



**REALIGNMENT ALTERNATIVE FOUNDATION ASSESSMENT
FOR
HIGHWAY 17 ROUTE PLANNING NORTH BAY TO BONFIELD
CITY OF NORTH BAY AND TOWNSHIPS OF EAST FERRIS AND
BONFIELD
DISTRICT OF NIPISSING, ONTARIO
GWP NO. 5105-09-00**

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REALIGNMENT ALTERNATIVE FOUNDATION ASSESSMENT REPORT

for

Highway 17 Route Planning North Bay to Bonfield
City of North Bay and Townships of East Ferris and Bonfield
District of Nipissing, Ontario
G.W.P. No. 5670-10-00

1. INTRODUCTION

This report provides the realignment alternative foundation assessment for a section of Highway 17 that extends from the Highway 11 south junction to 2.7 km east of Highway 531 in the District of Nipissing. The study was carried out for McCormick Rankin (MRC), a member of the MMM Group 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. The adjacent sections for this study corridor are GWP 5670- 10-00, Highway 17 from 2.7 km east of Highway 531 to 8 km east of Highway 630 by MTO/AECOM/PML and GWP 5077-07-00, Highway 17 from 8 km east of Highway 630 easterly through Mattawa by MTO/MRC/PML. Consequently, this study corridor should be made to match the alternate preferred route that is planned by MTO/AECOM/PML for the study corridor to the east.

The current study corridor extends about 26.0 km from the Highway 11 south junction in the City of North Bay easterly to 2.7 km east of Highway 531, through the City of North Bay and Townships of East Ferris and Bonfield in the District of Nipissing. This section of the existing Highway 17 is a two-lane highway with passing lanes. The chainage equation changes for the existing highway alignment at the following Stations:

- Sta. 14+363.40 City of North Bay = Sta. 10+000.00 Township of East Ferris
- Sta. 25+086.36 Township of East Ferris = Sta. 10+000.00 Township of Bonfield

A total of fourteen (14) realignment alternatives were generated using route optimization software by MTO/MRC for this planning study. Upon completion of the preliminary reviews by MTO and MRC, four (4) realignment alternatives were selected as representative from the foundation conditions perspective are detailed below and are shown on attached Drawings 1 to 14. These four (4) alignments were selected for further evaluation as each was determined to be



representative of the key elements of respective realignments within the original fourteen (14) realignment alternatives and the reduced sample size would permit a more practical comparison of the realignments.

STARTING POINT (SP) AT HIGHWAY 11	REALIGNMENT ALTERNATIVES ORIGINATED FROM QUANTM SOFTWARE	REALIGNMENT ALTERNATIVES SELECTED FOR FOUNDATION ASSESSMENT
SP#1 (Existing Highway 11/ Highway 17 Interchange)	<ul style="list-style-type: none"> • Realignment 1 • Realignment 2 • Realignment 3 	Realignment 2
SP#2 (About 1.7 km south of existing Highway 11/ Highway 17 Interchange)	<ul style="list-style-type: none"> • Realignment 4 • Realignment 5 • Realignment 6 	Realignment 6
SP#3 (About 3.2 km south of existing Highway 11/ Highway 17 Interchange)	<ul style="list-style-type: none"> • Realignment 7 • Realignment 8 • Realignment 9 • Realignment 10 	Realignment 10
SP#4 (About 2.5 km south of existing Lake Shore Drive overpass at Highway 11)	<ul style="list-style-type: none"> • Realignment 11 • Realignment 12 • Realignment 13 • Realignment 14 	Realignment 14

MRC provided a corridor study map which illustrated the realignment alternatives and respective profiles (QUANTM software profiles images) for this assessment. 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 in the City of North Bay and Townships of East Ferris and Bonfield. The study section of Highway 17 being reviewed extends from approximately the Highway 11 south junction to 2.7 km east of Highway 531, approximately 26.0 km. A Project Location Map (Figure 1) is enclosed for reference.



Land uses in the vicinity of the study corridor include rock quarries just east of Highway 11 and south of the existing Highway 17 and scattered sand/gravel pits along the existing Highway 17. Scattered residential houses are present along the Highway 17 from Highway 11 south junction to Highway 94. The residential houses are more numerous along the Highway 17 from Highway 94 to Highway 531. In addition, residential properties are also located along Highway 94 and Highway 531. Local restaurants and businesses are located along the existing Highway 17. The communities of Corbeil and Bonfield are located in the south limits of the study corridor.

The La Vase Portage Route traverses through the study corridor approximately 1.2 km east of the existing Highway 11/Highway 17 interchange in an approximately north to south direction.

Highway 94 and Highway 531 connect the existing Highway 17 to the Communities of Corbeil and Bonfield, respectively in the study corridor.

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

ROAD	STATION	STRUCTURES	STATION
City of North Bay			
Twin Lakes Road	10+460	–	
Bayview Road	12+325	–	
Birchcove Road	12+750	–	
Centennial Crescent	14+190	–	
Township of East Ferris			
Highway 94	15+420	–	
Johnson Road	15+870	–	
Dube Road	19+350	–	
Township of Bonfield			
Maple Road	12+090	Laren Creek Culvert Site No. 43-269	10+090
Highway 531	16+080	Barse Creek Culvert Site No. 43-270	13+580
Line 3S	16+310 (Note 1)	Kaibuskong River Bridge Site No. 43-113	15+860



The Ottawa Valley Railway (OVR) enters the study area from the west about 400 m north of the Highway 11 / Lake Shore Road interchange then primarily follows the study corridor south of the existing Highway 17. The Canadian National Railway (CNR) is located west of Highway 11 then crosses Highway 11 about 300 m north of the Birchs Road overpass at Highway 11.

A TransCanada Pipe Line (TCPL) corridor enters the study area from the north at a point about 1.7 km east of the existing Highway 11/Highway 17 interchange and approximately parallel to Highway 11 then exits the study corridor about 3 km east of Highway 11. A second TCPL corridor enters the study area from the north about 1.1 km east of the existing Highway 17/ Highway 531 at-grade crossing and generally follows Highway 17 easterly on south side.

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 study corridor from Ontario Geology Survey Maps 5041 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. Field visual reconnaissance surveys were carried out to verify the inferred data at 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 GEOCRE 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 water 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/clay) and rock outcrops along the study corridor were interpreted from maps including Ontario Base Maps and aerial photographs and were considered approximate and sufficient for the purpose of the current foundation assessment study.

3.3 Site Reconnaissance

PML carried out site reconnaissance surveys (SRS) on the selected portion of the realignment alternative where the permission to enter was not required. An initial 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. A follow-up second SRS was carried out on February 20 to 22, 2013 by Mr. A. Desira, M.Eng and Mr. D. Woodcock where permission to enter was obtained. The SRS consisted of a drive-by and walk-through the selected section of Highway 17 and adjacent lands. The ground truth checks verified the surficial geology and drainage conditions inferred from the literature and map reviews. A comprehensive commentary and notes from the site reconnaissance visits including inferred 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 28 representative site photographs are indicated on Drawings 1 to 14 and P1 to P15. The photographs are included in Appendix C.



3.4 Preliminary Subsurface Investigation

A limited preliminary subsurface investigation involving up to 20 exploratory boreholes was planned for the selected swamps and the proposed structures. The first round swamp investigation was completed in February/March 2013. The remaining boreholes were completed in June 2013. The results of this investigation will be provided separately in two Preliminary Foundation Investigation and Design Reports for embankments through swamps and for structures (PML Ref: 10TF031A-1 and 10TF031A-2). The investigation results were utilized for this foundation assessment report.

4. INFERRED SUBSURFACE CONDITIONS

4.1 General Geology

The site is located in the area of the Canadian Shield where extensive glaciation has occurred. This Highway 17 project is located in the Algonquin Highlands Physiographic region. The area is characterized by shallow glacial till overlying Precambrian bedrock. Locally, the overburden thickness can vary greatly over a short distance. Frequent bedrock outcrops are common.

The local topography is undulating as the highway corridor traverses areas which alternate between rock ridges and low lying swampy areas. Localized glaciolacustrine sandy/silty/clayey areas are present within the study corridor, particularly near Highway 94 and Highway 531 areas.

The realignment alternatives corridor traverses several different geological units:

- Wetland areas containing peat, silt, sand and clay deposits, typical of the Northern Ontario region
- Glaciolacustrine plains comprising sands and silts and clays
- 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



The study area of the Highway 17 is underlain by bedrock from 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 dips to more than 20 m below the ground surface. Bedrock outcrops/cuts are present in this area.

The approximate average extent of these physiographic/geologic formations along the Realignment Alternative 10 is generally summarized below with reference to chainage 10+000 starting at Highway 11. The details are provided for Alternative 10 as the preferred realignment alternative. The descriptions of the other realignment alternatives considered would be similar albeit with differing extents of the typical ground conditions namely;

- Bedrock Knobs and Organic Terrain
- Glaciolacustrine Plain and Bedrock Knobs
- Bedrock Knobs and Glaciolacustrine Plain or Organic Terrain over Bedrock
- Organic Terrain over Outwash Plain

APPROXIMATE CHAINAGE	PREDOMINANT GEOLOGIC UNIT	LENGTH (m)	PERCENT OF TOTAL (%)
Realignment Alternative 10, City of North Bay, Townships of East Ferris and Bonfield			
10+000 to 12+500	Bedrock Knobs and Organic Terrain [BR(N)+pOT]	2500	10.5
12+500 to 14+500	Glaciolacustrine Plain and Bedrock Knobs [GL(P)+BR(N)]	2000	8.4
14+500 to 16+450	Bedrock Knobs and Organic Terrain [BR(N)+pOT]	1950	8.1
16+450 to 17+100	Bedrock Knobs and Glaciolacustrine Plain or Organic Terrain over Bedrock [BR(N)+(GL(P),pOT/R)]	650	2.7
17+100 to 18+250	Bedrock Knobs and Organic Terrain [BR(N)+pOT]	1150	4.8
18+250 to 21+650	Bedrock Knobs and Glaciolacustrine Plain or Organic Terrain over Bedrock [BR(N)+(GL(P),pOT/R)]	3400	14.2



TABLE CONTINUED

APPROXIMATE CHAINAGE	PREDOMINANT GEOLOGIC UNIT	LENGTH (m)	PERCENT OF TOTAL (%)
Realignment Alternative 10, City of North Bay, Townships of East Ferris and Bonfield			
21+650 to 24+500	Bedrock Knobs and Organic Terrain [BR(N)+pOT]]	2850	11.9
24+500 to 25+900	Bedrock Knobs and Glaciolacustrine Plain or Organic Terrain over Bedrock [BR(N)+(GL(P),pOT/R)]	1400	5.8
25+900 to 26+400	Bedrock Knobs and Organic Terrain [BR(N)+pOT]]	500	2.1
26+400 to 26+900	Bedrock Knobs and Glaciolacustrine Plain or Organic Terrain over Bedrock [BR(N)+(GL(P), pOT/R)]	500	2.1
26+900 to 28+000	Bedrock Knobs and Organic Terrain [BR(N)+pOT]]	1100	4.6
28+000 to 28+800	Organic Terrain over Outwash Plain [pOT/sGO]	800	3.3
28+800 to 30+250	Bedrock Knobs and Organic Terrain [BR(N)+pOT]]	1450	6.1
30+250 to 30+650	Glaciolacustrine Plain over Ground Moraine Deposits over Bedrock [GL(P)/M(G)/R]	400	1.7
30+650 to 31+500	Bedrock Knobs and Organic Terrain [BR(N)+pOT]]	850	3.6
31+500 to 31+900	Glaciolacustrine Plain over Ground Moraine Deposits over Bedrock [GL(P)/M(G)/R]	400	1.7
31+900 to 33+900	Bedrock Knobs and Organic Terrain [BR(N)+pOT]]	2000	8.4
TOTAL LENGTH		23900	100.0



In summary, the total length of each predominant geologic unit along Realignment Alternative 10 is tabulated below:

PREDOMINANT GEOLOGIC UNIT	LENGTH (m)	PERCENT OF TOTAL (%)
Bedrock Knobs and Organic Terrain [BR(N)+pOT]	14350	60.1
Bedrock Knobs and Glaciolacustrine Plain or Organic Terrain over Bedrock [BR(N)+(GL(P),pOT/R)]	5950	24.9
Glaciolacustrine Plain and Bedrock Knobs [GL(P)+ BR(N)]	2000	8.4
Organic Terrain over Outwash Plain [pOT/sGO]	800	3.3
Glaciolacustrine Plain over Ground Moraine Deposits over Bedrock [GL(P)/M(G)/R]	800	3.3
TOTAL LENGTH	23900	100.0

4.2 Drainage

The study area of the Highway 17 realignment alternatives corridor drains into a number of lakes through creeks and rivers.

The Twinline Lake and Dugas Bay (southernmost bay in the Trout Lake) are situated north of the existing Highway 17 and Jennings Lake, Passmore Lake and Dreany Lake to the south of the highway in the City of North Bay and Township of East Ferris. The Laren and Barse Creeks cross the existing Highway 17 in the Township of Bonfield. The La Vase River flows approximately parallel and south of the CNR corridor. The Kaibuskong River crosses the existing Highway 17 at Sta. 15+860 in the Township of Bonfield and flows in an approximate south to north direction. Also, surface water runoff along the study corridor drains into other water bodies such as unnamed streams, creeks, swamps and scattered ponds. Extensive swamps/wetlands are located south of existing Highway 17 between Highway 11 and Highway 94.



Groundwater is inferred typically near ground surface (less than 1 m deep) in 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 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 alternative 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, preloading and staged construction) and is the least favourable.



5.1.2 Groundwater Conditions (Table F-2)

The extent of each alternative with inferred groundwater at depths greater than 5 m (most favourable condition); between 1 and 5 m deep; and between 0 and 1 m deep (least favourable condition) was 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 this 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 alternative.

5.1.4 Embankment Settlement (Table F-4)

Evaluation of embankment settlement was based on the total length of the realignment alternative 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 and major culverts required on each alternative and the length of embankment construction. In addition, embankments in competent ground requiring conventional construction were considered the most favourable. Embankments through swamps were considered the least favourable.



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

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

- 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 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 and/or swamps :						F-1
		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 depth:						F-2
		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		Other Type		Deep Foundation		
		F=5		F=3		F=1		
Embankment Settlement	0.15	Based on length of sections with compressible soil within three depth ranges:						F-4
		Less than 3 m deep		3 to 10 m deep		Deeper than 10 m		
		Silty/Sandy	Clayey	Silty/Sandy	Clayey	Silty/Sandy	Clayey	
		F=5	F=4	F=4	F=3	F=2	F=1	
Embankment Stability	0.15	Based on estimated type of construction required to establish embankment on competent ground:						F-5
		Conventional Embankment		Subexcavation		Potential Pre-Loading/ Surcharging/Wick Drains		
		F=5		F=3		F=1		
Construction Feasibility	0.20	Based on the required number of structures and length of embankment:						F-6
		Structure Foundation		Major 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_w for each subsection. For example, with reference to Table F-1, Soft Ground/Swamps Evaluation Criterion, the weighted favourability value A_{2w} for the embankment alternative was obtained by multiplying the Weighted Favourability factor F by the length of realignment alternative over which the criterion is applicable and dividing



by the total length of realignment alternative over which the criterion is applicable as presented below:

DEPTH RANGE (m)	LENGTH (m)	FAVOURABILITY FACTOR, F
0 – 3	1500	5
3 – 10	400	3
>10	200	1

$$A_{2w} = \text{Weighted Favourability Value} = \frac{(1500 \times 5) + (400 \times 3) + (200 \times 1)}{1500 + 400 + 200} = 4.24$$

The weighted favourability, value, A_{iw} , computed for each subsection is also normalized to take into account the total length of each alternate route in each criteria. This then reduces the weighted favourability factor based on the ratio of the alternate route length to the shortest alternative length. An example of the normalization conducted for the Realignment 6 in Table F1 is provided below:

$$A_2 = \text{Normalized Favourability Value for Realignment 6} = 4.24 \times \frac{\text{Realignment 14: 1350 m}}{\text{Realignment 6: 2100 m}} = 2.72$$

The normalized 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 F-7 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 **3.62** for the Realignment Alternative 6 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
Realignment 6	A _i	2.72	3.44	2.63	3.30	3.42	2.98
	N _i	0.59	0.99	0.66	0.78	0.72	0.75
Note: the following are the highest A _i values							
Highest A _i		4.63	3.48	4.00	4.21	4.74	3.98

$$\text{Normalized Score for Realignment 6} = 5[(2.72/4.63) \times 0.20 + (3.44/3.48) \times 0.10 + (2.63/4.00) \times 0.20 + (3.30/4.21) \times 0.15 + (3.42/4.74) \times 0.15 + (2.98/3.98) \times 0.20]$$

$$\text{Normalized Score for Realignment 6} = 3.62$$

[The ratios in brackets represent each of the N_i values, such as (2.72/4.63) = 0.59]

The results are summarized below:

REALIGNMENT ALTERNATIVES	SCORE	RANKING
Realignment 2	4.04	3
Realignment 6	3.62	4
Realignment 10	4.19	2
Realignment 14	4.61	1

The results indicated that Realignment Alternative 14 has the highest score of 4.61. Realignment Alternative 10 has the second highest score of 4.19. Realignment Alternative 2 has the score of 4.04. Realignment Alternative 6 has the lowest score of 3.62.

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



6. REALIGNMENT ALTERNATIVE REVIEW AND RECOMMENDATIONS

6.1 General

The recommendations in this report are based on assumptions derived from limited investigation and are for planning purposes only. The foundation evaluation involved a review of the available geological, topographical and hydrogeological mapping, existing geotechnical reports and aerial photographs. Field visual reconnaissance surveys were carried out to verify the inferred data. Further field investigation and design would be required for detail design and construction.

From the embankment and structure foundation design and construction perspective, the alternative that incorporates the highest scoring is considered to be preferred. As indicated previously, Realignment Alternative 14 has the highest score of 4.61 and Realignment Alternative 10 has the second highest score of 4.19. Realignments Alternatives 10 and 14 would be preferred over the remaining Realignment Alternatives 2 and 6 that have relatively lower scores of 4.04 and 3.62.

The preferred Realignment Alternative should be selected to minimize the depth of soft ground over bedrock or competent soil subgrade and to avoid swampy areas. Embankments constructed over bedrock or competent soil subgrade would be easier to drain; would be relatively easier to construct; would perform better; and would be subjected to only minimal post-construction settlements and therefore would require less maintenance.



6.2 Embankment Design

The embankments in Realignment Alternative 14 traverse through the least total length of soft grounds/swamps (1350 m) as compared to other realignment alternatives. The embankments in Realignment Alternatives 2 and 10 traverse the same total length of soft grounds/swamps (1850 m). Realignment Alternative 6 has the highest total length of soft grounds/swamps (2100 m).

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. The zones above the rockfill embankments may also be constructed with earth fill if agreed with MTO. Embankment design and construction procedures for rockfill and earth fill embankments shaped at 1.25H:1V and 2H:1V respectively above original grades may be considered for the preliminary planning purposes. Embankment geometry through swamps should include a minimum of 2 m wide bench on both sides according to Northern Region Directive 98-200, excluding any sections where the embankment fill is placed directly on bedrock.

The depth of the soft soil excavations will be determined during detail design to conformance with the MTO guidelines Embankment settlement criteria for Design dated March 2, 2010. For preliminary evaluation purposes the design of embankments through swamps should allow for subexcavation of organic soils and soft compressible soils where these soils extend to depths greater than about 5 to 8 m. Also as a guideline for preliminary design, the top of rockfill line should be carried at least 1.0 m above the water level in the swamps where earth fill is used over rockfill to construct the embankments. Above original grade, the embankments constructed with earth fill will be stable at 2H: 1V slopes or flatter above the water table. However, flatter slopes will be required, together with adequately designed protection to minimize erosion in areas of sandy soils. Rockfill embankments should also be stable at 1.25H: 1V slopes or flatter.



6.3 Embankment Stability

It is anticipated that most of the alternatives traverse similar geologic formations comprising bedrock and swamps and glaciolacustrine deposits containing clayey and sandy/silty soils. However, proposed realignments cross several open water swamps/wetlands. These areas will require special design and construction procedures to achieve stable embankment slopes.

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

As an example based on the preliminary longitudinal profile, Realignment 10 will require construction of embankments 3 m up to 13 m high over open water swampy areas (about 300 to 500 m long) including an up to 12 m high embankment over an Unnamed Creek floodplain about 400 m long, located west of Highway 94. These areas may require use of preloading/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 where embankments 4.5 m and up to 13 m high are required.

The magnitude and rate of the settlements will depend on the local 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 Highway 17 or railway embankments and TCPL corridor which are in close proximity.



Settlement of the rockfill should be calculated based on the latest MTO directive 'Post Construction Rockfill Settlement and Guidelines for Estimating Rockfill Quantity' dated September 14, 2010. 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 'Embankment Settlement Criteria for Design' dated March 2, 2010. These settlements should be evaluated during future preliminary or detail design studies.

6.5 Structure Foundations

As indicated previously, 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 for the representative Realignment Alternatives 2, 6, 10 and 14.

The types of foundations of the structures are likely to comprise shallow foundations (spread footings) on bedrock, native soil or structural 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 are located near Highway 94 and Highway 531. 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 for the swamps located east of Highway 11 and west of Highway 94 less than 10 m deep will be accomplished with conventional excavation or preloading methods. These swamps typically contain organics over sandy soils mantling the bedrock. However, it should be noted that these swamps are open water wetlands extending over relatively large areas and the slope of these new embankments will extend into



the open water. Particular attention will be required for the design and construction of these embankments to address deep excavation to remove organic materials, densification of significant depth of rockfill placed below water and the need for preloading/surcharging to reduce post construction settlement and enhance overall performance.

Realignment Alternative 10 crosses several swamps north of existing Highway 17 between Highway 94 and Maple Road. These swamps may contain organics over clayey soils over sandy soils. It is also anticipated that typical embankment construction can be carried out with conventional excavation and preloading/surcharging methods. However, detail analysis should be carried out during Detail Design.

In addition, it is inferred that Realignment Alternative 10 may cross organics over very soft to soft clay deposits up to 9 m depth at the creek flooded area just south of Highway 94 based on the Contract 2006-5061 soil profile. This area may require wick drains and surcharging methods for embankment construction.

For the Realignment Alternative 14, it is also anticipated the typical embankment construction will be accomplished with conventional excavation or preloading methods. However, Realignment Alternative 14 crosses the OVR within a swampy area about 3 km east of the existing Corbeil Road and 700 m north of the Lavigne Road. The approach embankments through this swamp may require wick drain and surcharging methods with instrumentation and monitoring or a relatively long structure to ensure the integrity of the railway embankment.



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.

REALIGNMENT ALTERNATIVES	ADVANTAGES	DISADVANTAGES
Realignment 2 (Ranking 3)	<ul style="list-style-type: none"> The total length of soft ground/ swamp crossings is about 250 m less than the Realignment 6 A total of 6 structure crossings are identified that is less than the other realignments Inferred favourable subgrade conditions along 93% of Route 	<ul style="list-style-type: none"> The total length of the new embankment construction is longer than the other alternatives Realignment 2 crosses the TCPL corridors in and adjacent to swampy areas and may require special design and construction methods with stringent instrumentation monitoring Realignment 2 crosses the open water swamps in and adjacent to the existing Highway 17 and north of the Passmore Lake and may require special design and construction methods Embankment construction along 7% of alternative may require preloading/surcharging design and construction
Realignment 6 (Ranking 4)	<ul style="list-style-type: none"> Inferred favourable subgrade conditions along 92% of alternative A total of 8 structure crossings are identified similar to Realignment 14 	<ul style="list-style-type: none"> The highest total length of soft ground/ swamp crossings than the other realignment alternatives The total length of the new embankments construction is more than all alternatives except Realignment 2 2 structure crossings approach embankments are in swampy areas Embankment construction along 8% of route may require preloading/surcharging design and construction
Realignment 10 (Ranking 2)	<ul style="list-style-type: none"> The total length of the new embankments construction is less than all alternatives except Realignment 14 Inferred favourable subgrade conditions along 92% of alternative A total of 7 structure crossings are identified that is less than Realignments 6 and 14 	<ul style="list-style-type: none"> Embankment construction along 8% of route may require preloading/surcharging design and construction 2 structure approach embankments are in swampy areas
Realignment 14 (Ranking 1)	<ul style="list-style-type: none"> The least total length of the new embankment construction Inferred favourable subgrade conditions along 94% of Route A total of 8 structure crossings are identified similar to the Realignment 6 	<ul style="list-style-type: none"> Embankment construction along 6% of route may require preloading/surcharging design and construction La Vase River crossings is adjacent to the CPR and approach embankments are in the swampy areas and may require special construction methods



7. **PREFERRED REALIGNMENT ALTERNATIVE REVIEW**

7.1 **General**

MRC indicated that the preferred alignment alternative is Realignment Alternative 10 located south of Highway 17 and north of the OVR. After its selection, Realignment Alternative 10 was subjected to numerous revisions of its horizontal and vertical alignment. The reviewed version of the preferred realignment alternative was dated April 2013 and is shown on the enclosed Drawings P1 to P15.

The preferred realignment alternative for the proposed four-laning Highway 17 is mostly 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 (m)			
	ON ORIGINAL GROUND	OVER SWAMP	ON OPEN WATER	TOTALS
0 to 4.5	500	1,050	350	1,900
4.5 to 8.0	1,650	450	1,150	3,250
8.0 to >13.0	1,725	-	700	2,425
Totals	3,875	1,500	2,200	7,575

The preferred realignment alternative crosses several open water swamps between Highway 11 and about 2 km west of Highway 94 (about 7.5 km section). In addition, the preferred realignment alternative crosses/borders several soft grounds/swamps between Highway 94 and Maple Road (6 km section). The estimated maximum depth to competent ground in the swamps has been provided in Drawings P1 to P15. The open water swamps will require excavation to organics soil and densification of significant depth of rockfill placed below water and the need for preloading/surcharging to reduce post construction settlement and enhance overall performance.

The preferred realignment alternative will require structure crossings for the La Vase Portage Route, Kaibuskong River and interchange locations at the existing Highway 11, Highway 94,



Highway 17 (west crossing), Highway 17 (east crossing) and Highway 531. 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.

As indicated previously, a limited preliminary subsurface investigation involving up to 20 exploratory boreholes was planned for the selected swamps and the proposed structures for the preferred realignment alternative. The first round of investigations was completed in February/March 2013. The remaining boreholes were completed in June 2013. The results of this investigation will be provided separately in two Preliminary Foundation Investigation and Design Reports for embankments through swamps and for structures (PML Ref: 10TF031A-1 and 10TF031A-2).

7.2 Additional Studies

The preliminary assessments in this report are based on literature reviews, site reconnaissance and the realignment alternative longitudinal profiles provided by MRC. 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 and high fills are listed in Table 1.

The potential major bridges and culvert locations including proposed interchange structure locations should also be 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 preferred 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. The report was finalized by Mr. C.M.P. Nascimento, P.Eng. and Mr. D. Dundas, P.Eng. MTO Designated Principal Contact Mr. Brian Gray, P.Eng., conducted an independent review of the Report.

Yours very truly,

Peto MacCallum Ltd.



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MTO Designated Principal Contact

CN/DD/BRG:dd-mi



TABLE 1
RECOMMENDED LOCATIONS FOR FOUNDATIONS INVESTIGATION
(SWAMPS/HIGH FILLS CROSSING)
PREFERRED REALIGNMENT ALTERNATIVE

STATIONS (Note 1)	LENGTH (m)	PROPOSED WORK	EXISTING DATA	
			NO. OF TEST HOLES (Note 3)	DEPTH TO BEDROCK (m)
Highway 17 (Preferred) Mainline Chainage (Starting at Highway 11 Easterly)				
10+000 to 11+200	(Note 2)			
11+350 to 11+600	250	Up to 7.0 m high fill		
11+600 to 11+750	150	Up to 5.0 m high fill		
11+750 to 12+075	325	Up to 7.0 m high fill		
12+075 to 12+125	50	Up to 4.0 m high fill over swamp	1	>1.5
12+350 to 12+650	300	Up to 6.0 m high fill over open water swamp	2	1.6 and 7.2
12+850 to 13+200	350	Up to 4.0 m high fill over open water swamp	10	0.0 to 7.2
13+550 to 13+600	50	Up to 5.0 m high fill		
13+750 to 13+900	150	Up to 5.0 m high fill		
13+950 to 14+300	350	Up to 6.0 m high fill over open water swamp	3	>1.5
15+200 to 15+400	200	Up to 3.0 m high fill over swamp		
16+400 to 16+500	100	Up to 3.0 m high fill over swamp		
18+100 to 18+500	400	Up to 12.0 m high fill over creek flooded area		
18+500 to 18+950	450	Up to 12.0 m high fill at Highway 17/ Highway 94 interchange area		
19+800 to 20+300	500	Up to 6.0 m high fill over creek flooded area		
20+650 to 20+750	100	Up to 5.0 m high fill		
21+150 to 21+300	150	Up to 5.0 m high fill		
22+000 to 22+450	450	Up to 5.0 m high fill over swamp		
22+450 to 22+800	350	Up to 6.0 m high fill		
23+100 to 23+600	500	Up to 3.0 m high fill		
23+900 to 24+100	200	Up to 2.0 m high fill over swamp	2	>1.5
24+450 to 24+750	300	Up to 3.0 m high fill over swamp		
26+450 to 26+650	200	Up to 3.0 m high fill over swamp		



TABLE 1
RECOMMENDED LOCATIONS FOR FOUNDATIONS INVESTIGATION
(SWAMPS/HIGH FILLS CROSSING)
PREFERRED REALIGNMENT ALTERNATIVE

STATIONS (Note 1)	LENGTH (m)	PROPOSED WORK	EXISTING DATA	
			NO. OF TEST HOLES (Note 3)	DEPTH TO BEDROCK (m)
28+150 to 28+450	300	Up to 12.0 m high fill over creek and swamp		
28+500 to 28+750	250	Up to 13.0 m high fill		
30+175 to 30+550	375	Up to 13.0 m high fill over Kaibuskong River and Highway 531		
31+450 to 31+650	200	Up to 10.0 m high fill		
32+050 to 32+300	250	Up to 12.0 m high fill		
32+375 to 32+500	125	Up to 8.0 m high fill		
32+700 to 32+900	200	Up to 10.0 m high fill adjacent to CPR crossing		
Proposed Interchanges				
Highway 11/Highway 17 Interchange				
Highway 17 WBL to Highway 11 NBL				
30+550 to 30+675	125	Up to 4 m high fill		
30+775 to 31+100	325	Up to 10 m high fill		
Highway 11 SBL to Highway 17 EBL				
40+050 to 40+300	250	Up to 4 m high fill over swamp		
40+300 to 40+600	300	Up to 10 m high fill over swamp	4	>17.9 and 19.9
40+750 to 40+850	100	Up to 5 m high fill		
41+025 to 41+100	75	Up to 4 m high fill over swamp		
41+250 to 41+575	325	Up to 10 m high fill over swamp		
E-S Ramp from Highway 17 to Highway 11				
50+075 to 50+150	75	Up to 6 m high fill		
50+250 to 50+450	200	Up to 16 m high fill over swamp		
50+800 to 50+900	100	Up to 3 m high fill		
51+175 to 51+375	200	Up to 8 m high fill over swamp		
S-E Ramp from Highway 11 to Highway 17				
60+025 to 60+125	100	Up to 4 m high fill		
60+525 to 60+600	75	Up to 5 m high fill		



TABLE 1
RECOMMENDED LOCATIONS FOR FOUNDATIONS INVESTIGATION
(SWAMPS/HIGH FILLS CROSSING)
PREFERRED REALIGNMENT ALTERNATIVE

STATIONS (Note 1)	LENGTH (m)	PROPOSED WORK	EXISTING DATA	
			NO. OF TEST HOLES (Note 3)	DEPTH TO BEDROCK (m)
Highway 17/Highway 94 Interchange				
W-N/S Ramp				
10+000 to 10+260	260	Up to 10 m high fill		
N/S-W Ramp				
40+160 to 40+260	100	Up to 8 m high fill		
N/S-E Ramp				
20+80 to 20+260	180	Up to 6 m high fill		
E-N/S Ramp				
30+000 to 30+100	100	Up to 4 m high fill		
West Crossing of Existing Highway 17				
21+125 to 21+225	100	Up to 8 m high fill		
21+300 to 21+400	100	Up to 7 m high fill		
Highway 17/Highway 531 Interchange				
W-N/S Ramp				
20+125 to 20+300	175	Up to 13 m high fill		

Notes:

1. Chainages are approximate and based on MRC drawings dated April 10, 2013, may vary for eastbound and westbound lanes and are to be confirmed / refined during detail design.
2. Refer to Highway 11/Highway 17 Interchange Ramp profiles
3. Test holes include auger probes, boreholes and dynamic cone penetration tests.



