



**ALTERNATE ROUTE FOUNDATION ASSESSMENT
FOR
HIGHWAY 17 ROUTE PLANNING BONFIELD EASTERLY
TOWNSHIPS OF BONFIELD, CALVIN AND PAPINEAU - CAMERON
DISTRICT OF NIPISSING, ONTARIO
GWP NO. 5670-10-00**

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ALTERNATE ROUTE FOUNDATION ASSESSMENT REPORT

for

Highway 17 Route Planning Bonfield Easterly
Townships of Bonfield, Calvin and Papineau-Cameron
District of Nipissing, Ontario
G.W.P. No. 5670-10-00

1. INTRODUCTION

This report provides the alternate route foundation assessment for a section of Highway 17 that extends from 0.6 km west of Highway 531 to 8.0 km east of Highway 630 in the District of Nipissing. The study was carried out for AECOM Canada Ltd. (AECOM) on behalf of the Ministry of Transportation of Ontario (MTO).

As part of the MTO's long term plan to four-lane Highway 17 between North Bay and Ottawa, two other route planning studies are also being carried out for the west (GWP 5105-09-00, Highway 17 from Highway 11 to Bonfield) and the east (GWP 5077-07-00, Highway 17 Mattawa four-laning) of this study corridor of Highway 17 by MTO/ McCormick Rankin Corporation (MRC) / PML. Consequently, this study corridor should be incorporated into west and east of the study corridor to match alternate routes that are designed by MTO/MRC.

For the purpose of this Foundation Assessment the study corridor extends from 0.6 km west of Highway 531 to 8.0 km east of Highway 630, about 26.9 km through the Townships of Bonfield, Calvin and Papineau – Cameron in the District of Nipissing according to the RFP. This section of the existing Highway 17 is a two-lane highway with passing lanes. The chainage equation changes of the existing highway alignment occur at the following Stations:

- Sta. 25+373.535 Township of Bonfield = Sta. 10+000.000 Township of Calvin
- Sta. 25+565.009 Township of Calvin = Sta. 10+000 Township of Papineau – Cameron

Upon completion of the preliminary reviews by AECOM and MTO, the study area was divided into four sections for the planning study: west, middle, east and easterly. The west section includes five alternate routes (Routes W1 to W5) and the east section has three alternate routes (Routes E1 to E3) as shown on Drawings A and B and 1 to 10. For the middle and easterly sections, twinning of the existing highway is proposed. Consequently, the foundation assessment for the middle and easterly section was not carried out at this time.



The approximate Highway 17 section locations and alternate routes are listed below:

Highway 17 Route Sections	Approximate Location	Alternate Routes
West	0.6 km west of Highway 531 to approximately 1.5 km east of the Township of Bonfield boundary, about 12.0 km, Townships of Bonfield and Calvin	<ul style="list-style-type: none"> • Route W1 • Route W2 • Route W3 • Route W4 • Route W5
Middle	From about 1.5 km east of the Township of Bonfield boundary to 1.9 km west of Highway 630, about 5.0 km, Township of Calvin	Twinning proposed
East	From about 1.9 km west of Highway 630 to approximately 3.9 km east of Highway 630, about 5.8 km, Township of Calvin	<ul style="list-style-type: none"> • Route E1 • Route E2 • Route E3
Easterly	From about 3.9 km east of Highway 630 to approximately 8.0 km east of Highway 630, about 4.1 km, Townships of Calvin and Papineau-Cameron	Twinning proposed

AECOM provided a corridor study map illustrating alternate Routes W1 to W5 for the west section and alternate Routes E1 to E3 for the east section. The purpose of this assessment was to identify the geologic features and hydrogeology along the highway corridor and to assess the potential impact of these features on the design and construction. All elevations in this report are expressed in metres.

2. SITE DESCRIPTION

The study area is located about 23 km east of City of North Bay in the Geographic Townships of Bonfield, Calvin and Papineau – Cameron. The study section of Highway 17 being reviewed extends from approximately 0.6 km west of Highway 531 to 8.0 km east of Highway 630 through Townships of Bonfield, Calvin and Papineau – Cameron, approximately 26.9 km. A Project Location Map (Figure 1) is enclosed for reference.



Land uses in the vicinity of the study corridor within the study limits include mainly agricultural areas and isolated residential areas and farmhouses. The community of Rutherglen is located in this study corridor. Local restaurants and businesses are located along the existing Highway 17. The Samuel De Champlain Provincial Park is located in the study area.

Currently, existing Highway 17 at-grade intersections and structures along the study corridor are listed in the following table.

ROUTE SECTIONS	ROAD	STATION	STRUCTURES	STATION
Township of Bonfield				
West	Highway 531 (Note 1)	Sta. 16+080	Kaibuskong River Bridge Site No. 43-113 (Note 1)	Sta. 15+860
	Line 3N	Sta. 16+310	Blueseal Creek Culvert Site No. 43-263	Sta. 21+590
	Line 3S	Sta. 16+330	Sharpes Creek Bridge Site No. 43-115	Sta. 23+340
	Trout Pond Road	Sta. 19+640		
	Pine Lake Road	Sta. 19+730		
	Trunk Road	Sta. 23+970		
	Park Street	Sta. 24+300		
	Talon Lake Road	Sta. 24+480		
Township of Calvin				
West	Columbia Road	Sta. 11+480		
Middle	Service Road to Pimisi Bay		Pimisi Bay Culvert Site No. 43-261	Sta. 13+300
East	Highway 630	Sta. 18+360	Amable Du Fond River Bridge Site No. 43-087	Sta. 19+480
Easterly	Samuel De Champlain Provincial Park Road	Sta. 23+480	Pautois Creek Bridge Site No. 43-088	Sta. 22+820
Township of Papineau – Cameron				
Easterly	Boundary Road	Sta. 10+090		

Note 1: Part of the west study corridor (Highway 17 North Bay to Bonfield).



Highway 531 connects the existing Highway 17 to the Community of Bonfield in the west section of the study corridor. Highway 630 connects the existing Highway 17 to Algonquin Provincial Park in the east section of the study corridor.

The Canadian Pacific Railway (CPR) enters the study area at about 500 m east of Highway 531 from the south and then primarily follows the existing Highway 17 on the south side. A TransCanada Pipe Line (TCPL) enters the study area from the north at about 2 km east of the Highway 17/Highway 531 intersection and mainly follows the existing Highway 17 on the south side.

Several local roads are located south of existing Highway 17 in the west section, namely; Line 3S, Trout Pond Road, Fichault Road, McNutt Road, Rutherglen Line, Park Street, Talon Lake Road and Columbia Road, Francoeur Road, Trunk Road and Von Doeler Road.

The terrain is generally flat in the west section with localized river valley and low-lying swampy areas, in particular from east of Highway 531 to Trout Pond Road. The Kaibuskong River, Blueseal and Sharpes Creeks flow through this area in an approximately south to north direction.

In the east section, terrain is characterized by steep grade changes where a 60 m drop occurs in the first 3 km section of the east section to Crooked Chute Lake/Amable Du Fond River. The terrain east of Crooked Chute Lake is generally flat with localized low-lying swampy areas. The Crooked Chute Lake is located in the east section where Routes E2/E3 traverses through the north edge of the lake. The Amable Du Fond River flows through this area from south to north.

The study area is located in the Canadian Shield where the geology comprises of bedrock outcrops alternating with swamps, glaciofluvial, ground moraine and glaciolacustrine deposits. A Site Geology map (Figure 2) showing the distribution of soils and the known bedrock depths along the alignment from Ontario Geology Survey Maps 5041 and 5042 is included with this report.



3. SITE ASSESSMENT PROCEDURES

3.1 General

The foundation evaluation involved a review of the available geological, topographical and hydrogeological mapping, existing geotechnical reports and aerial photographs. A field visual reconnaissance was carried out to verify the inferred data at the selected locations.

3.2 Reference Documents and Literature Review

The general physiographic conditions along the corridor were obtained primarily from existing geological maps and reports from the MTO GEOCREST library. Well records obtained from the 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 and the location of significant earth deposits (silt/sand) and rock outcrops along the study corridor were interpreted from maps including Ontario Base Maps and aerial photographs and are considered approximate and sufficient for the purposes of the current foundation assessment study.

3.3 Site Reconnaissance

A site reconnaissance visit of the existing and proposed alignments and the adjacent lands within the study corridor was carried out on October 17 to 19, 2012. The site reconnaissance visit consisted of a drive-by and walk-through of selected sections of the proposed alignments of Highway 17 and adjacent lands. The site reconnaissance was conducted by Mr. B. R. Gray, P. Eng., Mr. B. Rao, P. Eng. and Mrs. N. S. Balakumaran, P. Eng.



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 visit including inferred swamps, earth and rock knob/outcrops are presented in Appendix C.

Relevant natural features in selected areas of the corridor were photographed. The locations of 40 representative site photographs are indicated on Drawings 1 to 10. The photographs are included in Appendix C. The alternate routes were identified by unique colours as shown in Drawings A and B and 1 to 10.

4. INFERRED SUBSURFACE CONDITIONS

4.1 General

The site is located in the area of the Canadian Shield where extensive glaciation has occurred. This Highway 17 project borders on the south limits of the geomorphic sub-provinces known as the Muskoka Ridges and Pockets and the Algonquin Uplands and the north limit of the Eastern Sandy Uplands.

The local topography is undulating as the highway traverses areas which alternate between rock ridges and low lying swampy areas. The native overburden soils typically include varved clay and silt and sandy/silty soils at the west section. At the east section, the native overburden consists of sandy soils with cobbles and boulders. Glaciofluvial esker deposits (typically sand and gravel) are present near Trout Pond Road in the west section and at the east end of the east section.

The alignment traverses several different geological units:

- Wetland areas containing peat, silt, sand and clay deposits
- Glaciolacustrine plains comprising varved clay and silt, sand and silt
- Bedrock knobs, where the granite bedrock is overlain by a relatively shallow soil cover
- Bedrock outcrops, where the bedrock is exposed or under a relatively thin soil veneer
- Glaciofluvial esker deposits



The study area of the Highway 17 is located within the Central Gneiss Belt. The bedrock in this area consists of Precambrian rock of Mesoproterozoic age. The predominant bedrock types in the area are granites and gneisses. The local bedrock undulates from near or at ground surface and locally dipped to more than 30 m below the ground surface; bedrock outcrops/cuts are present in this area.

The approximate average extent of these physiographic/geologic formations along the proposed Highway 17 alternate routes is generally summarized below with reference to chainage 10+000 at the west end for Route W3 of the proposed alignment of Highway 17 and the existing alignment chainage in the east section for Route E1.

APPROXIMATE CHAINAGE (1)	PREDOMINANT GEOLOGIC UNIT	LENGTH (m)	PERCENT OF TOTAL (%)
West Section, Route W3, Townships of Bonfield and Calvin			
10+000 to 11+150	Glaciolacustrine Plain and Bedrock	1150	9.7
11+150 to 11+400	Wetland/swamp within Glaciolacustrine Deposits and Bedrock Knobs	250	2.1
11+400 to 12+300	Glaciolacustrine Plain and Bedrock	900	7.6
12+300 to 12+550	Wetland/swamp within Glaciolacustrine Deposits and Bedrock Knobs	250	2.1
12+550 to 13+500	Glaciolacustrine Plain and Bedrock Knobs	950	8.1
13+500 to 14+450	Glaciofluvial - Esker and Bedrock Knobs	950	8.1
14+450 to 14+700	Glaciolacustrine Plain and Bedrock Knobs	250	2.1
14+700 to 15+000	Wetland/swamp within Glaciolacustrine Deposits and Bedrock Knobs	300	2.5
15+000 to 18+200	Glaciolacustrine Plain and Bedrock Knobs	3200	27.1
18+200 to 18+600	Wetland/swamp within Alluvial Plain	400	3.4



APPROXIMATE CHAINAGE (1)	PREDOMINANT GEOLOGIC UNIT	LENGTH (m)	PERCENT OF TOTAL (%)
West Section, Route W3, Townships of Bonfield and Calvin			
18+600 to 19+450	Wetland/swamp within Ground Moraine Deposits and Bedrock Knobs	850	7.2
19+450 to 20+000	Ground Moraine Deposits and Bedrock Knobs	550	4.7
20+000 to 20+850	Wetland/swamp within Organic Terrain	850	7.2
20+850 to 21+810	Wetland/swamp within Ground Moraine Deposits and Bedrock Knobs	960	8.1
TOTAL LENGTH		11810	100
East Section, Route E1, Township of Calvin			
16+500 to 19+340	Glaciofluvial - Outwash Plain and Bedrock with veneer of soils	2840	48.7
19+340 to 19+450	Wetland/swamp within Glaciofluvial - Outwash Plain and Bedrock with veneer of soils	110	1.9
19+450 to 20+000	Glaciofluvial - Outwash Plain and Bedrock with veneer of soils	550	9.4
20+000 to 20+100	Wetland/swamp within Glaciofluvial - Outwash Plain and Bedrock with veneer of soils	100	1.7
20+100 to 21+060	Bedrock Knobs and Ground Moraine Deposits with Organic terrain	960	16.5
21+060 to 22+330	Glaciofluvial - Outwash Plain	1270	21.8
TOTAL LENGTH		5830	100

(1) Chainages are related to RFP reference drawings that were used in this report.

The average extent of the geologic units is approximate and varies for the different routes of the highway.

4.2 Drainage

Generally, surface water runoff along the study corridor drains into the Kaibuskong River and Amable Du Fond River, Blueseal Creek, Sharpes Creek and numerous unnamed creeks,



streams, swamps and scattered ponds. These streams flow generally from south to north into the Mattawa River System.

Groundwater is inferred typically near ground surface (less than 1 m deep) in swamps and the low-lying areas and near creeks.

5. FOUNDATION ASSESSMENT AND RANKING

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 for the structure alternatives. 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 for each alternate routes location was evaluated on the basis of the total length of the alternative with inferred soft ground/swamps between 0 and 3 m deep; 3 and 10 m deep; and over 10 m deep.

For the purpose of this discussion, soft ground/swamps less than 3 m deep that may be excavated with conventional backhoe equipment were considered the most favourable. Soft and/or swamp grounds that are between 3 and 10 m deep typically requires a long-stick excavator and are 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, pre-loading and staged construction) and are the least favourable.

5.1.2 Groundwater Conditions (Table F-2)

The extent of each alternate routes 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)

For the preliminary foundation assessment purposes, major river and railway crossing bridges, potential road crossing structures and major culverts are considered for this assessment and are listed in Appendix D.

The type of foundation required to support major river and railway crossing bridges, potential local road crossing 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 favourability of integral abutment foundations was considered to fall between the shallow and deep type of foundations. 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 the route alternatives over compressible materials. For evaluation purposes, the compressible soils were grouped into less than 3 m deep; 3 to 10 m deep; and more than 10 m deep zones. Each of these groups was further divided into potentially sandy/silty or clayey deposits.



The most favourable condition was defined as areas containing less than 3 m of compressible deposits of a sandy/silty nature (for example, loose sand/silt), 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 requiring pre-loading and wick drains.

5.1.6 Construction Feasibility (Table F-6)

The impact of construction feasibility was considered on the basis of the number and type of structures (bridge and major culvert) required on each alternative and the length of swamp sections. In addition, embankments in swamps requiring conventional construction and excavation less than 10 m were considered most favourable and those requiring special construction were considered least favourable.



5.2 Weighting of Evaluation Criteria for Route Alternatives (Tables F-1 to F-6)

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

- A favourability factor F to score the assessment for each of the evaluation criteria 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 assigned an individual impact weight as presented below:

EVALUATION CRITERION	IMPACT WEIGHT, B_i
Soft Ground/Swamp	0.20
Groundwater Conditions	0.10
Structure Foundations	0.20
Embankment Settlement	0.15
Embankment Stability	0.15
Construction Feasibility	0.20
TOTAL	1.00

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 criterion was deemed to have no impact on alternative route selection for the specific project.



The favourability factors, F, used in Tables F-1 to F-6, and the impact weights, B_i, used in the scoring Table F-7 are summarized in the following table.

EVALUATION CRITERION	IMPACT WEIGHT, B _i	FAVOURABILITY FACTOR, F						TABLE
		MOST		AVERAGE		LEAST		
Soft Ground/ Swamps	0.20	Based on relative length and depth of soft ground (SG) and/or swamps (SWP):						F-1
		SG or SWP		SG or SWP		SG or SWP		
		0 to 3 m Deep		3 to 10 m Deep		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		G/W		G/W		
		Deeper than 5 m		1 to 5 m Deep		0 to 1 m Deep		
		F=5		F=3		F=1		
Structure Foundations	0.20	Based on estimated type of foundation requirements:						F-3
		Shallow Foundation		Integral Abutment		Deep Foundation		
		F=5		F=4		F=3		
Embankment Settlement	0.15	Based on length of sections with compressible soil within three depth ranges:						F-4
		Less than 3 m deep		3 to10 m deep		Deeper than 10 m		
		Silty/Sandy	Clayey	Silty/Sandy	Clayey	Silty/Sandy	Clayey	
		F=5	F=3	F=4	F=2	F=3	F=1	
Embankment Stability	0.15	Based on estimated type of construction required to establish embankment on competent ground:						F-5
		Conventional Embankment		Significant Subexcavation		Potential Pre-Loading/ Wick Drains		
		F=5		F=3		F=1		
Construction Feasibility	0.20	Based on the required number of structures:						F-6
		Bridge Foundation		Culvert		Embankments		
		Shallow	Deep	Extension	New	Conventional	Special	
		F=5	F=3	F=5	F=3	F=5	F=1	



The computations provide Weighted Favourability Values A_i for each subsection. For example, with reference to Table F-1, Soft Ground/Swamps Evaluation Criterion, the weighted favourability value A_2 for the embankment alternative 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	500	5
3 – 10	3350	3
>10	700	1

$$A_2 = \text{Weighted Favourability Value} = \frac{(500 \times 5) + (3350 \times 3) + (700 \times 1)}{500 + 3350 + 700} = 2.91$$

The weighted favourability, value, A_i , computed for each subsection is also normalized to take into account the total length of each criteria in each alternate route. This would then reduce the weighted favourability factor based on the ratio of the alternate route with the least amount of length. An example of the normalization conducted for the Route W2 is provided below:

$$A_2 = \text{Weighted Favourability Value for Route W2} = 2.91 \times \frac{\text{Route W1: 2500 m}}{\text{Route W2: 4550 m}} = 1.60$$

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 for Structure Alternatives (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 alternate routes were scored by adding the N_i for each of the evaluation criteria multiplied by the Impact Weight, B_i for the criterion. The Scores based on the N_i values (multiplied by 5 to produce values higher than 1.00 for ease of comparison) are shown on Table F-7.

An example of the computation of the Scores is provided below, for reference. The example is the calculation of the Normalized Score of 3.95 for the Route W2 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_i	0.20	0.10	0.20	0.15	0.15	0.20
W2	A_i	1.60	2.53	2.67	2.29	2.98
	N_i	0.57	0.87	0.82	0.84	0.76
Note: For west section, the following are the highest A_i values						
Highest A_i	2.80	2.90	3.25	2.71	3.93	4.03

$$\text{Normalized Score W2} = 5[(1.60/2.80) \times 0.20 + (2.53/2.90) \times 0.10 + (2.67/3.25) \times 0.20 + (2.29/2.71) \times 0.15 + (2.98/3.93) \times 0.15 + (3.73/4.03) \times 0.20]$$

$$\text{Normalized Score for Route W2} = 3.95$$

[The ratios in brackets represent each of the N_i values, such as $(1.60/2.80) = 0.57$]

The results are summarized below:

ROUTE SECTIONS	ALTERNATE ROUTES	NORMALIZED SCORE	RANKING	TOTAL LENGTH (m)
West	Route W1	5.00	1	12000
	Route W2	3.95	5	11790
	Route W3	4.45	2	11810
	Route W4	4.42	3	12000
	Route W5	4.22	4	11950
Middle	N/A	N/A	N/A	N/A
East	Route E1	5.00	1	5830
	Route E2	4.19	2	5760
	Route E3	3.80	3	5820
Easterly	N/A	N/A	N/A	N/A



The results indicated that Route W1 for the west section has the highest score of 5.00. Routes W3 and W4 have the close scores of 4.45 and 4.42, respectively. Route W5 has the score of 4.22. Route W2 has the lowest score of 3.95.

For the east section, Route E1 has the highest score of 5.00. Route E2 has the second highest score of 4.19. Route E3 has the lowest score of 3.80.

The selection of the Preferred Route also depends on other parameters or facets that are being analysed by AECOM.

6. ALTERNATIVE ROUTE REVIEW AND RECOMMENDATIONS

6.1 General

From the embankment and structure foundation design and construction perspective, the route alternative that incorporates the highest scoring is considered to be preferred. As indicated previously, Route W1 has the highest score of 5.00 and would be preferred over the remaining west section alternate routes. For the east section, Route E1 has the highest score of 5.00 and would be preferred over the remaining alternatives.

The preferred structure location/access should be selected to achieve bedrock or competent soil subgrade and avoid swamp areas. Embankments constructed over bedrock or competent soil subgrade will be easier to drain; will be relatively easier to construct; will perform better; and will be subjected to only minimal post-construction settlements and therefore will require less maintenance.

6.2 Embankment Design

The embankments should be made of rockfill in sections requiring construction below the water table or in swampy terrain. Elsewhere embankments could be constructed of earth fill, including the zones above the rockfill. Embankment design and construction procedures for rockfill and



earth fill embankments shaped at 1.25H:1V and 2H:1V respectively above original grades should be suitable for this project. Embankment geometry through swamps should include a minimum 2 m wide bench on both sides according to Northern Region Directive 98-200.

For preliminary evaluation purposes the design of embankments through swamps should allow for subexcavation of soft and compressible soils to depths typically less than 3 m. Deeper deposits of soft and compressible soils greater than 10 m deep should be anticipated. Also 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. Above grade, the embankments constructed with earth fill will be stable at 2H: 1V slopes or flatter above the water table. Rockfill embankments should also be stable at 1.25H: 1V slopes or flatter.

6.3 Embankment Stability

It is anticipated that most of the west section alternatives traverse similar geologic formations comprising glaciolacustrine deposits containing clayey and sandy/silty soils and glaciofluvial esker deposits containing sand and gravel. For the east section, the proposed routes primarily traverse glaciofluvial outwash containing sandy/silty and sand and gravel. Embankments through these competent soils are considered to be stable where embankment height up to 4 m. However, proposed routes cross a number of soft ground/swamps and creek flood plains. These areas will require special design and construction procedures to achieve stable embankment slope.

The requirement to use non-standard slope configurations for the new embankments to achieve stable conditions, such as toe stabilizing berms or pre-loading/surcharging with wick drains and/or staged construction depends on the design embankment height and local depth of soft ground.

Based on the preliminary longitudinal profile, Route W1 will require construction of embankments up to 10 m high for CPR/TCPL crossings in swampy area (about 300 m long), up to 14 m high for Blueseal and Sharpes Creeks flood plains (about 550 m long) and up to 14 m high for Von Doeler Road swamp crossing (about 200 m long). These areas may require use of pre-



loading/surcharging with wick drains and/or staged construction for the new embankments to achieve stable conditions.

6.4 Embankment Settlements

It is anticipated that the post-construction settlement of embankments founded on bedrock, competent glaciolacustrine or glaciofluvial deposits will be minimal. Significant settlements may occur in the swampy areas and flood plains where embankment up to 14 m high is required.

Based on the preliminary longitudinal profile, Route W1 will require up to 10 m high embankments between Line 3S and Trout Pond located within swampy areas and 14 m high embankments at the Blueseal Creek and Sharpes Creek flood plains may undergo significant settlements.

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 and/or may affect the existing railway embankments and TCPL corridor which are in close proximity.

Settlement of the rockfill should be calculated based on the latest MTO directive dated September 14, 2010 'Post Construction Rockfill Settlement and Guidelines for Estimating Rockfill Quantity'. The magnitude of the rockfill settlements depends on the preferred/selected treatment for the swamps. In addition, longitudinal and transverse post-construction differential settlement of embankment should be checked for conformance with MTO guidelines dated March 2, 2010 'Embankment Settlement Criteria for Design'. These settlements should be evaluated during future preliminary or detail design studies.



6.5 Structure Foundations

As indicated previously, structure locations for alternate routes were not received from AECOM at the time of preparation of this report. For the preliminary foundation assessment purposes, major river/creek and railway crossing bridges, potential road crossing structures and major culverts are considered for this assessment and are listed in Appendix D.

The types of foundations of the structures are likely to comprise shallow foundations (spread footings) on bedrock, native soil or engineered fill and deep foundations to bedrock or integral abutment on piles. The need for rock trenches, to accommodate the minimum free pile length of 5 m will depend on the final road grades for integral abutments. The type of foundation will depend ultimately on the road grades at the structures and structural design concepts. Cobbles and boulders are anticipated where structures located in esker deposits in west and east sections. Based on the desktop study, the anticipated types of foundations for structures are included in Appendix D.

Foundations for culverts are expected to include competent native soils or rockfill.

6.6 Construction Considerations

It is anticipated that the typical embankment construction will be accomplished with conventional methods since the alignment traverses competent glaciolacustrine/glaciofluvial deposits for the most part of the alignments.

In west and east sections, non-conventional construction procedures for swamp crossings may be required to reduce post-construction settlements to tolerable levels and minimize disturbance to CPR and TCPL corridors. Special construction methods may include the use of lightweight fill, toe-stabilizing berms, wick drains and/or staged construction with stringent instrumentation monitoring.



6.7 Assessment of Advantages and Disadvantages

The following table presents an overview assessment of advantages, disadvantages, costs and risks/consequences of each alternative from the foundation perspective.

ALTERNATE ROUTES	ADVANTAGES	DISADVANTAGES
WEST SECTION		
Route W1 (Northerly Route)	<ul style="list-style-type: none"> The total length of soft ground/ swamp crossings is less than the other routes A total of 8 structure crossings is less than the other routes Inferred favourable subgrade conditions along 80% of Route Avoids municipal road network south of Highway 17 	<ul style="list-style-type: none"> Route W1 crosses the CPR and TCPL corridors in and adjacent to swampy areas between Line 3S and Trout Pond Road and may require special design and construction methods with stringent instrumentation monitoring 2 structure crossings and associated approach embankments in flood plain (Blueseal and Sharpes Creeks flood plain) Embankment construction along 5% of route may require wick drains design and construction
Route W2	<ul style="list-style-type: none"> Inferred favourable subgrade conditions along 60% of Route A total of 9 structure crossings is similar to the other routes except Route W1 	<ul style="list-style-type: none"> The highest total length of soft ground/ swamp crossings than the other routes Route W2 crosses the CPR and TCPL corridors in and adjacent to swampy areas between Line 3S and Trout Pond Road and may require special design and construction methods with stringent instrumentation monitoring Embankment construction along 18% of route may require wick drains design and construction
Route W3	<ul style="list-style-type: none"> Inferred favourable subgrade conditions along 75% of Route A total of 9 structure crossings are similar to the other routes except Route W1 	<ul style="list-style-type: none"> Embankment construction along 16% of route may require wick drains design and construction Route W3 crosses the CPR in and adjacent to swampy areas between Highway 531 and Line 3S and may require special design and construction methods with stringent instrumentation monitoring



ALTERNATE ROUTES	ADVANTAGES	DISADVANTAGES
Route W4	<ul style="list-style-type: none"> Inferred favourable subgrade conditions along 75% of Route A total of 9 structure crossings is similar to the other routes except Route W1 	<ul style="list-style-type: none"> Embankment construction along 15% of route may require wick drains design and construction Route W4 crosses the CPR in and adjacent to swampy areas between Highway 531 and Line 3S and may require special design and construction methods with stringent instrumentation monitoring
Route W5	<ul style="list-style-type: none"> Inferred favourable subgrade conditions along 77% of Route A total of 9 structure crossings is similar to the other routes except Route W1 	<ul style="list-style-type: none"> Embankment construction along 10% of route may require wick drains design and construction Route W5 crosses the CPR in and adjacent to swampy areas between Highway 531 and Line 3S and may require special design and construction methods with stringent instrumentation monitoring
EAST SECTION		
Route E1	<ul style="list-style-type: none"> The total length of soft ground/ swamp crossings is less than the other routes A total of 4 structure crossings is similar to the other routes Inferred favourable subgrade conditions along 96% of Route No TCPL crossing requires for Route E1 and no construction design and construction impact 	
Route E2	<ul style="list-style-type: none"> The total length of soft ground/ swamp crossings is similar to Route E3 A total of 4 structure crossings is similar to the other routes Inferred favourable subgrade along 94% of Route 	<ul style="list-style-type: none"> Route E2 requires 2 TCPL crossings and may impact on design and construction
Route E3	<ul style="list-style-type: none"> The total length of soft ground/ swamp crossings is similar to Route E2 A total of 4 structure crossings is similar to the other routes Inferred favourable subgrade conditions along 94% of Route 	<ul style="list-style-type: none"> Route E3 requires 2 TCPL crossings and may impact on design and construction



7. PREFERRED ROUTE ALTERNATIVE REVIEW

7.1 General

AECOM indicated that the preferred alignment is the combination of the following realignment alternatives:

Highway 17 Route Sections	Approximate Chainage	Preferred Alternative	Rank and Score
West	18+675 to 25+710 10+000 to 11+500 (25+710=10+000)	W2	Rank 5, Score 3.95
Common Middle Section	11+500 to 12+350	New alignment adjacent to south of Highway 17	Not Ranked
	12+350 to 15+500	New alignment	
	15+500 to 16+480	New alignment adjacent to south of Highway 17	
East	16+480 to 22+400	E3	Rank 3, Score 3.80
Common Easterly Section	22+400 to 23+250	New alignment	Not Ranked
	23+250 to 24+500	New alignment adjacent to south of Highway 17	
	24+500 to 25+727 10+000 to 11+050 (25+727=10+000)	New alignment	

These alignments are located south of Highway 17. After the selection, Realignment Alternatives W2 and E3 were subjected to numerous revisions of their horizontal and vertical alignment. The final reviewed version of the preferred realignment alternatives was dated May 28, 2014 and is shown on the enclosed Drawings P1 to P14.



The preferred alignment alternative for the proposed four-laning Highway 17 is about 24.0 km long and on new alignment. A summary of the estimated subgrade conditions for the embankments is provided in the following table.

RANGE OF FILL WEIGHT (m)	CONSTRUCTION CONDITIONS FOR FILLS (m)			
	ON ORIGINAL GROUND	OVER SWAMP	ON OPEN WATER	TOTALS
0 to 4.5	-	125	30	155
4.5 to 8.0	310	440	425	1,175
8.0 to 18.0	3,757	1,880	510	6,147
Totals	4,067	2,445	965	7,477

The preferred alignment alternative crosses/borders several swamps between about 1.5 km east of Trout Pond Road and about 1 km east of Boundary Road (about 7.5 km section). The estimated maximum depth to competent ground in the swamps has been provided in Drawings P1 to P14. The open water swamps will require excavation of organic soils and densification of significant depth of rockfill placed below water and the need for pre-loading/surcharging to reduce post construction settlement and enhance overall performance.

Up to 25.0 m deep cuts are planned along the preferred alignment and are listed below:

Geographic Township	Range of Estimated Maximum Depth of Cut (m)	Totals (m)
Bonfield	7 to 16	1,515
Calvin	9 to 25	3,510
Papineau - Cameron	7	100
Total Lengths (m)		5,125

The preferred alignment alternative will require structure crossings for the Trout Pond Road, Blueseal Creek, Trunk Road, McNutt Road, Sharpes Creek, Rutherberg Line, CP Rail, Columbia Road Forest, Highway 630, Amable Du Fond River, Pautois Creek and Boundary Road. The anticipated foundation types and bedrock depths based on the desktop study are provided in Appendix E. This information should be used for the planning purposes only.



A limited preliminary subsurface investigation involving exploratory boreholes was planned for selected swamps and the proposed structures for the preferred alignment alternative. The investigation for this study was carried out during the period of March and July 2014. The result of the investigation is provided separately in two Preliminary Foundation Investigation and Design Reports for embankments through swamps and for structures (PML Ref: 11TF063A-1 and 11TF063B-2).

7.2 Additional Studies

The preliminary assessments in this report are based on literature reviews, site reconnaissance and the route longitudinal profiles provided by AECOM, supplemented by a limited subsurface investigation where sites were accessible. The recommendations are intended for planning purposes only. Additional data should be obtained by conducting subsurface 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.

A foundation study of the entire preferred realignment alternative should be carried out to assess conditions through the earth/rock cuts and conventional embankment construction sections. Based on our preliminary assessment of the preferred realignment alternative, the inferred sections where standard OPSD 203 series construction techniques cannot be applied involving swamp, high fill and deep cut crossings are listed in Table 1.

The potential river and railway crossing bridges, road crossing structures and major culvert should also be confirmed and investigated and are listed in Table 2. The bedrock at each location should be carefully delineated both longitudinally and transversely and proven with cores to confirm that the sites are adequate for the construction of the structures.



8. CLOSURE

This report was prepared by Mr. B. Rao, P. Eng. and Mrs. N.S Balakumaran, P. Eng. who are no longer with the firm. Ms. M. Kamranzadeh MSc, EIT and Mr. C. Nascimento, P.Eng. completed the report, which was reviewed by Mr. B.R. Gray, MEng, P.Eng., MTO Designated Principal Contact.

Yours very truly,

Peto MacCallum Ltd.

A handwritten signature in blue ink, appearing to be "Marzieh", is located below the "Yours very truly," text.

