6.0 Recommended Plan

This section of the report describes the Recommended Plan for a 26.7 km long section of four-lane, fully controlled access Highway 69. At-grade intersections will not be permitted and access will be provided at interchanges at Magnetawan River, Bekanon Road and Highway 522. The Recommended Plan for the four-lane Highway 69 is illustrated in Exhibit 6-1 and detailed in Part 2 of this report.

The Recommended Plan also includes various grade separations, service roads, and road realignments that are required to maintain access to adjacent lands within the study area.

The Recommended Plan was developed through a process that included development of corridor alternatives, a Preferred Corridor, route and interchange alternatives within the Preferred Corridor and the development of the Preferred Route. A Value Engineering process was undertaken on the preferred route and interchanges subsequent to the development of the preliminary design. The changes that were incorporated as a result of this process are summarized in Section 6.19. Future work and mitigation as a result of these changes are also discussed in Exhibit 8-1.

6.1 Horizontal Alignment

The proposed Highway 69 four-laning alignment passes through the geographic unorganized townships of Wallbridge, Henvey and Mowat. The alignment also passes through the Municipality of Killarney and the Magnetawan and Henvey Inlet First Nations. The alignment consists of 11 horizontal curves, 10 having a radius of 1700 m with A-375 spirals and 1 having a radius of 3000 m with A-500 spirals.

The preferred alignment has 5.5 km of east twinning which will use the existing Highway 69 as the southbound lanes of the four-laning. Improvements to the existing pavement structure in the twinning sections will be determined in Detail Design.

The following is a description of the Recommended Route:

6.1.1 Magnetawan First Nation/Wallbridge Township

At the south limit of the project the alignment matches the completed and approved adjacent Highway 69 Four-Laning Route planning study for the project (WP 5377-02-00 South Section) with east side twinning. The east side twinning continues northerly 3.7 km through Magnetawan First Nation. The alignment continues east of the existing highway for a maximum offset of 150m before crossing the Magnetawan River at the northern border of Magnetawan First Nation.

The alignment continues north through Wallbridge Township for 2.5km. The existing Highway 69 swings west through this section while the new four-laning continues north and offsets from the existing highway by approximately 1km.

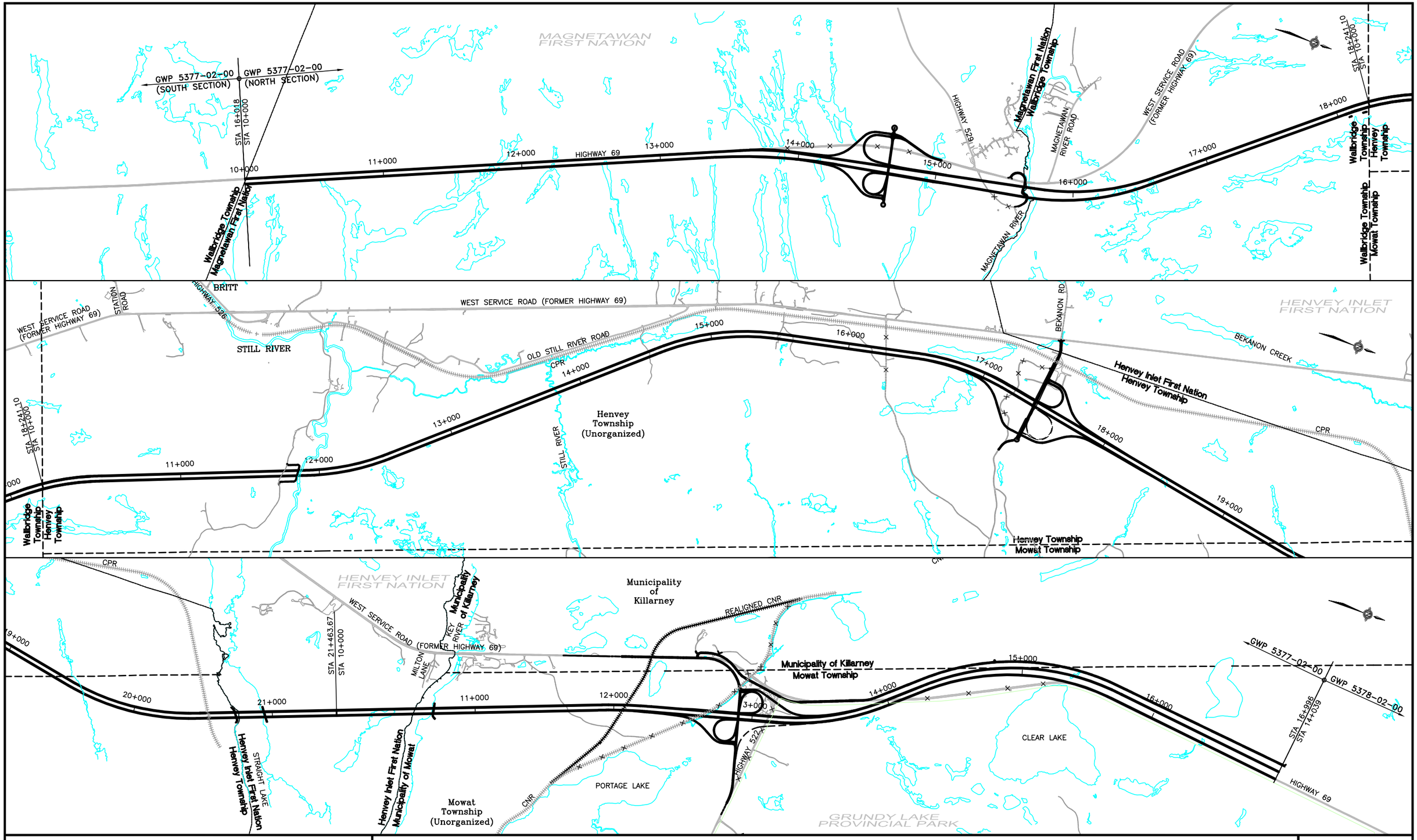
6.1.2 Henvey Township/Henvey Inlet First Nation

The alignment continues north through Henvey Township with an offset from the existing highway by approximately 1km and crosses Still River 1.9km into Henvey Township. Following Still River the alignment continues 3km North West before continuing parallel to the existing highway at an offset of 250m east of the existing Highway. The alignment continues north on this offset from the existing highway for 1.5km before deviating east of the existing highway to an offset of 1.4 km before crossing Straight Lake.

The alignment continues north for 1.1km though Henvey Inlet First Nation and crosses Key River at a 400m offset east of the existing Highway.

6.1.3 Mowat Township

The alignment continues north through Mowat Township for 2.3km at an offset of approximately 400m east of the existing Highway. The alignment then crosses Highway 522 before curving North West for 1km and continuing to cross the existing Highway 69. After crossing the existing Highway 69 the four-laning continues north for 1.5km on an alignment west of the existing Highway 69. The alignment rejoins the existing Highway 69 for 1.5km of west side twinning to match the Route Planning project GWP 5378-02-00, Highway 69 four-laning 3.8km north of Highway 522 to 4.5km north of Highway 64.



MRC

Highway 69 Four-Laning

North of Nobel to Highway 522

G.W.P. 5377-02-00 (North Section)

Recommended Plan

Exhibit

6-1

6.1.4 Summary of Horizontal Alignment

The horizontal alignment for the new Highway 69 is summarized in Exhibit 6-2.

Exhibit 6-2: Summary of Highway (Horizontal Curves and Spirals)

		Horizontal Curve Parameters			Design Speed (km/h)	
Curve No.	**PI Station**	**Radius (m)**	**Spiral In/Out (m)**	**Length of Curve (m)**	**Radius**	**Spirals**
Magnetawan Township						
1	13+648.25	1700	375	271.9	>160	120
2	15+796.35	1700	375	760.43	>160	120
3	18+129.29	1700	375	106.88	>160	120
Henvey Township						
4	10+000.00	1700	375	348.96	>160	120
5	11+965.46	1700	375	505.81	>160	120
6	14+650.13	1700	375	790.41	>160	120
7	16+555.05	1700	375	584.57	>160	120
8	19+470.23	1700	375	857.08	>160	120
Mowat Township						
9	11+961.81	3000	500	290.05	>160	120
10	13+230.55	1700	375	698.29	>160	120
11	14+306.73	1700	375	1336.04	>160	120

6.2 Vertical Alignment

The vertical alignment was designed with both a gentle drive in mind and to match as closely as possible the existing terrain to minimize cut/fill quantities. An adequate height of the top of pavement above groundwater level through swamps was also considered. A minimum of 1.5m above the existing ground was used in these areas.

A vertical alignment was designed, where possible, with parameters as would apply to a 140km/h design speed or greater. However this requirement was reduced to the 120 km/h design speed where deemed advantageous from a cost and construction perspective. Implementing a recommendation from the value engineering process discussed in Section 6.19, the vertical design speed was further reduced to 110km/h in areas where the existing highway platform can be maintained. Generally where the alignment was a twinning alignment for a significant stretch, the vertical design speed requirement for the lanes using the existing highway platform was maintained at 110 km/h design speed with sag curves of minimum K=50 and crest curves minimum K=90. The new alignment in the opposite direction in these areas was designed to a 120 km/h design speed with sag curves of minimum K=60 and crest curves minimum K=120. This allows for a greater use of the existing highway and therefore minimizes construction costs. On new alignment sections, opportunities to reduce cut/fill requirements by reducing the vertical design speed were reviewed, however it was determined that this would not result in a significant benefit and a 140 km/h design was used (a 140 km/h design speed requires a minimum K=80 sag curve and a K=180 crest curve).

Vertical curves were avoided or designed gentler in interchange areas to achieve optimal sight distance to the bullnose and end of acceleration lanes. With an object height of 0.0 m, a minimum sight distance of 470 m to the exit bullnose and the end of the acceleration speed change lane was achieved.

Vertical curves were generally designed to follow horizontal curves, avoiding a situation where the horizontal curve is hidden to the driver.

The existing ground quantity calculations are based on a digital terrain model (DTM) provided by MTO based on 2003 aerial photography. The existing ground profiles for the twinning section were derived from the ETR plates of existing Highway 69 provided by MTO. It should be noted that the original ETR plates were not available, therefore scanned versions were used, and a design profile was estimated to the extent possible. This inherently introduces some inaccuracy in the existing ground profiles through these areas, which will require further review in Detail Design.

The vertical alignment is summarized in Exhibit 6-3. There are 17 sag curves and 18 crest curves in each direction. Of these, 1 sag curve and 1 crest curve meets the minimal 110 km/h design speed in the southbound lanes. The rest of the vertical curves meet a 120 km/h design speed or greater. The maximum grade used was 2.7%.

Adjustments to the vertical alignment and existing ground profiles will be required during Detail Design when additional ground and subsurface information is available.

Exhibit 6-3: Summary of Highway 69 Vertical Curves

Curve No.	VPI Station		Curve Type	K Value	Design Speed (km/h)
	SBL	NBL			
Magnetawan Township					
1	10+275	10+234.91	Sag	70 SBL 120 NBL	130 >140
2	10+475	10+498.53	Crest	90 SBL 180 NBL	110 140
3	10+690	10+710.98	Sag	50 SBL 80 NBL	110 140
4	11+300	11+290.06	Crest	90 SBL 180 NBL	110 140
5	11+770	11+767.64	Sag	90 SBL 120 NBL	>140 >140
6	12+120	12+116.69	Crest	180 SBL 180 NBL	140 140
7	12+610.09	12+589.11	Sag	60 SBL 80 NBL	120 140
8	13+295.42	13+295.42	Crest	230	>140
9	14+045.35	13.993.10	Sag	140 SBL 200 NBL	>140 >140
10	14+819.48	14+833.75	Crest	410	>140
11	15+610.45	15+610.45	Sag	100	>140
12	16+057.47	16+105.98	Crest	180 SBL 160 NBL	140 130
13	17+225.71	17+275.01	Crest	180	140
14	17+470.00	17+480.49	Sag	140	>140
15	17+956.55	17+971.03	Crest	180	140
Henvey Township					
1	11+769.36	11+770.49	Sag	150	>140
2	12+988.73	12+991.89	Crest	230	>140
3	13+828.90	13+833.32	Sag	160	>140
4	14+810.92	14+816.04	Crest	300	>140
5	15+812.30	15+776.38	Sag	250	>140
6	16+545.77	16+595.31	Sag	250	>140
7	17+001.25	17+004.42	Crest	300	>140
8	17+600.56	17+603.72	Crest	300	>140
9	18+342.10	18+345.26	Sag	80	140
10	18+823.37	18+826.53	Crest	180	140
11	19+291.90	19+295.07	Sag	80	140
12	19+978.10	19+981.27	Crest	180	140
13	21+070.54	21+068.42	Sag	100	>140
Mowat Township					
1	10+151.46	10+155.29	Sag	100	>140
2	11+140.60	11+140.60	Crest	180	140
3	12+831.29	12+831.29	Sag	80	140
4	13+222.54	13+259.37	Crest	500	>140
5	15+639.97	15+611.32	Crest	200	>140
6	16+277.66	16+249.35	Sag	200	>140
7	17+043.37	17+015.62	Crest	150	130

6.3 Cross-Section

Highway 69 will be a four-lane Rural Freeway Divided highway. Each direction will consist of two 3.75 m wide lanes. The shoulder requirements are 3.0m wide on the right, 1.5m for the left shoulder and a 1.0 m rounding. The northbound and southbound lanes will be separated by a 30m open median.

Exhibit 6-4 shows the typical sections, Exhibit 6-5 shows further grading requirements. Although a typical section for earth is included, given the terrain of this study it is expected that all sections will either be swamp or rock cut/fill. Grading requirements may therefore be modified during Detail Design with further field investigations.