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

APPROXIMATE STATIONS (Note 1)	PROPOSED WORKS	EXISTING DATA	
		NO OF TEST HOLES (Note 5)	DEPTH TO BEDROCK (m)
50+550	E-S Ramp from Highway 17 to Highway 11	2	> 19.9
40 +650	Highway 11 SBL to Highway 17 EBL	2	> 17.9
14 + 800 (Note 2)	Highway 11/CNR NBL Overhead Widening	–	–
	Highway 11/CNR SBL Overhead Widening	8 (Note 3)	12.2 – 16.2 (Note 3)
11+480	Pit Access Road Culvert	–	–
11+760	La Vase Portage Route EBL Structure	1	> 13.7
	La Vase Portage Route WBL Structure		
18+480	Unnamed Creek Crossing EBL Bridge	–	–
	Unnamed Creek Crossing WBL Bridge	–	–
18+580	Highway 17 /Highway 94 Interchange EBL Structure	2	5.3 and 5.6
	Highway 17 /Highway 94 Interchange WBL Structure		
20+150	Unnamed Creek Crossing EBL Bridge	–	–
	Unnamed Creek Crossing WBL Bridge	–	–
21+120	Existing Highway 17 (West Crossing) Structure	–	–
27+120	Existing Highway 17 (East Crossing) Structure	6 (Note 4)	1.3 – 1.8 (Note 4)
28+700	Potential Snowmobile Culvert	–	–
30+240	Kaibuskong River EBL Crossing Bridge	–	–
	Kaibuskong River WBL Crossing Bridge		
30+490	Highway 17 /Highway 531 Interchange Structure	1	9.3
30+550	Line 3S Crossing	3	2.4 to 3.1



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

APPROXIMATE STATIONS (Note 1)	PROPOSED WORKS	EXISTING DATA	
		NO OF TEST HOLES (Note 5)	DEPTH TO BEDROCK (m)
Interchange Ramp Structures			
Highway 17/Highway 94 Interchange			
10 +160 (W-N/S Ramp)	Unnamed Creek Crossing Bridges	—	—
40 + 020 (N/S-W Ramp)			
Highway 17/Highway 531 Interchange			
20 + 200 (W- N/S Ramp)	Kaibuskong River Bridge	—	—

Notes:

1. Chainages are approximate and based on MRC Drawings dated April 10, 2013, may vary for eastbound and westbound lanes and are to be confirmed / refined during detail design.
2. Station refers to Highway 11 Chainage
3. Based on Foundation Investigation and Design Report, CNR Overhead Southbound, Highway 11, W.P. 71-74-02, GEOCREC No. 31L-34, dated February / March 1977.
4. Based on Geotechnical Survey Data, WP 174-98-00, dated July 2012.
5. Test holes include auger probes, boreholes and dynamic cone penetration tests.



TABLE F-1– SOFT GROUND/SWAMPS

REALIGNMENT ALTERNATIVES (Note 1)		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			
1	Realignment 2 (Starting Point # 1)	1850	1250	400	200	4.14	3.02	A ₁
2	Realignment 6 (Starting Point # 2)	2100	1500	400	200	4.24	2.72	A ₂
3	Realignment 10 (Starting Point # 3)	1850	1600	250	0	4.73	3.45	A ₃
4	Realignment 14 (Starting Point # 4)	1350	1100	250	0	4.63	4.63	A ₄

Notes:

- A total of fourteen (14) realignment alternatives were generated using route optimization software by MTO/MRC for this planning study.
 The four (4) selected realignment alternatives (Realignments 2, 6, 10 and 14) to be representative realignments from the foundation conditions perspective are detailed below:
 Starting Point #1 at Highway 11 : Realignments 1 to 3
 Starting Point #2 at Highway 11 : Realignments 4 to 6
 Starting Point #3 at Highway 11 : Realignments 7 to 10
 Starting Point #4 at Highway 11 : Realignments 11 to 14
 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

REALIGNMENT ALTERNATIVES (Note 1)		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			
1	Realignment 2 (Starting Point # 1)	26100	14200	9750	2150	3.92	3.32	A ₁
2	Realignment 6 (Starting Point # 2)	25400	14600	8250	2550	3.95	3.44	A ₂
3	Realignment 10 (Starting Point # 3)	23900	10350	11250	2300	3.67	3.40	A ₃
4	Realignment 14 (Starting Point # 4)	22100	6950	13500	1650	3.48	3.48	A ₄

Notes: Refer to note 1 in Table F-1.
 Enter weighted favourability value A_i in Table F-7.



TABLE F-3– STRUCTURE FOUNDATIONS

REALIGNMENT ALTERNATIVES (Note 1)		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			
1	Realignment 2 (Starting Point # 1)	6	3	3	0	4.00	4.00	A ₁
2	Realignment 6 (Starting Point # 2)	8	2	6	0	3.50	2.63	A ₂
3	Realignment 10 (Starting Point # 3)	7	1	6	0	3.29	2.82	A ₃
4	Realignment 14 (Starting Point # 4)	8	1	7	0	3.25	2.44	A ₄

Notes: Refer to note 1 in Table F-1 for full description.

Foundation Type

Shallow Foundation: Spread footings placed on bedrock or native soil or structural fill.

Other Type : Piles up to 8 m deep and intergral abutment design applicable.

Deep Foundation: Piles deeper than 8 m and integral abutment design applicable.

Enter weighted favourability value A_i in Table F-7.



TABLE F-4 – EMBANKMENT SETTLEMENT

REALIGNMENT ALTERNATIVES (Note 1)		Total Length (m)	SUBSOIL TYPE AND FAVOURABILITY						FAVOURABILITY VALUE(A _i)		
			Less than 3 m Deep		3-10 m Deep		Deeper than 10 m				
			L ₁	L ₂	L ₃	L ₄	L ₅	L ₆			
			Sandy/Silty (F ₁ =5)	Clayey (F ₂ =4)	Sandy/Silty (F ₃ =4)	Clayey (F ₄ =3)	Sandy/Silty (F ₅ =2)	Clayey (F ₆ =1)	Weighted	Normalized	
1	Realignment 2 (Starting Point # 1)	17300	11850	0	3000	2450	0	0	4.54	3.24	A ₁
2	Realignment 6 (Starting Point # 2)	16850	11000	0	3300	2550	0	0	4.50	3.30	A ₂
3	Realignment 10 (Starting Point # 3)	13100	4150	0	3400	5550	0	0	3.89	3.67	A ₃
4	Realignment 14 (Starting Point # 4)	12350	3750	0	7450	1150	0	0	4.21	4.21	A ₄

Notes: Refer to note 1 in Table F-1 for full description.
 Enter weighted favourability value A_i in Table F-7.



TABLE F-5 – EMBANKMENT STABILITY

REALIGNMENT ALTERNATIVES (Note 1)		Total Length (m)	EMBANKMENT REQUIRING SPECIAL OR CONVENTIONAL DESIGN			FAVORABILITY VALUE(A _i)		
			L ₁	L ₂	L ₃			
			Conventional Embankment (F ₁ = 5)	Embankment Requiring Subexcavation (F ₂ = 3)	Embankment Requiring Pre- loading/ Wick Drains (F ₃ = 1)			
						Weighted	Normalized	
1	Realignment 2 (Starting Point # 1)	17300	15450	1250	600	4.72	3.37	A ₁
2	Realignment 6 (Starting Point # 2)	16900	14800	1500	600	4.68	3.42	A ₂
3	Realignment 10 (Starting Point # 3)	13100	11250	1600	250	4.68	4.41	A ₃
4	Realignment 14 (Starting Point # 4)	12350	11000	1100	250	4.74	4.74	A ₄

Notes: Refer to note 1 in Table F-1 for full description.
 Enter weighted favourability value A_i in Table F-7.



TABLE F-6 –CONSTRUCTION FEASIBILITY

REALIGNMENT ALTERNATIVES (Note 1)		STRUCTURES/EMBANKMENT REQUIRING SPECIAL CONSTRUCTION						FAVOURABILITY VALUE(A _i)		
		No. of Structure Foundations (Note 2)		No. of Major Culvert Foundations (Note 2)		Embankment (Note 2)				
		Shallow Foundation (F ₁ =5)	Deep Foundation (F ₂ =3)	To be Extended (F ₃ =5)	To be Constructed (F ₄ =3)	Conventional (F ₅ =5)	Special (F ₆ =1)	Weighted	Normalized	
1	Realignment 2 (Starting Point # 1)	3	3	0	3	15450	1850	4.30	3.18	A ₁
2	Realignment 6 (Starting Point # 2)	2	6	0	2	14800	2100	4.15	2.98	A ₂
3	Realignment 10 (Starting Point # 3)	1	6	0	3	11250	1850	4.06	3.59	A ₃
4	Realignment 14 (Starting Point # 4)	1	7	0	1	11000	1350	4.14	3.98	A ₄

Notes: Refer to note 1 in Table F-3.

2. Constructibility Assessment

- Structure 20%
- Major Culvert 10%
- Embankment 70%

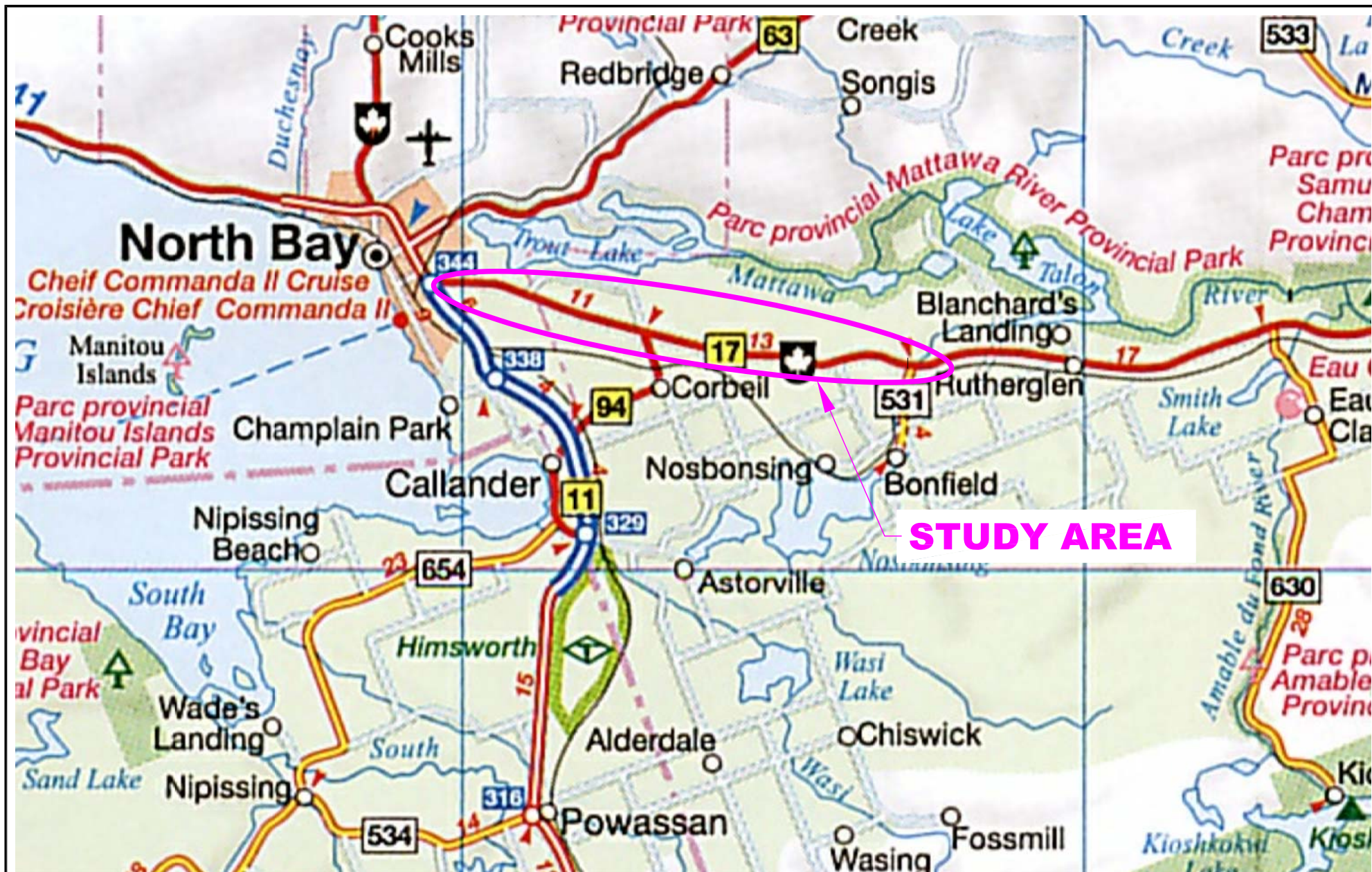
Enter weighted favourability value A_i in Table F-7.



TABLE F-7 – SCORING OF FOUNDATION CRITERIA

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			
REALIGNMENT ALTERNATIVES		Ai	Ni	Ai	Ni	Ai	Ni	Ai	Ni	Ai	Ni	Ai	Ni		
1	Realignment 2 (Starting Point # 1)	3.02	0.65	3.32	0.95	4.00	1.00	3.24	0.77	3.37	0.71	3.18	0.80	4.04	3
2	Realignment 6 (Starting Point # 2)	2.72	0.59	3.44	0.99	2.63	0.66	3.30	0.78	3.42	0.72	2.98	0.75	3.62	4
3	Realignment 10 (Starting Point # 3)	3.45	0.75	3.40	0.98	2.82	0.70	3.67	0.87	4.41	0.93	3.59	0.90	4.19	2
4	Realignment 14 (Starting Point # 4)	4.63	1.00	3.48	1.00	2.44	0.61	4.21	1.00	4.74	1.00	3.98	1.00	4.61	1

Notes: 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-175

METRIC

LOCATION MAP

HIGHWAY 17 ROUTE PLANNING

From Highway 11 South Junction to

2.7 km east of Highway 531 about 26.0 km

City of North Bay and Townships of East Ferris and Bonfield



Ontario



McCORMICK RANKIN
CORPORATION

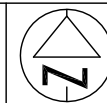
A member of MMM GROUP



Peto MacCallum Ltd.
CONSULTING ENGINEERS

HIGHWAY 17

G.W.P. 5105-09-00




FIGURE

1

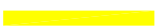
NOTES

- 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.
- 2. THE EXTENT OF SWAMPS, WATER BODIES AND FILL AREAS ARE 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.
- 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.
- 4. THE GEOLOGIC UNIT SYMBOLS SHOWN ON THE PLANS REPRODUCE THOSE SHOWN ON GEOLOGIC MAPPING OF THE AREA AND ARE ONLY A GENERAL REPRESENTATION OF BEDROCK AND SOIL UNITS.
- 5. THE PLANS ARE AN ENCLOSURE TO THE ALTERNATIVE FOUNDATION ASSESSMENT STUDY PREPARED BY PETO MACCALLUM LTD. THE DATA ON THESE PLANS MUST BE READ IN CONJUNCTION WITH THE REPORT.
- 6. THE DETAIL SHOWN ON THE PLANS IS CONSIDERED APPROPRIATE FOR ALTERNATIVE SELECTION PURPOSES. WHEN THE PREFERRED ALTERNATIVE HAS BEEN SELECTED, A SUBSURFACE INVESTIGATION SHOULD BE UNDERTAKEN TO DELINEATE THE SITE SPECIFIC STRATIGRAPHIC CONDITIONS FOR PRELIMINARY AND DETAILED DESIGN PURPOSES.


LEGEND




HIGHWAY 17 (EXISTING)




REALIGNMENT 2




REALIGNMENT 6




REALIGNMENT 10




REALIGNMENT 14




BEDROCK OUTCROP (R O/C)




SOFT GROUND / SWAMP




ANTICIPATED DEPTH (metres) TO
COMPETENT MATERIAL/BEDROCK




WATER BODY



PHOTOGRAPH NUMBER
(ARROW SHOWS DIRECTION OF VIEW)



MOE WATER WELL RECORD
(DEPTH TO BEDROCK)



GEOCRES No.: 31L-175

NOTES AND LEGEND
HIGHWAY 17 - ROUTE PLANNING

From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
City of North Bay and Townships of East Ferris and Bonfield

METRIC



Ontario



McCORMICK RANKIN
CORPORATION
A member of MIMM GROUP

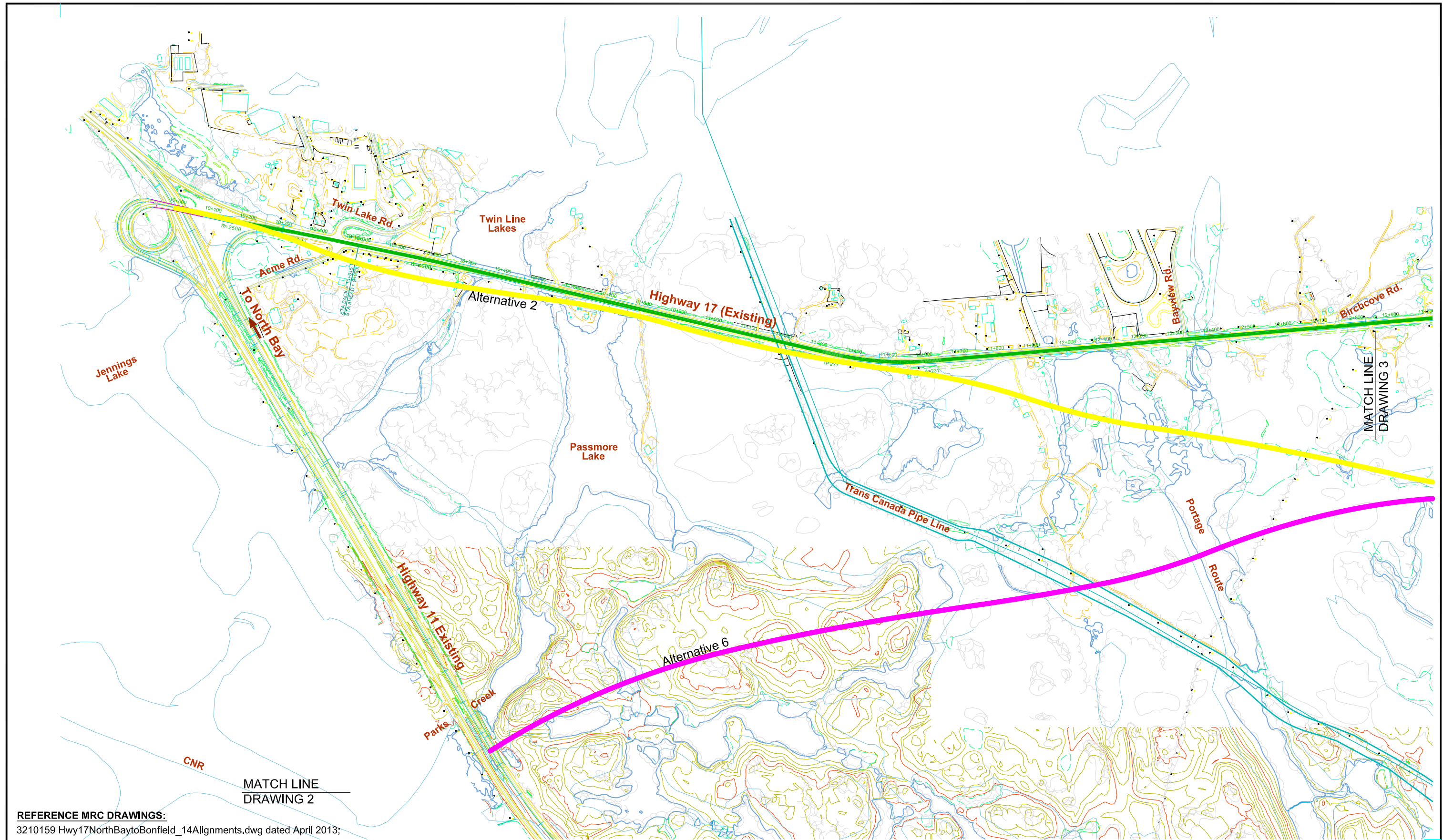


Peto MacCallum Ltd.
CONSULTING ENGINEERS

HIGHWAY 17
GWP No. 5105-09-00







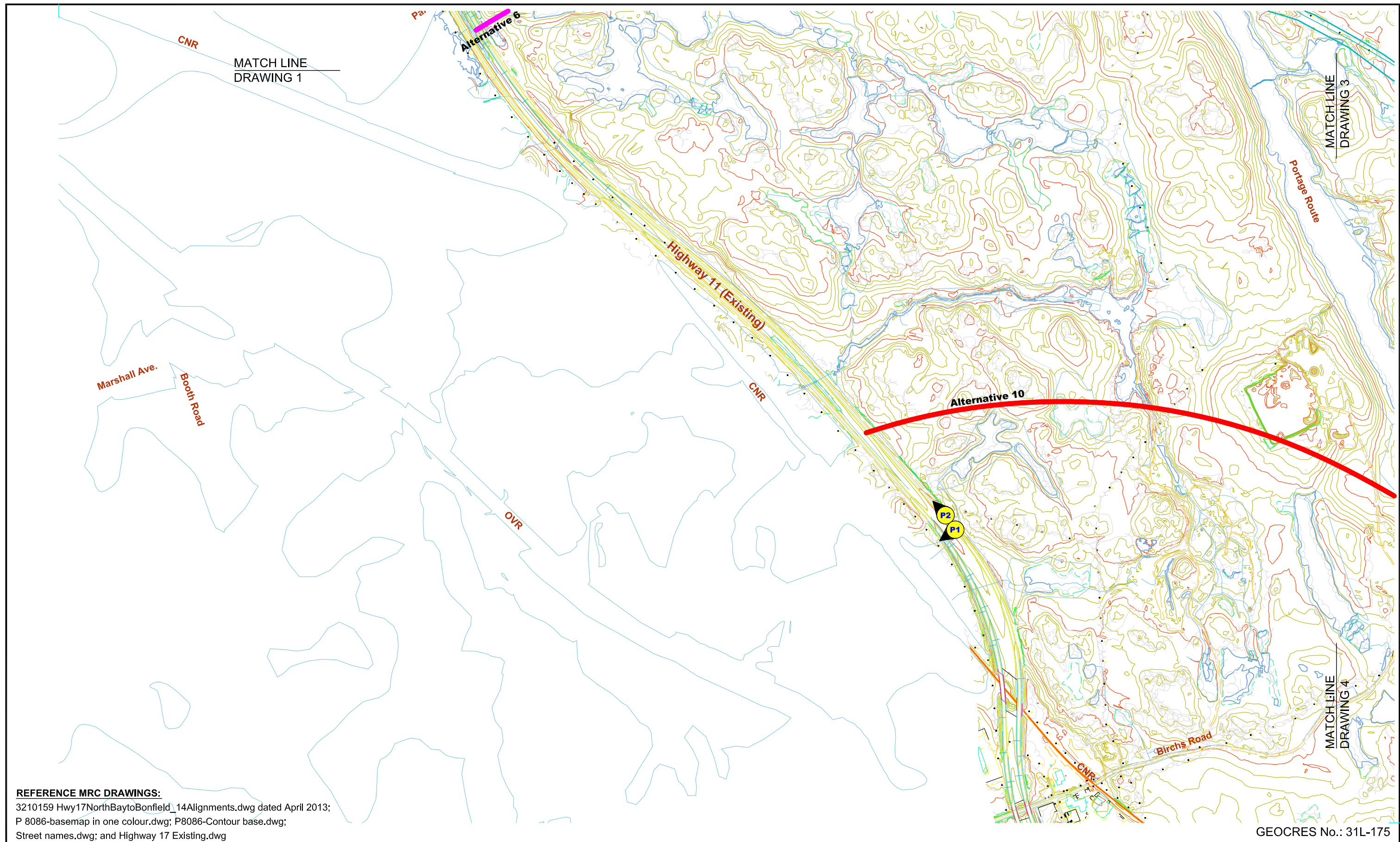
DRAWING
A



REFERENCE MRC DRAWINGS:
 3210159 Hwy17NorthBaytoBonfield_14Alignments.dwg dated April 2013;
 P 8086-basemap in one colour.dwg; P8086-Contour base.dwg;
 Street names.dwg; and Highway 17 Existing.dwg

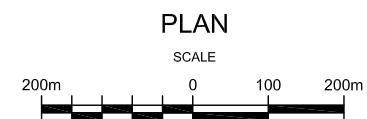
GEOCRES No.: 31L-175

<p align="center">REALIGNMENT ALTERNATIVES SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS HIGHWAY 17 - ROUTE PLANNING From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km City of North Bay</p> <p>METRIC</p>	<p align="center">PLAN SCALE 200m 0 100 200m</p>	<p align="center">  Ontario  McCORMICK RANKIN CORPORATION <small>A member of MRM GROUP</small> </p>	<p align="center">  Peto MacCallum Ltd. <small>CONSULTING ENGINEERS</small> </p> <p align="center"> HIGHWAY 17 GWP No. 5105-09-00 </p>	<p align="center">  DRAWING 1 </p>
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REALIGNMENT ALTERNATIVES
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
 From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
 City of North Bay

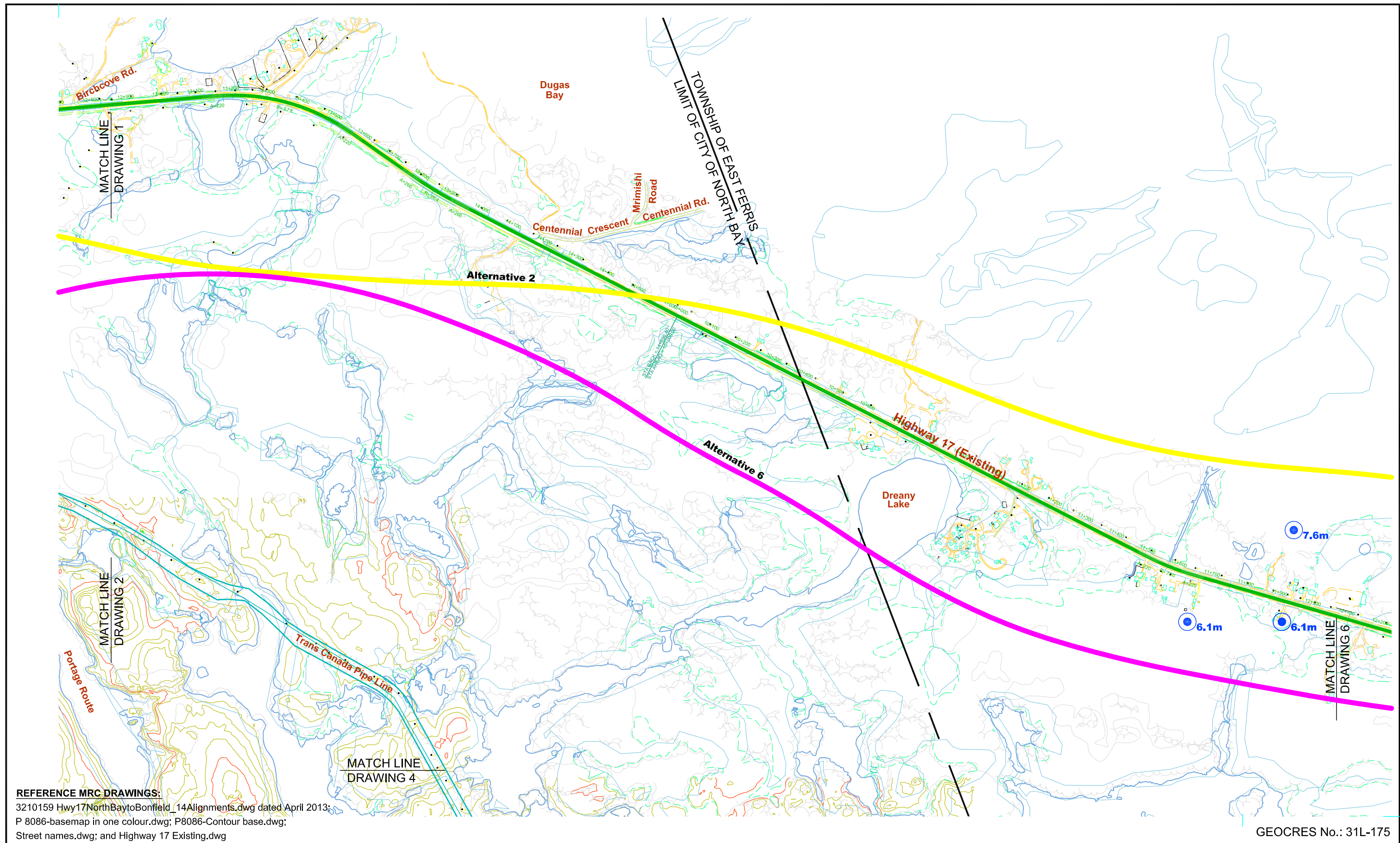
METRIC

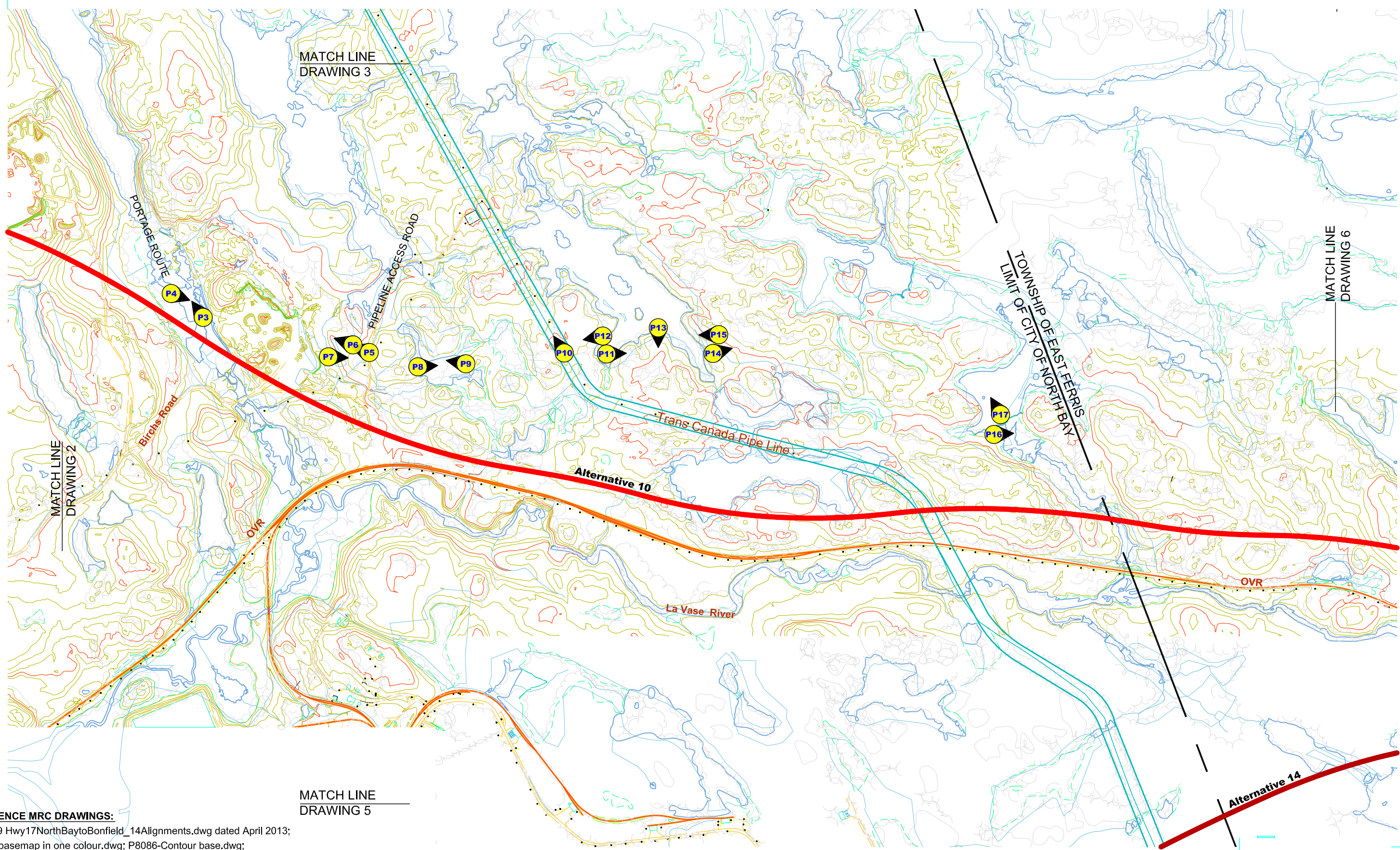


HIGHWAY 17
GWP No. 5105-09-00



DRAWING
2





REFERENCE MRC DRAWINGS:
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P 8086-basemap in one colour.dwg; P8086-Contour base.dwg;
Street names.dwg; and Highway 17 Existing.dwg