Marzieh Kamranzadeh, MSc, EIT
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TABLE 1
RECOMMENDED LOCATIONS FOR FOUNDATIONS INVESTIGATION
(SWAMP/HIGH FILL/DEEP CUT CROSSINGS)
PREFERRED REALIGNMENT ALTERNATIVE

STATIONS (Note 1)	LENGTH (m)	PROPOSED WORK	EXISTING DATA	
			NO. OF TEST HOLES (Note 2)	DEPTH TO BEDROCK (m)-(Note 3)
Highway 17 (Preferred) Mainline Chainage – Township of Bonfield				
19+070 to 19+550	480	Up to 16.0 m deep cut	-	Est. 12.0 west end
19+730 to 19+980	250	Up to 5.0 m high fill	-	-
20+500 to 20+580	80	Up to 6.0 m high fill over swamp	-	-
20+930 to 21+030	100	Up to 12.0 m high fill over Blueseal Creek	-	Est. 3.9 east end
21+100 to 21+400	300	Up to 7.0 m deep cut	-	Est. 3.9
21+900 to 22+100	200	Up to 10.0 m deep cut	-	Est. 2.4
22+950 to 23+200	250	Up to 10.0 m deep cut	-	Est. 1.5 - 3.0 west end
23+315 to 23+625	310	Up to 10.0 m high fill over McNutt Road	-	Est. 21.0 west end
23+700 to 24+125	425	Up to 8.0 m high fill over Sharpes Creek	-	-
24+200 to 24+680	480	Up to 10.0 m high fill over Rutherglen Line	-	Est. 5.4
24+950 to 25+235	285	Up to 12.0 m deep cut	-	-
25+340 to 25+440	100	Up to 12.0 m high fill	-	-
25+440 to 25+580	140	Up to 14.0 m high fill over swamp	-	-
25+580 to 25+710=10+000	130	Up to 14.0 m high fill		-
Highway 17 (Preferred) Mainline Chainage – Township of Calvin				
10+000 to 10+080	80	Up to 17.0 m high fill	-	-
10+080 to 10+160	80	Up to 18.0 m high fill over swamp	-	-
10+160 to 10+340	180	Up to 12.0 m high fill over CP Rail	-	-
10+360 to 10+730	370	Up to 20.0 m deep cut	-	Est. 33.0
11+360 to 11+460	100	Up to 8.0 m high fill over swamp	-	Est. 0.6
12+300 to 12+330	30	Up to 3.0 m embankment over unnamed creek	2	0.8 and 1.2
12+490 to 12+540	50	Up to 3.0 m embankment over swamp	1	0.3
12+925 to 12+970	50	Up to 14.0 m high fill	-	-



TABLE 1
RECOMMENDED LOCATIONS FOR FOUNDATIONS INVESTIGATION
(SWAMP/HIGH FILL/DEEP CUT CROSSINGS)
PREFERRED REALIGNMENT ALTERNATIVE

STATIONS (Note 1)	LENGTH (m)	PROPOSED WORK	EXISTING DATA	
			NO. OF TEST HOLES (Note 2)	DEPTH TO BEDROCK (m)-(Note 3)
12+970 to 13+020	50	Up to 15.0 m high fill over possible swamp	-	-
13+020 to 13+040	20	Up to 13.0 m high fill	-	-
13+070 to 13+270	200	Up to 25.0 m cut	-	-
13+310 to 13+710	400	Up to 15.0 m high fill over swampy area adjacent to Pimisi Bay	-	-
13+780 to 13+925	145	Up to 20.0 m deep cut	-	-
14+200 to 14+260	60	Up to 7.0 m high fill	-	-
14+390 to 14+575	185	Up to 9.0 m deep cut	-	-
14+650 to 14+780	130	Up to 10.0 m high fill over swamp	-	-
15+380 to 16+300	920	Up to 10.0 m deep cut	-	-
17+335 to 17+800	465	Up to 9.0 m deep cut	-	Est. 15.9
18+050 to 18+940	890	Up to 13.0 m high fill over Highway 630, CP Rail and TransCanada Pipelines	-	20.4 and 32.7 North end
19+270 to 19+370	100	Up to 10.0 m high fill over Amable Du Fond River	-	-
19+440 to 19+560	120	Up to 9.0 m deep cut	-	-
19+740 to 19+890	150	Up to 6.0 m high fill over swamp	-	-
20+020 to 20+475	455	Up to 14.0 m deep cut	-	-
20+860 to 21+670	810	Up to 10.0 m high fill over swamp	2	3.5 and 5.1
21+670 to 22+200	530	Up to 13.0 m high fill over CP rail and TransCanada Pipelines	-	-
22+400 to 22+760	360	Up to 12.0 m deep cut	-	-
22+800 to 23+110	310	Up to 18.0 m high fill over Pautois Creek	-	-
23+580 to 23+850	270	Up to 11.0 m high fill over swamp	2	> 0.5
23+850 to 24+020	170	Up to 9.0 m high fill	-	-
24+260 to 24+550	290	Up to 8.0 m deep cut	3 (Note 4)	2.0 to 3.2
25+050 to 25+160	110	Up to 5.5 m high fill over swamp	2	1.2 and 1.3



TABLE 1
RECOMMENDED LOCATIONS FOR FOUNDATIONS INVESTIGATION
(SWAMP/HIGH FILL/DEEP CUT CROSSINGS)
PREFERRED REALIGNMENT ALTERNATIVE

STATIONS (Note 1)	LENGTH (m)	PROPOSED WORK	EXISTING DATA	
			NO. OF TEST HOLES (Note 2)	DEPTH TO BEDROCK (m)-(Note 3)
25+250 to 25+727=10+000	477	Up to 9.0 m high fill west of Boundary Road	-	-
Highway 17 (Preferred) Mainline Chainage – Township of Papineau-Cameron				
10+000 to 10+340	340	Up to 10.0 m high fill east of Boundary Road	-	-
10+630 to 10+730	100	Up to 7.0 m deep cut	-	-
10+905 to 10+980	75	Up to 4.0 m embankment over swamp	2	0.5 and 0.6

Notes:

1. Chainages are approximate and based on AECOM drawings dated May 28, 2014, may vary for eastbound and westbound lanes and are to be confirmed / refined during detail design.
2. Test holes include auger probes, boreholes and dynamic cone penetration tests.
3. Based on Water Well Records provided by the Ministry of Environment, from 1949-2011 and PML site investigation in March and June 2014.
4. Boreholes in perched swamps for preliminary design profile.



TABLE 2
RECOMMENDED LOCATIONS FOR FOUNDATIONS INVESTIGATION
(STRUCTURES)
PREFERRED REALIGNMENT ALTERNATIVE

APPROXIMATE STATIONS (Note 1)	PROPOSED WORKS	EXISTING DATA	
		NO OF BOREHOLES	DEPTH TO BEDROCK (m)-(Note 2)
Highway 17 (Preferred) Mainline Chainage – Township of Bonfield			
18+995	Trout Pond Road Structure	2	5.5 and 8.7
20+535	Tributary to Blueseal Creek Culvert	-	-
20+980	Blueseal Creek Culvert	-	3.9*
22+670	Trunk Road Structure	2	> 6.7
23+500	McNutt Road Structure	1	9.2
23+800	Sharpes Creek Bridge	-	-
24+490	Rutherglen Line Structure	2	4.4 and 5.1
Highway 17 (Preferred) Mainline Chainage – Township of Calvin			
10+250	CP Rail Structure	-	33.0*
18+380	Highway 630 Interchange Structure	2	5.5
18+620	CP Rail Structure	-	20.4*
19+310	Amable Du Fond River Bridge	-	-
21+760	CP Rail Structure	-	-
22+950	Pautois Creek Bridge or Culvert	-	-
Highway 17 (Preferred) Mainline Chainage – Townships of Calvin and Papineau-Cameron			
25+727	Boundary Road Structure	2	1.7 and 2.4

Notes:

1. Chainages are approximate and based on AECOM Drawings dated May 28, 2014, may vary for eastbound and westbound lanes and are to be confirmed / refined during detail design.
2. Bedrock depth is estimated from Water Well Records* provided by the Ministry of Environment, from 1949-2011 or established in PML site investigation, June 2014.



TABLE F-1– SOFT GROUND/SWAMPS

ROUTE SECTIONS (Note 1)	ROUTE ALTERNATIVES		Total Length (m)	SOFT GROUND/SWAMPS DEPTHS AND FAVOURABILITY			FAVOURABILITY VALUE(A _i)		
				Depth Range (0 - 3 m)	Depth Range (3 - 10 m)	Depth Range (>10 m)	Weighted	Normalized	
				L ₁	L ₂	L ₃			
				F ₁ = 5	F ₂ = 3	F ₃ = 1			
West	1	Route W1 (Northerly Route)	2500	200	1850	450	2.80	2.80	A ₁
	2	Route W2	4550	500	3350	700	2.91	1.60	A ₂
	3	Route W3	2900	200	2150	550	2.76	2.38	A ₃
	4	Route W4	2950	200	2200	550	2.76	2.34	A ₄
	5	Route W5 (Southerly Route)	2800	100	2300	400	2.79	2.49	A ₅
Middle	N/A (Note 2)		N/A						
East	1	Route E1 (Northerly Route)	200	0	200	0	3.00	3.00	A ₆
	2	Route E2 (Middle Route)	350	0	350	0	3.00	1.71	A ₇
	3	Route E3 (Southerly Route)	350	0	350	0	3.00	1.71	A ₈
Easterly	N/A (Note 2)		N/A						

Notes:

1. Route sections (west, middle, east and easterly) are based on alternate routes received to date.
2. No alternate routes were developed to date. Consequently the foundation assessment for the middle and easterly section was not carried out at this time.
 Enter weighted favourability value A_i in Table F-7.
 L_i is length and F_i is favourability factor.



TABLE F-2– GROUNDWATER CONDITIONS

ROUTE SECTIONS (Note 1)	ROUTE ALTERNATIVES		Total Length (m)	GROUNDWATER DEPTHS AND FAVOURABILITY			FAVOURABILITY VALUE(A _i)		
				Depth Range (> 5 m)	Depth Range (1 - 5 m)	Depth Range (0 - 1 m)	Weighted	Normalized	
				L ₁	L ₂	L ₃			
				F ₁ = 5	F ₂ = 3	F ₃ = 1			
West	1	Route W1 (Northerly Route)	12000	2200	7300	2500	2.95	2.90	A ₁
	2	Route W2	11790	1800	5440	4550	2.53	2.53	A ₂
	3	Route W3	11810	1250	7660	2900	2.72	2.72	A ₃
	4	Route W4	12000	1550	7500	2950	2.77	2.72	A ₄
	5	Route W5 (Southerly Route)	11950	1550	7600	2800	2.79	2.75	A ₅
Middle	N/A (Note 2)			N/A					
East	1	Route E1 (Northerly Route)	5830	900	4730	200	3.24	3.20	A ₆
	2	Route E2 (Middle Route)	5760	150	5260	350	2.93	2.93	A ₇
	3	Route E3 (Southerly Route)	5820	150	5320	350	2.93	2.90	A ₈
Easterly	N/A (Note 2)			N/A					

Notes:

Refer to notes 1 and 2 in Table F-1 for full descriptions.

Enter weighted favourability value A_i in Table F-7.



TABLE F-3– STRUCTURE FOUNDATIONS

ROUTE SECTIONS (Note 1)	ROUTE ALTERNATIVES		Total Number of Structures	FOUNDATION TYPE AND FAVOURABILITY			FAVOURABILITY VALUE(A _i)		
				Shallow Foundation	Other Type	Deep Foundation	Weighted	Normalized	
				F ₁ = 5	F ₂ = 3	F ₃ = 1			
West	1	Route W1 (Northerly Route)	8	3	3	2	3.25	3.25	A ₁
	2	Route W2	9	3	3	3	3.00	2.67	A ₂
	3	Route W3	9	3	3	3	3.00	2.67	A ₃
	4	Route W4	9	2	4	3	2.78	2.47	A ₄
	5	Route W5 (Southerly Route)	9	2	4	3	2.78	2.47	A ₅
Middle	N/A (Note 2)			N/A					
East	1	Route E1 (Northerly Route)	4	0	2	2	2.00	2.00	A ₆
	2	Route E2 (Middle Route)	4	0	2	2	2.00	2.00	A ₇
	3	Route E3 (Southerly Route)	4	0	0	4	1.00	1.00	A ₈
Easterly	N/A (Note 2)			N/A					

Notes:

Refer to notes 1 and 2 in Table F-1 for full descriptions.

Enter weighted favourability value A_i in Table F-7.

TABLE F-4 – EMBANKMENT SETTLEMENT

ROUTE SECTIONS (Note 1)	ROUTE ALTERNATIVES		Total Length (m)	SUBSOIL TYPE AND FAVOURABILITY						FAVOURABILITY VALUE(A _i)		
				Less than 3 m Deep		3-10 m Deep		Deeper than 10 m		Weighted	Normalized	
				L ₁	L ₂	L ₃	L ₄	L ₅	L ₆			
				Sandy/Silty (F ₁ =5)	Clayey (F ₂ =3)	Sandy/Silty (F ₃ =4)	Clayey (F ₄ =2)	Sandy/Silty (F ₅ =3)	Clayey (F ₆ =1)			
West	1	Route W1 (Northerly Route)	6690	1200	940	560	3340	200	450	2.81	2.70	A ₁
	2	Route W2	6540	490	790	130	4130	300	700	2.32	2.29	A ₂
	3	Route W3	6430	300	1600	390	3490	100	550	2.44	2.44	A ₃
	4	Route W4	6490	1070	1630	240	3000	0	550	2.73	2.71	A ₄
	5	Route W5 (Southerly Route)	7740	990	1610	790	3650	300	400	2.78	2.31	A ₅
Middle	N/A (Note 2)		N/A									
East	1	Route E1 (Northerly Route)	3640	0	0	3290	200	150	0	3.85	3.85	A ₆
	2	Route E2 (Middle Route)	4130	0	0	3730	260	140	0	3.84	3.38	A ₇
	3	Route E3 (Southerly Route)	3960	0	0	3640	260	60	0	3.85	3.54	A ₈
Easterly	N/A (Note 2)		N/A									

Notes:

Refer to notes 1 and 2 in Table F-1 for full descriptions.
 Enter weighted favourability value A_i in Table F-7.



TABLE F-5 – EMBANKMENT STABILITY

ROUTE SECTIONS (Note 1)	ROUTE ALTERNATIVES		Total Length (m)	EMBANKMENT REQUIRING SPECIAL OR CONVENTIONAL DESIGN			FAVORABILITY VALUE(A _i)		
				L ₁	L ₂	L ₃	Weighted	Normalized	
				Conventional Embankment (F ₁ = 5)	Embankment Requiring Subexcavation (F ₂ = 3)	Embankment Requiring Pre- loading/ Wick Drains (F ₃ = 1)			
West	1	Route W1 (Northerly Route)	6690	4240	1850	600	4.09	3.93	A ₁
	2	Route W2	6540	2190	2250	2100	3.03	2.98	A ₂
	3	Route W3	6430	3780	750	1900	3.58	3.58	A ₃
	4	Route W4	6490	3690	1000	1800	3.58	3.55	A ₄
	5	Route W5 (Southerly Route)	7740	5090	1450	1200	4.01	3.33	A ₅
Middle	N/A (Note 2)			N/A					
East	1	Route E1 (Northerly Route)	3640	3440	200	0	4.89	4.89	A ₆
	2	Route E2 (Middle Route)	4130	3870	10	250	4.75	4.19	A ₇
	3	Route E3 (Southerly Route)	3960	3700	160	100	4.82	4.43	A ₈
Easterly	N/A (Note 2)			N/A					

Notes:

Refer to notes 1 and 2 in Table F-1 for full descriptions.

Enter weighted favourability value A_i in Table F-7.



TABLE F-6 –CONSTRUCTION FEASIBILITY

ROUTE SECTIONS (Note1)	ROUTE ALTERNATIVES		STRUCTURES/EMBANKMENT REQUIRING SPECIAL CONSTRUCTION						FAVOURABILITY VALUE(A _i)		
			No of Structure Foundations		No of Major Culvert Foundations		Embankment		Weighted	Normalized	
			Shallow Foundation (F ₁ =5)	Deep Foundation (F ₂ =3)	To be Extended (F ₃ =5)	To be Constructed (F ₃ =3)	Conventional (F=5)	Special (F=1)			
West	1	Route W1 (Northerly Route)	3	5	0	0	6090	600	4.20	4.03	A ₁
	2	Route W2	2	6	0	1	4440	2100	3.80	3.73	A ₂
	3	Route W3	2	6	0	1	4530	1900	3.85	3.85	A ₃
	4	Route W4	1	7	0	1	4690	1800	3.76	3.72	A ₄
	5	Route W5 (Southerly Route)	1	7	0	1	6540	1200	4.00	3.33	A ₅
Middle	N/A (Note 2)		N/A								
East	1	Route E1 (Northerly Route)	0	4	0	0	3640	0	4.00	4.00	A ₆
	2	Route E2 (Middle Route)	0	4	0	0	3880	250	3.88	3.42	A ₇
	3	Route E3 (Southerly Route)	0	4	0	0	3860	100	3.95	3.63	A ₈
Easterly	N/A (Note 2)		N/A								

Notes:

Refer to notes 1 and 2 in Table F-1 for full descriptions.
 Enter weighted favourability value A_i in Table F-7.



TABLE F-7 – SCORING OF FOUNDATION CRITERIA

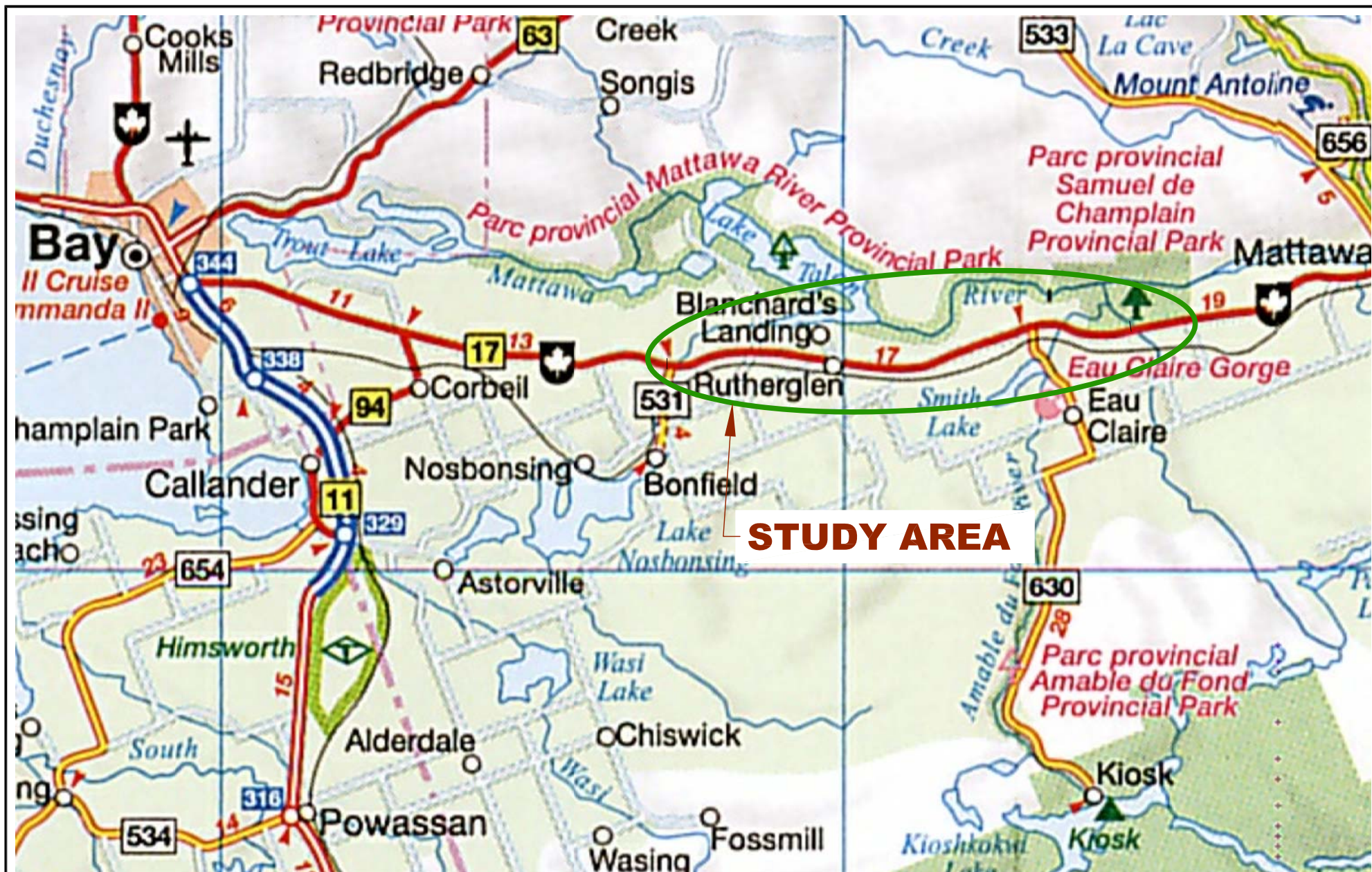
ROUTE SECTIONS (Note1)	EVALUATION CRITERIA		SOFT GROUND/ SWAMPS		GROUNDWATER CONDITIONS		STRUCTURE FOUNDATIONS		EMBANKMENT SETTLEMENT		EMBANKMENT STABILITY		CONSTRUCTION FEASIBILITY		NORMALIZED SCORE	RANKING
	TABLE NO.		F1		F2		F3		F4		F5		F6			
	IMPACT WEIGHT		0.20		0.10		0.20		0.15		0.15		0.20			
	ROUTE ALTERNATIVES		Ai	Ni	Ai	Ni	Ai	Ni	Ai	Ni	Ai	Ni	Ai	Ni		
West	1	Route W1 (Northerly Route)	2.80	1.00	2.90	1.00	3.25	1.00	2.70	1.00	3.93	1.00	4.03	1.00	5.00	1
	2	Route W2	1.60	0.57	2.53	0.87	2.67	0.82	2.29	0.84	2.98	0.76	3.73	0.93	3.95	5
	3	Route W3	2.38	0.85	2.72	0.94	2.67	0.82	2.44	0.90	3.58	0.91	3.85	0.95	4.45	2
	4	Route W4	2.34	0.84	2.72	0.94	2.47	0.76	2.71	1.00	3.55	0.90	3.72	0.92	4.42	3
	5	Route W5 (Southerly Route)	2.49	0.89	2.75	0.95	2.47	0.76	2.31	0.85	3.33	0.85	3.33	0.82	4.22	4
Middle	N/A (Note 2)		N/A													
East	1	Route E1 (Northerly Route)	3.00	1.00	3.20	1.00	2.00	1.00	3.85	1.00	4.89	1.00	4.00	1.00	5.00	1
	2	Route E2 (Middle Route)	1.71	0.57	2.93	0.92	2.00	1.00	3.38	0.88	4.19	0.86	3.42	0.85	4.19	2
	3	Route E3 (Southerly Route)	1.71	0.57	2.90	0.91	1.00	0.50	3.54	0.92	4.43	0.91	3.63	0.91	3.80	3
Easterly	N/A (Note 2)		N/A													

Notes:

Refer to notes 1 and 2 in Table F-1 for full descriptions.

Ai - Weighted Favourability Value from Tables F-1 to F-6.

Ni - Normalized Favourability Value; Normalized Score based on Ni values.



REFERENCE: THIS FIGURE WAS REPRODUCED FROM ONTARIO ROAD ATLAS 2006 EDITION BY MAPART PUBLISHING CORP.

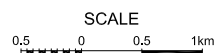
GEOCREs No.: 31L-182

LOCATION MAP

HIGHWAY 17 ROUTE PLANNING

From 0.6 km west of Highway 531 Easterly
to 8.0 km east of Highway 630, about 26.9 km
Townships of Bonfield and Calvin

METRIC

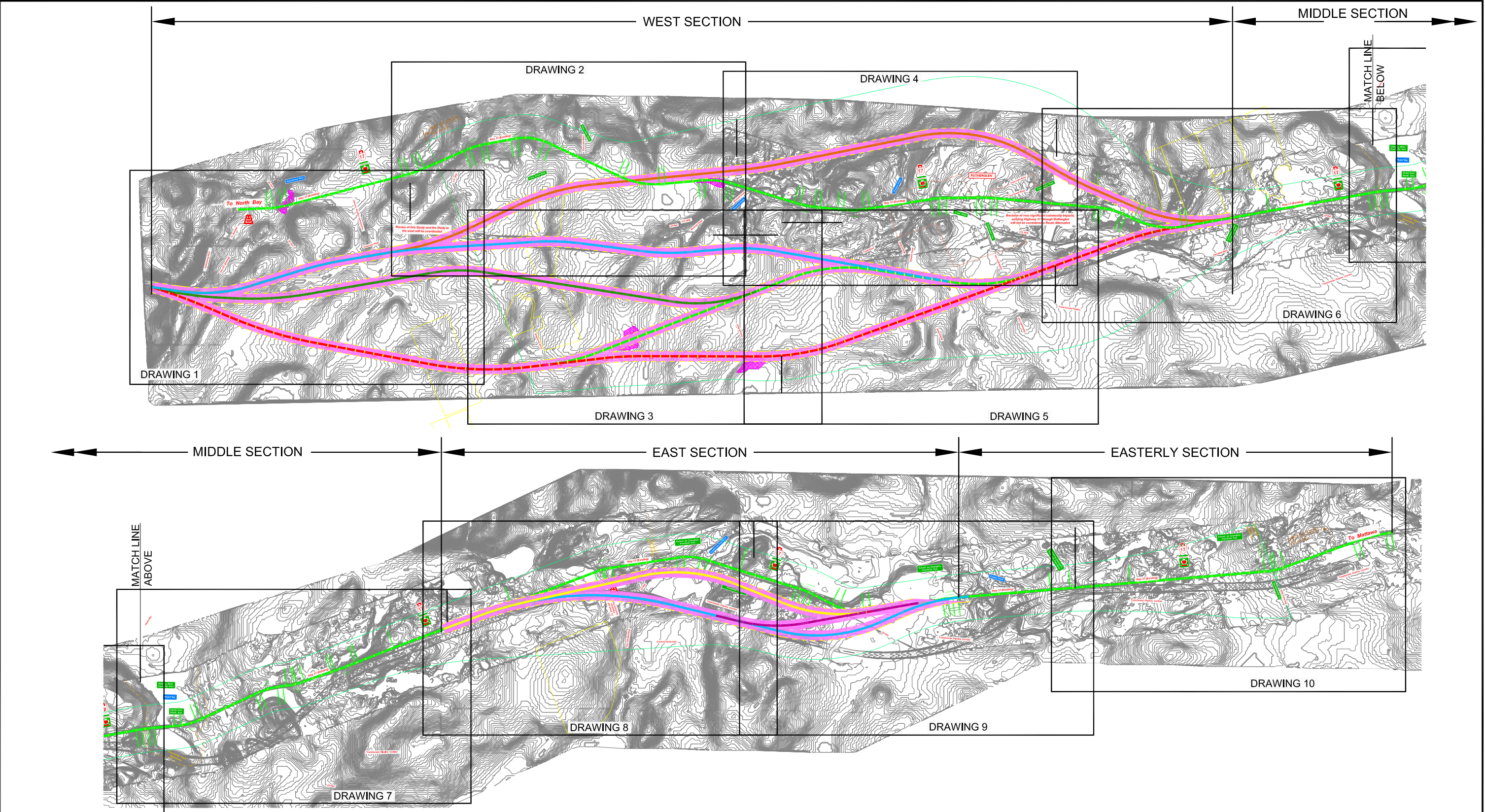


HIGHWAY 17
G.W.P. 5670-10-00



FIGURE
1

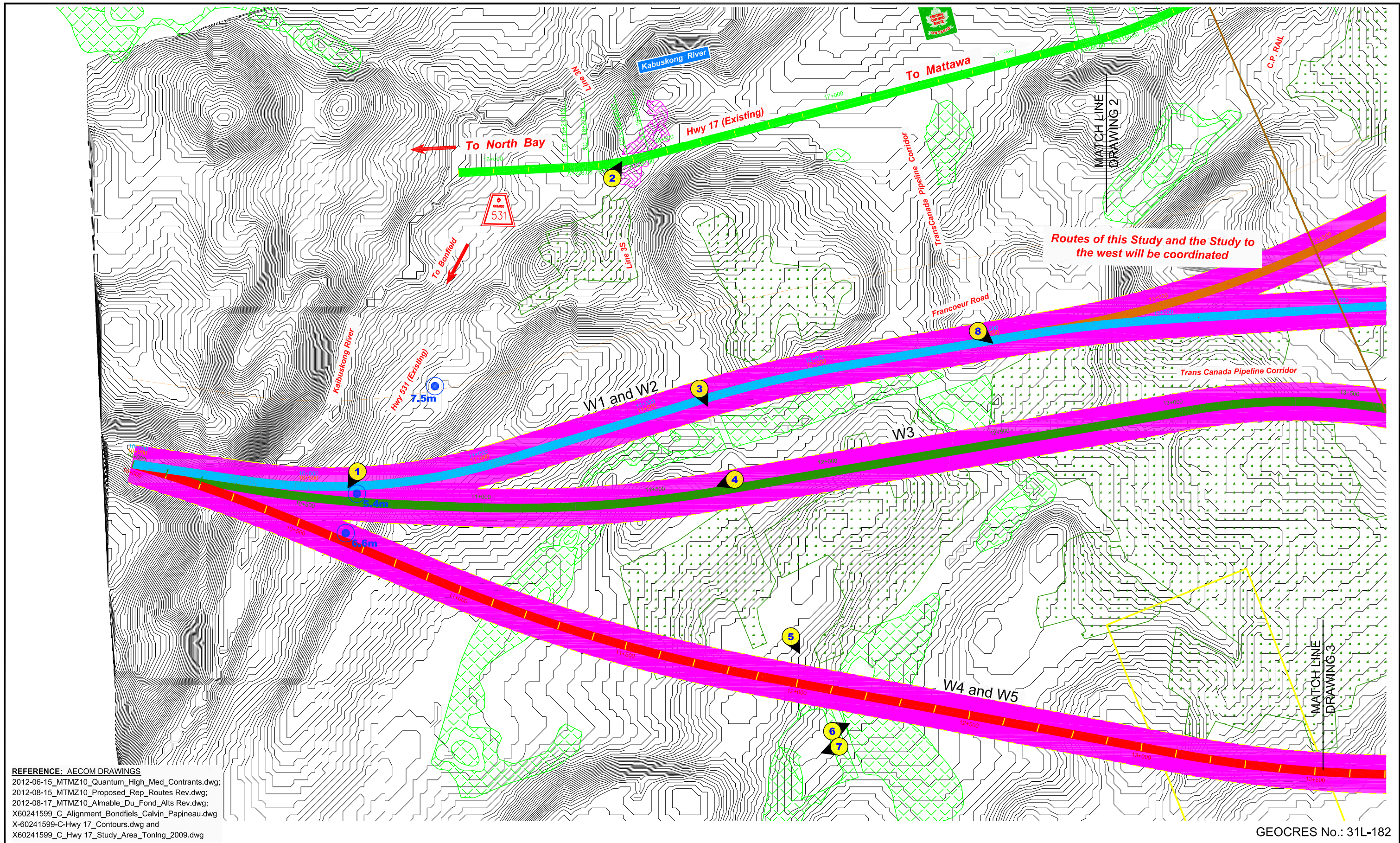
NOTES	LEGEND
<div>1. BEDROCK OUTCROPS SHOWN ON PLAN ARE BASED ON SITE RECONNAISSANCE AND AERIAL PHOTOGRAPHS. THE SYMBOLS ON THE PLANS INDICATE THE LOCAL PRESENCE OF THE BEDROCK UNIT AND DO NOT REPRESENT THE FULL EXTENT OF EACH ROCK OUTCROP.</div> <div>2. THE EXTENT OF SWAMPS, WATER BODIES AND FILL AREAS IS AS INTERPRETED FROM SITE RECONNAISSANCE AND AERIAL PHOTOGRAPHS. THE AREA'S EXTENT SHOWN ON THE PLANS REPRESENT ESTIMATES ONLY AND ACTUAL AREAS MAY VARY FROM THOSE SHOWN.</div> <div>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 AND MAY VARY SUBSTANTIALLY WITHIN THE LIMITS OF THE SWAMP.</div> <div>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.</div> <div>5. THE PLANS ARE AN ENCLOSURE TO THE ALTERNATIVE FOUNDATION ASSESSMENT STUDY PREPARED BY PETO MACCALLUM LTD. THE DATA ON THESE PLANS MUST BE READ IN CONJUNCTION WITH THE REPORT.</div> <div>6. THE DETAIL SHOWN ON THE PLANS IS CONSIDERED APPROPRIATE FOR ALTERNATIVE ROUTE SELECTION PURPOSES. WHEN THE PREFERRED ALTERNATIVE HAVE BEEN SELECTED, A SUBSURFACE INVESTIGATION SHOULD BE UNDERTAKEN TO DELINEATE THE SITE SPECIFIC STRATIGRAPHIC CONDITIONS FOR PRELIMINARY AND DETAILED DESIGN PURPOSES.</div>	<div><div><div><div></div><div>HIGHWAY 17 (EXISTING)</div></div><div><div></div><div>ALTERNATIVE W1</div></div><div><div></div><div>ALTERNATIVE W2</div></div><div><div></div><div>ALTERNATIVE W3</div></div><div><div></div><div>ALTERNATIVE W4</div></div><div><div></div><div>ALTERNATIVE W5</div></div><div><div></div><div>ALTERNATIVE E1</div></div><div><div></div><div>ALTERNATIVE E2</div></div><div><div></div><div>ALTERNATIVE E3</div></div></div><div><div><div></div><div>WEST SECTION</div></div><div><div></div><div>EAST SECTION</div></div></div><div><div><div></div><div>BEDROCK OUTCROP (R O/C)</div></div><div><div></div><div>SOFT GROUND / SWAMP</div></div><div><div></div><div>AGRICULTURAL AREA</div></div><div><div></div><div>WATER BODY</div></div><div><div><div></div><div>40</div></div><div>PHOTOGRAPH NUMBER (ARROW SHOWS DIRECTION OF VIEW)</div></div><div><div><div></div><div>5.4m</div></div><div>MOE WATER WELL RECORD (DEPTH TO BEDROCK)</div></div></div></div>



REFERENCE AECOM DRAWINGS :
X-60241599-C-Alignment_Bondfield_Calvin_Papineau.dwg ;
2012-06-15_MTMZ10_Quantum_High_Med_Constraints.dwg ;
2012-08-15_MTMZ10_Proposed_Rep_Routes Rev.dwg ;
2012-08-17_MTMZ10_Almable_Du_Fond_Alts Rev.dwg ;
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GEOCRES No.: 31L-182

<div data-bbox="708 1798 1268 1878" data-label="Section-Header"><p>KEY MAP HIGHWAY 17 - ROUTE PLANNING</p></div> <div data-bbox="491 1884 1485 1945" data-label="Text"><p>From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km Townships of Bonfield, Calvin and Papineau-Cameron</p></div> <div data-bbox="254 1919 379 1959" data-label="Text"><p>METRIC</p></div> <div data-bbox="1609 1818 2026 1951" data-label="Figure"><p>PLAN SCALE</p></div>	<div data-bbox="2088 1778 2368 1951" data-label="Image"></div>	<div data-bbox="2449 1790 2896 1858" data-label="Image"></div> <div data-bbox="2554 1891 2790 1951" data-label="Text"><p>HIGHWAY 17 GWP No. 5670-10-00</p></div>	<div data-bbox="2958 1778 3052 1870" data-label="Image"></div> <div data-bbox="2958 1878 3052 1951" data-label="Text"><p>DRAWING B</p></div>
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Site Reconnaissance Details, Water Well and Photograph Locations
HIGHWAY 17 ROUTE PLANNING