Granular side slopes will match the cut or fill slope for the particular grading treatment, and will have a minimum slope of 4:1 where guide rail is required. Rock fill slopes that do not have guide rail will be covered with earth, topsoil and seeded.

Exhibit 6-4: Typical Cross-Section – Highway 69 Four-Laning

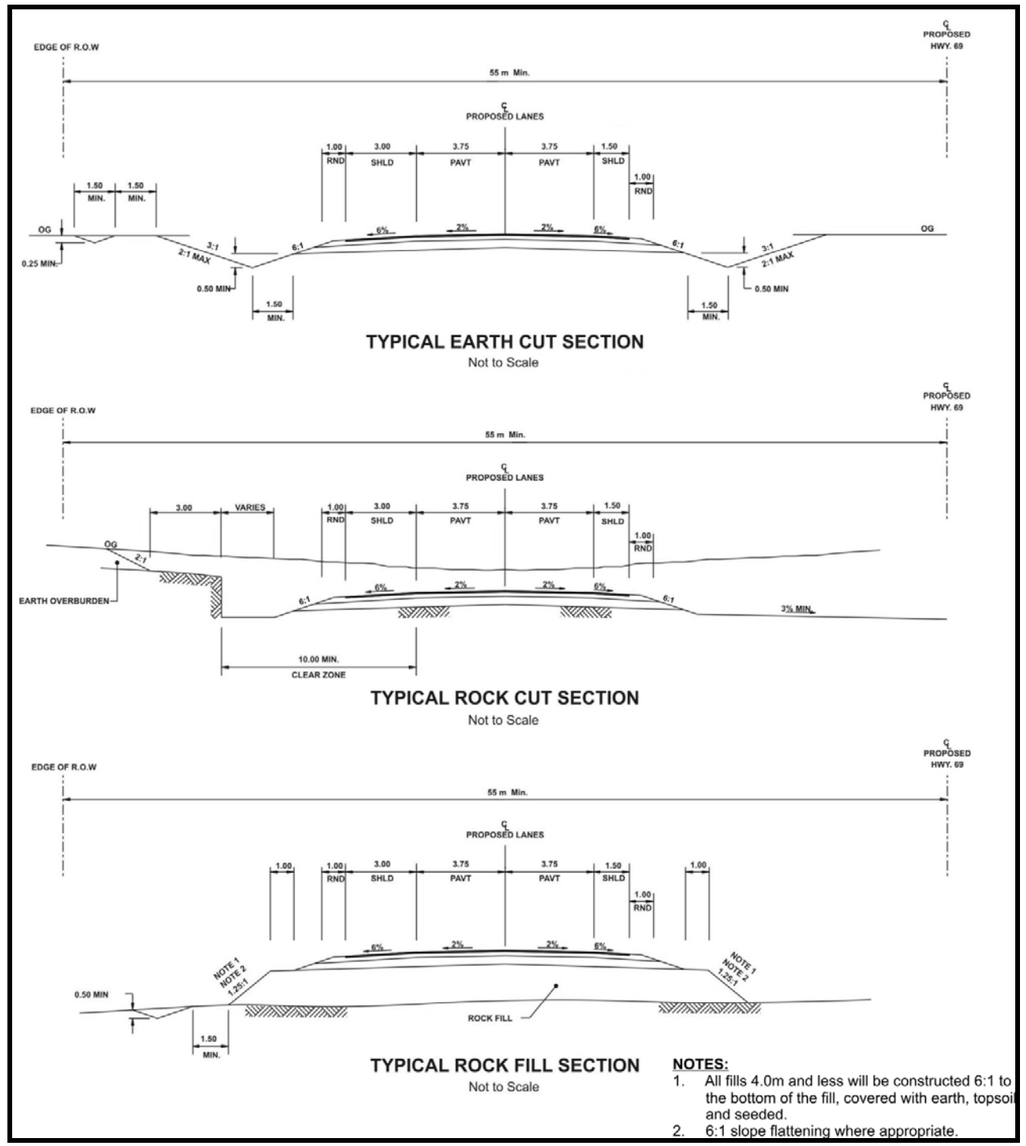


Exhibit 6-5: Summary of Highway 69 Cross-Section Requirements

FILLS		
Terrain	Grading Height	Requirements
Earth or Rock	<4.0 m	• 6:1 foreslope
Earth	4.0-6.0 m	• 4:1 foreslope
Earth	>6.0 m	• 2:1 sideslope with roadside barrier
Rock	>4.0 m	• 1.25:1 sideslope with roadside barrier
CUTS		
Terrain	Grading Height	Requirements
Earth	<4.0m	• 6:1 foreslope • Roadside ditch 12.0m from traveled lane • Min 1.2m flat bottom on ditch • 3:1 backslope
Earth	>4.0m	• 6:1 foreslope • Roadside ditch 12.0m from traveled lane • Min 1.2m flat bottom on ditch • 2:1 backslope
Rock	<10.0m	• 6:1 foreslope • Roadside ditch 10.0m from traveled lane
Rock	>10.0m	• Requires slope variation as per Northeastern Region Engineering Directive #2000-204
SWAMP FILL		
• A minimum platform widening of 2.0 m on each side will be provided in swamp environments in accordance with MTO Northeastern Region Engineering Directive #98-200 to accommodate future grade-raises. A minimum platform widening of 1.0 m is required for rock fills		

6.4 Interchanges

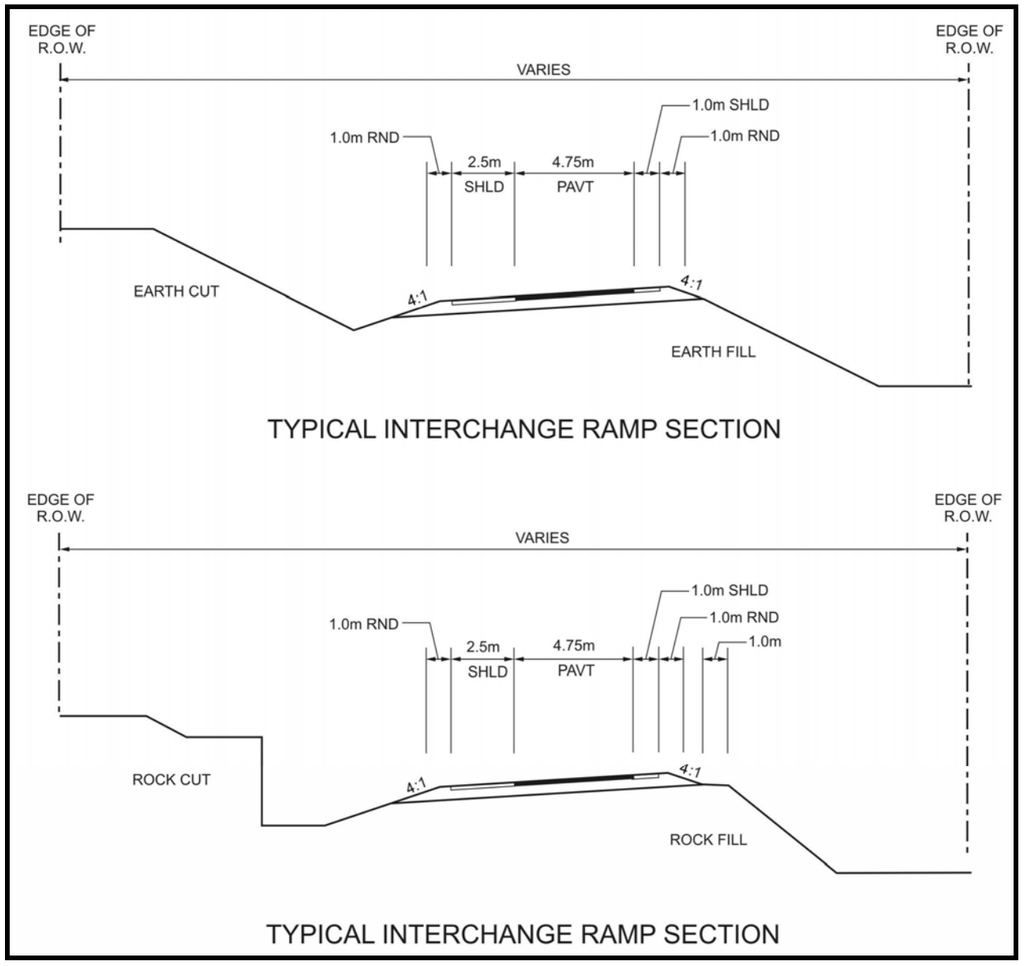
Highway 69 will be a fully-controlled access freeway or Controlled Access Highway (CAH). Interchanges will be provided at Magnetawan River, Bekanon Road and Highway 522. This will provide interchange spacing as summarized in Exhibit 6-6.

Exhibit 6-6: Interchange Spacing

Interchange	*Spacing from Closest Southerly*
Harris Lake Road Interchange (WP 5377-02-00 south section)	---
Magnetawan River Interchange	9.0km
Bekanon Road Interchange	11.0km
Highway 522 Interchange	7.0km
Pickerel River Road Interchange (WP 5378-02-00)	7.4km

All interchange ramps are single lane ramps with a 4.75 m lane, 1.0 m wide fully paved left shoulder, a 2.5m wide fully paved right shoulder, and 1.0m rounding. Typical cross-sections for interchange ramps are shown in Exhibit 6-7.

Exhibit 6-7: Typical Interchange Ramp Sections



The grading of the interchange ramps will be designed to provide gentle and traversable slopes to minimize roadside hazards. Exhibit 6-8 summarizes the typical cross-section earth grading requirements for the interchange ramps.

Exhibit 6-8: Summary of Interchange Ramp Cross-Section Grading Requirements (Earth Fill)

Design Speed	*Foreslope*
<100 km/h	4:1 or Flatter
>100 km/h	6:1 or Flatter

All rock fills 4m or less are to be constructed to the earth fill slope requirements to the bottom of the fill, covered with earth, topsoil and seeded. Rock fills over 4m shall be constructed according to the Ontario Provincial Standard Drawings.

All sight distance requirements including decision sight distance to exit bullnoses on the crossing road are achieved within the interchange. Exhibit 6-9 summarizes the sight distance requirements for the interchanges:

Generally the crossing road will cross Highway 69 on a vertical tangent to achieve the adequate sight distance requirements.

Exhibit 6-9: Stopping/Decision Sight Distance for Interchanges

Design Speed (km/h)	Stopping Sight Distance (m)	Decision Sight Distance (m)		*Intersection Sight Distance*		
		Minimum	Desirable	Turning Movement Condition B (Crossing 2 lane roadway)	Turning Movement Condition C (Turning Left Vehicle approaches from left)	*Turning Movement Condition D&E (Turning L\R, attain speed before being overtaken)*
60	85	170	230	120	140	175
70	110	200	270	135	165	220
80	135	230	310	155	185	270

Notes for Exhibit 6-9:

- Decision and Stopping Sight Distance: driver height 1.05 m, object 0.38 m.
- Decision Sight Distance to exit Bullnose: driver height 1.05 m, object 0.0 m.
- Intersection Sight Distance: driver height 1.05 m, object 0.0 m.

6.4.1 Magnetawan River Interchange

An interchange is proposed at Highway 69 south of Magnetawan River and 600m south of Highway 529. the configuration is a Parclo B-2 on the west side of the highway and a Parclo A-2 on the east side. The B inner loop on the west side intersects the crossing road without providing a N-E ramp. Given current lack of development on the east side of Highway 69 a direct E-N ramp is not needed at this time to accommodate traffic.

This interchange will provide access to Highway 529, the Magnetawan First Nation community and Byng Inlet. The interchange will also access the existing Highway 69 which will continue north to serve the communities of Britt and Still River. The design speed of the Magnetawan River Interchange crossing road is 80 km/h.

The profile of the interchange crossing road across Highway 69 includes a tangent section over Highway 69. This tangent section achieves the desirable sight distance (object height=0.0 m) to the exit bullnoses for the design speed of 80 km/h.

The vertical alignment of the crossing road at the interchange is completely on tangent and therefore all decision and stopping sight distance requirements are achieved for a 80km/h design speed as indicated in Exhibit 6-9.

The final alignments and profiles of the Magnetawan River interchange will be confirmed in Detail Design when detailed survey information is available.

6.4.2 Bekanon Road Interchange

An interchange is proposed at Highway 69 and an extension of Bekanon Road to provide access to the Henvey Inlet First Nation community. The interchange will also access the existing Highway 69 which will serve the communities of Britt and Still River south of the interchange.

The interchange consists of a Parclo A-2 configuration on the west side with a 75m inner loop. The east side is a diamond configuration. The Parclo A inner loop on the west side will intersect with the Bekanon Road extension and not include a E-S ramp. Given current lack of development on the east side of Highway 69 a direct E-S ramp is not needed at this time to accommodate traffic. The design speed of the Bekanon Road Interchange crossing road is 60 km/h.

The profile of Bekanon Road extension across Highway 69 includes a tangent section under Highway 69. This tangent section achieves the desirable sight distance (object height=0.0 m) to the exit bullnoses for a design speed of 80km/h.

An at grade railway crossing (CPR) will occur 130m west of this interchange.

The N-E/W Ramp terminal is on a K=70 crest curve while the S-E/W Ramp terminal is on a K=50 sag curve. Both situations achieve the intersection sight distance requirements for turning movements condition D & E in Exhibit 6-9.

The final alignments and profiles of the Bekanon Road interchange will be confirmed in Detail Design when detailed survey information is available.