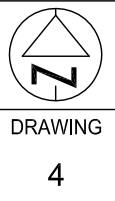
MATCH LINE
DRAWING 5

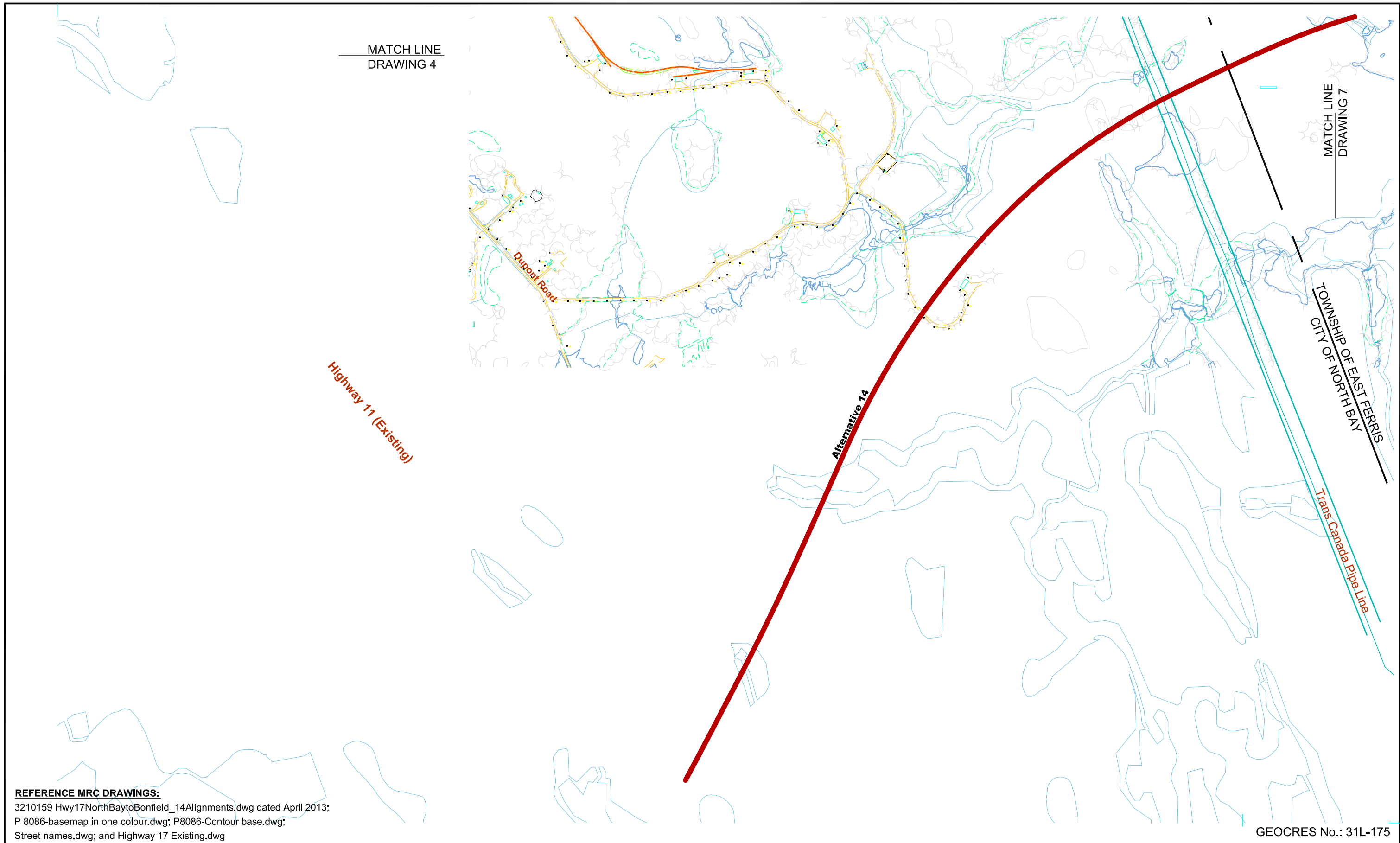
MATCH LINE
DRAWING 6

GEOCRES No.: 31L-175

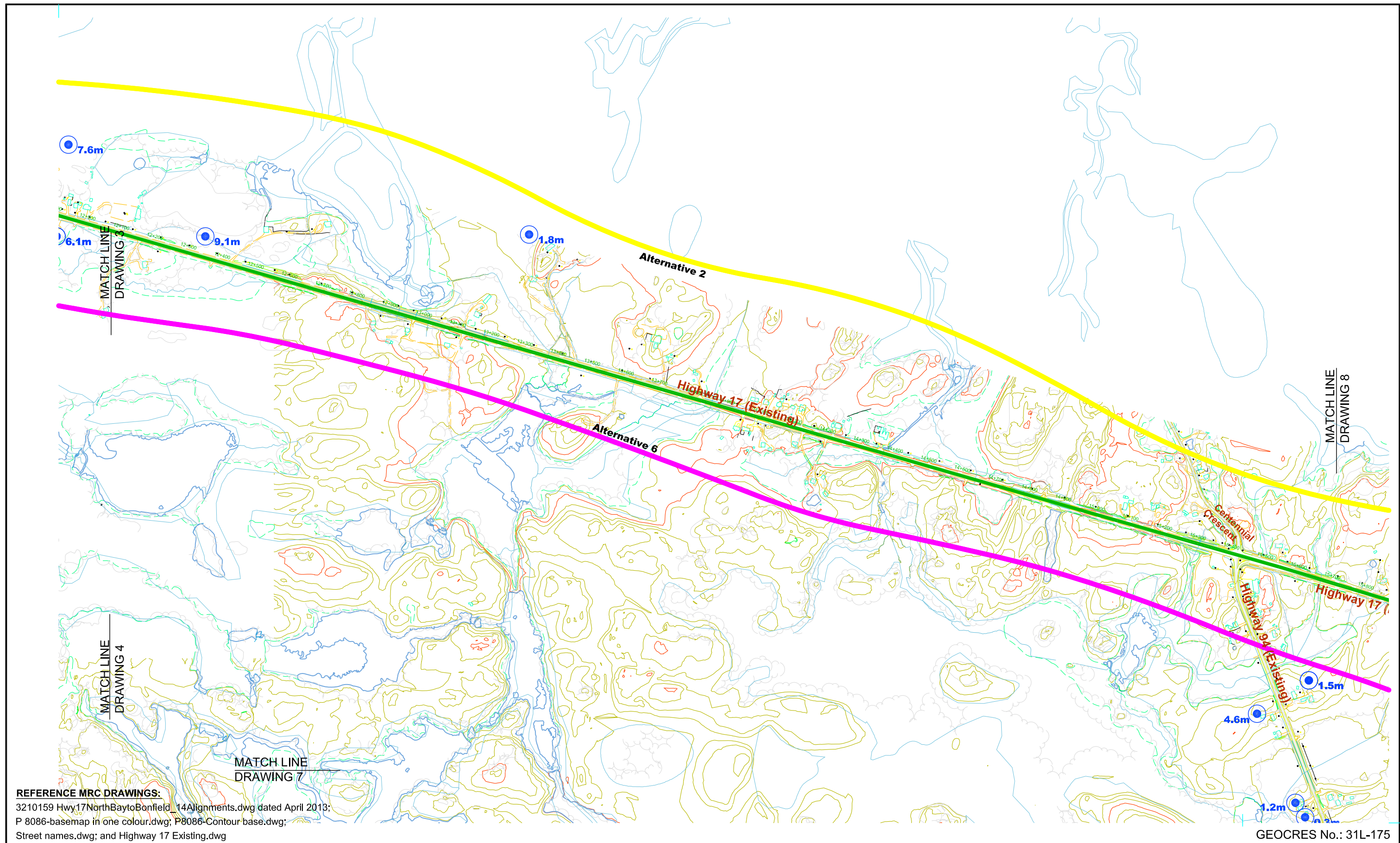
REALIGNMENT ALTERNATIVES
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
City of North Bay and Township of East Ferris

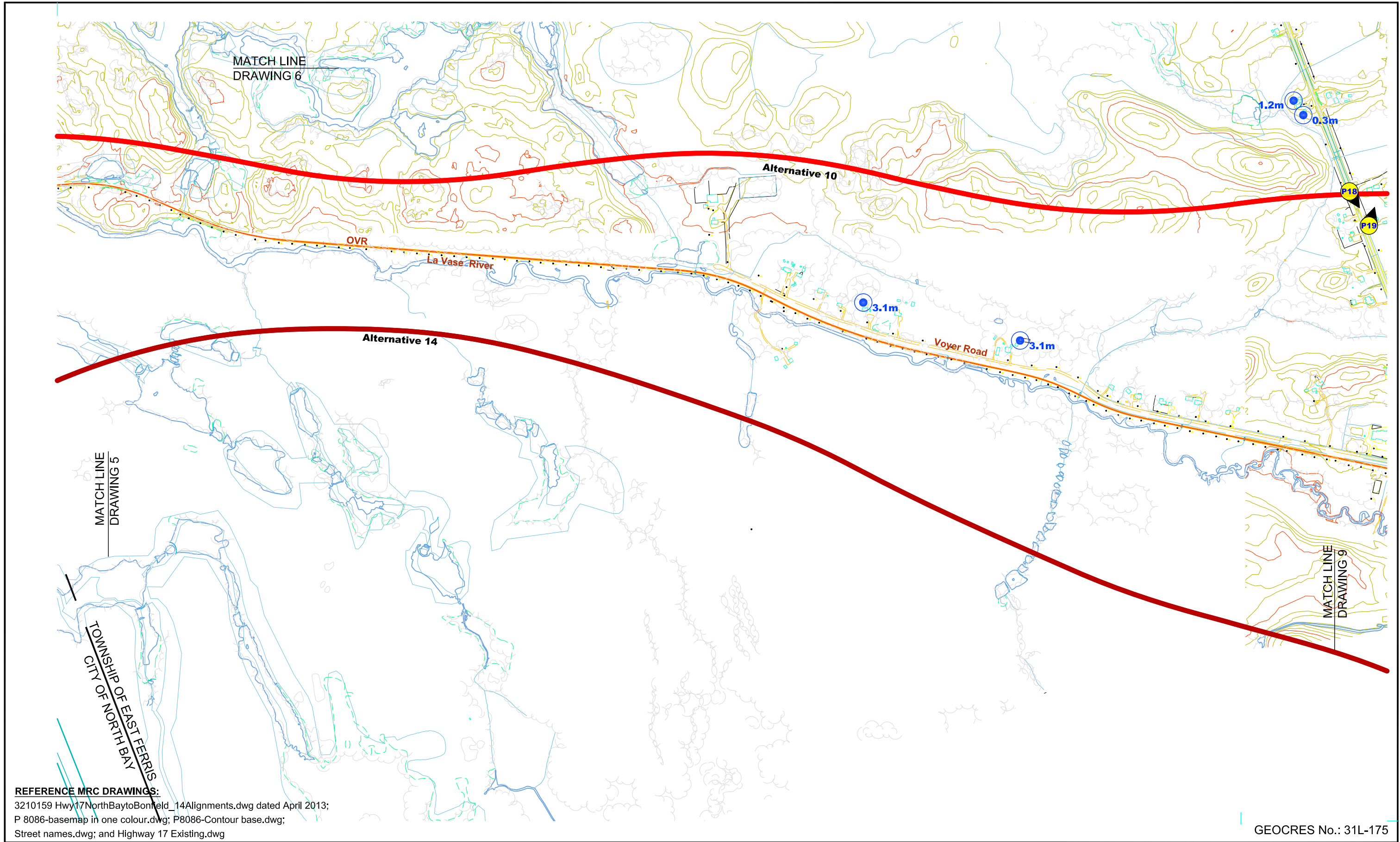
METRIC










GEOCRES No.: 31L-175



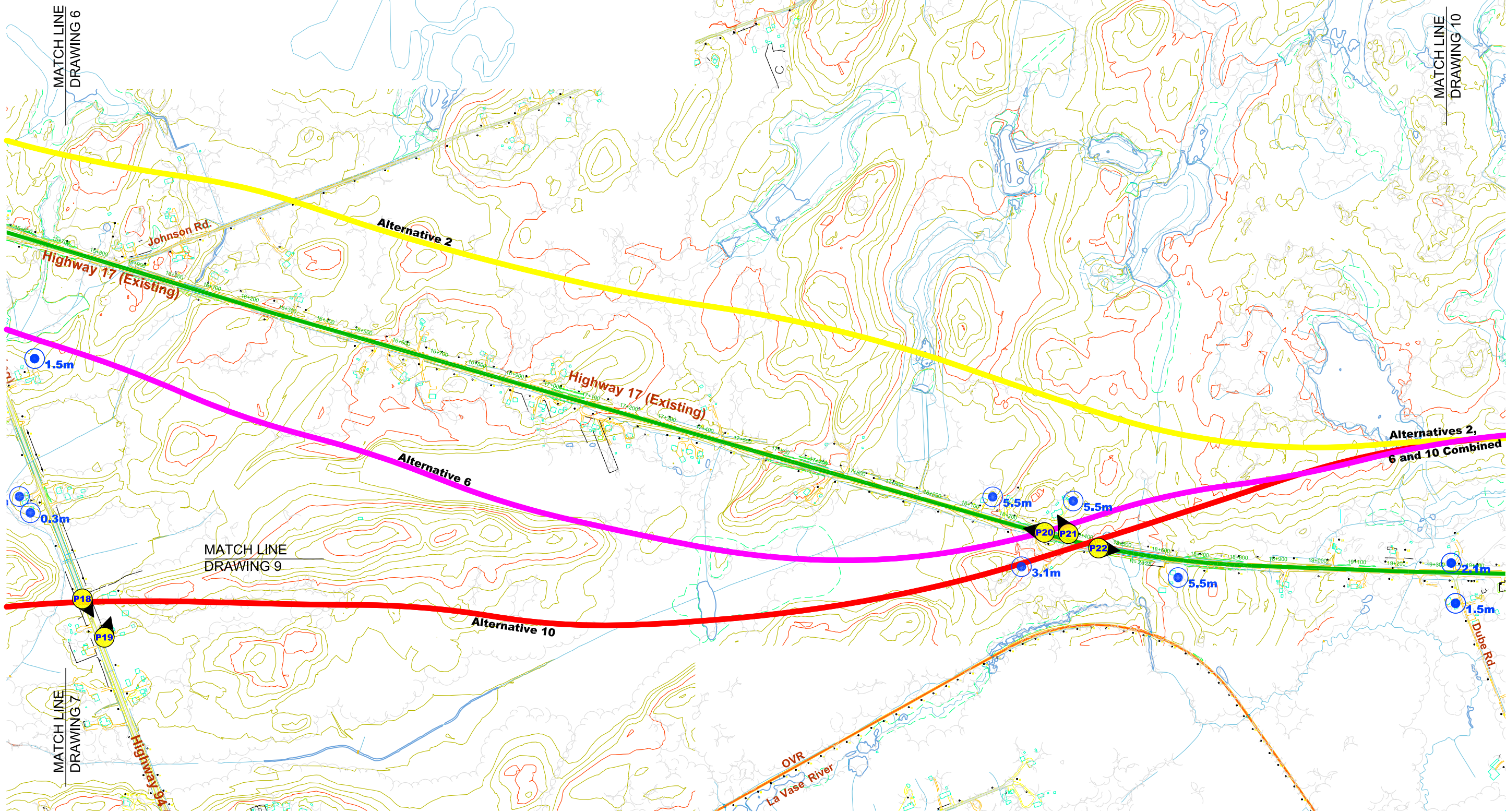


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Street names.dwg; and Highway 17 Existing.dwg

GEOCRES No.: 31L-175

<p>REALIGNMENT ALTERNATIVES SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS HIGHWAY 17 - ROUTE PLANNING From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km City of North Bay and Township of East Ferris</p> <p>METRIC</p>	<p>PLAN SCALE 200m 0 100 200m</p> <p> Ontario</p> <p> MCCORMICK RANKIN CORPORATION A member of </p>	<p> Peto MacCallum Ltd. CONSULTING ENGINEERS</p> <p>HIGHWAY 17 GWP No. 5105-09-00</p>	<p> DRAWING 7</p>
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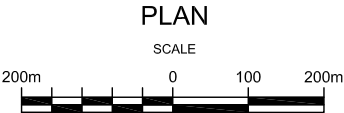
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Street names.dwg; and Highway 17 Existing.dwg



GEOCRES No.: 31L-175

REALIGNMENT ALTERNATIVES
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
Township of East Ferris

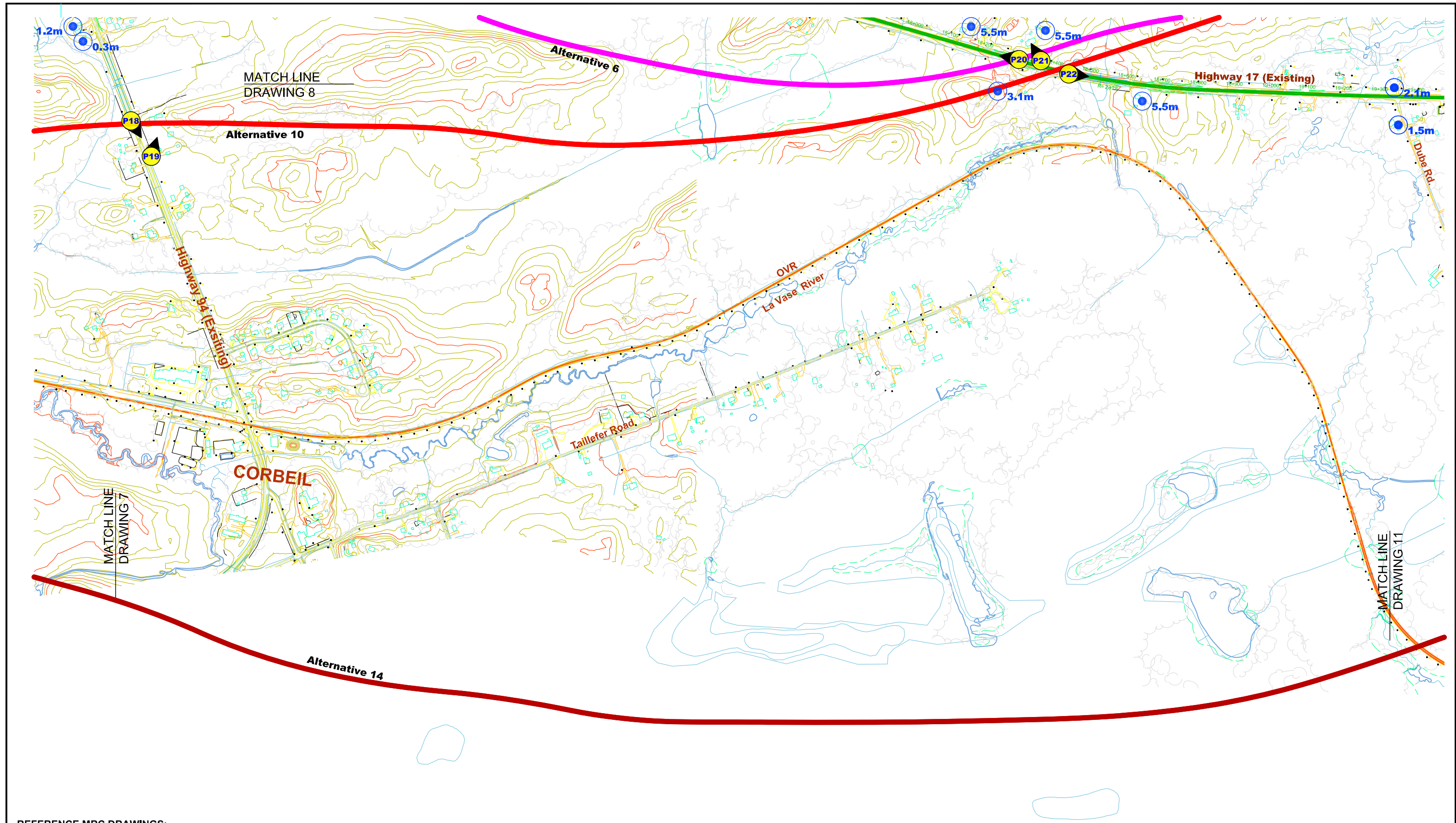
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HIGHWAY 17
GWP No. 5105-09-00



DRAWING
8

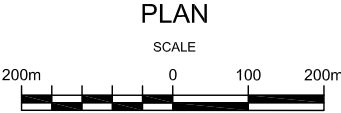


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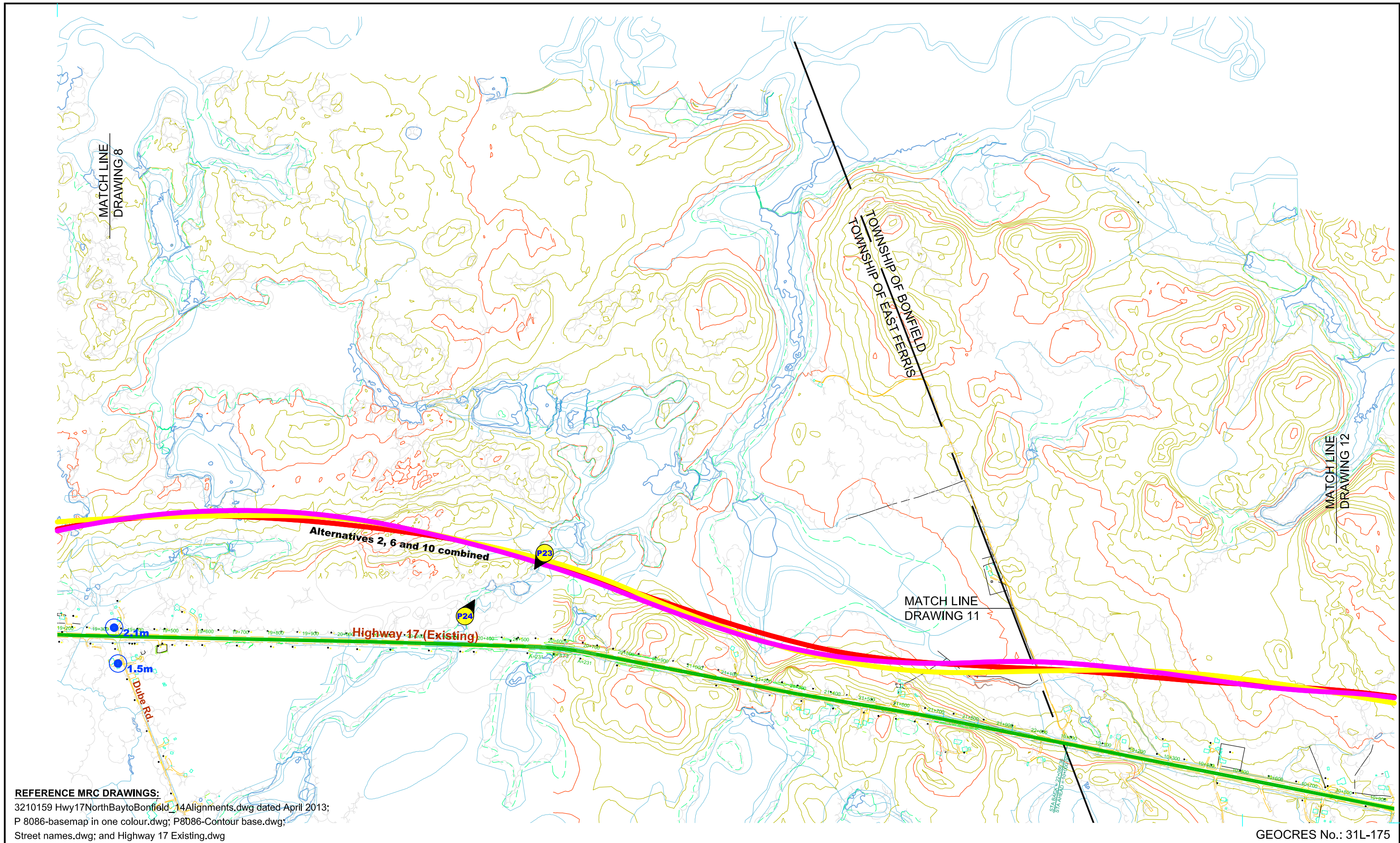
REALIGNMENT ALTERNATIVES
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
Township of East Ferris

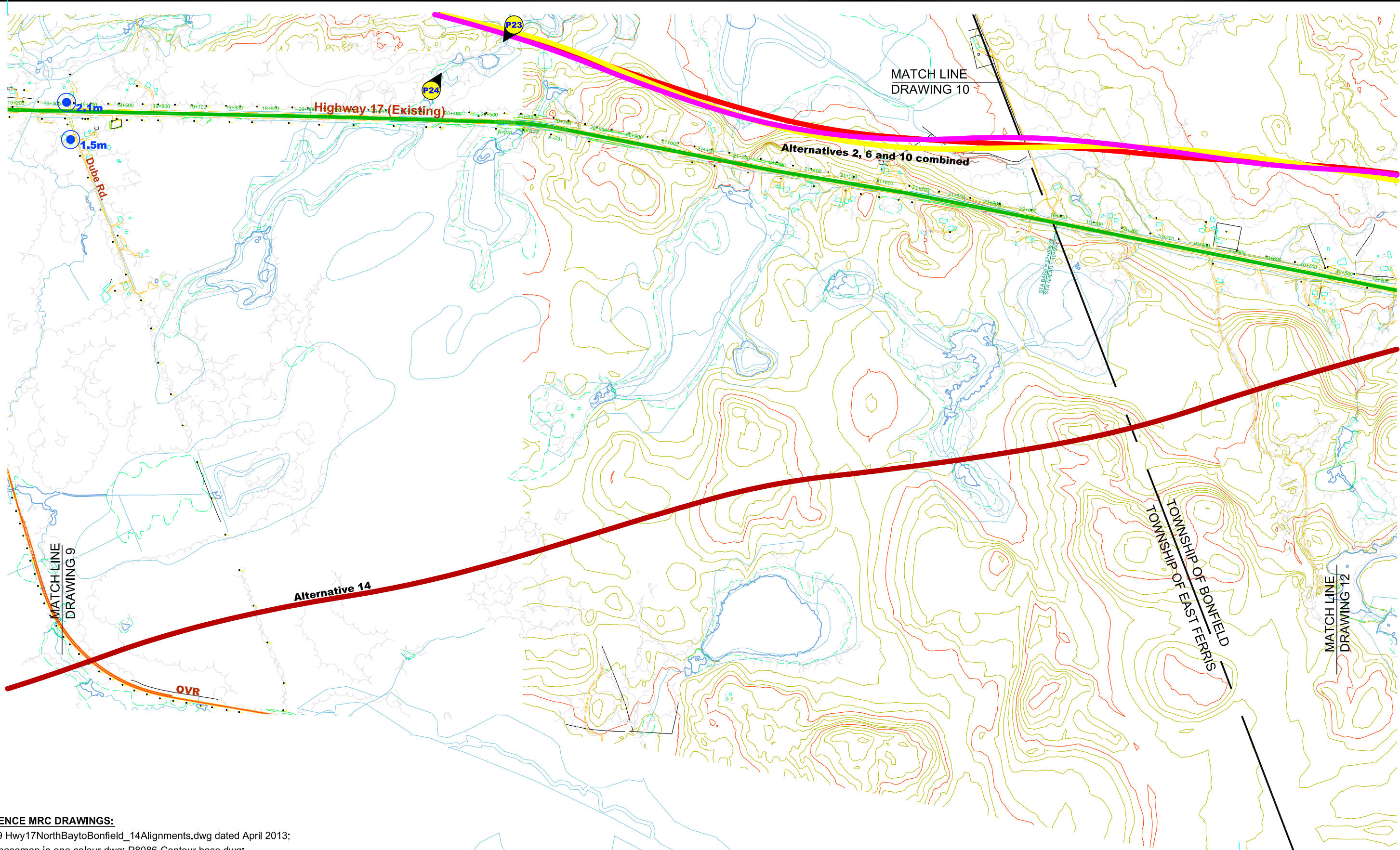
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HIGHWAY 17
GWP No. 5105-09-00





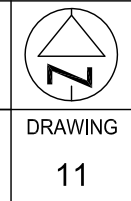


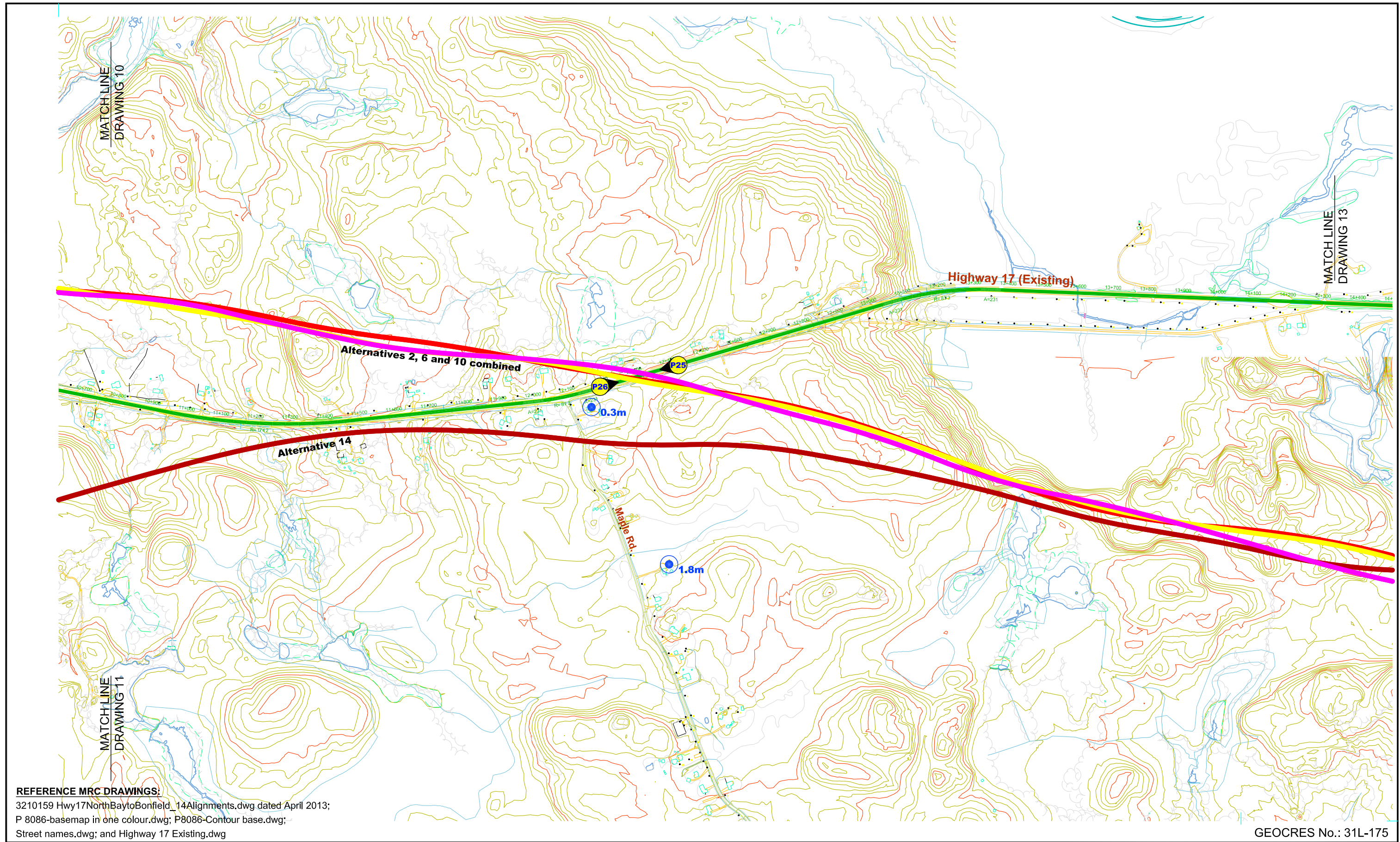
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GEOCRES No.: 31L-175

REALIGNMENT ALTERNATIVES
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
Townships of East Ferris and Bonfield