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Townships of Bonfield

METRIC

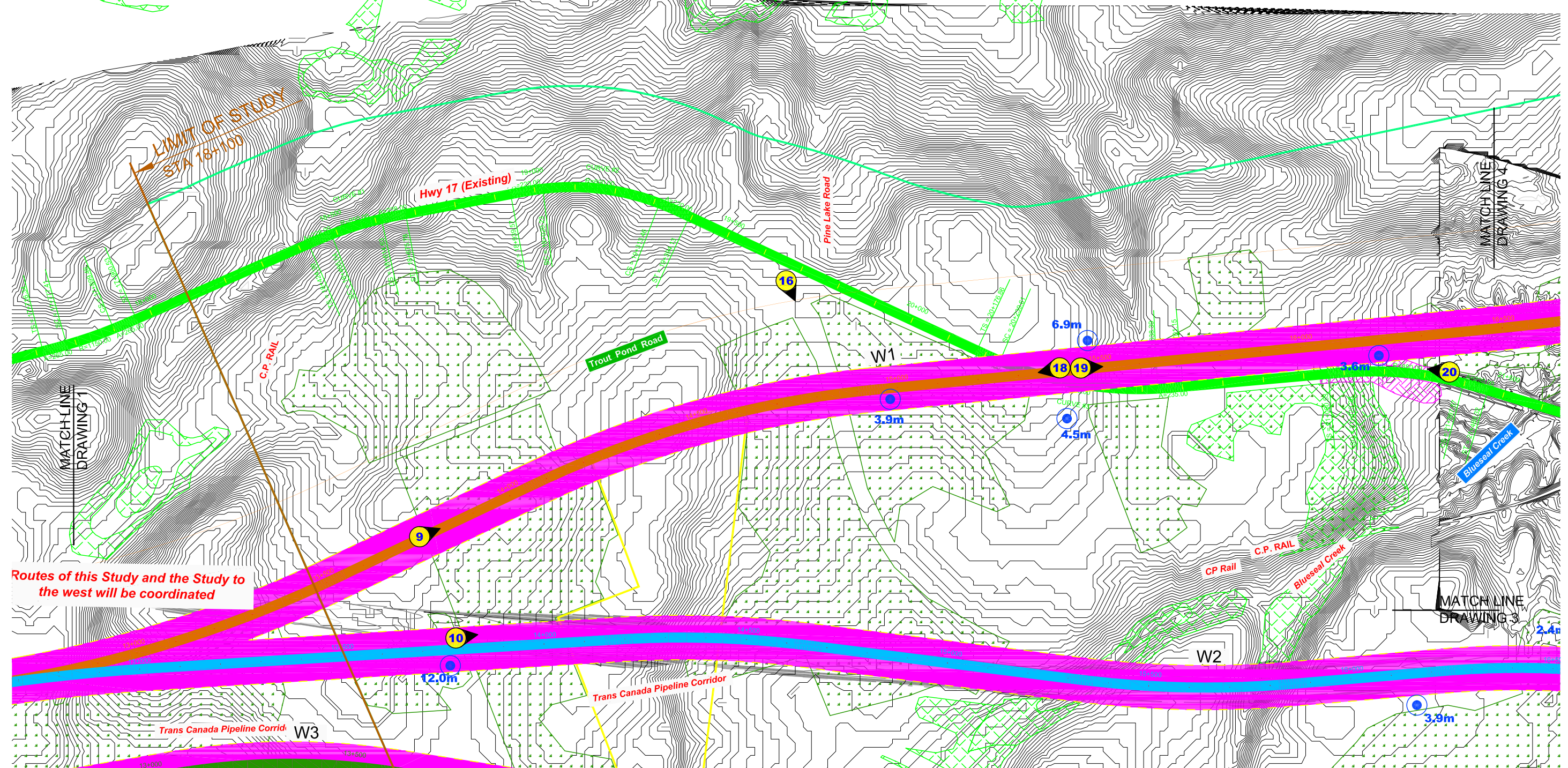


HIGHWAY 17
GWP No. 5670-10-00



DRAWING
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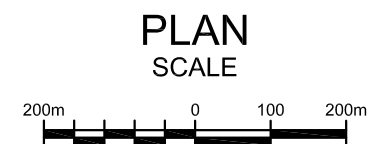


GEOCRES No.: 31L-182

Site Reconnaissance Details, Water Well and Photograph Locations HIGHWAY 17 ROUTE PLANNING

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Townships of Bonfield

METRIC

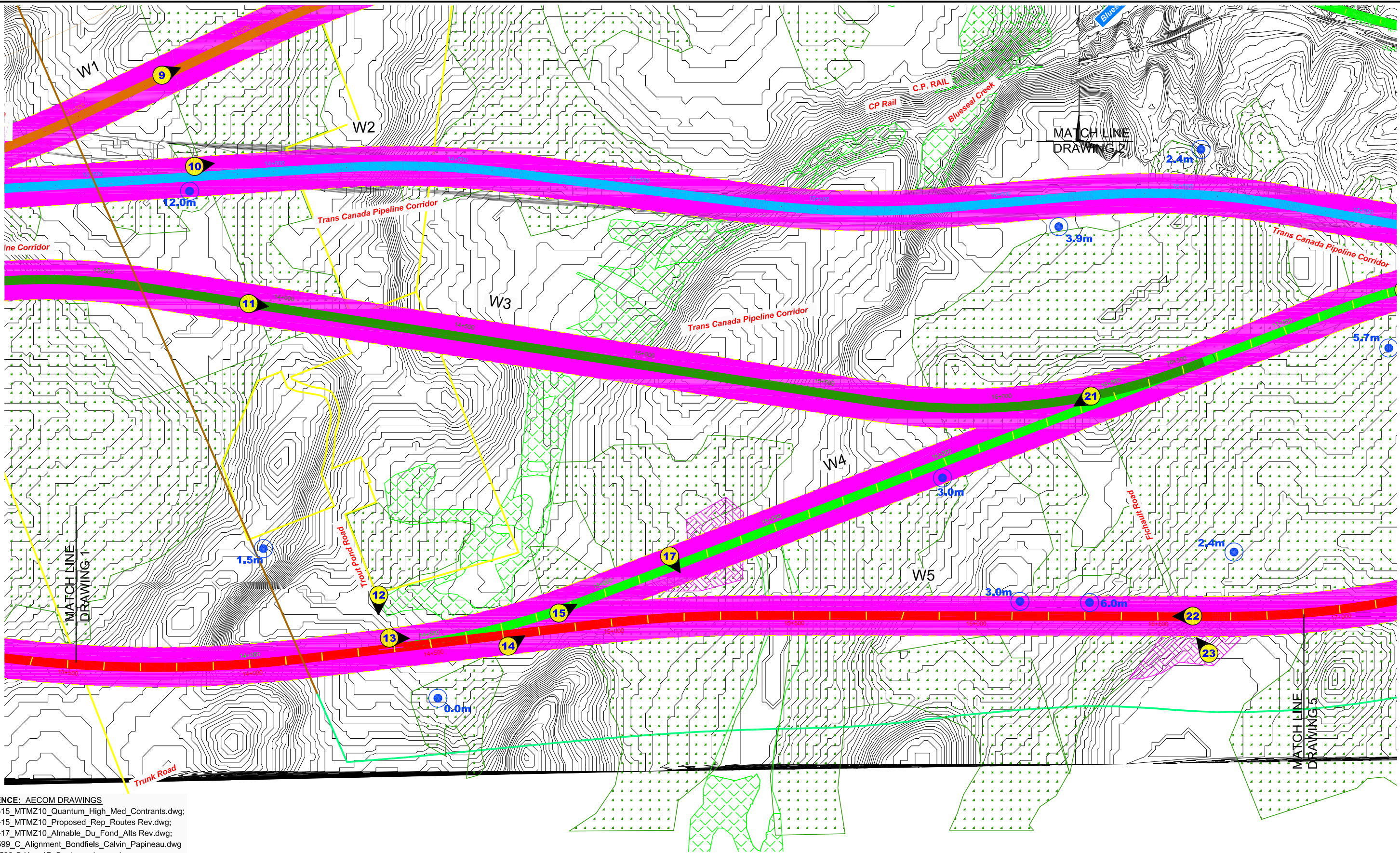


HIGHWAY 17
GWP No. 5670-10-00



DRAWING

2



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X60241599_C_Hwy 17_Study_Area_Toning_2009.dwg

GEOCRES No.: 31L-182

Site Reconnaissance Details, Water Well and Photograph Locations HIGHWAY 17 ROUTE PLANNING

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Townships of Bonfield

METRIC

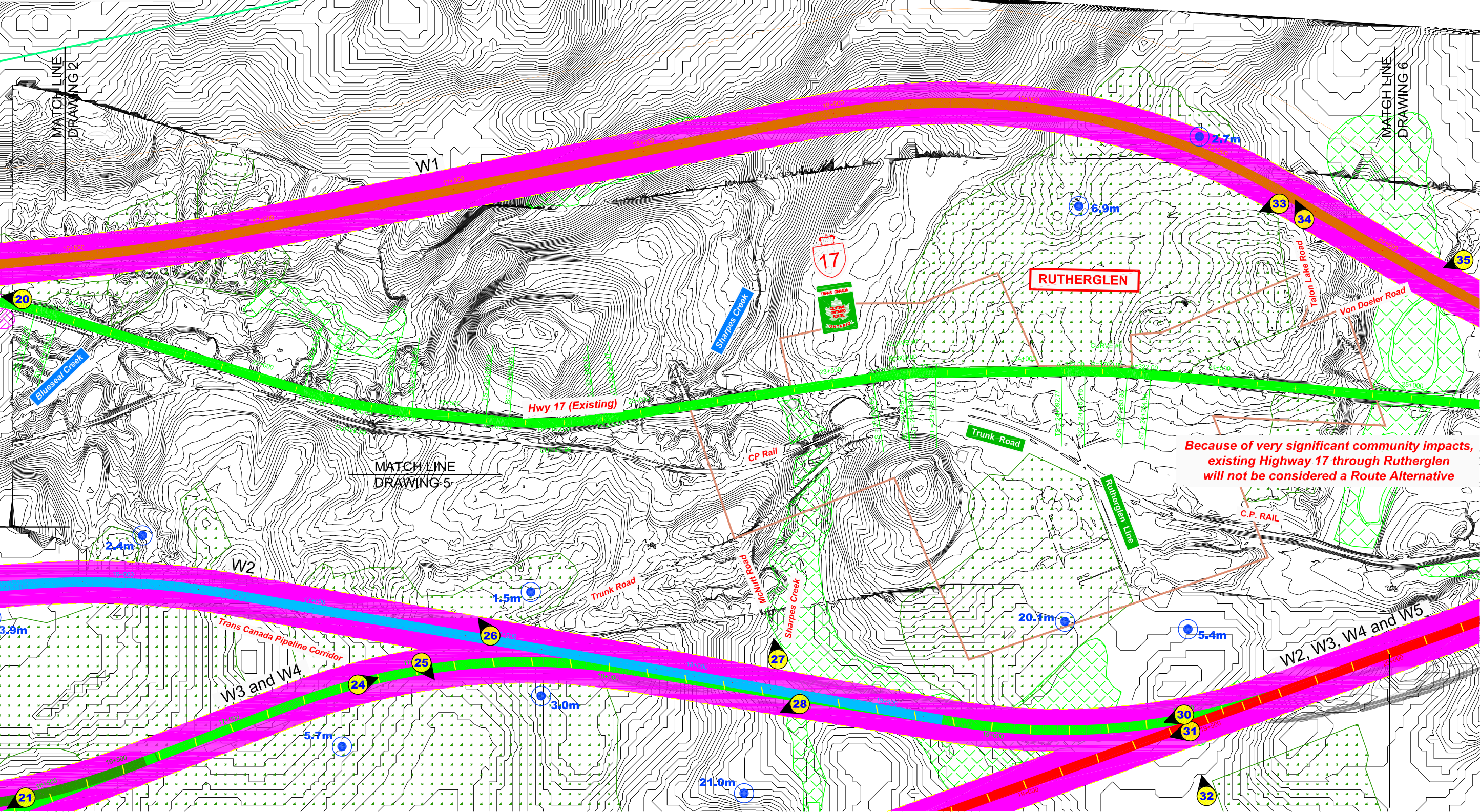


HIGHWAY 17
GWP No. 5670-10-00



DRAWING
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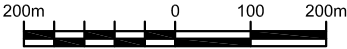
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Site Reconnaissance Details, Water Well and Photograph Locations
HIGHWAY 17 ROUTE PLANNING

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Township of Bonfield

METRIC

PLAN
SCALE

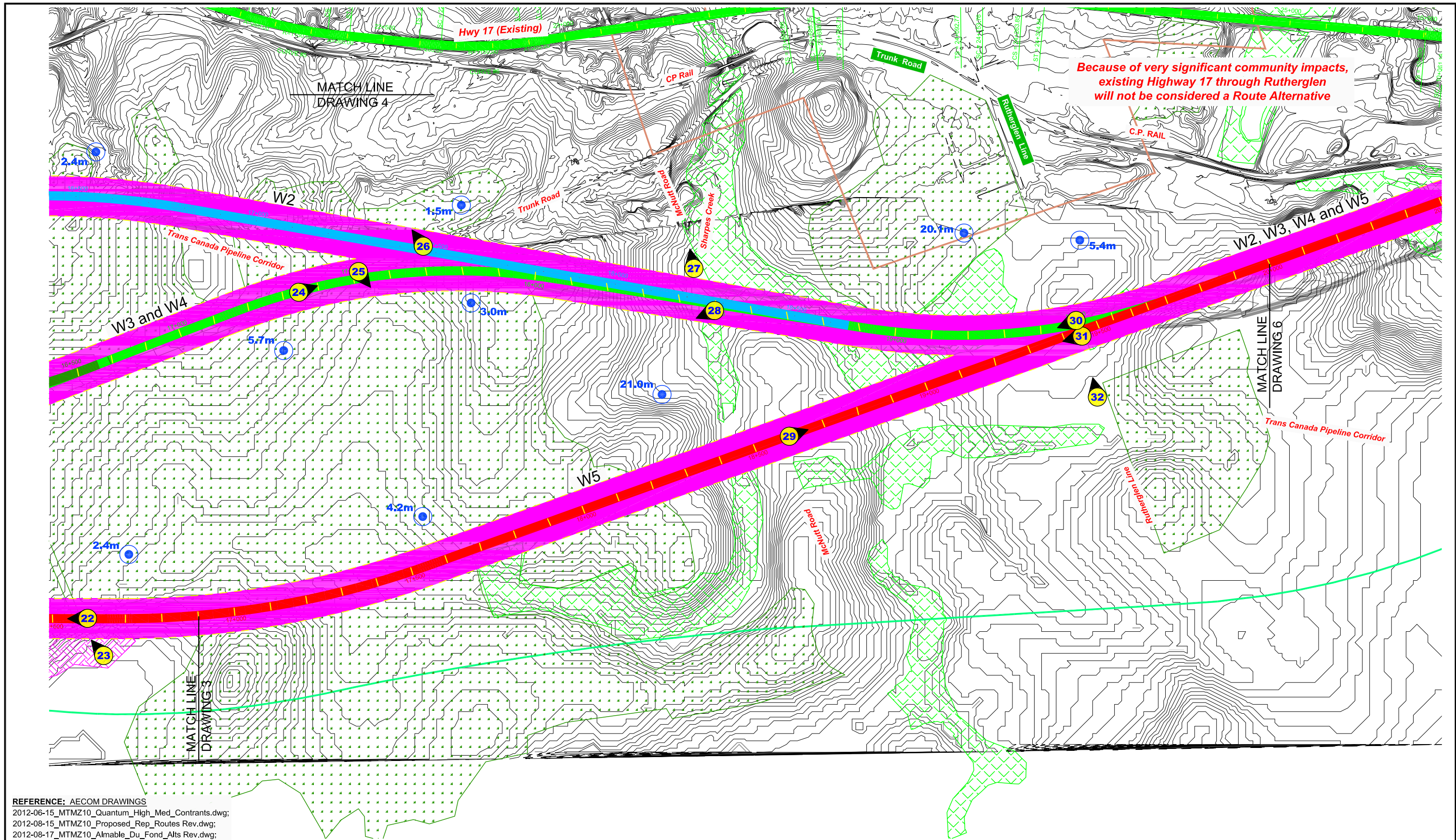


HIGHWAY 17
GWP No. 5670-10-00



DRAWING

4



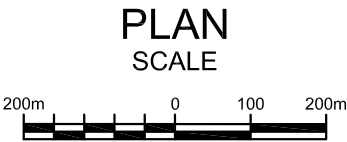
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GEOCRES No.: 31L-182

Site Reconnaissance Details, Water Well and Photograph Locations
HIGHWAY 17 ROUTE PLANNING

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Townships of Bonfield and Calvin

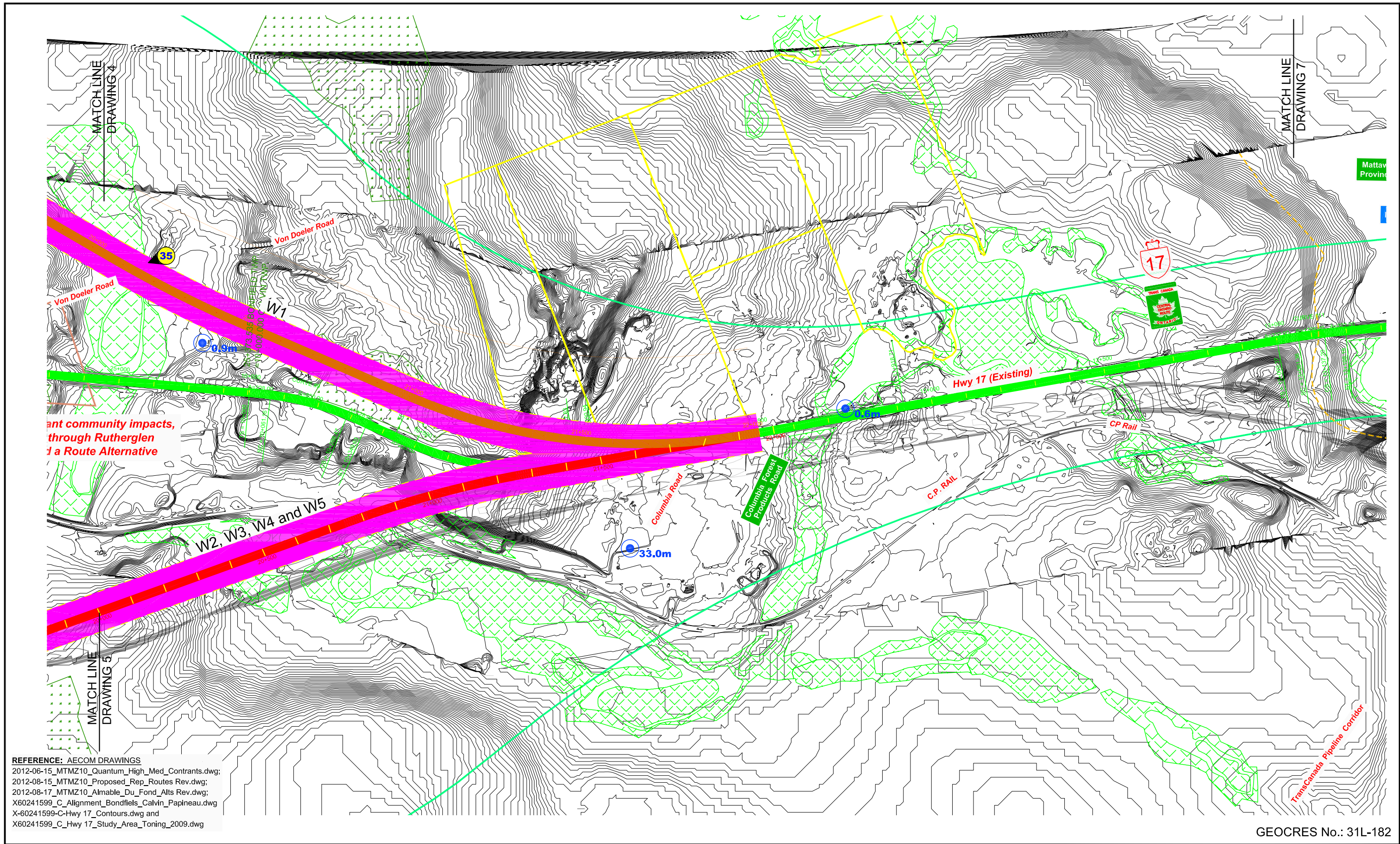
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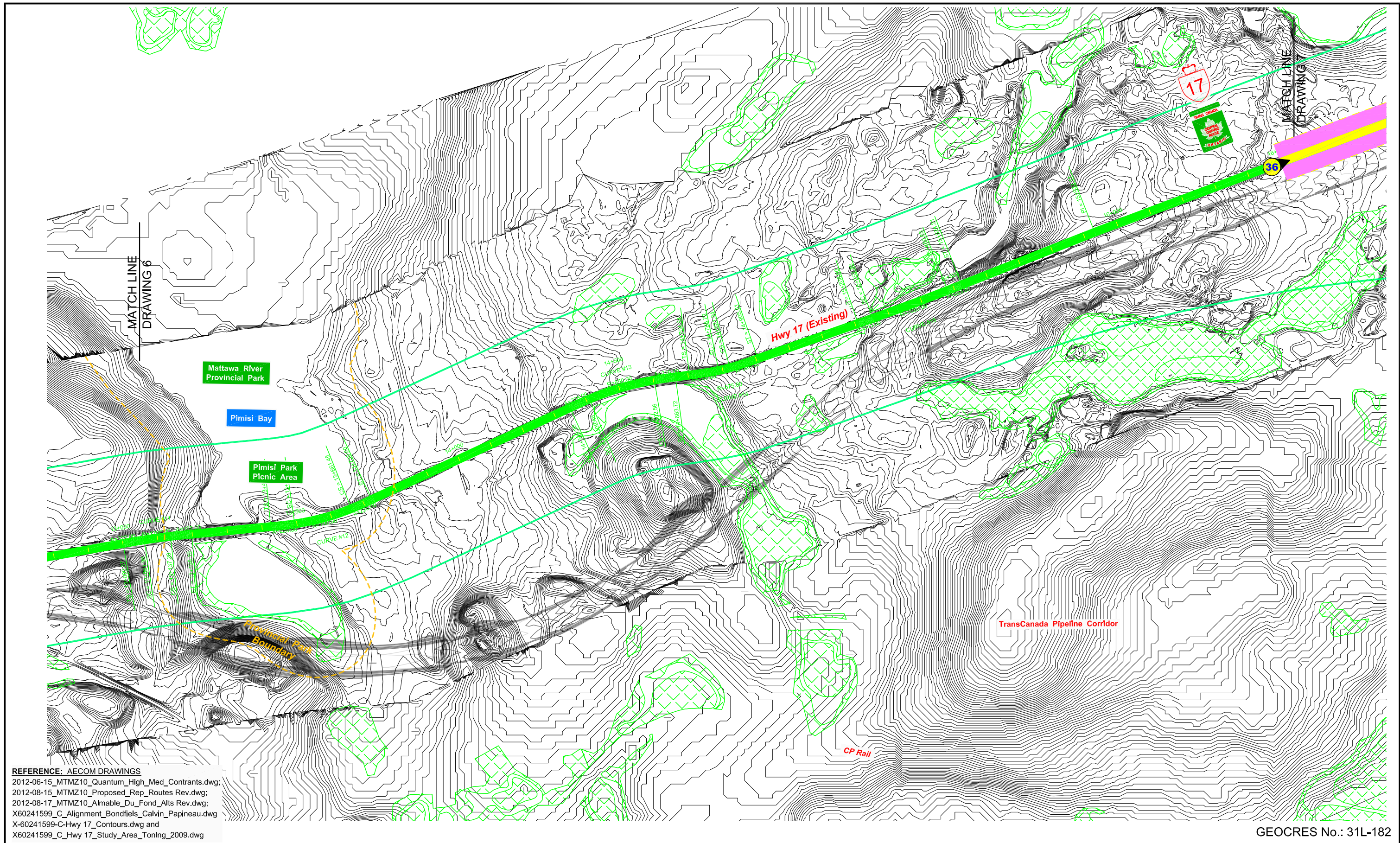


HIGHWAY 17
GWP No. 5670-10-00



DRAWING
5





GEOCRES No.: 31L-182

Site Reconnaissance Details, Water Well and Photograph Locations
HIGHWAY 17 ROUTE PLANNING

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Township of Calvin

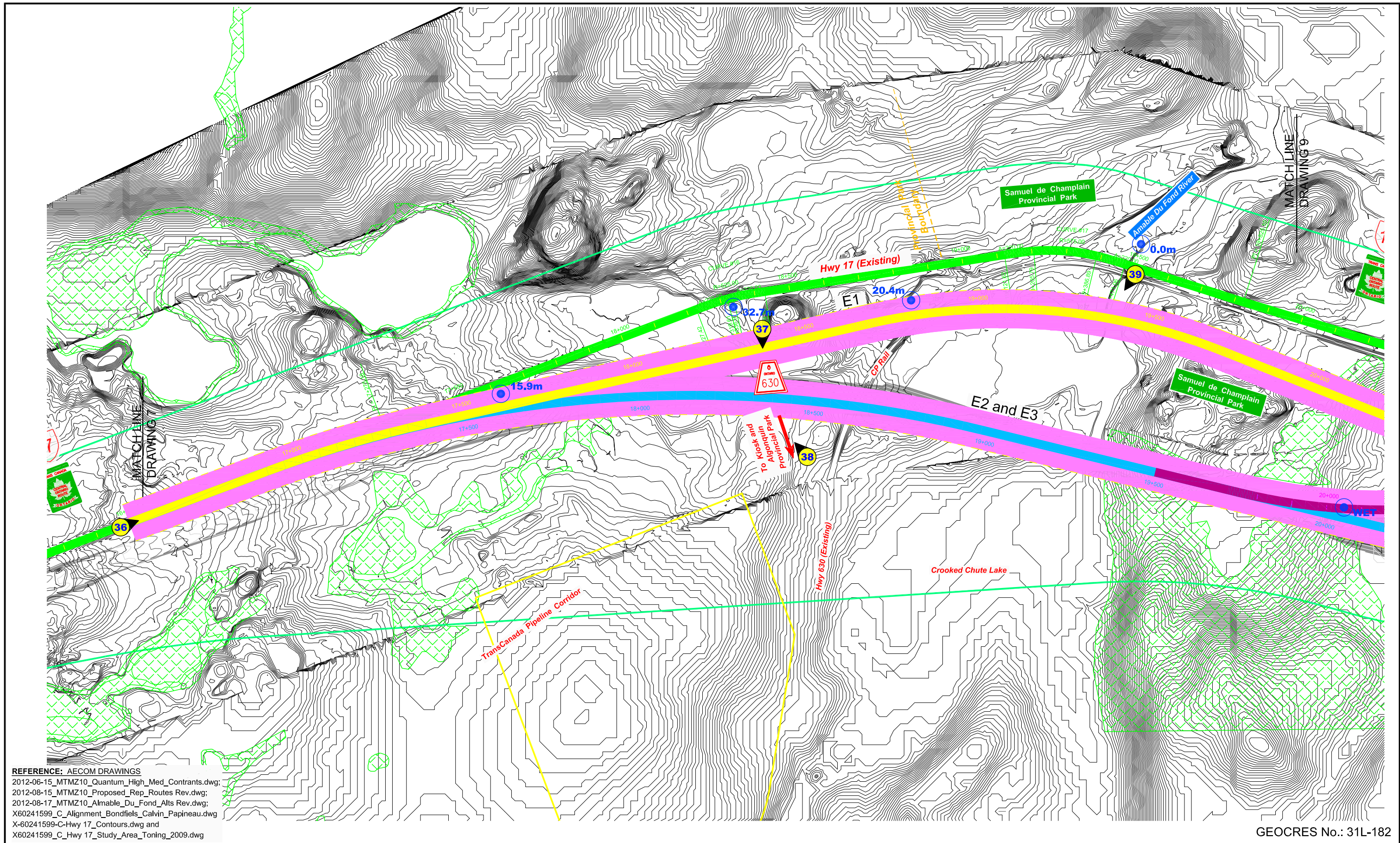
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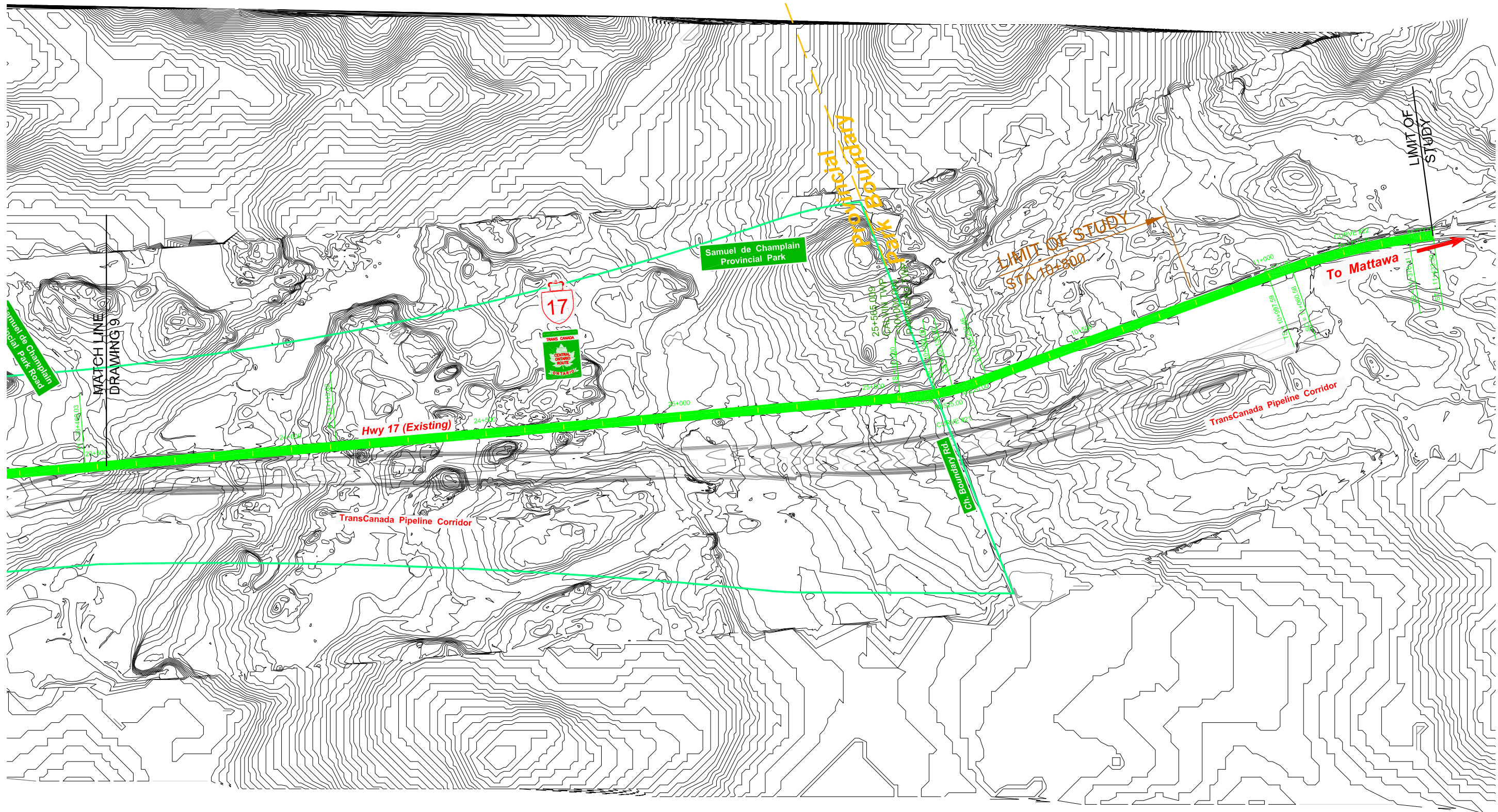


HIGHWAY 17
GWP No. 5670-10-00



DRAWING
7





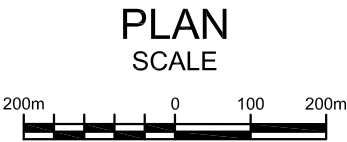
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X60241599_C_Hwy 17_Study_Area_Toning_2009.dwg

GEOCRES No.: 31L-182

Site Reconnaissance Details, Water Well and Photograph Locations
HIGHWAY 17 ROUTE PLANNING

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Townships of Calvin and Papineau-Cameron

METRIC






HIGHWAY 17
GWP No. 5670-10-00

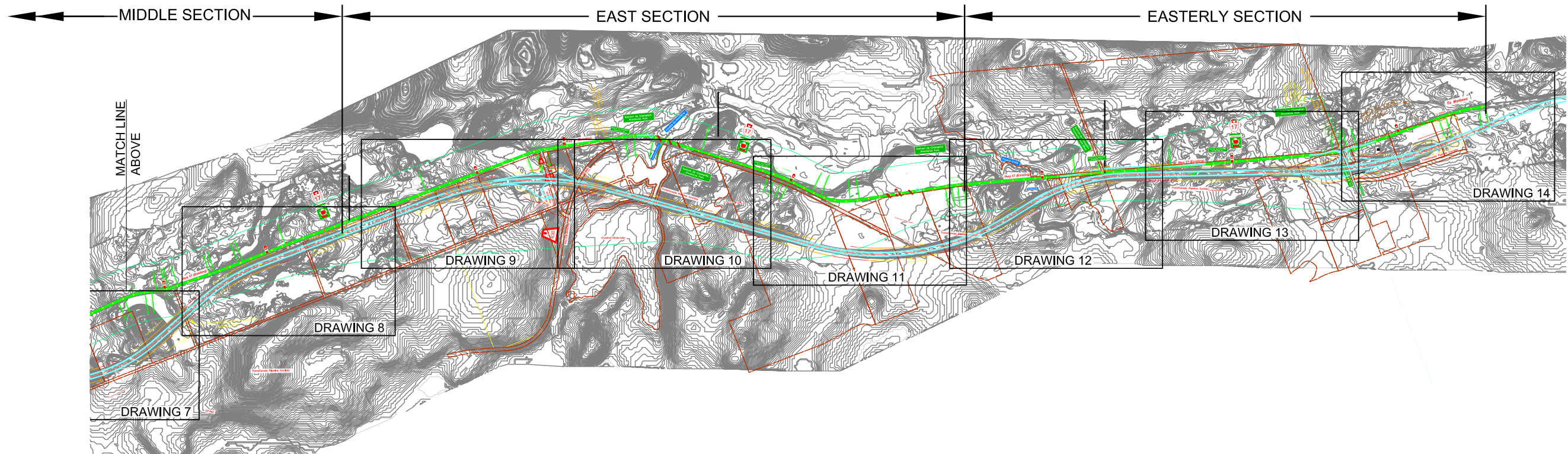
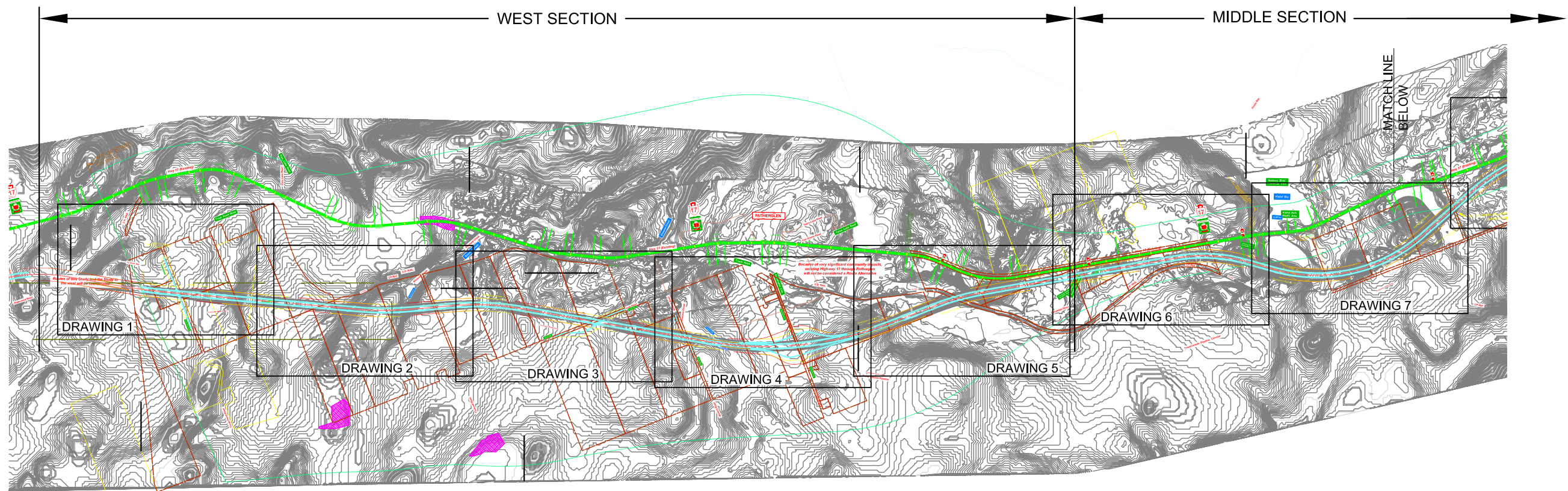


