive Intersection Township of Broder Sta. 11+350 to 12+100, W.P. 183-97-00 prepared by Trow Consulting Engineers Ltd. Report Reference S07326G-B dated September 30, 1997.
- Foundation Investigation Report for Proposed Highway 17, Sudbury By-Pass Interchange, W.P. 62-74-10 & 11, Highway 17 West prepared by William Trow Associates Ltd. Reference No. S-2506 dated 1975 (estimated). Geocres No. 41I-90.
- Geotechnical/Foundation Investigation Report for Proposed Grade Separation and New Interchange, Highway 17 and Regional Road 80 and Proposed New S-E Ramp. Highway 69 and Highway 17, GWP No. 99-98-00. Prepared by John Emery Geotechnical Engineering Limited, Reference 199170 dated October 28, 1999, Geocres No. not available.
- Drawings for Construction of Junction Creek Bridge at Highway 17 Sudbury By-Pass WP No. 911-71-01 Contract No. 72-212, dated June 1972, Geocres No. 41I-69.

### **D. MISCELLANEOUS REPORTS AND DATA**

- Preliminary Design Report for Highway 17 Four-Laning from 1.5 km West of Sudbury Regional Road 80 Easterly to 1.1 km East of Highway 69 and Assessment of Timing and Need for Four-Laning Between Sudbury Regional Road 55 and Highway 69, W.P. No. 99-98-00. Prepared by Stantec Consulting Ltd. dated December 2002.
- Planning, Preliminary Design and Transportation Environmental Study Report of Highway 17 from 1.0 km West of Regional Road 80 (Long Lake Road) to 1.3 km East of Regional Road 80, GWP 99-98-00. Prepared by Stantec Consulting Ltd. dated February 2001.
- Water Resources Bulletin 2-9 from Ministry of the Environment Water Well Records for Ontario Northern Area 1946-1969.
- Aerial Photographs from Ministry of Natural Resources 89-4615 Series, 20-15 to 20-31.



## **APPENDIX B**

### Water Well Records







GROUND WATER BULLETIN REPORT											
WATER WELL DATA SYSTEM    Feb 08 2007    PAGE: 1    COUNTY:    SUBURRY											
MUNICIPALITY CONCESSION ETC	LOT	WELL EASTING UTM NO	ELEV FEET	DATE DRILLER	INS WATER FEET	PUMP STAT	TEST RATE	TIME HR:MM	WATER DEPTH	LENGTH IN FEET TO WHICH FORMATIONS EXTEND	
											CSG KIND DIA OF DRILLER
BRODER TOWNSHIP											
CON	05	003	59- 501720	890	1963/10 2612	02	FR	0033	0006 0015 0002 8 :0	DO	---
			00495 5142290								BLDR 0005 WHIT GRNT 0035
CON	05	003	59- 502580	875	1960/09 1641	02	FR	0090	0020 0035 0002 1 :0	DO	---
			00460 5142100								ROCK 0091
CON	05	003	59- 501944-		1955/12 3014	02	FR	0031	0001 0001 0004 1 :0	DO	---
			00470 5141438								ROCK 0031
CON	05	003	59- 502110	900	1973/09 5210	06	FR	0025	0005 0040 0003 1 :0	DO	---
			03111 5142316								CLAY 0008 GREY ROCK 0040
CON	05	003	59- 499332	940	1973/09 5210	06	FR	0051	0007 0055 0003 1 :0	DO	---
			03110 5143008								CLAY 0010 BLDR 0012 GREY ROCK 0055
CON	05	003	59- 502300	900	1984/09 5210	06	FR	0155	0005 0165 0025 1 :0	CO DO	---
			04960 5142100								SAND GRVL 0005 GREY GRNT 0165
CON	05	003	59- 501900	890	1969/07 4402	02	FR	0072	0002 24:0	IN	---
			02153 5142070								QSDN 0070 GRVL 0072
CON	05	003	59- 502090	890	1971/07 3616	02	FR	0087	0005 0005 0005 3 :0	IN	---
			02586 5142170								GREY CLAY 0074 GREY GRVL BLDR 0083 RED GRNT
CON	05	003	59- 501960	885	1977/06 5210	06	FR	0095	0010 0115 0006 1 :0	IN	---
			03746 5142040								0087 WHIT GRNT 0092
CON	05	004	59- 501240	930	1972/09 5210	06	FR	0085	0010 0130 0001 2 :0	CO	---
			02932 5142080								CLAY 0064 GREY GRNT 0115
CON	05	004	59- 501278	900	1971/06 2646	02	FR	0023	0007 0007 0002 1 :0	DO	---
			02651 5142228								CLAY BLDR 0004 GREY GRNT 0130
CON	05	004	59- 501240	885	1970/07 2646	02	FR	0019	0003 0024 0003 24:0	DO	---
			02348 5142220								GREY CLAY 0014 GREY GRVL 0019
CON	05	004	59- 501840	900	1968/08 4402	02	FR	0122	0010 0015 0001 24:0	DO	---
			01976 5142270								FSND STMS 0015 GREY GRNT 0127
CON	05	004	59- 501400	920	1974/11 3652	02	FR	0106	0005 0007 0002 3 :0	DO	---
			03274 5142060								YLLW FILL 0002 WHIT GRNT 0111
CON	05	004	59- 501300	930	1962/10 4403	02	FR	0192	0008 0020 0001 4 :0	DO	---
			00477 5142220								MSND BLDR 0005 QRTZ 0197
CON	05	004	59- 501230	900	1961/10 2612	01	FR	0032	0005 0018 0003 24:0	DO	---
			00476 5142230								GREY CLAY 0006 GRVL 0012 GREY GRNT 0033
CON	05	004	59- 501210	925	1961/11 1738	02	FR	0157	0006 0001 8 :0	DO	---
			00475 5142105								MSND CLAY 0006 GREY ROCK 0162
CON	05	004	59- 501460	900	1961/10 1738	02	FR	0120	0004 0001 5 :0	DO	---
			00474 5142230								BRWN CLAY 0004 GREY ROCK 0125
CON	05	004	59- 591105~	910	1958/08 1738	02	FR	0085	0010 0001 3 :0	DO	---
			00473 5142220								MSND 0006 GREY ROCK 0117
CON	05	004	59- 501290~	900	1958/05 1738	02	FR	0070	0010 0025 0001 4 :0	DO	---
			00472 5142220								GRVL STMS FILL 0004 BLCK ROCK 0070
CON	05	004	59- 501400~	900	1955/12 3014	02	FR	0066	0010 0018 0003 5 :0	DO	---
			00471 5142230								MSND 0026 GRNT 0066
CON	05	004	59- 501510	900	1967/06 4402	02	FR	0089	0010 0015 0002 8 :0	DO	---
			00479 5142180								PRDG 0067 GRNT 0100
CON	05	004	59- 501533	900	1975/09 4817	02	FR	0115	0022 0022 0001 1 :0	DO	---
			03432 5142184								YLLW GRVL BLDR 0013 GREY ROCK 0125
CON	05	005	59- 500800	950	1961/09 1738	02	FR	0093	FLW 0002 4 :0	DO	---
			00485 5141810								BRWN CLAY 0010 GRVL 0014 GREY ROCK 0096
CON	05	005	59- 500860	960	1968/12 4402	02	FR	0057	0001 0010 0002 8 :0	DO	---
			02079 5142120								GRVL 0006 GREY GRNT 0065
CON	05	005	59- 500200	915	1977/08 3652	02	FR	0133	0002 0005 0010 2 :0	DO	---
			03801 5141980								GRVL FILL 0004 GREY CLAY 0008 GREY ROCK 0138

GROUND WATER BULLETIN REPORT

PAGE: 2 COUNTY: SUDBURY

WATER WELL DATA SYSTEM Feb 08 2007

MUNICIPALITY CONCESSION ETC	LOT	WELL EASTING UTM NO NORTHING FEET	ELEV FEET	DATE	DRILLER	INS	WATER FEET	DIA OF FOUND LVL FEET	CSG KIND	WATER STAT PUMP TEST	TEST TIME HR:MM	WATER DEPTH FEET	SCREEN DEPTH FEET	OWNER FORMATIONS EXTEND	DEPTHS IN FEET TO WHICH FORMATIONS EXTEND	
CONTINUING... BRODER TOWNSHIP																
CON	05	005	59-	500200	975	1978/08	3652	02	FR	0126	0001	0007	0006	1 :30	DO	---
CON	05	005	03988	5141950	925	1971/05	4402	02	FR	0056	0006	0012	0002	16:0	DO	GREY SAND 0027 GREY STNS 0130
CON	05	005	02548	5141830	750	1967/05	4402	02	FR	0078	0010	0014	0002	8 :0	DO	GREY LOAM 0004 QSND 0009 GREY GRNT 0065
CON	05	005	00489	5141720	975	1962/09	4817	02	FR	0055	0001	0030	0002	2 :0	DO	BLDR QSND 0006 GREY GRNT 0084
CON	05	005	00488	5141810	915	1976/08	3652	02	FR	0099	0006	0007	0005	2 :30	DO	YLLW MSND 0005 GREY ROCK 0065
CON	05	005	03603	5142580	960	1961/12	1738	01	FR	0021	0015	0001	8 :0	DO	GREY CLAY 0018 GREY ROCK 0104	
CON	05	005	00486	5141940	940	1966/06	4402	02	FR	0021	0017	0017	0001	24:0	DO	MSND CLAY 0019 GRVL 0022
CON	05	005	00528	5142215	950	1961/09	1738	02	FR	0115	0010	0001	8 :0	DO	FSND 0006 HPAN 0021	
CON	05	005	00484	5142140	920	1961/09	1738	02	FR	0136	0008	0001	5 :0	DO	MSND CLAY 0070 GRVL BLDR 0076 GREY ROCK 0119	
CON	05	005	00483	5141930	900	1961/08	1524	02	FR	0090	0009	0033	0002	2 :0	DO	CLAY MSND 0008 GRVL 0010 GREY ROCK 0140
CON	05	005	00482	5142240	930	1959/05	3014	02	FR	0042	0015	0025	0002	2 :0	DO	GRVL 0007 GREY GRNT 0090
CON	05	005	00481	5142005	885	1978/08	3652	02	FR	0140	0004	0006	0003	2 :0	DO	--- QSND 0024 QRTZ 0047
CON	05	005	03989	5142220	966	1963/09	4402	02	FR	0027	0025	0027	0002	9 :0	DO	GREY SNDS 0006 GREY ROCK 0167
CON	05	005	00478	5142230	960	1979/08	5210	06	FR	0085	0006	0080	0010	6 :0	DO	GRVL BLDR 0029
CON	05	005	59- 593150-	500600	975	1980/07	5210	06	FR	0065	0015	0090	0002	20:0	DO	SAND 0010 GREY GRNT 0095
CON	05	005	04305	5141900	960	1966/05	4402	01	FR	0024	0000	0001	24:0	DO	--- FILL 0017 CGVL 0019 GREY GRNT 0105	
CON	05	005	00487	5142120	950	1973/10	4402	02	FR	0228	0029	0080	0002	24:0	DO	QSDND 0021 GRVL 0024
CON	05	005	59- 500671	500671	920	1976/08	3652	02	FR	0108	0004	1 :10	DO	---	GREY SAND CLAY HPAN 0009 GREY GRNT QRTZ 0243	
CON	05	005	59- 500130	500130	920	1976/08	3652	02	FR	0085	0005	0025	0003	1 :0	DO	GREY CLAY 0006 GREY ROCK 0115
CON	05	005	03602	5142545	925	1971/04	4817	02	FR	0085	0005	0025	0003	1 :0	DO	CLAY BLDR 0017 WHIT GRNT 0094
CON	05	005	02539	5141730	915	1963/07	4402	01	FR	0026	0020	0020	0001	4 :0	DO	GRVL 0006 QSDND BLDR 0022 GRVL 0026
CON	05	005	00430	5142230	920	1975/07	3652	02	FR	0146	0007	0008	0006	2 :10	DO	---
CON	05	005	59- 500160	500160	920	1975/07	3652	02	FR	0085	0028	0070	0003	3 :30	NU	BROWN SAND 0012 GRSN 0152
CON	05	005	03395	5141960	925	1971/10	4406	06	FR	0085	0028	0070	0003	3 :30	NU	---
CON	05	005	02791	5142050	920	1975/09	3652	02	FR	0132	0003	0007	0006	1 :15	DO	RED GRVL BLDR STNS 0055 BLACK GRNT 0090
CON	05	005	03446	5141800	950	1973/06	4817	06	FR	0047	0012	0012	0004	1 :0	DO	BROWN SAND 0045 GRSN 0139
CON	05	005	03039	5142396	950	1989/06	5210	06	UK	0250	0010	0170	0000	20:0	DO	GRVL 0008 GREY GRNT 0049
CON	05	006	59- 499531-	499531-	1989/06	5210	06	UK	0250	0010	0170	0000	20:0	DO	---	
CON	05	006	05856	5141440	1987/10	3364	06	FR	0135	0013	0060	0002	6 :0	DO	CLAY 0040 GRVL 0042 GREY GRNT 0430	
CON	05	006	59- 499168	499168	1987/10	3364	06	FR	0135	0013	0060	0002	6 :0	DO	---	
CON	05	006	05470	5141526	950	1984/04	5210	06	FR	0042	0005	0025	0010	5 :0	DO	BROWN CLAY SAND SOFT 0020 GREY GRNT 0145
CON	05	006	59- 499250	499250	950	1984/04	5210	06	FR	0042	0005	0025	0010	5 :0	DO	---
CON	05	006	04964	5142000	920	1975/07	3652	02	DRY							SAND GRVL 0005 CLAY 0030 GRVL 0042
CON	05	006	03394	5141822	920	1975/07	3652	02	DRY							BLDR STNS 0006 YLLW SAND 0045 GRSN 0068

--- GREY SAND 0027 GREY STNS 0130  
 --- GREY LOAM 0004 QSDND 0009 GREY GRNT 0065  
 --- BLDND QSDND 0006 GREY GRNT 0084  
 --- YLLW MSND 0005 GREY ROCK 0065  
 --- GREY CLAY 0018 GREY ROCK 0104  
 --- MSND CLAY 0019 GRVL 0022  
 --- PSND 0006 HPAN 0021  
 --- MSND CLAY 0070 GRVL BLDND 0076 GREY ROCK 0119  
 --- CLAY MSND 0008 GRVL 0010 GREY ROCK 0140  
 --- GRVL 0007 GREY GRNT 0090  
 --- QSDND 0024 QRTZ 0047  
 --- GREY SNDS 0006 GREY ROCK 0167  
 --- GRVL BLDND 0029  
 --- SAND 0010 GREY GRNT 0095  
 --- FILL 0017 CGVL 0019 GREY GRNT 0105  
 --- QSDND 0021 GRVL 0024  
 --- GREY SAND CLAY HPAN 0009 GREY GRNT QRTZ 0243  
 --- GREY CLAY 0006 GREY ROCK 0115  
 --- CLAY BLDND 0017 WHIT GRNT 0094  
 --- GRVL 0006 QSDND BLDND 0022 GRVL 0026  
 --- BRWN SAND 0012 GRSN 0152  
 --- RED GRVL BLDND STNS 0055 BLCK GRNT 0090  
 --- BRWN SAND 0045 GRSN 0139  
 --- GRVL 0008 GREY GRNT 0049  
 --- CLAY 0040 GRVL 0042 GREY GRNT 0430  
 --- BRWN CLAY SAND SOFT 0020 GREY GRNT QRTZ HARD 0145  
 --- SAND GRVL 0005 CLAY 0030 GRVL 0042  
 --- BLDND STNS 0006 YLLW SAND 0045 GRSN 0068



WATER WELL DATA SYSTEM										GROUND WATER BULLETIN REPORT									
Municipality										OWNER									
CONCESSION										SCREEN									
ETC										DEPTHS IN FEET TO WHICH FORMATIONS EXTEND									
CONTINUING... BRODER TOWNSHIP																			
CON	05	006	59-	500170	920	1975/06	3652	02	FR	0147	0003	0006	0009	3 : 0	DO				
			03369	5141981												GREY CLAY 0007 GRSN 0151			
CON	05	006	59-	500150	920	1975/09	3652	02	FR	0145	0006	0012	0001	3 : 10	DO				
			03452	5141990												BRWN SAND 0026 GRSN 0149			
CON	05	006	59-	500159	920	1975/10	3652	02	FR	0147	0007	0009	0003	2 : 0	DO				
			03466	5142030												GREY SAND 0020 GRSN 0153			
CON	05	006	59-	500190	940	1969/07	3614	02	FR	0213	0014	0070	0002	2 : 0	DO				
			02184	5141570												RED GRNT 0218			
CON	05	006	59-	500170	925	1975/10	3652	02	FR	0061	0003	0005	0001	2 : 0	DO				
			03467	5141743												GREY SAND 0007 GRSN 0065			
CON	05	006	59-	500140	920	1971/10	4402	02	FR	0048	0000		0005	24 : 0	DO				
			02816	5141840												OSND 0043 GRVL 0048			
CON	05	006	59-	500160	960	1967/10	4402	02	FR	0090	0000	0010	0001	8 : 0	DO				
			00490	5142150												CLAY 0001 GREY GRNT 0101			
CON	05	006	59-	500600	950	1961/09	1738	02	FR	0190	0005		0001	3 : 0	DO				
			00491	5141740												CLAY 0004 0005 GREY ROCK 0203			
CON	05	006	59-	500240	915	1976/06	3652	02	FR	0102	0006	0010	0004	1 : 30	DO				
			03568	5142240												GREY FSND 0026 GREY ROCK 0109			
CON	05	006	59-	500200	940	1969/09	3616	02	FR	0066	0004	0026	0003	3 : 0	DO				
			02208	5141800												YLLW MSND 0007 GREY GRNT 0070			
CON	05	007	59-	999999~		1999/05	1462	06	FR	0220	0020		0002	1 :	DO				
			07620	999999~												SAND GRVL 0014 GREY GRNT 0262			
CON	05	008	59-	497919~		1998/07	7023	06	FR	0180	0015	0200	0010	1 : 0	DO				
			07500	5141413												RED UNKN 0200			
CON	05	009	59-	496960	860	1964/11	4402	02	FR	0090	0011	0017	0001	12 : 0	DO				
			00492	5141170												MSND BLDR 0017 RED QRTZ 0057			
CON	05	009	59-	497020	880	1969/07	4817	02	FR	0095	0038	0100	0002	1 : 0	DO				
			02144	5140920												CLAY BLDR 0008 GREY GRNT 0118			
CON	05	009	59-	496846	930	1973/09	4817	06	FR	0088	0030	0030	0005	1 : 0	DO				
			03069	5140100												BLCK CLAY 0010 GRNT ROCK 0090			
CON	05	010	59-	496314~		1989/10	2612	06	FR	0030	0010		0007	1 : 0	CO MN				
			06016	5141389												GRVL 0008 QRTZ 0330			
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			06774	5141389												GRNT 0290			
CON	05	012	59-	504066		1989/10	2612		FR	0132	0012		0004	1 : 0	DO				
			06078	5142035												GREY CLAY 0015 GREY SAND 0131 SAND GRVL 0132			

GROUND WATER BULLETIN REPORT									
WATER WELL DATA SYSTEM    Feb 08 2007    PAGE: 4    COUNTY: SUDBURY									
MUNICIPALITY CONCESSION ETC	LOT	UTM WELL EASTING ELEV NO NORTHING FEET DATE	CSG KIND DIA OF FOUND LVL	WATER STAT PUMP TEST LVL RATE TIME FEET GPM	TEST HR:MN USE	SCREEN		OWNER	FORMATIONS EXTEND
						FEET	FEET		
CONTINUING... BRODER TOWNSHIP									
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			05792 5143434					GREY QRTZ 0126	
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CON	06	009	59- 497110-	1992/07 2612	06	FR	0180		0004 1 :0 DO
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			06525 5143007					BRDN 0003	GREY GRNT 0180 RED GRNT 0207
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CON	06	010	59- 496420	825 1976/10 5210	06	FR	0060	0015 0072	0001 1 :0 ST
			03687 5143640					SAND 0016	GREY GRNT 0072
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			00659 5142860					QSDN 0024	HPAN 0027
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			07907 9999999					CLAY 0010	BLDR GRVL 0017 GRVL 0145
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			08060 9999999					CLAY BLDR 0113	GREY ROCK SOFT 0142



## **APPENDIX C**

Site Reconnaissance Observations and

Site Photographs 1 to 80, 13A, 14A, 32A, 50A and 55A

## **APPENDIX C**

### **SITE RECONNAISSANCE OBSERVATIONS AND SITE PHOTOGRAPHS Highway 17, Sudbury Southwest By-Pass Four-Laning From Sudbury Municipal Road 55 (Middle Junction) Easterly to Highway 69 for 13.3 km GWP No. 5825-05-00 P.O. No.: 5005-E-0003**

Site Reconnaissance Surveys (SRS) of the existing alignment and adjacent lands approximately within the study corridor were conducted on July 5 and September 12, 2006. The SRS consisted of a drive-by and walk-through of selected sections of Highway 17 and adjacent lands. The SRS was started at SMR 80 and progressed westward (Photographs 1 to 63 and 13A, 14A, 32A, 50A and 55A). The section between SMR 80 and Highway 69 was covered next (Photographs 63 to 74). Additional photographs were taken at the possible Kantola Road/Fielding Road Interchange (Photographs 75 to 80). The eighty-five photographs are presented in this Appendix, their locations and view directions are indicated on the attached Drawings.