METRIC

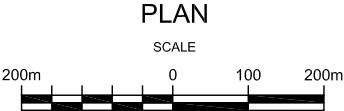




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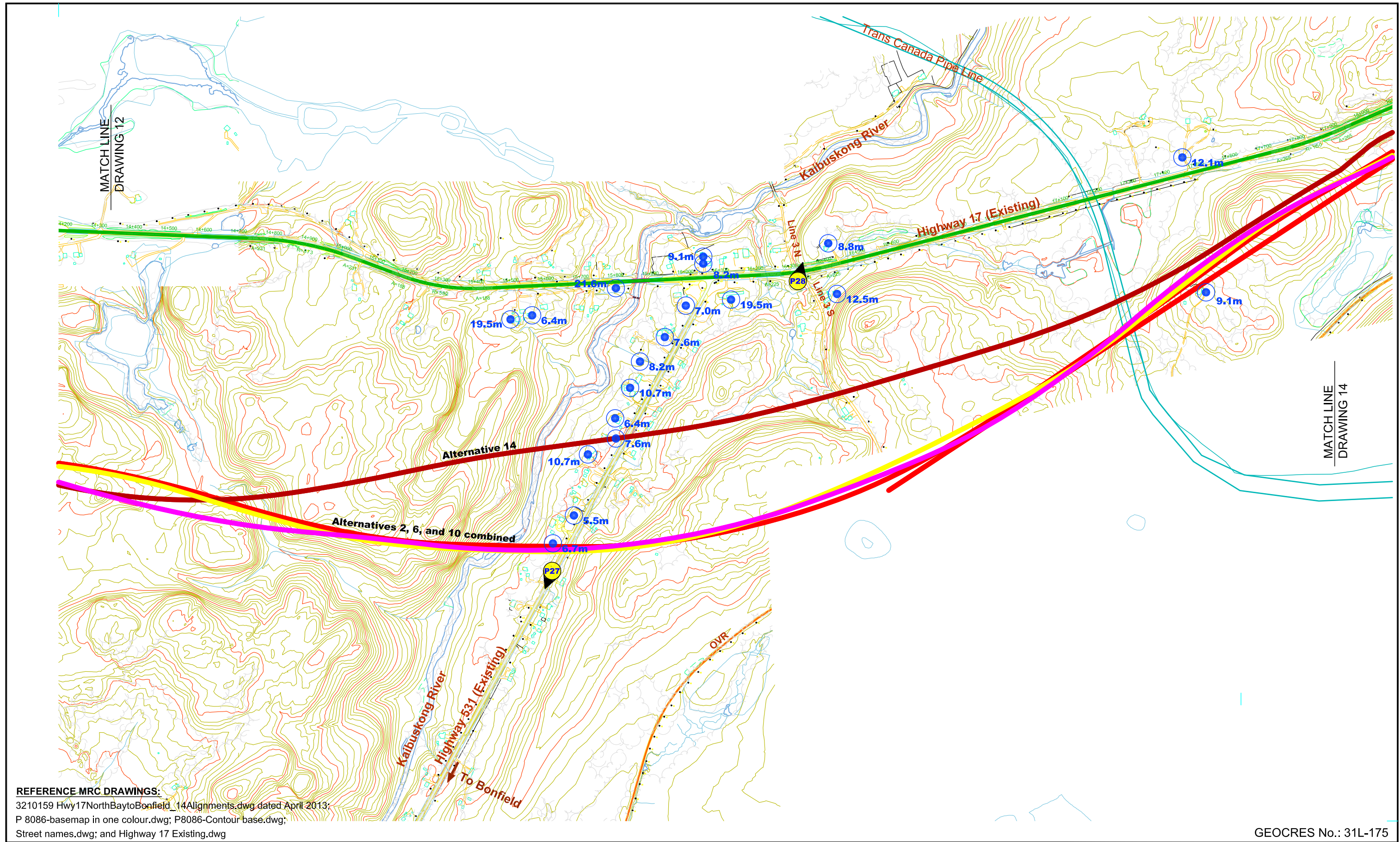
REALIGNMENT ALTERNATIVES
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
Township of Bonfield

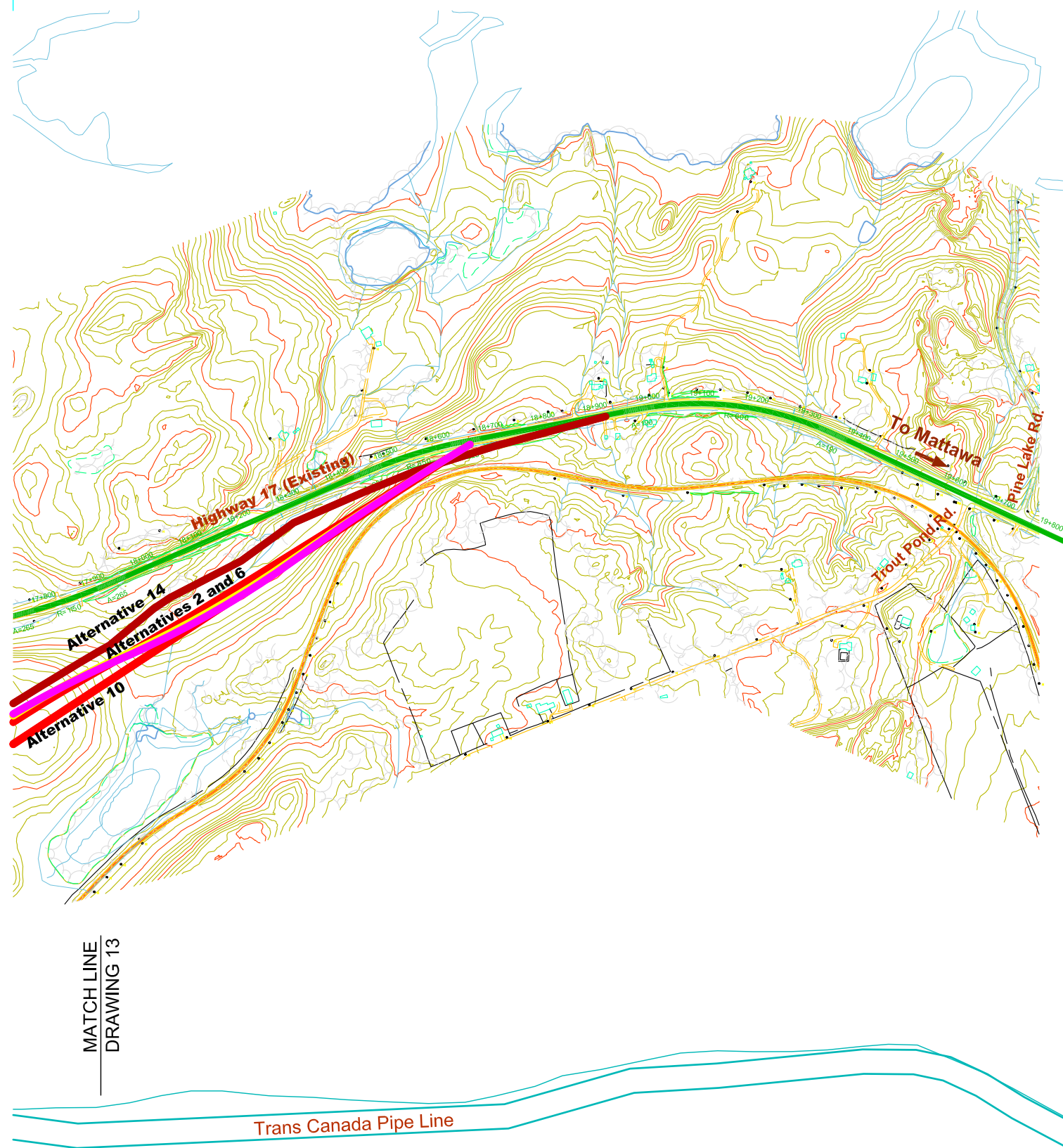
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HIGHWAY 17
GWP No. 5105-09-00





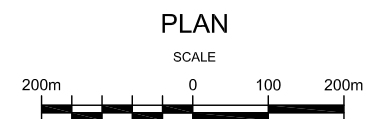


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GEOCRES No.: 31L-175

REALIGNMENT ALTERNATIVES
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
 From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
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METRIC



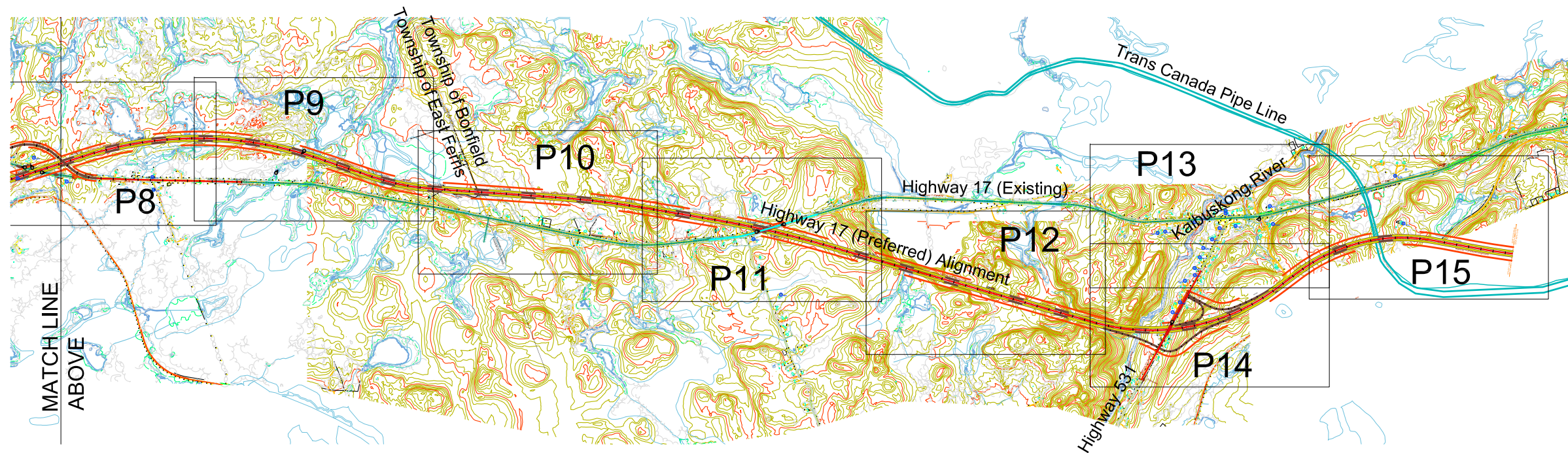
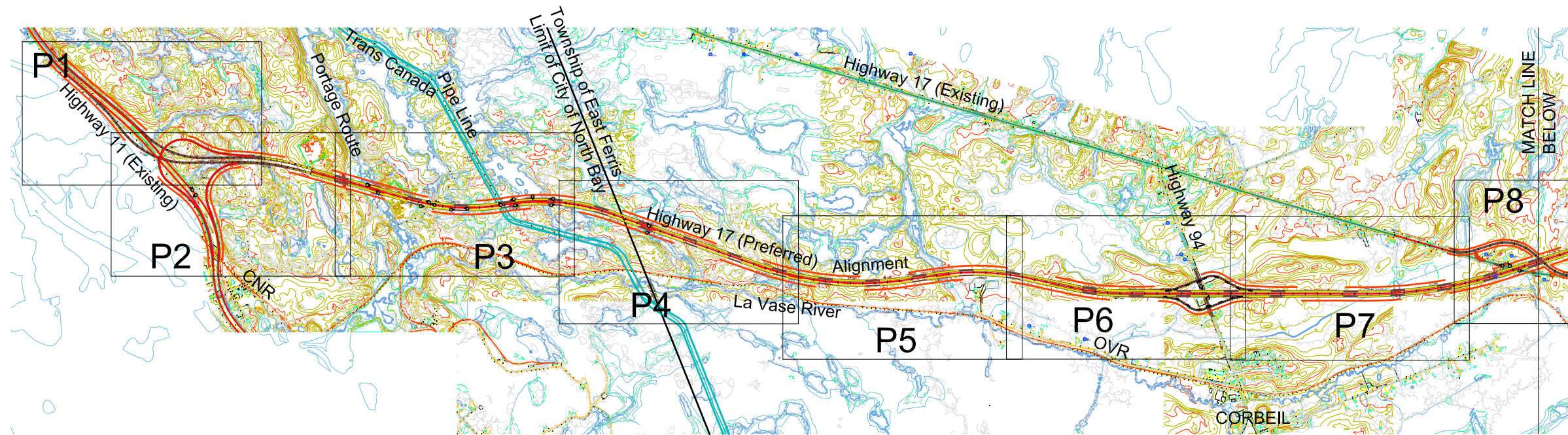
HIGHWAY 17
 GWP No. 5105-09-00



DRAWING
 14

NOTES	LEGEND
<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>HIGHWAY 17 (EXISTING)</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>5m</div></div><div>ANTICIPATED DEPTH (metres) TO COMPETENT MATERIAL/BEDROCK</div></div><div><div></div><div>WATER BODY</div></div><div><div>BR (N)</div><div>BEDROCK (KNOBS)</div></div><div><div>pOT</div><div>ORGANIC TERRAIN</div></div><div><div>GL (P)</div><div>GLACIOLACUSTRINE (PLAIN)</div></div><div><div>M (G)</div><div>GROUND MORAINE (TILL)</div></div><div><div><div>28</div></div><div>PHOTOGRAPH NUMBER (ARROW SHOWS DIRECTION OF VIEW)</div></div><div><div><div>5.4m</div></div><div>MOE WATER WELL RECORD (DEPTH TO BEDROCK)</div></div><div><div>..</div></div></div>

GEOCRES No.: 31L-175



REFERENCE MRC DRAWINGS:
 3210158-Hwy 17 North Bay - Interchange Plans &
 Profiles - April 10, 2013.dwg;
 P 8086-basemap in one colour.dwg;
 P8086-Contour base.dwg; Street names.dwg and
 Existing Hwy 17.dwg

GEOCRES No.: 31L-175

KEY MAP - PREFERRED ALIGNMENT

HIGHWAY 17 - ROUTE PLANNING

From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
 City of North Bay and Townships of East Ferris and Bonfield

PLAN
SCALE

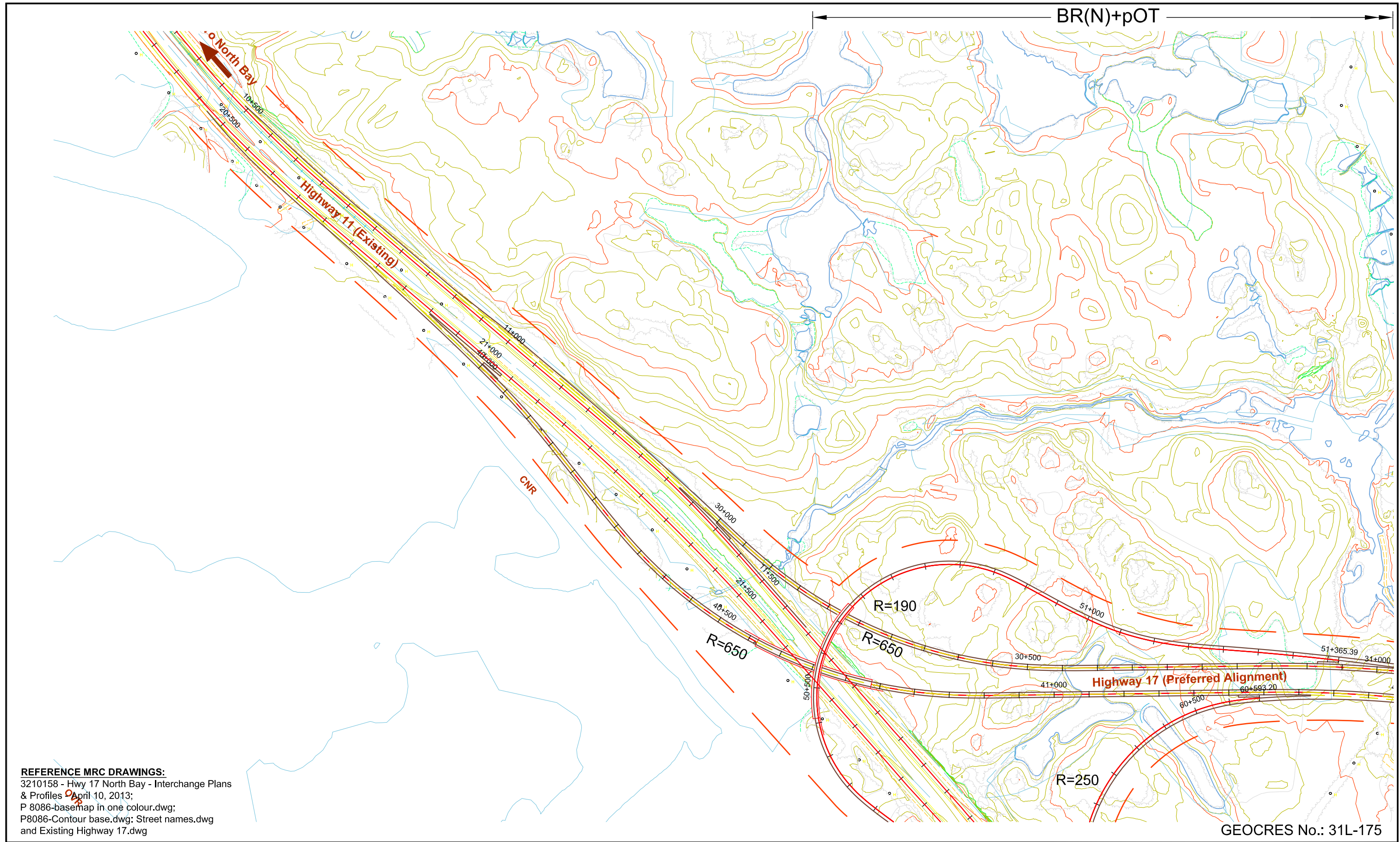


HIGHWAY 17
 GWP No. 5105-09-00

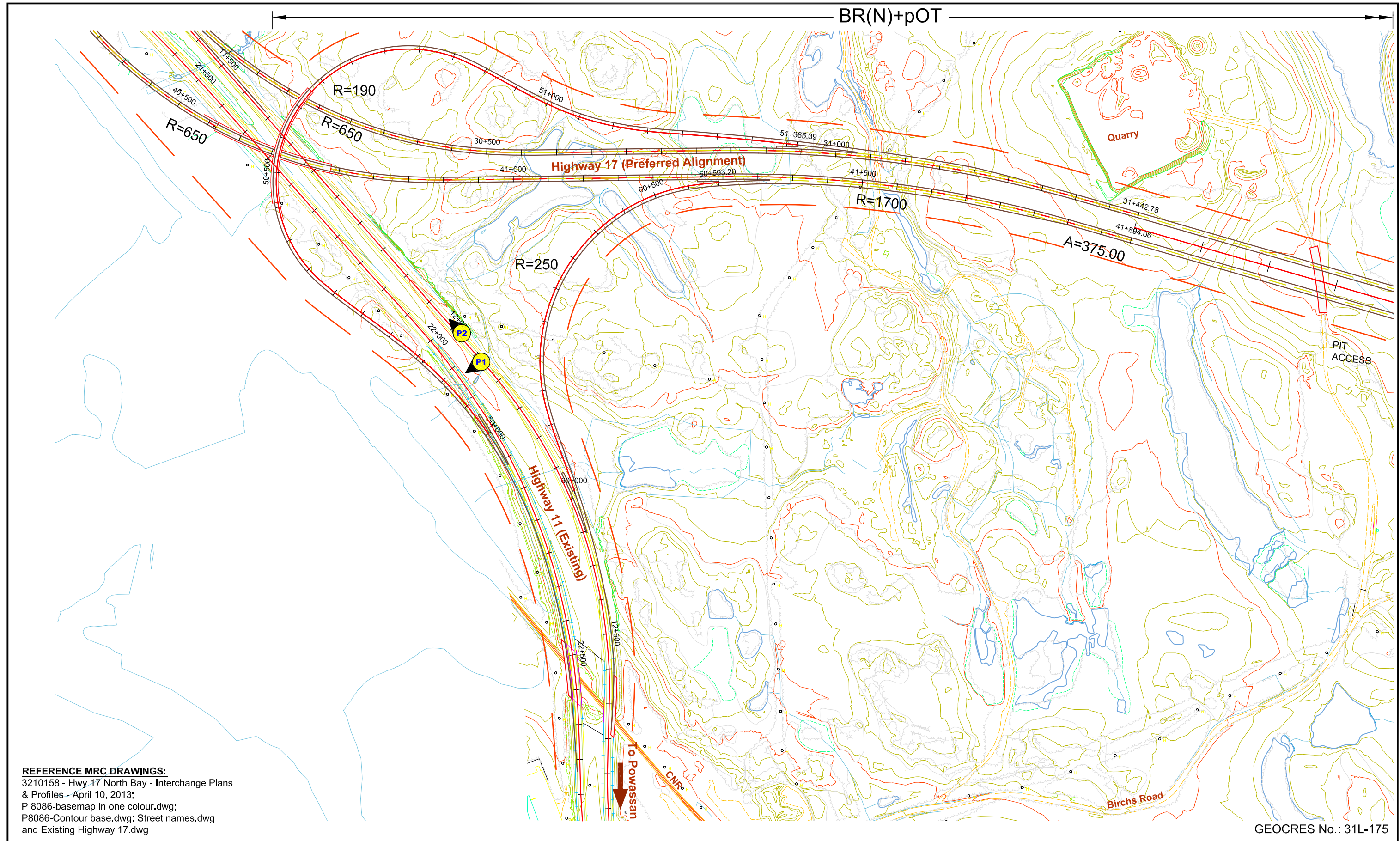


DRAWING
PB

METRIC



<p>PREFERRED ALIGNMENT SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS HIGHWAY 17 - ROUTE PLANNING From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km City of North Bay</p> <p>METRIC</p>	<p>PLAN SCALE</p> <p>100m 0 50 100m</p> <p>Ontario MRC McCORMICK RANKIN CORPORATION A member of MRM GROUP</p>	<p>PML Peto MacCallum Ltd. CONSULTING ENGINEERS</p> <p>HIGHWAY 17 GWP No. 5105-09-00</p>	<p>DRAWING P1</p>
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REFERENCE MRC DRAWINGS:
3210158 - Hwy 17 North Bay - Interchange Plans
& Profiles - April 10, 2013;
P 8086-basemap in one colour.dwg;
P8086-Contour base.dwg: Street names.dwg
and Existing Highway 17.dwg

GEOCRES No.: 31L-175

PREFERRED ALIGNMENT
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
City of North Bay

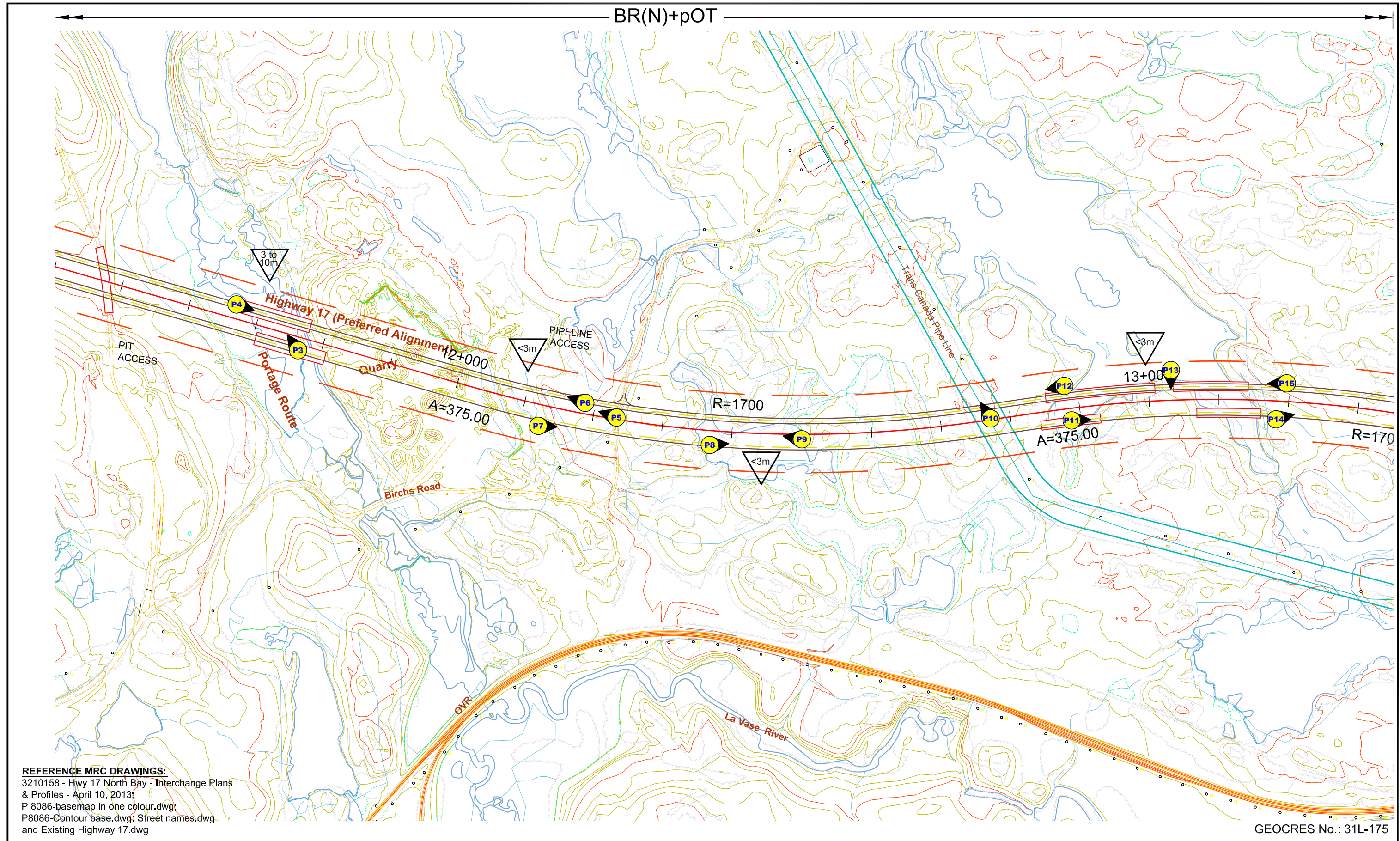
METRIC

PLAN
SCALE



HIGHWAY 17
GWP No. 5105-09-00





PREFERRED ALIGNMENT
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
City of North Bay

METRIC

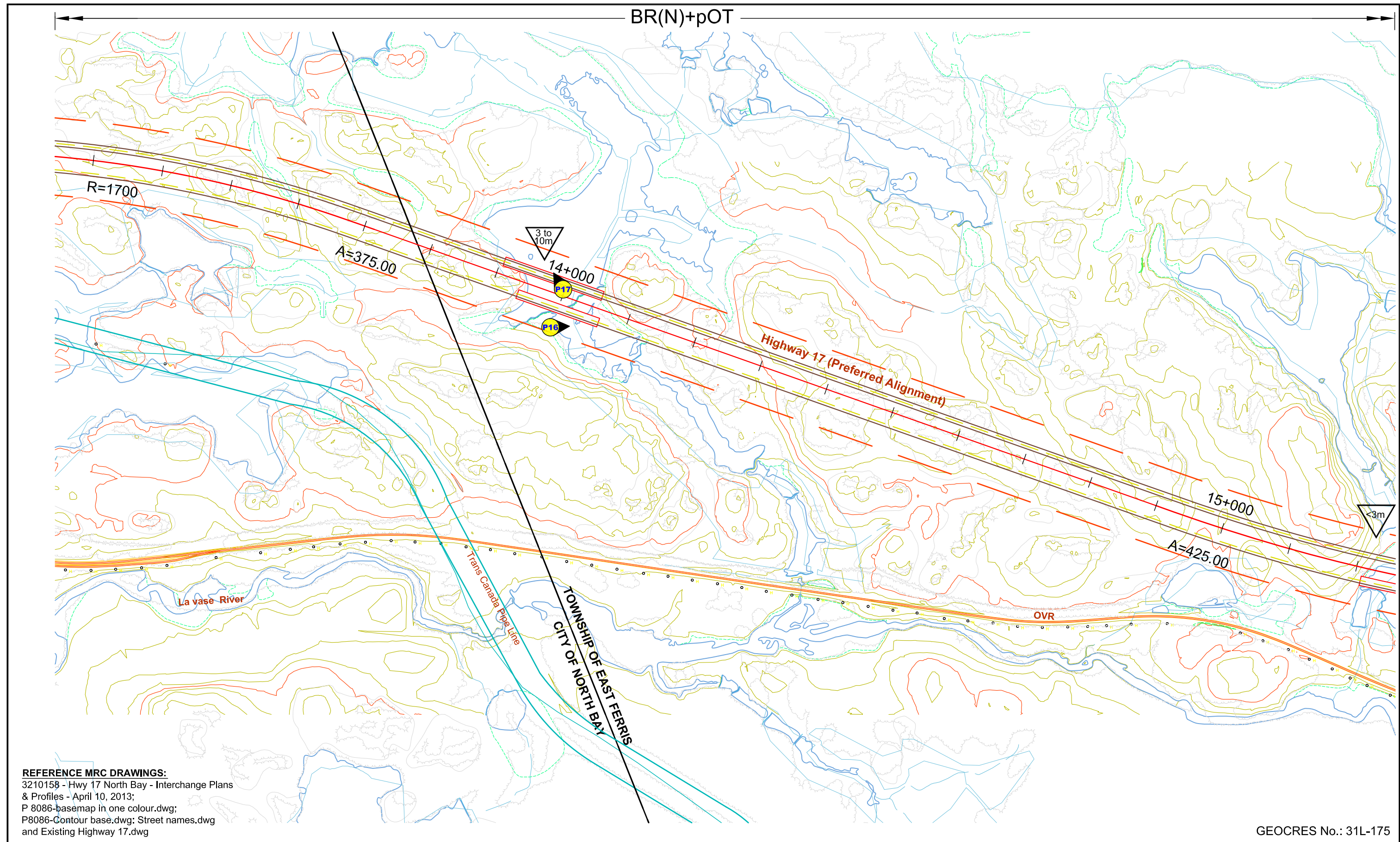
PLAN
SCALE



HIGHWAY 17
GWP No. 5105-09-00



DRAWING
P3



PREFERRED ALIGNMENT
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
 From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
 City of North Bay / Township of East Ferris