DRAWING
10

<div>1. BEDROCK OUTCROPS SHOWN ON PLAN 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.</div> <div>2. THE EXTENT OF SWAMPS, WATER BODIES AND FILL AREAS IS AS INTERPRETED FROM SITE RECONNAISSANCE AND AERIAL PHOTOGRAPHS AND AS SHOWN ON THE PLANS ARE REPRESENTATIVE ESTIMATES ONLY. ACTUAL AREAS MAY VARY FROM THOSE SHOWN.</div> <div>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 AND MAY VARY SUBSTANTIALLY WITHIN THE LIMITS OF THE SWAMP.</div> <div>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.</div> <div>5. THE PLANS ARE AN ENCLOSURE TO THE PREFERRED ALIGNMENT FOUNDATION ASSESSMENT STUDY PREPARED BY PETO MACCALLUM LTD. THE DATA ON THESE PLANS MUST BE READ IN CONJUNCTION WITH THE REPORT.</div> <div>6. THE DETAIL SHOWN ON THE PLANS IS CONSIDERED APPROPRIATE FOR PLANNING PURPOSES. A SUBSURFACE INVESTIGATION SHOULD BE UNDERTAKEN TO DELINEATE THE SITE SPECIFIC STRATIGRAPHIC CONDITIONS FOR PRELIMINARY AND DETAILED DESIGN PURPOSES.</div> <div>.</div>	<div><div><div><div></div></div><div>HIGHWAY 17 (EXISTING)</div></div><div><div><div></div></div><div>HIGHWAY 17 - (PREFERRED) ALIGNMENT</div></div></div> <div><div><div></div><div>BEDROCK OUTCROP (R O/C)</div></div><div><div></div><div>SOFT GROUND / SWAMP</div></div><div><div></div><div>AGRICULTURAL AREA</div></div><div><div></div><div>WATER BODY</div></div><div><div><div></div><div>40</div></div><div>PHOTOGRAPH NUMBER (ARROW SHOWS DIRECTION OF VIEW)</div></div><div><div><div></div><div>5.4m</div></div><div>MOE WATER WELL RECORD (DEPTH TO BEDROCK)</div></div></div>

GEOCRES No.: 31L-182

METRIC	<div>Notes and Legend</div> <div>HIGHWAY 17 - PREFERRED ALIGNMENT</div> <div>From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km</div> <div>Townships of Bonfield, Calvin and Papineau-Cameron</div>	<div><div> Ontario</div><div></div></div>	<div><div></div><div><div>HIGHWAY 17</div><div>GWP No. 5670-10-00</div></div></div>	
			DRAWING	PA



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 X-60241599-C-Hwy 17_PDR_Recommended Design.dwg and
 X-60241599-C-Hwy 17_Contours.dwg

GEOCRES No.: 31L-182

KEY MAP HIGHWAY 17 - PREFERRED ALIGNMENT

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
 Townships of Bonfield, Calvin and Papineau-Cameron

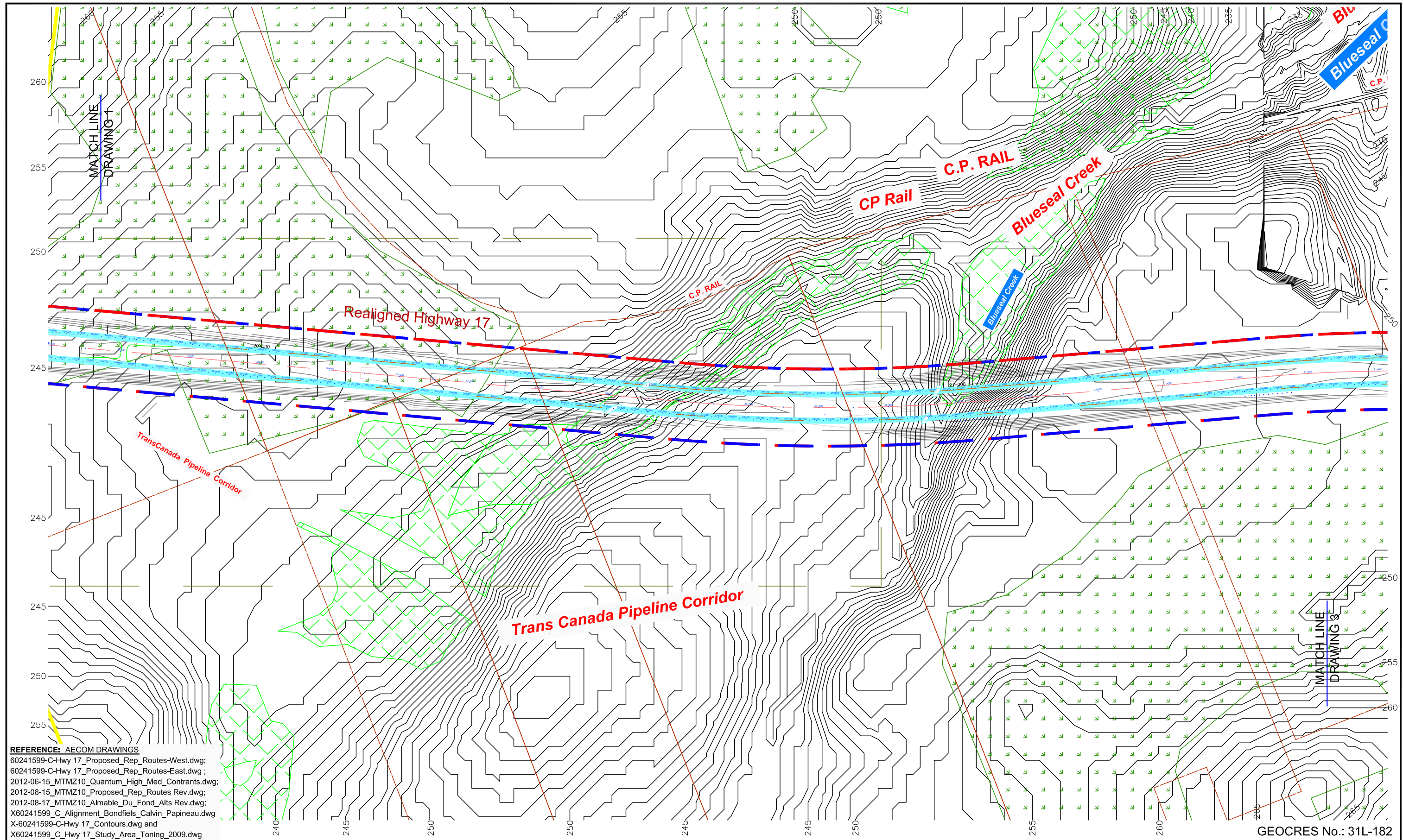
METRIC



HIGHWAY 17
GWP No. 5670-10-00



DRAWING
PB



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X60241599_C_Alignment_Bondfields_Calvin_Papineau.dwg
X-60241599-C-Hwy 17_Contours.dwg and
X60241599_C_Hwy 17_Study_Area_Toning_2009.dwg

GEOCRES No.: 31L-182

Site Reconnaissance Details, Water Well and Photograph Locations HIGHWAY 17 - PREFERRED ALIGNMENT

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Township of Bonfield

PLAN
SCALE

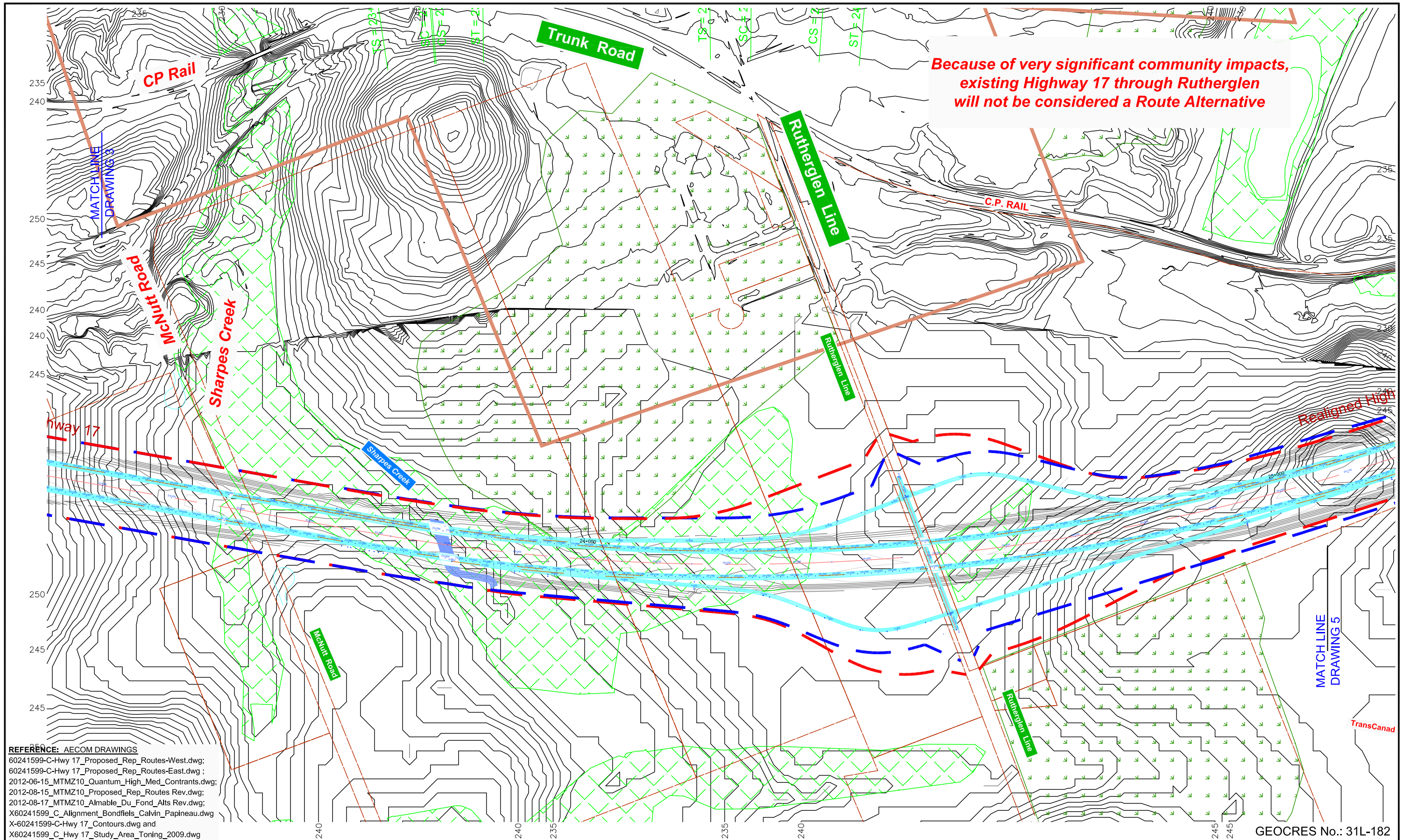


HIGHWAY 17
GWP No. 5670-10-00



DRAWING
P2

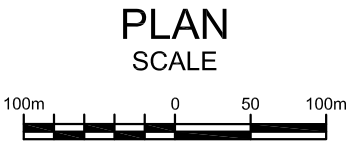
METRIC



Site Reconnaissance Details, Water Well and Photograph Locations
HIGHWAY 17 - PREFERRED ALIGNMENT

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Township of Bonfield

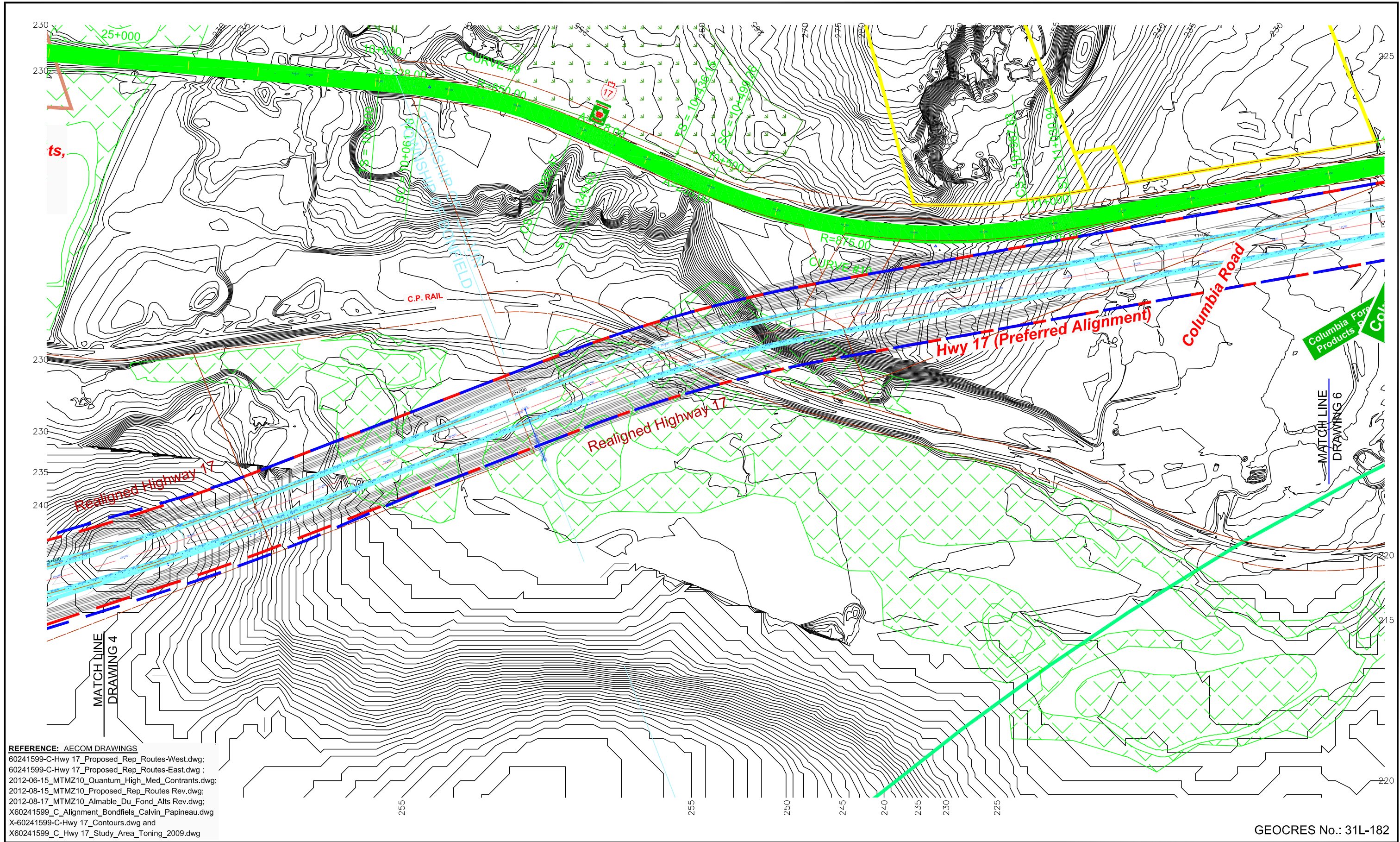
METRIC



HIGHWAY 17
GWP No. 5670-10-00



DRAWING
P4



GEOCRES No.: 31L-182

**Site Reconnaissance Details, Water Well and Photograph Locations
HIGHWAY 17 - PREFERRED ALIGNMENT**

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Townships of Bonfield and Calvin

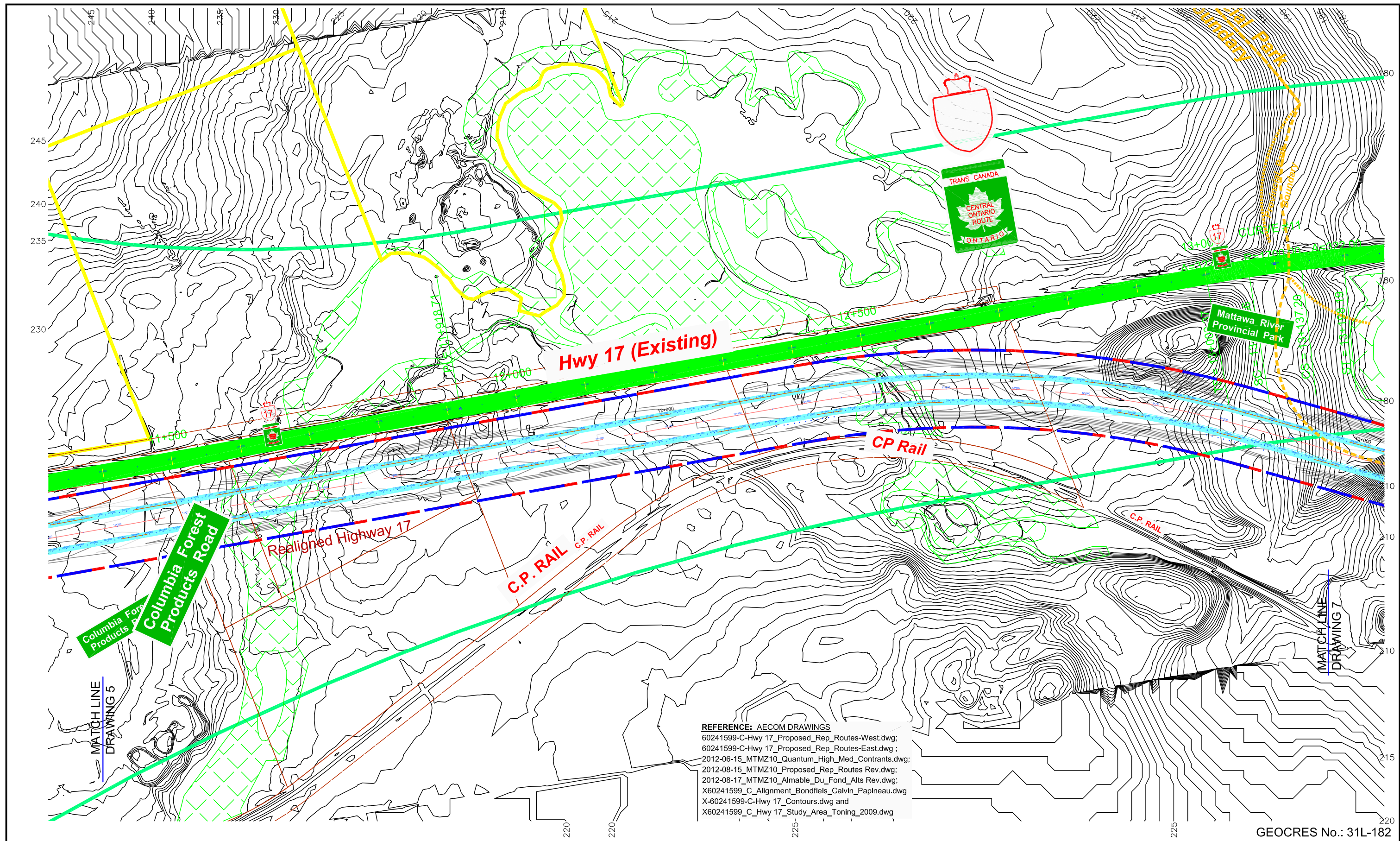
METRIC



HIGHWAY 17
GWP No. 5670-10-00



DRAWING
P5



REFERENCE: AECOM DRAWINGS
60241599-C-Hwy 17_Proposed_Rep_Routes-West.dwg;
60241599-C-Hwy 17_Proposed_Rep_Routes-East.dwg ;
2012-06-15_MTMZ10_Quantum_High_Med_Contrants.dwg;
2012-08-15_MTMZ10_Proposed_Rep_Routes Rev.dwg;
2012-08-17_MTMZ10_Almable_Du_Fond_Altis Rev.dwg;
X60241599_C_Alignment_Bondfields_Calvin_Papineau.dwg
X-60241599-C-Hwy 17_Contours.dwg and
X60241599_C_Hwy 17_Study_Area_Toning_2009.dwg

GEOCREs No.: 31L-182

Site Reconnaissance Details, Water Well and Photograph Locations
HIGHWAY 17 - PREFERRED ALIGNMENT

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Township of Calvin

METRIC

PLAN
SCALE

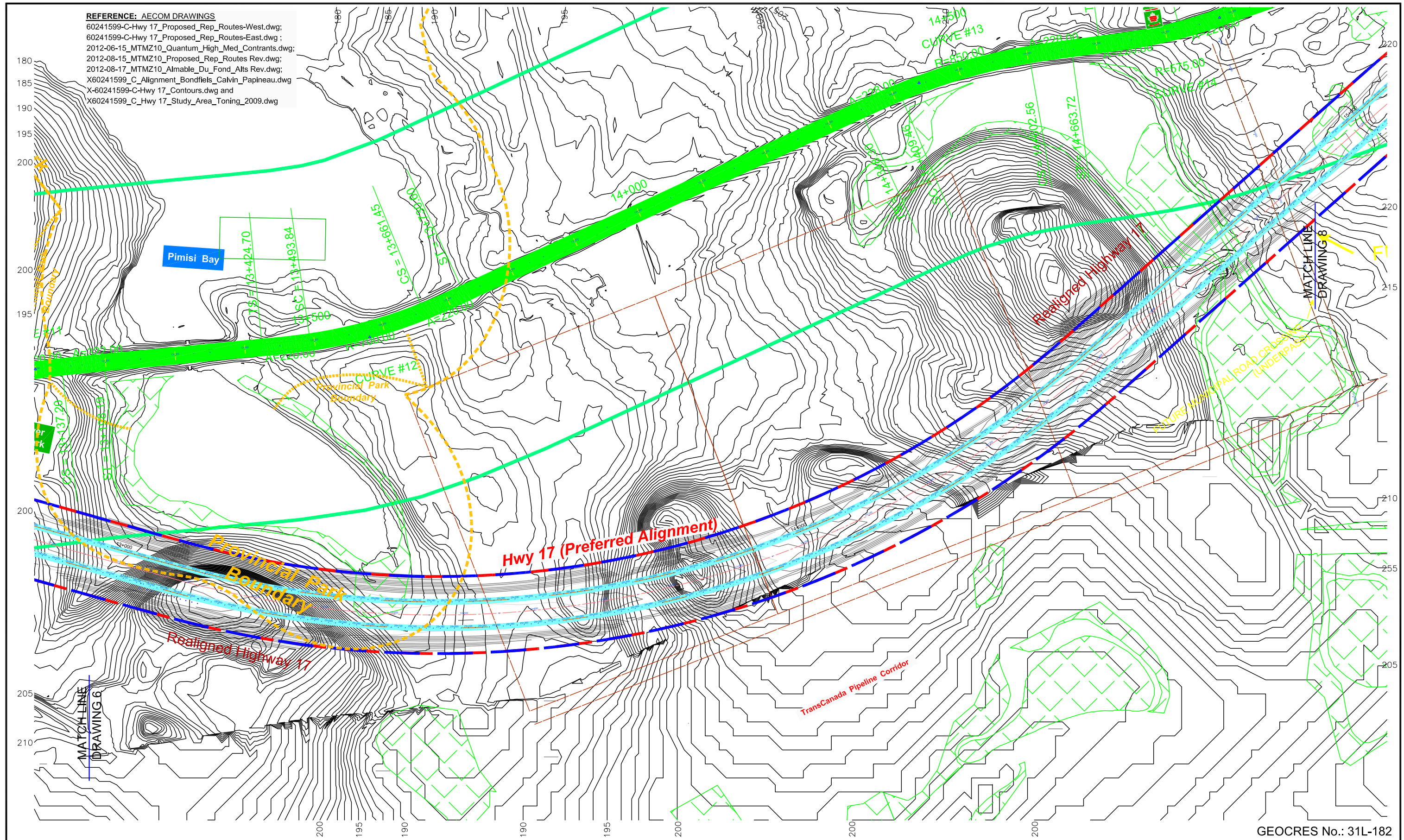


HIGHWAY 17
GWP No. 5670-10-00



DRAWING
P6

REFERENCE: AECOM DRAWINGS
60241599-C-Hwy 17_Proposed_Rep_Routes-West.dwg;
60241599-C-Hwy 17_Proposed_Rep_Routes-East.dwg;
2012-06-15_MTMZ10_Quantum_High_Med_Contrants.dwg;
2012-08-15_MTMZ10_Proposed_Rep_Routes Rev.dwg;
2012-08-17_MTMZ10_Almable_Du_Fond_Altis Rev.dwg;
X60241599_C_Alignment_Bondfields_Calvin_Papineau.dwg
X-60241599-C-Hwy 17_Contours.dwg and
X60241599_C_Hwy 17_Study_Area_Toning_2009.dwg

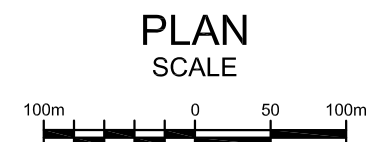


GEOCREs No.: 31L-182

Site Reconnaissance Details, Water Well and Photograph Locations HIGHWAY 17 - PREFERRED ALIGNMENT

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Township of Calvin

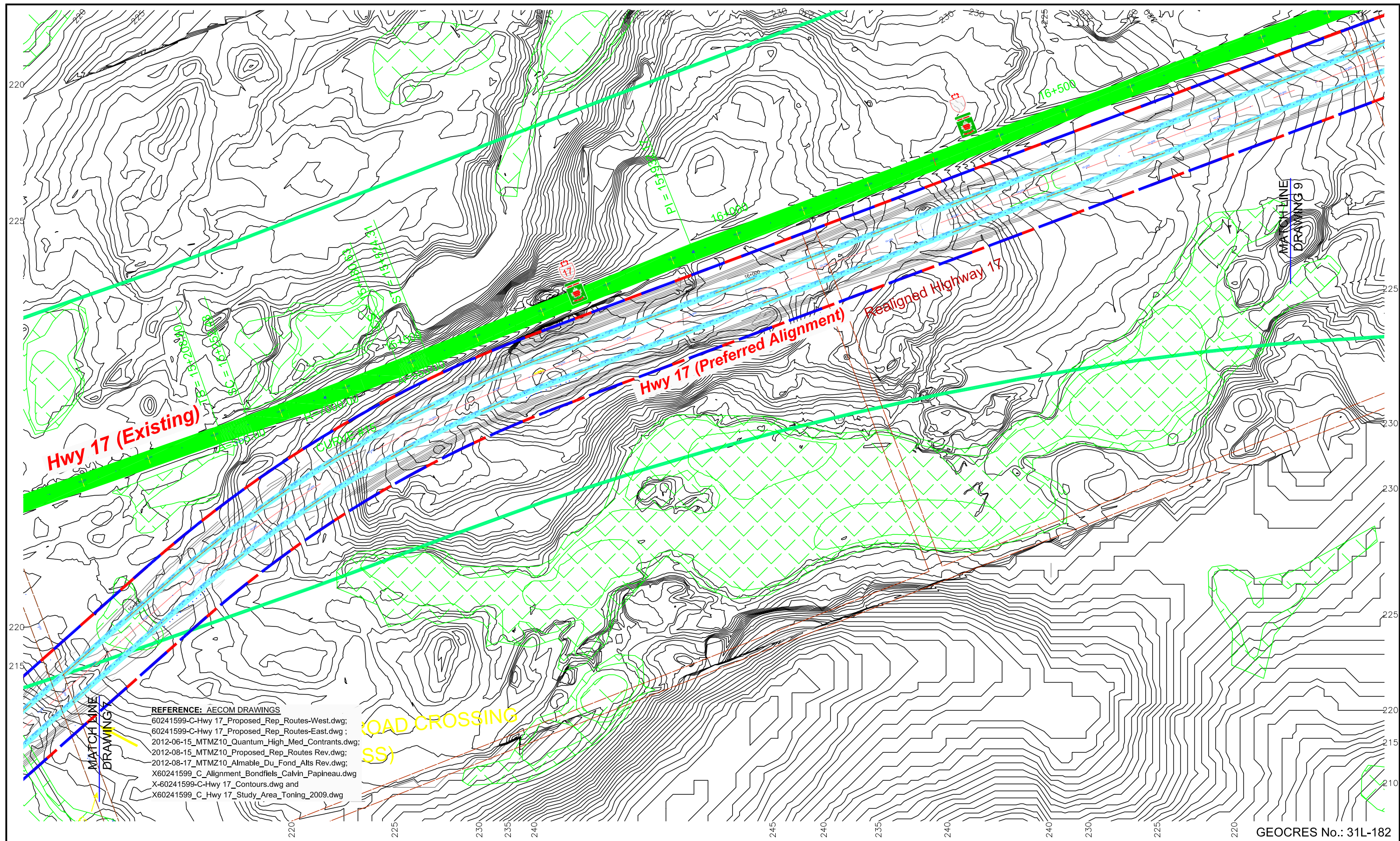
METRIC



HIGHWAY 17
GWP No. 5670-10-00



DRAWING
P7



REFERENCE: AECOM DRAWINGS
60241599-C-Hwy 17_Proposed_Rep_Routes-West.dwg;
60241599-C-Hwy 17_Proposed_Rep_Routes-East.dwg ;
2012-06-15_MTMZ10_Quantum_High_Med_Contrants.dwg;
2012-08-15_MTMZ10_Proposed_Rep_Routes Rev.dwg;
2012-08-17_MTMZ10_Almable_Du_Fond_Alts Rev.dwg;
X60241599_C_Alignment_Bondfields_Calvin_Papineau.dwg
X-60241599-C-Hwy 17_Contours.dwg and
X60241599_C_Hwy 17_Study_Area_Toning_2009.dwg

GEOCRES No.: 31L-182

Site Reconnaissance Details, Water Well and Photograph Locations
HIGHWAY 17 - PREFERRED ALIGNMENT

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Township of Calvin

METRIC

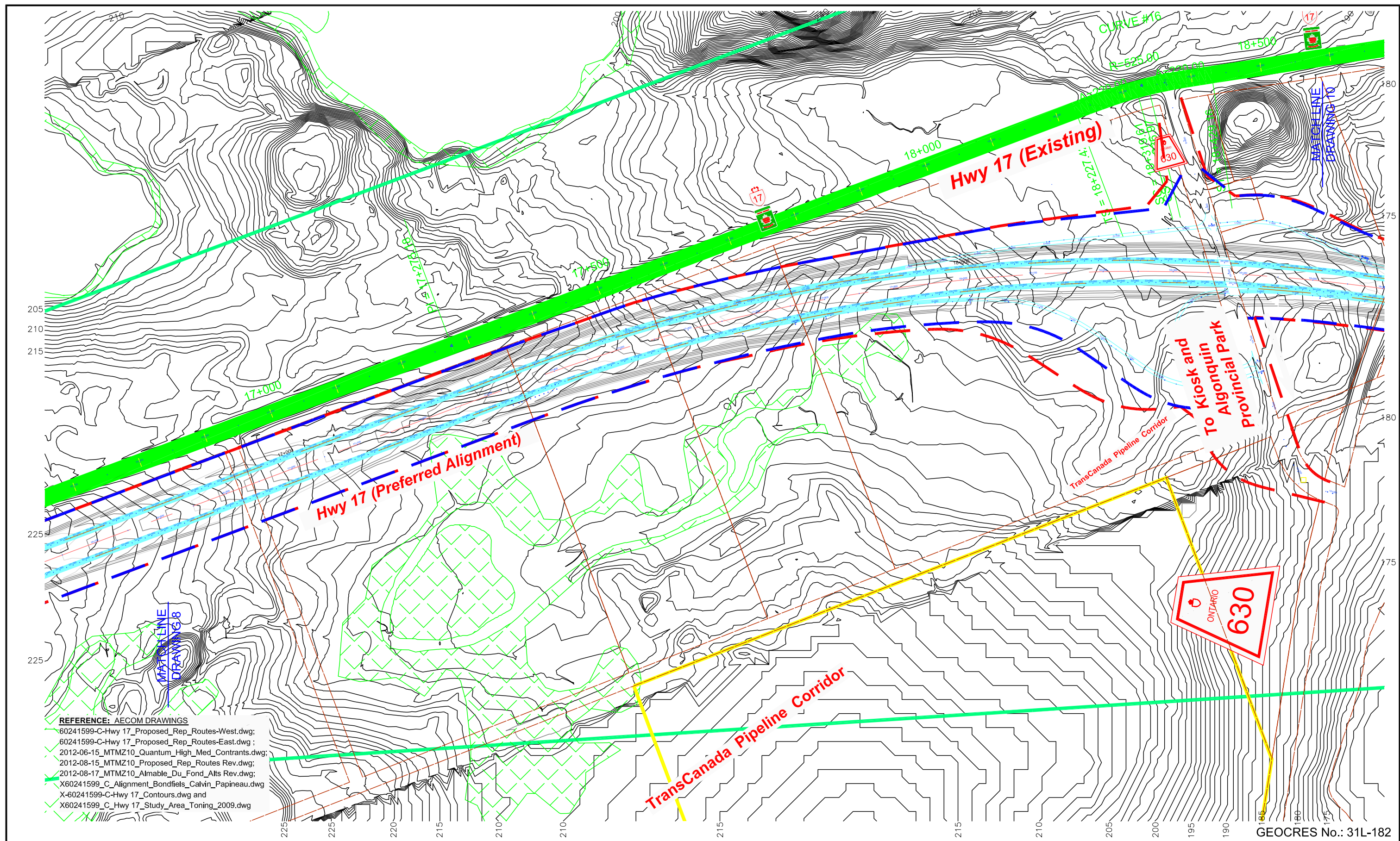
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SCALE