6.4.3 Highway 522 Interchange

A Parclo A-2 interchange is proposed on a realigned section of Highway 522, with protection for an ultimate Parclo A-4 configuration on the east side with the completion of the E-N direct ramp. This interchange will provide access to Highway 522 easterly and the existing Highway 69 west which will continue to act as a service road southerly. The interchange will also serve the residences and businesses at Key River.

The profile of the interchange crossing road across Highway 69 includes a tangent section over Highway 69. This tangent section achieves the desirable sight distance (object height=0.0 m) to the exit bullnoses for the design speed of 80 km/h.

The ramp terminals are on a vertical tangent between 2 K=100 sag curves. This situation achieves the intersection sight distance requirements for turning movements condition D & E in Exhibit 6-9.

The final alignments and profiles of the Highway 522 interchange will be confirmed in Detail Design when detailed survey information is available.

6.5 Structures

6.5.1 Existing Structures

There are four major existing structures on this section of Highway 69 consisting of the Magnetawan River Bridge, the Still River Bridge, the Key River Bridge, and the CNR Overhead at Cranberry Lake Bridge. For a brief description of these bridges, see Section 2.4.6. For a discussion of the existing condition of each structure, refer to the *Existing Structure Inspection Report (Highway 69 Four-Laning, North of Highway 559 to North of Highway 522, McCormick Rankin Corporation, July 28, 2006).* The following sections present recommendations for each bridge.

6.5.1.1 Magnetawan River Bridge

The existing bridge is generally in fair to very good condition. The bridge deck and floor beams, which were replaced as part of the 1990 structure rehabilitation, are in very good condition. The barrel arch is in fair to good condition. Many of the original concrete components of the bridge exhibit significant alkali-aggregate reaction cracking, including:

- the facia and extrados of the barrel arch;
- the facia of the piers;
- the wingwalls;

There are no apparent defects that would affect the structural capacity of the bridge, but monitoring of the alkali-aggregate reaction cracking in the substructure elements is recommended. The remaining service life of the existing bridge is estimated to be between 20 to 35 years, depending on the findings of a more detailed investigation of the arch and substructure. Based on the existing condition of the bridge, the next rehabilitation of the bridge can probably wait until completion of the four-laning of Highway 69 (i.e. about 10 years).

An access road (Spirit Road) will be constructed through the south end span of the existing bridge. The steep slope under and adjacent to the bridge at this location will likely require the construction of a concrete retaining wall system under the bridge and extending about 20 m east of the bridge in order to create a platform for the road. Details of the retaining system required are to be determined during detail design.

6.5.1.2 Still River Bridge

The existing bridge superstructure is in good to very good condition (the deck was replaced in 1986). The substructure, however, is in fair to poor condition.

The only defect that could potentially impact the structural capacity of the bridge is the deterioration of the arch thrust blocks. Accordingly, this area of the bridge warrants further investigation. Additional components that require repair include the rust jacking that is occurring under the batten plates of the arch ribs, although this issue is not expected to impact the structural capacity of the bridge in the short term. Accordingly, depending on the findings of further investigation of the thrust blocks, consideration could be given to waiting until the four-laning of Highway 69 is complete prior to undertaking the rehabilitation of this bridge. Should an investigation of the thrust block reveal deterioration of the concrete under the arch rib anchorages, consideration could be given to undertaking repair of these areas only in the interim while leaving the remaining work until the four-laning of Highway 69 is complete.

The remaining service life of the existing bridge is estimated to be between 20 to 30 years, depending on the findings of detailed investigations of the substructure components.

6.5.1.3 Key River Bridge

The existing bridge is in poor condition and is approaching the end of its useful service life. Based on the existing condition of the bridge, it is recommended that the bridge be replaced within the next five to ten years. Additionally, the condition of the bridge should be carefully monitored for further deterioration until it is replaced. It is understood that the bridge is currently scheduled for replacement. The impact of

the bridge replacement on the fill approaches to the structure, which encroach into the river, will have to be reviewed during detail design.

6.5.1.4 C.N.R. Overhead at Cranberry Lake Bridge

The existing bridge is in generally good condition. However, fatigue cracks were detected in 2006 in the webs of the steel girders and some of the steel bracing stiffeners. Beyond these cracks, there are no apparent defects that would affect the structural capacity of the bridge. The remaining service life is estimated to be about 35 years. In the short term, the fatigue cracks should be repaired and the expansion joint dams should be repaired with a quick set proprietary product. Alternatively, the joints could be eliminated and the ends of the deck could be converted to a semi-integral abutment detail. The Recommended Plan, however proposes that this bridge be removed following completion of the four-laning since the CNR trackage is to be relocated and the structure becomes unnecessary.

6.5.2 New Major Structures

New Major Structures

There are 17 new major structures within the study area. The structure locations, types and sizes are summarized in Exhibit 6-12.

Exhibit 6-12: Summary of Major Structures

Structure #	Location	Description	Type	Spans	Length (m)
WALLBRIDGE\MAGNETAWAN FIRST NATION					
1	14+655	Hwy 69 - Magnetawan Rd Interchange	Post-Tension Concrete	2	101.5
2 & 3	15+673 (NB) 15+700 (SB)	Hw 69 - Magnetawan River Crossing	Slab-on-Precast Girders	3 (each)	117 (NB) 73 (SB)
HENVEY TOWNSHIP					
4 & 5	11+889 (NB) 11+865 (SB)	Hwy 69 - Still River Crossing	Slab-on-Precast Girders	2 (each)	85 (NB) 90 (SB)
6 & 7	17+438 (NB) 17+408 (SB)	Hwy 69 - Bekanon Road Interchange	Concrete Rigid Frame	1 (each)	15 (each)
8 & 9	20+537 (NB) 20+536 (SB)	Hwy 69 - CPR Crossing	Slab-on-Precast Girders	1 (each)	29 (each)
10 & 11	20+874 (NB)	Hwy 69 - Straight Lake Crossing	Slab-on-Precast Girders	6 (NB) 7 (SB)	255 (NB) 257 (SB)
12 & 13	10+635 (NB) 10+620 (SB)	Hwy 69 - Key River Crossing	Slab on Steel Girders	3 (each)	186 (NB) 181 (SB)
14 & 15	12+085 (NB) 12+062 (SB)	Hwy 69 – Realigned CNR Crossing (Twp of Mowat)	Slab-on-Precast Girders	3 (each)	66 (each)
16	9+915	West Service Rd - Realigned CNR Overpass (Twp of Mowat)	Slab-on-Precast Girders	1	38
17	12+902	Hwy 69 – Hwy 522 Interchange (Twp of Mowat)	Slab-on-Precast Girders	2	82.5

The proposed bridges are typically straight and square (i.e. zero skew) for ease of construction. The exceptions to this include the twin, single-span rigid frame bridges at the Bekanon Road Overpass, which have a 4° skew to reduce the structure span, and the Magnetawan River Bridge (NBL Structure only) and the Highway 69 - CNR Crossing structures which are located on curved sections of the highway alignment.

Shoulder widths were established in accordance with the Ministry's Geometric Design Standards (GDSOH) and road classifications. Consideration was given to reducing shoulder widths for long structures (>50 m in total length) in accordance with provisions in the GDSOH. However, it was determined that the full shoulder widths would be used to maximize the available snow storage on the bridges.

Rock fill embankments are assumed at all structures. At the river crossings, the rock fill was set at the maximum permitted fill slope of 1.25:1. Where the embankment height exceeded 10 m, 2 m wide, mid-height berms were provided for surficial stability. Typically, at the interchange and fly-over structures, a slightly flattened fill slope of 1.5:1 was used to ensure that the toe of the slope did not creep forward into clear zones or over rock cuts as a result of minor slope erosion. A Granular 'B' Type 2 surface (300 mm thick) is provided on top of the rock fill wherever the fill could be mounted by a vehicle in order to provide a recoverable driving surface.

The structure foundations have been established based on the following documents:

1. Preliminary Foundation Investigation and Design Report for Selected Structures, Structural Area Foundation Investigation - 2, Highway 69 Route Selection Study, 3.5km N of Highway 559 to 3.8

km N of Highway 522, AMEC Earth and Environmental Ltd, July 27, 2006. This report provides foundation recommendations for the following structures:

- Magnetawan River Bridges;
- Still River Bridges;
- Straight Lake Bridges; and
- Key River Bridges.

2. Golders Associate Ltd. Technical Memorandum, June 18, 2007 - Foundation and Geotechnical Assessment Value Engineering Recommendations- North Section Proposed Four-Laning of Highway 69 from 3.5km North of Highway 559 to 3.8km North of Highway 522. This memorandum provides foundation assessment for the following structures:

   a. Magnetawan River Bridge (NBL only) (refer to Value Engineering Location SW-2);

   b. Hwy 69 – Realigned CNR Crossing (Twp of Mowat) (refer to Value Engineering Location SMR-1) ;

   c. West Service Rd - Realigned CNR Overpass (Twp of Mowat) – Refer to CNR Realignment-West End (approx. station 11+700 to 12+400) (refer to Value Engineering Location SMR-1)

   d. Hwy 69 – Hwy 522 Interchange (Twp of Mowat) (refer to Value Engineering Location RNA-2)

Both documents are provided in Appendix T.

The proposed foundations for these structures are described in the following sections for each structure.

Additionally, the foundation report indicates that bedrock outcroppings and ridges are visible along much of the existing Highway 69 corridor. Accordingly, at the other structures in the North Section, it is assumed that rock is typically exposed or taken to be at shallow depth. Given the low cost and superior durability of integral abutment bridges, integral abutments are typically shown for the bridges in fill situations. It is anticipated that some rock removal may be required at some of these bridges to permit the use of 5 to 6 m long piles (the minimum pile length for integral abutment bridges). Semi-integral abutment structures are typically shown for the bridges in cut situations.

For all structures, foundation types are to be confirmed during Detail Design.

The span lengths for interchange and flyover bridges were established based on providing clear zone requirements from the edge of the travelled lane to either the toe of the backslope, or for closed abutment overpass structures, to the face of abutment, as appropriate.

The span lengths for the CNR and CPR crossings were established based on a minimum 14.5 m wide clearance envelope in accordance with the directions of CNR. This clearance envelope accommodates a 5.5 m track clearance on one side of the track and an 8.0 m service road clearance on the opposite side of the track (as required by the Respecting Railway Clearance for Canada), plus an additional 0.5 m clearance on each side

A minimum vertical clearance of 5.0 m is provided at all bridges over roadways. As per Northeastern Region policy, an additional minimum clearance allowance of 100 mm was provided to accommodate future padding of the road below the bridge (resulting in a total minimum vertical clearance of 5.1 m). A minimum vertical clearance of 7.01 m is provided under all structures passing over CPR and CNR track – measured from the top of rail.

Standard Performance Level 3 barriers are provided on all structures.

All the bridges were designed to permit, at minimum, a single lane widening of Highway 69 into the median (in both the northbound and southbound directions).

The following water crossings have been identified as potentially being navigable (Exhibit 6-13). The large openings provided by the proposed structures at the water crossings should accommodate the navigable requirements at each structure. The approximate navigable opening at each crossing is provided in Exhibit 6-13. Details regarding navigability will be confirmed with Transport Canada during Detail Design.

Exhibit 6-13: Structures Crossing Navigable Waters

Structure/Water Crossing	Approximate Navigable Opening Provided
Magnetawan River Crossing	10.0m Vertical x 10.0 m Horizontal
Still River Crossing	8.0m Vertical x 8.0 m Horizontal
Key River Crossing	18.0m Vertical x 55.0 m Horizontal
Straight Lake Crossing	15.5m Vertical x 40.0 m Horizontal

The following sections provide additional details on each of the bridges in the North Section. Preliminary General Arrangement Drawings for these structures are provided in Appendix U.

6.5.2.1 Highway 69 - Magnetawan River Interchange

This bridge consists of a two-span (50 m - 51.5 m) underpass structure. The superstructure consists of a post-tensioned concrete, voided slab deck with rectangular voids. The 12.05m deck width consists of two 3.50 m lanes, and 2 m shoulders. The bridge is square.

Integral abutments are not typically considered for post-tensioned bridges because of the large deck contractions resulting from post-tensioning of the deck (both elastic contraction during the actual post-tensioning operation, and long-term contraction under the effect of creep). Accordingly, the abutments are shown as semi-integral and are founded on Granular 'A' pads. It should be noted that the construction of the approach slabs will have to be delayed about 6 months to reduce the post-construction deck contractions due to creep in order to construct a serviceable joint at the end of the approach slabs.

6.5.2.2 Highway 69 - Magnetawan River Crossing (NBL & SBL Bridges)

The Magnetawan River bridges consist of a three-span NBL structure with spans of 45 m, 45 m and 27m, and a three-span SBL structure with spans of 20 m, 33 m and 20 m. The superstructure for both bridges consists of a concrete slab on precast girders (CPCI [Canadian Precast/Prestressed Concrete Institute] 2300 girders for the NBL structure and CPCI 1600 girders for the SBL structure). Both structures have a deck width of 14.05 m, comprised of two 3.75 m lanes, a 3 m right shoulder and a 2.5 m left shoulder. The large radius of the NBL horizontal alignment will be accommodated by varying the width of the deck overhangs.

The south pier of the NBL structure will largely be constructed on a small island in the river. Depending on the foundation type, some part of the pier foundation may be in the water. During detail design, consideration should be given to both a spread footing foundation and a caisson foundation (i.e. socketing the pier columns directly into bedrock). Other associated issues to be resolved during detail design include, the requirement for barges and/or cofferdams for construction at the pier; potential HADD (Harmful Alteration, Disruption or Destruction of fish habitat) resulting from construction of the pier; and, the possible requirement for a Permit to Take Water (PTTW) for construction.

The foundations for both structures are expected to be constructed on bedrock. The abutments will be made semi-integral for durability.