PLAN
SCALE

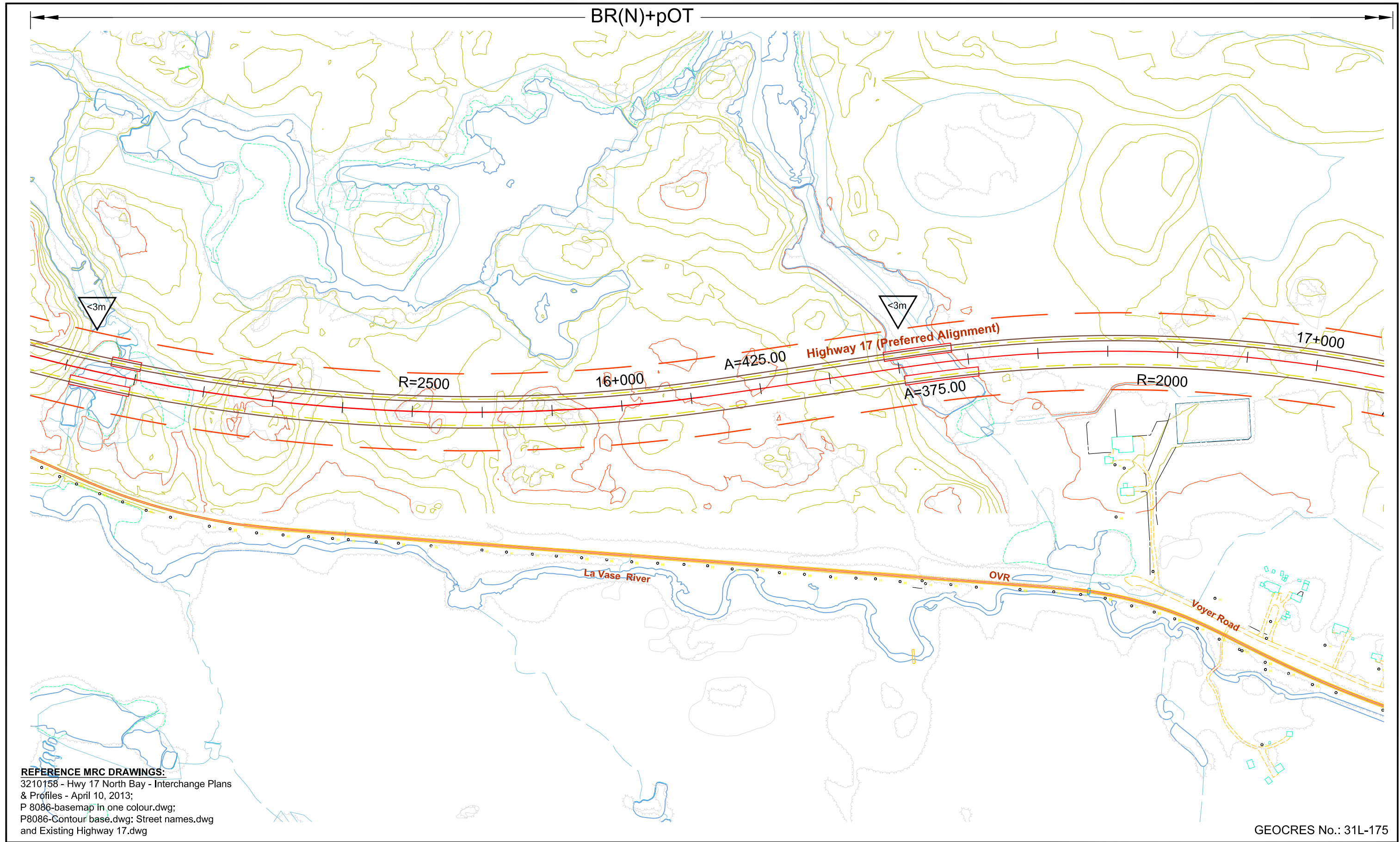


HIGHWAY 17
 GWP No. 5105-09-00

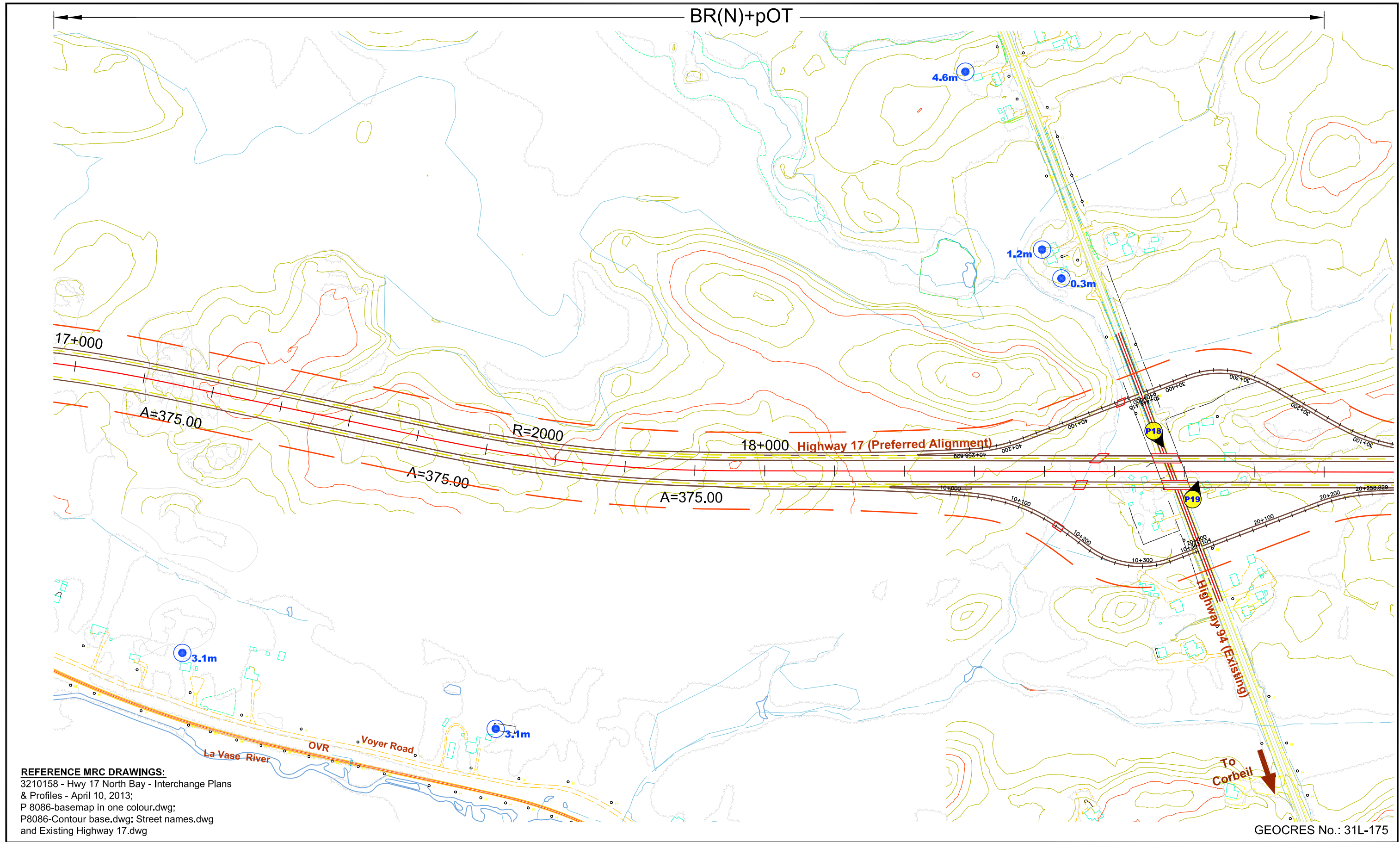


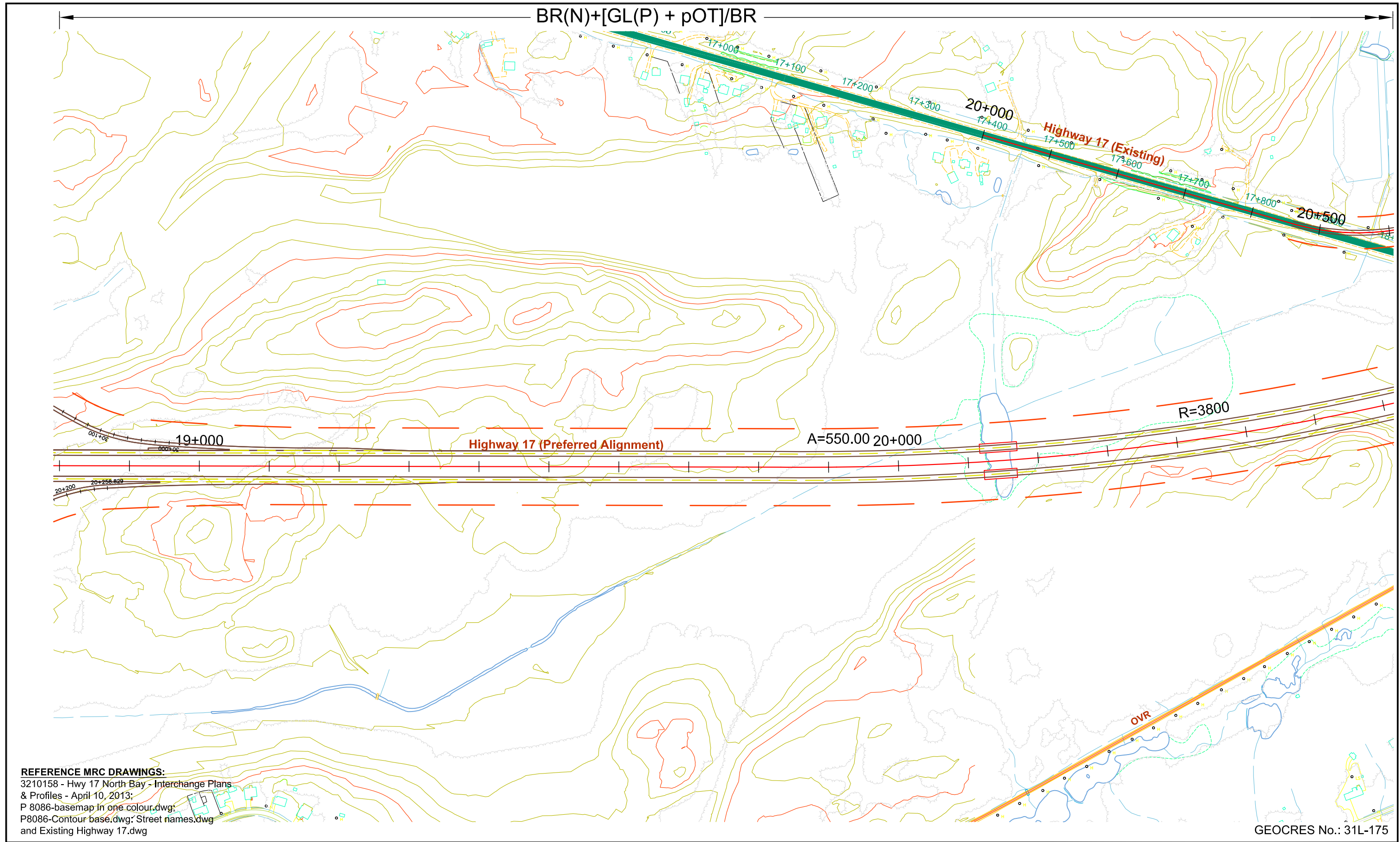
DRAWING
P4

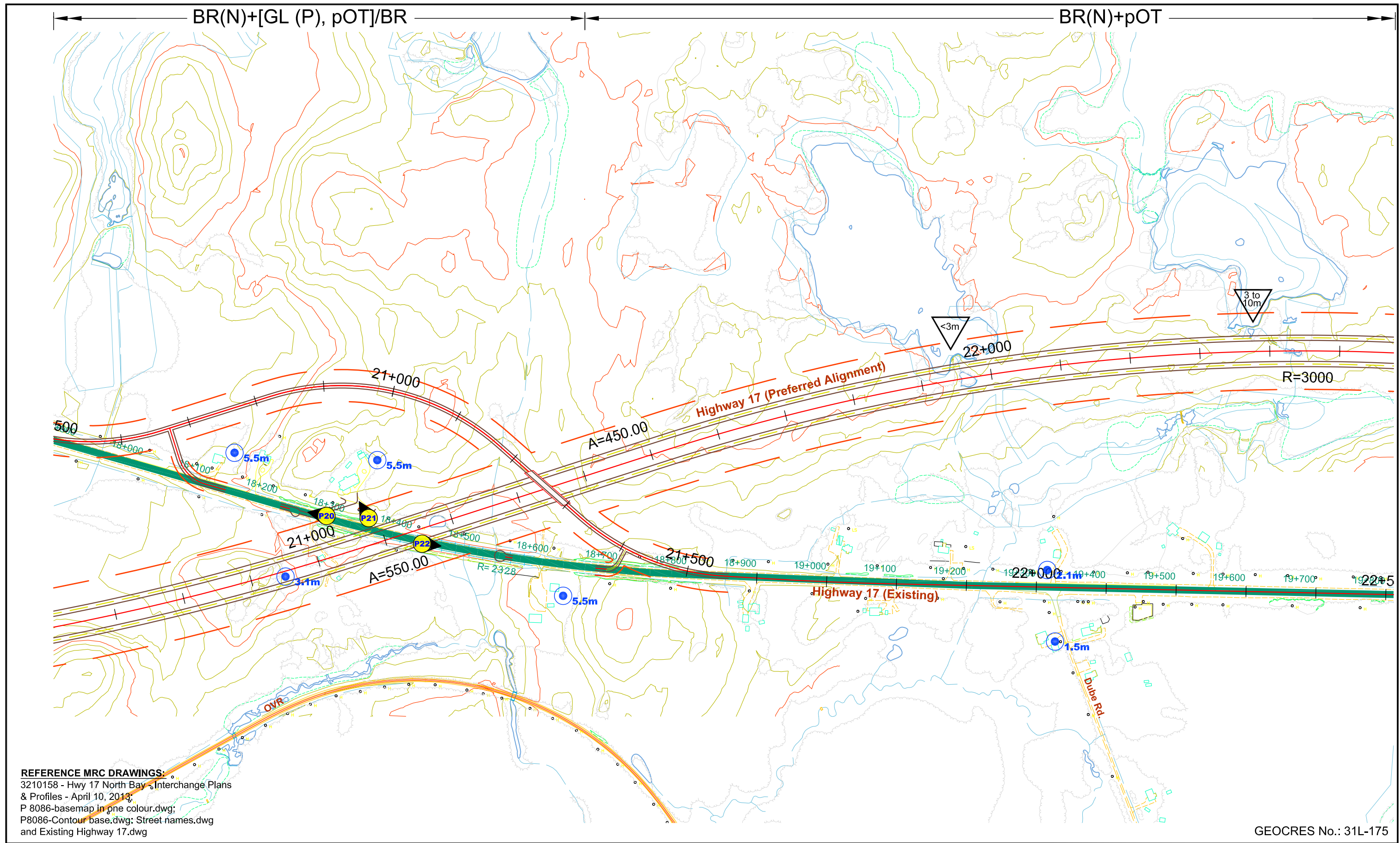
METRIC



<p>PREFERRED ALIGNMENT</p> <p>SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS</p> <p>HIGHWAY 17 - ROUTE PLANNING</p> <p>From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km</p> <p>Township of East Ferris</p>	<p>PLAN</p> <p>SCALE</p>	 MRC McCORMICK RANKIN CORPORATION <small>A member of MCM GROUP</small>	 CONSULTING ENGINEERS	 DRAWING P5
<p><i>METRIC</i></p>		<p>HIGHWAY 17</p> <p>GWP No. 5105-09-00</p>		

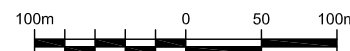






PREFERRED ALIGNMENT
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
 From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
 Township of East Ferris

PLAN
SCALE

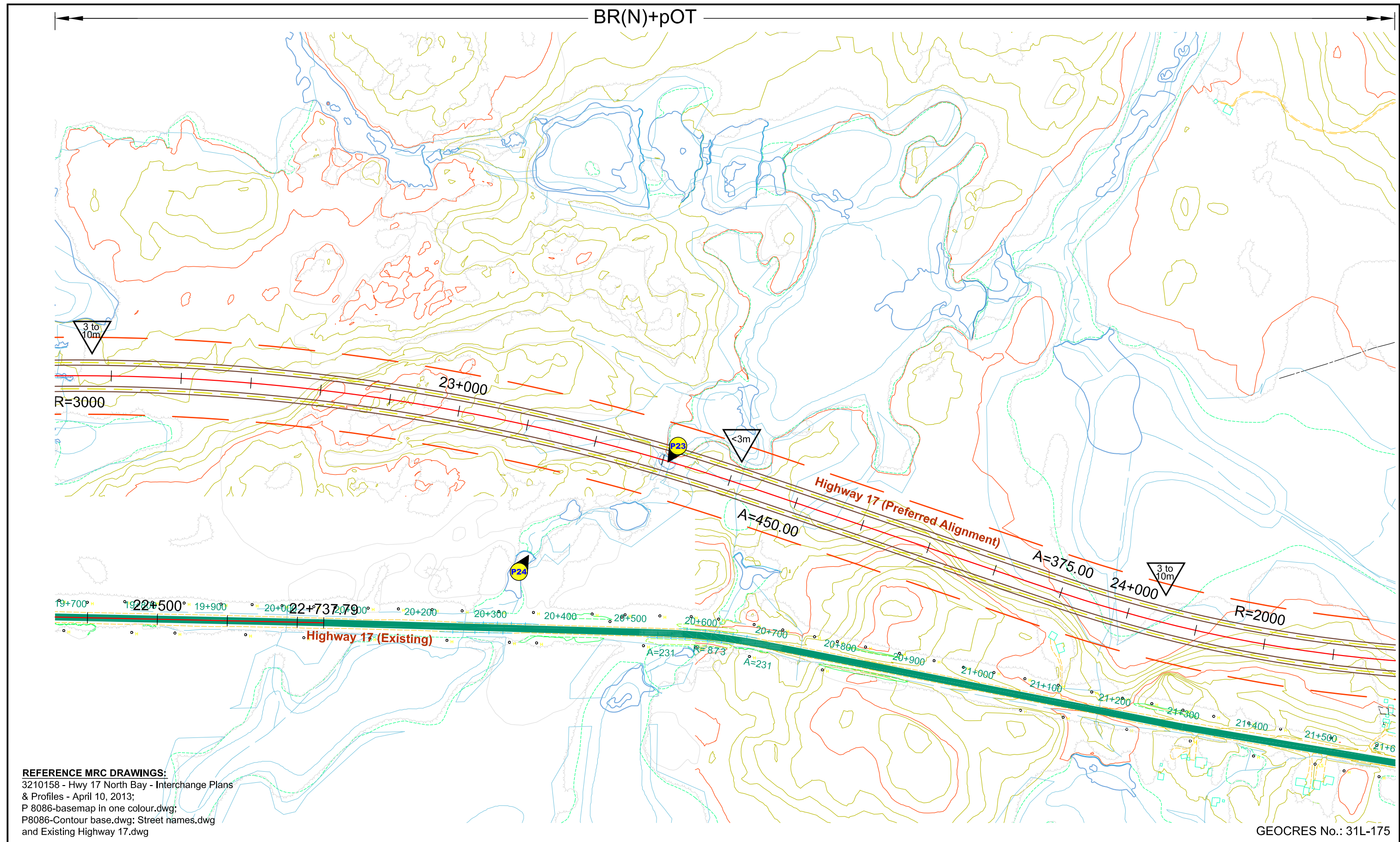


HIGHWAY 17
 GWP No. 5105-09-00



DRAWING
P8

METRIC



PREFERRED ALIGNMENT
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
Township of East Ferris

PLAN
SCALE

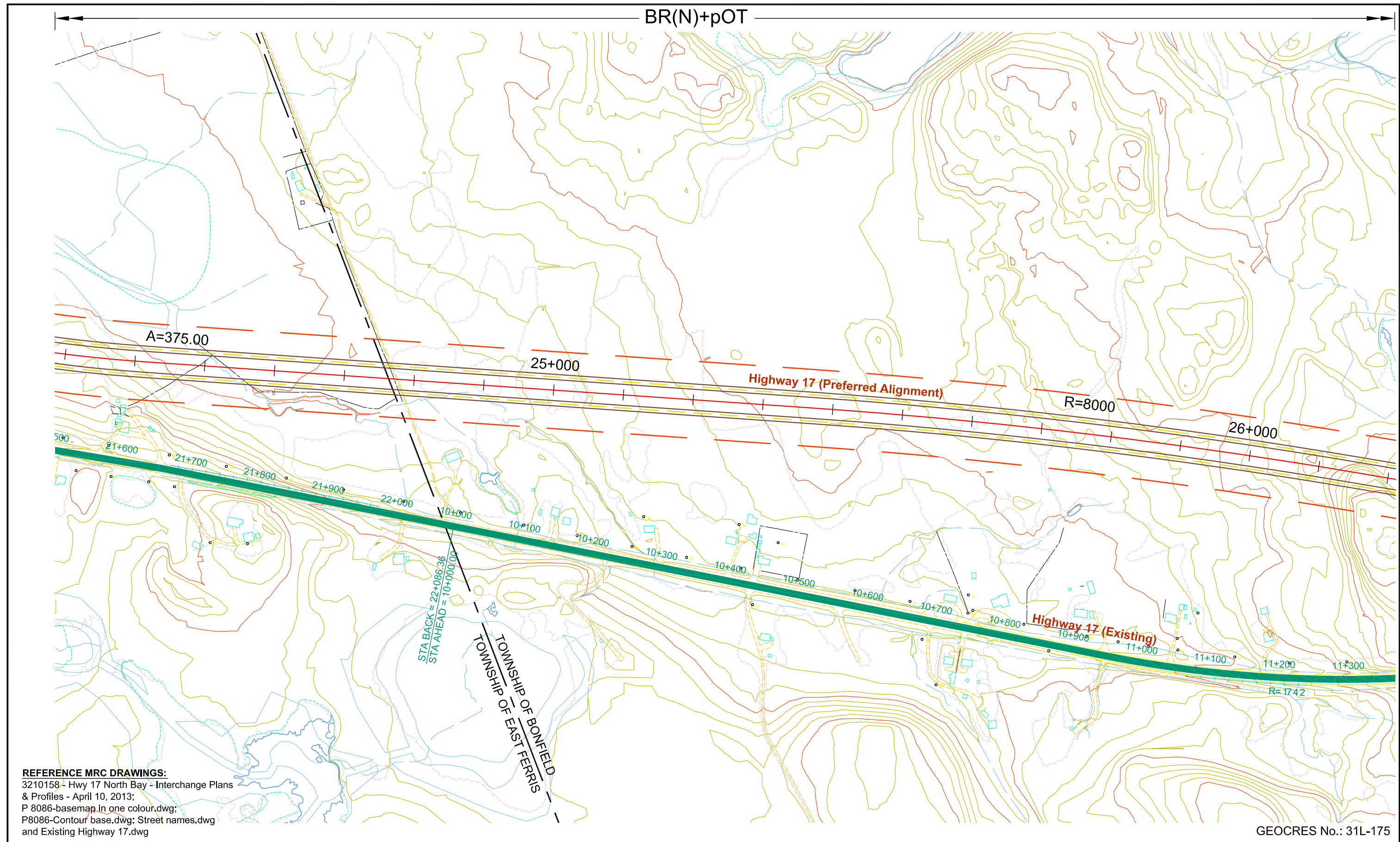


HIGHWAY 17
GWP No. 5105-09-00



DRAWING
P9

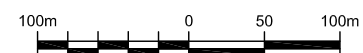
METRIC



PREFERRED ALIGNMENT
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
Townships of East Ferris and Bonfield

METRIC

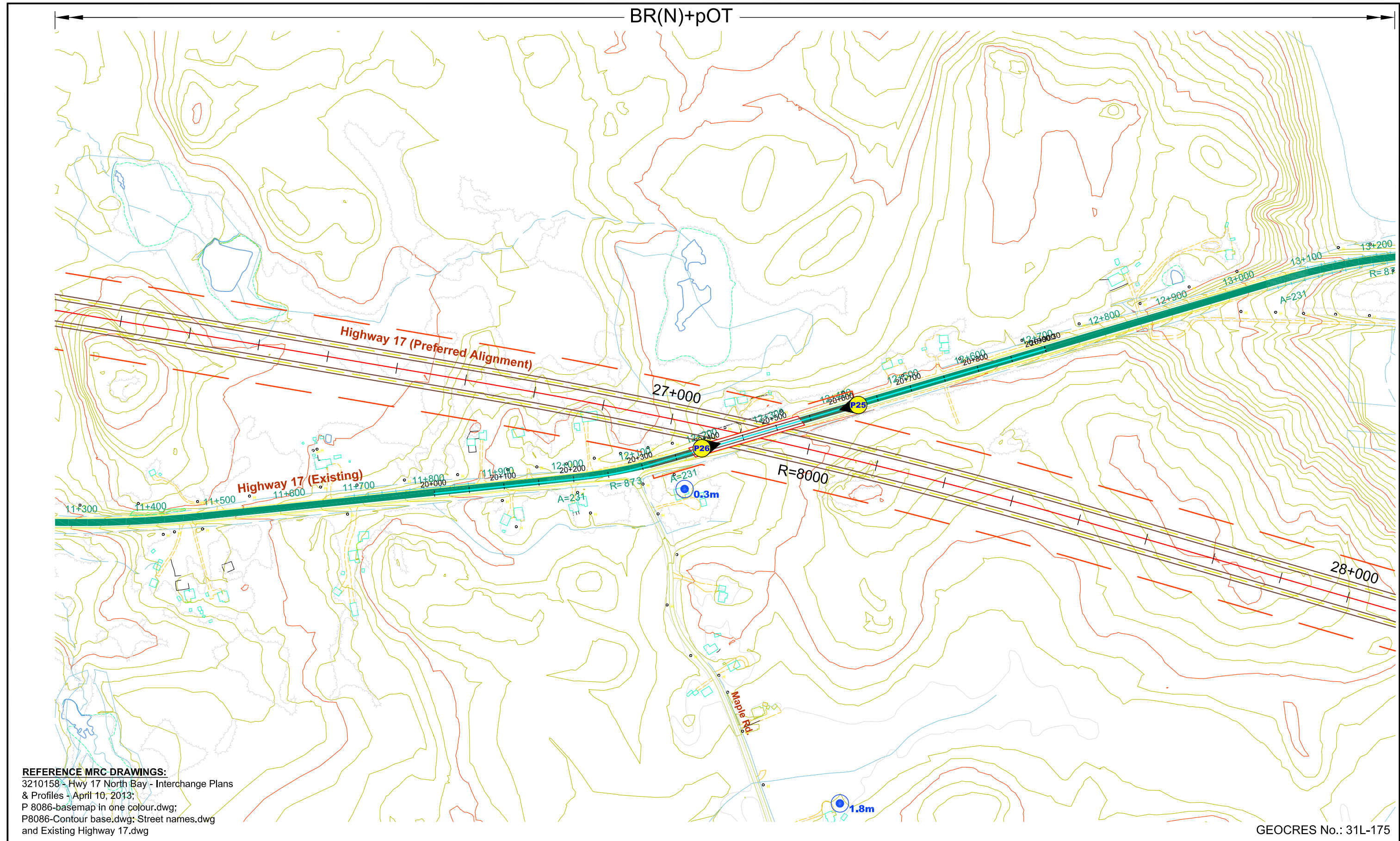
PLAN
SCALE



HIGHWAY 17
GWP No. 5105-09-00



DRAWING
P10



PREFERRED ALIGNMENT
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
Township of Bonfield

PLAN
SCALE

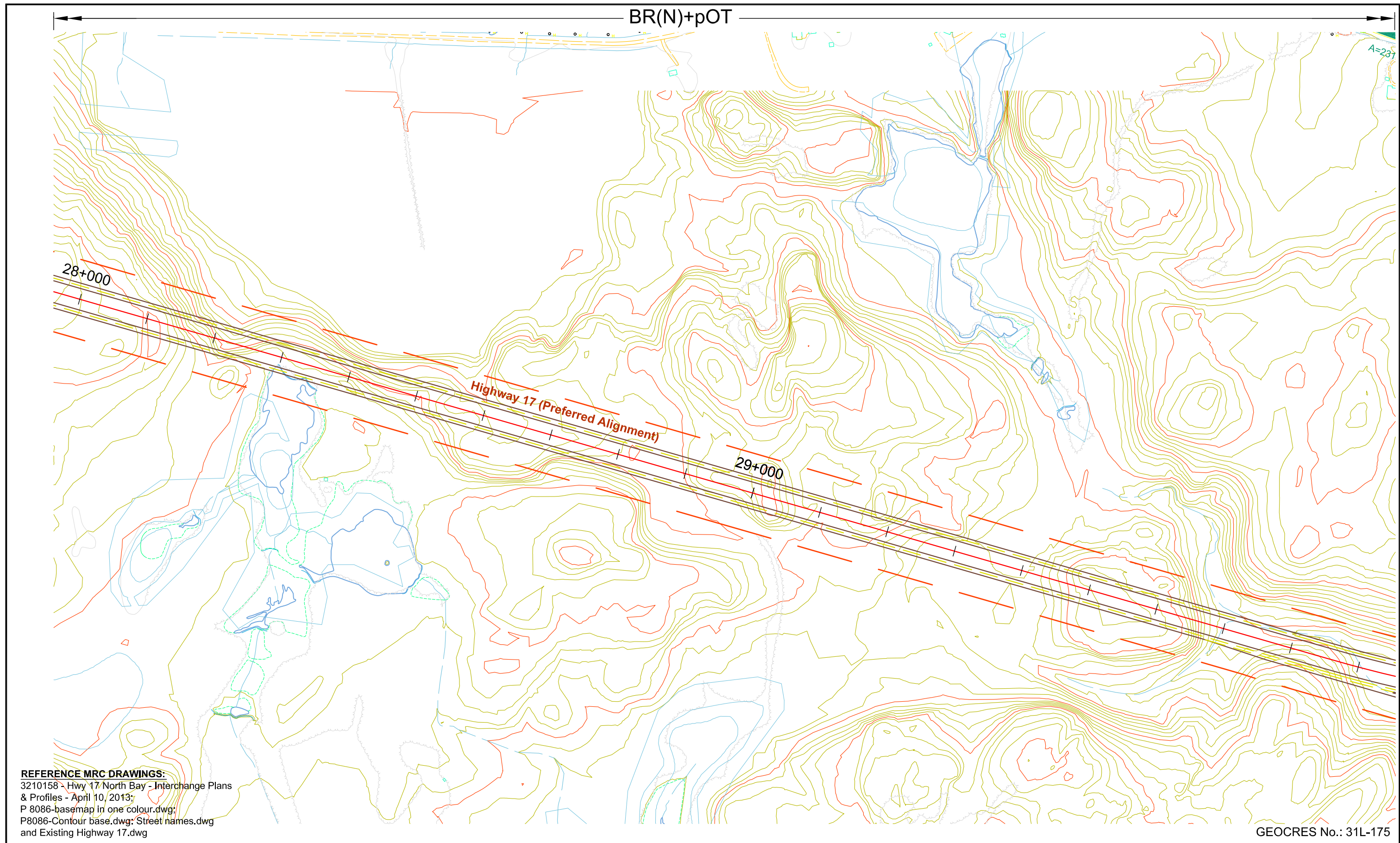


HIGHWAY 17
GWP No. 5105-09-00



DRAWING
P11

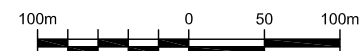
METRIC



PREFERRED ALIGNMENT
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
Township of Bonfield

METRIC

PLAN
SCALE



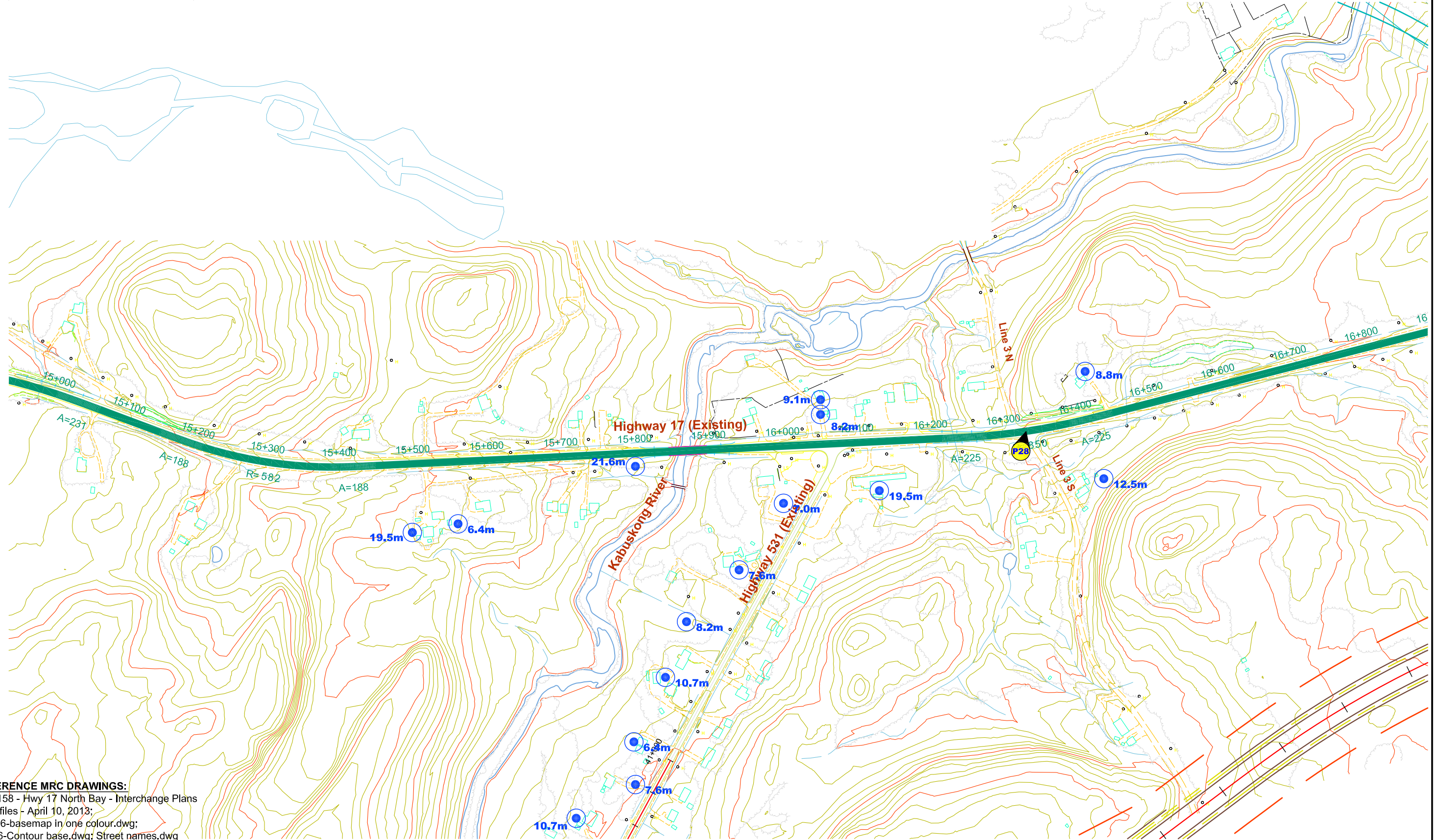
HIGHWAY 17
GWP No. 5105-09-00



DRAWING
P12

BR(N)+pOT

GL(P) / M(G) / BR



REFERENCE MRC DRAWINGS:
3210158 - Hwy 17 North Bay - Interchange Plans
& Profiles - April 10, 2013;
P 8086-basemap in one colour.dwg;
P8086-Contour base.dwg; Street names.dwg
and Existing Highway 17.dwg

GEOCRES No.: 31L-175

PREFERRED ALIGNMENT
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
Township of Bonfield