The ground truth checks verified the surficial geology and drainage conditions inferred from the literature and map reviews as summarized below.

#### **A. SMR 80 (Long Lake Road) to Middle Lake Road (Photographs 1 to 17, 13A and 14A)**

- Bedrock outcrops interspaced with swamps can be seen along the existing alignment (Photographs 1 to 6). Typical rock cuts 2 to 5 m high can be seen along the alignment. Hilly terrain with extensive bedrock ridges were documented (Photographs 3, 4, 6, 7, 8, 13, 14, 16 and 17).
- Shallow drift of gravelly sand (till) was noted over bedrock outcrops (Photograph 9).
- Shallow swamps were found within the bedrock outcrops (Photographs 8 and 11).
- Swamp crossings with embankment up to 12 m high were encountered through the low terrain south of Middle Lake (Photographs 12 and 13A).
- A blasted rock disposal area was photographed north of the highway (Photograph 15).

#### **B. Middle Lake Road to Hannah Lake Road (Photographs 17 to 22)**

- Bedrock outcrops were noted on both sides of the existing highway (Photographs 17, 18 and 22).
- A 500 m long embankment over a swamp was photographed to the north and south of Hannah Lake Road (Photographs 18 to 22).

#### **C. Southview Drive Area (Photographs 23 to 32 and 32A)**

- Extensive bedrock outcrops and rock cuts up to 8.0 m high were found both north and south of the highway (Photographs 23 to 32 and 32A).
- A large swampy area was noted to the north of the Southview Drive intersection. The highway embankment was constructed over this swamp (Photographs 24 and 25). The smaller part of the swamp south of the highway was also photographed (Photographs 26 and 27).
- A small silt plain with birch trees was noted on the southwest quadrant of the highway 17 and Southview Drive intersection (Photograph 28).



- Extensive outcrops with forested areas and rock ridges were documented south of the intersection area (Photographs 29 to 32 and 32A).

**D. Southview Drive to Kantola Road/Fielding Road (Photographs 33 to 50 and 50A)**

- Extensive bedrock and earth exposures of silts/sands were encountered at the east end of this section terminating near the existing driveway signed as the entrance of the "Boart Longyear" property (Photographs 33, 34, 35 and 36).
- Extensive swamps were found to the north and south of the shallow highway embankment (Photographs 37, 41 to 50 and 50A).
- Earth slopes typically covered with rip-rap were noted along the highway embankment on the north side (Photographs 38 to 41).

**E. Kantola Road/Fielding Road Area (Photographs 51 to 56 and 55A)**

- Earth deposits were encountered at the intersection with swamps on the southeast guardant area (Photographs 51 to 56).
- A large rock outcrop was encountered to the south of the intersection away from the proposed alignment alternatives (Photographs 52 and 55A).

**F. Kantola Road/Fielding Road to SMR 55 (Photographs 57 to 63)**

- Extensive earth cuts up to 6 m high were encountered within this section of the highway corridor. The soils are inferred to be a glacial ground moraine formation (Photographs 57, 58, 59, 61 and 62).
- Approach embankments up to 10 m high were found at the existing Junction Creek bridge site (Photographs 60 and 61).
- Bedrock outcrops were visible on the creek bed near the bridge (Photograph 61).
- The western end of the corridor (SMR 55) is located over earth deposits. Bedrock outcrop on the S-W and E-N Ramps were not visible on the photograph (Photograph 63).

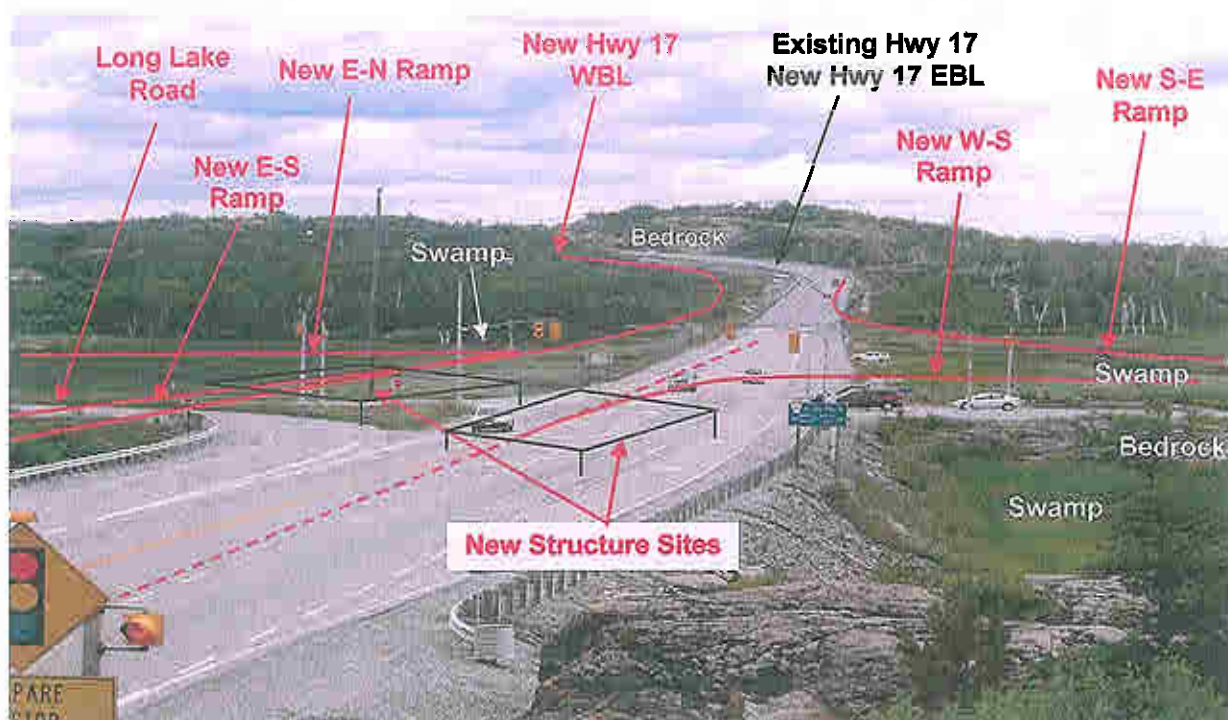
**G. SMR 80 (Long Lake Road) to Highway 69 (Photographs 64 to 74)**

- Bedrock outcrops interspaced with swamps can be seen along the existing alignment (Photographs 64 to 67, 69 and 70).
- Extensive rock cuts up to 11 m high was observed along this section (Photographs 64, 68, 70, 71 to 74).
- Shallow drift of glacial till locally covered bedrock outcrops (Photograph 74).

**H. Kantola Road/Fielding Road Area of Possible Interchange (Photographs 75 to 80)**

- Extensive ground moraine/ice contact deposits of silt till/silt observed (Photographs 75 to 80).
- Rip-rap erosion protection required over ditches and earth cuts (Photographs 79 and 80).





**Photograph 1 VIEW:** Looking east from bedrock cut on south side of Highway 17 at about STA. 15+600, 200 m west of the Highway 17/Sudbury MR80 (Long Lake Road) intersection. Bedrock outcrops at all four quadrants of intersection with adjacent wet swamp in ramp areas. (July 5, 2006)



**Photograph 2 VIEW:** Looking east from bedrock outcrop on south side of Highway 17 at STA. 15+430, some 370 m west of the Highway 17/Sudbury MR80 (Long Lake Road) intersection. Extensive 4 m high rock cuts both sides of highway. (July 5, 2006)





**Photograph 3 VIEW:** Looking west from bedrock outcrop on south side of Highway 17 at STA. 15+430, some 370 m west of Highway 17/Sudbury MR80 intersection. Bedrock outcrop in mid foreground. Swamp L-9, Sta. 14+940 to 15+125 visible on north side of highway. Extensive bedrock ridges to north of highway in proposal twinning area. (July 5, 2006)



**Photograph 4 ZOOM VIEW:** Looking west from bedrock outcrop on south side of Highway 17 at STA. 15+430, some 370 m west of Highway 17/Sudbury MR80 intersection. Bedrock outcrop in foreground. Swamp L-9, STA. 14+940 to 15+125 visible mid photo. (July 5, 2006)





**Photograph 5** VIEW: Looking east from north side of Highway 17, at about STA. 14+940, near west end of Swamp L-9. Existing highway crosses swamp via 3 to 4 m high rockfill embankment. (July 5, 2006)



**Photograph 6** VIEW: Looking east from bedrock ridge on north side of Highway 17 at about STA. 14+850. Bedrock cuts on both sides of highway. Swamp L-9 in distance at curve in road. (July 5, 2006)





**Photograph 7 VIEW:** Looking west from ridge on north side of Highway 17 at about STA. 14+850. Bedrock cuts on both side of highway. (July 5, 2006)



**Photograph 8 VIEW:** Looking east across typical rock ridge and swamp terrain of Swamp L-8 at about STA. 14+850. (July 5, 2006)



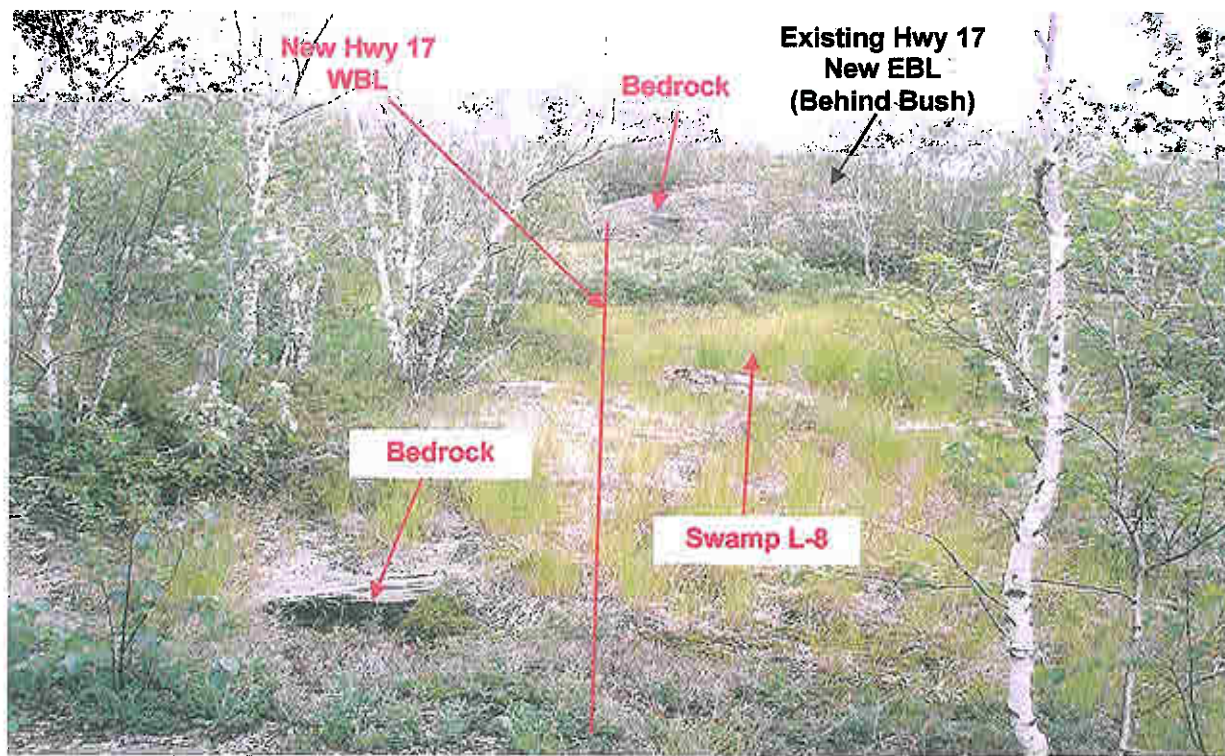


**Photograph 9** VIEW: Looking east from north side of Highway 17 at about STA. 14+700. Bedrock cuts visible on both sides of highway, low bedrock ridge and swamp terrain to left side photo typical of Swamp L-7. Gravelly sand overburden mantles bedrock in foreground. (July 5, 2006)



**Photograph 10** VIEW: Looking to west from north side of Highway 17 at about STA. 14+700. Bedrock cuts visible both sides of highway, low bedrock ridge and swamp terrain to right side photo typical of Swamp L-8. (July 5, 2006)



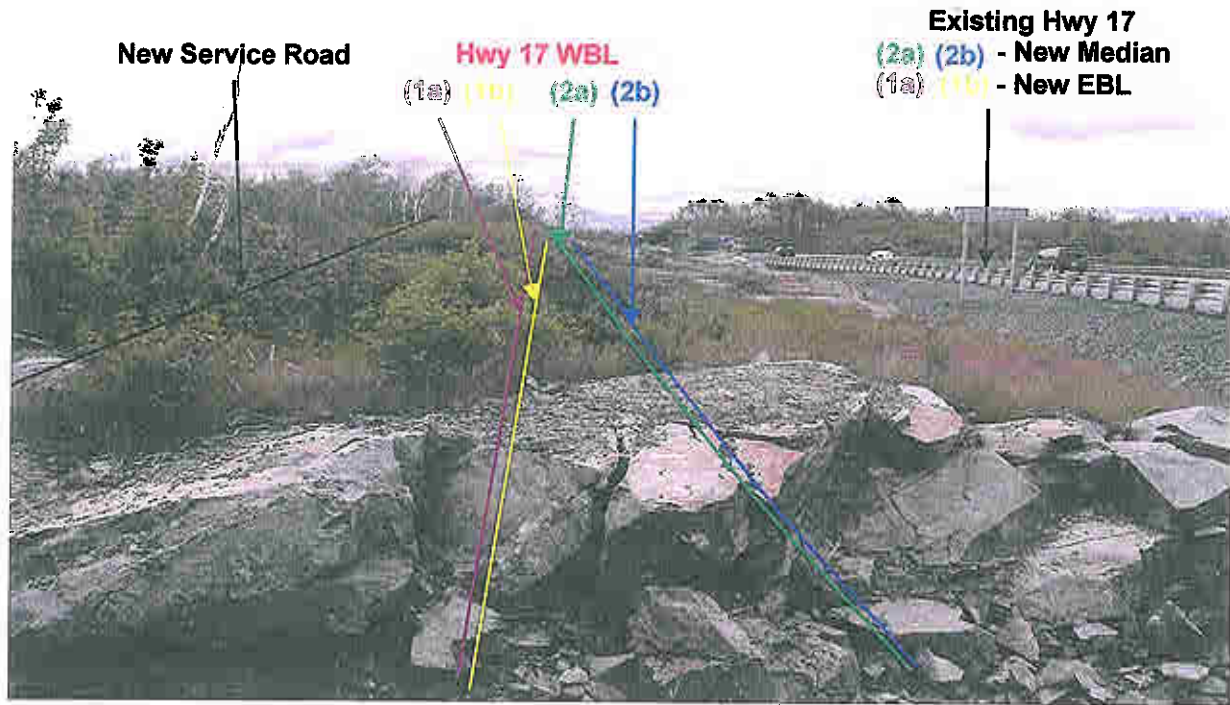


**Photograph 11** VIEW: Looking east at about STA. 14+700 across Swamp L-8. Low bedrock ridge and swamp terrain typical of area. (July 5, 2006)



**Photograph 12** VIEW: Looking west from bedrock outcrop on north side of Highway 17 at about STA. 14+550 across 200 m wide Swamp L-7 at south end of Middle Lake. Existing rockfill embankment is 12 m high. (July 5, 2006)





**Photograph 13** VIEW: Looking east from east side of Middle Lake Road at 10 m north of Highway 17. New highway twinning to north will cross extensive bedrock ridge terrain. (July 5, 2006)



**Photograph 13A** VIEW: Looking east from toe of rockfill embankment on south side of Highway 17 opposite Middle Lake Road at about STA. 13+770. (September 12, 2006)



**Photograph 14** VIEW: Looking west from east side of Middle lake Road about 10 m north of Highway 17. Low bedrock ridge and shallow swamp terrain in middle of photo. Bedrock outcrop exposed in 6 to 8 m cut on both sides of road in distance at about STA. 13+050. (July 5, 2006)

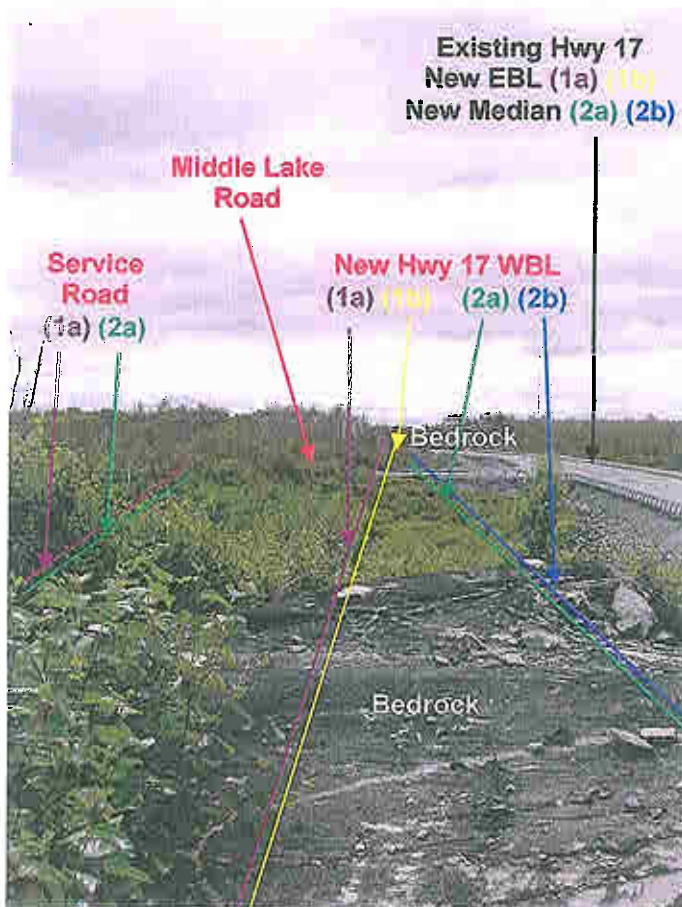


**Photograph 14A** VIEW: Looking west from toe of rockfill embankment on south side of Highway 17 at about STA. 13+740, 30 m west of Middle Lake Road. (September 12, 2006)