HIGHWAY 17
GWP No. 5670-10-00



DRAWING
P8



Site Reconnaissance Details, Water Well and Photograph Locations

HIGHWAY 17 - PREFERRED ALIGNMENT

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Township of Calvin

METRIC

PLAN
SCALE

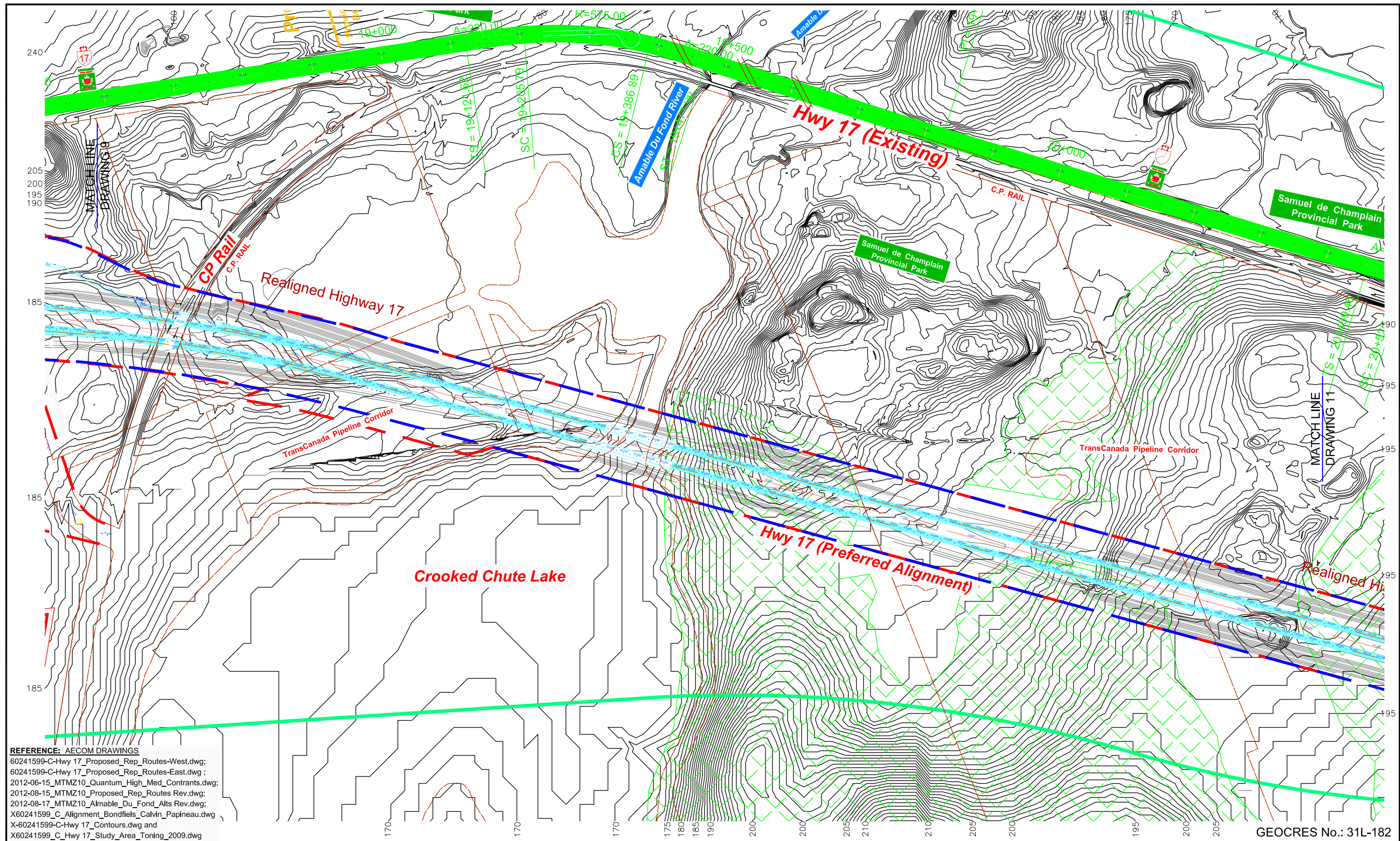


HIGHWAY 17
GWP No. 5670-10-00



DRAWING

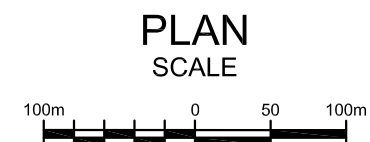
9



Site Reconnaissance Details, Water Well and Photograph Locations HIGHWAY 17 - PREFERRED ALIGNMENT

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Township of Calvin

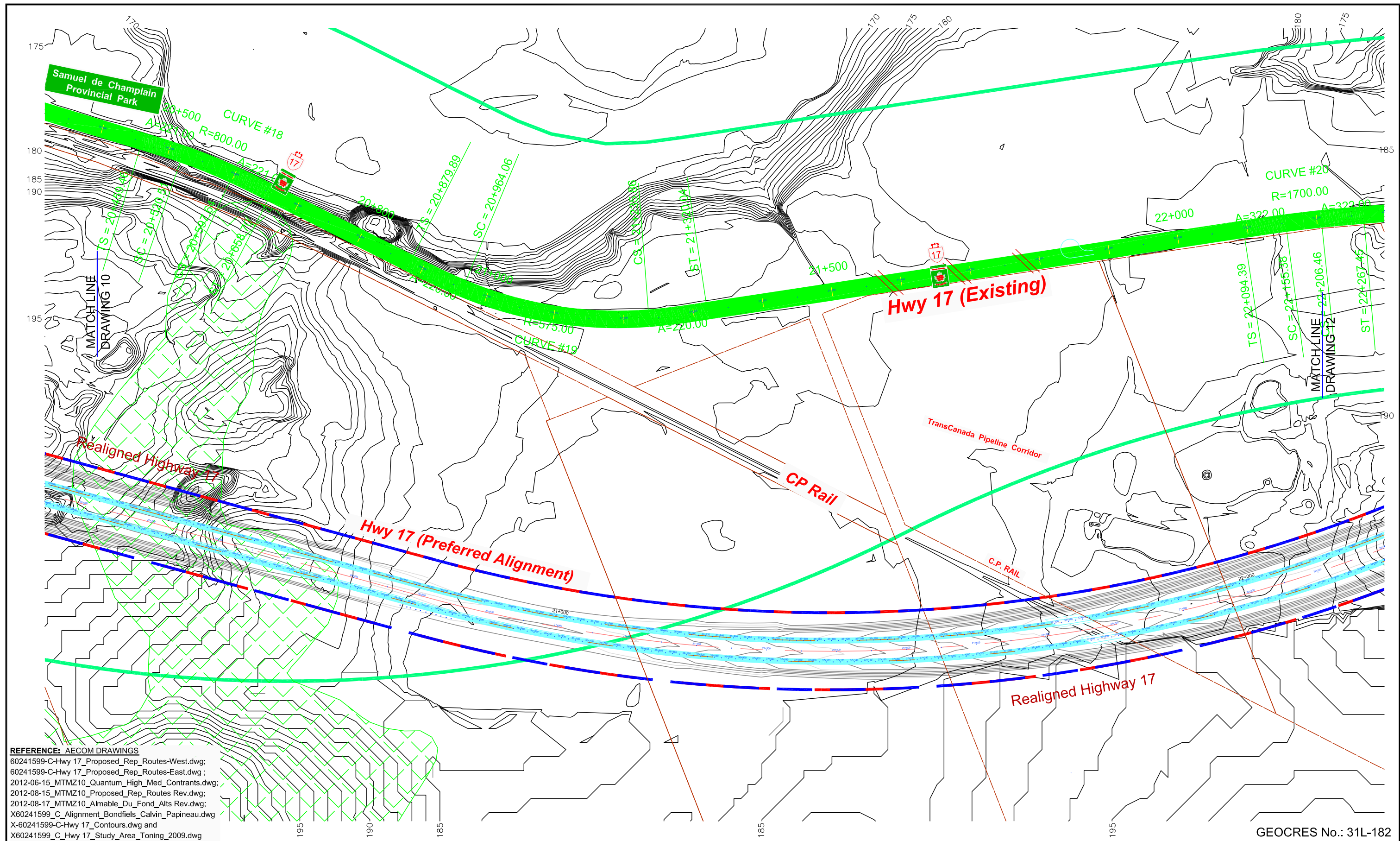
METRIC



HIGHWAY 17
GWP No. 5670-10-00



DRAWING
P10



GEOCRES No.: 31L-182

Site Reconnaissance Details, Water Well and Photograph Locations HIGHWAY 17 - PREFERRED ALIGNMENT

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Township of Calvin

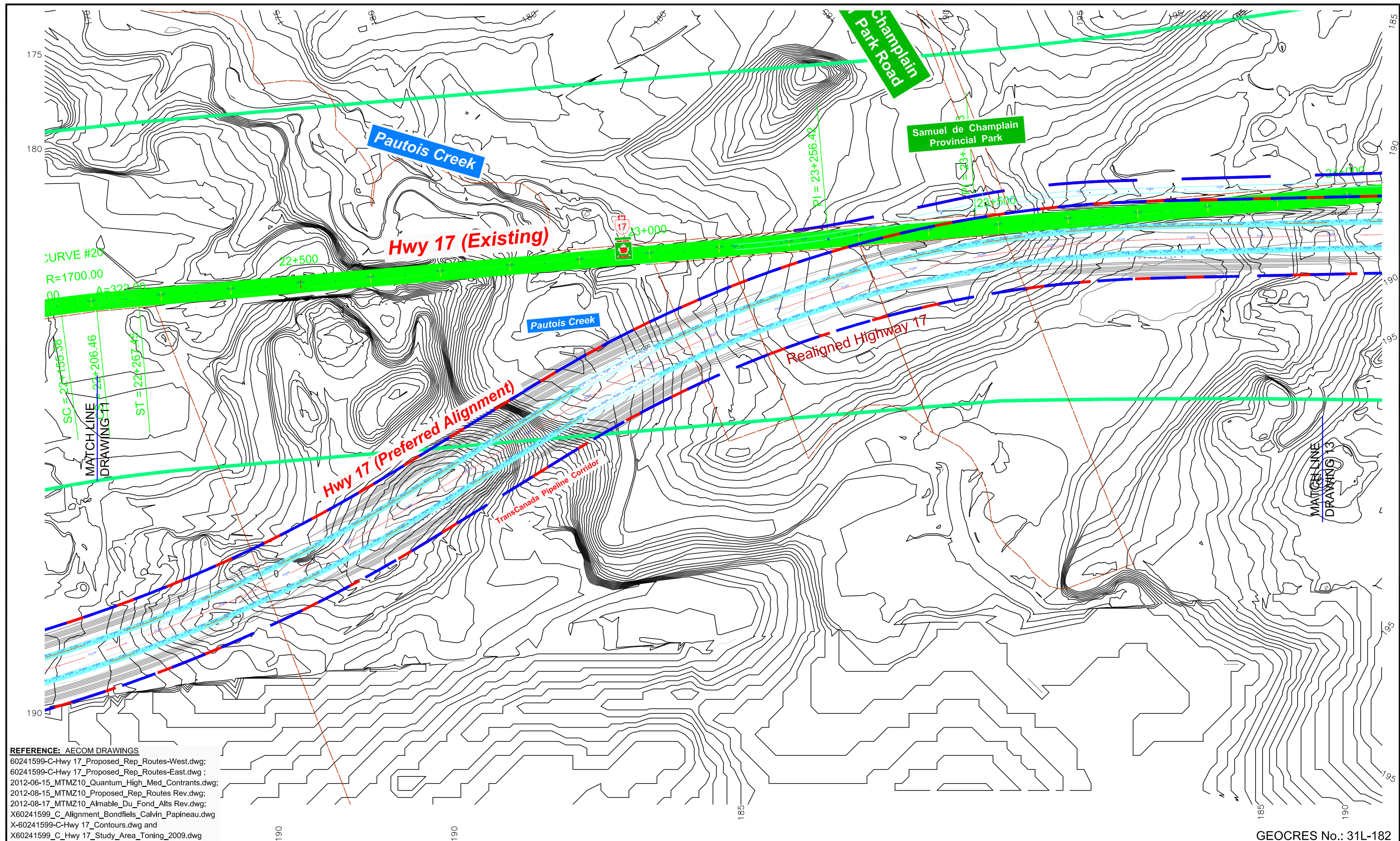
METRIC



HIGHWAY 17
GWP No. 5670-10-00



DRAWING
P11



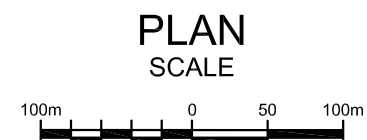
REFERENCE: AECOM DRAWINGS
60241599-C-Hwy 17_Proposed_Rep_Routes-West.dwg;
60241599-C-Hwy 17_Proposed_Rep_Routes-East.dwg ;
2012-06-15_MTMZ10_Quantum_High_Med_Contrants.dwg;
2012-08-15_MTMZ10_Proposed_Rep_Routes Rev.dwg;
2012-08-17_MTMZ10_Almable_Du_Fond_Alts Rev.dwg;
X60241599_C_Alignment_Bondfields_Calvin_Papineau.dwg
X60241599-C-Hwy 17_Contours.dwg and
X60241599_C_Hwy 17_Study_Area_Toning_2009.dwg

GEOCRES No.: 31L-182

Site Reconnaissance Details, Water Well and Photograph Locations HIGHWAY 17 - PREFERRED ALIGNMENT

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Township of Calvin

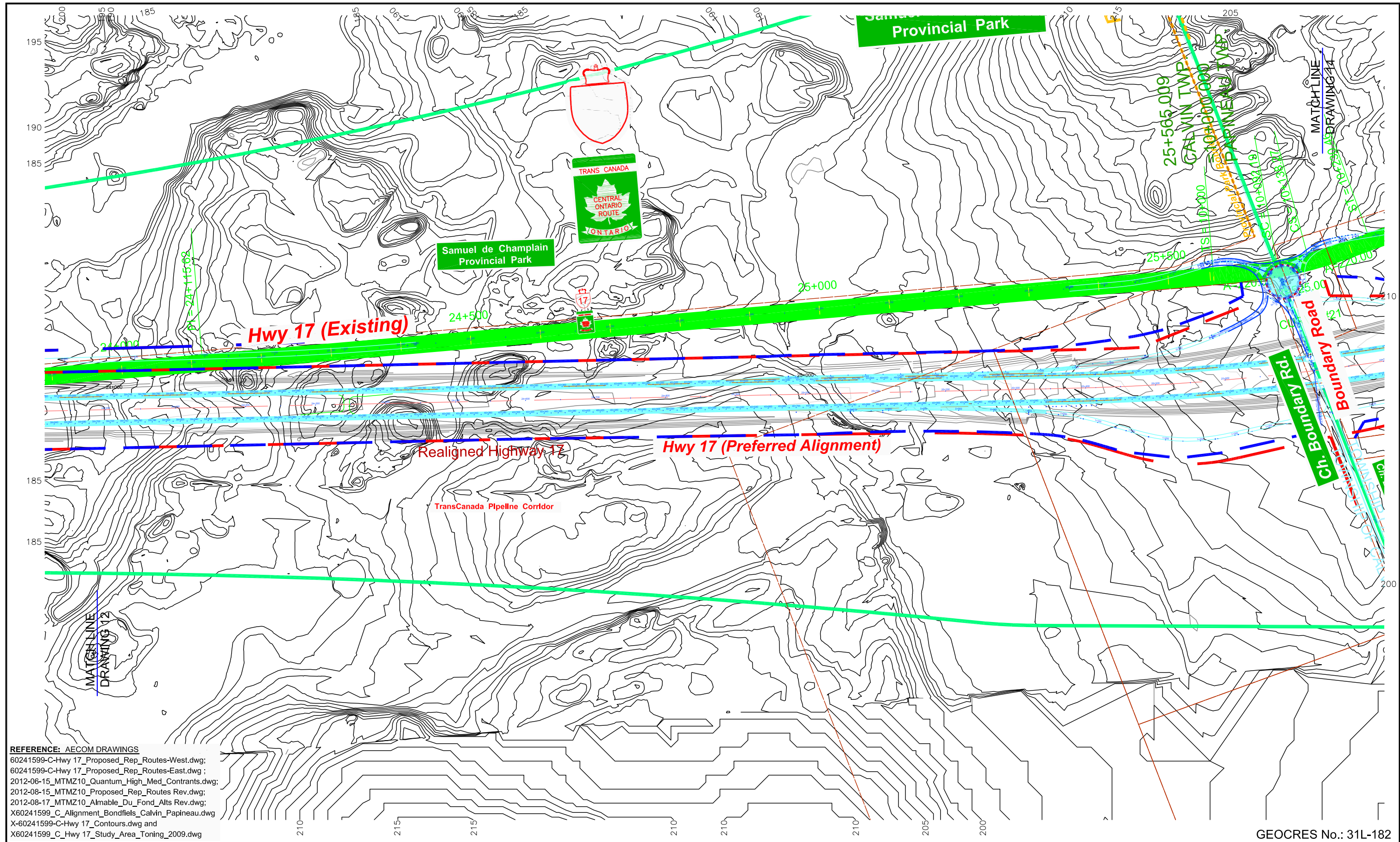
METRIC



HIGHWAY 17
GWP No. 5670-10-00



DRAWING
P12



GEOCRES No.: 31L-182

Site Reconnaissance Details, Water Well and Photograph Locations
HIGHWAY 17 - PREFERRED ALIGNMENT

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Township of Calvin

METRIC

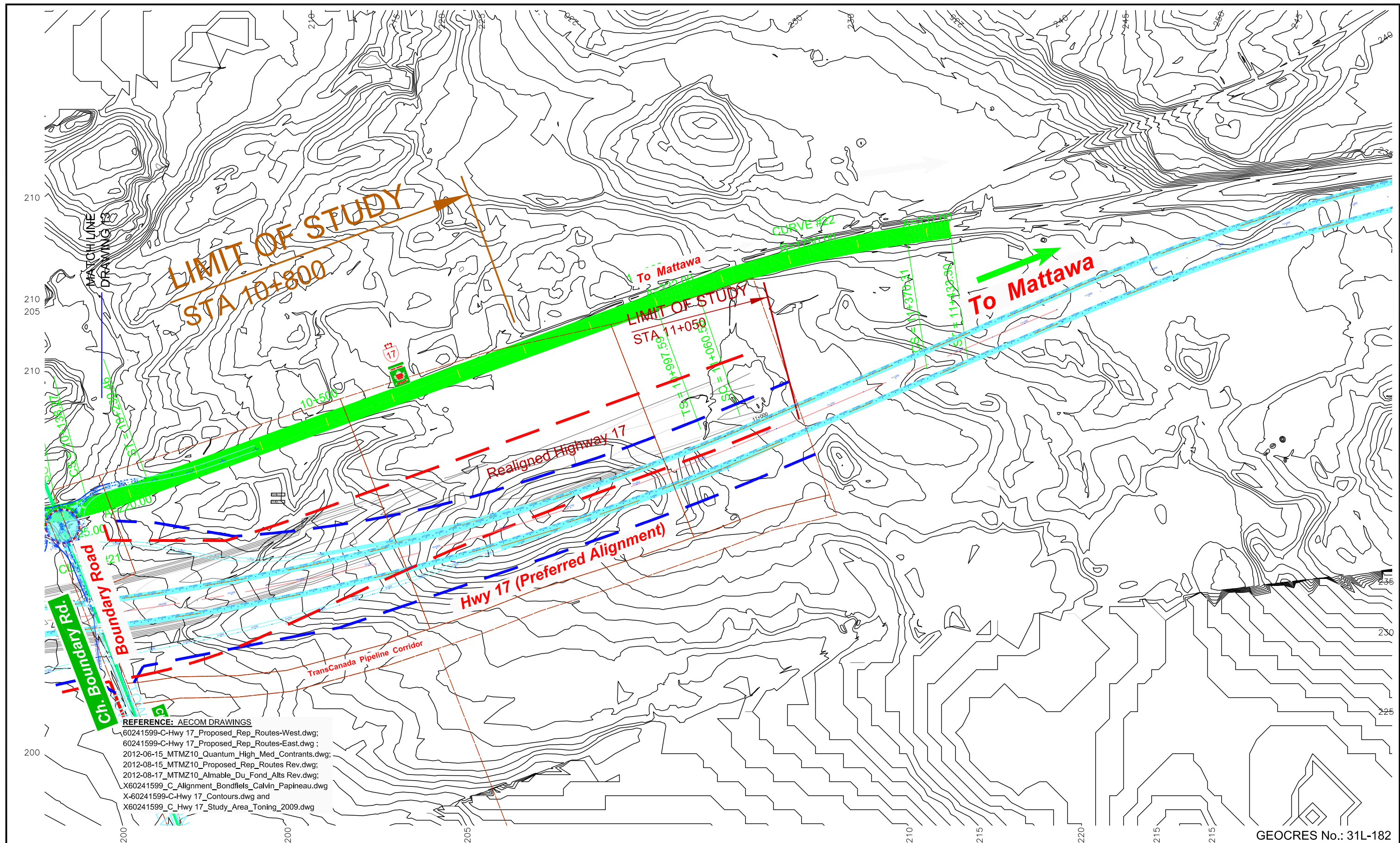
PLAN
SCALE



HIGHWAY 17
GWP No. 5670-10-00



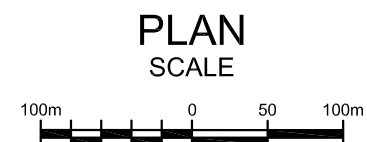
DRAWING
P13



Site Reconnaissance Details, Water Well and Photograph Locations
HIGHWAY 17 - PREFERRED ALIGNMENT

From 0.6 km west of Highway 531 Easterly to 8.0 km east of Highway 630, about 26.9 km
Townships of Calvin and Papineau-Cameron

METRIC



HIGHWAY 17
GWP No. 5670-10-00



DRAWING
P14

GEOCRES No.: 31L-182



APPENDIX A

List of Reference Documents



APPENDIX A

LIST OF REFERENCE DOCUMENTS

A. Geological Maps

- Quaternary Geology North Bay – Mattawa Region, Ontario-Quebec, MAP 3-1971, from Geological Survey of Canada, Published 1972, Scale 1:125 000
- Ontario Geological Survey 1979, Northern Ontario Engineering Geology Terrain Study, Data Base Map, North Bay, Map 5041, Scale 1:100,000
- Ontario Geological Survey 1979, Northern Ontario Engineering Geology Terrain Study, Data Base Map, Mattawa, Map 5042, Map 5041, Scale 1:100,000

B. Resource Documents

- Aggregate Resources Inventory Paper 70, Districts of Nipissing and Parry Sound from the Ontario Geological Survey, Ministry of Natural Resources, Issued 1984

C. MTO Reports

- Foundation Investigation, Kaibuskong River Bridge, Highway 17, District 13, Geocres No. 31L-022, May 1958
- Soil Condition and Slope Stability, Highway 17, approximately 14 miles, West of Mattawa, Geocres No. 31L-023, January 1963
- Foundation Investigation, Sparkes Creek Crossing, Highway 17, District 13, Geocres No. 31L-37, April 1958.
- Final Foundation Investigation and Design Report, Pimisi Bay Culvert, GWP 175-98-00, WP 5161-01-00, Foundation Area A, Highway 17, Township of Bonfield, Geocres No. 31L-98, February 2006.
- Final Foundation Investigation and Design Report, Culvert at Station 10+470, GWP 175-98-00, WP 5161-01-00, Foundation Area B, Highway 17, Township of Calvin, Geocres No. 31L-99, February 2006.



- Final Foundation Investigation and Design Report, Culvert at Station 11+715, GWP 175-98-00, WP 5161-01-00, Foundation Area C, Highway 17, Township of Calvin, Geocres No. 31L-100, February 2006.
- Final Foundation Investigation and Design Report, Pimisi Bay Culvert, GWP 175-98-00, WP 5161-01-00, Foundation Area D, Highway 17, Township of Calvin, Geocres No. 31L-102, April 2006.
- Foundation Investigation at Highway 17, Amable du Fond River, District 13, Geocres No. 31L-025, November 1964
- Foundation Investigation Report, Amable du Fond River Bridge Replacement-North Channel, GWP 177-98-00, Highway 630, Township of Calvin, Site No. 43-085, Geocres No. 31L-125, August, 2009
- Foundation Investigation Report, Amable du Fond River Bridge Replacement-South Channel, GWP 177-98-00, WP 177-98-01, Highway 630, Township of Calvin, Site No. 43-086, Geocres No. 31L-126, August, 2009
- Foundation Conditions at New Bridge over Pautois Creek at Highway 17, Geocres No. 31L-26, April 1961

D. MOE Well Records (See Appendix B)

- Water Well Records provided by the Ministry of Environment, from 1949 - 2011.

E. Air Photo

- Photo Mosaic of Oblique Aerial view along the study corridor provided by AECOM
- Aerial Photographs 58R - 4612, 014 - 76 to 014 - 83
- Aerial Photographs 89 - 4610, 3 - 117 to 3 - 120



APPENDIX B

Water Well Records

TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 08(021)	17 646641 5123975 ^W	1949/08 2640	05 05	FR 0084	035 / / :0	DO		4300061 () GRNT 0084
BONFIELD TOWNSHIP CON 08(021)	17 646953 5123164 ^W	2012/05 1462						7182162 (Z144346) A119194
BONFIELD TOWNSHIP CON 08(024)		2001/07 1462	06 06	FR	030 / 120 002 / 15:0	DO		4307055 (231082) CLAY 0006 GREY GRNT 0100 RED GRNT 0362
BONFIELD TOWNSHIP CON 08(024)	17 648082 5124067 ^L	1998/03 1462	06 06	FR 0425	/ 001 / 1:0	DO		4306471 (189002) SAND 0021 RED GRNT 0100 GREY GRNT 0170 RED GRNT 0207 GREY GRNT 0464
BONFIELD TOWNSHIP CON 08(025)		1998/11 1462	06 06	FR 0035	012 / 002 / 1:0	DO		4306667 (189610) CLAY 0010 RED GRNT 0078 RED GRNT 0103 BRWN GRNT 0200 RED GRNT 0262
BONFIELD TOWNSHIP CON 08(025)	17 648465 5124227 ^L	1996/08 1462	06	FR 0395	020 / 003 / 1:0	DO		4306219 (172992) SAND 0010 CLAY 0017 SAND BLDR 0020 RED GRNT 0100 GREY GRNT 0180 RED GRNT 0210 GREY GRNT 0362 RED GRNT 0395 BRWN GRNT 0400 RED GRNT 0401
BONFIELD TOWNSHIP CON 08(025)	17 648676 5124085 ^W	1972/05 4405	06 06	FR 0071	010 / 040 004 / 4:0	DO		4301770 () SAND 0013 RED GRNT 0071
BONFIELD TOWNSHIP CON 08(026)	17 648836 5124379 ^L	1991/10 2305	06	FR 0345	036 / 100 / 1:0	DO		4305215 (097264) BRWN SAND 0008 GREY GRNT 0354
BONFIELD TOWNSHIP CON 08(028)	17 649166 5124975 ^W	1975/09 4406	06	UK 0105	008 / 010 003 / 1:30	DO ST		4302281 () BLUE CLAY 0019 GREY GRNT 0110
BONFIELD TOWNSHIP CON 08(029)	17 649876 5124819 ^L	2003/04 1462	06 06		014 / 130 002 / 24:0	DO		4307349 (239578) CLAY 0023 SAND BLDR 0026 GREY GRNT 0200 GREY GRNT 0380
BONFIELD TOWNSHIP CON 08(029)	17 649756 5125150 ^W	1971/11 1443	02 02	FR 0232	014 / 040 003 / 2:0	DO ST		4301705 () CLAY 0010 RED GRNT 0235
BONFIELD TOWNSHIP CON 08(029)	17 649762 5125490 ^W	2010/12 1462	06	FR	011 / / :0	DO		7156580 (Z124389) A093711 SAND CLAY 0014 GREY GRNT 0280
BONFIELD TOWNSHIP CON 08(030)	17 650276 5124969 ^L	1992/06 1377	06 06	UK 0470	022 / 300 008 / 1:0	DO		4305461 (82745) SILT 0009 GREY CLAY 0030 QSND 0050 SAND GRVL 0068 QSND 0070 GREY ROCK 0500
BONFIELD TOWNSHIP CON 08(032)	17 651076 5125633 ^W	1991/10 3678	06 06	FR 0450	003 / 450 004 / 1:5	DO		4305266 (87626) BRWN SAND 0002 GREY CLAY 0061 GREY ROCK 0455
BONFIELD TOWNSHIP CON 08(032)	17 651098 5125311 ^L	1991/07 3665	06 06	FR 0159	001 / 155 006 / 1:0	DO		4305170 (87681) BRWN CLAY 0030 GREY SAND SILT 0067 GREY GRNT 0165
BONFIELD TOWNSHIP CON 08(032)	17 651066 5125825 ^W	1961/09 1443	02 02	FR 0060	/ 023 006 / 3:0	DO		4300062 () FSND 0032 BLDR 0035 RED GRNT 0070

TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 08(032)	17 651016 5125875 ^M	1981/11 1120	06	FR 0135	003 / 125 010 / 1:0	DO		4303451 () BRWN CLAY 0054 BLCK GRNT 0145
BONFIELD TOWNSHIP CON 08(032)	17 651098 5125311 ^L	1991/07 3665	06 06	FR 0067 FR 0142	001 / 130 006 / 1:0	DO	65 3	4305169 (87680) BRWN CLAY 0031 GREY SAND SILT 0062 GREY GRNT 0145
BONFIELD TOWNSHIP CON 08(033)	17 651451 5125457 ^L	1995/10 6780	02	FR 0022		NU	15 7	4306124 () BRWN GRVL FILL 0005 GREY SAND SLTY FSND 0007 GREY SAND SLTY FSND 0012 GREY SAND SLTY FSND 0017 GREY SAND SLTY FSND 0023
BONFIELD TOWNSHIP CON 08(033)	17 651216 5125875 ^M	1965/09 2305	02 02	FR 0054	024 / 006 / 2:30	DO		4300063 () PRDG 0024 MSND GRVL 0040 RED GRNT 0067
BONFIELD TOWNSHIP CON 08(033)	17 651451 5125457 ^L	1995/10 6780	02	FR 0250		NU	17 7	4306123 () BLCK UNKN CMTD 0003 BRWN SAND FILL 0025 GREY CLAY SLTY 0050 GREY SAND SLTY 0075 GREY SAND SLTY 0100 GREY FSND FGRD 0120 GREY SAND FSND 0150 GREY SAND FSND 0175 GREY SAND FSND 0250
BONFIELD TOWNSHIP CON 08(033)	17 651366 5125325 ^M	1976/05 4406	06	FR 0028 UK 0095	008 / / :0	DO		4302404 () RED SAND 0010 RED GRVL STNS BLDR 0018 BLCK GRNT 0080 QRTZ 0085 BRWN GRNT 0105
BONFIELD TOWNSHIP CON 08(033)	17 651216 5125825 ^M	1976/09 4541	02 02	FR 0038	010 / 007 / 2:0	DO		4302446 () GREY CLAY SAND SOFT 0027 RED GRNT 0050
BONFIELD TOWNSHIP CON 08(033)	17 651451 5125457 ^L	1995/10 6780	02	FR 0025		NU	17 7	4306125 () UNKN 0025
BONFIELD TOWNSHIP CON 08(033)	17 651451 5125457 ^L	1989/08 1377	06	FR 0038 FR 0098	/ 008 / :0	PS		4304809 (58536) GRVL 0004 BRWN CLAY 0017 QSND 0026 GRVL SAND 0033 ROCK 0125
BONFIELD TOWNSHIP CON 08(033)	17 651216 5125875 ^M	1979/05 4541	02 02	FR 0040	008 / 010 003 / :0	DO		4303018 () GREY CLAY SOFT 0019 RED GRNT 0050
BONFIELD TOWNSHIP CON 08(033)	17 651466 5125955 ^M	1970/04 1443	02	FR 0172	015 / 025 001 / 10:0	DO		4301492 () CLAY MSND 0032 RED GRNT 0180
BONFIELD TOWNSHIP CON 08(034)	17 651822 5125603 ^L	1998/06 2305	06 06	FR 0225	015 / 228 010 / 1:0	DO		4306468 (172731) BRWN SAND BLDR 0023 RED GRNT 0229
BONFIELD TOWNSHIP CON 08(034)	17 651616 5126025 ^M	1976/08 1120	06	FR 0272	016 / 020 001 / 1:0	DO		4302508 () BRWN CLAY 0007 BLCK GRNT 0283
BONFIELD TOWNSHIP CON 08(034)	17 651591 5126025 ^M	1962/05 2305	02 02	FR 0067 FR 0088 FR 0094	022 / 004 / 1:30	DO		4300064 () CLAY 0006 GREY MSND 0021 GREY GRNT 0072 RED GRNT 0103

Well Computer Print Out Data as of September 24 2012

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TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 08(034)	17 651822 5125603 ^L	1992/11 1462	06	FR 0180	012 / 001 / 1:0	DO.		4305533 (096859) CLAY FILL 0028 BLDR 0031 GREY GRNT 0180 BRWN GRNT 0200 GREY GRNT 0227
BONFIELD TOWNSHIP CON 08(034)	17 651616 5126055 ^M	1973/04 2305	02 02	FR 0139	038 / 038 002 / 2:10	DO		4301910 () GREY SAND 0023 GREY GRNT 0139 RED GRNT 0145
BONFIELD TOWNSHIP CON 08(035)	17 652216 5125825 ^M	1979/06 2305	06 06	FR 0119	017 / 048 002 / 1:20	DO		4303011 () BRWN SAND BLDR CLAY 0019 GREY GRNT QTZ 0149 RED GRNT 0150 GREY GRNT QTZ 0299 RED GRNT 0300 RED GRNT 0402
BONFIELD TOWNSHIP CON 08(035)	17 652266 5125975 ^M	1978/08 4541	02 02	FR 0052	010 / 018 002 / 2:0	DO		4302883 () BRWN SAND GRVL 0003 RED GRNT SOFT 0057
BONFIELD TOWNSHIP 08(021)	17 646761 5123626 ^M	2006/08 1462	06	FR	024 / 045 010 / 1:0	DO		4307990 (Z50419) A046798 SAND 0008 GREY GRNT 0320
BONFIELD TOWNSHIP 08(021)	17 646769 5123707 ^M	2004/11 1462	06	FR 0125 FR 0165 FR 0070	030 / 005 / 1:0	DO		4307662 (Z12977) A012880 CLAY 0005 SAND BLDR 0021 RED GRNT 0182
BONFIELD TOWNSHIP 08(025)	17 648047 5124594 ^M	2009/11 3678	06 06	FR 0084	008 / 151 004 / 1:0	DO		7144256 (Z104263) A090501 BRWN CLAY 0010 RED ROCK 0360
BONFIELD TOWNSHIP 08(026)	17 648836 5124379 ^L	1994/07 1462	06	FR 0256	/ 015 / 1:0	DO		4305903 (145216) GREY GRNT 0256 RED GRNT 0260 GREY GRNT 0270
BONFIELD TOWNSHIP 08(034)	17 651512 5126043 ^M	2009/11 1462	06	FR 0083 FR 0096	018 / 024 005 / 1:0	DO		7137402 (Z108441) A084354 CLAY 0040 BLDR SAND 0042 GREY GRNT 0122

TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 09(016)	17 644962 5123403 ^W	2004/04 1462	06		025 / 020 004 / 1:0	DO		4307519 (Z12846) A012868 SAND 0024 GREY GRNT 0034 RED GRNT SOFT 0050 RED GRNT 0420
BONFIELD TOWNSHIP CON 09(016)	17 644666 5123325 ^W	1976/08 1443	02	FR 0259	036 / 048 001 / 2:30	DO		4302562 () SAND GRVL BLDR 0016 GREY GRNT 0266
BONFIELD TOWNSHIP CON 09(016)	17 644657 5123744 ^L	1991/12 1377	06	FR		DO		4305289 (82715) SAND 0003 SAND GRVL 0015 GREY ROCK 0445
BONFIELD TOWNSHIP CON 09(017)	17 645039 5123902 ^L	1991/05 1377	06	FR 0360	033 / 350 / 1:20	DO		4305127 (82575) SAND 0010 SAND GRVL 0020 ROCK FCRD 0024 RED GRNT ROCK 0420
BONFIELD TOWNSHIP CON 09(020)	17 646174 5124374 ^L	1999/09 1462	06 06	FR 0340	040 / 362 007 / 1:0	DO		4306784 (203422) SAND 0057 GREY GRNT 0300 RED GRNT 0355 GREY GRNT 0562
BONFIELD TOWNSHIP CON 09(020)	17 646366 5124325 ^W	1978/06 1120	06 06	FR 0085	015 / 075 010 / 1:0	ST DO		4302864 () BRWN CLAY STNS 0078 SAND GRVL 0090
BONFIELD TOWNSHIP CON 09(020)	17 646174 5124374 ^L	1996/10 1462	06	FR 0098	025 / 010 / 1:0	DO		4306245 (173013) SAND BLDR 0005 RED GRNT 0098 BRWN GRNT 0104 RED GRNT 0122
BONFIELD TOWNSHIP CON 09(021)		2000/05 1462	06 06		055 / 004 / :0	DO		4306882 (203493) SAND 0072 RED GRNT 0342
BONFIELD TOWNSHIP CON 09(023)	17 646166 5126225 ^W	1979/05 1120	06 06	FR 0400	060 / 525 001 / 2:0	DO		4303142 () BRWN CLAY BLDR 0062 BLCK GRNT 0545
BONFIELD TOWNSHIP CON 09(025)	17 648266 5124765 ^W	1972/08 1443	02 02	FR 0115	012 / 003 / 2:0	DO		4301801 () SAND CLAY 0010 GRNT 0119
BONFIELD TOWNSHIP CON 09(026)	17 648427 5125309 ^L	1992/08 1462	06	FR 0232	012 / 015 / 1:0	DO		4305449 (096808) CLAY 0013 GREY GRNT 0100 RED GRNT 0200 BRWN GRNT 0232 GREY GRNT 0250
BONFIELD TOWNSHIP CON 09(026)	17 648616 5124875 ^W	1976/08 4541	02 02	FR 0145 FR 0190	010 / 011 001 / 3:0	DO		4302420 () GREY CLAY SOFT 0012 RED GRNT HARD 0200
BONFIELD TOWNSHIP CON 09(027)	17 648775 5125454 ^L	1991/10 2305	06	FR	028 / 003 / 1:0	DO		4305214 (097266) BRWN SAND GRVL 0008 BRWN GRNT 0372
BONFIELD TOWNSHIP CON 09(028)	17 649125 5125601 ^L	1992/06 3803	06	FR 0035 FR 0230	011 / 100 010 / 1:0	DO		4305405 (121133) GREY CLAY 0015 GREY CLAY STNS 0017 BLCK GRNT 0265
BONFIELD TOWNSHIP CON 09(030)	17 649975 5125973 ^W	2011/08 1462	06	FR 0030	008 / 008 005 / 1:0	DO		7172920 (Z134831) A110180 SAND 0004 RED GRNT 0042
BONFIELD TOWNSHIP CON 09(030)	17 650011 5125762 ^W	2009/08 1462	06	FR 0090 FR 0140 FR 0260	025 / 070 010 / 1:0	DO		7137040 (Z096811) A084396 CLAY 0044 SAND BLDR 0063 GREY GRNT 0320
BONFIELD TOWNSHIP CON 09(031)	17 650299 5126084 ^L	1987/09 3665	06 06	FR 0320	021 / 001 / 1:0	DO		4304368 () BRWN CLAY 0011 GREY SAND SILT 0049 GREY CLAY STNS 0059 GREY GRNT 0385

TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 09(031)	17 650299 5126084 ^L	1987/09 3665	06 06	FR 0124 FR 0113	025 / 005 / 1:0	DO		4304367 () BRWN CLAY 0008 GREY FSND SILT 0028 GREY GRNT 0113 RED GRNT 0130
BONFIELD TOWNSHIP CON 09(031)	17 650266 5126025 ^W	1969/04 1443	02 02	FR 0238	026 / 055 001 / 2:0	DO		4301384 () MSND 0014 RED GRNT 0240
BONFIELD TOWNSHIP CON 09(032)	17 650416 5125975 ^W	1978/06 2305	06 06	FR 0118 FR 0108	012 / 036 007 / 1:0	DO		4302831 () BRWN SAND 0005 GREY GRNT 0125
BONFIELD TOWNSHIP CON 09(032)	17 650816 5126025 ^W	1957/03 2512	05 05	FR 0030	006 / 014 018 / 1:0	PS		4300074 () CLAY 0012 SNDS 0018 RED SHLE 0101
BONFIELD TOWNSHIP CON 09(032)	17 650416 5125875 ^W	1978/07 1120	06 06	FR 0132 FR 0168	006 / 175 002 / 1:0	DO		4302888 () BRWN CLAY 0027 BLCK GRNT 0185
BONFIELD TOWNSHIP CON 09(032)	17 650841 5125925 ^W	1949/07 2640	05 05	FR 0060	018 / / :0	DO		4300071 () CLAY 0020 GRNT 0060
BONFIELD TOWNSHIP CON 09(032)	17 651016 5125925 ^W	1979/09 1443	02 02	FR 0102	/ 005 / 3:30	DO		4303197 () SAND CLAY 0042 RED GRNT 0107
BONFIELD TOWNSHIP CON 09(033)	17 651316 5126225 ^W	1964/05 3614	02 02	FR 0072 FR 0136	033 / 045 003 / 72:0	ST DO		4300075 () CLAY 0016 GREY GRNT 0143
BONFIELD TOWNSHIP CON 09(033)	17 651116 5125925 ^W	1977/11 3359	06 06	FR 0070	025 / 025 002 / :0	DO		4302750 () GREY CLAY 0023 GREY GRNT 0065 RED GRNT 0073
BONFIELD TOWNSHIP CON 09(033)	17 651066 5126397 ^L	1988/10 3678	06 06	FR 0145	015 / 008 / 1:10	DO		4304628 () BRWN SAND 0023 GREY ROCK 0145
BONFIELD TOWNSHIP CON 09(033)	17 651416 5126025 ^W	1981/07 2305	06	FR 0146	011 / 002 / 1:0	DO		4303423 () BRWN SAND CLAY 0039 GREY GRNT 0155
BONFIELD TOWNSHIP CON 09(033)	17 651166 5125945 ^W	1969/11 4405	06	FR 0167	008 / 168 001 / :0	PS		4301470 () GRVL 0036 RED GRNT 0170
BONFIELD TOWNSHIP CON 09(033)	17 651292 5125967 ^W	1992/04 3665	06 06	FR 0160	019 / 155 006 / 1:0	DO		4305353 (115038) BRWN CLAY 0028 GREY GRNT 0165
BONFIELD TOWNSHIP CON 09(033)	17 651061 5126397 ^L	2003/11 1462	06 06	FR 0092	020 / 025 012 / 1:0	DO		4307490 (259159) BLUE CLAY 0015 SAND BLDR 0027 GREY GRNT 0092 RED GRNT 0102
BONFIELD TOWNSHIP CON 09(033)	17 651366 5126075 ^W	1949/07 2640	05 05	FR 0058	012 / / :0	DO		4300072 () CLAY 0026 GRNT 0058
BONFIELD TOWNSHIP CON 09(033)	17 651216 5126075 ^W	1968/08 1443	02 02	FR 0169	015 / 040 004 / 2:0	DO		4301343 () CLAY MSND 0035 RED GRNT 0170
BONFIELD TOWNSHIP CON 09(034)	17 651616 5126150 ^W	1949/07 2640	05	FR 0034	020 / / :0	DO		4300073 () CLAY GRVL 0034

TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 09(034)	17 651439 5126548 ^L	1990/10 3665	06 06	UK 0309	030 / 315 001 / 1:0	DO		4305061 (87788) BRWN SAND 0009 GREY GRNT 0325
BONFIELD TOWNSHIP CON 09(034)	17 651439 5126548 ^L	1989/04 2305	06	FR 0105	043 / 060 / 1:0	DO		4304708 () BRWN SAND CLAY 0025 GREY GRNT 0126
BONFIELD TOWNSHIP CON 09(034)	17 651439 5126548 ^L	1989/07 1462	06	FR 0165	018 / 004 / 1:0	DO		4304822 () SAND 0010 GREY GRNT 0160 RED GRNT 0166 GREY GRNT 0188
BONFIELD TOWNSHIP CON 09(035)	17 651816 5127075 ^M	1979/09 1120	06 06	FR 0145	023 / 125 004 / 2:0	DO		4303064 () BRWN CLAY BLDR 0030 RED GRNT 0145
BONFIELD TOWNSHIP CON 09(035)	17 651816 5126925 ^M	1978/08 4541	02 02	FR 0186	025 / 030 002 / 2:0	DO		4302882 () GREY CLAY BLDR SOFT 0056 RED GRNT HARD 0191
BONFIELD TOWNSHIP CON 09(035)		1999/12 2305	06 06	FR	/ 285 004 / 1:0	DO		4306831 (203142) BRWN SAND GRVL 0012 GRNT 0286
BONFIELD TOWNSHIP 09(030)	17 649866 5125434 ^M	2008/09 1462	06	FR 0132	020 / 026 005 / 1:0	DO		7116838 (Z85484) A071470 0005 GREY GRNT 0132 RED GRNT 0134 GREY GRNT 0140
BONFIELD TOWNSHIP 09(033)	17 644107 5125825 ^M	2006/07 1462	06	FR 0345	040 / 100 010 / 1:0	DO		4307966 (Z50385) A035331 GRVL BLDR 0049 GREY GRNT 0382

TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 10(022)	17 646216 5126025 ^M	1983/08 1120	06	FR 0063	050 / 070 010 / 1:0	DO		4303745 {} BRWN CLAY BLDR 0068 RED GRNT FCRD 0075
BONFIELD TOWNSHIP CON 10(023)	17 646716 5126065 ^M	1951/09 2512	04	FR 0088 FR 0040	030 / 060 001 / 0:30	DO		4300078 {} BLUE CLAY 0010 GREY MSND 0040 HPAN GRVL 0041 GREY MSND GRVL 0088 GRVL 0090
BONFIELD TOWNSHIP CON 10(023)	17 646938 5125773 ^L	1995/10 2305	06 06	FR 0191	054 / 003 / 1:0	ST		4306069 {} BRWN SAND CLAY 0081 RED GRNT 0203
BONFIELD TOWNSHIP CON 10(024)	17 647308 5125921 ^L	1988/06 3665	06 06	SA 0020		NU		4304497 {} GREY CLAY STKY 0007 GREY GRNT FCRD WBRG 0043 GREY GRNT HARD 0565
BONFIELD TOWNSHIP CON 10(024)	17 647308 5125921 ^L	1993/10 2305	06 06	SA	017 / 005 / 1:0	DO		4305684 (097975) BRWN SAND BLDR 0009 GREY GRNT 0412
BONFIELD TOWNSHIP CON 10(024)	17 647066 5126025 ^M	1967/10 2305	02 02	UK 0063 FR 0079 UK 0054	016 / 003 / 3:30	ST DO		4300081 {} PRDG 0013 RED GRNT 0094
BONFIELD TOWNSHIP CON 10(024)	17 647308 5125921 ^L	1988/08 3665	06 06	SA 0045		NU		4304543 {} GREY CLAY SAND 0008 GREY GRNT FCRD HARD 0565
BONFIELD TOWNSHIP CON 10(024)	17 647316 5125825 ^M	1956/09 2905	02	FR 0020	/ 020 003 / 5:0	DO		4300079 {} PRDR 0040
BONFIELD TOWNSHIP CON 10(024)	17 647308 5125921 ^L	1988/07 3665	06 06	SA 0023	008 / 002 / 1:10	DO	18 3	4304542 {} BRWN SAND STNS 0017 RED GRNT 0191 GREY GRNT 0280
BONFIELD TOWNSHIP CON 10(024)	17 647566 5126175 ^M	1958/05 2512	05 05	FR 0123	053 / 126 001 / 0:30	CO		4300080 {} MSND 0004 CLAY 0023 RED GRNT 0118 RED SHLE 0126
BONFIELD TOWNSHIP CON 10(024)	17 647133 5126308 ^M	1974/07 3811	02	FR 0092 FR 0188	015 / 020 003 / 7:0	CO		4302169 {} BRWN CLAY 0018 RED GRNT 0200
BONFIELD TOWNSHIP CON 10(025)	17 647466 5126000 ^M	1967/07 2305	02 02	FR 0076	004 / 006 / 2:30	DO		4300082 {} GRVL BLDR CLAY 0015 RED GRNT 0090
BONFIELD TOWNSHIP CON 10(025)	17 647486 5126100 ^M	1967/07 2305	02 02	UK 0087 FR 0108	012 / 002 / 2:30	DO		4300083 {} PRDG 0009 RED GRNT 0115
BONFIELD TOWNSHIP CON 10(026)		1999/03 1462	06 06	FR 0117 FR 0125	040 / 060 015 / 12:0	DO		4306692 (189629) BRWN SAND BLDR 0108 RED GRNT LOOS 0142
BONFIELD TOWNSHIP CON 10(027)	17 648346 5126175 ^M	1963/07 1443	02 02	FR 0056 FR 0096	004 / 023 003 / 16:0	DO		4300084 {} CLAY 0012 RED GRNT 0103
BONFIELD TOWNSHIP CON 10(027)	17 648421 5126389 ^L	1989/10 1462	06	FR 0045 FR 0092	012 / 001 / 1:0	DO		4304878 {} CLAY 0015 GREY GRNT 0016 RED GRNT 0045 GREY GRNT 0106

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TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP 10 (020)	17 645915 5125443 ^N	2010/04 3678	06 06		030 / 034 004 / 1:0	DO		7144493 (Z114080) A099700 BRWN SAND 0040 GREY ROCK 0085

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TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 11(013)	17 642754 5125153 ^L	1987/12 1462	06	UK 0300	010 / 001 / 1:0	DO		4304470 () SAND 0017 RED GRNT 0030 GREY GRNT 0050 BRWN GRNT 0076 RED GRNT 0082 GREY GRNT 0115 RED GRNT 0331
BONFIELD TOWNSHIP CON 11(013)	17 642966 5125075 ^N	1982/10 4541		UK 0295 UK 0260	030 / 052 002 / 6:0	DO		4303615 () PRDG 0076 RED GRNT HARD 0306
BONFIELD TOWNSHIP CON 11(013)	17 642754 5125153 ^L	1997/07 2428	06	FR 0320	030 / 150 004 / 2:0	DO		4306360 (161255) RED CLAY BLDR 0021 RED GRNT 0250 GREY GRNT 0290 RED GRNT 0330
BONFIELD TOWNSHIP CON 11(013)	17 642916 5125025 ^N	1962/08 1443	02 02	FR 0047	017 / 023 003 / 10:0	DO		4300087 () GRVL MSND BLDR 0021 RED GRNT 0052
BONFIELD TOWNSHIP CON 11(013)	17 642616 5125675 ^N	1979/11 1120	06 06	FR 0255 FR 0225	010 / 250 005 / 1:0	ST		4303143 () CLAY BLDR 0046 BLCK GRNT 0265
BONFIELD TOWNSHIP CON 11(013)	17 642749 5125152 ^L	2002/10 1462	06 06	FR 0215	025 / 260 003 / 1:0	DO		4307301 (231448) CLAY 0050 SAND BLDR 0056 GREY GRNT 0160 RED GRNT 0230 RED GRNT 0260
BONFIELD TOWNSHIP CON 11(013)	17 642749 5125152 ^L	2002/08 2305	06 06	FR 0135	021 / 007 / 1:0	DO		4307243 (239607) BRWN SAND GRVL 0064 GREY GRNT 0141
BONFIELD TOWNSHIP CON 11(013)	17 642754 5125153 ^L	1987/09 1462	06	FR 0230	019 / 005 / :0	DO		4304369 () SAND 0005 RED GRNT 0020 GREY GRNT 0035 RED GRNT 0060 GREY GRNT 0075 RED GRNT 0080 GREY GRNT 0106 RED GRNT 0249
BONFIELD TOWNSHIP CON 11(013)	17 643016 5124945 ^N	1976/06 1120	06	FR 0175	/ / 1:0	DO		4302501 () BRWN CLAY BLDR 0025 BLCK GRNT 0342
BONFIELD TOWNSHIP CON 11(013)	17 642754 5125153 ^L	1987/10 1462	06	FR 0075	010 / 006 / 1:0	DO		4304418 () GRVL 0004 RED GRNT 0035 GREY GRNT 0040 RED GRNT 0086
BONFIELD TOWNSHIP CON 11(013)	17 642836 5124645 ^N	1976/12 4541	02 02	FR 0075	025 / 002 / 3:0	DO		4302471 () GREY CLAY GRVL SOFT 0022 GREY GRNT HARD 0080
BONFIELD TOWNSHIP CON 11(013)	17 642896 5124725 ^N	1960/10 2905	06 06	FR 0022	013 / 023 001 / 1:0	DO		4300086 () PRDG 0018 RED GRNT 0024
BONFIELD TOWNSHIP CON 11(013)	17 643095 5125374 ^N	1986/07 1120	06	FR 0060	025 / 010 / 2:0	DO		4304120 () BRWN CLAY BLDR 0028 BLCK GRNT 0225
BONFIELD TOWNSHIP CON 11(013)	17 642916 5124755 ^N	1972/10 2428	06 06	FR 0057	003 / 028 005 / 4:0	DO		4301879 () CLAY 0016 RED GRNT 0059
BONFIELD TOWNSHIP CON 11(013)	17 642944 5125120 ^N	2011/09 2305	06		033 / 200 020 / 1:0	DO AC		7174468 (Z136459) A109076 BRWN CLAY GRVL 0035 GREY GRNT 0202
BONFIELD TOWNSHIP CON 11(013)	17 642873 5124997 ^N	2011/05 2305	06	0190	027 / 198 020 / 1:0	DO		7168798 (Z123225) A109081 BRWN SAND CLAY 0035 GREY GRNT 0202

TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 11(014)	17 643247 5125576 ^W	1986/07 1120	06	FR 0105 FR 0095	026 / 010 / 1:0	DO		4304119 () BRWN CLAY BLDR 0054 RED GRNT 0125
BONFIELD TOWNSHIP CON 11(014)	17 643103 5125301 ^L	1990/07 1377	06	FR 0061	016 / 021 009 / 1:0	DO		4305018 (71177) BRWN CLAY 0012 GREY CLAY 0053 QSND 0057 GRVL SAND 0060 ROCK FCRD 0061 ROCK 0085
BONFIELD TOWNSHIP CON 11(014)	17 643044 5125747 ^W	1975/11 1443	02	FR 0090	016 / 024 003 / 3:0	DO		4302288 () SAND BLDR 0025 RED GRNT 0095
BONFIELD TOWNSHIP CON 11(014)	17 643101 5125339 ^W	1989/06 1377	06	FR 0075	/ 020 / :30	DO		4304807 () GRVL SAND 0005 GREY CLAY 0070 ROCK FCRD 0075
BONFIELD TOWNSHIP CON 11(014)	17 643266 5125445 ^W	1972/06 3811	02 02	FR 0045	027 / 028 004 / 4:0	DO		4301790 () BRWN CLAY SAND 0034 GREY GRNT 0074
BONFIELD TOWNSHIP CON 11(014)	17 643103 5125301 ^L	1992/11 1462	06	FR 0149	/ 005 / 1:0	DO		4305530 (096863) SAND BLDR 0017 RED GRNT 0100 GREY GRNT 0149 BRWN GRNT 0166
BONFIELD TOWNSHIP CON 11(014)	17 643103 5125301 ^L	1991/06 1377	06	FR 0083 FR 0360	050 / 373 005 / 1:0	DO		4305163 (82588) GRVL 0030 ROCK FCRD 0032 GREY ROCK 0440
BONFIELD TOWNSHIP CON 11(014)	17 643119 5125353 ^W	1990/04 1377	06	FR 0072	019 / 021 012 / 1:0	DO		4304941 (71151) SAND GRVL 0006 GREY CLAY 0047 QSND 0059 SAND GRVL 0066 GREY ROCK 0077
BONFIELD TOWNSHIP CON 11(014)	17 643056 5125215 ^W	1970/06 1445	02	FR 0063	022 / 022 002 / 6:0	DO		4301505 () BRWN GRVL 0008 GREY CLAY 0056 BRWN GRVL 0064
BONFIELD TOWNSHIP CON 11(014)	17 643156 5125235 ^W	1968/07 2305	02 02	UK 0167 FR 0202	018 / 028 002 / 4:0	DO		4301342 () MSND GRVL 0025 RED GRNT 0210
BONFIELD TOWNSHIP CON 11(014)	17 643103 5125301 ^L	1992/08 1377	06 06	FR 0215	030 / 037 012 / 1:0	DO		4305463 (82746) SAND 0002 BRWN CLAY 0019 ROCK FCRD 0033 GREY ROCK 0245
BONFIELD TOWNSHIP CON 11(014)	17 643006 5125105 ^W	1970/06 1445	02 02	FR 0055	020 / 020 006 / 6:0	DO		4301504 () BRWN GRVL 0007 GREY CLAY 0043 GRNT 0062
BONFIELD TOWNSHIP CON 11(014)	17 643157 5125240 ^W	1974/06 3811	02	FR 0126 FR 0122	020 / 030 003 / 2:30	DO		4302091 () BRWN CLAY BLDR 0018 BLCK ROCK 0134
BONFIELD TOWNSHIP CON 11(014)	17 643103 5125301 ^L	1986/09 3665	06 06	FR 0321	035 / 004 / 2:0	DO		4304206 () BRWN SAND 0009 GREY CLAY 0025 GREY GRNT 0325
BONFIELD TOWNSHIP CON 11(014)	17 643006 5125155 ^W	1970/06 1445	02	FR 0043	020 / 020 002 / 3:0	DO		4301506 () BRWN GRVL 0007 GREY CLAY 0042 BRWN GRVL 0044
BONFIELD TOWNSHIP CON 11(014)	17 643103 5125301 ^L	1998/08 1462	06	FR 0212	030 / 004 / 24:0	DO		4306553 (189219) CLAY 0025 BRWN SAND BLDR 0032 RED GRNT 0200 GREY GRNT 0242
BONFIELD TOWNSHIP CON 11(014)		2001/04 7062	06 06	UK 0055	027 / 050 010 / 2:0	DO		4307004 (189668) BRWN GRVL STNS 0008 BRWN CLAY SILT 0019 GREY CLAY 0044 RED GRNT 0072

TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 11(014)	17 643266 5125465 ^M	1966/08 2305	02 02	UK 0058 FR 0062	024 / 004 / 5:0	DO		4300090 () MSND GRVL 0030 RED GRNT 0071
BONFIELD TOWNSHIP CON 11(014)	17 642916 5125725 ^M	1964/06 2305	02 02	FR 0049	008 / 008 003 / 12:0	DO		4300089 () CLAY 0016 RED GRNT 0056
BONFIELD TOWNSHIP CON 11(014)	17 643216 5125325 ^M	1971/11 3811	02 02	FR 0050	019 / 024 002 / 2:0	DO		4301706 () BRWN CLAY SAND 0023 GREY GRNT 0056
BONFIELD TOWNSHIP CON 11(014)	17 643241 5125535 ^M	1962/08 1443	02 02	FR 0073	011 / 023 002 / 4:0	DO		4300088 () CLAY QSND 0055 GRVL BLDR 0065 GREY GRNT 0075
BONFIELD TOWNSHIP CON 11(014)		2001/05 1462	06 06	FR 0046	025 / 062 012 / 1:0	DO		4307017 (219167) CLAY 0008 RED GRNT SOFT 0062
BONFIELD TOWNSHIP CON 11(014)	17 643103 5125301 ^L	1994/08 1462	06	FR 0210 FR 0191	020 / 004 / 1:0	DO		4305902 (145236) CLAY 0032 SAND HPAN 0038 RED GRNT 0160 GREY GRNT 0191 BRWN GRNT 0195 RED GRNT 0210 BLCK GRNT 0227 RED GRNT
BONFIELD TOWNSHIP CON 11(015)	17 643478 5125448 ^L	2002/09 1462	06 06	FR 0053	030 / 082 015 / 1:0	DO		4307263 (231435) CLAY 0010 SAND BLDR 0032 RED GRNT 0082
BONFIELD TOWNSHIP CON 11(015)	17 643502 5125805 ^M	1976/04 4541	02 02	FR 0040	005 / 005 005 / 2:0	DO		4302385 () GREY CLAY GRVL 0032 RED GRNT 0050
BONFIELD TOWNSHIP CON 11(015)	17 643266 5125725 ^M	1979/10 1120	06	SA 0056	018 / 020 020 / 2:0	DO		4303144 () BRWN CLAY 0045 BRWN GRVL 0060
BONFIELD TOWNSHIP CON 11(015)	17 643016 5125375 ^M	1983/04 1120	06	FR 0155	015 / 004 / 1:0	DO		4303753 () CLAY BLDR 0071 GREY GRNT 0165
BONFIELD TOWNSHIP CON 11(015)		2002/03 1462	06 06	FR 0071	/ 049 012 / 48:0	DO		4307183 (231371) SAND BLDR 0056 GREY GRNT 0070 RED GRNT 0072 GREY GRNT 0082
BONFIELD TOWNSHIP CON 11(015)	17 643316 5125875 ^M	1973/10 2305	02 02	FR 0129	013 / 040 003 / 2:0	DO		4302024 () GREY CLAY 0009 GREY SAND BLDR 0053 RED GRNT 0144
BONFIELD TOWNSHIP CON 11(015)	17 643484 5125449 ^L	1994/08 1462	06	FR 0140	010 / 006 / 1:0	DO		4305945 (145260) SAND BLDR 0056 GREY GRNT 0070 RED GRNT 0080 GREY GRNT 0120 RED GRNT 0186
BONFIELD TOWNSHIP CON 11(016)	17 643316 5125675 ^M	1982/05 1120	06	FR 0075	010 / 015 025 / 1:0	DO		4303622 () BRWN CLAY SAND 0064 RED GRNT 0085
BONFIELD TOWNSHIP CON 11(016)	17 643716 5125675 ^M	1977/10 4541	02 02	FR 0087	010 / 015 002 / 3:0	DO		4302705 () GREY CLAY SAND SOFT 0041 RED GRNT HARD 0090
BONFIELD TOWNSHIP CON 11(017)	17 644516 5125575 ^M	1980/10 1120	06	FR 0250	020 / 003 / 2:0	DO		4303325 () BRWN CLAY BLDR 0030 BLCK GRNT 0365

TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 11(018)	17 644666 5126075 ^W	1981/04 1120	06	FR 0205	008 / 205 010 / 1:0	DO		4303454 () BRWN CLAY 0040 BLCK GRNT 0225
BONFIELD TOWNSHIP 11(014)	17 642826 5125624 ^W	2006/10 1462	06	FR 0225	013 / 053 010 / 1:0	DO		7038948 (258808) A046839 CLAY SAND 0022 GREY GRNT 0240
BONFIELD TOWNSHIP 11(015)	17 643580 5125596 ^W	2005/05 1462	06	FR 0040 FR 0050	010 / 010 / 1:0	DO		4307694 (224652) A012789 SAND BLDR 0029 RED GRNT 0082
BONFIELD TOWN CON 11(014)	17 643103 5125301 ^L	1985/12 2428	06	FR 0205	012 / 070 006 / 5:0	NU		4304057 () GREY CLAY BLDR 0060 GREY GRNT 0180 RED GRNT 0210
BONFIELD TOWN 11(014)	17 663163 5125328 ^W	2007/11 3678	00	FR	040 / 100 004 / 1:0	DO		7052997 (268348) A056565 GREY CLAY 0010 GREY STNS 0030 GREY ROCK 0320
BONFIELD TOWN 11(016)	17 643986 5125178 ^W	2008/05 1462	06	FR 0147 FR 0160 FR 0170 FR 0200	036 / 100 010 / 1:0	DO		7116820 (277243) A061170 CLAY 0007 GRVL BLDR SAND 0044 GREY GRNT 0220

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TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
CALVIN TOWNSHIP CON 09(033)	17 654066 5125925 ^N	1979/10 1748	06 06	FR 0305 FR 0480	010 / 482 002 / 1:0	DO		4303078 () BRWN SAND GRVL 0002 GREY CLAY STNS 0029 RED GRNT 0482
CALVIN TOWNSHIP CON 09(034)	17 653561 5125496 ^N	1974/04 4406	06 06	FR 0110	022 / 025 025 / 20:0	CO		4302082 () RED SAND 0010 BLUE CLAY SILT 0063 QSND 0090 BLUE FSND 0103 BLUE GRVL STNS BLDR 0110 RED GRNT 0112
CALVIN TOWNSHIP CON 09(036)	17 653366 5124575 ^N	1977/10 1445	02 02	FR 0115 FR 0100	035 / 035 001 / 4:0	DO		4302711 () BRWN SAND QSND GRVL 0084 RED GRNT GNIS 0119
CALVIN TOWNSHIP 09(034)	17 653450 5124577 ^N	2007/08 3678	06 05	FR 0080 FR 0087	035 / 043 004 / 1:0	DO	81 6	7048613 (Z65854) A056605 BRWN SAND SLTY 0080 BRWN SAND 0088

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TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
CALVIN TOWNSHIP CON 10(033)	17 653807 5126322 ^L	1990/05 1377	06	FR 0059	014 / 036 012 / 1:0	DO		4304971 (58527) SAND 0010 BRWN CLAY 0036 GREY CLAY 0040 QSND 0046 SAND GRVL 0055 ROCK FCRD 0058 ROCK 0060
CALVIN TOWNSHIP CON 10(033)	17 653807 5126322 ^L	1983/07 2305	06 06	FR	025 / 006 / 32:0	DO		4305577 (097938) BRWN SAND BLDR 0030 GRNT 0411 GREY UNKN 0411
CALVIN TOWNSHIP CON 10(034)	17 653816 5125925 ^M	1983/08 1120	06	FR 0065	040 / 065 012 / 1:0	DO		4303755 () BRWN SAND 0012 GREY CLAY 0045 BRWN SAND 0060 RED GRVL 0073
CALVIN TOWNSHIP CON 10(035)	17 652716 5126375 ^M	1978/09 1462	06 06	FR 0143	043 / .001 / 1:30	DO		4302891 () BRWN FSND 0059 RED GRNT 0123 GREY GRNT 0143
CALVIN TOWNSHIP CON 10(036)	17 652558 5126000 ^M	2010/10 2305	06	0003	050 / 198 004 / 1:0	DO		7158649 (Z123213) A094162 GREY CLAY SAND 0038 RED GRNT 0200

TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
CALVIN TOWNSHIP CON 07(010)		2000/06 2305	06 06	FR 0130	014 / 140 010 / 1:0	DO		4306865 (203166) GREY CLAY SAND 0064 GREY GRNT 0141
CALVIN TOWNSHIP CON 07(013)		1987/07 3665	06 06	FR 0185	030 / 020 / 2:0	DO		4304318 (17146) GREY GRNT 0190
CALVIN TOWNSHIP 07(012)	17 660744 5126553 ^W	2006/06 1462	06	FR 0242 FR 0330	034 / 100 005 / 1:0	DO		4307956 (Z50356) A035274 GRVL BLDR 0032 RED GRNT 0342

TOWNSHIP CONCESSION (LOT)	UTM ¹	DATE ² CNTR ³	CASING DIA ⁴	WATER ^{5,6} DETAIL	STAT LVL/PUMP LVL ⁷ RATE ⁸ /TIME HR:MIN	WATER USE ⁹	SCREEN INFO ¹⁰	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
CALVIN TOWNSHIP CON 09(014)	17 661416 5128100 ^W	1959/10 1508	02 02	FR 0042	010 / 020 002 / 2:0	DO		4300182 () GRNT 0045
CALVIN TOWNSHIP CON 09(014)	17 661316 5128100 ^W	1952/04 2512	05	FR 0036	020 / 020 001 / 2:0	DO		4300181 () GRVL BLDR MSND 0035 GRVL 0036
CALVIN TOWNSHIP CON 09(015)	17 660944 5128393 ^L	1994/04 1462	06	FR 0141	/ 003 / 1:0	DO		4305843 (129575) SAND BLDR 0054 GREY GRNT 0090 RED GRNT 0110 GREY GRNT 0141 BRWN GRNT 0145 GREY GRNT 0165
CALVIN TOWNSHIP CON 09(016)	17 660685 5127936 ^W	2011/09 3678	06 06	FR 0175 FR 0235	040 / 065 004 / 1:0	DO		7169620 (Z138336) A121990 BRWN SAND 0030 GREY GRVL BLDR 0068 RED ROCK 0240
CALVIN TOWNSHIP CON 09(017)		2001/09 3678	06 06	FR 0385	060 / 295 003 / 1:10	DO		4307096 (235751) BRWN LOAM 0010 GREY ROCK 0445
CALVIN TOWNSHIP CON 09(017)	17 660209 5128008 ^W	2006/04 2305	06	FR 0065	028 / 065 020 / 1:0	DO		4307870 (Z35654) A032574 BRWN SAND CLAY GRVL 0067 GRNT 0081
CALVIN TOWNSHIP CON 09(017)	17 660278 5127927 ^L	1996/10 1462	06	FR 0140 FR 0155	030 / 006 / 1:0	DO		4306220 (173008) GRVL BLDR 0020 CLAY 0080 SAND 0085 SAND BLDR 0109 RED GRNT 0162
CALVIN TOWNSHIP CON 09(018)	17 660716 5127915 ^W	1969/03 2305	02 02	FR 0104 UK 0076 FR 0083	043 / 043 001 / 20:0	DO		4301373 () MSND 0042 GRVL BLDR 0062 ROCK 0069 RED GRNT 0122
CALVIN TOWNSHIP 09(019)	17 659535 5127613 ^L	1984/06 1377	06	FR 0292		DO		4304506 (33918) SAND 0020 SAND GRVL 0053 BLCK ROCK 0325

Notes:

1. UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
2. Date Work Completed
3. Well Contractor Licence Number
4. Casing diameter in inches
5. Unit of Depth in Feet
6. See Table 4 for Meaning of Code

7. STAT LVL: Static Water Level in Feet ; PUMP LVL: Water Level After Pumping in Feet
8. Pump Test Rate in GPM, Pump Test Duration in Hour : Minutes
9. See Table 3 for Meaning of Code
10. Screen Depth and Length in feet
11. See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms									
Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY
CRYS	CRYSTALLINE	GRSN	GREENSTONE	MRBL	MARBLE	SHRP	SHARP	WBRG	WATER-BEARING
CSND	COARSE SAND	GRVL	GRAVEL	MSND	MEDIUM SAND	SHST	SCHIST	WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED	GRWK	GREYWACKE	MUCK	MUCK	SILT	SILT	WTHD	WEATHERED
DLMT	DOLOMITE	GVLY	GRAVELLY	OBDN	OVERBURDEN	SLTE	SLATE		
DNSE	DENSE	GYPS	GYPSUM	PCKD	PACKED	SLTY	SILTY		
DRTY	DIRTY	HARD	HARD	PEAT	PEAT	SNDS	SANDSTONE		
DRY	DRY	HPAN	HARDPAN	PGVL	PEA GRAVEL	SNDY	SANDY		

2. Core Color	
Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GRN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Water Use			
Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial		
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail			
Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		



APPENDIX C

Site Reconnaissance Observations
and Site Photographs 1 to 40



APPENDIX C

SITE RECONNAISSANCE OBSERVATIONS AND SITE PHOTOGRAPHS 1 TO 40

PML carried out the site reconnaissance survey (SRS) on the selected portion of the study corridor and adjacent lands. SRS was carried out on October 17 to 19, 2012 by Mr. B . R. Gray, P.Eng., Mr. B. Rao, P.Eng., and Mrs. N. S. Balakumaran, P.Eng. The SRS consisted of a drive-by and walk-through the selected section of Highway 17 alternatives.