An access road (Spirit Road) will be constructed under the south end spans of both bridges. This access will also accommodate wildlife movement. As noted in section 6.5.1.1, the steep slope under and adjacent to the bridge at this location will likely require the construction of a concrete retaining wall system under the bridge and extending about 20 m east of the bridge in order to create a platform for the road. Details of the retaining system required are to be determined during detail design. Wildlife passage will also be accommodated on the north side of both bridges.

6.5.2.3 Highway 69 - Still River Crossing (NBL & SBL Bridges)

The Still River bridges consist of a two-span NBL structure with spans of 40 m and 45 m, and a two-span SBL structure with twin spans of 45 m. Both superstructures consist of a concrete slab on CPCI 2300 precast concrete girders. Both structures have a deck width of 14.05 m, comprised of two 3.75 m lanes, a 3 m right shoulder and a 2.5 m left shoulder.

The height and slope on the south approach embankments are limited to 6m and 1.5:1, respectively, to avoid potential slope instability issues. The north abutments have been located beyond the loose and very soft sub soil conditions in the flood plain. The bridges will be supported on deep foundations. Integral abutments will be used to optimize structure durability. The issue of slope stability along the approach fills will require further investigation during in detail design.

A 4 m x 4 m opening will be provided under the south spans of both structures for a local access road. Wildlife passage will be accommodated under both bridges on both sides of the river.

6.5.2.4 Highway 69 - Bekanon Road Interchange (NBL & SBL Bridges)

The structures consist of twin, single-span (15 m square opening) concrete rigid frame overpass bridges. Both structures support two, 3.75 m though lanes, a 3.0 m right shoulder and a 2.5 m left shoulder. The SBL structure also supports a variable width speed change lane. Both bridges are skewed at 3°46'15".

Given that both bridges are in cut, it is anticipated that they will be founded directly on bedrock. RSS walls will be required along Bekanon Road to retain the fill embankment.

6.5.2.5 Highway 69 - CPR Crossing (NBL & SBL Bridges)

The structures consist of twin, single-span (29 m), slab on CPCI 1400 precast girder bridges. The 14.05 m deck widths each consist of two 3.75 m lanes, a 3 m right shoulder and a 2.5 m left shoulder.

Given that both bridges are in cut at the south abutment, it is anticipated that the south abutments will be founded directly on bedrock. The north abutments, however, are on fill and are therefore likely to be piled.

The bridges will be constructed over live rail traffic.

6.5.2.6 Highway 69 - Straight Lake Crossing (NBL and SBL Bridges)

Both structures consist of a multi-span, slab on CPCI 2300 precast girder bridge. The six-span NBL structure has, from south to north, 5 spans at 45 m and a north end span of 30 m. The seven-span SBL structure has spans of, from south to north, 25 m, 37 m, 3 spans at 45 m, 35 m and 25 m. Both structures have a 14.05 m deck width comprised of two 3.75 m lanes, a 3 m right shoulder and a 2.5 m left shoulder.

Both structures are expected to be supported on piled foundations.

Four piers on each structure will be constructed in the water. Given the shallow depth of the lake (approximately 3 m), it is anticipated that the most economical foundation system would consist of a piled foundation constructed in the dry, inside of cofferdams.

It is anticipated that modular expansion joints will be required at ends of each bridge to accommodate the significant thermal expansion and contraction that will occur in these long structures. Wildlife access is provided on both shorelines under the bridges.

6.5.2.7 Highway 69 - Key River Crossing (NBL and SBL Bridges)

The structures consist of twin, three-span, slab on haunched steel girder bridges. The span arrangements for the NBL and SBL structures are 53 m – 80 m – 53 m and 53 m – 80 m - 48 m, respectively. The 14.05 m deck widths each consist of two 3.75 m lanes, a 3 m right shoulder and a 2.5 m left shoulder.

The abutment foundations are all in cut. As a result, they are expected to be founded either directly on bedrock, or on a granular pad supported on bedrock.

Given the 12 to 15 m depth of the river and the steeply sloping river bed, it is anticipated that large diameter caissons would be more appropriate than H-piles for the pier foundations. It is anticipated that each pier would consist of a pier cap supported on two columns. The columns would, in turn, each be supported on a single large diameter caisson (3.0± m diameter), socketed into bedrock. It should be noted that this size of caisson would be unique for Ontario. As a result, at detail design, consideration should be given to assessing the risk associated with constructing these piers. This could include the review of alternate pier and/or structure concepts that would entail more conventional construction methods and therefore lower risk (e.g. large diameter concrete filled pipe piles with float-in-place pier cap).

It is anticipated that a modular expansion joint will be required at one end of each bridge to accommodate the significant thermal expansion and contraction that will occur in these long structures. A Class A armoured joint will be required at the opposite end of each deck. Wildlife passage will be accommodated under both bridges on both sides of the river.

6.5.2.8 Highway 69 – Realigned CNR Crossing (NBL and SBL Bridges)

The structures consist of twin, three-span (18 m – 30 m – 18 m), slab on CPCI1400 precast girder bridges. The 14.05 m deck widths each consist of two 3.75 m lanes, a 3 m right shoulder and a 2.5 m left shoulder. The bridge decks will be curved to suit the curved highway alignment (3000m radius). Both bridges are superelevated at 2.7%.

It is anticipated that the track alignment will be refined at detail design. This would include ensuring that the proposed alignment avoids a swamp in the vicinity of the north approach to the structures. Additionally the track alignment should be reviewed to determine if the skew between the track and the highway can be reduced. Reducing the skew would shorten the length of the bridges and possibly allow the use of a single-span bridge configuration.

It is anticipated that the bridge will be supported on piled foundations. The issue of potential differential settlement between the north abutment and north approach fills (due to the presence of the swamp) will require further investigation during detail design.

6.5.2.9 West Service Road – Realigned CNR Crossing

The structure consists of a single-span (38 m), slab on CPCI1900 precast girder bridge. The 12.05 m deck width consists of two 3.50 m lanes, a 2.0 m shoulders.

It is proposed to remove the earth fill in the approach embankments at the abutments and replace it with rock fill. This will permit the use of 1.25:1 slopes at the abutments, which results in a shorter span length. (i.e. 38 m as described above).

It has been assumed that the bridge will be supported on piled foundations. This assumption will have to be reviewed at detail design.

Similarly to the Highway 69 – CNR Crossing, it is anticipated that the realigned track alignment will be refined at detail design to suit the existing soil conditions, and/or to optimize the structure configuration (i.e. to reduce the crossing skew). It is also anticipated that the construction of the new bridge will be carried out using a detour of Highway 69 traffic around the work site and prior to relocation of the rail traffic.

6.5.2.10 Highway 69 - Highway 522 Interchange

The structure consists of a two-span (42 m – 40.5 m), slab on precast girder bridge. The 12.05 m deck width consists of two 3.50 m lanes, 2.0 m shoulders. The proposed girders are CPCI2300 girders.

At detail design, consideration should be given to steepening the 1.5:1 fill slope at the abutments to 1.25:1 in order to reduce the span length to permit the use of CPCI1900 girders. CPCI1900 girders are typically more economical than CPCI2300 girders, and are a more slender, and therefore, aesthetically attractive girder.

It is anticipated that the bridge will be supported on piled, integral abutments. The pier may be supported on either piled foundation or a spread footing foundation.

6.5.3 Snowmobile Structure

There is one dedicated snowmobile crossing of Highway 69 in the North Section. Its location between the Magnetawan River interchange and the Magnetawan River was determined through input provided by

local snowmobile clubs and the Magnetawan First Nation. The site was chosen to minimize the impact to the existing trail network and to suit the existing topography. This structure avoids a trail location along realigned Spirit Road that would bring snowmobiles in close proximity to residences east of the highway. At detail design, the wingwall configuration shown on the Preliminary General Arrangement drawing provided in Appendix U is to be reviewed based on the actual foundation conditions. The presence of exposed bedrock, particularly at the NBL structure, could impact the wingwall lengths and details. The crossing consists of twin, concrete rigid frame, open footing culverts (NBL and SBL structures, respectively). The culvert openings are 4 m wide by 4 m high. Both structures are square.

It was determined that, separate wildlife structures were not warranted as the wildlife could be accommodated by using proposed river crossings as discussed in the following section on ecopassages. The crossing is identified in Exhibit 6-16. A General Arrangement drawing for the crossing is provided in Appendix U. Opportunities to connect the TOPS trail system east and west of the new Highway 69 at Still River will be undertaken during detail design. The options consist of: crossing on the north shore of Magnetawan River or the south shore of Straight Lake.

Exhibit 6-16: Summary of Snowmobile Crossing

Location	Description	Span (m)	Height (m)	*Length (m)*
MAGNETAWAN TOWNSHIP				
15+050.000(NBL) *15+056.901 (SBL)*	*Snowmobile*	*4.0*	*4.0*	18 m (Each Structure)

6.5.4 Ecopassages

Extensive data collection and analysis was completed to facilitate the understanding of animal movement generally, and specifically in relation to Highway 69. Data reviewed included:

- large mammal collision data on Highway 69 over the 13 year period from 1988 to 2000;
- MNR NRVIS and NHIC database information;
- findings of an early winter aerial deer survey (trails, animals and direction of movement) (January 2004);
- general landscape and other information (e.g. valleys, cover type and ecotones/ 'changes') from map sources (CLI, Ontario Base Map, topo, Forest Resource Inventory, waste disposal sites);
- preliminary field observations (e.g. trails, scat); and
- other general wildlife information obtained from public consultation.

Although the distribution of collisions varied along the highway, collisions were generally spread out along the length of the highway.

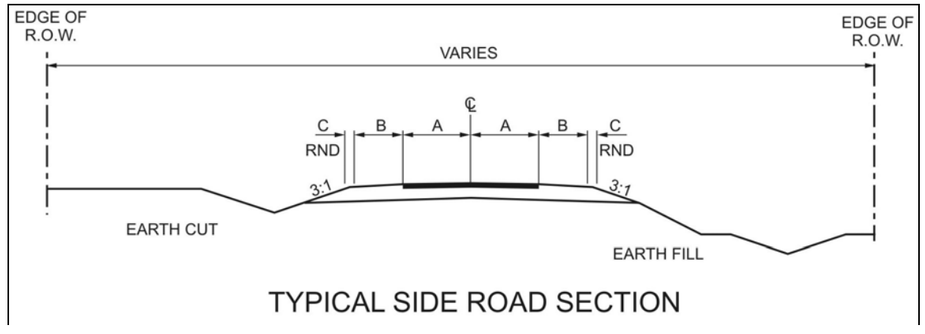
There was not a strong ecological rationale to construct dedicated large mammal crossing structures. Specifically, there are no discrete, focused crossing points used by concentrations of large animals, the overall mortality is not excessive, and the large animal populations are 'secure'.

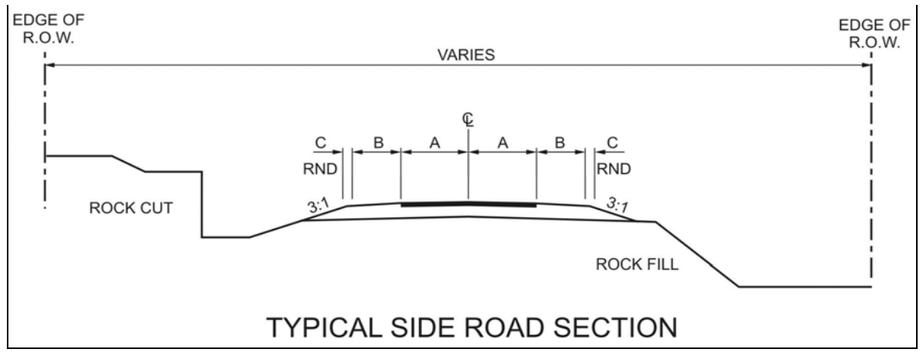
There are three larger watercourses/waterbodies and/or associated valleys that will be crossed by the new highway on structures that are large enough to accommodate wildlife underneath. These waterbody crossings are generally spaced along the length of the highway. These locations include the Magnetawan River, Straight Lake and Key River. Design provisions have been integrated into these bridge crossing locations to ensure large mammal movement can be accommodated. Where the existing shoreline was deemed inadequate, a separate wildlife crossing platform has been incorporated. Fencing requirements will be determined during Detail Design (included in Exhibit 8.1).

6.6 Other Road Infrastructure

The Recommended Plan includes various service roads, side road realignments and extensions, and local access roads to maintain access to existing land uses within the study area. The details are discussed in the following section. Typical cross-sections are shown in Exhibit 6-17.

Exhibit 6-17: Typical Side Road Cross-Sections





TYPICAL SIDE ROAD SECTION

SIDEROAD	DIMENSIONS (m)		
	A	B	C
Magnetawan River Interchange to Highway 522 Interchange connection	3.5	1.0	0.5
Bekanon Road Extension	3.5	1.0	0.5
Realigned Spirit Road	3.0	N/A	0.5
Still River Access Road	3.0	N/A	0.5
Forest Access Roads	3.0	N/A	0.5

6.6.1 Service Roads

6.6.1.1 Magnetawan RIver Interchange to Highway 522 Interchange.

A 20 km long service road will be provided from the Magnetawan River interchange northerly to the Highway 522 interchange.

The south end of this service road begins as the Magnetawan River interchange crossing road and 400m of realignment of the existing Highway 69 to intersect with this crossing road at the E/W-N ramp terminal on the west side of the proposed four-laning. The service road will then continue north for 18km using the Existing Highway 69 before tying into the Highway 522 realignment using 1.6km of new roadway which will act as a crossing road for the Highway 522 interchange and will include a new crossing of the realigned CNR track.