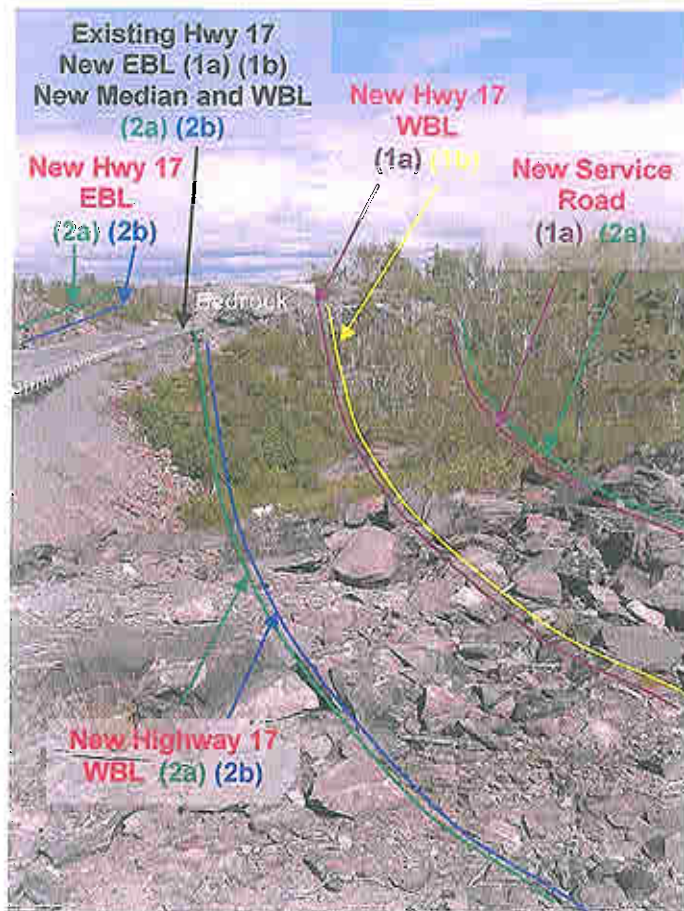




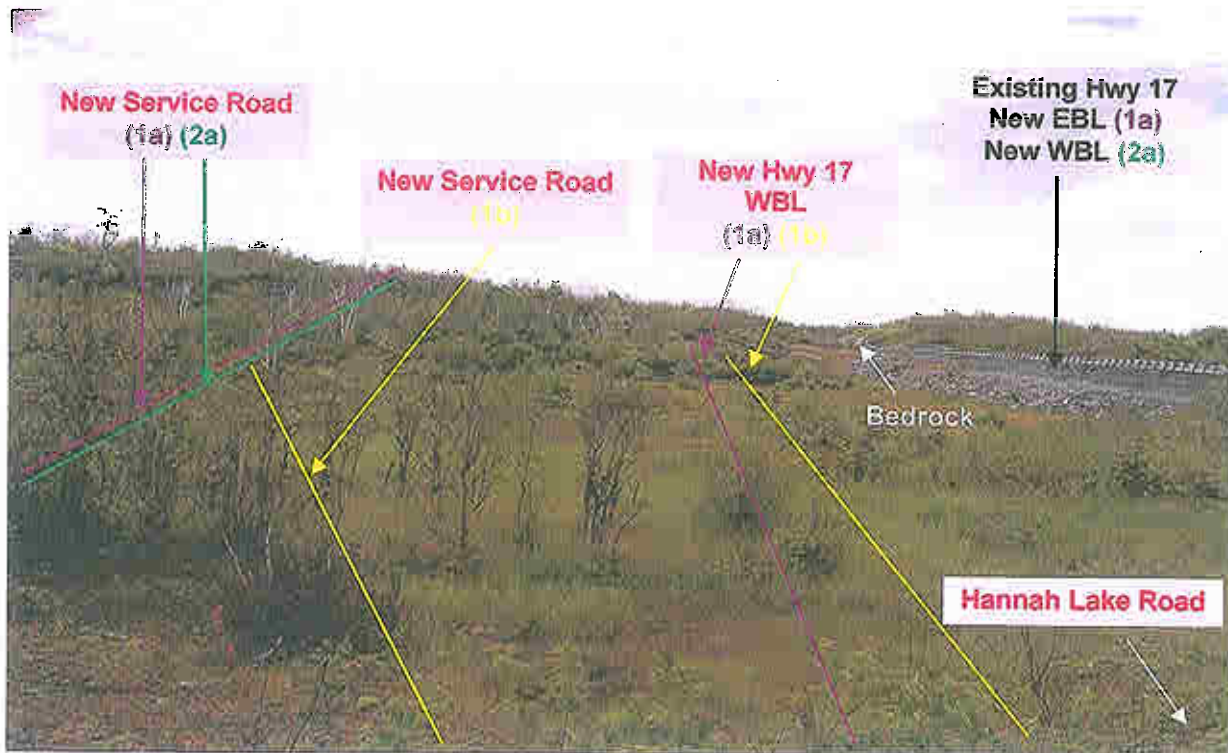
**Photograph 15 VIEW:** Looking west from east side of Middle Lake Road, at 55 m north of Highway 17 along alignment of proposed service road. Bedrock ridge and shallow swamp at left with extensive fill disposal area of blasted rock extending over 250 m to west. (July 5, 2006)



**Photograph 16 VIEW:** Looking east from bedrock outcrop on north side of Highway 17 at about STA. 13+650 across bedrock ridge and shallow swamp terrain to Middle Lake Road. (July 5, 2006)

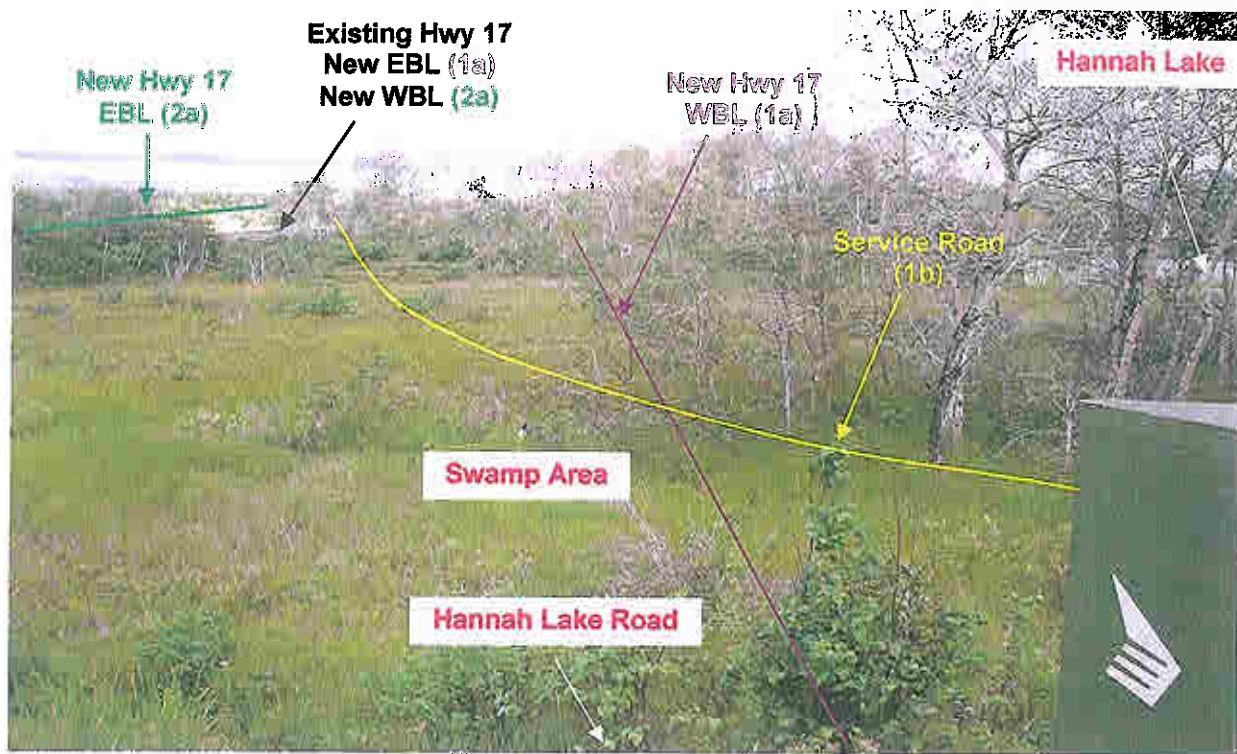


**Photograph 17 VIEW:** Looking west from bedrock outcrop on north side of Highway 17 at about STA. 13+625 across swamp area to 6 to 8 m rock cuts on both sides of highway in distance at STA. 13+450. (July 5, 2006)



**Photograph 18 VIEW:** Looking east from east side of Hannah Lake Road at STA. 12+790 about 15 m north of Highway 17. Low flat swamp terrain visible in foreground extending to low bedrock ridge in distance. (July 5, 2006)



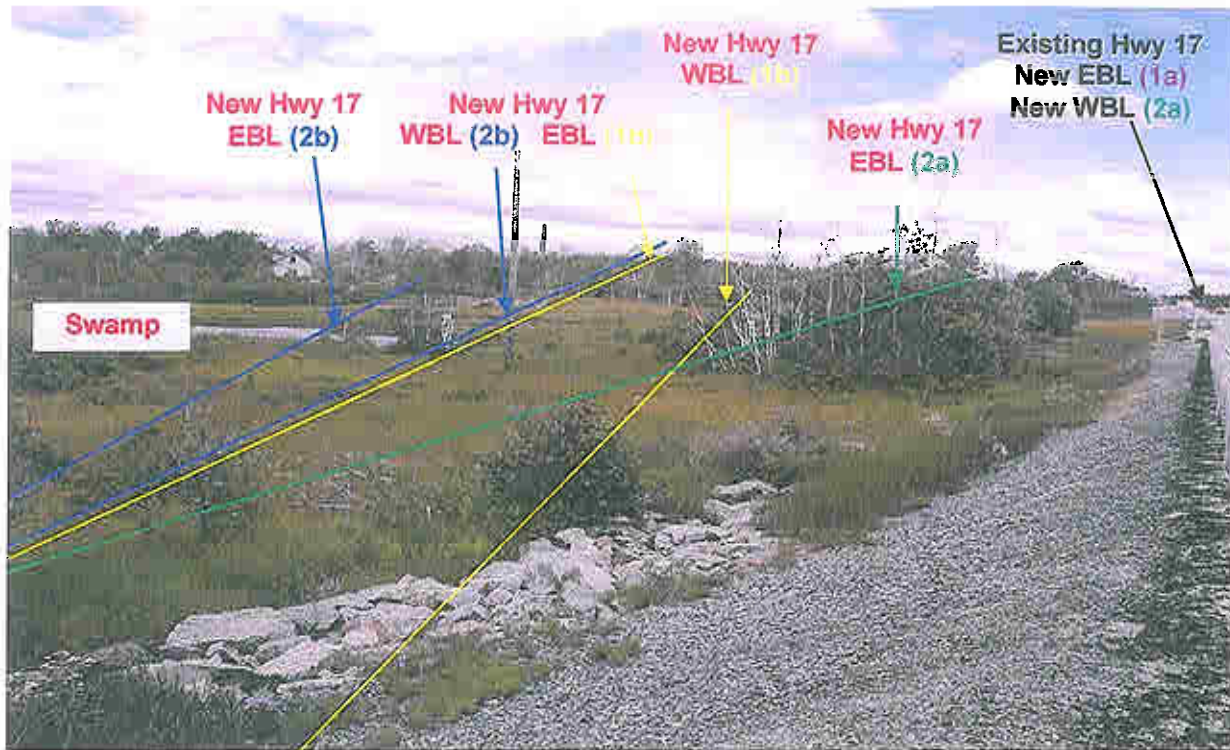


**Photograph 19** VIEW: Looking west from east side of Hannah Lake Road at about STA. 12+790, about 15 m north of Highway 17. Extensive swamp area extending about 200 m to west at south end of Hannah Lake. (July 5, 2006)



**Photograph 20** VIEW: Looking east from south shoulder of Highway 17 at about STA. 12+850 at swamp area at southerly extension of Hannah Lake. (July 5, 2006)





**Photograph 21** VIEW: Looking west from south shoulder of Highway 17 at about STA. 12+850 looking across swamp area at southerly extension of Hannah Lake. (July 5, 2006)

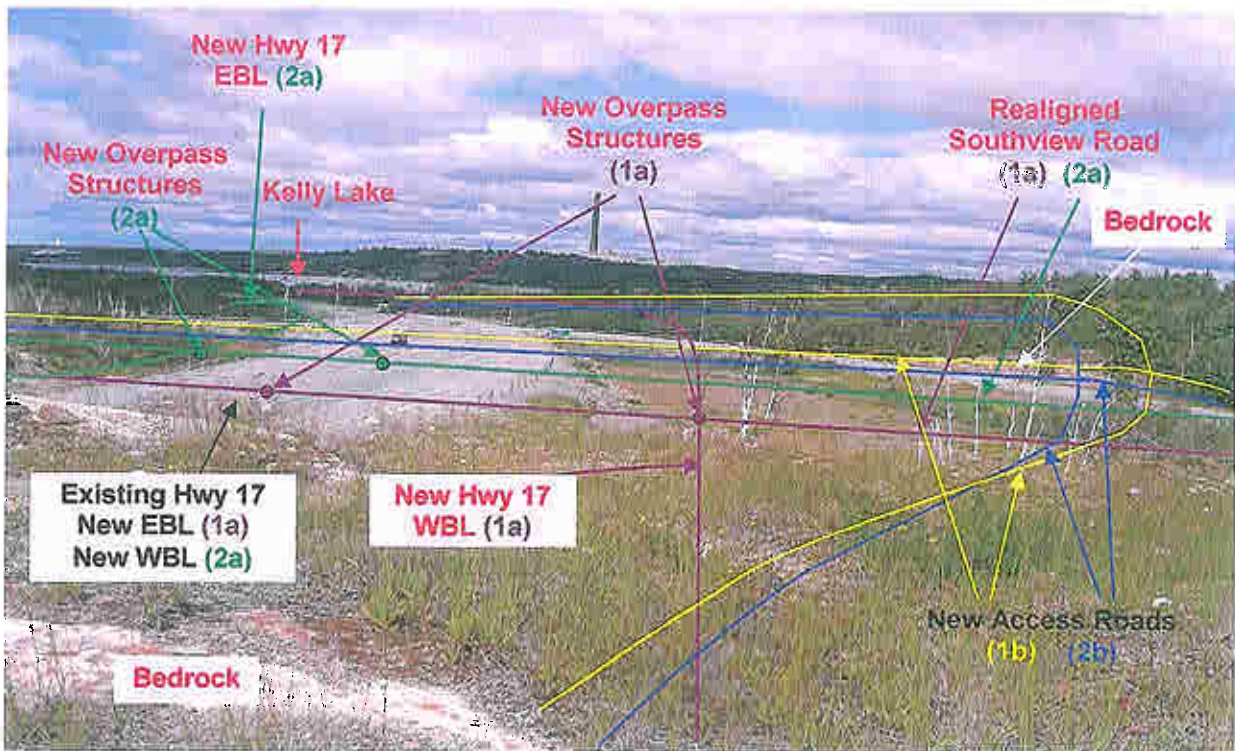


**Photograph 22** VIEW: Looking west from south shoulder of Highway 17 at about STA. 12+680 at south end of extension of Hannah Lake swamp area. Bedrock outcrop in 4 to 5 m high cut in distance at STA. 12+400. (July 5, 2006)



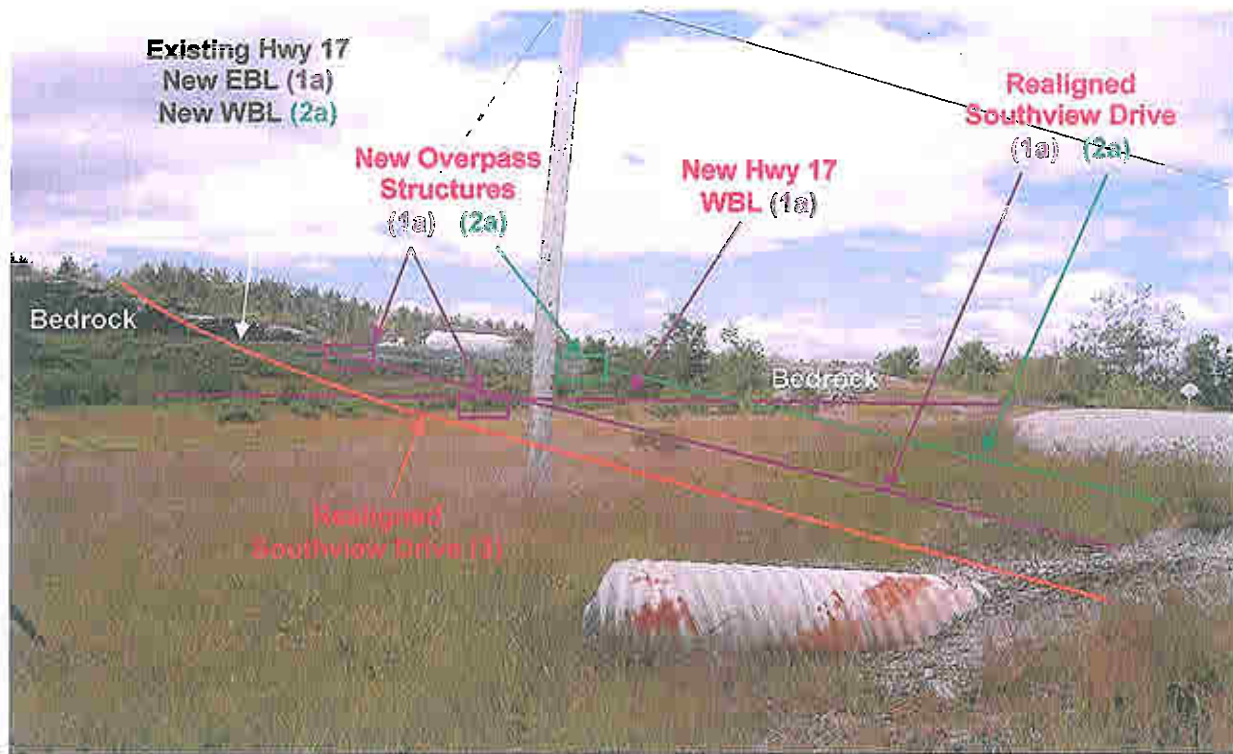


**Photograph 23** VIEW: Looking east from bedrock outcrop on north side of Highway 17, at about STA. 12+050. Extensive bedrock exposures readily visible in 4 m high rock cuts at STA. 12+200 to 12+300 mid photo. (July 5, 2006)

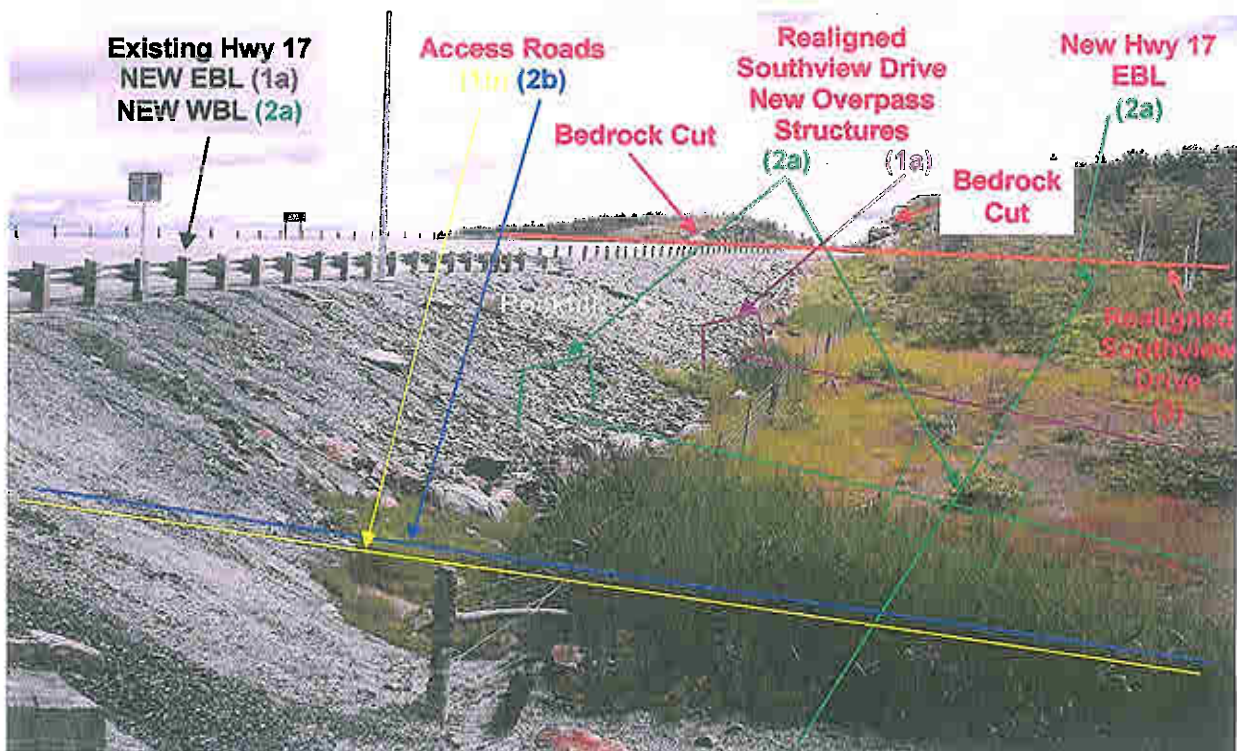


**Photograph 24** VIEW: Looking west from bedrock outcrop on north side of Highway 17 at about STA. 12+050. Bedrock exposure on Southview Drive stabilization berm/rock disposal area up to 10 m wide at toe of 8 m high rockfill embankment. (July 5, 2006)