PLAN
SCALE



HIGHWAY 17
GWP No. 5105-09-00

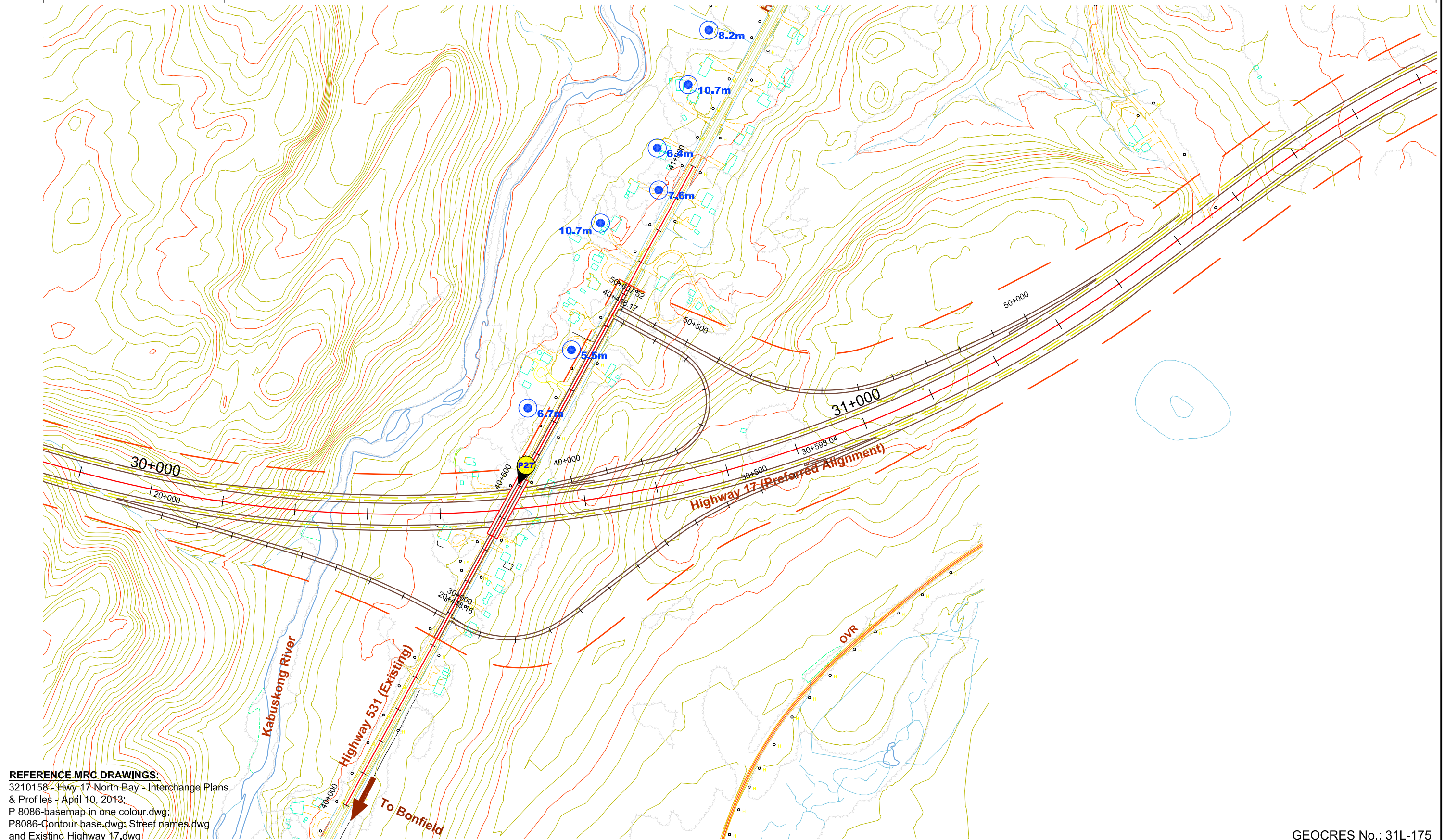


DRAWING
P13

METRIC

BR(N)+pOT

GL(P) / M(G) / BR



REFERENCE MRC DRAWINGS:
3210158 - Hwy 17 North Bay - Interchange Plans
& Profiles - April 10, 2013;
P 8086-basemap in one colour.dwg;
P8086-Contour base.dwg; Street names.dwg
and Existing Highway 17.dwg

GEOCRES No.: 31L-175

PREFERRED ALIGNMENT
SITE RECONNAISSANCE DETAILS, PHOTOGRAPHS AND WATER WELL LOCATIONS
HIGHWAY 17 - ROUTE PLANNING
From Highway 11 South Junction to 2.7 km east of Highway 531, about 26.0 km
Township of Bonfield

PLAN
SCALE

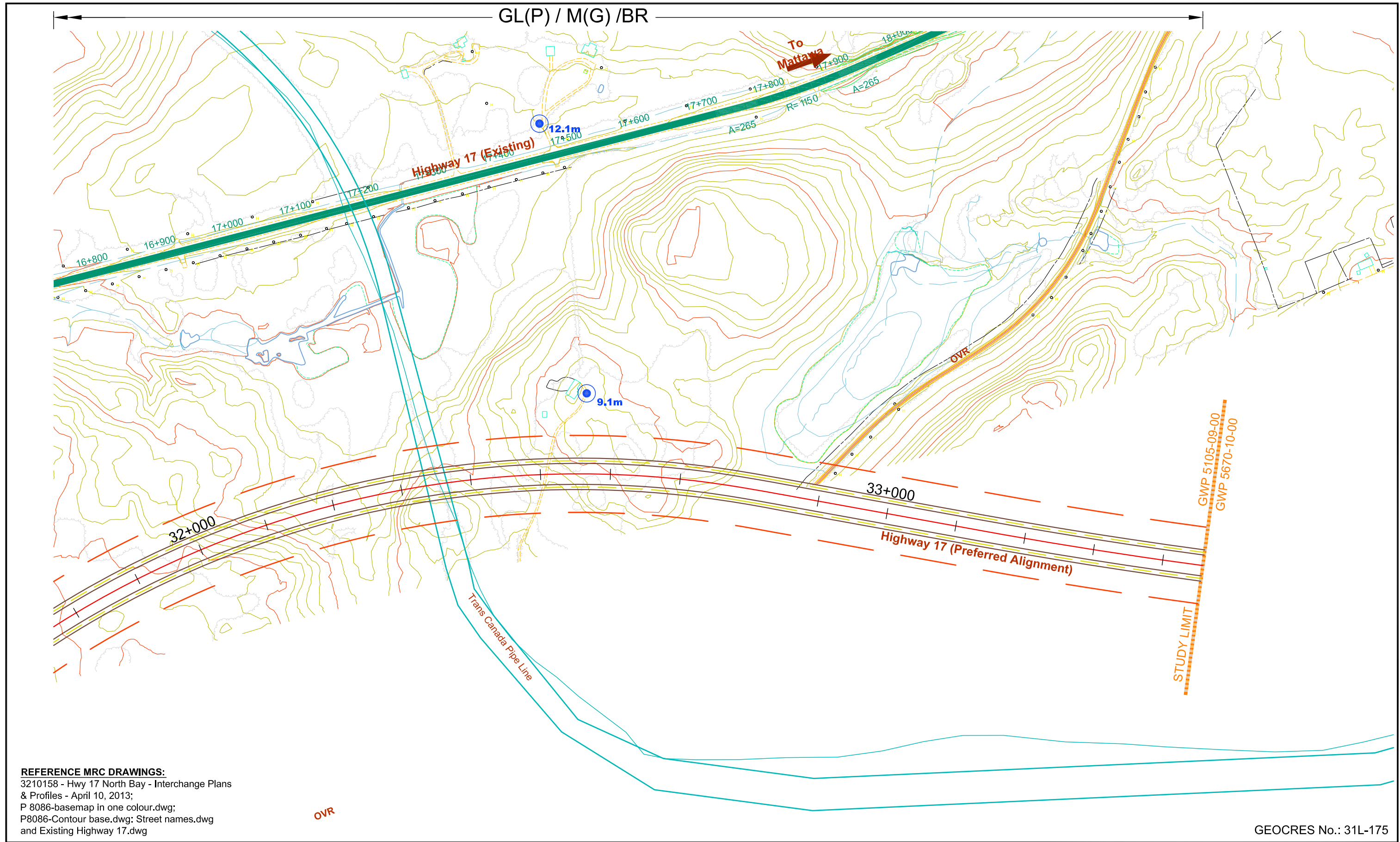


HIGHWAY 17
GWP No. 5105-09-00



DRAWING
P14

METRIC





APPENDIX A

List of Reference Documents



APPENDIX A

LIST OF REFERENCE DOCUMENTS

A. Geological Maps

- Bedrock Geology of Ontario, Southern Sheet, Map 2544, Scale 1:100,000
- 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

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

D. Ontario Base Maps

- Ontario Base Maps from Ontario Ministry of Natural Resources
 - Sheet No. 20 17 6200 51200, Published 2002, Scale 1:20,000
 - Sheet No. 20 17 6300 51200, Published 2002, Scale 1:20,000
 - Sheet No. 20 17 6400 51200, Published 2002, Scale 1:20,000

D. MTO Documents

- Foundation Investigation and Design Report, Brich's Road Overpass SB / NB, Highway 11 W.P 71-74-03 / 04, District 13, Site No. 43-199A / B, Geocres No. 31L-38, February 1977
- Foundation Investigation Report, Lakeshore Drive Underpass W.P 71-74-07, Site No. 43-201 Highway 11, District 13, North Bay, Geocres No. 31L-40, January 1978
- Foundation Investigation and Design Report CNR Overhead Southbound, Highway 11, W.P 71-74-02, District 13, Site 43-105B, Geocres No. 31L-34, February / March 1977



- Foundation Investigation Report, CPR and Lavase River O'Heads, North and Southbound Lanes W.P 71-74-05 / 06, Site No. 43-200 A & B, Geocres No. 31L-46, February 1977
- Foundation Investigation Report, Highway 11 and Highway 17 Interchange, District 13, North Bay, Site 43-350, Geocres No. 31L-54, July 1990
- Foundation Investigation and Design Report, Embankment Widenings, Highway 17. From Highway 94 Westerly 10.6 km to the east Junction of Highway 11 / 17, GWP 90-94-00, Geocres No. 31L-69, November 1999
- Foundation Memo Report, Lavase River Culvert, Highway 94, Site No. 43-368 East Ferris Township, W.P 65-98-00, Geocres No. 31L-68, November 1998
- Foundation Investigation and Design Report, Variable Message Sign # 14, Highway 17 Eastbound, approximately 5 km, East of Highway 11, North Bay, GWP 5766-04-01, Geocres No. 31L-122, July 15, 2008
- Foundation Investigation, Kaibuskong River Bridge, Highway 17, District 13, Geocres No. 31L-022, May 1958
- MTO Contract Drawings
 - Contract No. 91-216
 - Contract No. 2000-0219
 - Contract No. 2006-5061
 - Geotechnical survey data for Contract No. 2000-0210

D. MOE Well Records (See Appendix B)

- Water Well Records provided by the Ministry of Environment as of 2012

E. Air Photographs

- Photo Mosaic of Oblique Aerial view along the study corridor provided by MRC
- Aerial Photographs 89-4609, 16-96 to 16-116



APPENDIX B

Water Well Records

TOWNSHIP OF EAST FERRIS

Well Computer Print Out Data as of February 26 2013

Page: 1 / 2

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 # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
EAST FERRIS TOWNSHIP CON 10(001)	17 636897 5126120 L	1993/07 2305	06 06	FR	044 / 088 / 72:0	DO		4305578 (097940) BRWN SAND BLDR 0013 GREY GRVL 0332
EAST FERRIS TOWNSHIP CON 10(002)	17 636285 5125905 W	1975/12 1120	06	FR 0235	020 / 025 015 / 2:0	DO		4302359 () BRWN CLAY 0015 BLCK GRNT 0245
EAST FERRIS TOWNSHIP CON 10(002)	17 636421 5125693 W	1974/07 3811	02	FR 0077 FR 0084 FR 0064	004 / 010 004 / 2:30	DO		4302096 () BRWN CLAY 0003 RED GRNT 0097
EAST FERRIS TOWNSHIP CON 10(002)	17 636528 5125971 L	1988/07 2305	06	FR 0096	012 / 060 / 1:0	DO		4304559 () BRWN SAND BLDR 0004 RED GRNT 0105
EAST FERRIS TOWNSHIP CON 10(004)	17 635788 5125669 L	1986/12 2428	06	FR 0100	006 / 040 010 / 2:0	DO		4304276 () RED CLAY 0022 RED GRNT DKCL 0092 RED GRNT 0105
EAST FERRIS TOWNSHIP CON 10(006)	17 634732 5125596 W	2010/07 1462	06	FR 0190 FR 0210 FR 0234	003 / 018 005 / 1:0	DO		7155686 (Z108498) A093769 CLAY 0010 SAND BLDR 0020 RED GRNT 0240

Well Computer Print Out Data as of February 26 2013

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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 # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
EAST FERRIS TOWNSHIP CON 12(012)	17 631556 5126565 W	1968/09 1443	02 02	FR 0088	006 / 040 004 / 16:0	DO		4301362 {} MSND BLDR 0003 RED GRNT 0090
EAST FERRIS TOWNSHIP CON 12(012)	17 632016 5126305 W	1967/08 1407	02 02	FR 0101	006 / 035 002 / 3:0	DO		4300362 {} MSND 0003 RED GRNT 0103
EAST FERRIS TOWNSHIP CON 12(012)	17 631866 5126375 W	1980/02 1120	06	FR 0130	010 / 005 / 1:0	DO		4303332 {} BRWN CLAY 0003 BLCK GRNT 0145
EAST FERRIS TOWNSHIP CON 12(012)	17 632016 5126400 W	1961/08 1407	02 02	FR 0196	008 / 023 004 / 4:0	DO		4300363 {} BLDR GRVL 0005 GREY GRNT 0175 RED GRNT 0202
EAST FERRIS TOWNSHIP CON 12(012)	17 632004 5126324 L	2003/05 1462	06 06	FR 0135	012 / 142 010 / 1:0	DO		4307389 (258911) SAND GRVL BLDR 0018 GREY GRNT LYRD 0142
EAST FERRIS TOWNSHIP CON 12(012)	17 632009 5126323 L	1993/04 1377	06	FR 0203	033 / 034 010 / 1:0	DO		4305548 (125905) SAND 0005 BLCK ROCK 0225
EAST FERRIS TOWNSHIP CON 12(012)	17 632256 5126265 W	1971/05 2305	02	FR 0186 FR 0165	026 / 043 003 / 4:0	DO		4301613 {} BRWN LOAM 0002 GRNT 0193
EAST FERRIS TOWNSHIP CON 12(012)	17 632196 5126275 W	1971/05 2305	02	FR 0076	001 / 030 006 / 3:30	DO		4301614 {} BRWN LOAM 0002 GRNT 0141
EAST FERRIS TOWNSHIP CON 12(012)	17 632009 5126323 L	1991/10 2305	06	FR 0290	038 / 030 / 24:0	DO		4305253 (097275) BRWN SAND CLAY 0006 GREY GRNT 0291
EAST FERRIS TOWNSHIP CON 12(013)	17 631466 5126655 W	1965/06 1407	02 02	FR 0248	022 / 060 002 / 8:0	DO		4300364 {} MSND 0002 RED GRNT 0250
EAST FERRIS TOWNSHIP CON 12(014)		2001/09 6344	06 06	FR 0045 FR 0088	002 / 095 003 / 4:0	DO		4307071 (231055) GREY CLAY PCKD 0012 GREY GRNT HARD 0032 BRWN GRNT HARD 0040 GREY GRNT HARD 0045 BRWN GRNT HARD 0047 RED GRNT HARD 0098
EAST FERRIS TOWNSHIP CON 12(014)	17 631016 5126325 W	1982/09 1120	06	FR 0135	010 / 125 003 / 2:0	DO		4303634 {} BRWN CLAY 0005 BLCK GRNT 0145

Well Computer Print Out Data as of February 26 2013

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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 # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
EAST FERRIS TOWNSHIP CON 12 (014)	17 631076 5125995 W	1973/05 3811	02 02	FR 0214	005 / 010 005 / 2:0	DO		4301926 () BRWN CLAY 0003 BLCK GRNT 0227
EAST FERRIS TOWNSHIP CON 12 (015)	17 630870 5125868 L	1991/05 3665	06 06	FR 0341	020 / 003 / 2:0	DO		4305110 (87723) BRWN GRVL SAND 0006 GREY GRNT FCRD 0012 GREY GRVL 0345
EAST FERRIS TOWNSHIP CON 12 (015)	17 630956 5126135 W	1958/09 1424	07 07	FR 0137	002 / 125 002 / 24:0	DO		4300365 () LOAM MSND 0001 GREY GRNT 0137
EAST FERRIS TOWNSHIP CON 12 (015)	17 630870 5125868 L	1987/09 1462	06	FR 0220	010 / 002 / 1:0	DO		4304388 () CLAY 0004 RED GRNT 0020 GREY GRNT 0040 RED GRNT 0045 RED GRNT 0055 GREY GRNT DKCL 0060 GREY GRNT 0078 RED GRNT 0106 GREY GRNT 0249
EAST FERRIS TOWNSHIP CON 12 (015)	17 630891 5126235 W	1971/10 1445	02 02	FR 0120 FR 0218	010 / 010 002 / 8:0	DO		4301677 () BRWN SAND BLDR 0019 RED GRNT 0227
EAST FERRIS TOWNSHIP CON 12 (015)	17 630916 5126275 W	1982/02 1120	06	FR 0120 FR 0200	010 / 200 005 / 1:0	DO		4303644 () BRWN CLAY 0015 BLCK GRNT 0205
EAST FERRIS TOWNSHIP CON 12 (017)	17 630094 5125574 L	2003/10 1462	06 06	FR 0275	006 / 100 004 / 1:0	DO		4307463 (259190) GRVL 0002 GREY GRNT LYRD 0282
EAST FERRIS TOWNSHIP CON 12 (017)	17 630216 5125275 W	1982/08 3424	06			DO		4303584 () A BRWN SAND 0010 GREY GRNT 0150
EAST FERRIS TOWNSHIP CON 12 (018)	17 629816 5125325 W	1977/11 4541	02 02	FR 0251	005 / 005 007 / 2:0	DO		4302706 () GREY CLAY GRVL SOFT 0014 BLCK GRN GRNT SOFT 0255
EAST FERRIS TOWNSHIP CON 12 (018)	17 629656 5125435 W	1971/06 1443	02 02	FR 0097	018 / 018 003 / 2:0	DO		4301619 () BLDR 0003 RED GRNT 0098
EAST FERRIS TOWNSHIP CON 12 (018)	17 629716 5125425 W	1978/10 1120	06 06	FR 0085 FR 0277	004 / 260 001 / 2:0	DO		4302973 () BRWN CLAY 0009 RED GRNT 0285
EAST FERRIS TOWNSHIP CON 12 (018)	17 629766 5125375 W	1977/08 1120	06 06	FR 0373	020 / 020 020 / 1:0	DO		4302649 () CLAY BLDR 0010 BLCK GRNT 0385

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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 # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
EAST FERRIS TOWNSHIP CON 12 (018)	17 629761 5125394 W	1975/10 4541	02 02	FR 0103	010 / 020 001 / 2:0	DO		4302289 () BRWN SAND 0007 GREY GRNT 0112
EAST FERRIS TOWNSHIP CON 12 (018)	17 629516 5125225 W	1977/07 4541	02 02	FR 0070	005 / 006 008 / 3:0	DO		4302640 () BRWN SAND GRVL SOFT 0002 RED GRNT SOFT 0072
EAST FERRIS TOWNSHIP 12 (015)	17 631225 5125410 W	2008/09 1462	06	FR 0338	012 / 014 010 / 1:0	DO		7116596 (Z85491) A071409 CLAY 0005 RED GRNT 0340
EAST FERRIS TOWNSHIP 12 (018)	17 629651 5125391 W	2006/08 3678	05 06	FR 0067	020 / 222 004 / 1:0	DO		4307929 (Z50761) A045449 GREY CLAY 0010 GREY BLDR 0015 GREY ROCK 0425

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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 # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
EAST FERRIS TOWNSHIP CON 13 (020)	17 628766 5125725 W	1982/08 2305	06		028 / 002 / 1:30	DO		4303718 {} BRWN SAND BLDR 0006 GREY GRNT 0515
EAST FERRIS TOWNSHIP CON 14 (019)	17 628416 5127265 W	1965/07 2305	02 02	FR 0143	004 / 012 003 / 8:0	DO		4300375 {} MSND 0001 ROCK 0149
EAST FERRIS TOWNSHIP CON 15 (020)	17 627841 5127525 W	1967/05 2305	02 02	FR 0133	012 / 012 006 / 3:30	DO		4300391 {} PRDR 0030 RED GRNT 0142
EAST FERRIS TOWNSHIP CON 15 (020)	17 627841 5127525 W	1958/07 2905	06 06	FR 0020	006 / 030 001 / 2:0	DO		4300390 {} BLDR CLAY 0011 RED GRNT 0020 GREY GRNT 0030
EAST FERRIS TOWNSHIP CON 15 (020)	17 628016 5127675 W	1982/05 2305	06	FR 0283	004 / 002 / 2:0	DO		4303580 {} GREY CLAY SAND GRVL 0014 GREY GRNT 0298
EAST FERRIS TOWNSHIP CON 15 (020)	17 628166 5127425 W	1962/10 2305	02 02	FR 0096	012 / 016 002 / 6:30	DO		4300394 {} GREY SILT BLDR GRNT 0009 RED GRNT 0012 GREY ROCK 0094 RED GRNT 0105
EAST FERRIS TOWNSHIP CON 15 (020)	17 627833 5127941 L	1990/05 2305	06	FR 0110	012 / 020 / 1:0	DO		4304950 (58651) BRWN SAND BLDR 0014 GREY GRNT 0126
EAST FERRIS TOWNSHIP CON 15 (021)	17 627566 5127475 W	1978/11 1120	06 06	FR 0265	020 / 385 / 2:0	DO		4302965 {} BRWN CLAY 0010 BLCK GRNT 0405
EAST FERRIS TOWNSHIP CON 15 (021)	17 627450 5127787 L	1998/08 6344	06 06	FR 0035 FR 0082 FR 0092 FR 0120	028 / 120 010 / 2:30	DO		4306564 (179817) BRWN SAND BLDR LOOS 0025 BRWN GRNT HARD 0065 GREY GRNT HARD 0070 BRWN GRNT HARD 0100 GREY GRNT HARD 0110 BRWN GRNT HARD 0130
EAST FERRIS TOWNSHIP CON 15 (021)	17 628826 5127400 W	1962/06 1407	02 02	FR 0131	007 / 023 002 / 18:0	DO		4300392 {} MSND 0005 RED GRNT 0135
EAST FERRIS TOWNSHIP CON 15 (021)	17 627736 5127555 W	1964/08 2512	05 05	FR 0274 FR 0061 FR 0103	009 / 016 007 / 1:0	PS		4300376 {} MSND STNS 0011 GRNT 0292

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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 # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
EAST FERRIS TOWNSHIP CON 15(021)	17 627416 5127525 W	1981/06 2305	06	FR 0041	003 / 025 / 1:0	DO		4303405 () GREY CLAY SAND 0020 GREY GRNT 0052
EAST FERRIS TOWNSHIP CON 15(021)	17 627691 5127565 W	1964/08 2305	02 02	FR 0111	010 / 020 003 / 5:0	DO		4300393 () MSND BLDR 0010 RED GRNT 0117
EAST FERRIS TOWNSHIP CON 15(021)	17 627450 5127787 L	1997/08 2305	06 06	FR 0230	009 / 240 003 / 1:30	DO		4306356 (172780) BRWN CLAY SAND 0011 RED GRNT 0242
EAST FERRIS TOWNSHIP CON 15(022)	17 627266 5127475 W	1977/09 1120	06 06	FR 0135	010 / 050 003 / 1:0	DO		4302812 () BRWN CLAY 0005 BLCK GRNT 0145
EAST FERRIS TOWNSHIP CON 15(022)	17 627116 5127625 W	1981/08 1120	06	FR 0075	015 / 065 007 / 1:0	DO		4303470 () BRWN SAND CLAY 0012 BLCK GRNT 0085
EAST FERRIS TOWNSHIP CON 15(023)		1999/09 1377	06	UK 0243	014 / 149 004 / 1:0	DO		4306860 (172548) SAND 0001 GRNT 0280
EAST FERRIS TOWNSHIP CON 15(023)	17 626626 5127760 W	1971/06 2305	02	FR 0058	005 / 005 003 / 2:40	CO		4301622 () BRWN LOAM 0001 RED GRNT 0070
EAST FERRIS TOWNSHIP 15(023)	17 626613 5127962 W	2008/05 1462	06	FR 0182 FR 0264	022 / 078 010 / 1:0			7106695 (Z77236) A061143 GRVL 0002 RED GRNT 0280
EAST FERRIS TOWNSHIP 15(023)	17 626693 5127479 L	1994/05 1377	06	FR 0181	021 / 055 008 / 1:0	DO		4305881 (125939) SAND 0002 GRNT 0190

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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 # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
EAST FERRIS TOWNSHIP CON 11(005)	17 635035 5126454 L	1997/07 1462	06 06	FR 0170	045 / 020 / 1:0	DO		4306340 (179877) SAND 0006 RED GRNT 0100 GREY GRNT 0170 RED GRNT 0175 GREY GRNT 0182
EAST FERRIS TOWNSHIP CON 11(006)	17 634660 5126303 L	1992/11 2305	06	FR 0180	008 / 005 / 72:0	DO		4305505 (097914) BRWN SAND GRVL 0014 UNKN 0187
EAST FERRIS TOWNSHIP CON 11(006)	17 634660 5126303 L	1994/08 2305	06 06	FR 0200	010 / 015 / 72:0	DO		4305889 (129048) BRWN SAND BLDR 0002 RED GRNT 0205 GREY UNKN
EAST FERRIS TOWNSHIP CON 11(006)	17 634606 5125875 W	1972/06 3811	02 02	FR 0122	006 / 008 001 / 4:0	DO		4301763 () BRWN CLAY SAND 0007 BLCK GRNT 0131
EAST FERRIS TOWNSHIP CON 11(006)	17 634766 5125925 W	1981/10 3816	06	FR 0155	015 / 015 / 1:0	DO		4303521 () BRWN CLAY 0002 BLCK GRNT 0165
EAST FERRIS TOWNSHIP CON 11(006)	17 634616 5125925 W	1958/08 3014	02 02	FR 0126	003 / 013 003 / 20:0	DO		4300350 () MSND 0002 GREY GRNT 0130
EAST FERRIS TOWNSHIP CON 11(007)	17 634629 5125773 W	2009/07 1462	06	FR 0061 FR 0250	008 / 100 010 / 1:0	DO		7136810 (Z096774) A077701 CLAY 0005 RED GRNT 0180 GREY GRNT 0282
EAST FERRIS TOWNSHIP CON 11(007)	17 634284 5126147 L	1997/07 1462	06 06	FR 0139 FR 0160	/ 020 / 1:0	DO		4306342 (179882) GRVL 0008 GREY GRNT 0070 RED GRNT 0080 GREY GRNT 0134 RED GRNT 0140 GREY GRNT 0160 RED GRNT 0162 GREY GRNT 0162
EAST FERRIS TOWNSHIP CON 11(007)	17 634284 5126147 L	1999/09 1462	06 06	FR 0195	015 / 222 006 / 1:0	DO		4306787 (203421) SAND 0007 GREY GRNT 0185 RED GRNT 0222 GREY GRNT 0222
EAST FERRIS TOWNSHIP CON 11(007)	17 634284 5126147 L	1997/10 1462	06 06	FR 0298	/ 002 / 1:0	DO		4306421 (179980) GRVL 0003 GREY GRNT 0030 RED GRNT 0040 GREY GRNT 0200 BLCK GRNT 0298 RED GRNT 0310 GREY GRNT 0322
EAST FERRIS TOWNSHIP CON 11(007)		1999/04 1462	06 06	FR 0203	004 / 015 / 1:0	DO		4306697 (189632) SAND BLDR 0009 RED GRNT 0100 GREY GRNT 0180 RED GRNT 0209

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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 # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
EAST FERRIS TOWNSHIP CON 11(007)	17 634241 5125785 W	1961/05 2305	02 02	FR 0054	002 / 012 002 / 3:0	DO		4300351 () YLLW MSND 0007 RED GRNT 0065
EAST FERRIS TOWNSHIP CON 11(008)	17 633896 5125825 W	1971/08 1443	02 02	FR 0075	011 / 011 003 / 2:0	DO		4301635 () SAND BLDR 0018 RED GRNT 0077
EAST FERRIS TOWNSHIP CON 11(009)	17 633251 5126091 W	1974/11 3811	02	FR 0085 FR 0105	004 / 008 003 / 2:0	DO		4302165 () BRWN CLAY 0003 RED GRNT 0010 UNKN 0105
EAST FERRIS TOWNSHIP CON 11(009)	17 633516 5126025 W	1979/09 2305	06 06	FR 0163	022 / 022 030 / 1:0	DO		4303060 () BRWN LOAM 0016 GREY GRNT 0173
EAST FERRIS TOWNSHIP CON 11(009)	17 633541 5126025 W	1961/08 2305	02 02	FR 0112	004 / 040 001 / 2:30	CO		4300352 () MSND 0001 GREY GRNT 0116
EAST FERRIS TOWNSHIP CON 11(009)	17 633527 5125845 L	2003/09 1462	06 06	UK 0218 UK 0204	024 / 030 030 / 1:0	DO		4307478 (259000) SAND BLDR 0010 GREY GRNT 0050 RED GRNT 0240
EAST FERRIS TOWNSHIP CON 11(009)	17 633566 5125985 W	1963/07 2305	02 02	FR 0067	004 / 020 002 / 2:0	DO		4300353 () MSND 0005 ROCK 0032 RED GRNT 0076
EAST FERRIS TOWNSHIP CON 11(010)	17 633220 5125245 W	1994/04 3665	06 06	FR 0317	012 / 310 005 / 1:0	DO		4305818 (134277) BRWN CLAY 0006 GREY GRNT 0088 RED GRVL 0127 GREY GRNT 0325
EAST FERRIS TOWNSHIP CON 11(010)	17 633147 5125687 L	1998/09 2305	06 06	FR 0359	018 / 365 002 / 1:0	DO		4306536 (189108) BRWN CLAY SAND 0014 RED GRNT 0366
EAST FERRIS TOWNSHIP CON 11(010)	17 633016 5125175 W	1983/08 1120	06	FR 0155	010 / 145 001 / 1:0	DO		4303771 () BRWN CLAY BLDR 0010 BLCK GRNT 0165
EAST FERRIS TOWNSHIP CON 11(011)	17 632755 5125528 L	2003/09 1462	06 06	FR 0165	010 / 072 010 / 1:0	DO		4307476 (258998) CLAY 0024 SAND 0032 GREY GRNT 0182
EAST FERRIS TOWNSHIP 11(007)	17 630844 5126559 W	2006/10 2305	06		009 / 003 / 1:0	DO		4307997 (Z53386) A032550 BRWN SAND CLAY 0012 GREY GRNT 0265

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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 # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 11(010)	17 643085 5125165 W	1991/06 1377	06	FR 0261	030 / 133 006 / 1:0	DO		4305141 (82589) SAND 0002 BRWN CLAY 0007 SAND GRVL 0027 RED GRNT ROCK 0285
BONFIELD TOWNSHIP CON 11(010)	17 642494 5124014 W	1996/06 3665	06 06	FR 0084	003 / 260 360 / 1:0	DO		4306161 (172128) BRWN GRVL BLDR 0014 RED GRNT 0062 GREY GRNT 0097 RED GRNT 0265
BONFIELD TOWNSHIP CON 11(013)	17 642737 5124706 W	2012/09 1462						7194063 (Z144424) A127477 P
BONFIELD TOWNSHIP CON 11(013)	17 642873 5124997 W	2011/05 2305	06	0190	027 / 198 020 / 1:0	DO		7168798 (Z123225) A109081 BRWN SAND CLAY 0035 GREY GRNT 0202
BONFIELD TOWNSHIP CON 11(013)	17 642966 5125075 W	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 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 642616 5125675 W	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 643016 5124945 W	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	1987/09 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 642836 5124645 W	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 642916 5125025 W	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 642916 5124755 W	1972/10 2428	06 06	FR 0057	003 / 028 005 / 4:0	DO		4301879 () CLAY 0016 RED GRNT 0059

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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 # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 11(013)	17 642944 5125120 W	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 643095 5125374 W	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 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 642896 5124725 W	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 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 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 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(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)	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)		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 643241 5125535 W	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)	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

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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 # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
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	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(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 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 643103 5125301 L	1990/07 1377	06	FR 0061	016 / 021 009 / 1:0	DO		4305018 (71177) BRWN CLAY 0012 GREY CLAY 0053 QSDN 0057 GRVL SAND 0060 ROCK FCRD 0061 ROCK 0085
BONFIELD TOWNSHIP CON 11(014)	17 642916 5125725 W	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 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 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 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 643266 5125465 W	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 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