This service road will provide an alternate route between these interchanges with Bekanon Road Interchange accessible between them. This service road will also act as a connecting road to the Four-Laning Interchanges for the Magnetawan and Henvey Inlet First Nations, the communities of Britt, Byng Inlet and Still River as well as the residences and businesses on Key and Magnetawan Rivers.

This service road will intersect with Highway 529, Magnetawan River Road and the realigned Spirit Road in the south end. The service road will also maintain the existing intersections and the many entrances along the existing Highway 69 section including Highway 526 and Bekanon Road.

This service road will have an asphalt (high class bituminous) driving surface. The design and posted speed will be 80 km/h.

6.6.2 Side Roads

6.6.2.1 Bekanon Road

The existing Bekanon Road will be extended from existing Highway 69 on the east side and continue as an 800m crossing road under the four-laning for the Bekanon Road Interchange.

A new at-grade crossing of the CPR track is proposed 200m east of the existing Highway 69 on the Bekanon road extension. This crossing will be further considered in subsequent design to determine the need for gates and flashing signals.

The Bekanon Road extension will have an asphalt (high class bituminous) driving surface. The posted speed will be 60km/h.

6.6.3 Local Access Roads

All new local access/forest access roads will meet a 50 km/h design speed, and will have a granular driving surface.

6.6.3.1 Realigned Spirit Road

A new 400 m access road is proposed to intersect the existing Highway 69 on the west side and by crossing under the existing and the four-laning structures at the Magnetawan River. This access road will provide a connection for the residences on the existing Spirit Road to the Magnetawan First Nation community and the service road.

6.6.3.2 Forest Access Road north of Highway 522

A new 4.5km forest access road is proposed from the entrance to the Killarney waste disposal site to the north study limit. The forest access road will be parallel to the new four-laning on the west side. It will

intersect the service road on the south end and continue north to tie into a proposed forest access road north of this study (WP 5378-02-00).

This forest access road will serve lands north of Highway 522 which will lose access from the existing Highway 69 and provide local road connection between the two Henvey Inlet First Nation community nodes.

6.7 Entrances

As the four-lane highway will be fully controlled-access, all of the existing entrances on Highway 69 will be removed to accommodate the Recommended Plan. No new or existing entrances will be permitted directly onto the four-lane highway. Entrances will be reconstructed, if necessary, to connect to service roads or other local roadways. Access will be provided for by service roads and access roads that will connect to new interchanges. The existing entrances and impact are listed in Exhibit 6-19.

The chainages in the following table refer to the existing highway chainage as shown on MTO's ETR plates, which also uses geographic Township boundaries rather than the current administrative boundaries. Also, "Old Highway 69" does not refer to the existing highway but an earlier alignment.

Exhibit 6-19: Existing Highway 69 Entrances and Impacts

Location (Existing highway 69 chainage)		Description	
WALLBRIDGE TOWNSHIP			
21+300	Left	Existing Hwy 529 Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
21+320	Right	Old Hwy 69 Access	*To Be Removed*
21+900	Left	Old Hwy 69 Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
23+800	Left	Old Hwy 69 Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
24+700	Right	Antenna Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
HENVEY TOWNSHIP			
10+300	Right	Antenna Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
10+600	Left	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
10+700	Right	Tower Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
10+950	Right	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
11+370	Left/Right	Existing Hwy 526 Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
11+660	Right	Existing Hwy 526 Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
11+800	Left	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
11+850	Left	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
11+940	Right	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
12+210	Right	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
12+215	Left	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
12+300	Right	Abandoned Commercial Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
12+400	Right	Abandoned Commercial Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
12+530	Left/Right	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
14+590	Left	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
14+640	Left	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
14+690	Right	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
14+890	Right	Private Entrance	*Access maintained from existing Highway 69 which*

Location (Existing highway 69 chainage)		Description	
			acts as a service road to an interchange.
14+900	Left	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
15+160	Left	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
15+300	Left	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
15+360	Left	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
15+520	Left	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
15+690	Left	Abandoned Commercial Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
15+750	Right	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
15+790	Left	Abandoned Commercial Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
16+100	Left/Right	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
16+200	Left	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
16+830	Left	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
16+850	Left	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
16+920	Left	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
17+400	Left	Bekanon Access	*To Be Removed*
17+400	Right	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
19+980	Left	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
21+100	Right	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
21+180	Right	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
21+940	Right	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
22+250	Right	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
22+350	Left	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
22+580	Right	Private Entrance	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
23+800	Left	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*

Location (Existing highway 69 chainage)		Description	
23+900	Left	Forest Access	*Access maintained from existing Highway 69 which acts as a service road to an interchange.*
MOWAT TOWNSHIP			
10+190	Right	Private Entrance	*To Be Removed*
10+290	Right	Existing Hwy 529 Access.	*Realignment to act as an interchange crossing road*
11+990	Right	*Forest Access*	*To Be Removed*

6.8 Median Crossovers

Interchange	*Spacing from Closest Southerly*
Harris Lake Road Interchange (WP 5377-02-00 south section)	---
Magnetawan River Interchange	9.0km
Bekanon Road Interchange	11.0km
Highway 522 Interchange	7.0km
Pickerel River Road Interchange (WP 5378-02-00)	7.4km

Median crossovers will be considered between the following interchanges in accordance with Northeastern Region Engineering Directive NRE 02-204. The following sections have interchange spacing greater than 8km.

- Harris Lake Road Interchange (WP 5377-02-00 south section) to Magnetawan River Interchange
- Magnetawan River Interchange to Bekanon Road Interchange
- Median crossing requirements will be evaluated during Detail Design (included in Exhibit 8-1).

6.9 Property

The preliminary right-of-way requirements are shown on the Recommended Plan. Other than areas of extreme grading requirements, the basic right-of-way for the four-laning is 110 m. Property will also be required to construct the interchanges, and new sideroad and service road alignments. The right-of-way width for each of these roadways has been selected to accommodate the local grading requirements, and are detailed in the Design Criteria included in Part 2.

Where the new four-lane Highway 69 is located adjacent to a service road, sufficient separation has been provided to accommodate independent grading and drainage and a separate right-of-way has been defined for each roadway.

Final right-of-way limits will be confirmed during Detail Design (included in Exhibit 8-1).

6.10 Construction Staging and Traffic Management

The traffic management plan has been developed to provide access to local roads at all times during construction. Construction activities will be kept as far as possible from the travelling public.

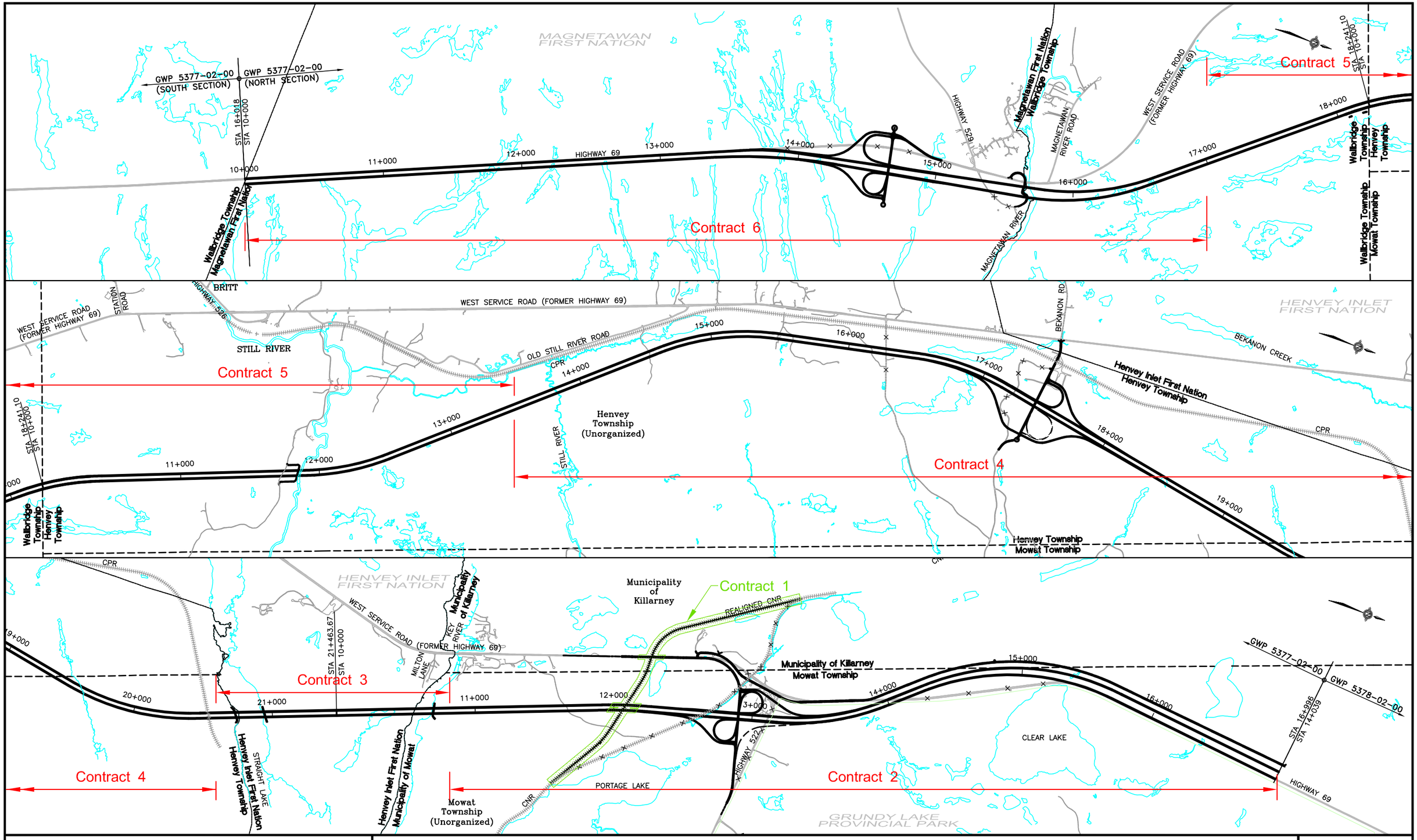
The Recommended Plan will be separated into six contracts. The contract limits have been established based on the proposed staging and anticipated construction cost of each segment. The sequence of contracts being constructed will be established during Detail Design and by MTO.

The suggested contract limits are illustrated in Part 2 of this report and described below. The stages for each contract limit are described in Exhibits 6-20 and 6-21. The sections and staging will be finalized during Detail Design.

- **CONTRACT 1**: 2.4km of CNR realignment south of Highway 522, west of new Highway 69. Includes rail overpass structures for the proposed four-laning and a service road overpass of the rail. A temporary detour is required to construct the service road CNR overpass.

- **CONTRACT 2**: From north shore of Key River to 4.2 km north of Highway 522 (Mowat 12+800-17+000), 6.2 km. Contract 1 will provide a four-lane Highway 69 from north shore of Key River to north of Highway 522 for approximately 6.0 km northerly, including an interchange at Highway 522 and all associated local roadworks. A four to two lane transition and temporary detour to the existing Highway 69 is required at the north limit of this contract. The paving of the "completed construction – not open to traffic" sections shall be deferred until Contract 5.

- **CONTRACT 3**: From south shore of Straight Lake to north shore of Key River (Henvey 20+650-21+463, Mowat 10+000-10+800), 1.6 km. Contract 3 will provide a four-lane Highway 69 from south shore of Straight Lake to north shore of Key River. This contract goes through the Henvey Inlet First Nation and includes all associated roadworks including Bekanon Road extension. The paving of the "completed construction – not open to traffic" sections shall be deferred until Contract 5.



MRC

Highway 69 Four-Laning

North of Nobel to Highway 522

G.W.P. 5377-02-00 (North Section)

Recommended Contract Limits

Exhibit

6-20

- **CONTRACT 4**: From north of Still River to south shore of Straight Lake (Henvey 13+500-20+650), 7.2 km. Contract 4 will provide a four-lane Highway 69 from north of Still River to south shore of Straight Lake, including an interchange at Bekanon Road and all associated local roadworks. The paving of the "completed construction – not open to traffic" sections shall be deferred until Contract 5.

- **CONTRACT 5**: From north of Magnetawan River to north of Still River (Magnetawan 17+000-18+241, Henvey 10+000-13+500), 4.7 km. Contract 5 will provide a four-lane Highway 69 from north of Magnetawan River to north of Still River, including all associated local roadworks. The paving of the previously "completed construction – not open to traffic" sections shall be completed.

  Also Forest Access Road from local access road to Highway 522.

- **CONTRACT 6**: From north of Harris Lake Road to north of Magnetawan River (Magnetawan 10+000-17+000), 7.0 km. Contract 6 will provide a four-lane Highway 69 from the south limit of the north section of this project to north of the Magnetawan River. This contract goes through the Magnetawan First Nation and includes an interchange at East Service Road (south of Highway 529) and all associated local roadworks.