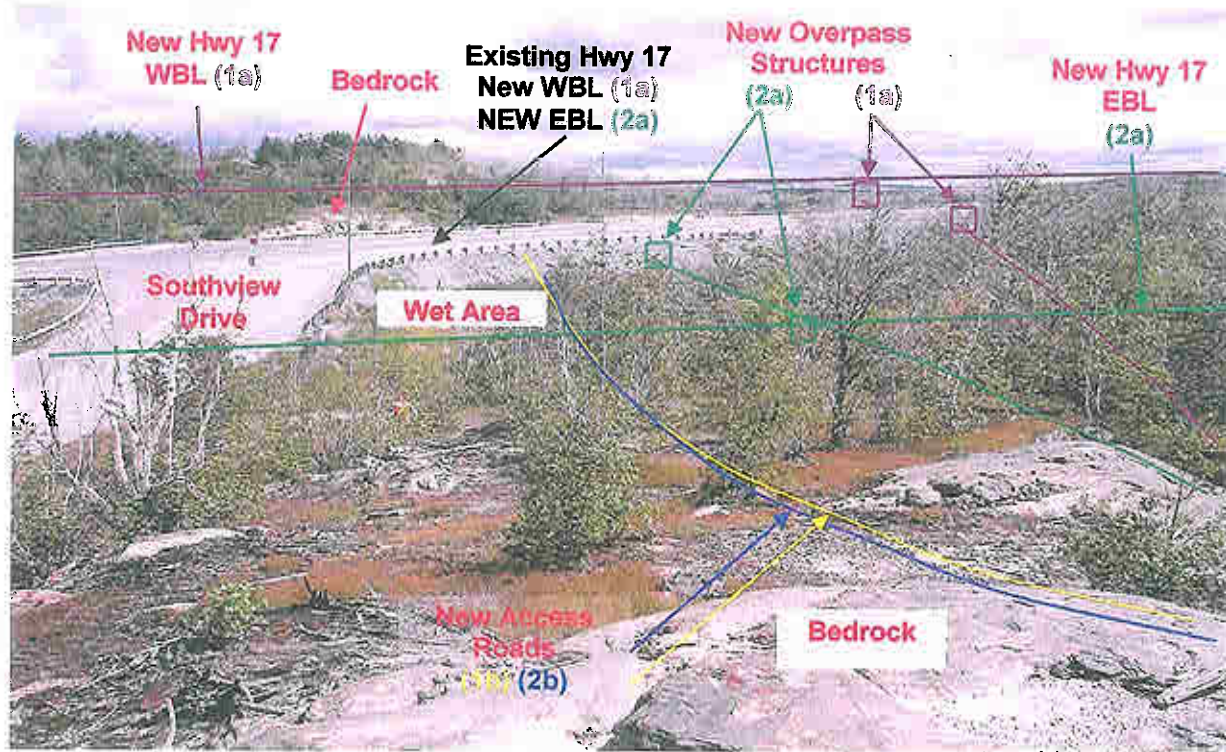


**Photograph 25** VIEW: Looking south from west shoulder of Southview Drive about 200 m north of Highway 17 rockfill embankment with stabilization berm/rock disposal area. Rock cut 8 m high visible at south side of Highway 17 at STA. 12+025 at left of photo (Access Roads for Options (1a) and (2b) not shown for clarity). (July 5, 2006)



**Photograph 26** VIEW: Looking east from east shoulder of Southview Drive about 10 m south of Highway 17. Wetland at toe of 6 m high rockfill embankment. Rock cuts up to 8 m high visible in background between about STA. 12+000 to 12+100. (July 5, 2006)



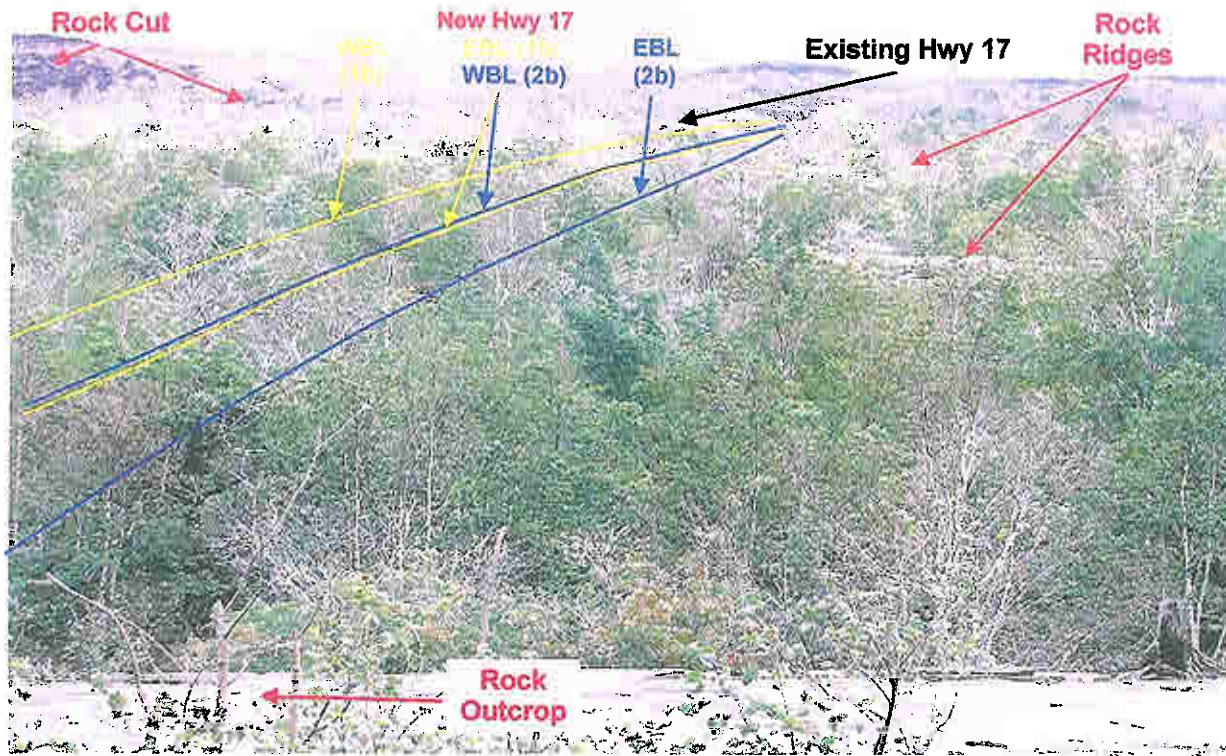


**Photograph 27 VIEW:** Looking north from bedrock outcrop about 25 m east of Southview Drive and about 100 m south of Highway 17. Bedrock visible on Southview Drive north of Highway 17 intersection. Bedrock slopes to north to wet area at toe of rockfill embankment. (July 5, 2006)

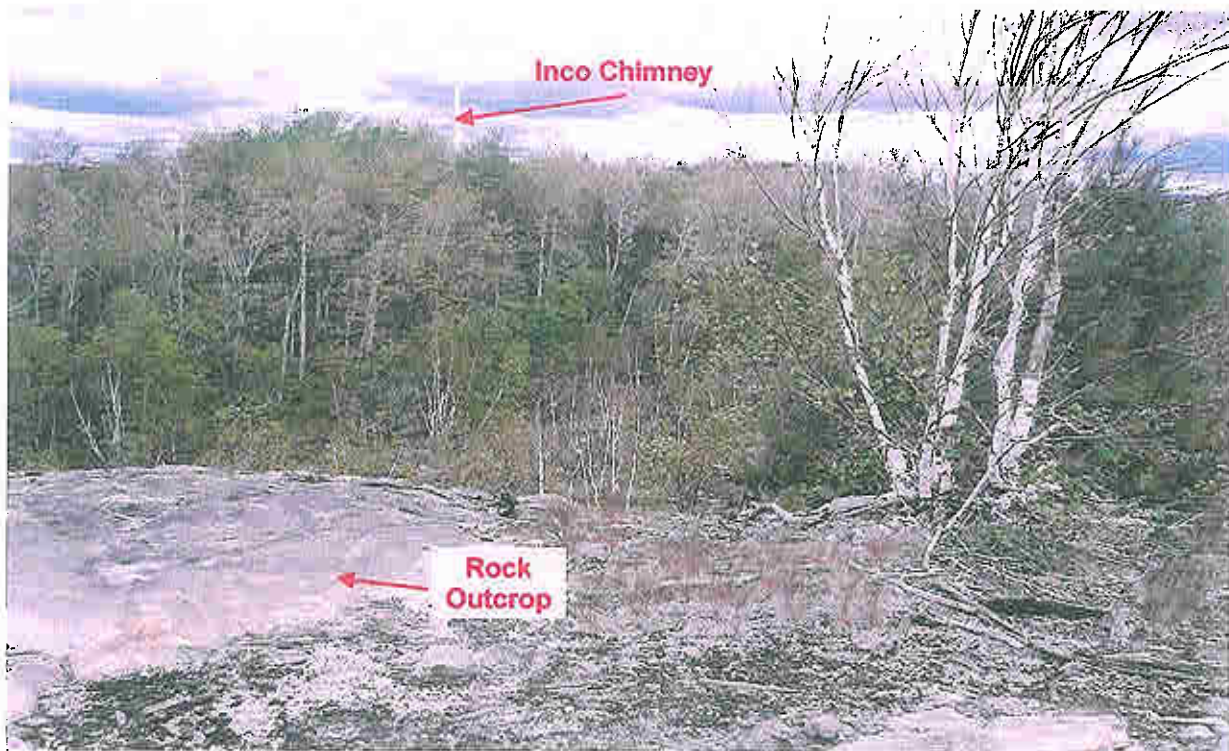


**Photograph 28 VIEW:** Looking northwest from bedrock outcrop about 25 m east of Southview Drive and about 100 m south of Highway 17. White areas in photo are exposed silt soils mantling the bedrock. (July 5, 2006)



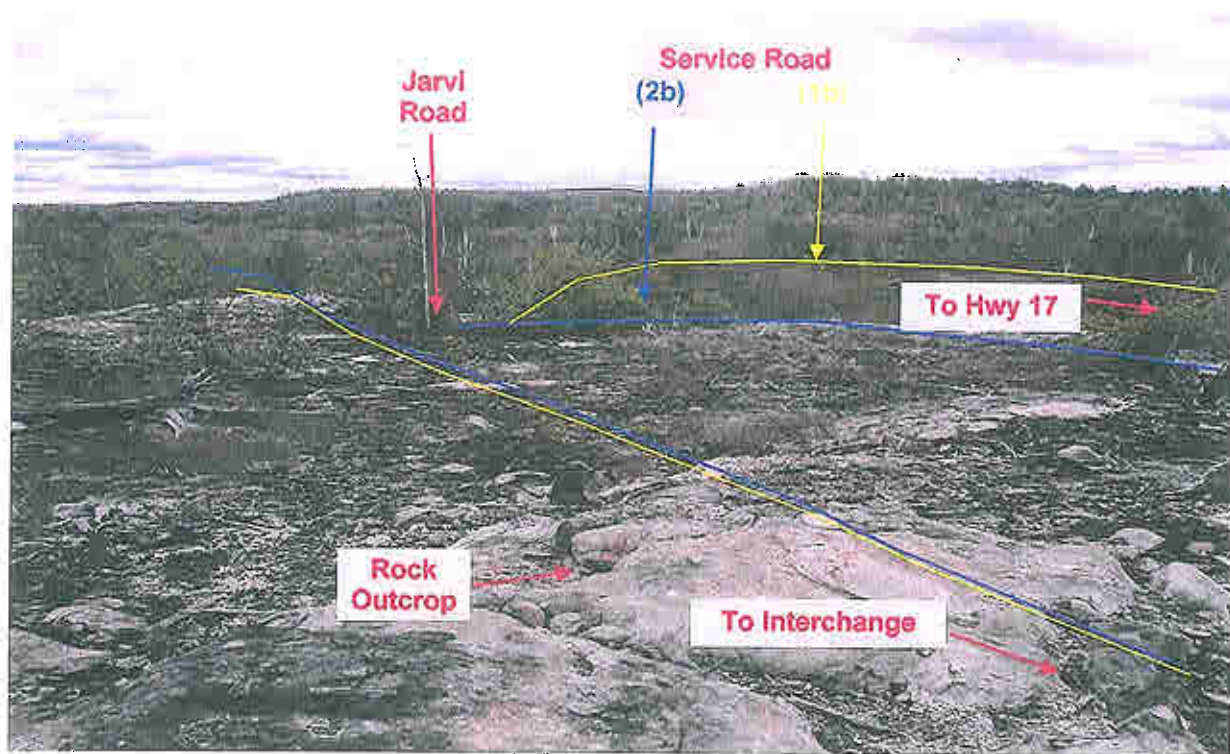


**Photograph 29 VIEW:** Looking east from top of rock outcrop located about 300 m south of STA. 11+900 Highway 17. Note frequent rock ridges and outcrops between treed valleys along proposed alternate alignments. (July 5, 2006)

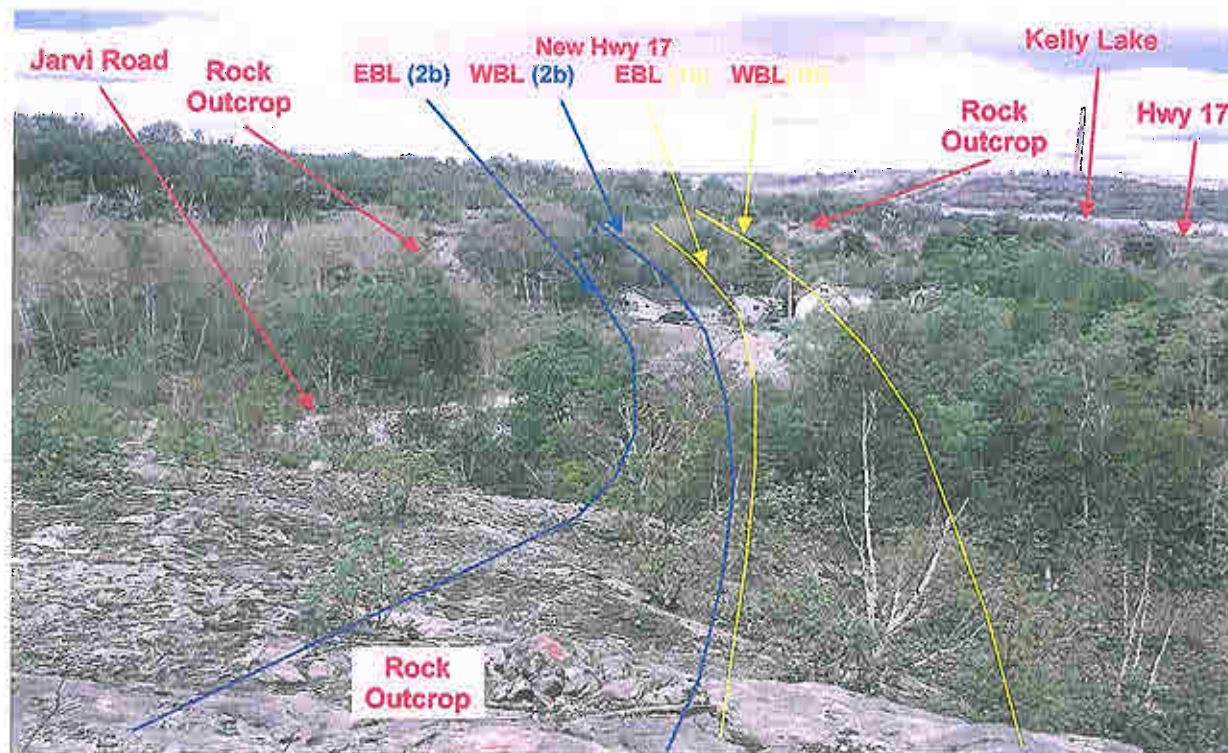


**Photograph 30 VIEW:** Looking northwesterly from top of rock outcrop located about 150 m south of STA. 11+800 Highway 17. Note typical topography comprising deep valleys between massive bedrock outcrops. (July 5, 2006)





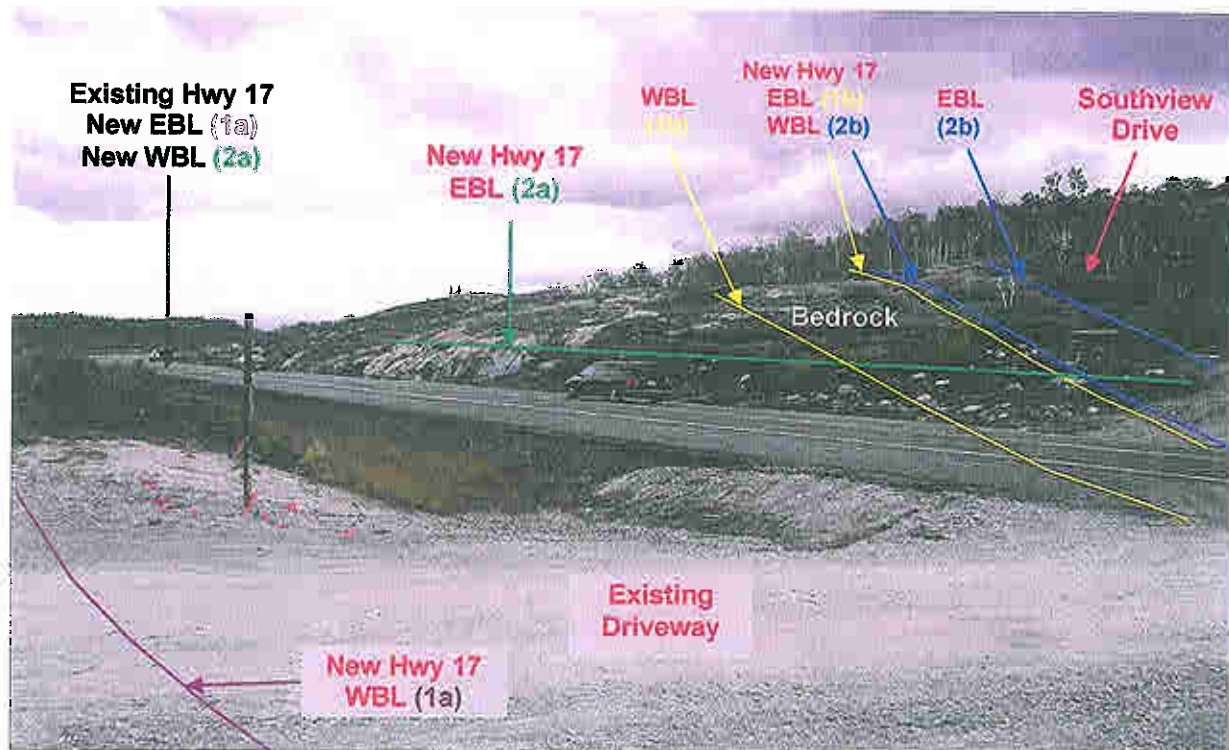
**Photograph 31** VIEW: Looking southerly from top of rock outcrop located about 200 m south of STA. 11+800 Highway 17. Note typical topography comprising deep valleys between massive bedrock outcrops. (July 5, 2006)