The study area was divided into four sections and is listed below.

Highway 17 Route Sections	Approximate Location	Alternate Routes
West	0.6 km west of Highway 531 to approximately 1.5 km east of the Township of Bonfield boundary, about 12 km, Townships of Bonfield and Calvin	<ul style="list-style-type: none"> • Route W1 • Route W2 • Route W3 • Route W4 • Route W5
Middle	From about 1.5 km east of the Township of Bonfield boundary to 1.9 km west of Highway 630, about 5 km, Township of Calvin	Twinning proposed
East	From about 1.9 km west of Highway 630 to approximately 3.9 km east of Highway 630, about 5.8 km, Township of Calvin	<ul style="list-style-type: none"> • Route E1 • Route E2 • Route E3
Easterly	From about 3.9 km east of Highway 630 to approximately 8.0 km east of Highway 630, about 4.1 km	Twinning proposed

The SRS was carried out for the west and east sections of the Highway 17 alternatives.

West Section (Photographs 1 to 35)

- This section is mostly developed farm land with farm houses and local road network to the Rutherglen community located at the Highway 17 about middle of this section.



- The terrain along this section is generally flat with deep Kaibuskong River Valley, a number of creek valley, low-lying swampy and bedrock outcrop/knob areas.
- Routes W1 to W5 diverges at the west limits approximately 0.6 km west the existing Highway 531. Routes W1/W2, Route W3 and Routes W4/W5 cross Highway 531 at 850, 1000, 1150 m south of the existing Highway 17/ Highway 531 intersection (Photograph 1).
- The terrain consists of typically a surface layer of cohesionless sandy/silty soils over cohesive varved clay and silt over non-cohesive sandy/silty soil over localized till deposit containing cobbles and boulders mantling the bedrock. The bedrock is typically 5.4 to 6.6 m deep from water well records to deeper than 6.0 m (about elevation 203) at the Kaibuskong River Bridge at the Highway 17. A shallow overburden over the exposed rock cut was observed at the existing Highway 17/Line 3S intersection (Photograph 2).
- The west section routes cross the Line 3S at the various locations. Low-lying swampy areas are present west and east of Line 3S to north of Francoeur Road (Photographs 3 to 7).
- The west section routes cross the CPR and TCPL corridor and open pasture land with localized treed areas at the east of Line 3S and south of the Francoeur Road (Photograph 8).
- Routes W1 and W2 cross Trout Pond Road in an open land with Microwave Tower (Photographs 9 and 10).
- Route W3 crosses Trout Pond Road in a relative flat area and traverses through farmland at near the Trout Pond Road to with heavily treed areas to the Blueseal Creek plain (Photograph 11). A low-lying swampy area is present in the middle of the heavily treed area.
- Route W4/W5 crosses the Trout Pond Road and then Route W5 diverge off of the Trunk Road and Route W4 (Photographs 12 to 15). The terrain typically consists of shallow soil cover over bedrock. In this area, the bedrock is typically at surface to 12.0 m from the water well record. The exposed bedrock was observed at the Trunk Road (Photograph 17).
- Route W1 crosses the CPR corridor about 280 m south of the Trout Pond Road and CPR intersection (Photographs 16). A shallow soil cover is anticipated in this area. The bedrock is up to 3.9 m deep from water well record.



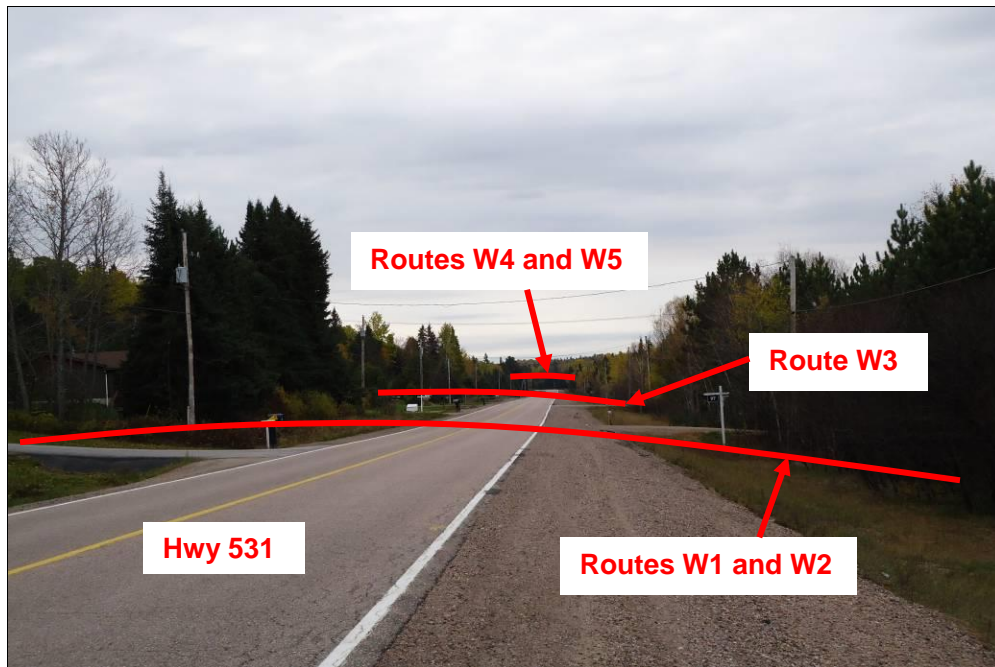
- Route W1 crosses the existing Highway 17 about 470 m east of Highway 17/Pine Lake Road intersection (Photographs 18 and 19). The bedrock is 4.5 to 6.9 m deep near this crossing from the water well records. The rock cut up to 5 m was observed at the existing Highway 17 and about 100 m west of the Blueseal Creek crossing at the Highway 17 (Photograph 20).
- Routes W2 to W5 traverse through open farmland with farm houses between Fichault Road and McNutt Road (Photographs 21 to 26). The TCPL corridor is present in this section. The terrain typically consists of shallow soil cover over the bedrock. The cut slope erosion is visible at the McNutt Road (Photograph 27). The bedrock was exposed to 5.7 m deep from the water well records.
- About 400 m west of McNutt Road to Rutherglen Line, Routes W2 to W5 cross low-lying swampy areas at the Sharpes Creek flood plain with bedrock with up to 21 m deep (Photographs 28 to 29).
- Routes W2/W3 and W4/W5 merges into one route at the Rutherglen Line in an open farm land (Photographs 30 to 32). TCPL corridor is present about 300 m south of proposed routes at the Rutherglen Line.
- Route W1 crosses the Talon Lake Road about 400 m north of the existing Highway 17 (Photographs 33 and 34). Low-lying swampy areas are present both sides of the Von Doeler Road where Route W1 crosses.

East Section (Photographs 36 to 40)

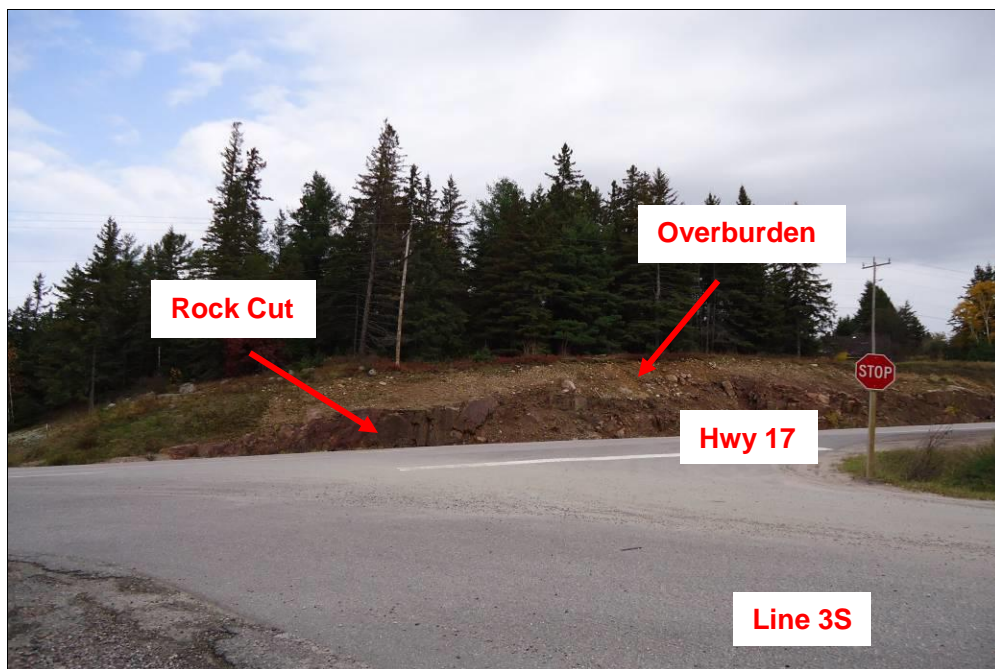
- This section of the route is primarily in Samuel de Champlain Provincial Park area encompassing the Crooked Chute Lake and Amable du Fond River. In addition, the existing Highway 630, CP Rail and Trans-Canada Pipeline corridor are located south of the existing Highway 17 and follows to the end of east section.
- The terrain along east section is characterized by relatively steep grade changes at the first 3 km section to generally flat at the remaining section. The terrain slope downwards towards the Crooked Chute Lake and Amable Du Fond River about 60 m drop in the first 3 km length of the east section. East of the Crooked Chute Lake, the terrain is generally flat with localized low-lying swampy areas.



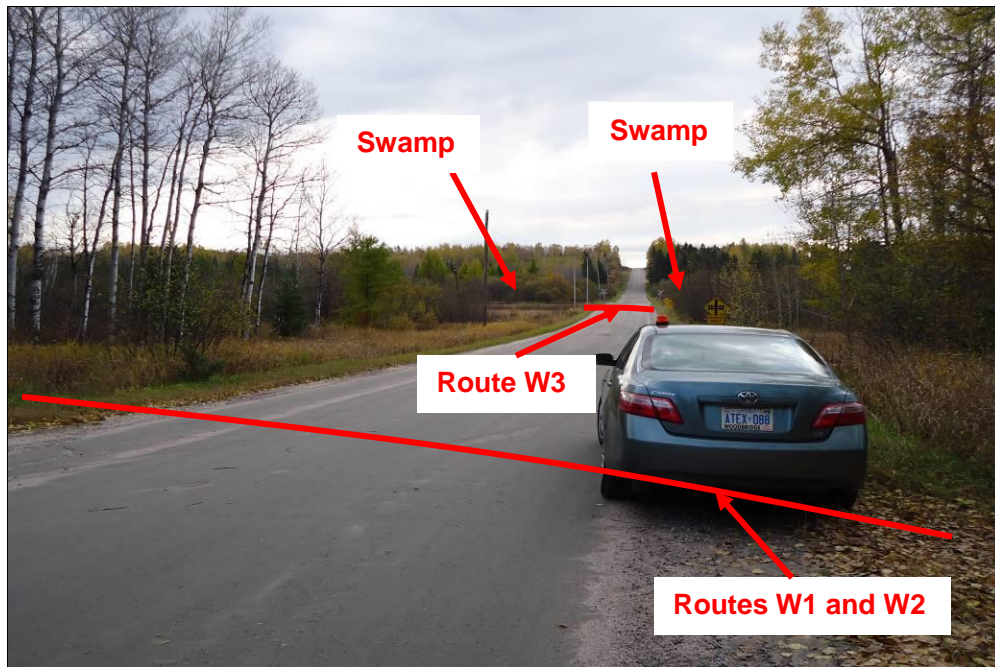
- The east section alternate Routes E1 to E3 diverge off from the existing Highway 17 at about 1.9 km west of Highway 17/Highway 630 intersection (Photograph 36).
- Route E1 and Routes E2/E3 cross the existing Highway 630 at about 160 and 310 m south of Highway 17/ Highway 630 intersection, respectively (Photographs 37 and 38). The terrain consists of typically non-cohesive (sandy soils) over till deposit containing cobbles and boulders mantling the bedrock. The bedrock is typically deep about 15.9 to 32.7 m from water well records to greater than 30 m at the Amable Du Fond River Bridge at the Highway 17.
- Route E1 follows the existing Highway 17 cross the Amable Du Fond River about 150 m south of the existing Highway 17 and south of the CP Rail crossing (Photograph 39). Terrain typically covered with stands of trees and bushes. The localized low-lying swampy areas are present in Route E1 and east of the Amable Du Fond River crossing.
- Routes E2/E3 cross the Trans-Canada Pipeline (TCPL) corridor about 600 m east of Highway 630 and follows the TCPL corridor southerly and north of Crooked Chute Lake. The localized low-lying swampy areas are present at west and east of the Crooked Chute Lake.
- Routes E1 to E3 merge with the existing Highway 17 about 3 km east of the existing Highway 17/ Highway 630 intersection (Photograph 40).



PHOTOGRAPH 1: Looking south from west shoulder of Hwy 531. Routes W1 to W5 cross Hwy 531 at 3 locations, about 850 m, 1000 m and 1150 m south of the intersection of Hwy 17 and Hwy 531. (October 17, 2012)



PHOTOGRAPH 2: Rock cut at the intersection of Hwy 17 and Line 3S. Three meter thick overburden of sandy soils, gravel and boulders mantling bedrock. (October 17, 2012)



PHOTOGRAPH 3: Looking south from west shoulder of Line 3S. Routes W1 to W3 cross Line 3S at 2 locations, about 10 m and 130 m south of the intersection of Line 3S and Francoeur Road. Route W3 will pass swamps on the two sides of Line 3S. (October 17, 2012)



PHOTOGRAPH 4: Swamp at west side of Line 3S and at the location where Route W3 crosses Line 3S, about 210 m south of the intersection of Line 3S and Francoeur Road. (October 17, 2012)



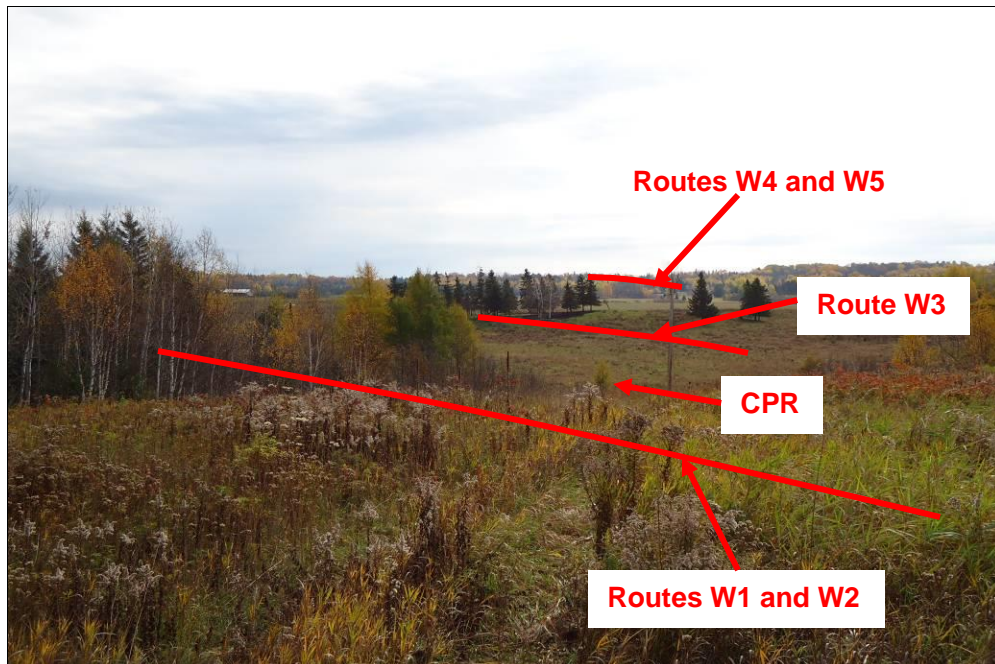
PHOTOGRAPH 5: Looking south from west shoulder of Line 3S. Routes W4 and W5 cross Line 3S at the location, about 620 m south of the intersection of Line 3S and Francoeur Road. (October 17, 2012)



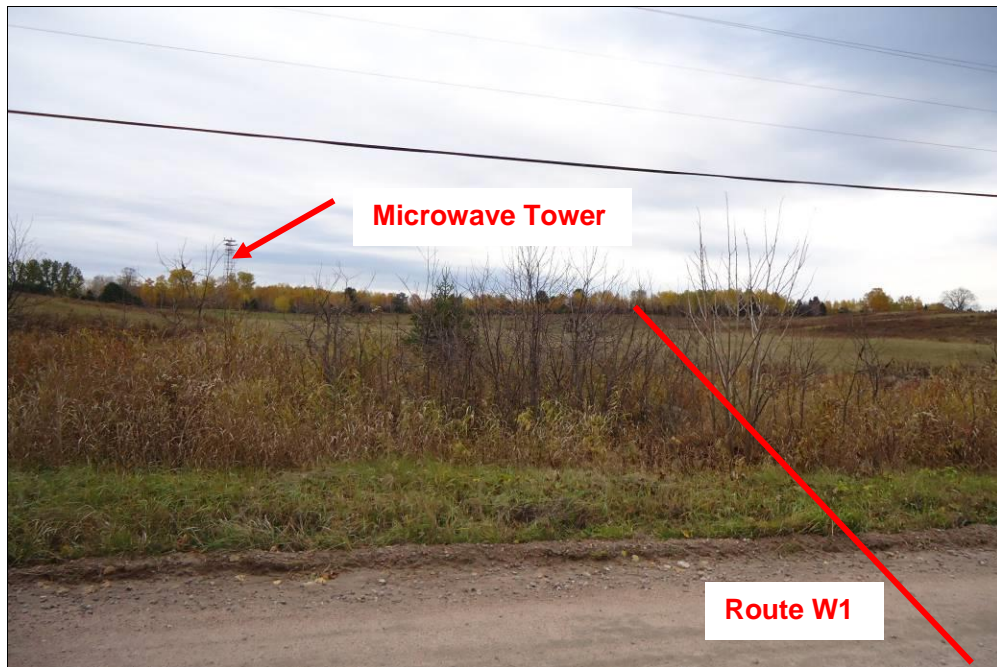
PHOTOGRAPH 6: Swamp and culvert exist at east side of Line 3S, about 140 m south of the location where Routes W4 and W5 cross Line 3S. (October 17, 2012)



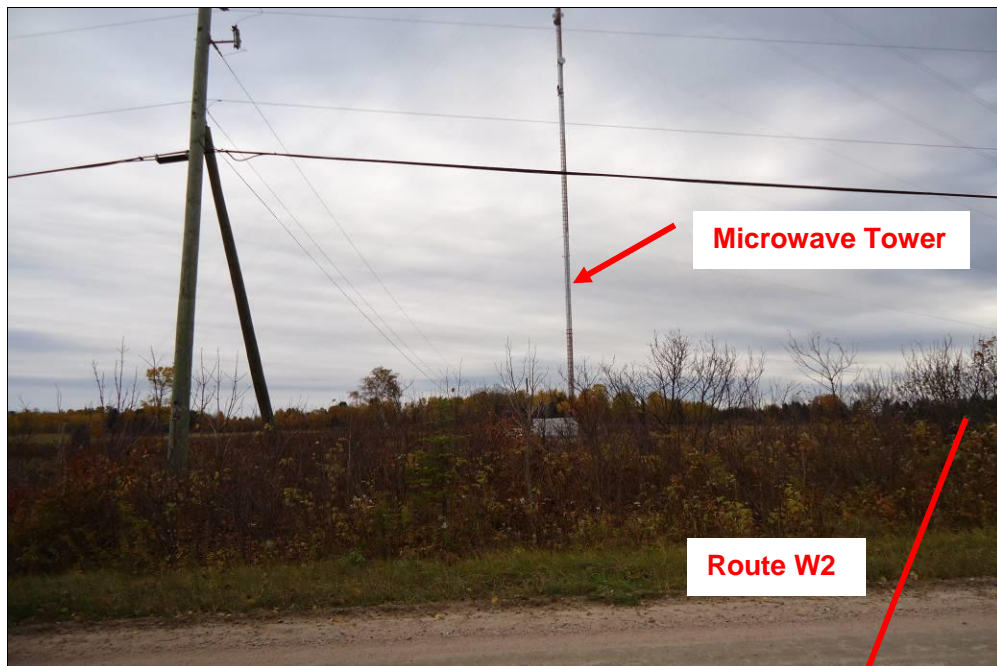
PHOTOGRAPH 7: Swamp and culvert exist at west side of Line 3S, about 140 m south of the location where Routes W4 and W5 cross Line 3S. (October 17, 2012)



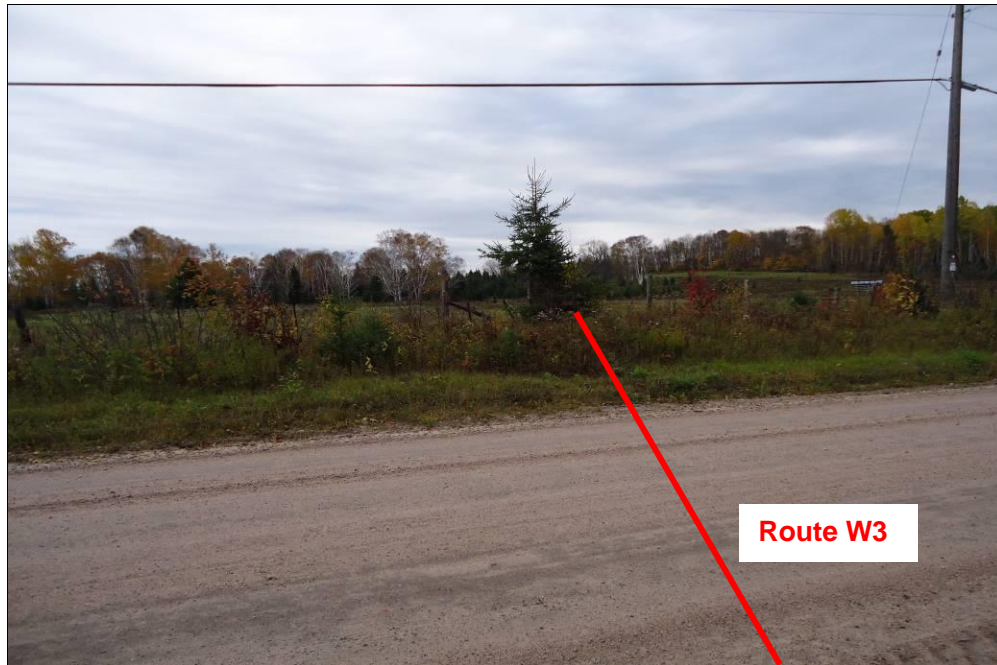
PHOTOGRAPH 8: Looking south from the location where Routes W1 and W2 cross TCPL, about 110 m south of east end of Francoeur Road. Route W3 passes by the green tress in middle horizon and Routes W4 and W5 by the yellow tress in distance. (October 17, 2012)



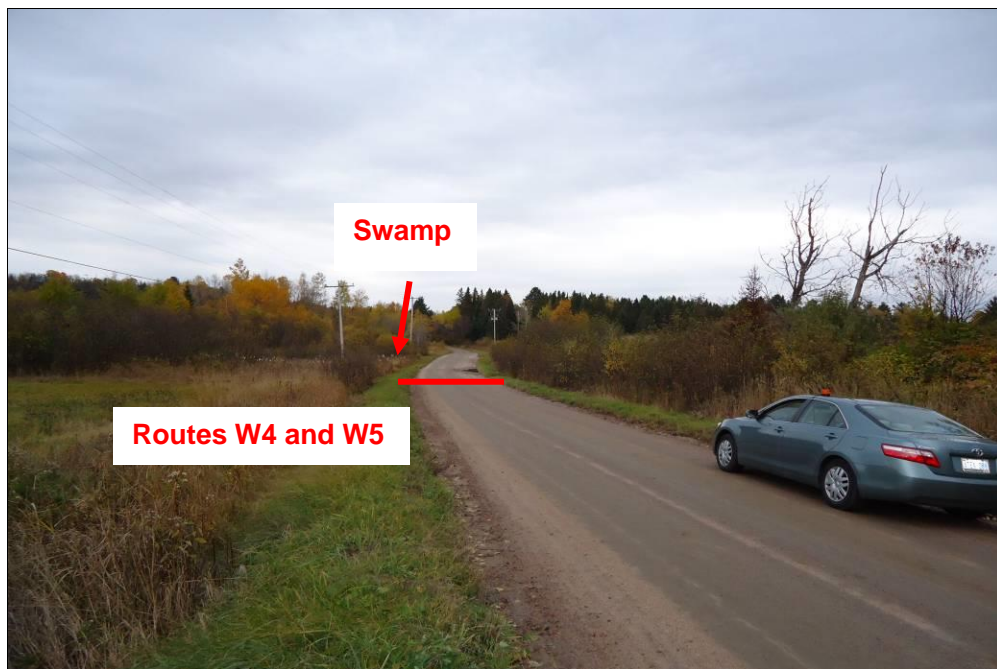
PHOTOGRAPH 9: Looking east from west shoulder of Trout Pond Road at the location where Route W1 crosses Trout Pond Road, about 160 m south of right angle bend. (October 17, 2012)



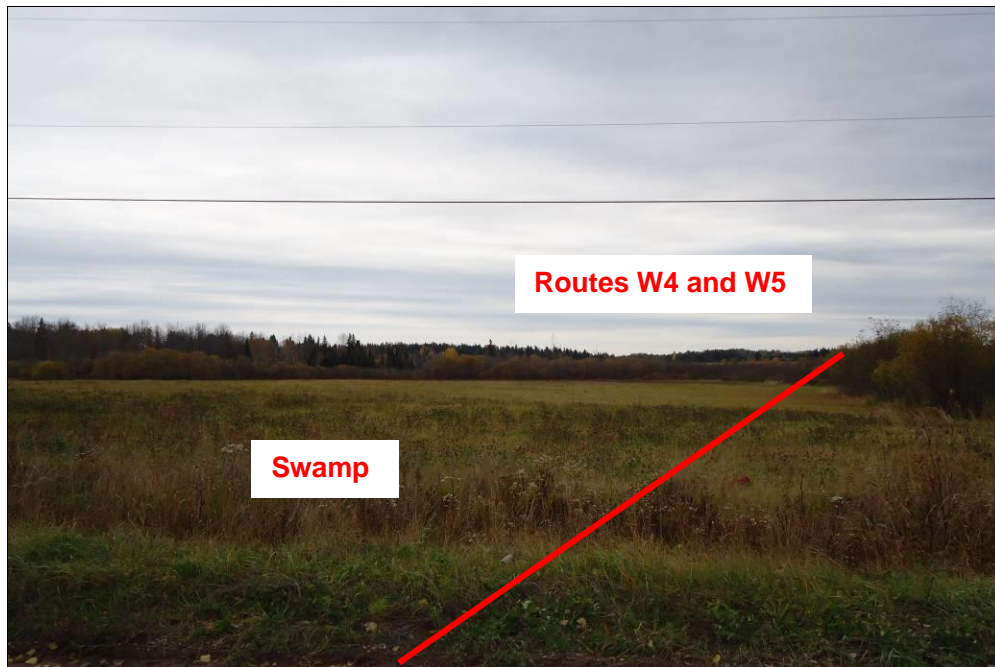
PHOTOGRAPH 10: Looking east from west shoulder of Trout Pond Road at the location where Route W2 crosses Trout Pond Road, about 500 m south of right angle bend. Route W2 passes by at about 100 m south of Microwave Tower. (October 17, 2012)



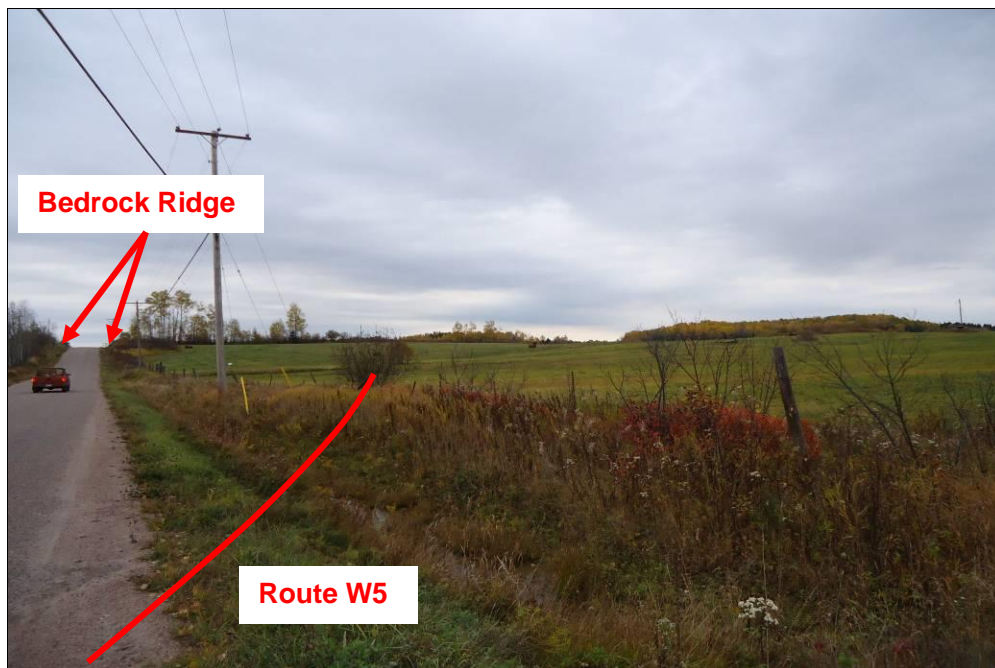
PHOTOGRAPH 11: Looking east from west shoulder of Trout Pond Road at the location where Route W3 crosses Trout Pond Road, about 860 m south of right angle bend. (October 17, 2012)



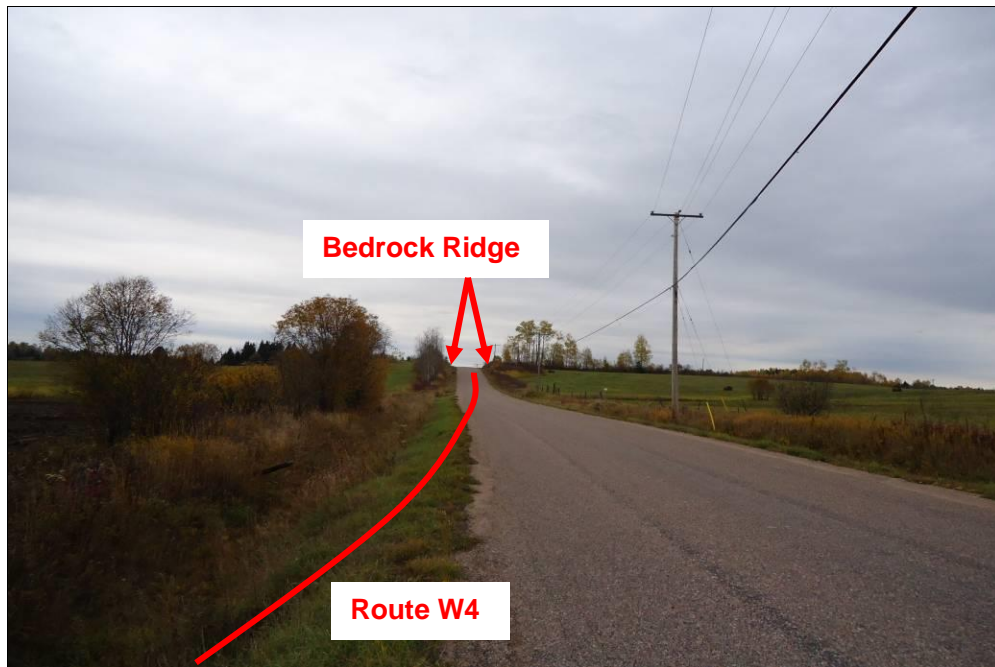
PHOTOGRAPH 12: Looking south from east shoulder of Trout Pond Road at the location where Routes W4 and W5 cross Trout Pond Road, about 260 m north of the intersection of Trout Pond Road and Trunk Road. (October 17, 2012)