Exhibit 6-21: Preliminary Construction Staging

CONTRACT 1, CNR realignment and structures, at Highway 522 Interchange, west of new Highway 69		
Stage (Exhibits)	**Traffic**	**Construction Activity**
Stage 1 (S01)	- All on existing	- Construct detour for service road at intersection with CNR rail realignment - Construct CNR rail realignment
Stage 2A (S02)	- All on existing except at detour on service road at CNR crossing	- Construct service road and structure – service road overpass at CNR crossing
Stage 2B (S03)	- All on existing and new service road section with CNR overpass at crossing	- Construct CNR rail realignment at detour crossing - Removal of existing tracks
Stage 3 (S04)	- All on existing and new service road section with CNR overpass at crossing - Rail traffic on realigned CNR	- Remove detour for service road at intersection with CNR rail realignment

CONTRACT 2, From north shore of Key River to 4.2 km north of Highway 522, 6.2 km		
Stage (Exhibits)	**Traffic**	**Construction Activity**
Stage 1 (S05-S06)	- All on existing	- Construct new Highway 69 SB lanes up to detour from new Highway 69 SB lanes to existing Highway 69 - Construct Forest Access Road up to local access road - Construct four to two lane transition at the north end of Contract 1 - Construct detour from new Highway 69 SB lanes to existing Highway 69
Stage 2 (S07-S08)	- All on existing up to detour to new Highway 69 SB lanes – 2-lane highway traffic	- Construct new Highway 69 NB and remaining SB lanes – except intersections at old Highway 522 - Construct Highway 522 interchange and ramps - Construct structure – interchange overpass at Highway 522 interchange and highway overpass at proposed CNR crossing - Remove existing Highway 69 north of detour from new Highway 69 SB lanes to existing Highway 69
Stage 3 (S09-S10)	- All on existing up to detour to new Highway 69 SB lanes – 2-lane highway traffic	- The paving of the "completed construction – not open to traffic" sections shall be deferred until Contract 5.

CONTRACT 3, From south shore of Straight Lake to north shore of Key River, 1.6 km		
Stage (Exhibits)	**Traffic**	**Construction Activity**
Stage 1 (S11-S12)	- All on existing	- Construct new Highway 69 NB and SB lanes - Construct structures – Bridges over Straight Lake and Key River - Construct Bekanon Road at interchange west of new Highway 69 - Provide construction access roads
Stage 2 (S13-14)	- All on existing	- Remove construction access roads - The paving of the "completed construction – not open to traffic" sections shall be deferred until Contract 5.

CONTRACT 4, From north of Still River to south shore of Straight Lake, 7.2 km		
Stage (Exhibits)	**Traffic**	**Construction Activity**
Stage 1 (S15-S16)	- All on existing	- Construct new Highway 69 NB and SB lanes - Construct Bekanon Road interchange and ramps - Construct structures – highway overpass at Bekanon Road Interchange and CPR crossing
Stage 2 (S17-S18)	- All on existing	- The paving of the "completed construction – not open to traffic" sections shall be deferred until Contract 5.

CONTRACT 5, From north of Magnetawan River to north of Still River, 4.7 km		
Stage (Exhibits)	**Traffic**	**Construction Activity**
Stage 1 (S19-S20)	- All on existing	- Construct new Highway 69 NB and SB lanes - Construct detour from new Highway 69 NB lanes to existing Highway 69 via new Highway 69 SB lanes with link to Magnetawan River Road - Construct new Highway 69 NB and SB lanes and Highway 522 interchange ramps at old Highway 522 crossing (left from Contract 2) - Construct structure – Bridge over Still River - The paving of the previously "completed construction – not open to traffic" sections shall be completed.
Stage 2 (S21-S23)	- 4-lane highway traffic on new Highway 69 lanes up to detour to existing Highway 69 via new Highway 69 SB lanes - 2-lane highway traffic on detour to existing Highway 69	- Construct remainder of Forest Access Road from local access road - Remove detour from new Highway 69 SB lanes to existing Highway 69
Stage 3 (S24)	- 4-lane highway traffic on new Highway 69 lanes up to detour to existing Highway 69 via new Highway 69 SB lanes - 2-lane highway traffic on detour to existing Highway 69	

CONTRACT 6, From north of Harris Lake Road to north of Magnetawan River, 7.0 km		
Stage (Exhibits)	**Traffic**	**Construction Activity**
Stage 1 (S25-S26)	- All on existing except on detour from new Highway 69 to old Highway 69 at north end of Contract 6	- Construct two to four lane transition at north limit of the contract - Construct new Highway 69 NB (for the entire length of the contract) and SB (from the divergence between existing and new Highway 69 to the north limit of the contract) lanes - Construct East Service Road and interchange and ramps east of existing Highway 69 - Construct four to two lane transition at south limit of the contract - Construct structure – Bridge over Magnetawan River at Spirit Road crossing and East Service Road overpass at interchange - Construct temporary intersection at Highway 529 and new Highway 69 - Construct Spirit Road realignment underpass
Stage 2 (S27-S28)	- 4-lane highway traffic on new Highway 69 NB and SB lanes until just after south contract limit where 4-lane traffic transitions to 2-lane traffic on new Highway 69 NB lanes - Temporary intersection at Highway 529 and new Highway 69	- Construct remainder of new Highway 69 SB lanes - Construct remainder of East Service Road and interchange and ramps - Remove detour from new Highway 69 NB lanes to existing Highway 69 via new Highway 69 SB lanes with link to Magnetawan River Road (from Contract 5) - Remove four to two lane transition from south contract limit (from south section contract)
Stage 3 (S29-S30)	- Highway 69 NB and SB traffic on new four-lane Highway	- Remove transitions at the north and south limits of the contract - Remove temporary intersection at Highway 529 and new Highway 69

6.11 Utilities and Rail Relocation

6.11.1 Utilities

Utility relocations will be required to accommodate the new four-lane Highway 69 and side roads. The utility impacts and proposed relocations are summarized in Exhibit 6-22. Final utility relocations will be confirmed during Detail Design.

Exhibit 6-22: Utility Relocations

Location	Utility Description	Proposed Relocation
MAGNETAWAN FIRST NATION		
10+000-15+000 (East Side, Existing ROW)	Overhead Hydro and Bell	West of proposed Highway 69.
MOWAT TOWNSHIP		
Along proposedCNR track removal at station 12+700.	Overhead Hydro	To be determined during detail design.
Along proposedCNR track removal at station 12+700.	Underground fibre optic cable	Along proposed realignment of CNR track
13+800-16+996 (West Side, Existing ROW)	Overhead Hydro and Bell	West of proposed Highway 69.

6.11.2 Rail

A 2.4km CNR rail relocation will be required to accommodate the new four-lane Highway 69 and interchange at Highway 522. The rail currently crosses under the existing Highway 69 250m south of Highway 522 and Highway 69 intersection. The CNR track is proposed to be realigned to cross the existing Highway 69 1,000 m south of the existing Highway 522 and Highway 69 intersection and cross the four-laning at station 12+100 (Mowat). Two structures will be required at the four-laning to overpass the realigned track and a third structure will be required for the service road (existing Highway 69) to overpass the rail. In addition CNR buildings, signalling and communications plant will need to be relocated to the realigned rail and access will be provided off the existing Highway 69 which will be maintained as a service road.

A new at-grade crossing is required on the CPR track crossing the new Bekanon Road and is discussed in section 6.6.2.1

Final rail relocation details will be confirmed during Detail Design.

6.12 Drainage and Hydrology

An assessment of existing drainage conditions and the preliminary drainage design for the South Section was carried out. The following is a summary of the report found in Appendix R.

The following are the drainage study objectives:

For the entire Study Area:

- Define existing drainage characteristics within the entire 68 km study area; and
- Identify deficient sizes of hydraulic structures along the existing highway.

For the North Section Area:

- Identify the required drainage improvements along the existing highway for sections that will remain in service following four-laning of the highway;
- Identify drainage requirements for the new highway along sections adjacent to the existing highway that will remain in service; and
- Identify drainage requirements for the realigned highway sections.

6.12.1 Study Area Characteristics

The drainage basins of the watercourses within the Study Area are comprised predominantly of natural areas with mixed forests, wetland areas and barren rock areas. The topography of the study reach is such that the majority of the area is covered with Precambrian Bedrock at or near to the ground surface. In addition, wetlands or small lakes cover a large percentage of the study area.

The drainage basins within the North Study Section that drain to the highway culverts range in size from 1.8 ha to 1633 ha. Larger watercourses cross the highway at the bridge locations identified in Section 4. All lands that drain to the highway culverts are comprised predominantly of natural areas with very little development.

Throughout the study limits, the roadside vegetation communities located within and immediately adjacent to the highway right-of-way (ROW) are diverse. Ponded water/marsh conditions occur at many locations, on the upstream and downstream sides of the existing highway. In other locations the vegetation along the banks of the roadside ditches is characterized by brush and long grass.

6.12.2 Policy Framework and Design Criteria

The MTO Drainage Management Manuals and Directive B-100 (1980) were used to determine the various guidelines and policies that provided a framework for the drainage assessment.

The Ministry of Transportation design flood criteria identified in Directive B-100 (1980) were applied to assess the hydraulic performance of the existing and proposed culverts.

All culverts under Highway 69 and all associated interchange ramps will be cast-in-place concrete box culverts (with an option for precast) of a minimum size of 1.2m. A 1.2 m x 1.2 m concrete box culvert was selected as the minimum highway culvert.

Most of the existing highway culverts are CSP culverts that are less than the minimum required 1.2 m size However, in many locations the existing highway does not have sufficient cover to accommodate the 1.2 m culvert. In these locations, the existing highway profile was raised to accommodate the 1.2m culvert height.

The culvert size recommendations provided in this report are based on the hydraulic performance criteria and the minimum culvert size to satisfy fisheries and wildlife requirements. The culverts located on fisheries watercourses and those required for wildlife passage are identified in Tables 4.1 in Section 3.4.1. in Appendix R.

Fisheries concrete box culvert will have substrate (river stone) and a baseflow channel and an allowance for wildlife passage. The substrate and the baseflow channel within the substrate layer will be provided for all culverts located on fisheries watercourses. The substrate gradation includes a range of river stone sizes. The average stone size (d50, 50% passing) will be provided to withstand the velocity of the culvert design flow.

6.12.3 Existing Highway Drainage

An existing conditions drainage mosaic for the study area was prepared for all watercourse crossings along the entire 68 km reach of Highway 69. This mosaic (included in Appendix R) shows the drainage boundaries for all highway culverts. A total of 199 culverts and 5 bridge crossings were identified within the study limits based on available MTO contract drawings and ETR sheets.

A typical cross section of the existing Highway 69 within the study area (consists of a southbound and a northbound lane, and paved shoulders on both sides of the highway). There are no storm sewers within the study limits. Runoff from the highway lanes and the paved shoulder is conveyed overland from the crown of the highway to the roadside ditches or to natural drainage features that exist on either side of the highway.

The overall drainage pattern within the study area occurs from east to west as the runoff crosses Highway 69 en route to Georgian Bay. There are many large watercourse crossings along this section of Highway 69 as Georgian Bay is the outlet.

6.12.4 Hydrologic Modeling

The design flows for drainage areas less than 25 km^2 were generated using both the hydrologic SWMHYMO model (Version 4.02) and the Rational Method. SWMHYMO is an event-based hydrologic model widely used to determine runoff characteristics for rural and urban watersheds. This model generates storm hydrographs using the Soil Conservation Service Curve Number Method of estimating runoff characteristics.

The Soil Conservation Service Type II Storm - Huntsville District 11 rainfall was selected as the design rainfall distribution for the SWMHMO model.

Streamflow gauge data from the Water Survey of Canada was available for a few of the larger watercourse crossings, including Harris Creek at the existing Highway 69 bridge. For areas larger than 25 km^2 where gauge data was not available, the Modified Index Flood Method was used to calculate flows. The Modified Index Flood Method accounts for the large amount of storage present within the large drainage basins.

The flows calculated using the SWMHYMO model and the Rational Method were compared and were found to be similar. The Rational Method flows were used for watercourse crossings of Highway 69 with contributing drainage areas less than 100 hectares. SWMHYMO was used to determine flows at watercourse crossings with contributing drainage areas greater than 100 hectares.

The dominant soil types in this area of Ontario are highly variable ranging from sand to organics. Frequently bedrock is encountered less than 1 m below the existing grade. There is no available Soil Survey Report for the Study Area Reach from the Ontario Centre for Soil Evaluation. The absence of soils mapping makes it difficult to determine the hydrologic modelling parameter (curve number) that is used to assess the proportion of water that is infiltrated. In general, the hydrologic soil group 'C', was found to best represent the range of soil conditions found within the study area and it was applied universally to all study drainage catchments.

6.12.5 Existing Conditions Hydrologic Assessment

The hydrologic modeling was completed to determine design flows for the 199 culverts along the 68 km stretch of Highway 69. The hydrologic analysis for existing conditions used higher than required design flows based on the current classification of the highway. Highway 69 within the study area reach is currently classified as a rural arterial and thus the 25 year and 50 year design flows should be used to assess the culvert capacity. However, the future four-lane divided Highway 69 with new interchanges will be upgraded to a freeway. Consequently, the 50 and 100 year design flows were used to assess both the existing and future conditions.

Hydraulic assessment for the existing 199 culverts was undertaken using the CulvertMaster hydraulic model. The model input included the calculated design flows and parameters representing physical culvert characteristics. The results reveal that 79 of the 199 culverts do not meet one or more of the Desirable Culvert Performance Criteria.

6.12.6 Future Conditions Hydrologic Assessment

Hydrologic assessments were completed for all culverts crossing based on the revised drainage boundaries and the change in imperviousness.

Due to the rural land use of the study area, all culvert subcatchments within the study limits were modeled using routines designed to simulate the drainage from natural or rural areas.

SWMHYMO uses the NASHYD routine to model the drainage from natural or rural areas. An increase in imperviousness due to the additional highway lanes is expressed in the NASHYD routine by increasing the curve number. The curve number parameter was updated for drainage areas to all existing culverts in the South Section to reflect future conditions.

6.12.7 Highway 69 Bridge Assessment

Hydraulic analyses were carried out for the existing and proposed structures at the four bridge locations within the South Section. These bridge locations include crossings of the Magnetawan River (B6), Still River (B7), Straight Lake (B8) and Key River (B9).

The bridge assessment section in Appendix R outlines the required performance standards and documents the findings from the hydraulic model that were used to evaluate the hydraulic performance of the existing and proposed bridges.