**Photograph 32** VIEW: Looking west from bedrock outcrop at 200 m east of the Jarvi Road and Southview Drive intersection. Extensive bedrock knobs and ridges dominate entire area. (July 5, 2006)

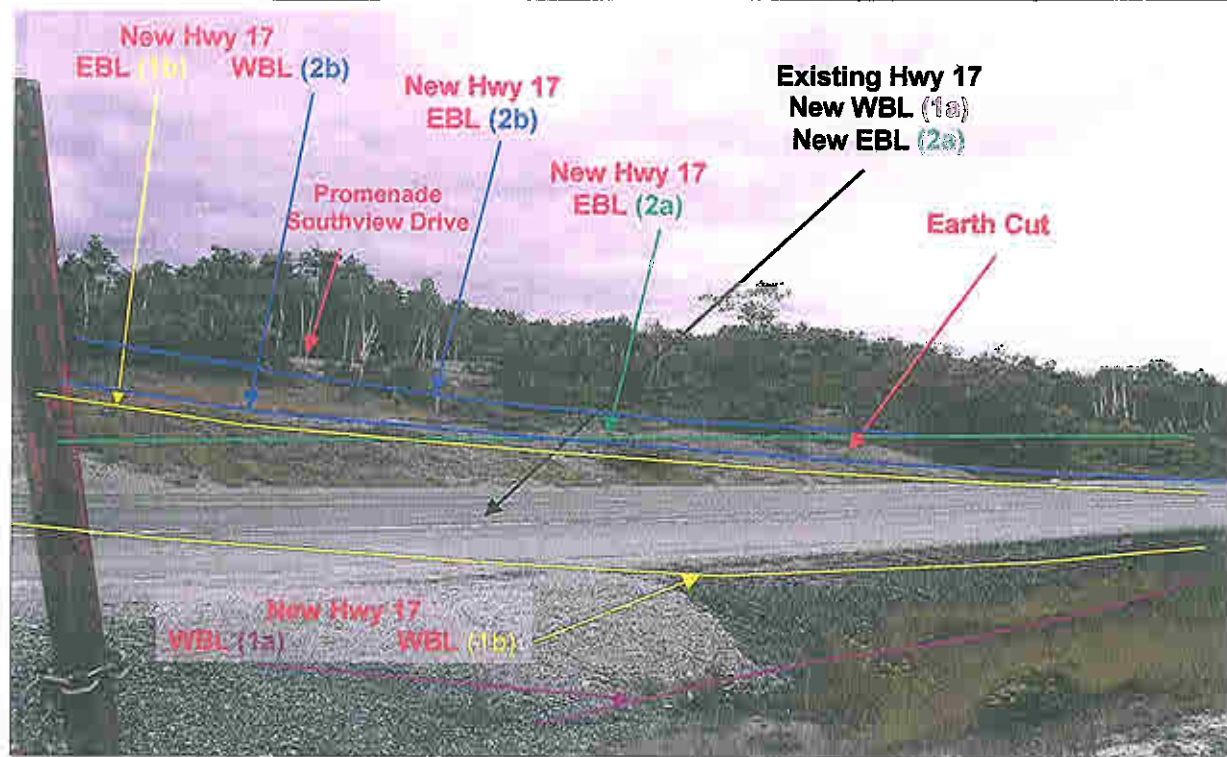


**Photograph 32A** VIEW: Looking north from east shoulder of Jarvi Road about 700 m south of Southview Drive. (September 12, 2006)



**Photograph 33** VIEW: Looking east from west side of Boart Longyear driveway about 10 m north of Highway 17 at about STA. 10+925. Extensive bedrock exposures dominate south of Highway 17. (July 5, 2006)





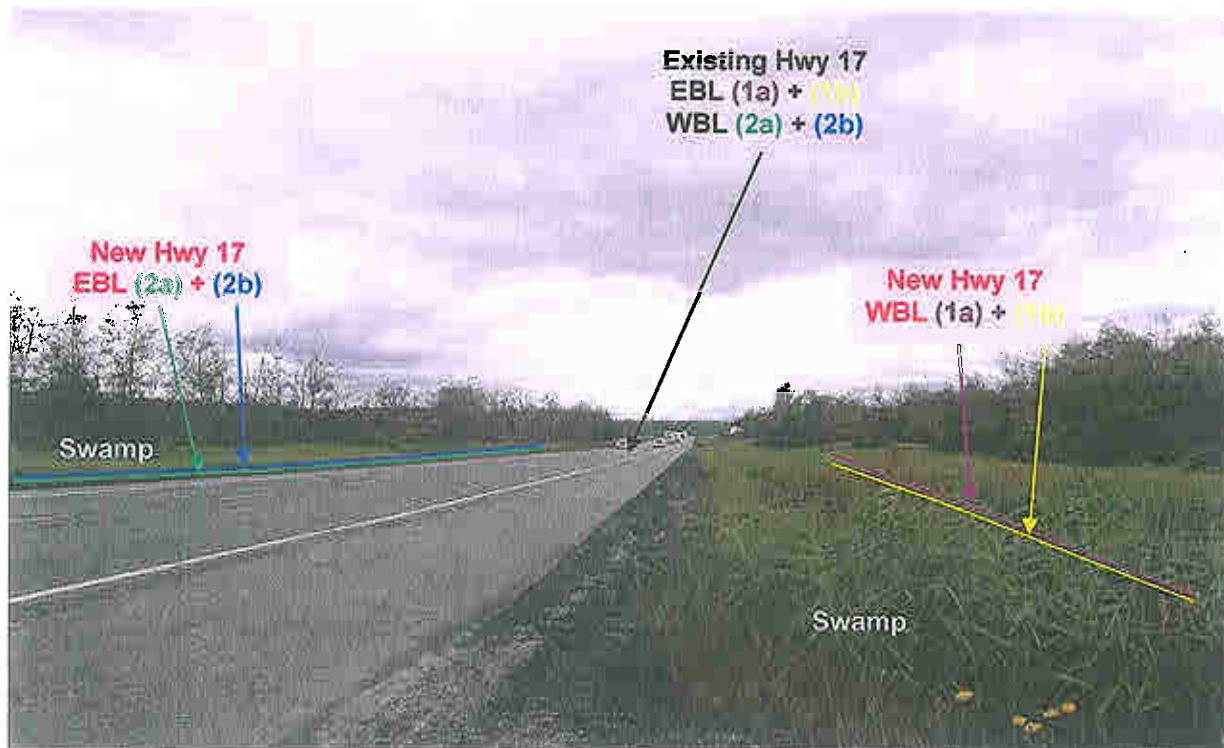
**Photograph 34 VIEW:** Looking south from west side of 'Boart Longyear' driveway about 10 m north of Highway 17 at about STA. 10+925. Earth slope on south side of highway mantles sloping bedrock. Bedrock outcrops in bush area at left of photo south of Promenade Southview Drive. (July 5, 2006)



**Photograph 35 VIEW:** Looking west from west side of 'Boart Longyear' driveway about 10 m north of Highway 17 at about STA. 10+925. Earth slopes visible north and south side of Highway 17. (July 5, 2006)



**Photograph 36** VIEW: Looking east from north shoulder of Highway 17 at about STA. 10+475. Earth slope covered with stone riprap on south side of highway. Bedrock outcrop visible on distance at Sta. 11+000. (July 5, 2006)



**Photograph 37** VIEW: Looking west from north shoulder of Highway 17 at about STA. 10+475, approximately easterly limit of swamp L-4. Note: Extensive swamp areas extend on both sides of highway about 350 to 400 m to the west. (July 5, 2006)





**Photograph 38** VIEW: Looking east from north ditch area of Highway 17 at about STA. 10+020. Earth slope and stone riprap visible in foreground left. Swamp area for twinning to the south beyond truck in photo. (July 5, 2006)



**Photograph 39** VIEW: Looking west from north ditch area of Highway 17 at about STA. 10+020, near Twp Waters/Twp Broder boundary. Earth slope typically 2 to 3 m high covered with stone riprap. (July 5, 2006)





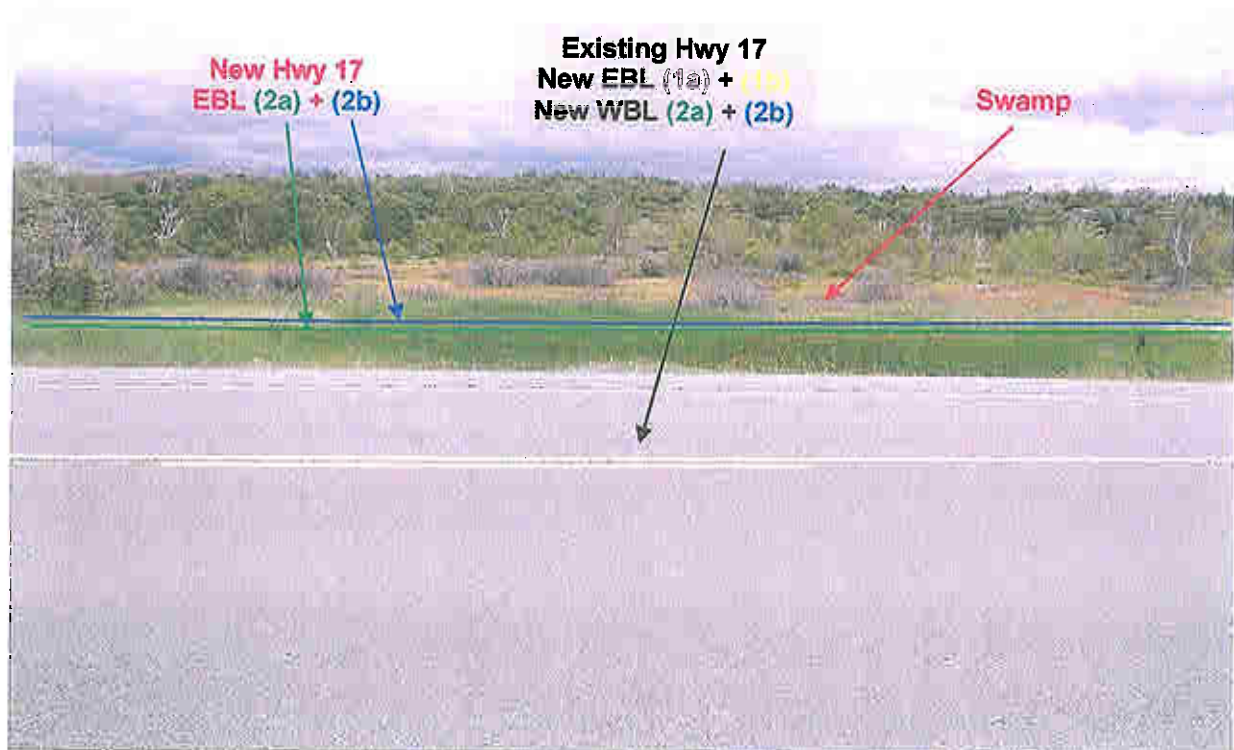
**Photograph 40** VIEW: Looking east from north ditch of Highway 17 at about STA. 18+950. Earth slopes typically 2 to 3 m high covered with stone riprap. Bedrock outcrop to north (left) beyond R.O.W. limit. (July 5, 2006)



**Photograph 41** VIEW: Looking east along north ditch line of Highway 17 at about STA. 18+750. North earth slope grassed then provided with stone riprap. Bedrock outcrops to north (left) beyond R.O.W. limits. Swamp area exists on south side of Highway 17. (July 5, 2006)



**Photograph 42** VIEW: Looking west from north shoulder of Highway 17 at about STA. 18+450 near easterly limit of Swamp L-3. Swamp extends on both sides of Highway 17, some 600 to 700 m to the west. (July 5, 2006)



**Photograph 43** VIEW: Looking south from north shoulder of Highway 17 at about STA. 18+430. Extensive swamp existing on south side of highway. (July 5, 2006)





**Photograph 44** VIEW: Looking east from edge of south shoulder of Highway 17 at about STA. 18+450 across extensive swamp area. Earth slope with stone riprap at left of photo. (July 5, 2006)



**Photograph 45** VIEW: Looking west from edge of south shoulder of Highway 17 at about STA. 18+450 across extensive swamp area. (July 5, 2006)





**Photograph 46** VIEW: Looking west from north shoulder of Highway 17 at about STA. 18+350. Swamp L-3 exists on both sides of Highway 17. Bedrock outcrops 150 m to the north (right) at margin of Kelly Lake. (July 5, 2006)

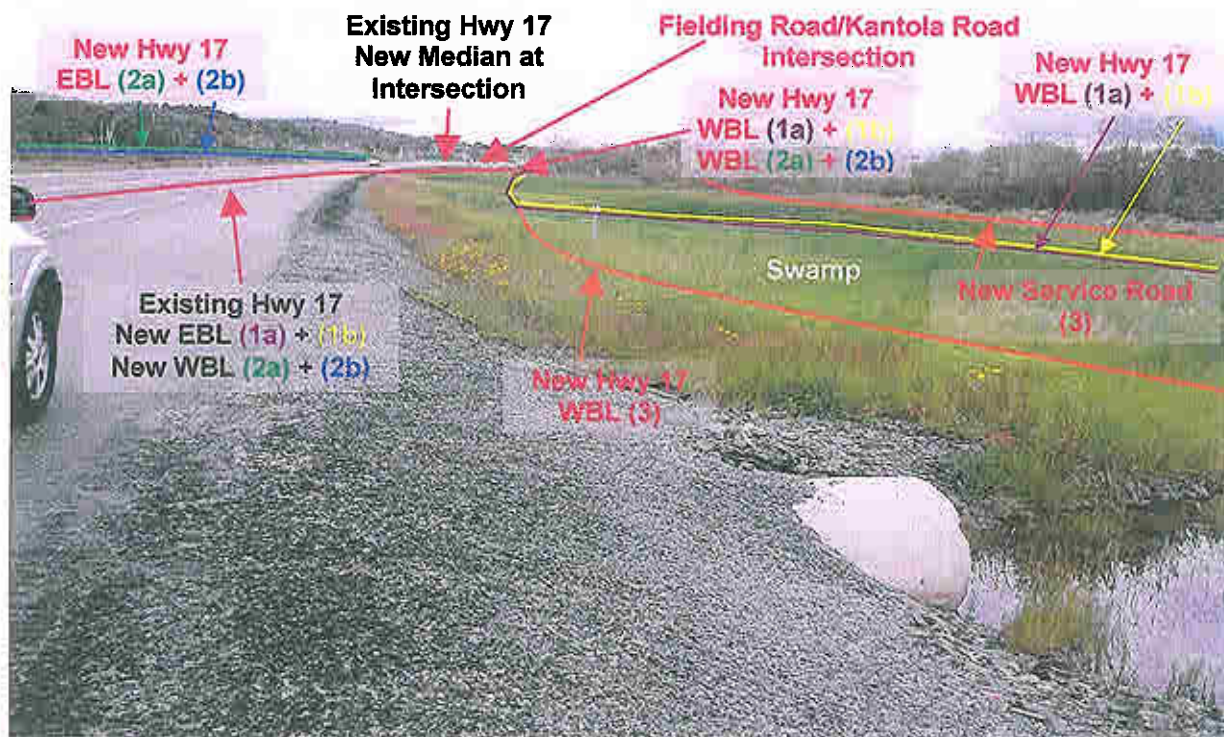


**Photograph 47** VIEW: Looking east about 25 m north of Highway 17 at about STA. 18+200 across extensive Swamp area L-3. (July 5, 2006)



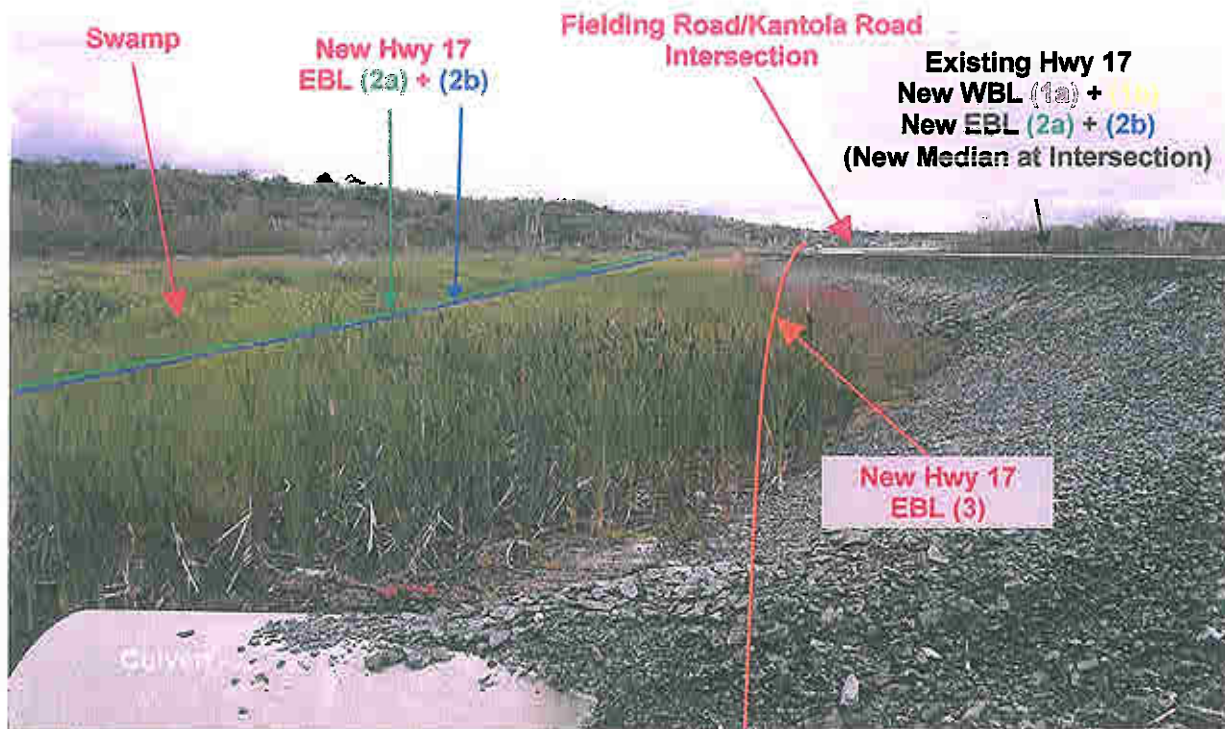


**Photograph 48** VIEW: Looking east from north shoulder of Highway 17 at about STA. 17+845 across Swamp L-3. Swamp areas exist on both sides of highway. (July 5, 2006)



**Photograph 49** VIEW: Looking west from north shoulder of Highway 17 at about STA. 17+855. Swamp L-3 appears to extend westerly to bushline 250 m to west at about STA. 17+600. (July 5, 2006)