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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 QSD 0059 SAND GRVL 0066 GREY ROCK 0077
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 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 643216 5125325 W	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 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 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)		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
BONFIELD TOWNSHIP CON 11(015)	17 643016 5125375 W	1983/04 1120	06	FR 0155	015 / 004 / 1:0	DO		4303753 () CLAY BLDR 0071 GREY GRNT 0165
BONFIELD TOWNSHIP CON 11(015)	17 643502 5125805 W	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)		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 643636 5125413 W	2012/05 1462						7193089 (Z144349) A119201 P
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

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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 # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 11(015)	17 643316 5125875 W	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 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 643266 5125725 W	1979/10 1120	06	SA 0056	018 / 020 020 / 2:0	DO		4303144 () BRWN CLAY 0045 BRWN GRVL 0060
BONFIELD TOWNSHIP 11(014)	17 642826 5125624 W	2006/10 1462	06	FR 0225	013 / 053 010 / 1:0	DO		7038948 (Z58808) 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 (Z24652) 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 (Z68348) A056565 GREY CLAY 0010 GREY STNS 0030 GREY ROCK 0320

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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 # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 12(006)	17 639791 5125072 L	1993/08 1462	06	FR 0280 FR 0270	/ 002 / 1:0	DO		4305660 (129791) FSND 0006 GREY GRNT 0200 RED GRNT 0230 GREY GRNT 0290
BONFIELD TOWNSHIP CON 12(006)	17 639791 5125072 L	1997/05 1462	06 06	FR 0126	012 / 007 / 48:0	DO		4306309 (173046) GRVL BLDR 0007 GREY GRNT 0126 RED GRNT 0140 GREY GRNT 0142
BONFIELD TOWNSHIP CON 12(006)	17 639716 5125625 W	1972/10 1445	02 02	FR 0098	006 / 006 004 / 2:0	DO		4301810 () BLCK GRVL 0002 GRNT 0107
BONFIELD TOWNSHIP CON 12(006)	17 639791 5125072 L	1998/09 1462	06	FR 0340	/ 100 002 / 24:0	DO		4306551 (189214) BRWN SAND BLDR 0060 GREY GRNT 0362
BONFIELD TOWNSHIP CON 12(006)	17 639677 5125070 W	1998/08 2305	06 06	FR	023 / 303 003 / 1:0	DO		4306534 (189103) BRWN SAND BLDR 0010 RED GRNT 0304
BONFIELD TOWNSHIP CON 12(006)	17 639791 5125072 L	1992/02 2305	06	FR 0154	002 / 060 / 72:0	DO		4305325 (096501) BRWN CLAY SAND 0023 GREY GRNT 0166
BONFIELD TOWNSHIP CON 12(006)	17 639487 5125465 W	1974/10 3811	02	FR 0086 FR 0125	002 / 006 012 / 2:0	DO		4302168 () BRWN CLAY BLDR 0003 RED GRNT 0137
BONFIELD TOWNSHIP CON 12(006)	17 639791 5125072 L	1992/07 2305	06	FR 0028	041 / 003 / 24:0	DO		4305416 (097285) A BRWN SAND GRVL 0017 GREY GRNT 0515
BONFIELD TOWNSHIP CON 12(007)	17 640155 5125223 L	1991/12 2305	06	FR	045 / 002 / 24:0	DO		4305298 (097299) BRWN SAND GRVL 0003 GRNT 0535
BONFIELD TOWNSHIP CON 12(008)	17 640166 5125785 W	1972/08 2305	02					4301796 () GREY SAND 0040 SAND GRVL BLDR 0085 RED GRNT 0150
BONFIELD TOWNSHIP CON 12(008)	17 640266 5125775 W	1976/04 2305	02 02	FR 0259	017 / 028 002 / 2:10	DO		4302381 () PRDR 0150 GREY GRNT 0275
BONFIELD TOWNSHIP CON 12(008)	17 640513 5125371 L	1993/11 6344	06 05	FR 0094	043 / 100 010 / 2:0	DO		4305710 (096635) BRWN SAND BLDR PCKD 0030 BRWN SAND GRVL LOOS 0094 BRWN GRNT HARD 0100
BONFIELD TOWNSHIP CON 12(010)	17 641226 5125668 L	2003/05 1462	06 06	FR 0108 FR 0130	/ 142 015 / 1:0	DO		4307348 (258903) SAND BLDR 0036 RED GRNT SOFT 0142

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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 # (AUDITH) WELL TAG # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 13(002)	17 637786 5125430 W	2011/08 1462	06	FR 0041	005 / 005 010 / 1:0	DO		7173053 (2134841) A110192 SAND 0004 CLAY 0033 SAND BLDR 0036 RED GRNT LOOS 0042
BONFIELD TOWNSHIP CON 13(002)		2000/08 1462	06 06	FR 0125	020 / 142 005 / 1:0	DO		4306900 (219043) SAND 0022 RED GRNT 0142
BONFIELD TOWNSHIP CON 13(002)		2000/10 1462	06	FR 0370	/ 050 / 1:0	DO		4306955 (219050) GREY GRNT 0372
BONFIELD TOWNSHIP CON 13(002)	17 638616 5125425 W	1977/09 4541	02 02	FR 0075	005 / 010 002 / 4:0	DO		4302667 () GREY CLAY GRVL SOFT 0020 RED GRNT SOFT 0082
BONFIELD TOWNSHIP CON 13(002)	17 637924 5125405 L	1989/07 1462	06	FR 0340	012 / 002 / 1:0	DO		4304821 () CLAY GRVL 0016 RED GRNT 0017 BRWN GRNT 0340 RED GRNT 0350
BONFIELD TOWNSHIP CON 13(003)	17 638290 5125565 L	1987/06 3665	06 06	FR 0281	020 / 002 / 2:0	DO		4304300 () BRWN SAND BLDR 0006 GREY GRNT 0285
BONFIELD TOWNSHIP CON 13(004)	17 638866 5125325 W	1978/12 1120	06 06	FR 0115	006 / 100 004 / 2:0	DO		4302961 () BRWN CLAY 0003 BLCK GRNT 0125
BONFIELD TOWNSHIP CON 13(004)	17 639016 5125375 W	1982/08 2305	06	FR 0396	018 / 002 / 2:0	DO		4303589 () BRWN SAND 0003 GREY GRNT 0402
BONFIELD TOWNSHIP CON 13(005)	17 639030 5125885 L	1991/10 2305	06	FR 0040	/ 060 / 24:0	DO		4305297 (097281) A BRWN SAND CLAY 0016 GRNT 0248
BONFIELD TOWNSHIP CON 13(005)	17 639066 5125275 W	1983/09 1120	06	FR 0165	/ / 1:0	DO		4303752 () A BRWN CLAY 0004 BLCK GRNT FCRD 0505
BONFIELD TOWNSHIP CON 13(005)	17 639030 5125885 L	1992/12 2305	06	FR 0081	012 / 015 / 72:0	DO		4305501 (097919) BRWN SAND GRVL 0002 GREY GRNT 0126
BONFIELD TOWNSHIP CON 13(005)	17 639030 5125885 L	1991/08 2305	06	FR 0094	025 / 020 / 24:0	DO		4305161 (097245) BRWN SAND 0003 GREY GRNT 0128
BONFIELD TOWNSHIP CON 13(005)	17 639030 5125885 L	1991/11 2305	06	FR 0343	041 / 010 / 72:0	DO		4305283 (097291) BRWN SAND 0002 GREY GRNT 0354

Well Computer Print Out Data as of February 26 2013

Page: 2 / 3

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 # STATE ¹² DEPTHS TO WHICH FORMATIONS EXTEND ^{5,11}
BONFIELD TOWNSHIP CON 13(005)	17 639030 5125885 L	1991/12 2305	06	FR 0489	/ 004 / 48:0	DO		4305296 (096497) BRWN SAND CLAY 0017 GRNT 0495 BLCK SHST
BONFIELD TOWNSHIP CON 13(005)	17 639066 5125475 W	1951/05 1546	02 02	FR 0220	004 / 008 002 / 3:0	ST DO		4300096 () GRVL 0004 RED GRNT 0225
BONFIELD TOWNSHIP CON 13(006)	17 639516 5125625 W	1975/04 2305	02 02	FR 0027 FR 0366	001 / 060 002 / 2:20	DO		4302242 () BRWN SAND 0002 GREY GRNT 0376
BONFIELD TOWNSHIP CON 13(006)	17 639386 5126049 L	1996/10 2428	06	FR 0365	010 / 250 004 / 2:30			4306232 (161246) BRWN SAND 0003 BLCK GRNT 0205 BLCK QRTZ GRNT 0370
BONFIELD TOWNSHIP 13(002)	17 637924 5125405 L	1994/06 1377	06	FR 0364	002 / 028 006 / 1:0	DO		4305877 (125929) BRWN CLAY 0006 SAND GRVL 0010 ROCK FCRD 0011 GRNT 0380

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
12. A: Abandonment; P: Partial Data Entry Only

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
GREN	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 28



APPENDIX C

SITE RECONNAISSANCE OBSERVATIONS AND SITE PHOTOGRAPHS 1 TO 28

PML carried out site reconnaissance surveys (SRS) on the selected portion of the Realignment Alternative 10 (preferred alternative). An initial 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 where permission to enter was not required. A follow-up second SRS was carried out on February 20 to 22, 2013 by Mr. A. Desira, M.Eng and Mr. D. Woodcock where permission to enter was obtained. The SRS consisted of a drive-by and walk-through the selected section of Highway 17 and adjacent lands.

The photographs were numbered from west to east to follow increasing chainage along the preferred alignment.

Preferred Realignment Alternative (Photographs 1 to 28)

- The preferred Highway 17 alignment starting point at Highway 11 is located about 3.4 km south of the existing Highway 11 / Highway 17 interchange. Structures are proposed for the interchange. Canadian National Railway (CNR) corridor is located about 100 m west of the existing Highway 11 southbound Lane at the proposed interchange.
- The terrain at the interchange location is typically exposed bedrock to 6 m high bedrock cuts at the east abutment location and swampy areas are at the west abutment location. (Photographs P1 and P2)
- The preferred alignment crosses the La Vase Portage Route about 1.8 km east of Highway 11. Structures are anticipated at this crossing. (Photograph P3)
- The preferred realignment crosses three active rock quarries between 700 m and 2 km east of the Highway 11. (Photograph P4)



- The Ottawa Valley Railway (OVR) is located 150 to 1100 m South of the preferred alignment for the first 11.1 km sector from about Sta. 10+100 to 21+200. The La Vase River flows south of the OVR.
- The Dyno Nobel Canada Inc has dynamite storage facilities that are located at the south limit of the study corridor, east of the Highway 11 and south of Birchs Road
- Beyond the interchange location, the terrain along the preferred alignment is generally undulating (about 7.5 km) to approximately 2 km west of the Highway 94. The terrain consists of bedrock outcrops and bedrock knobs at the higher elevation and swamps/wetlands at the lower elevation. Most of the swampy/wetlands are open water with beaver dams. Peat over sandy soils is encountered/anticipated at most of the swamps. Depth to bedrock at theses swamps are variable up to 7.2 m. (Photographs 6 to P9 and P11 to P17)
- The preferred alignment crosses the TCPL corridor about 2.8 km east of Highway 11. (Photograph P10)
- About 2 km west of the Highway 94 easterly for about 3.6 km to Highway 17 (existing), the terrain along the preferred alignment alternative consists of bedrock knobs or sand/silt/clay lacustrine plain and/or organic terrain over bedrock with creek flooded areas. It is inferred that the creek flooded area just west of the Highway 94 may contain up to 2.0 m peat over very soft to soft clay up to 9 m depth based on the Contract 2006-5061 soil profile.
- Structures are proposed for the creek crossing and Highway 17 (preferred)/Highway 94 interchange with up to 12 m high approach embankments located about 1 km south of the existing Highway 17 and Highway 94 at-grade crossing. Boulders are in foreground east of the Highway 94 at the proposed Highway 17/ Highway 94 interchange. Bedrock is up to 5.8 m deep based on the water well record. (Photographs 18 and 19)
- At the preferred alignment crossing of the existing Highway 17 (west crossing), a structure is proposed for the existing Highway 17. Bedrock is up to 5.5 m deep based on nearby



water well records. Bedrock cuts are present just east of the crossing along the existing Highway 17. (Photographs 20 to 22)

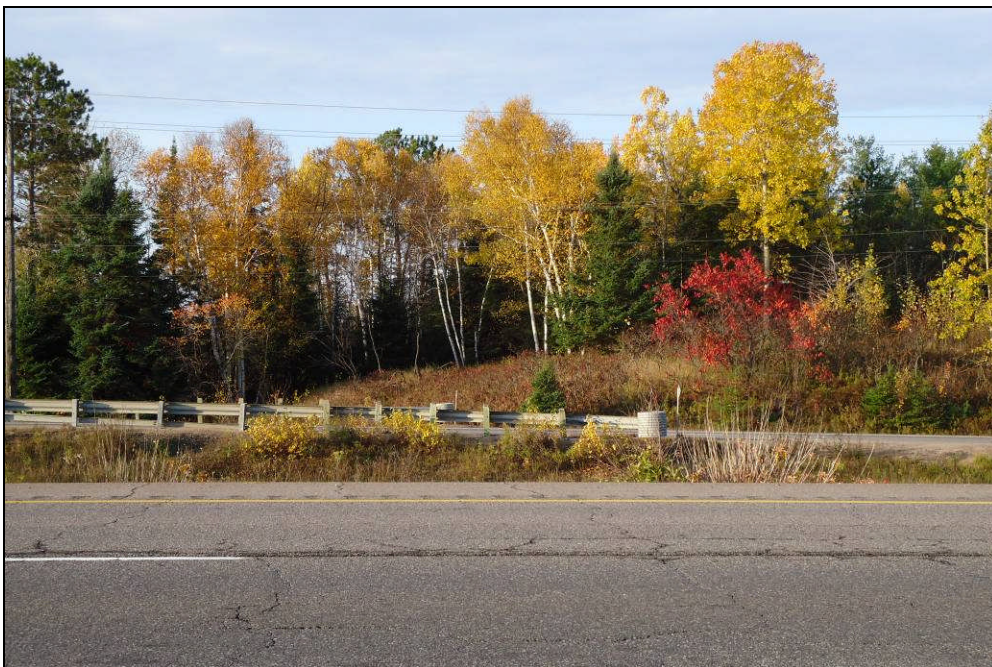
- The preferred alignment crosses/borders several swamps/wet lands for the 6 km section north of existing Highway 17. Organics over clayey soils are anticipated in these swamps. (Photographs 23 and 24)
- The preferred alignment then again crosses the existing Highway 17 just east of the Maple Road. A structure is proposed for the existing Highway 17. The preferred alignment will be an up to 6 m deep cut. Bedrock is up to 2 m deep based on the Geotechnical Survey Data (GWP 174-98-00). (Photographs 25 and 26)
- Beyond the east crossing for about 3 km to about 100 m west of the Kaibuskong River valley, the terrain along the preferred alignment section is generally hilly with localized low-lying swampy/wetland and creek areas.
- The preferred alignment crosses the existing Highway 531 about 900 m south of the existing Highway 17/ Highway 531 at-grade crossing. (Photograph 27)
- 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 underlain by localized till deposit containing cobbles and boulders mantling the bedrock. The bedrock is typically 5.5 to 10.7 m deep from water well records. The bedrock is 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 28)
- The preferred realignment crosses the Line 3S. Low-lying swampy areas are present west and east of the Line 3S to north of Francoeur Road.
- The preferred realignment crosses the CPR and TCPL corridor and open pasture land with localized treed areas to the east of Line 3S and south of the Francoeur Road. Bedrock is up to 9.1 m deep at Kaibuskong River and soil cover consists of soft clay and sand based on nearby water well records.



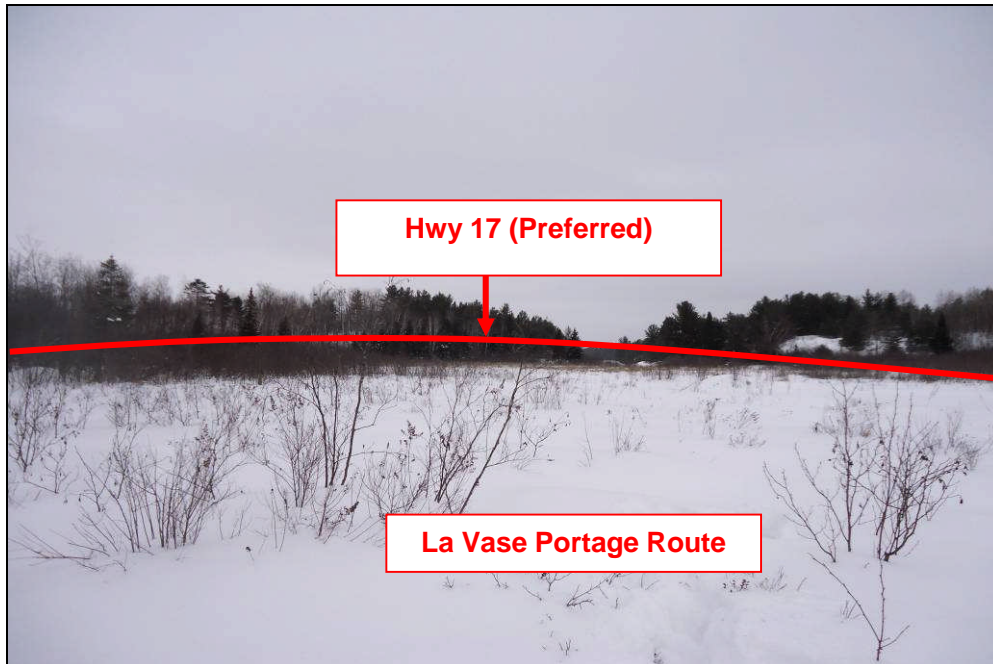
Site Photographs 1 to 28



Photograph P1: Looking north from east shoulder of northbound lane of Hwy 11. Hwy 17 (preferred) starting point at Hwy 11 will be located about 200 m north of above bedrock area. (October 18, 2012)



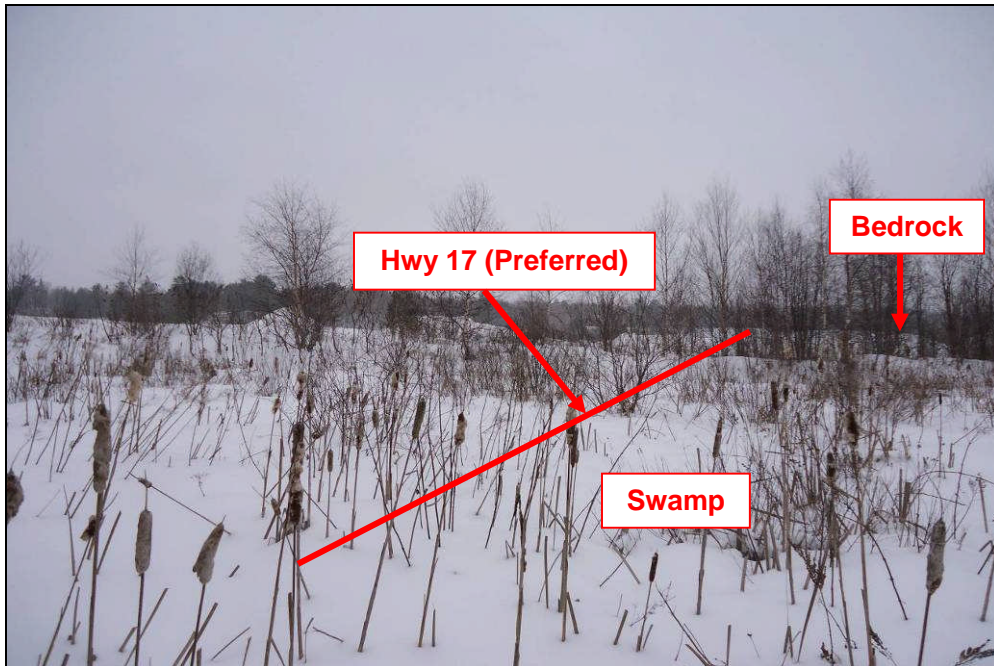
Photograph P2: Looking west from east shoulder of northbound lane of Hwy 11 and about 200 m south of Hwy 17 (preferred) starting point at Hwy 11. Extensive swampy areas present west of Hwy 11 and east of CNR tracks. (October 18, 2012)



Photograph P3: Looking north from approximately 20 m south of Sta. 11+850. Hwy 17 (Preferred) crosses the La Vase Portage route. Structures are proposed for this crossing. (February 21, 2013)



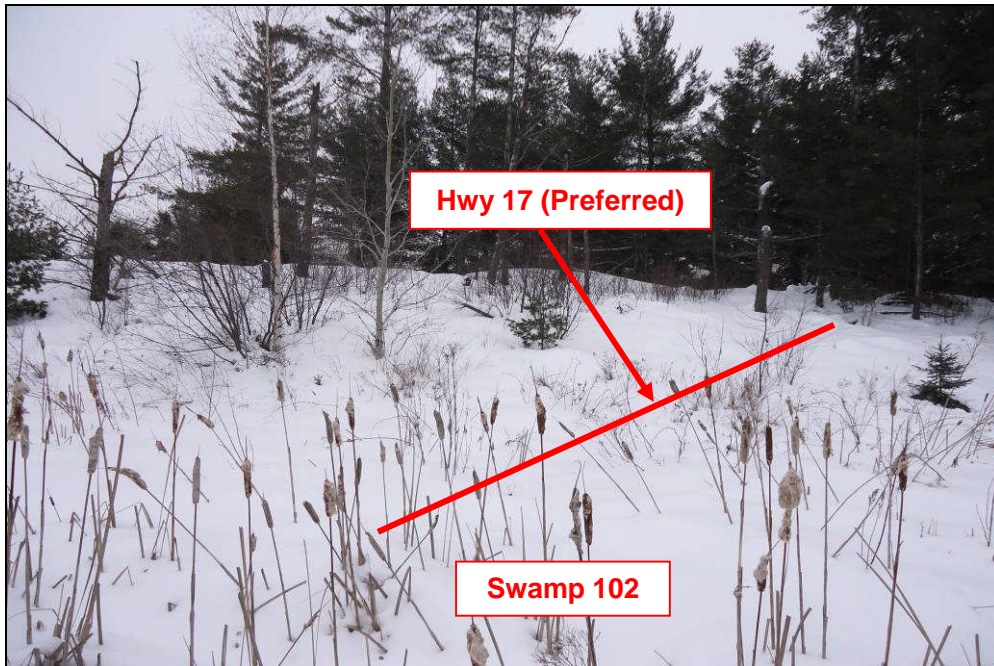
Photograph P4: Looking east from about 20 m east of west end of the La Vase Portage route. Active rock quarry located east of the La Vase Portage route crossing at Hwy 17 (preferred). (February 21, 2013)



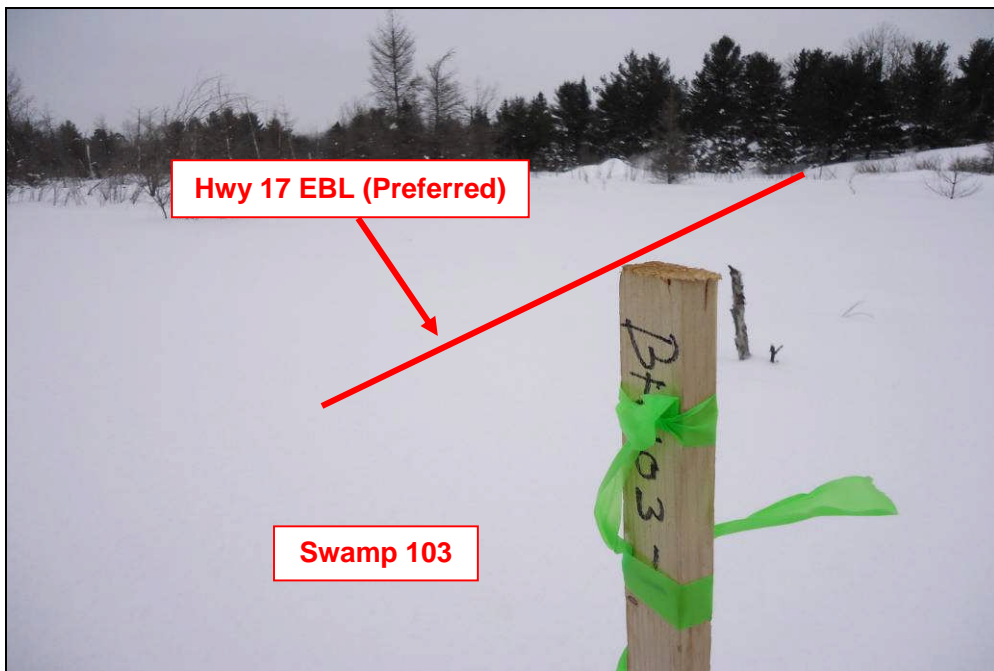
Photograph P5: Looking west from about Sta. 12+100 Hwy 17 (preferred) crosses swamp. (February 21, 2013)



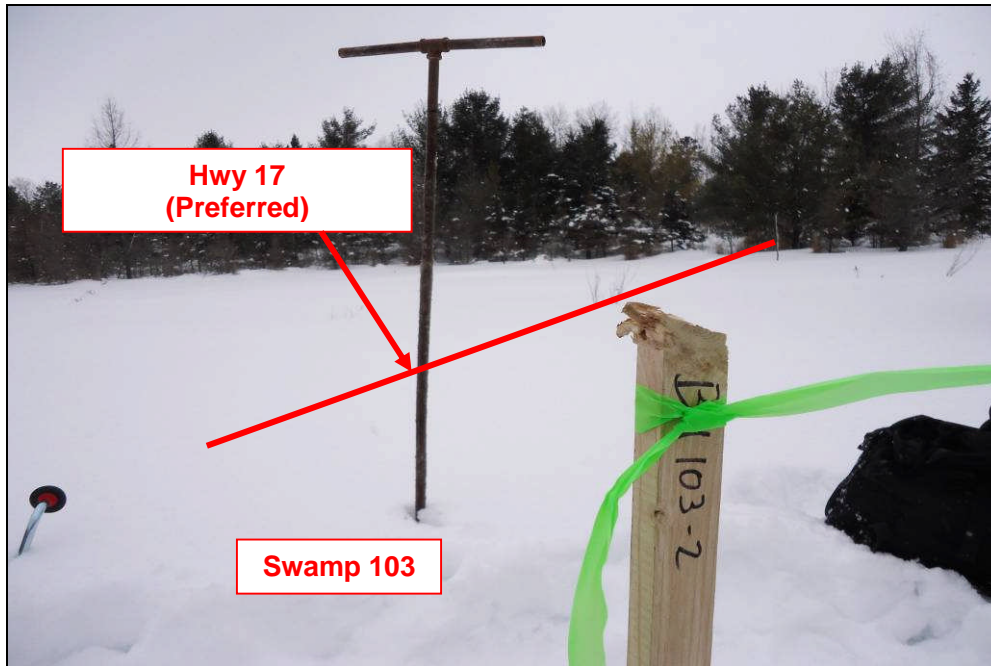
Photograph P6: Close up view of bedrock at west end of swamp. (February 20, 2013)



Photograph P7: Looking east at about Sta. 12+150. Heavily treed area is on the east end of swamp. (February 21, 2013)



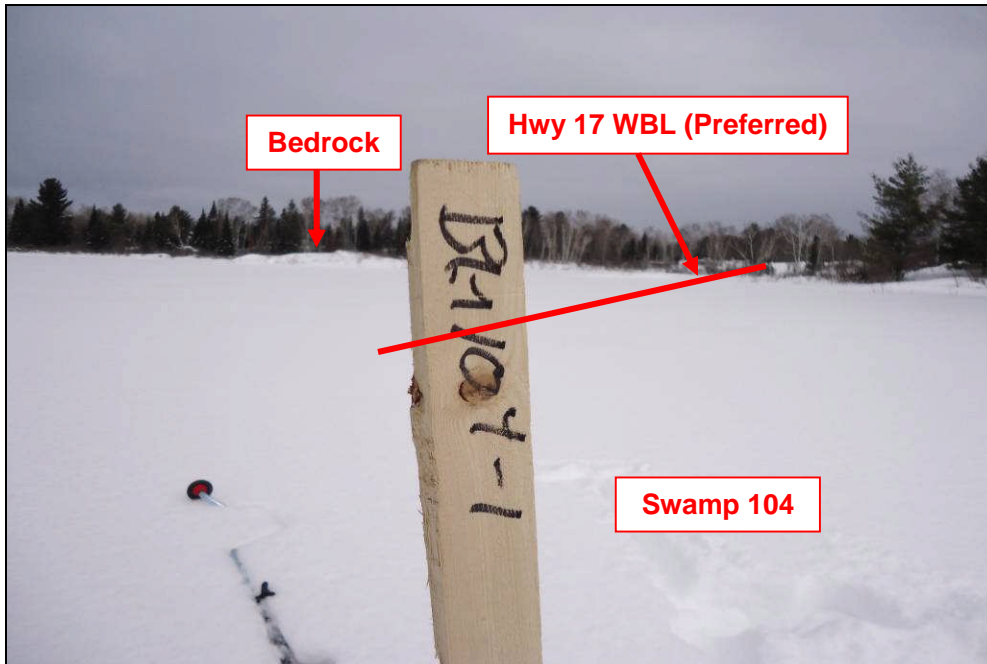
Photograph P8: Looking east from at about Sta. 12+380. Hwy 17 (preferred) crosses swamp 103. (February 20, 2013)



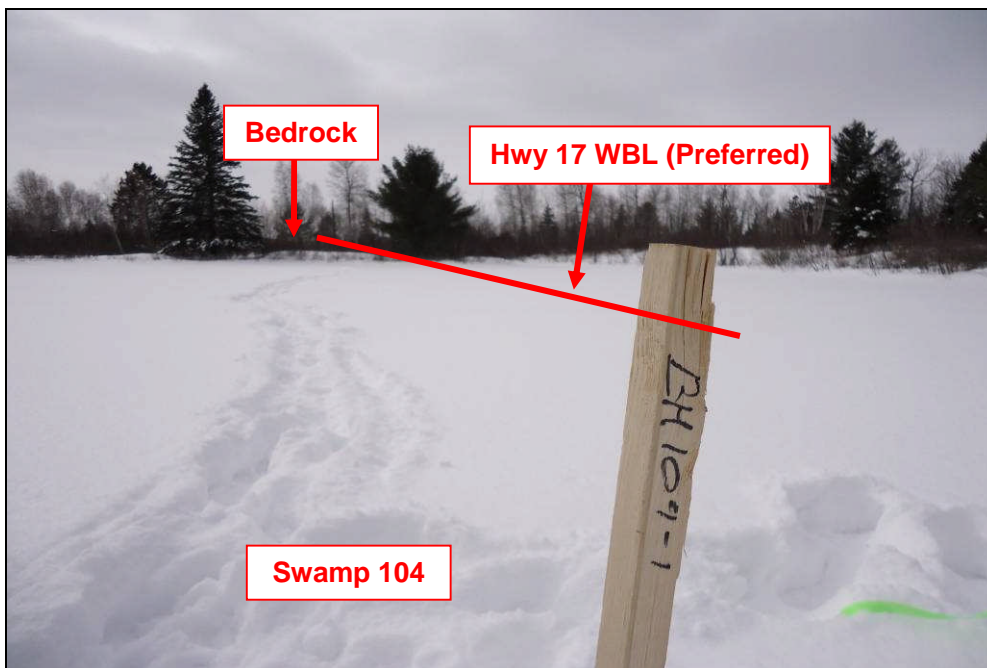
Photograph P9: Looking west from swamp 103, about 0.9 and 1.5 m thick peat over sandy soils. Probable bedrock was inferred by auger refusal at 1.6 and 7.2 m. (February 20, 2013)