The following criteria were used to assess the hydraulic performance of the structures:

- the design storm used to calculate flood elevations;
- the freeboard between the design flood elevation and the top of road; and
- the soffit clearance between the design flood elevation and the soffit of the bridge or culvert.

On the basis of the analysis, all the existing and proposed structures meet all criteria for the 100 year design storm.

6.13 Geotechnical and Foundations

6.13.1 Alternative Route Assessment

Golder Associates Ltd. completed a preliminary geotechnical and foundation assessment as input to the evaluation of corridor and route alternatives. This input is included in the detailed summary of this process in Sections 4.0 and 5.0 and in the Technical Reports in Appendices S and T.

6.13.2 Preliminary Foundation Investigation and Design for Swamp Crossings

Preliminary foundation investigations were completed for identified swamps along the Preferred Route in 2005 (Trow Associates) and 2006 (AMEC). The Preliminary Foundation Investigation and Design Reports are included in Appendix T.

6.13.3 Preliminary Foundation Investigations and Design for Structures

The preliminary foundation design recommendations are presented in Section 6.5.1.

Preliminary foundation investigations were completed for identified structures along the Preferred Route in 2005 (Trow Associates) and 2006 (AMEC). The Preliminary Foundation Investigation and Design Reports are included in Appendix T.

6.13.4 Preliminary Pavement Design

A Pavement Selection Report and Pavement Design Services were not part of this assignment and will be undertaken in Detail Design. However for preliminary pavement design purposes a pavement design is submitted as part of the Alternative Route Geotechnical Assessment Report in Appendix S. This pavement design is comparable with pavement structure designs used on Contract 2005-5146 (Highway 69) to the south of this project.

6.13.5 Future Geotechnical and Foundation Work

A full geotechnical investigation and pavement design will be required during Detail Design. The suggested Detail Design foundation investigation requirements are summarized as part of the preliminary foundation investigations in Appendix T.

6.14 Roadside Safety

6.14.1 Clear Zone

The clear zone is the distance from the edge of the travelled roadway to an unprotected hazard. This concept is based accident studies recording the angle at which a vehicle will leave the roadway, the distance along the roadway travelled and the offset from the roadway when the vehicle has stopped. The MTO guidelines are based on a length which will allow 80% of vehicles in an accident to come to complete stop unobstructed. The clear zone width for this section of Highway 69, which has a design speed of 120 km/h, is 10.0 m on tangent sections. A curve factor of 1.0 is applied for a curve radius of 1000 m and higher.

Roadside safety design for Highway 69, the interchange ramps, and the side roads will be fully reviewed during Detail Design.

6.14.2 Rock Cuts

Rock cuts will be cleared to achieve the appropriate clear zone offset. In Northeastern Region, the clear zone width is modified according to Northeastern Region Engineering Directive NRE 98-203. Northeastern Region Engineering Directive NRE 2000-204 provides additional grading requirements for rock cuts greater than 10m. The rock cut design for Highway 69, the interchange ramps, and the side roads will be determined during Detail Design.

6.14.3 Guiderail

Guiderail will be designed in accordance with current ministry standards. Excess earth material will be used where practical to provide minimum 4:1 slopes to reduce guiderail requirements. Full guiderail requirements will be determined during Detail Design.

6.15 Road Closings and Transfers

6.15.1 Road Closings

Under the *Public Transportation and Highway Improvement Act*, Ontario Municipal Board (OMB) approval is required to close all public roads under local jurisdiction where they intersect the right-of-way of a controlled access highway. It is prudent to also use this process to close access roads or trails on Crown land which the public may perceive as publicly accessible. Closure of Provincial highways or other roads under MTO jurisdiction do not need OMB approval.

It should be noted that even if an existing roadway is to be realigned to cross the controlled access highway at a structure, the original road allowance must still be legally closed using the OMB approval process.

Exhibit 6-23 summarizes the proposed non-provincial road closures within the project limits. This information will require further review and confirmation in Detail Design.

Exhibit 6-23: Summary of Road Closings

Station (Township)	***Roadway***
10+000 (Magnetawan First Nation)	Unopened Road Allowance
15+300 LT and RT (Magnetawan First Nation)	Spirit Road
13+320 LT and RT (Mowat Township)	Unopened Road Allowance
15+500 LT and RT (Mowat Township)	Unopened Road Allowance

6.15.2 Road Transfers

No roads are currently planned to be transferred to the municipalities or First Nations.

6.16 Surveying and Plan Preparation

6.16.1 Base Information

Photogrammetric base plans and digital terrain models (DTM) from aerial photography were provided for this project. Additional information including existing alignment data, property data, swamp locations, Eastern Massasauga Rattlesnake (EMR) Habitat, etc. were subsequently added to the base plans. This additional information was gathered from aerial photography, field reconnaissance, ETR plates for existing Highways 69 and 529, consultation with agencies, First Nations and the public, and property assessment plans. This additional information is provided for information only and will be verified in Detail Design.

6.16.2 Plans and Profiles for the Recommended Plan

The following plans have been prepared based on the MTO AutoCAD Standards Version 2.1 These plans are on file with the Geomatics Section.

- Highway 69 B Plan;
- Highway 69 C Plan; and
- B and C Plans for interchanges and side roads.

6.16.3 Horizontal and Vertical Control

Horizontal and vertical control for the Recommended Plan will be established in Detail Design.

6.16.4 Alignment

All alignments for the Recommended Plan were calculated in NAD 83 MTM Zone 10. Minor adjustments may be required to the Recommended Plan alignments in Detail Design when control and topographical surveys have been completed to MTO requirements.

6.16.5 Detail

Survey detail (edges of pavement, shoulders, C/L of lanes etc.) was not surveyed for this project and will be completed during Detail Design.

6.17 Miscellaneous

6.17.1 Illumination

The recommended locations for partial illumination are located on all the critical decision points on the interchanges as well as at all the four to two lane transitions.

Final illumination requirements will be determined in Detail Design.

6.17.2 Traffic Signals

Permanent traffic gates and signals may be required at the new at-grade crossing of the CPR track discussed in section 6.6.2.1

Other permanent traffic signals are not required for the Recommended Plan.

6.17.3 Signing and Pavement Markings

Permanent and temporary signing and pavement markings will be required to freeway standards in accordance with the Ontario Traffic Manual. Additional signing and pavement markings are required at the four-to-two lane transition locations.

6.17.4 Intelligent Transportation Systems (ITS)

The following section is an overview of recommended ITS undertakings for this section of Highway 69 F-four-laning.

6.17.4.1 Changeable Message Signs (CMS)

There is an existing CMS, installed under Contract 2004-5104 1 km north of Key River, and known commonly as site 3, that will be impacted by the realignment of Highway 69. it is recommended that the impacted sign be moved as to be viewed on the new four-laning alignment. There are no additional signs identified in the strategy document Contract 2004-5104 to be installed on Highway 69/400 between Parry Sound and Sudbury.

The construction of the four-lane works will introduce a new secondary road system that could be utilized as an alternate route in the event of a blockage of the controlled access highway. In these circumstances the diversion would be undertaken by responding police officers. The police could close the main line road to traffic, and potentially divert traffic onto what are presently signed secondary highway routes as one of their response actions. The relatively minor throughput expectations of the alternate route using the secondary highway, with its lack of unified signing, does not at this time warrant any additional permanent CMS at potential diversion points, to advise motorist to take this alternate route.

6.17.4.2 Fog Monitoring

The new works do not appear to move the alignment to any locations more susceptible to fog than the existing road is. Accordingly, is recommended that no dedicated fog monitoring systems are warranted.

6.17.4.3 Data Counting Stations

The four-lane effort does not impact any permanent data counting station plant. Consulting with the relevant MTO department, it has been determined that a new site is planned to be deployed on this road in the vicinity of the Highway 522 intersection. This planned new location is outside of this project's limits.

6.17.4.4 Weather Sensing

The four-lane effort does not impact any RWIS weather sensing station plant. In consultation with the relevant MTO department, there are currently no plans under way to install any additional RWIS monitoring sites within the project limits. An existing field site exists north of these projects limits, in the vicinity of the radar and antenna node south of the existing Highway 69 and Highway 526 intersection.

6.17.4.5 Accident Locating

There is already existing moderately complete cellular telephone coverage from more than one network carrier. There is also a sufficient volume of traffic in most time periods that a broken down vehicle or accident location can summon aid.

The geographically isolated nature of the corridor might suggests that more frequent than standard 'mile marker' signage be deployed, in order that people can accurately report where they are when they call for assistance. This handicap is likely to be overcome soon with Global Positioning System reporting functionality presently being mandated in the ongoing roll out of new cellular telephone handsets. It is currently projected that this technology will have proliferated before this road upgrade project is commissioned.

6.17.4.6 Snow Plow Tracking

There is anecdotal information on government web sites that lands to the east of Lake Huron and Georgian Bay receive the highest snow fall amounts in the province. Research efforts to date on Environment Canada's 30 year climate normals reports do not place any weather sensing site used to generate climate normals within the proximity of this sparsely populated are of the province. The nearest weather stations, at the Britt CGS, and at the Parry Sound airport, at this time do not have 30 year normals data publicly available.

Accordingly, to date it is not possible to statistically confirm if there are materially more severe winter snow and icing conditions local to this project, than the average conditions found in Ontario's north.

There are long sections of this corridor between amenities and shelter and restaurant locations. There may be merit in providing the traveling public with real time location of snow plows in order that they may determine if the road is currently being, or has been plowed prior to planning to embark or re-embarking on a journey during or after a winter storm. Existing road report information available over the telephone may be judged to be satisfactory in this regard.

The MTO is currently advancing the tracking of snow plows, as a part of a wider effort to move towards tracking all of its maintenance fleet by Automatic Vehicle Location means. Over the winter of 2005/2006 the MTO ran a pilot program to track snow plow locations and provide this information on a web interface in the Ottawa area. The outcome of this pilot projects efforts were not available at the time this report was compiled. Such a system may be in place over the limits of this project by the time the four-lane efforts are completed.

6.17.4.7 Wildlife Tracking

The incidence of vehicular/wildlife collisions has been identified as non-linear over the length of the study area. Certain areas statistically indicate areas where past collisions are concentrated.

There have been initiatives to electronically identify wildlife within a corridor, mostly in the mountain regions of the US. Some projects use motion sensing to activate warning signs to alert drivers to slow down. The sensing is by way of automated motion detection, usually with cameras identifying rapid lateral movement across a Closed-Circuit Television camera image. This only works in a scene where the vehicular traffic approaches the scene in a relatively slow change to the pixels mode. This method is not effective for animals grazing and then bolting into traffics path when the vehicle approaches. They are also not effective at night, or in lighting situations where there is poor contrast between the wildlife and the background.

Other projects have been undertaken in National Parks, where key wildlife are equipped with radar emitter collars. In vehicles an in-ear radar detector is used to sense when the so equipped wildlife are in close proximity to the road.

A third approach has been trialed by International Road Dynamics Inc, a Canadian manufacturer to attempt to reduce the frequency of deer collisions. With their system, infrared detectors sense vehicles approaching areas that have been identified as having high wildlife populations or migration corridors across a highway. The system then sends out a RF signal to trigger ultrasonic emitters located along the road down stream from the sensor site. To date this type of system does not appear to have been widely deployed. The initial trial in Saskatchewan could not statistically identify that wildlife collisions were reduced, but anecdotally the local residents believed that it was effective. The lack of valid statistical support is principally due to incomplete data sets on the history of animal/vehicles collisions with wildlife prior to the system going into service. There was also a lack of maintenance funds to ensure that the system was kept in good working order throughout the study period.

There appears to be no magic bullet for wildlife sensing and warning systems.

There are systems that have been used in Ontario that reflect the headlights of approaching vehicles. We do not consider these systems to be ITS related, and have not included them in this report.

6.17.4.8 Construction

During the construction of this four-lane project there are circumstances of where Intelligent Transportation System (ITS) initiates can offer benefits.

There are merge warning systems that can selectively activate merge warning signs further back from the merge point where two lane road sections must merge back to a single lane. These systems sense the queue length as it grows, to try to better maintain free flowing traffic. They de-activate the advance merge signs when the queue length decreases, so as to increase the reliability of the information presented on the message boards.

There is the possibility of deploying portable CMS to advise motorists of work zone activity. These when regularly updated can reduce frustration when motorists are faced with queuing to enter work zones, or periodic closures to facilitate blasting. They can also be used to reinforce when speed restrictions are in effect in work zones.

Interim variable signage, such as merge warning signs or portable CMS could potentially have to comply with the *French Language Services Act* requirements of the areas where they are deployed. This could require second sign displays be used, depending on the approach speed to the message and the message content.

In areas where there may be trucks carrying rock crossing the existing highway, there may be circumstances where traffic portable traffic signals are placed. This is more a traffic issues. An ITS application could be the ability to implement wireless co-ordination between the signals when such temporary signals are located close enough to one another to benefit from co-coordinated operation

ITS measures could also be deployed to aid in screening for over height or over weight vehicles during any restricted or sub-standard corridor constraints that may be in effect during certain stages of construction. These situations may apply where false work supports for new over passes must span over live lanes to construct the new restricted access provisions.

6.18 Permanent Traffic Counter Loops

Permanent Traffic Counter Loops will be required at the following locations on Highway 69:

- South of Magnetawan Interchange;
- Between Magnetawan Interchange and Bekanon Road Interchange;
- Between Bekanon Road Interchange and Highway 522 Interchange; and
- North of Highway 522 Interchange

6.19 Value Engineering

Near the finish of the North Section study process, it was determined to be appropriate that a Value Engineering (VE) review should be carried out on the Recommended Plan.