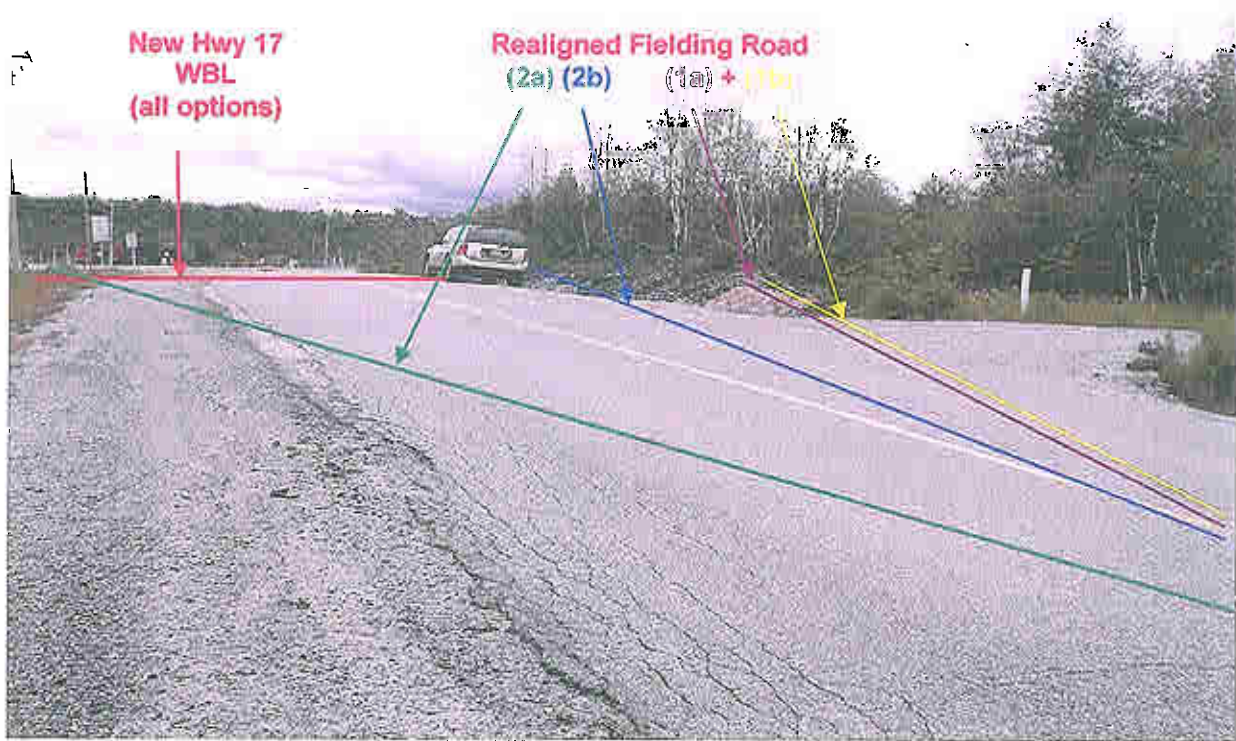


**Photograph 50** VIEW: Looking west from south shoulder of Highway 17 at about STA. 17+855. Extensive swamp on south side of highway extending 200 to 300 westerly to bushline. (July 5, 2006)

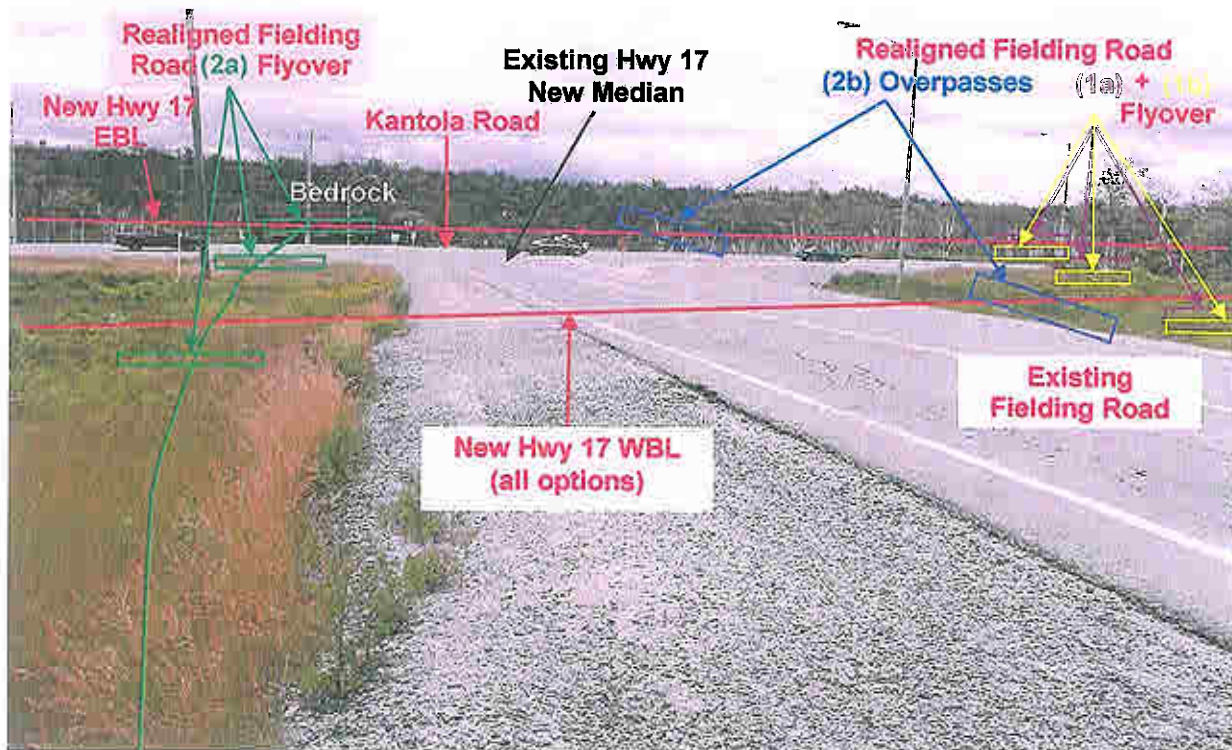


**Photograph 50A** VIEW: Looking east from south shoulder at about STA. 17+840 about 750 m east of Fielding/Kantola Roads across major swamp area south side Highway 17. (September 12, 2006)



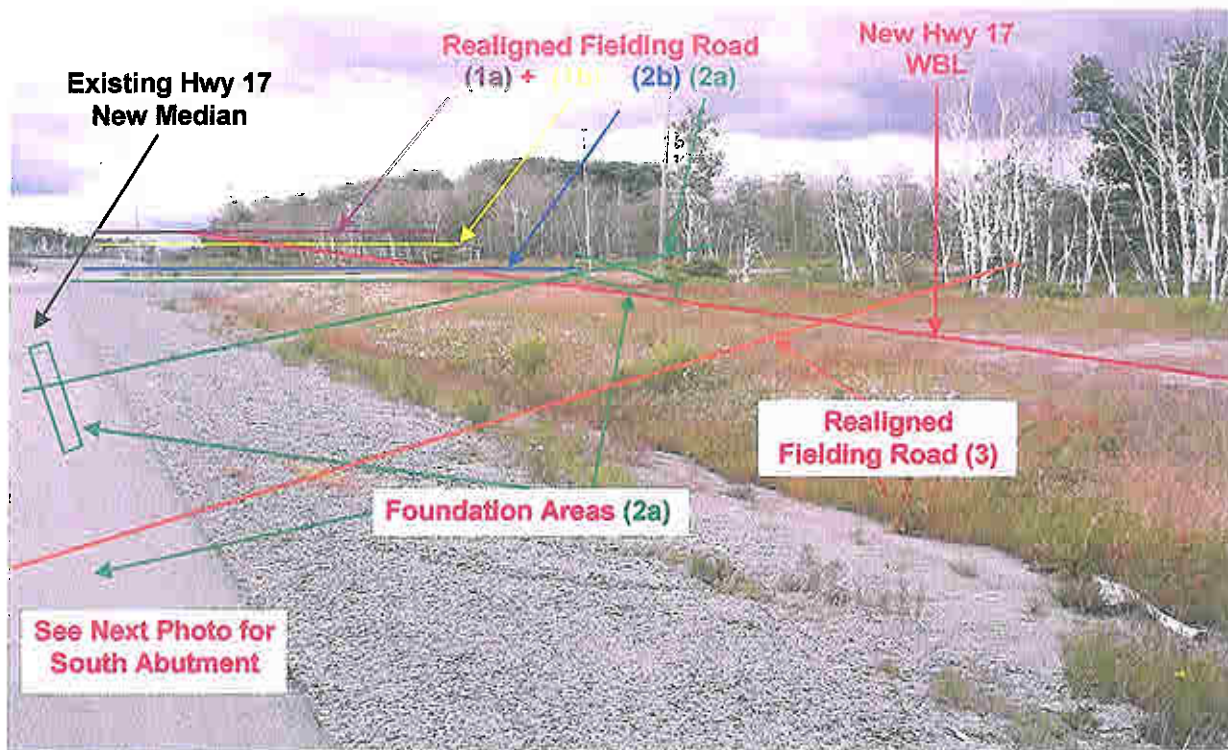


**Photograph 51** VIEW: Looking south from east shoulder of Fielding Road about 200 m north of Highway 17. Brown sandy till exposed in west ditch just south of driveway to borrow pit. Bedrock outcrops in bush area south of Highway 17 in distance. (July 5, 2006)

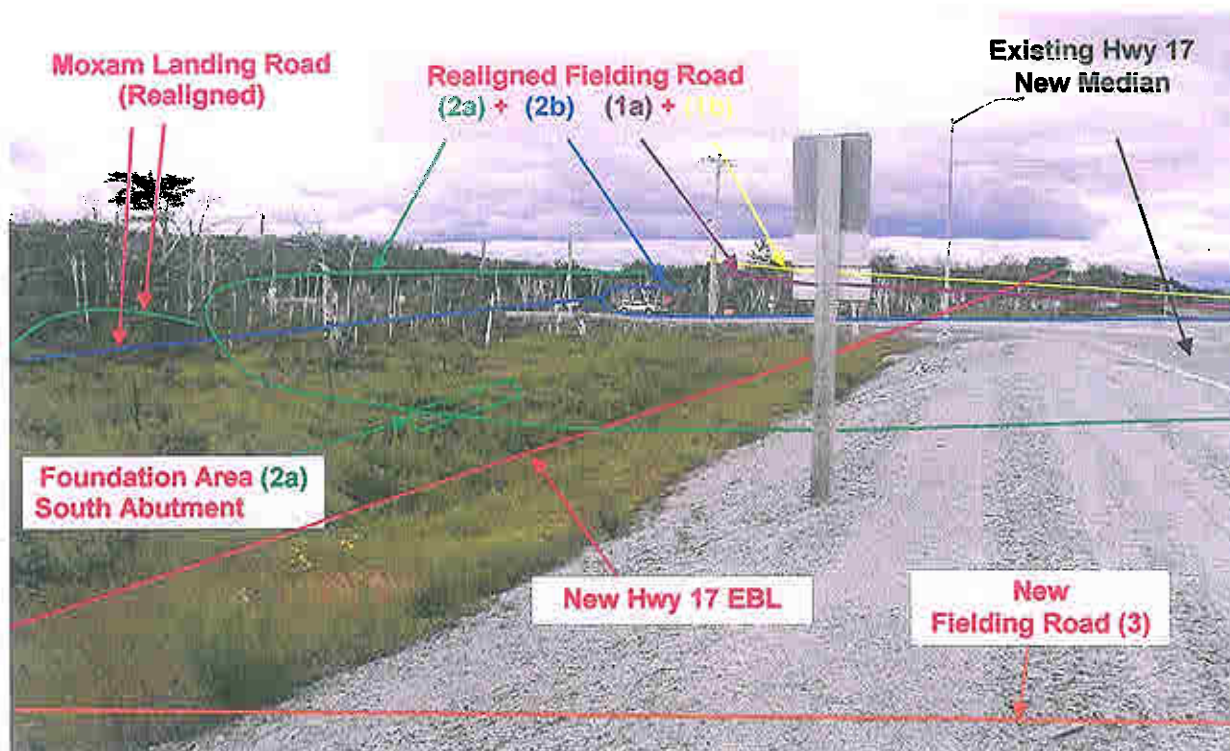


**Photograph 52** VIEW: Looking south from east shoulder of Fielding Road, about 100 m north of Highway 17. Bedrock outcrops in bush area about 200 m south of Highway 17 in distance. (July 5, 2006)



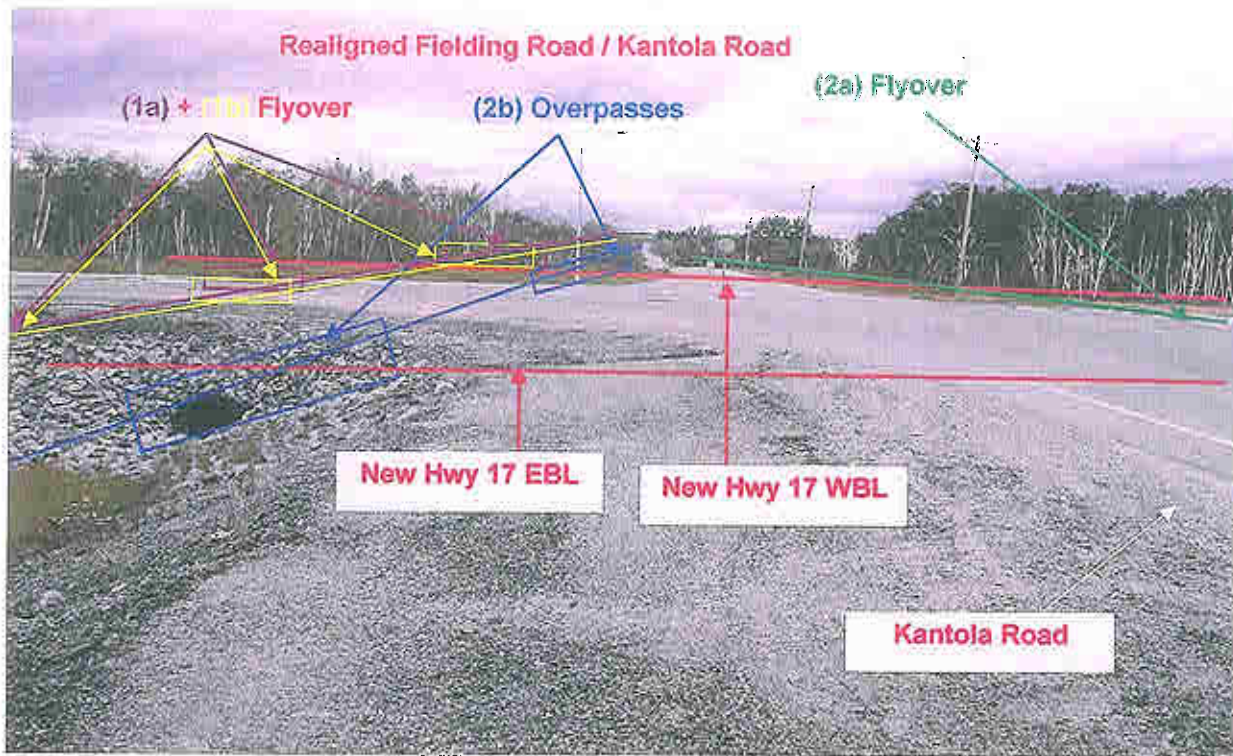


**Photograph 53 VIEW:** Looking west from north shoulder of Highway 17, about 50 m east of Fielding Road/Kantota Road intersection. No bedrock exposures in view. (July 5, 2006)



**Photograph 54 VIEW:** Looking west from south shoulder of Highway 17, about 50 m east of Fielding Road/Kantota Road intersection. No bedrock exposures in view. (July 5, 2006)





**Photograph 55** VIEW: Looking north from west shoulder of Kantola Road about 50 m south of Highway 17. No bedrock exposures in view. (July 5, 2006)

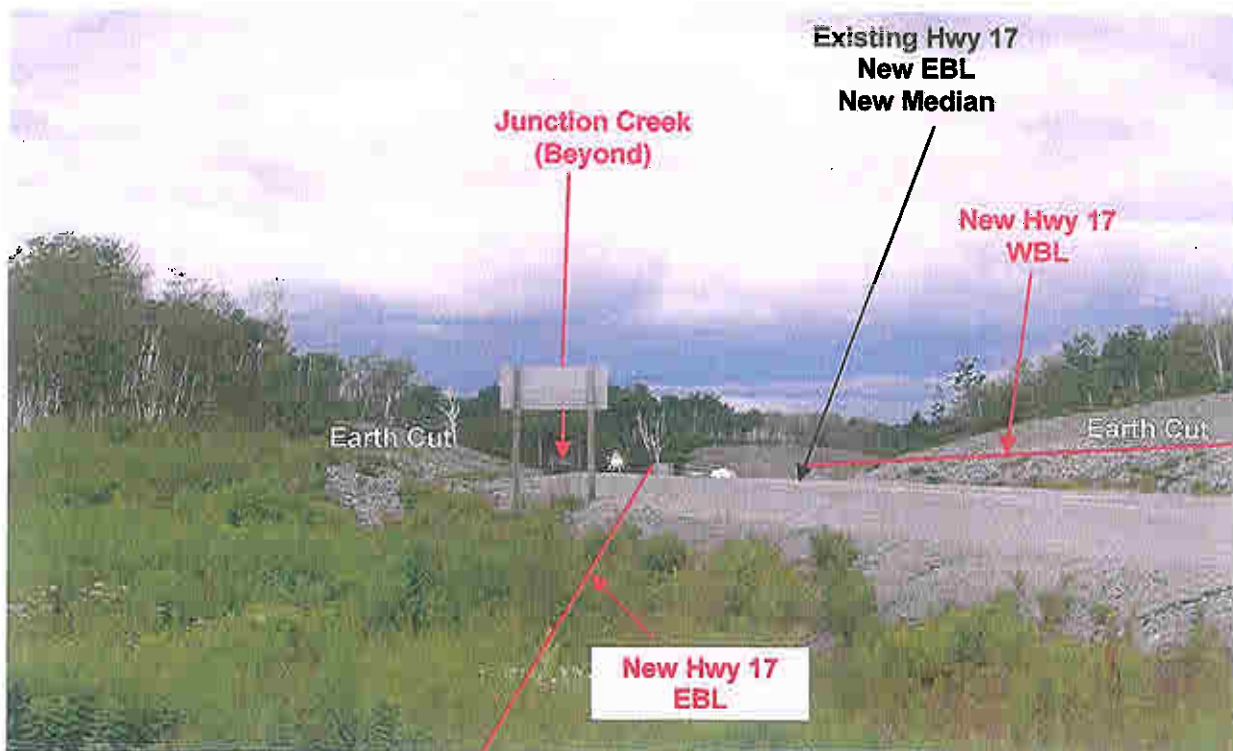


**Photograph 55A** VIEW: Looking east along south shoulder of Kantola Road about 400 m south of Highway 17 intersection. (September 12, 2006)



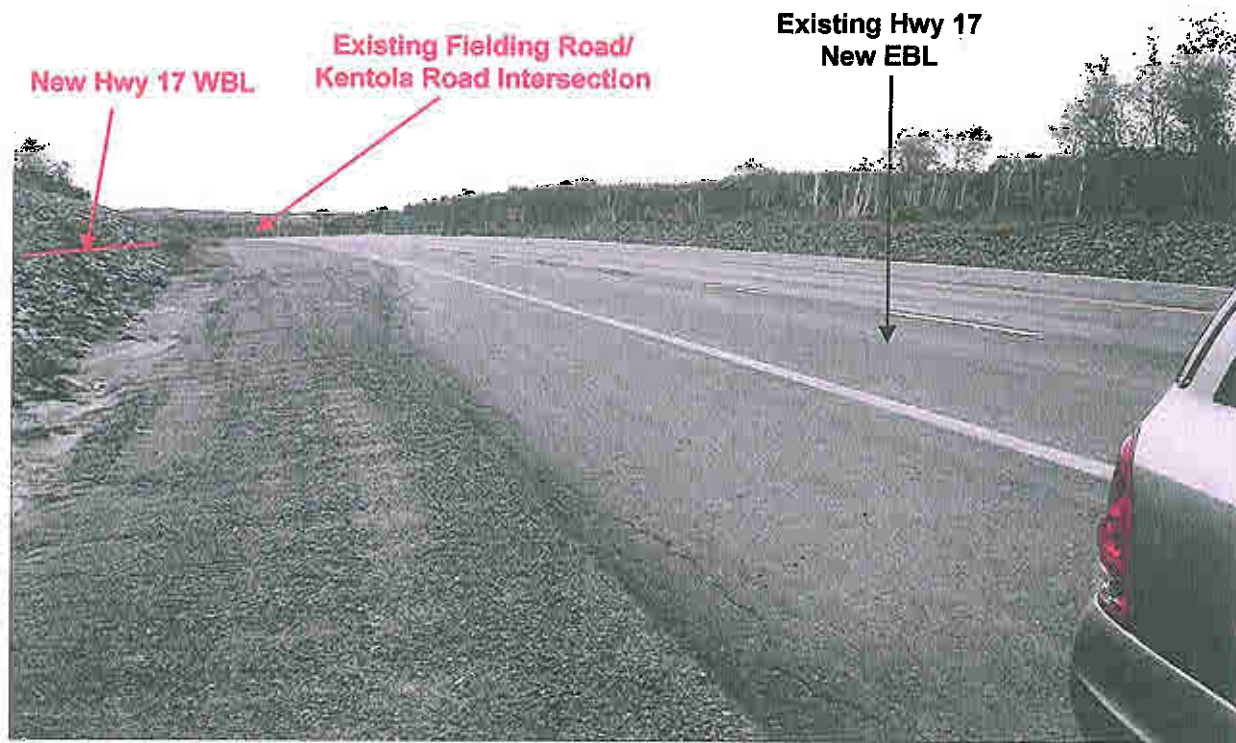


**Photograph 56 VIEW:** Looking west from west shoulder of Kantola Road at Highway 17 south ditch line. No bedrock exposure in view. Existing 6 m high earth slopes with stone riprap at STA. 16+800 visible in distance. (July 5, 2006)