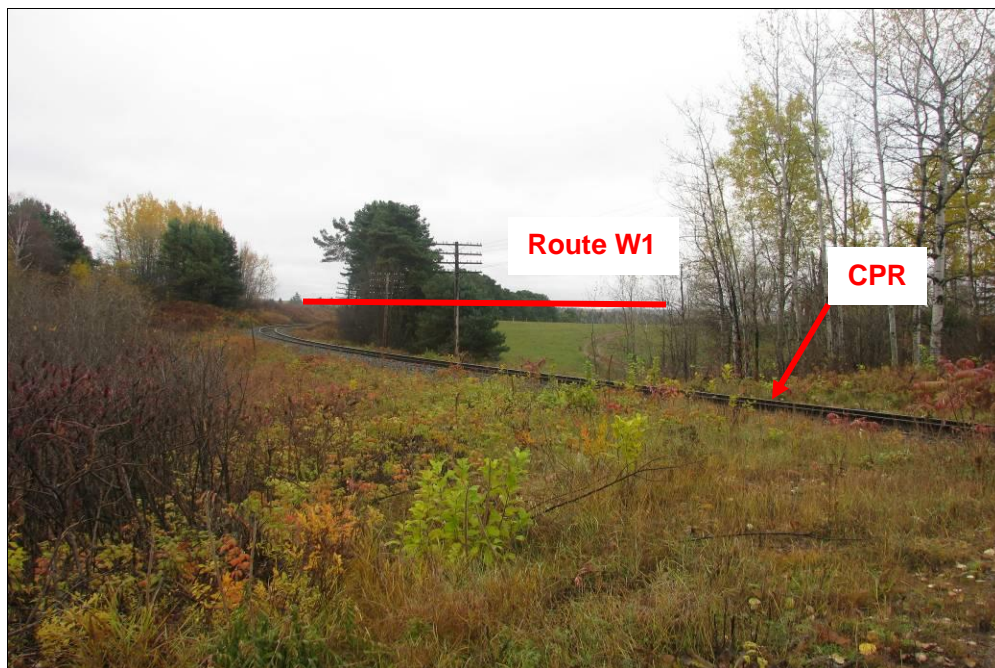
PHOTOGRAPH 13: Swamp on east side of Trout Pond Road and at the location where Routes W4 and W5 cross Trout Pond Road, about 260 m north of the intersection of Trout Pond Road and Trunk Road. (October 17, 2012)



PHOTOGRAPH 14: Looking east from south shoulder of Trunk Road at the location where Route W5 crosses Trunk Road, about 490 m east of the intersection of Trout Pond Road and Trunk Road. (October 17, 2012)



PHOTOGRAPH 15: Looking east from north shoulder of Trunk Road at the location where Route W4 approaches and merges with Trunk Road, about 500 m east of the intersection of Trout Pond Road and Trunk Road. (October 17, 2012)



PHOTOGRAPH 16: Looking southeast from north side of CPR at the intersection of CPR and Trout Pond Road. Route W1 crosses CPR about 280 m southeast of the intersection of CPR and Trout Pond Road. (October 19, 2012)



PHOTOGRAPH 17: Rock outcrop in both sides of Trunk Road, about 800 m east of the intersection of Trout Pond Road and Trunk Road. (October 17, 2012)



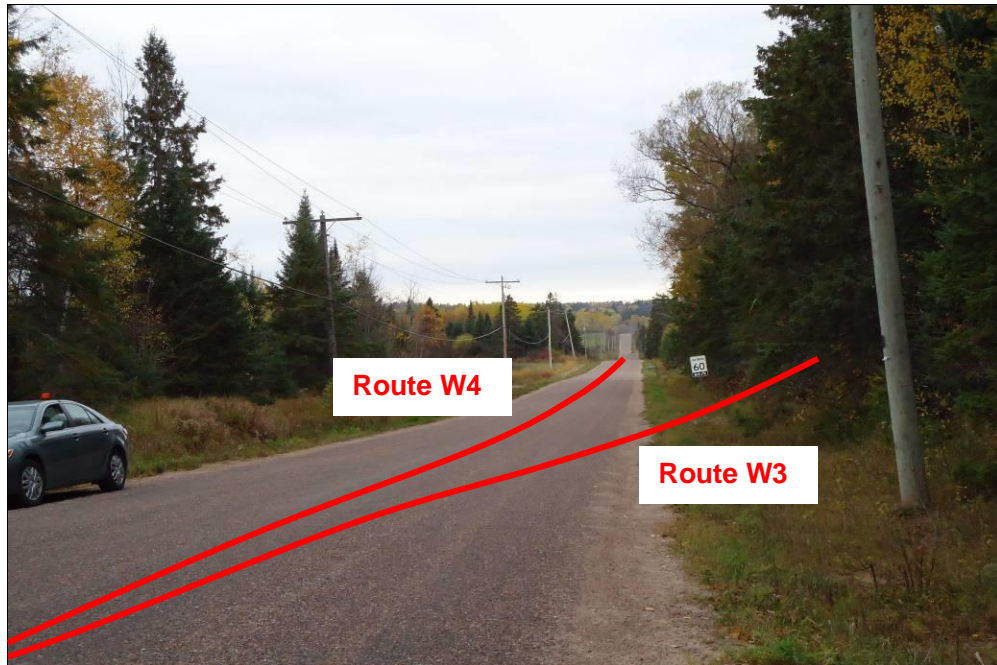
PHOTOGRAPH 18: Looking west from north shoulder of Hwy 17. Route W1 crosses Hwy 17, about 470 m east of the intersection of Pine Lake Road and Hwy 17. (October 19, 2012)



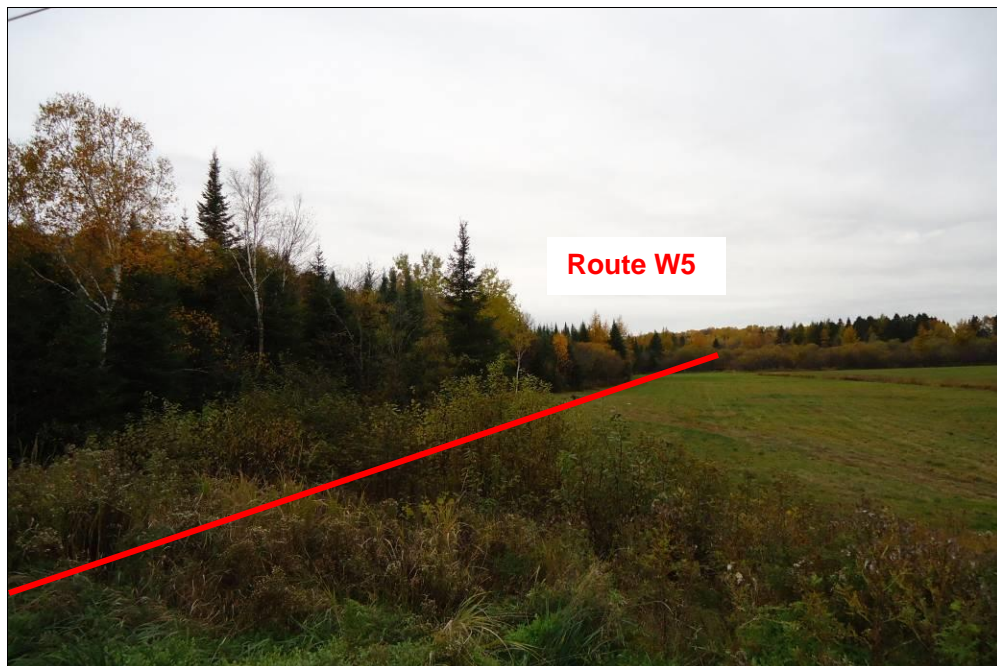
PHOTOGRAPH 19: Looking east from north shoulder of Hwy 17. Route W1 crosses Hwy 17, about 470 m east of the intersection of Pine Lake Road and Hwy 17. (October 19, 2012)



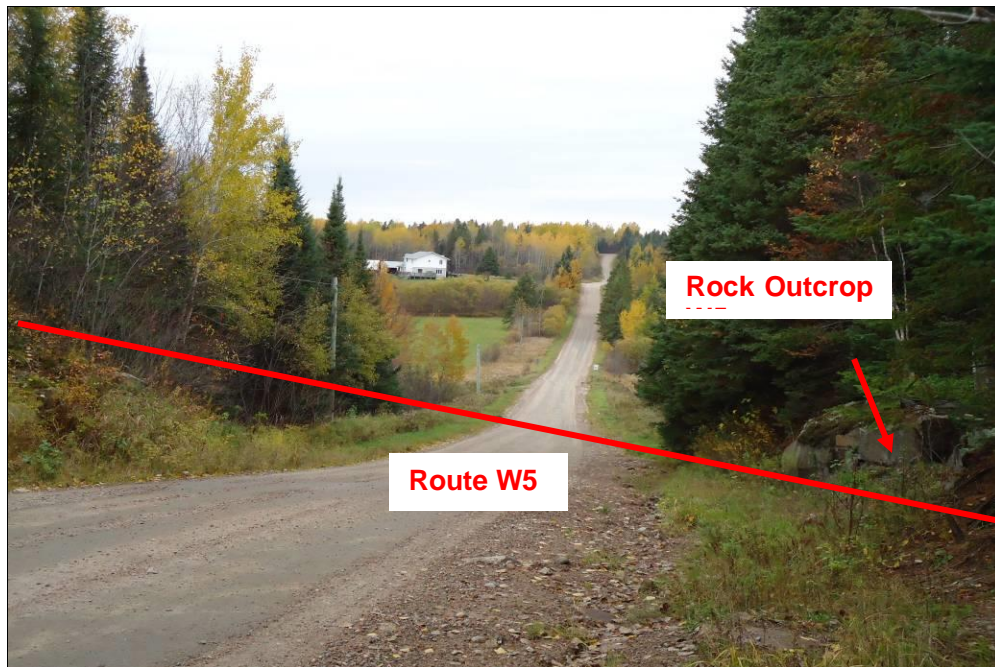
PHOTOGRAPH 20: Looking west from north shoulder of Hwy 17 at rockfill embankment and 5 m rock cut in distance. Route W1 parallels Hwy 17 about 70 m to the north. (October 19, 2012)



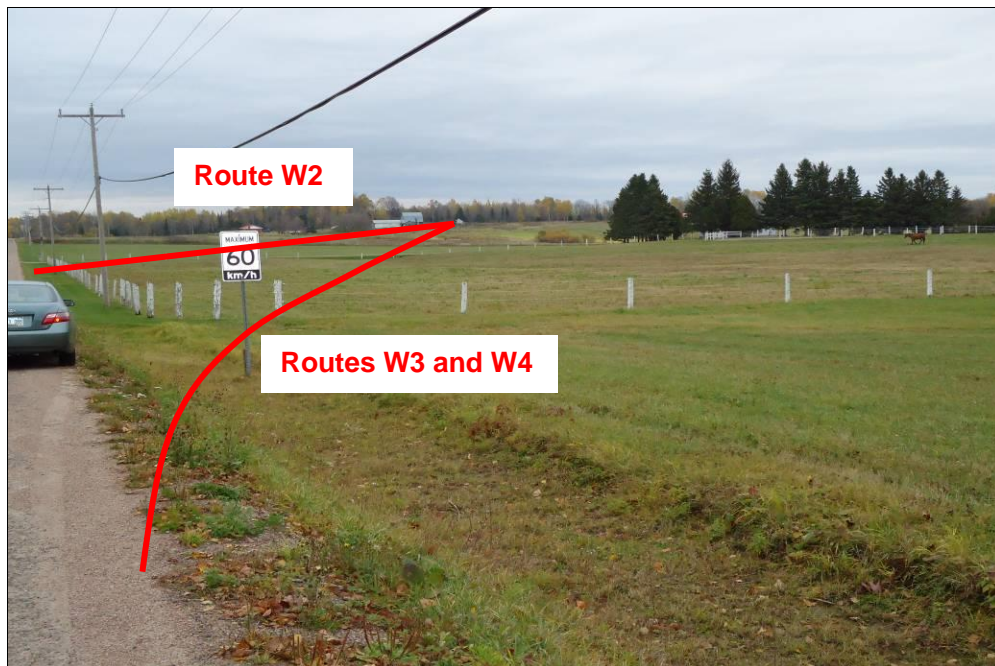
PHOTOGRAPH 21: Looking west from the intersection of Trunk Road and Fichault Road. Route W4 is along Trunk Road and Route W3 approaches from north side and merges with Trunk Road. (October 17, 2012)



PHOTOGRAPH 22: Looking west from the location Route W5 crosses Fichault Road, about 600 m south of the intersection of Fichault Road and Trunk Road. (October 17, 2012)



PHOTOGRAPH 23: Looking north from east shoulder of Fichault Road at the location where Routes W5 crosses Fichault Road, about 600 m south of the intersection of Fichault Road and Trunk Road. (October 17, 2012)



PHOTOGRAPH 24: Looking east from south shoulder of Trunk Road at the location where Routes W3 and W4 shift off Trunk Road, about 650 m east of the intersection of Fichault Road and Trunk Road. Route W2 crosses Trunk Road, about 950 m east of the intersection of Fichault Road and Trunk Road, and join Routes W3 and W4 at south side of Trunk Road. (October 17, 2012)



PHOTOGRAPH 25: Looking east from south shoulder of Trunk Road at the intersection of TCPL and Trunk Road. Route W2 crosses Truck Road, about 950 m east of the intersection of Fichault Road and Trunk Road, and joins Routes W3 and W4 at the south side of Trunk Road. (October 17, 2012)



PHOTOGRAPH 26: Looking west from north shoulder of Trunk Road at the location where Route W2 crosses Trunk Road, about 950 m east of the intersection of Fichault Road and Trunk Road. (October 17, 2012)



PHOTOGRAPH 27: Looking north from west shoulder of McNutt Road. Visible erosion on 3 m high sandy silt slope surface on west side of McNutt Road about 350 m south of the intersection of McNutt Road and Trunk Road. (October 17, 2012)



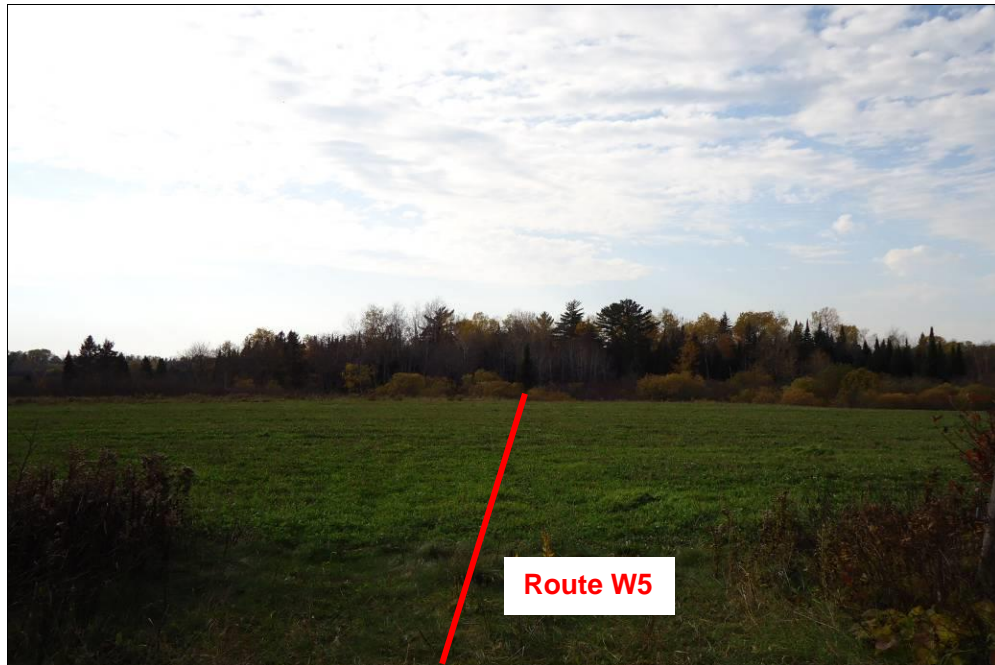
PHOTOGRAPH 28: Looking west from west shoulder of McNutt Road at the location where Routes W2 to W4 cross McNutt Road, about 450 m south of the intersection of McNutt Road and Trunk Road. (October 17, 2012)



PHOTOGRAPH 29: Looking east from east shoulder of McNutt Road at the location where Route W5 crosses McNutt Road, about 860 m south of the intersection of McNutt Road and Trunk Road. (October 17, 2012)



PHOTOGRAPH 30: Looking west from west shoulder of Rutherglen Line. Routes W2 to W4 cross Rutherglen Line at this location, about 720 m south of the intersection of Rutherglen Line and Trunk Road. (October 17, 2012)



PHOTOGRAPH 31: Looking west from west shoulder of Rutherglen Line. Route W5 crosses Rutherglen Line, about 800 m south of the intersection of Rutherglen Line and Trunk Road. (October 17, 2012)



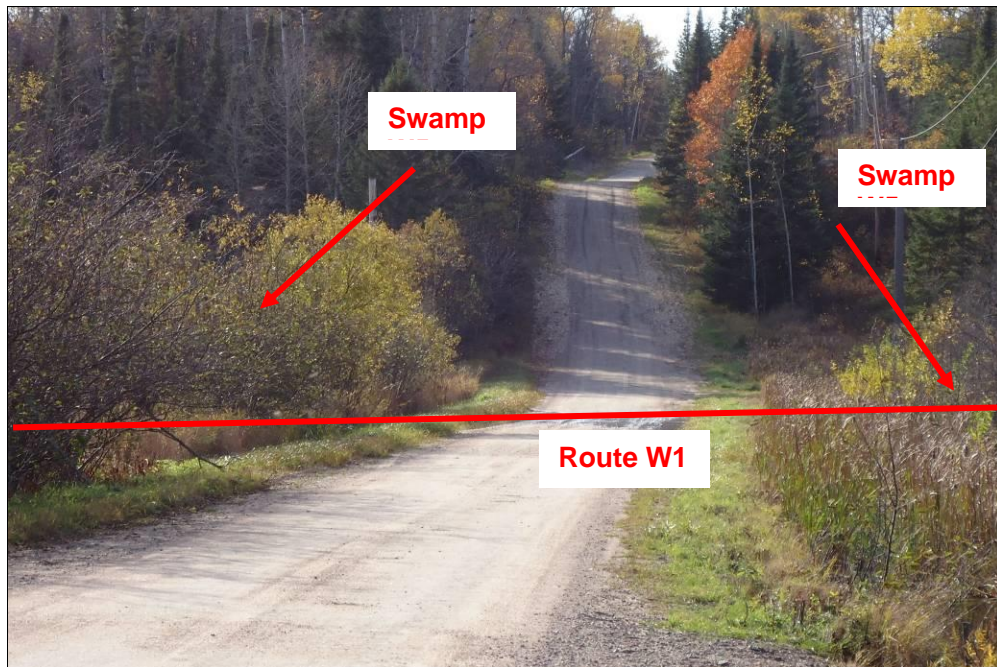
PHOTOGRAPH 32: Looking north from west shoulder of Rutherglen Line. Route W5 crosses Rutherglen Line, about 800 m south of the intersection of Rutherglen Line and Trunk Road, and Routes W2 to W4, about 720 m south of the intersection, and join up on the east side of Rutherglen Line. (October 17, 2012)



PHOTOGRAPH 33: Looking northwest from west shoulder of Talon Lake Road at the location where Route W1 crosses Talon Lake Road, about 300 m north of the intersection of Von Doeler Road and Talon Lake Road. (October 17, 2012)



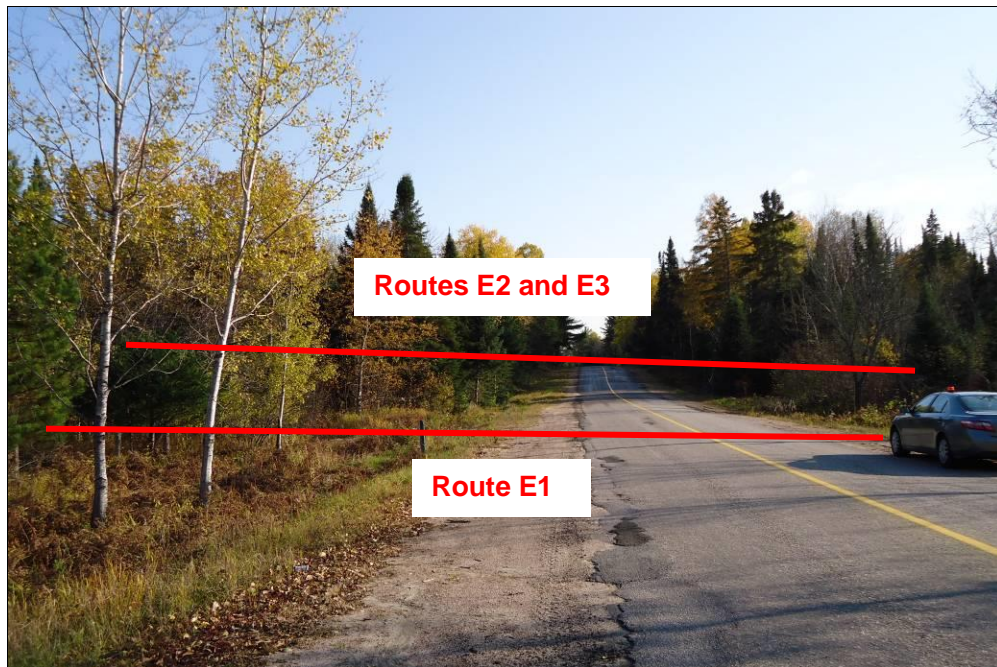
PHOTOGRAPH 34: Looking north from east shoulder of Talon Lake Road. Route W1 crosses Talon Lake Road about 300 m north of the intersection of Von Doeler Road and Talon Lake Road. (October 17, 2012)



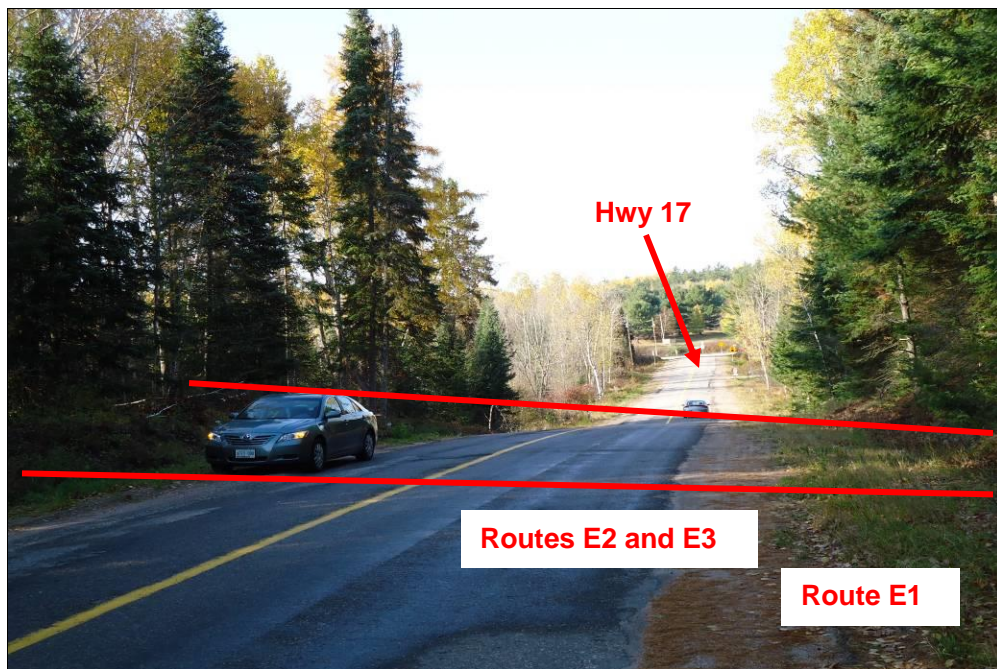
PHOTOGRAPH 35: Looking west from north shoulder of Von Doeler Road. Route W1 crosses Von Doeler Road at the flooded location, about 330 m east of the intersection of Von Doeler Road and Talon Lake Road. (October 17, 2012)



PHOTOGRAPH 36: Looking east from north shoulder of Hwy 17. Routes E1 to E3 shift off Hwy 17, about 1860 m west of the intersection of Hwy 17 and Hwy 630. (October 17, 2012)



PHOTOGRAPH 37: Looking south from east shoulder of Hwy 630. Route E1 and Routes E2 and E3 cross Hwy 630, about 160 m and 310 m south of the intersection of Hwy 17 and Hwy 630 respectively. (October 17, 2012)



PHOTOGRAPH 38: Looking north from east shoulder of Hwy 630. Route E1 and Routes E2 and E3 cross Hwy 630, about 160 m and 310 m south of the intersection of Hwy 17 and Hwy 630 respectively. (October 17, 2012)



PHOTOGRAPH 39: Looking south from underside of CPR Bridge up Amable Du Fond River. Overpass structure for Route E1 passes at the narrow river course location, about 140 m south of Hwy 17. (October 17, 2012)



PHOTOGRAPH 40: Looking east from the ditch at south side of Hwy 17, about 3.0 km east of the intersection Highway 17 and Highway 630. Routes E1 to E3 approach and join Hwy 17. (October 17, 2012)



APPENDIX D

Preliminary Structure Locations Considered for Foundation Assessment



APPENDIX D

PRELIMINARY STRUCTURE LOCATIONS CONSIDERED FOR FOUNDATION ASSESSMENT

No	Crossing	Foundation Type	Remarks
West Section, Route W1, Township of Bonfield			
(*)	Kaibuskong River Bridge	Integral abutments on piles	Bedrock about elevation 203 at the existing Kaibuskong River bridge at the Highway 17. Varved clay and silt at the approach embankment
(*)	Highway 531 Interchange structure	Integral abutments on piles	Bedrock is up to 6.6 m deep based on the water well record.
1	Line 3S	Assumed Integral abutments on piles and possible shallow foundations	Bedrock is up to 6.6 m deep based on the water well record. Possible shallow bedrock (less than 3 m deep)
2	CPR	Integral abutments on piles	High approach embankment
3	Trout Pond Road	Assumed shallow foundations	Bedrock is up to 12 m deep based on the water well record. Possible dense cohesionless soils below frost depth
4	CPR	Integral abutments on piles	Approach embankment about 3 m high. Bedrock is about 3.9 m deep based on the nearby water well record.
5	Highway 17 existing	Assumed shallow foundations	Bedrock outcrop observed close to this crossing during site reconnaissance. the bedrock depth is 4.5 m deep based on the nearby water well record
6	Blueseal Creek Bridge	Deep foundations	High approach embankment over swampy flood plain
7	Sharpes Creek Bridge	Deep foundations	High approach embankment over swampy flood plain
8	Talon Lake Road	Shallow Foundations on Native Soils	—



No	Crossing	Foundation Type	Remarks
West Section, Route W2, Township of Bonfield			
Is (*)	Kaibuskong River Bridge	Integral abutments on piles	Bedrock about elevation 203 at the existing Kaibuskong River bridge at the Highway 17. Varved clay and silt at the approach embankment
(*)	Highway 531 Interchange structure	Integral abutments on piles	Bedrock is up to 6.6 m deep based on the water well record.
1	Line 3S	Assumed Integral abutments on piles and possible shallow foundations	Bedrock is up to 6.6 m deep based on the water well record. Possible shallow bedrock (less than 3 m deep)
2	CPR	Integral abutments on piles	High approach embankment
3	Trout Pond Road	Assumed shallow foundations	Bedrock is up to 12 m deep based on the water well record. Possible dense cohesionless soils below frost depth
4	Blueseal Creek Culvert	Shallow foundations	—
5	Trunk Road	Assumed shallow foundations	Bedrock is up to 1.5 to 5.7 m deep based on the water well record.
6	McNutt Road	Deep foundations	Approach embankment over swampy flood plain
7	Sharpes Creek Bridge	Deep foundations	Approach embankment over swampy flood plain
8	Rutherglen Line	Deep foundations	—
9	CPR	Integral abutments on piles	High approach embankment



No	Crossing	Foundation Type	Remarks
West Section, Route W3, Township of Bonfield			
(*)	Kaibuskong River Bridge	Integral abutments on piles	Bedrock about elevation 203 at the existing Kaibuskong River bridge at the Highway 17. Varved clay and silt at the approach embankment
(*)	Highway 531 Interchange structure	Integral abutments on piles	Bedrock is up to 6.6 m deep based on the water well record.
1	CPR	Integral abutments on piles	High approach embankment
2	Line 3S	Assumed Integral abutments on piles and possible shallow foundations	Bedrock is up to 6.6 m deep based on the water well record. Possible shallow bedrock (less than 3 m deep)
3	Trout Pond Road	Assumed shallow foundations	Bedrock is up to 12 m deep based on the water well record. Possible dense cohesionless soils below frost depth
4	Blueseal Creek Culvert	Shallow foundations	—
5	Trunk Road	Assumed shallow foundations	Bedrock is up to 1.5 to 5.7 m deep based on the water well record.
6	McNutt Road	Deep foundations	Approach embankment over swampy flood plain
7	Sharpes Creek Bridge	Deep foundations	Approach embankment over swampy flood plain
8	Rutherglen Line	Deep foundations	—
9	CPR	Integral abutments on piles	High approach embankment



No	Crossing	Foundation Type	Remarks
West Section, Route W4, Township of Bonfield			
(*)	Kaibuskong River Bridge	Integral abutments on piles	Bedrock about elevation 203 at the existing Kaibuskong River bridge at the Highway 17. Varved clay and silt at the approach embankment
(*)	Highway 531 Interchange structure	Integral abutments on piles	Bedrock is up to 6.6 m deep based on the water well record.
1	CPR	Integral abutments on piles	High approach embankment
2	Line 3S	Assumed Integral abutments on piles and possible shallow foundations	Bedrock is up to 6.6 m deep based on the water well record. Possible shallow bedrock (less than 3 m deep)
3	Trout Pond Road	Integral abutments on piles	Approach embankment adjacent to swampy area
4	Trunk Road	Assumed shallow foundations	Bedrock is up to 1.5 to 5.7 m deep based on the water well record.
5	Blueseal Creek Culvert	Shallow foundations	—
6	McNutt Road	Deep foundations	Approach embankment over swampy flood plain
7	Sharpes Creek Bridge	Deep foundations	Approach embankment over swampy flood plain
8	Rutherglen Line	Deep foundations	Approach embankment over swampy flood plain
9	CPR	Integral abutments on piles	High approach embankment



No	Crossing	Foundation Type	Remarks
West Section, Route W5, Township of Bonfield			
(*)	Kaibuskong River Bridge	Integral abutments on piles	Bedrock about elevation 203 at the existing Kaibuskong River bridge at the Highway 17. Varved clay and silt at the approach embankment
(*)	Highway 531 Interchange structure	Integral abutments on piles	Bedrock is up to 6.6 m deep based on the water well record.
1	CPR	Integral abutments on piles	High approach embankment
2	Line 3S	Assumed Integral abutments on piles and possible shallow foundations	Bedrock is up to 6.6 m deep based on the water well record. Possible shallow bedrock (less than 3 m deep)
3	Trout Pond Road	Integral abutments on piles	Approach embankment adjacent to swampy area
4	Blueseal Creek Culvert	Shallow foundations	—
5	Fichault Road	Assumed shallow foundations	Bedrock outcrop present at the route crossing
6	McNutt Road	Deep foundations	Approach embankment over swampy flood plain
7	Sharpes Creek Bridge	Deep foundations	Approach embankment over swampy flood plain
8	Rutherglen Line	Deep foundations	Approach embankment over swampy flood plain
9	CPR	Integral abutments on piles	High approach embankment
East Section, Route E1, Township of Calvin			
1	Highway 630 interchange structure	Assumed deep foundations	—
2	CPR	Integral abutments on piles	High approach embankment
3	Amable du Fond River Bridge	Assumed deep foundations and possible shallow foundations	High approach embankment
4	CPR	Integral abutments on piles	High approach embankment



No	Crossing	Foundation Type	Remarks
East Section, Route E2, Township of Calvin			
1	Highway 630 interchange structure	Assumed deep foundations	—
2	CPR	Integral abutments on piles	High approach embankment
3	Amable du Fond River Bridge	Assumed deep foundations and possible shallow foundations	High approach embankment
4	CPR	Integral abutments on piles	High approach embankment
East Section, Route E3, Township of Calvin			
1	Highway 630 interchange structure	Assumed deep foundations	—
2	CPR	Assumed deep foundations	High approach embankment
3	Amable du Fond River Bridge	Assumed deep foundations and possible shallow foundations	High approach embankment
4	CPR	Assumed deep foundations	High approach embankment

Notes: (*) These structures may be designed as part of west route planning study corridor (Highway 17, North Bay to Bonfield, GWP 5105-09-00) by others. Consequently, they were not included in this assessment.



APPENDIX E

Structure Locations on Preferred Alignment for Foundation Assessment



APPENDIX E

STRUCTURE LOCATIONS ON PREFERRED ALIGNMENT FOR FOUNDATION ASSESSMENT

No	Crossing	Foundation Type	Remarks
Preferred Alignment, Townships of Bonfield, Calvin and Papineau-Cameron			
1	Trout Pond Road	Assumed shallow foundations	Bedrock is up to 12 m deep based on water well record. Possible dense cohesionless soils below frost depth
2	Tributary to Blueseal Creek Culvert	Assumed shallow foundations	Approach embankment over swampy flood plain
3	Blueseal Creek Culvert	Shallow foundations	Bedrock is at 3.9 m based on water well records nearby
4	Trunk Road	Assumed shallow foundations	Bedrock is up to 1.5 to 5.7 m deep based on the water well record
5	Tributary to Sharpes Creek Culvert (McNutt Road)	Deep foundations	Approach embankment over swampy flood plain. Bedrock is at 21.0 m approximately.
6	Sharpes Creek Bridge	Deep foundations	Approach embankment over swampy flood plain
7	Rutherglen Line	Deep foundations	Bedrock is at approximately 5.4 m depth
8	CPR	Integral abutments on piles	High approach embankments Bedrock may be 33.0 m deep
9	Highway 630 interchange structure	Assumed deep foundations	Bedrock may be 33.0 m deep
10	CPR	Integral abutments on piles	High approach embankments Possible bedrock at 20.4 m
11	Amable du Fond River Bridge	Assumed deep foundations and possible shallow foundations	High approach embankments



APPENDIX E
**STRUCTURE LOCATIONS ON PREFERRED ALIGNMENT FOR
FOUNDATION ASSESSMENT**

No	Crossing	Foundation Type	Remarks
12	CPR	Integral abutments on piles	High approach embankments
13	Pautois Creek Bridge or Culvert	—	—
14	Boundary Road	—	—