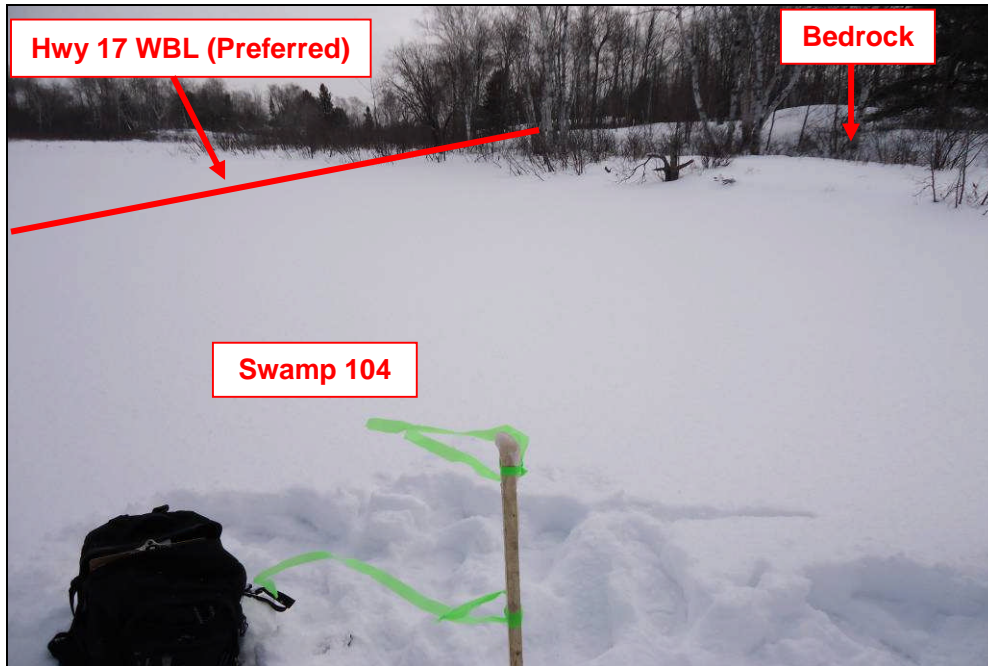
Photograph P10: Looking north along TCPL corridor at Hwy 17 (preferred) crossing. (February 22, 2013)



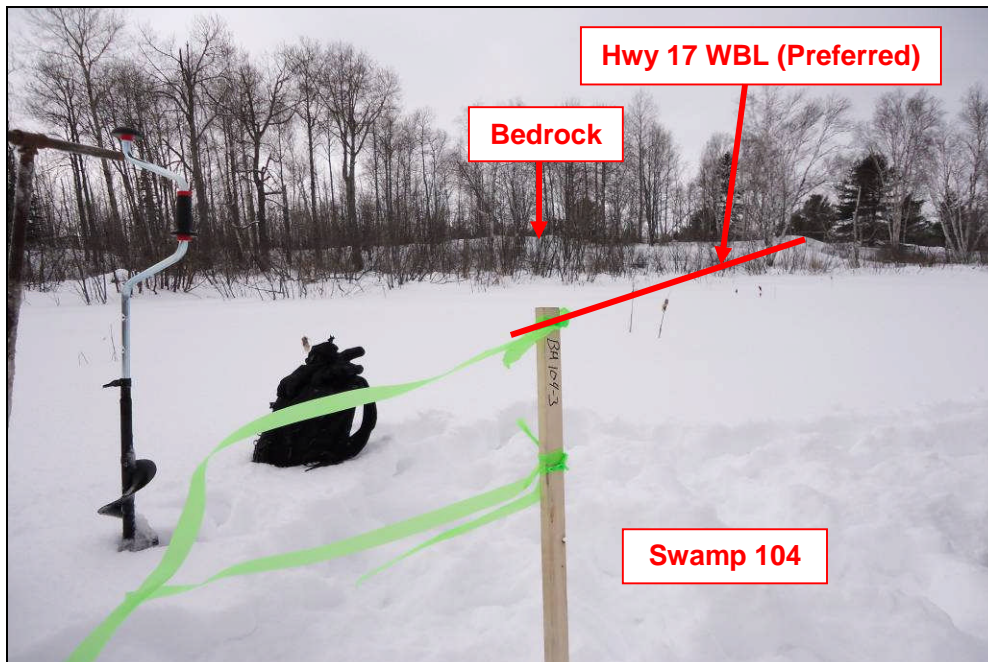
Photograph P11: Looking east at about Sta. 11+920 and about 150 m east TCPL corridor, Hwy 17 (preferred) crosses swamp 104. (February 20, 2013)



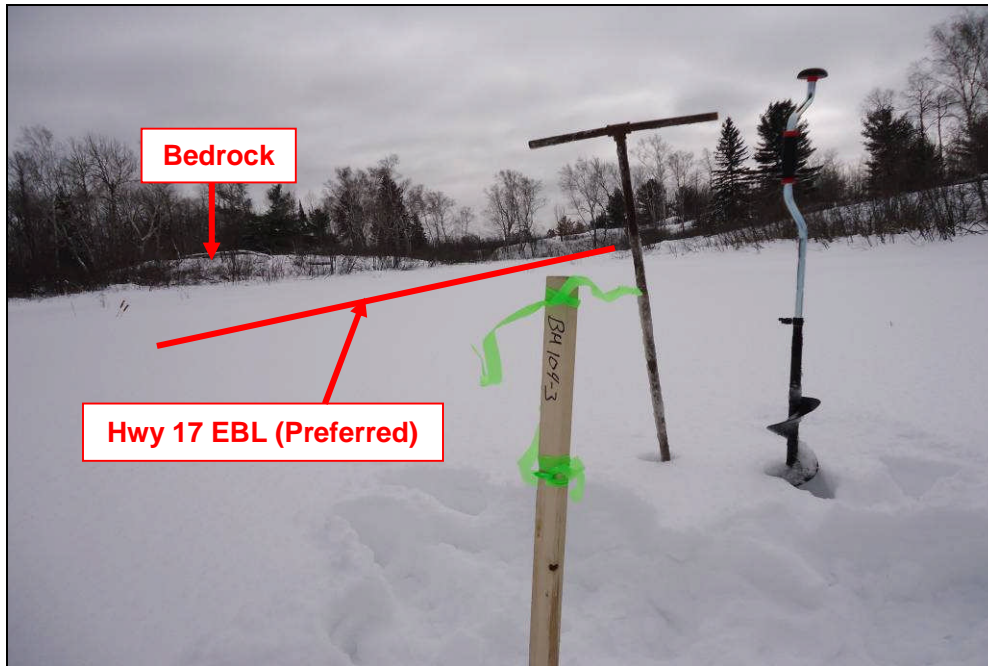
Photograph P12: Looking west from swamp borehole 104-1. Bedrock outcrops visible in distance. About 1.8 m thick ice and water over 2.3 m thick peat underlain sandy soils was encountered in borehole 104-1. Bedrock inferred by spoon refusal at 5.2 m. (February 20, 2013)



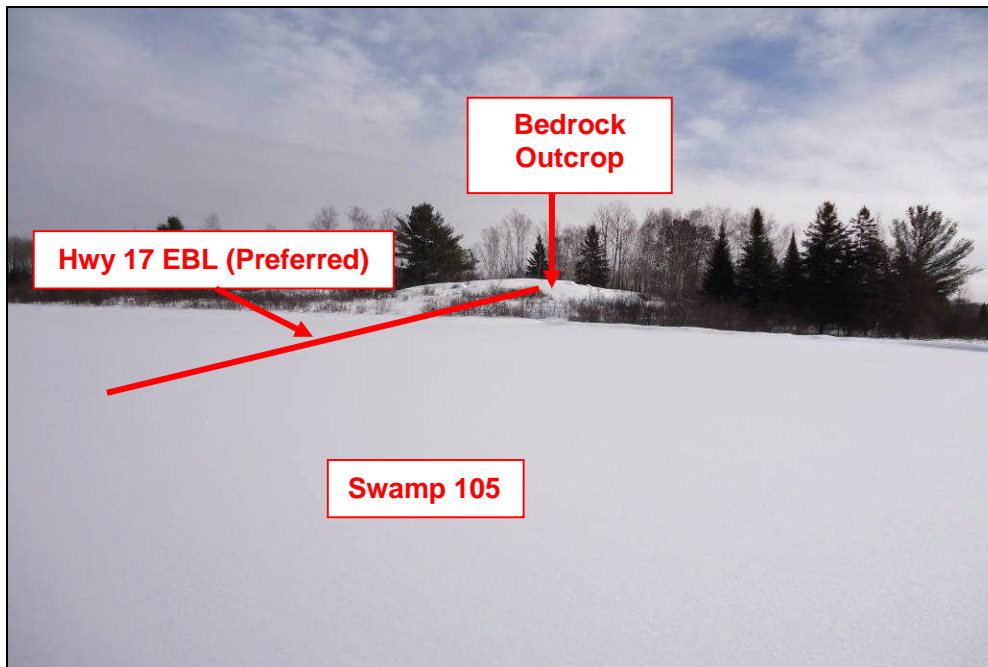
Photograph P13: Looking south from about 20 m north of Hwy 17 WBL (preferred) at about Sta. 13+020. About 1.8 m thick ice and water over 0.6 m thick peat underlain by sandy soils was encountered. Probable bedrock inferred by auger refusal at 4.8 m. (February 20, 2013)



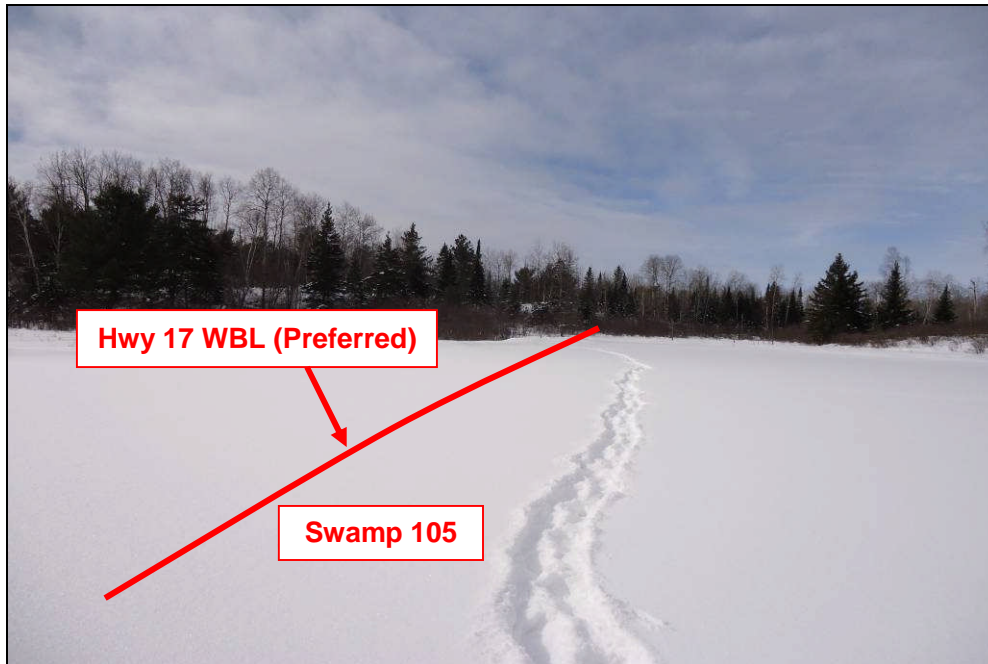
Photograph P14: Looking west from at about Sta. 13+120. About 0.5 m ice and water over 1.3 m thick peat underlain by sandy soils was encountered. Probable bedrock was inferred by refusal at 7.2 m. (February 20, 2013)



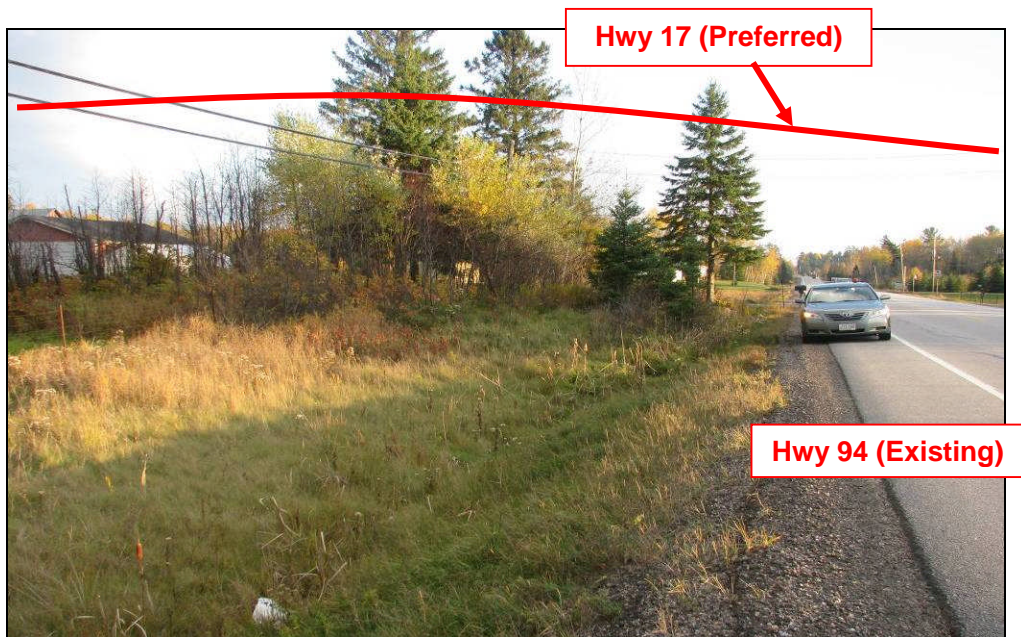
Photograph P15: Looking south from swamp borehole 104-3. (February 20, 2013)



Photograph P16: Looking east from at about Sta. 14+000, structure crossing is proposed. Bedrock outcrop visible at east end of the swamp. (February 22, 2013)



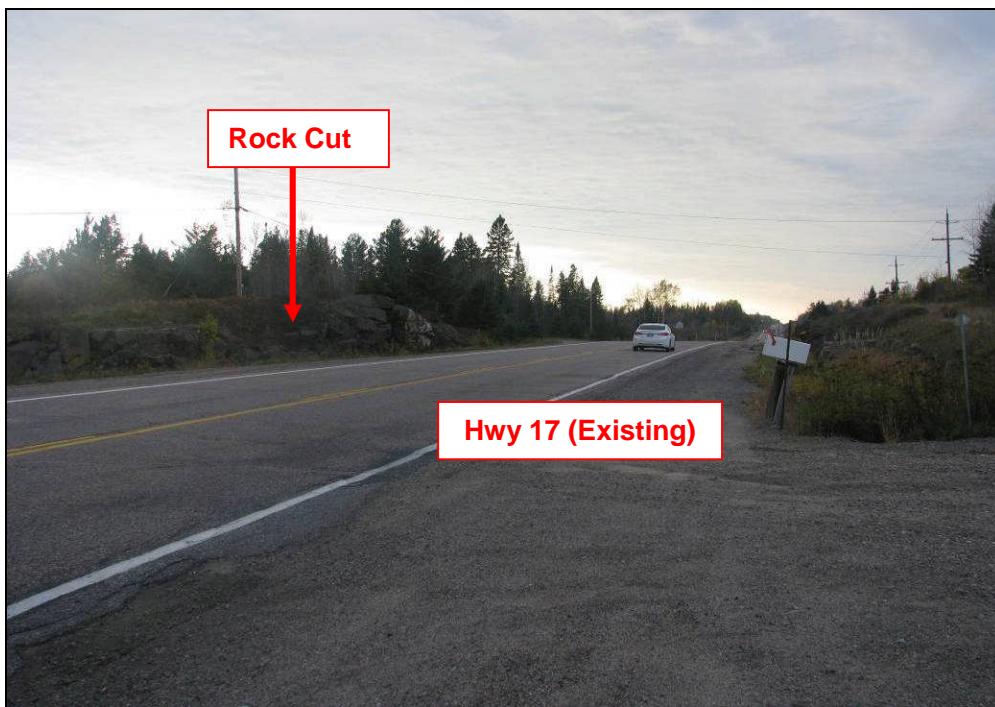
Photograph P17: Looking west from about Sta. 14+000 (preferred route chainage) along preferred Hwy 17 WBL. Structure crossing is proposed over swamp 105. No bedrock outcrop visible at west end of swamp. (February 22, 2013)



Photograph P18: Looking south from Hwy 94 east shoulder at Hwy 17 (preferred)/ Hwy 94 interchange. About 12 m high east approach embankment is proposed. (October 18, 2012)



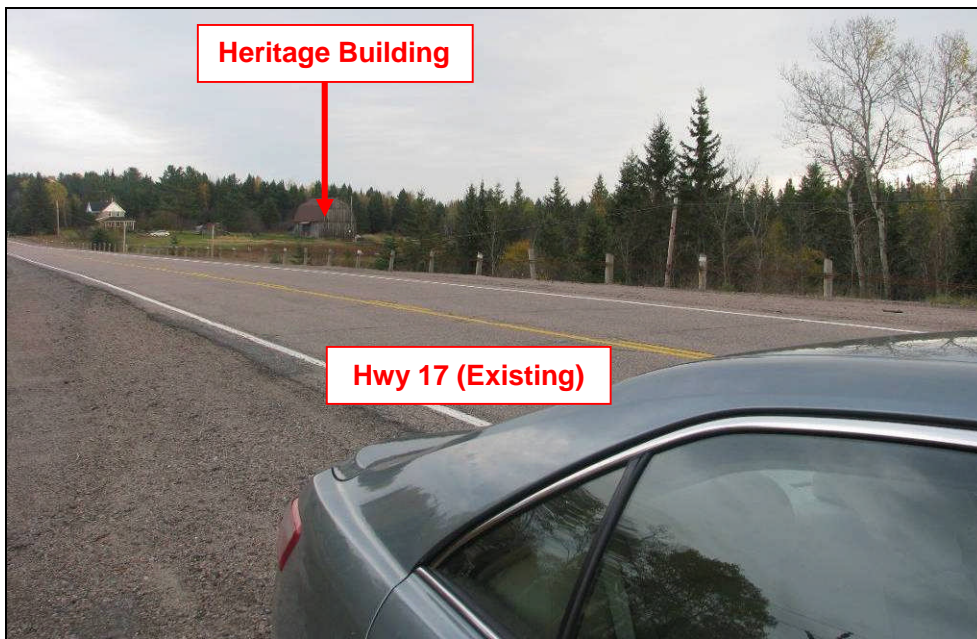
Photograph P19: Looking northeast from east shoulder of Hwy 94 at the proposed Hwy 17/Hwy 94 interchange area. Boulders are in foreground at the proposed Hwy 17/Hwy 94 interchange area. (October 18, 2012)



Photograph P20: Looking west from Hwy 17 north shoulder at about Sta. 8+350 (Hwy 17, existing). Rock cuts on south side. (October 18, 2012)



Photograph P21: Looking west from Hwy 17 north shoulder at about Sta. 18+350 (Hwy 17, existing chainage), boulders are visible on the north side House #3648. (October 18, 2012)



Photograph P22: Looking southeast from Hwy 17 north shoulder at about Sta. 18+450 (Hwy 17, existing chainage). The Heritage building is visible in distance. (October 18, 2012)



Photograph P23: Looking south from about Sta. 23+400 Hwy 17 WBL (preferred) crosses swamp. (February 21, 2013)



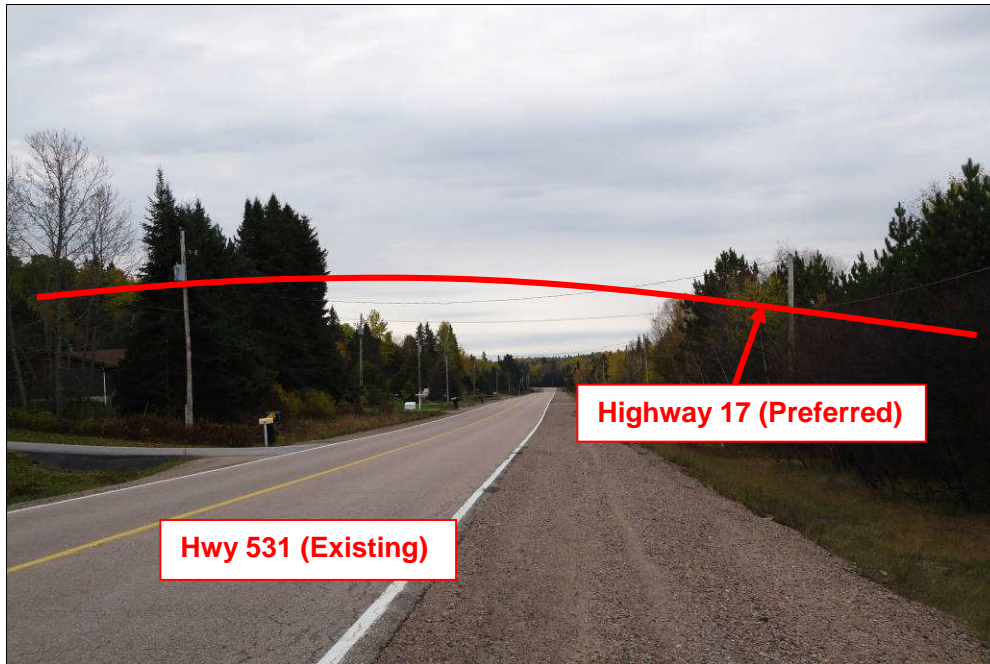
Photograph P24: Beaver dam/creek between south of Hwy 17 (preferred) Sta. 23+400 and Hwy 17 (existing). (February 21, 2013)



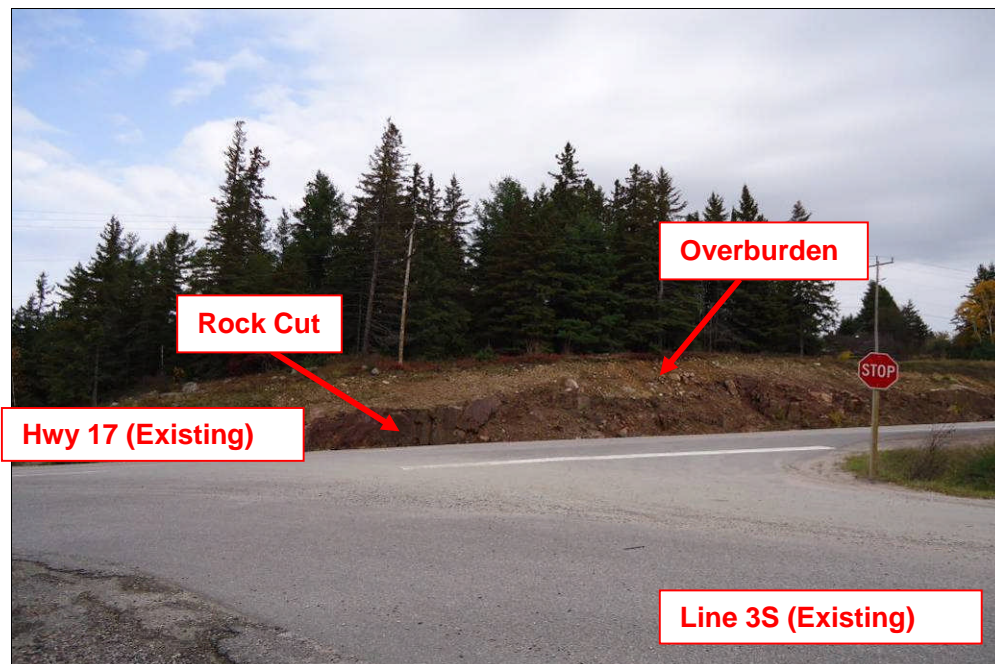
Photograph P25: Looking west from north shoulder of Hwy 17 (existing) approximately 200 m east of Maple Road. Hwy 17 (preferred) east crossing is behind the cars on up to 6 m cut. (October 18, 2012)



Photograph P26: Looking southwest from north shoulder of Hwy 17 (Existing) at proposed Hwy17 (preferred) east crossing area. Shallow overburden up to 2m thick over bedrock based on Geotechnical Survey Data (GWP 174-98-00). (October 18, 2012)



Photograph P27: Looking south from west shoulder of Hwy 531, Hwy 17 (preferred) crosses Hwy 531 at this location. (October 17, 2012)



Photograph P28: 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)



APPENDIX D

STRUCTURE LOCATIONS CONSIDERED FOR FOUNDATION ASSESSMENT



APPENDIX D

STRUCTURE LOCATIONS CONSIDERED FOR FOUNDATION ASSESSMENT

No	Crossing	Foundation Type	Remarks
Realignment 2, City of North Bay, Townships of East Ferris and Bonfield			
1	La Vase Portage Route Structure	Integral abutments on piles	Bedrock is up to 8.0 m deep based on the bedrock map. Approach embankments are about 5.0 m high on swampy area.
2	Highway 17 existing (West crossing)	Shallow foundation	Shallow bedrock anticipated (1.0 to 2.0 m deep) based on the bedrock map
3	Open water swamp (Assumed culvert)	Assumed shallow Foundation	Culvert placed on rockfill
4	Open water swamp (Assumed culvert)	Assumed shallow Foundation	
5	Open water swamp (Assumed culvert)	Assumed shallow Foundation	Culvert placed on rockfill
6	Centennial Crescent	Shallow foundation	Bedrock cuts present at Centennial Crescent east shoulder
7	Highway 17 existing (East crossing)	Shallow foundation	Shallow bedrock anticipated up to 2.0 m deep based on the Geotechnical Survey Data (GWP 174-98-00)
8	Kaibuskong River Bridge	Integral abutments on piles	Bedrock is about elevation 203 at the existing Kaibuskong River Bridge at the Highway 17. Varved clay and silt at the approach embankment.
9	Highway 531	Integral abutments on piles	Bedrock is up to 10.7 m deep based on the water well record
(*)	Line 3S	Deep foundations	Bedrock is up to 12.5 m deep based on the water well record
(*)	CPR	Deep foundations	Bedrock is up to 9.1 m deep based on the water well record. Soil cover includes clay and sand.



APPENDIX D

STRUCTURE LOCATIONS CONSIDERED FOR FOUNDATION ASSESSMENT

No	Crossing	Foundation Type	Remarks
Realignment 6, City of North Bay, Townships of East Ferris and Bonfield			
1	Highway11 / Highway 17 Interchange	Integral abutments on piles	Approach embankments on swampy area
2	Open water swamp (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill
3	La Vase Portage Route Structure	Assumed shallow foundation	Shallow bedrock anticipated
4	Dreany Lake (Assumed structure)	Integral abutments on piles	
5	Open water swamp (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill
6	Highway 94	Integral abutments on piles	Bedrock is anticipated up to 1.0 to 5.0 m deep based on the bedrock map and the nearby well records.
7	Highway 17 existing (West crossing)	Integral abutments on piles	Bedrock is anticipated up to 3.0 to 8.0 m deep based on the bedrock map and the nearby well records. Approach embankments are 5.0 to 8.0 m high.
8	Highway 17 existing (East crossing)	Shallow foundation	Shallow bedrock anticipated up to 2.0 m deep based on the Geotechnical Survey Data (GWP 174-98-00)
9	Kaibuskong River Bridge	Integral abutments on piles	Bedrock is at about elevation 203 at the existing Kaibuskong River Bridge at the Highway 17. Varved clay and silt at the approach embankment.
10	Highway 531	Integral abutments on piles	Bedrock is up to 10.7 m deep based on the water well record
(*)	Line 3S	Deep foundations	Bedrock is up to 12.5 m deep based on the water well record
(*)	CPR	Deep foundations	Bedrock is up to 9.1 m deep based on the water well record. Soil cover includes clay and sand.



APPENDIX D

STRUCTURE LOCATIONS CONSIDERED FOR FOUNDATION ASSESSMENT

No	Crossing	Foundation Type	Remarks
Realignment 10, City of North Bay, Townships of East Ferris and Bonfield			
1	Highway11 / Highway 17 Interchange	Integral abutments on piles	Shallow bedrock to exposed bedrock at east abutment and swampy areas at west abutment
2	Unnamed Creek (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill
3	La Vase Portage Route Structure	Integral abutments on piles	Shallow bedrock anticipated
4	Open water swamp (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill
5	Unnamed Creek (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill
6	Highway 94	Integral abutments on piles	Bedrock is up to 2.0 to 8.0 m deep based on the bedrock map and the nearby well records. The approach embankment is about 5.0 m high.
7	Highway 17 existing (West crossing)	Integral abutments on piles	Bedrock is anticipated up to 5.5 to 8.0 m based on the bedrock map and the nearby well records. Approach embankments are about 5.0 to 8.0 m high.
8	Highway 17 existing (East crossing)	Shallow foundation	Shallow bedrock anticipated up to 2.0 m deep based on the Geotechnical Survey Data (GWP 174-95-00)
9	Kaibuskong River Bridge	Integral abutments on piles	Bedrock is at about elevation 203 at the existing Kaibuskong River Bridge at the Highway 17. Varved clay and silt at the approach embankment.
10	Highway 531	Integral abutments on piles	Bedrock is up to 10.7 m deep based on the water well record
(*)	Line 3S	Deep foundations	Bedrock is up to 12.5 m deep based on the water well record
(*)	CPR	Deep foundations	Bedrock is up to 9.1 m deep based on the water well record. Soil cover includes clay and sand.



APPENDIX D

STRUCTURE LOCATIONS CONSIDERED FOR FOUNDATION ASSESSMENT

No	Crossing	Foundation Type	Remarks
Realignment 14, City of North Bay, Townships of East Ferris and Bonfield			
1	Highway11 / Highway 17 Interchange	Assumed integral abutments on piles and possible shallow foundations	Bedrock cuts at Highway 11 east abutment and exposed bedrock of west abutment
2	CNR	Integral abutments on piles	Shallow bedrock anticipated at west abutment and swampy/creek flooded area at east abutment
3	Unnamed Creek (Assumed culvert)	Shallow foundation	Culvert placed on rockfill
4	Highway 94	Integral abutments on piles	Bedrock is up to 5.7 m deep based on Contract 2006-5061 Geotechnical Survey Data. Approach embankments are about 5.0 m high.
5	La Vase River Bridge	Integral abutments on piles	Adjacent to OVR corridor
6	OVR	Integral abutments on piles	Bedrock is up to 8.0 m based on the bedrock map. Approach embankments are up to 5.0 m high on swampy areas
7	Maple Road	Shallow foundation	Shallow bedrock anticipated up to 2.0 m deep based on the Geotechnical Survey Data (GWP 174-98-00)
8	Kaibuskong River Bridge	Integral abutments on piles	Bedrock is at about elevation 203 at the existing Kaibuskong River Bridge at the Highway 17. Varved clay and silt at the approach embankment.
9	Highway 531	Integral abutments on piles	Bedrock is up to 10.7 m deep based on the water well record
(*)	Line 3S	Deep foundations	Bedrock is up to 12.5 m deep based on the water well record
(*)	CPR	Deep foundations	Bedrock is up to 9.1 m deep based on the water well record. Soil cover includes clay and sand.

(*) These structures may be designed as part of east route planning study corridor (Highway 17, Bonfield. Easterly, GWP 5670-10-00) by others. Consequently, these structures were not included in this assessment.



APPENDIX E

STRUCTURE LOCATIONS ON PREFERRED ALIGNMENT FOR FOUNDATION ASSESSMENT



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STRUCTURE LOCATIONS ON PREFERRED ALIGNMENT FOR FOUNDATION ASSESSMENT

No	Crossing	Foundation Type	Remarks
Preferred Alignment, City of North Bay, Townships of East Ferris and Bonfield			
1	Highway11 / Highway 17 Interchange	Integral abutments on piles	Shallow bedrock to exposed bedrock at east abutment and swampy areas at west abutment
2	Unnamed Creek (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill
3	La Vase Portage Route Structure	Integral abutments on piles	Shallow bedrock anticipated
4	Open water swamp (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill
5	Open water swamp (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill
6	Unnamed Creek (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill
7	Open water swamp (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill
8	Open water swamp (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill
9	Unnamed Creek (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill
10	Highway 94	Integral abutments on piles	Bedrock is up to 2.0 to 8.0 m deep based on the bedrock map and the nearby well records. The approach embankment are about 9.0 m high.
11	Unnamed Creek (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill



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STRUCTURE LOCATIONS ON PREFERRED ALIGNMENT FOR FOUNDATION ASSESSMENT

No	Crossing	Foundation Type	Remarks
12	Highway 17 existing (West Crossing)	Integral abutments on piles	Bedrock is anticipated up to 5.5 to 8.0 m based on the bedrock map and the nearby well records. Approach embankments are about 5.0 to 8.0 m high.
13	Open water swamp (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill
14	Open water swamp (Assumed culvert)	Assumed shallow foundation	Culvert placed on rockfill
15	Highway 17 existing (East Crossing)	Shallow foundation	Shallow bedrock anticipated up to 2.0 m deep based on the Geotechnical Survey Data (GWP 174-95-00)
16	Kaibuskong River Bridge	Integral abutments on piles	Bedrock is at about elevation 203 at the existing Kaibuskong River Bridge at the Highway 17. Varved clay and silt at the approach embankments
17	Highway 531	Integral abutments on piles	Bedrock is up to 10.7 m deep based on the water well records
(*)	Line 3S	Deep foundations	Bedrock is up to 12.5 m deep based on the water well records
(*)	CPR	Deep foundations	Bedrock is up to 9.1 m deep based on the water well records. Soil cover includes clay and sand.

(*) These structures may be designed as part of east route planning study corridor (Highway 17, Bonfield. Easterly, GWP 5670-10-00) by others. Consequently, these structures were not included in this assessment.