**Photograph 57 ZOOM VIEW:** Looking west from west shoulder of Kantola Road at Highway 17 south ditch line. No bedrock exposure in view. Existing 6 m high earth slopes with stone riprap at STA. 16+800 visible in distance. (July 5, 2006)





**Photograph 58 VIEW:** Looking east from north shoulder of Highway 17 at about STA. 16+800, some 300 m west of Fielding Road/Kantola Road intersection. No bedrock exposures visible in view. Existing 6 m high earthslope with stone riprap visible both sides of Highway 17. (July 5, 2006)

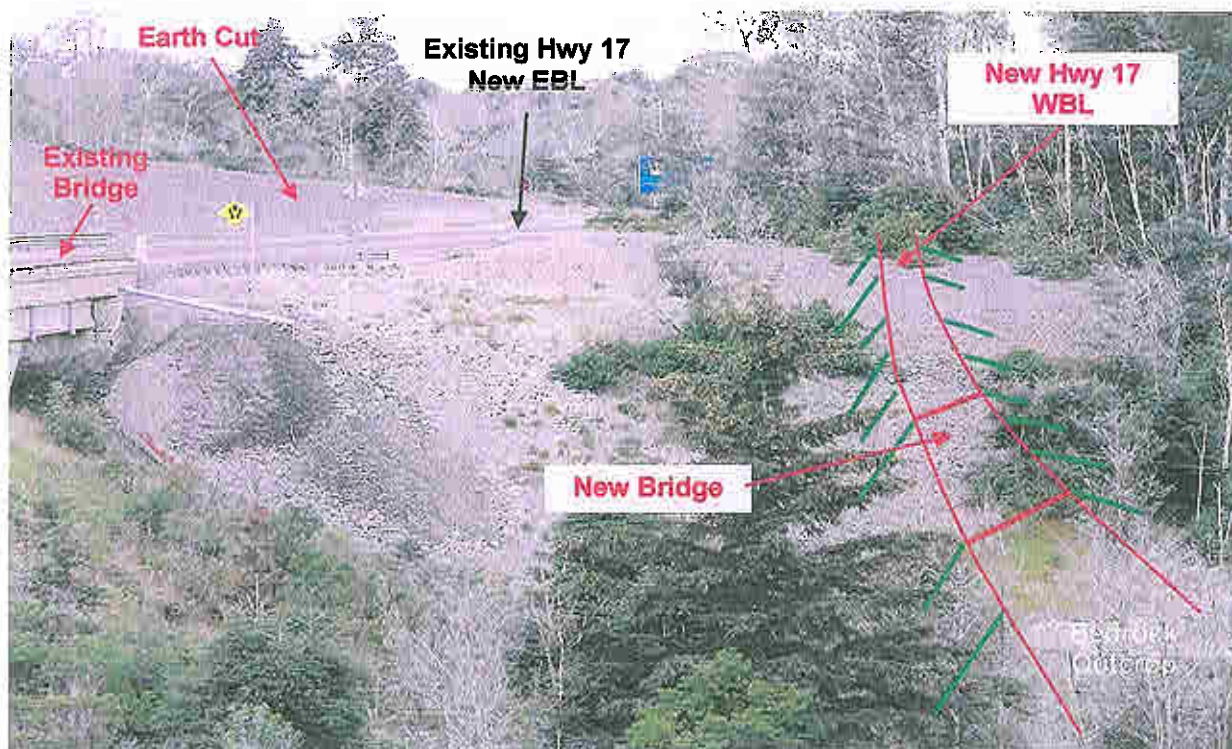


**Photograph 59 VIEW:** Looking west from north shoulder of Highway 17 at STA. 16+800, at about 350 m east of the existing Junction Creek bridge. No bedrock exposures in view. Existing 6 m high earthslopes with stone riprap visible both sides of highway. (July 5, 2006)





**Photograph 60 VIEW:** Looking west along alignment new WBL Highway 17, at about STA. 16+600, some 150 m, east of the existing Junction Creek bridge. Bedrock exposed in creek bed (west side) some 10 m below bridge deck level. (July 5, 2006)

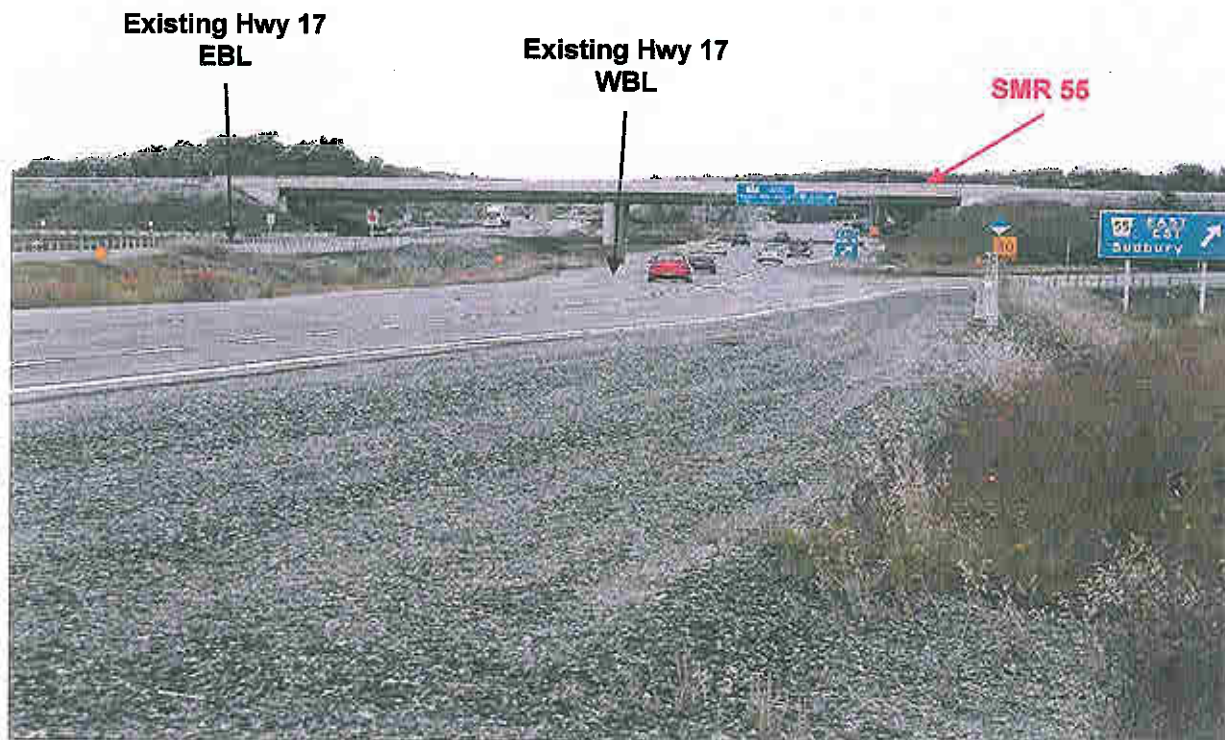


**Photograph 61 ZOOM VIEW:** Looking west along alignment at new WBL Highway 17, at about STA. 16+600 some 150 m, east of the existing Junction Creek bridge. Overburden soils comprises 11.5 m surficial sandy silt to silt deposit mantling Diorite bedrock. (July 5, 2006)





**Photograph 62** VIEW: Looking east from north ditch line existing Highway 17 WBL at about STA. 15+600 some 400 m east of Highway 17/Sudbury MR 55 interchange. Existing 6 m high earth slope with stone riprap visible to north (left) of photo. (July 5, 2006)



**Photograph 63** VIEW: Looking west from ditch line existing Highway 17 WBL about STA. 15+550 some 350 m east of Highway 17/Sudbury MR 55 interchange (west limit of project). (July 5, 2006)





**Photograph 64 VIEW:** Looking east from top of rock cut on south side of Highway 17 at about STA. 15+600, 200 m west of Highway 17/Long Lake Road intersection. Note the alignment of new Highway 17 North twinning through swamp and rock outcrop. (July 5, 2006)



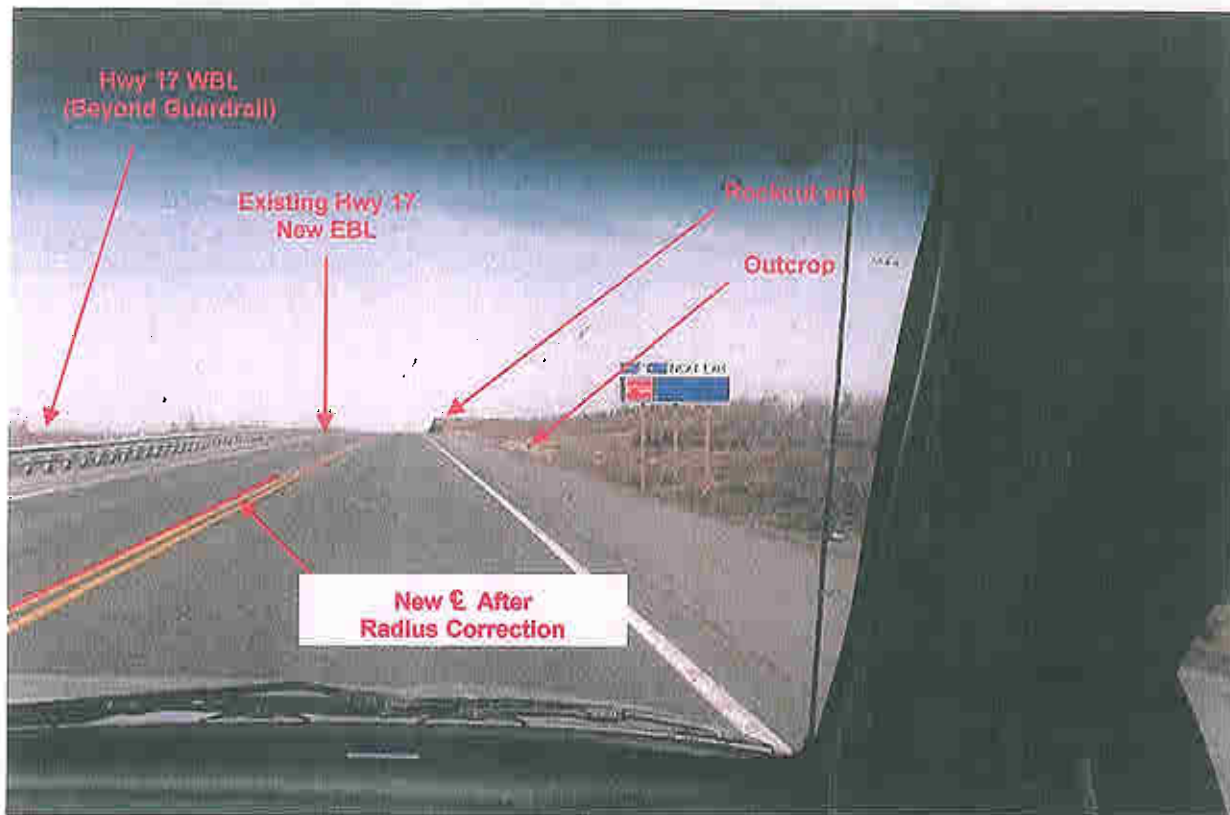
**Photograph 65 VIEW:** Looking north from north shoulder of Highway 17 at STA. 16+000, about 200 m east of Highway 17/Long Lake Road intersection. Note alignment of new Highway 17 WBL and E-N Ramp through swamp area. (July 5, 2006)



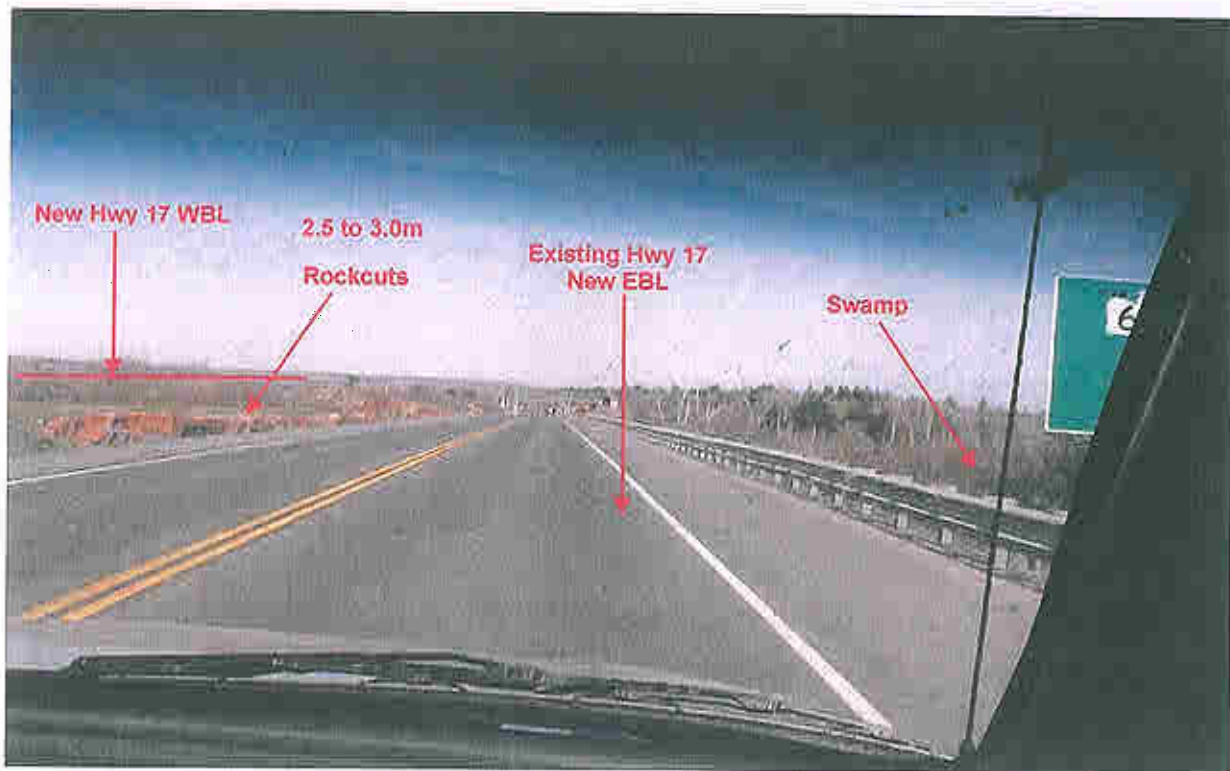
**Photograph 66** VIEW: Looking north from north shoulder of Highway 17 at STA. 16+200, about 400 m east of Long Lake Road/Highway 17 intersection. Note alignment of new Highway 17 WBL through swamp area. (July 5, 2006)



**Photograph 67** VIEW: Looking north from north shoulder of Highway 17 at STA. 16+500, about 700 m east of Highway 17/Long Lake Road intersection. Note new alignment of Highway 17 WBL through a swamp area. (July 5, 2006)



**Photograph 68** VIEW: Looking easterly from STA. 17+100 along EBL of existing Highway 17, new Highway 17 EBL. Note rockcut and outcrops at about STA. 17+500, right shoulder. (May 01, 2006)



**Photograph 69** VIEW: Looking easterly from STA. 17+800 along EBL of existing Highway 17, new Highway 17 EBL. Note rockcuts/outcrops beyond the left shoulder of the Highway 17. A major swamps exists 40 to 80m beyond guard rail on east side of Highway. (May 01, 2006)



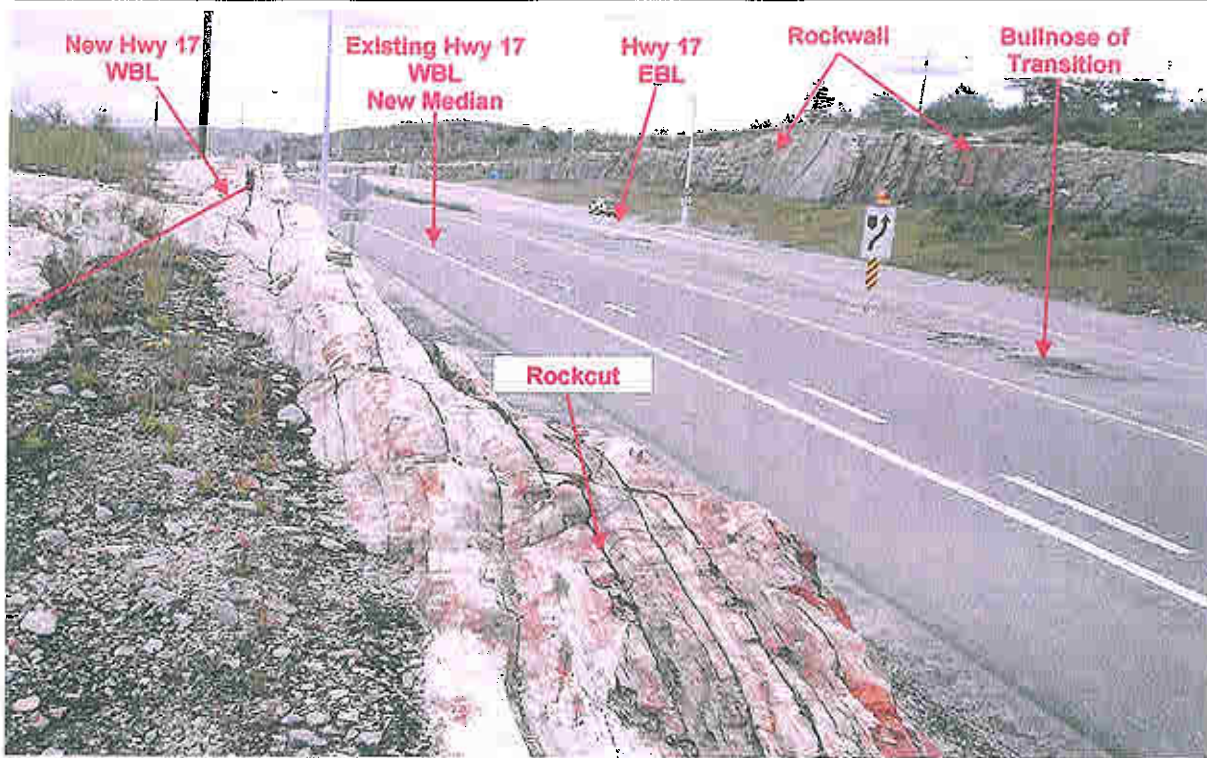


**Photograph 70 VIEW:** Looking westerly from STA. 18+120, south shoulder of Highway 17. Note new Highway 17 WBL alignment over a rock outcrop, swamp exist 40 to 80m beyond guardrail along south side of existing Highway. (July 05, 2006)