The objective of the Value Engineering phase for the north section of this project was to carry out a structured review to provide assurance that the design concept being pursued was well investigated and that the project decisions being carried forward to detailed design were sound and reasonable. By applying recognized VE methodologies to review the preliminary design, it was anticipated that value-enhancing opportunities could be identified for consideration by the Ministry and Project Team.

The review was conducted as a five day workshop, by a specialist team whose members were completely independent of the preliminary design/planning team for this section of Highway 69. The workshop focussed on reviewing the major conceptual design components, major items, constructability, staging, detours, traffic management, etc.

A Highway Safety and Value Review was also carried out for this study and provided additional value in the corridor features. Elements of geometric roadway design which have a bearing on operational performance were examined to determine where there was additional value in relation to construction cost, constructability and impacts to the socio-economic and natural environments.

The workshop followed an internationally accepted 6-step job plan:

- Information Phase;
- Analysis Phase;
- Creativity Phase;
- Judgement Phase;
- Development Phase; and
- Presentation Phase.

Following the workshop, a presentation was made to MTO Senior Staff by the VE Leader and VE Assistant Leader. The presentation included a summary of 4 scenarios that were recommended as a result of the workshop. These scenarios were: VE Scenario 1: Minor Modifications; VE Scenario 2: Major Modifications; VE Scenario 3: “Workin on the Railroad”

Following submission of the Draft VE Report, the recommended scenarios were presented to the Ministry’s Regional Director. Scenario 3 was selected for inclusion to the project due to the improvement in constructability and highway safety improvements while saving approximately $31 million. The recommendations that were presented and adopted include the following:

Alternative ICC-8: Spirit Road Interchange: Remove parallel lane and provide a direct taper off the bridge for the west-to-north loop

The parallel lane can be taken off the bridge and replaced with a direct taper starting at the end of the bridge. Removing the parallel lane from the bridge reduces the structure width thereby decreasing cost and improving constructability. This alternative reduces the cost of the interchange from $3.6 million to $2.9 million.

Alternative ICC-18B: Bekanon Interchange, use diamond ramps on the east side (northbound lanes)

This alternative trades off the operational features inherent in a diamond interchange verses a Parclo B interchange. The operational efficiency of the Parclo B ramp termini intersection capacity must be weighed against the additional cost and safety concerns with wrong-way movemenyts or adjacent ramps. The level of service of the diamond ramp intersection is sufficient given forecast volumes. This alternative reduces the cost of the interchange from $3,648,000 to $2,772,000.

Alternative ICC-24: Provide a parallel deceleration lane for the westbound lanes of Highway 522 approaching the southbound loop ramp to Highway 69.

Anticipated operating speeds on Highway 522 approaching the interchange are a concern because Highway 69 passes over the crossing road. The inner loop on-ramp is hidden by the structures from the driver and the proposed 75m loop ramp is tighter then desired. Providing a westbound deceleration lane in advance of the loop ramp will provide drivers the opportunity to slow down without impeding other through traffic. It also provides a cue that a speed reduction is needed.

Alternative MA-13: Eliminate Spirit Road by providing access under the Magnetawan River Bridge.

Elimination of the realigned Spirit Road on the east side of Highway 69 and replacing it with an access road on the south side of Magnetawan River under the proposed and existing structures provides a more direct link between the residents on the east side of Highway 69 and the community on the west side. Furthermore, this proposed design may provide a less visible, and therefore more desirable, access to the Magnetawan First Nation's spiritual area. This alternative reduces the cost of the sideroad from $665,600 to $445,000.

Alternative SMR-1: Realign CNR railway tracks from Portage Lake to west of existing highway

The previous preliminary design carries a high level of risk associated with disturbance to the existing CNR tracks during construction. The soil conditions are such that a very long (and expensive) structure must be designed to minimize disturbance to the underlying soft clays/silts. Given the significant advantages with realigning the CNR tracks to the south, major cost savings were realized while minimizing risk both long term as well as during construction. This alternative reduces the cost of the interchange from $23 million to $9,302,500.

Alternative RNA-2: Relocate Highway 522 interchange south and utilize existing Highway 69 alignment to north (combines with SMR-1)

This alternative has significant advantages from an overall safety and operation standpoint. The proposed alignments for Hwy 69 and Hwy 522 not only eliminate the skewed crossing structure but also provide an opportunity for increasing the radii on the inner loop ramps. Staging is also improved as the majority of the new interchange can be constructed offline. The continuity of Hwy 522 to the Service Road is also be an added benefit. This alternative reduces the cost of the interchange from $10,342,500 to $9,075,000.

Alternative SW-2: Magnetawan River Bridge, shift northbound lanes over a rock island

Shifting the northbound structure east approximately 35m to the Rock island location provides the opportunity to found the pier on the Rock Island as opposed to founding it in the middle of the river. The second pier will be required on the north shore. This improves the contractibility of the structure. Span lengths of the northbound structure provide an opportunity to use concrete girders for both structures.

Alternative SW-8/12: Still River, shift alignment of new Highway 69 50m east to shorten structure spans.

A small 50m shift to the horizontal alignment results in a 10m reduction in the span of the SB structure based on the terrain. Small shift in horizontal alignment has no discernable impacts to the environment and business and produces a cost savings of $500,000.

Alternative PRR-4: Provide traversable ditch line cross-section; modify to a 4:1 back slope in lieu of 2:1 and 3:1

This alternative provides a foreslope/backslope combination that provides a traversable cross section for errant vehicles. This alternative will only be applied in locations of low cuts in earthen sections. This alternative also reduces collision severity and cost.

Alternative PRR-5/6: Apply 4:1 foreslopes at interchanges

It was determined that a reduction in collision severity and cost can be realized through the introduction of flattened interchange ramp foreslopes. Flattening of only the interchange on-ramp foreslopes is proposed. The rationale behind this alternative appears to be that vehicles entering the on-ramp from the minor roadways will be traveling at reduced operating speeds.

Alternative PRR-8: Reduce shoulder rounding to 1m

A review of Provincial and nationally accepted design standards suggests at 1.0 m rounding is typically used on high-speed facilities with design speeds greater than 100 km/h. This is also consistent with other sections of Highway 69 under design and matches the Highway 69 corridor design criteria. This

alternative reduces the cost of the interchange from $536,314 to $285,580 by reducing grading and granular material.

Alternative PRR-9: Use a consistent 1.5m inside shoulder

Maintain inside (median) shoulder at consistent 1.5 m width throughout. This is consistent with sections of Hwy 69 under design to the north and south and matches the corridor Design Criteria as well as exceeding provincial design standards. Uniform alignment enhances highway safety by providing the driver with certain levels of expectation, therefore reducing driver concern for and reaction to those objects. This alternative provides a cost savings of approximately $300,000.

Other scenarios that were rejected are not included in this above list. Key excerpts of the Draft Value Engineering Report are included in Appendix W and a full version of the report is available through the Northeastern Region Planning and Environmental Section.

6.20 Preliminary Cost Estimate

The estimated cost of the Highway 69 four-laning within the study area is approximately $270 Million. This cost relates to the North Section only.

The preliminary cost estimate is based on major grading item quantities, which were determined from preliminary design plans, profiles and cross-sections. The unit costs were estimated on the basis of recent similar projects for the Ministry of Transportation entering the construction phase. The cost of the other minor grading items including culverts and illumination were calculated as 60% of the major grading item costs and 10% for staging. The costs of the structures are also included in Exhibit 6-26.

3% of all items was also added for utility relocations, 12% for contingency and 15% for Engineering and Contract Administration.

The cost estimates for each of the suggested contract limits are summarized in Exhibit 6-26. The contracts are listed from south to north, with contract 1 in the north anticipated to be the first constructed with subsequent construction continuing south.

The contract limits an quantities will be further reviewed in Detail Design in conjunction with detailed survey and geotechnical information.

Exhibit 6-24 Preliminary Construction Quantities Estimate (m^3)

ITEM	UNIT	CONTRACT 6 (7 km)	CONTRACT 5 (4.7 km)	CONTRACT 4 (7.2 km)	CONTRACT 3 (1.6 km)	CONTRACT 2 (6.2 km)	CONTRACT 1 (2.4 km, CNR realignment and structures)	TOTAL
Asphalt	T	45,148	32,535	54,998	8,201	49,219	1,274	*191,374*
Granular A	T	86,837	60,406	103,595	15,226	95,073	4,082	*365,219*
Granular B	T	133,369	93,249	157,434	23,504	146,557	7,452	*561,565*
Earth Excavation	m^3	42,000	28,500	43,200	9,600	36,900	-	*160,200*
Rock Excavation	m^3	272,369	412,430	479,095	170,631	575,331	56,408	*1,966,263*
x Bulking Factor (1.35)	m^3	367,699	556,781	646,778	230,352	776,696	76,151	*2,654,456*
Rock Face	m^2	22,863	32,068	37,985	13,108	44,526	4,102	*154,652*
Rock Fill	m^3	414,903	207,368	580,258	180,635	627,917	40,936	*2,052,018*
Swamp Excavation	m^3	117,425	-	-	31,835	125,590	-	*274,850*
Rock Embankment	m^3	491,229	207,368	580,258	201,328	709,551	40,936	*2,230,670*
Rock Supply	m^3	142,060	41,243	87,039	30,199	106,433	6,140	*413,114*
Balance	m^3	(123,531)	349,413	66,519	29,024	67,146	35,215	423,785

Exhibit 6-25: Unit Costs

ITEM	Cost/Ton	*UNIT*
ASPHALT	$ 110.00	*/Ton*
GRANULAR A	$ 15.00	*/Ton*
GRANULAR B TYPE 2	$ 13.00	*/Ton*
BULKING FACTOR	1.35	
ROCK EXCAVATION	$ 12.00	*/m^3*
EARTH EXCAVATION	$ 10.00	*/m^3*
ROCK EMBANKMENT	$ 7.00	*/m^3*
SWAMP EXCAVATION	$ 12.00	*/m^3*
ROCK FACE	$ 40.00	*/m^2*

Exhibit 6-26: Preliminary Construction Cost Estimate

ITEM	CONTRACT 6	CONTRACT 5	CONTRACT 4	CONTRACT 3	CONTRACT 2	CONTRACT 1	*TOTALS*
						CNR REALIGNMENT	
Asphalt	$4,966,000	$3,579,000	$6,050,000	$902,000	$5,414,000	$140,000	*$21,051,000*
Granular A	$1,303,000	$906,000	$1,554,000	$228,000	$1,426,000	$61,000	*$5,478,000*
Granular B	$1,734,000	$1,212,000	$2,047,000	$306,000	$1,905,000	$97,000	*$7,301,000*
Rock Excavation	$3,268,000	$4,949,000	$5,749,000	$2,048,000	$6,904,000	$677,000	*$23,595,000*
Earth Excavation	$420,000	$285,000	$432,000	$96,000	$369,000	$0	*$1,602,000*
Rock Embankment	$3,439,000	$1,452,000	$4,062,000	$1,409,000	$4,967,000	$287,000	*$15,616,000*
Rock Supply	$1,705,000	$495,000	$1,044,000	$362,000	$1,277,000	$74,000	*$4,957,000*
Rock Face	$915,000	$1,283,000	$1,519,000	$524,000	$1,781,000	$164,000	*$6,186,000*
Swamp Excavation	$1,409,000	$-	$-	$382,000	$1,507,000	$-	*$3,298,000*
SUBTOTAL 1	$19,159,000	$14,161,000	$22,457,000	$6,257,000	$25,550,000	$1,500,000	*$89,084,000*
Staging (10% of Subtotal 1)	$1,915,900	$1,416,100	$2,245,700	$625,700	$2,555,000	$150,000	*$8,908,400*
Minor Items (60% of Subtotal 1)	$11,495,400	$8,496,600	$13,474,200	$3,754,200	$15,330,000	$900,000	*$53,450,400*
SUBTOTAL 2	$32,570,300	$24,073,700	$38,176,900	$10,636,900	$43,435,000	$2,550,000	*$151,442,800*
Structures							
- Magnetawan Interchange Underpass	$2,568,000						*$2,568,000*
- NB & SB Magnetawan River Crossing	$5,339,000						*$5,339,000*
- NB & SB Still River Crossing		$4,918,000					*$4,918,000*
- NB & SB Bekanon Overpass			$1,505,000				*$1,505,000*
- NB & SB CPR Overpass			$2,119,000				*$2,119,000*
- NB & SB Straight Lake Crossing				$15,053,000			*$15,053,000*
- NB & SB Key River Crossing				$14,438,000			*$14,438,000*
- Highway 522 Underpass					$1,789,000		*$1,789,000*
- NB & SB CNR Overpass						$3,338,000	*$3,338,000*
- Highway 522 CNR Overpass						$1,397,000	*$1,397,000*
CNR Rail Realignment						$9,233,000	
SUBTOTAL 3	$40,477,300	$28,991,700	$41,800,900	$40,127,900	$45,224,000	$16,517,950	*$213,139,750*
Utility Relocations (3% of Subtotal 3)	$1,214,319	$869,751	$1,254,027	$1,203,837	$1,356,720	$495,538	*$6,394,192*
Construction Contingency (12% of Subtotal 3)	$4,857,276	$3,479,004	$5,016,108	$4,815,348	$5,426,880	$1,982,154	*$25,576,770*
Engineering & C.A. (15% of Subtotal 3)	$6,071,595	$4,348,755	$6,270,135	$6,019,185	$6,783,600	$2,477,692	*$31,970,962*
PRELIMINARY CONSTRUCTION COST ESTIMATE:	***$52,600,000***	***$37,700,000***	***$54,300,000***	***$52,200,000***	***$58,800,000***	***$21,500,000***	***$277,100,000***