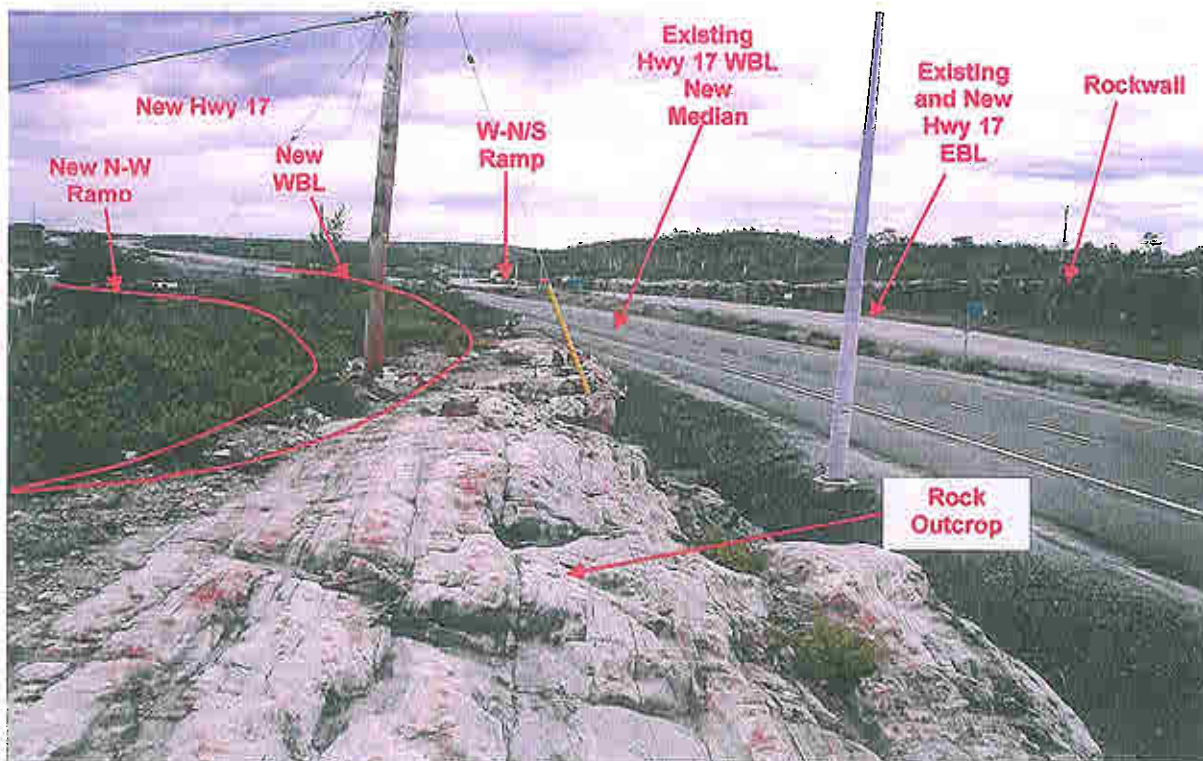


**Photograph 71 VIEW:** Looking east from STA. 18+120, south shoulder of Highway 17. Note numerous rockcuts and outcrops on both sides of existing Highway 17(new EBL). (July 05, 2006).





**Photograph 72** VIEW: Looking easterly from STA. 18+200, top of rockcut/outcrop on north side of existing Highway 17. Note long rockcut(rockwall) on south side of Highway 17, location of existing transition to become new Highway 17 median upon construction of new Highway 17 WBL to the north. (July 05, 2006)

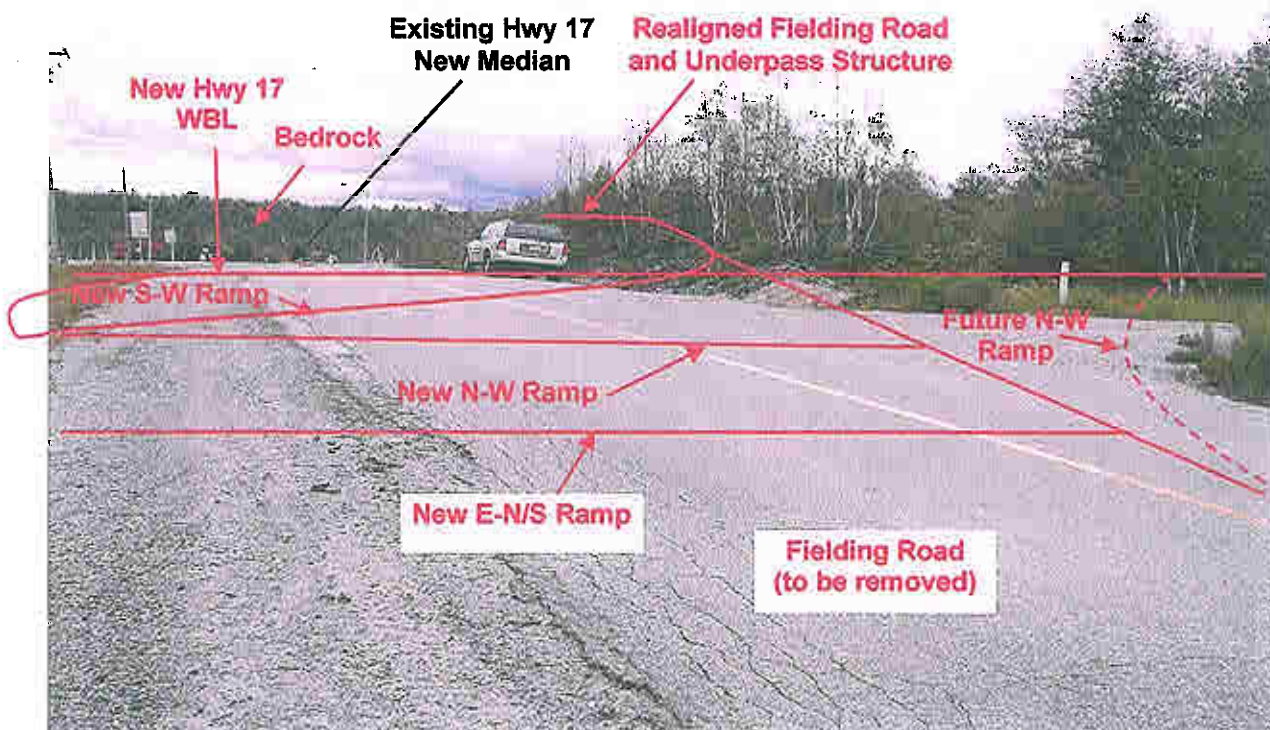


**Photograph 73** VIEW: Looking easterly from about STA. 18+440, top of rock cut/outcrop on north side of existing Highway 17. Note long rockcut south of Highway 17 and rockcut on north side. (July 05, 2006)



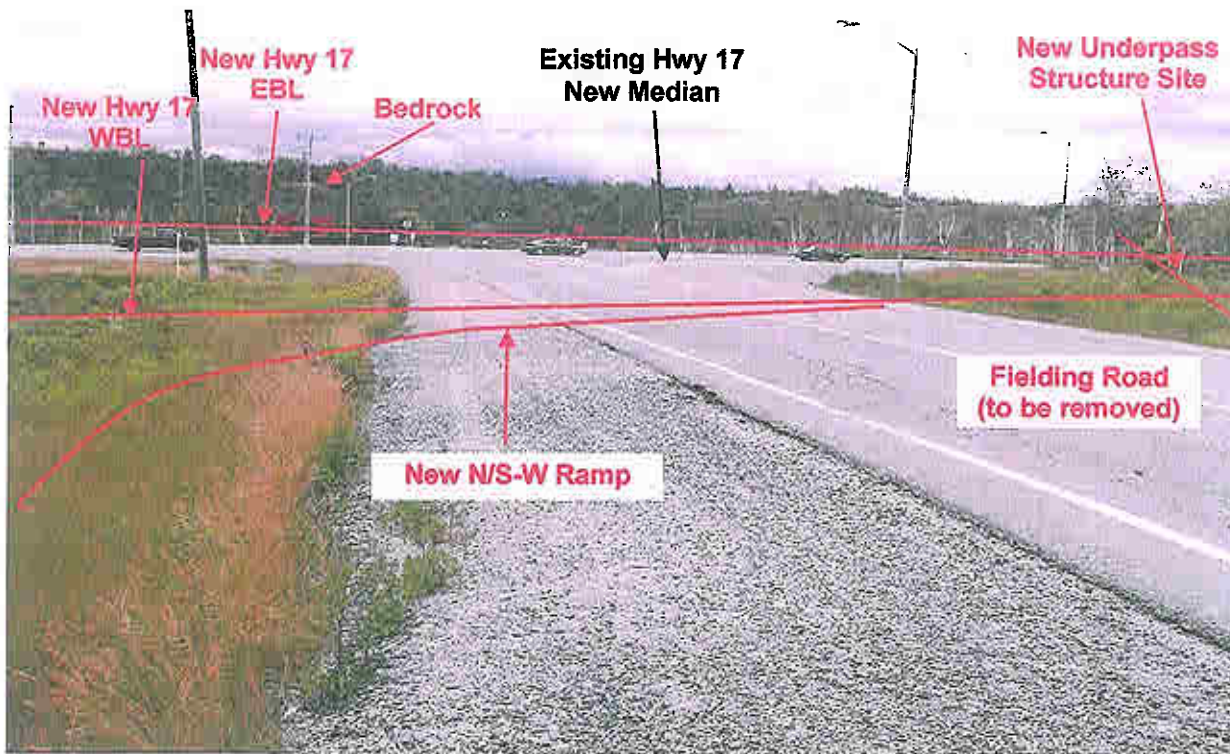


**Photograph 74 VIEW:** Looking easterly from STA. 18+700, top of rock cut/outcrop on north side of Highway 17. Note rock outcrop in foreground, new N-W ramp from Highway 69 through industrial area on low ground in centre of photograph and start of new WBL from existing WBL at Highway 69 crossing. (July 05, 2006)

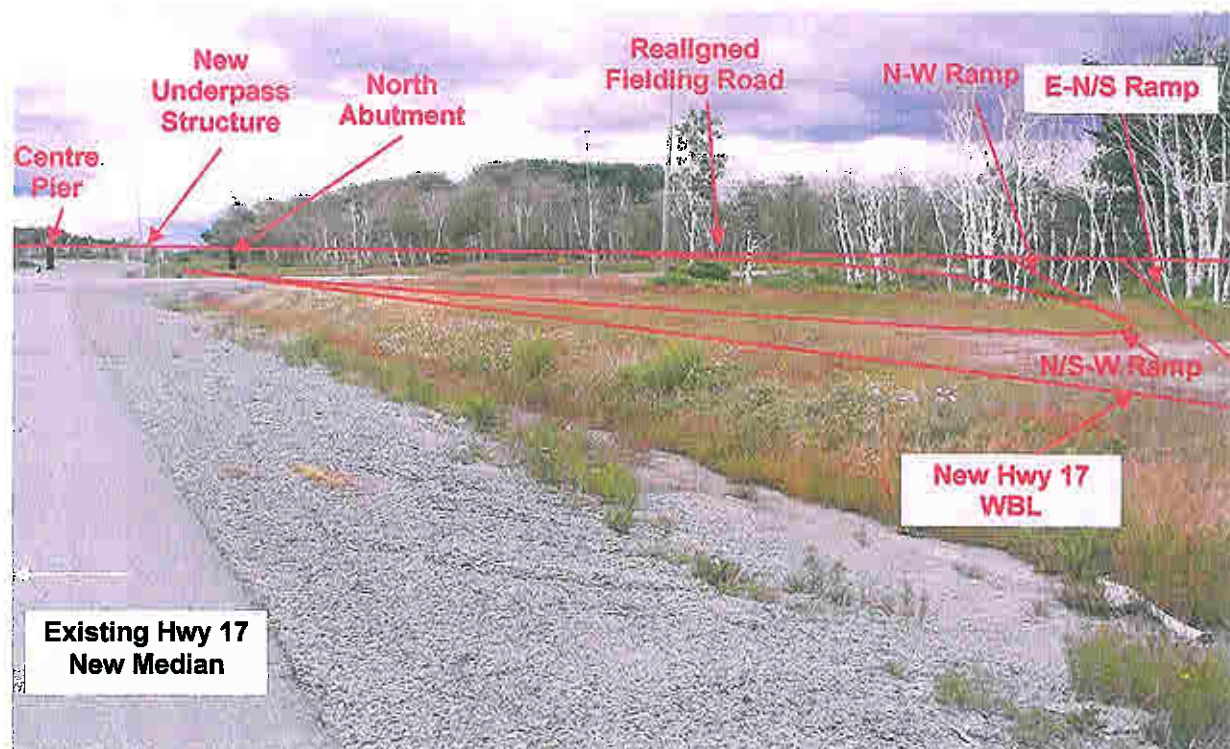


**Photograph 75 VIEW:** Looking south from east shoulder of Fielding Road about 200 m north of Highway 17. Brown sandy till exposed in west ditch just south of driveway to borrow pit. Bedrock outcrops in bush area south of Highway 17 in distance. (July 5, 2006)





**Photograph 76 VIEW:** Looking south from east shoulder of Fielding Road, about 100 m north of Highway 17. Bedrock outcrops in bush area about 200 m south of Highway 17 in distance. (July 5, 2006)

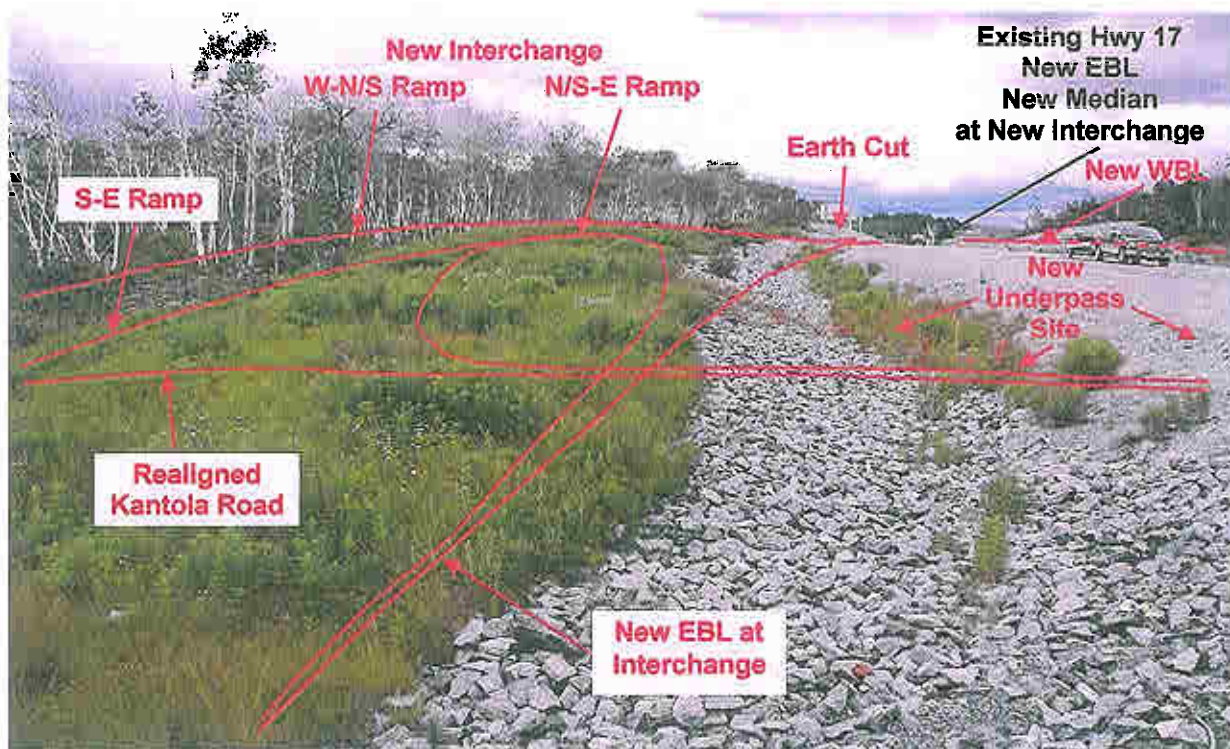


**Photograph 77 VIEW:** Looking west from north shoulder of Highway 17, about 50 m east of Fielding Road/Kantota Road intersection. No bedrock exposures in view. (July 5, 2006)

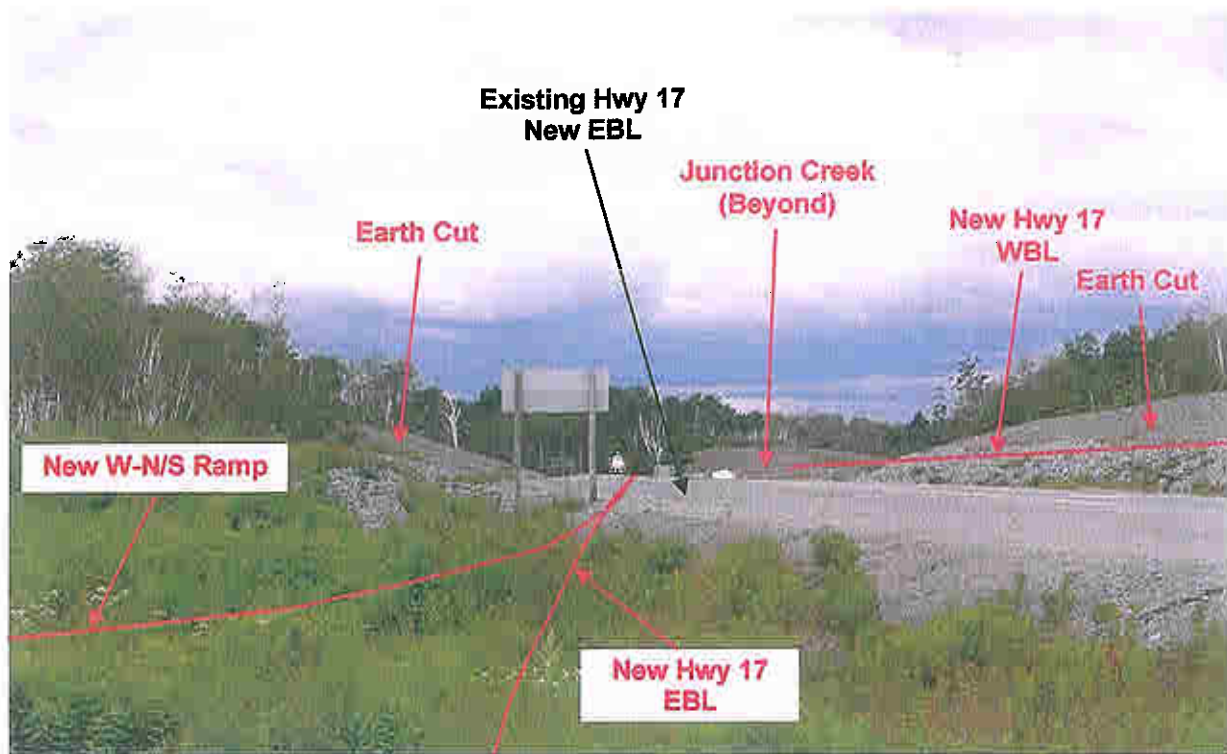




**Photograph 78 VIEW:** Looking west from north shoulder of Highway 17, about 50 m east of Fielding Road/Kantola Road intersection. No bedrock exposures in view. (July 5, 2006)



**Photograph 79 VIEW:** Looking west from west shoulder of Kantola Road at Highway 17 south ditch line. No bedrock exposure in view. Existing 6 m high earth slopes with stone riprap at STA. 16+800 visible in distance. (July 5, 2006)



**Photograph 80 ZOOM VIEW:** Looking west from west shoulder of Kantola Road at Highway 17 south ditch line. No bedrock exposure in view. Existing 6 m high earth slopes with stone riprap at STA. 16+800 visible in distance. (July 5, 2006)