The Application of Roundabouts to Improve the Safety Performance on Alberta Rural Highways

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ABSTRACT

The application of roundabouts has been reported to show an improved safety performance of intersections in various countries around the world. What is relatively unknown is whether or not roundabouts will provide a similar benefit considering a rural Alberta context.

This paper attempts to address the suitability of installing roundabouts in a rural location with respect to improving the overall safety performance.

The road authority for Alberta's provincial highway system, Alberta Infrastructure and Transportation (AIT), has identified locations where safety performance issues exist that require addressing. As part of the drive to enhance safety throughout the highway system, EBA Engineering Consultants Ltd. (EBA) has identified improvement options on a site-specific basis to address safety performance issues. One of the improvement options identified at certain intersections has been the possibility of installing a roundabout as opposed to maintaining more traditional intersection types. These intersections tend to be similar in terms of their safety performance but generally differ in the existing traffic control.

It is anticipated that as the benefits of roundabouts in terms of an improved safety performance are more fully recognized, the popularity of roundabouts in a rural location will increase. The first rural roundabout in Alberta is to be built at the intersection of two provincial highways, Highway 8 and Highway 22, west of the City of Calgary. The first stage of construction has been scheduled to commence in 2007.

This paper considers whether or not roundabouts are a suitable improvement option as well as identifying and discussing some of the design and operational considerations given an Alberta context. These considerations include:

- The appropriate design vehicle.
- The type of collisions mitigated.
- The traffic volumes accommodated.
- Approach and circumnavigating speeds.
- Public education.
- Divided/undivided highways.

INTRODUCTION

The road authority for Alberta's provincial highway system, Alberta Infrastructure and Transportation (AIT) has identified locations where safety performance issues exist that require addressing. As part of our ongoing work with the province, EBA Engineering Consultants Ltd. (EBA) undertakes safety assessments or In-Service Road Safety Reviews to identify improvement options on a site-specific basis to address safety performance issues. One of the improvement options reviewed for certain intersections is the installation of roundabouts. Roundabouts and conventional intersections tend to be similar in terms of their safety performance but generally differ in the existing traffic control.

This paper examines one site in Alberta where a safety assessment was conducted to address a high number of collisions. The safety assessment was conducted in January 2006 at the intersection of Highway 13 and Highway 21. From the analysis of the safety performance and other available data, one improvement option identified for review was the installation of a roundabout. This paper then considers whether or not roundabouts are a suitable improvement option as well as identifying and discussing some of the design and operational considerations given an Alberta context.

PRELIMINARY ROAD ENGINEERING ASSESSMENTS – ALBERTA

Alberta's provincial highway system road authority, AIT, has conducted preliminary road engineering assessments to address geometric, safety or roadway appurtenance needs within the province.

Assessments to address safety needs are referred by AIT as safety assessments. These assessments are similar to the Transportation Association of Canada (TAC) In-Service Road Safety Review.

Conducting safety assessments at highway locations (intersections, interchanges, curves, bridges and highway sections) with poor safety or performance records and implementing the recommended improvements through regular programming serves to continue to improve Alberta's safety record. Assessments are based on readily available road, traffic, collision and other data, established standards and guidelines and practical experience. The safety assessments include a comprehensive analysis of reported collisions that have occurred at a particular location in conjunction with an engineering assessment of the roadway and traffic conditions. The assessments provide recommendations for improvements to enhance the safety performance of these locations. These recommendations may include low cost improvements such as improved signing and pavement markings, or major capital improvements to upgrade intersection treatments or sections of highway.

Preliminary Road Engineering Assessments are also an important part of the successful planning and delivery of highway construction projects on the provincial highway network. Through an appropriate amount of engineering assessment, needs are identified and prioritized for improvement such that detailed engineering can be undertaken with a better understanding of the scope. This also allows funding requirements to be programmed in advance of the detailed engineering phase.

AIT has identified locations where safety performance issues exist. As part of our ongoing work with the province, EBA Engineering Consultants Ltd. (EBA) undertakes safety assessments or In-Service Road Safety Reviews to identify improvement options on a site-specific basis to address safety performance issues. One of the improvement options reviewed for certain intersections is the installation of roundabouts.

BENEFITS OF ROUNDABOUTS

According to the Federal Highway Administration's (FHWA) R*oundabouts: An Informational Guide*, some of the most important benefits of a roundabout compared to a traffic signal will accrue during the off-peak periods (1). The following information is noted from the FHWA guide:

- The installation of a roundabout instead of signalization of an intersection is considered to provide better operational performance in terms of stops, delay, fuel consumption, and pollution emissions.
- Intersections with a large proportion of left turning vehicles are good roundabout candidates.
- The benefit of roundabout installation is the improvement in overall safety performance compared to other intersection forms. Although there is an improvement in the overall safety performance, the frequency of collisions at an isolated location may not necessarily decrease.
- There are fewer conflict points at a roundabout than at a conventional intersection. A conventional four-leg intersection has 32 conflicts points, four times as many as roundabouts, which have only eight.
- Due to the geometry of a roundabout, collision types that tend to result in a high severity including angle (right angle and left turn across path) and head-on collisions are significantly reduced if not eliminated. The most severe crashes at signalized intersections occur when there is a violation of a traffic control device designed to separate conflicts by time (e.g. a right angle collision due to running a red light).
- The ability of single-lane roundabouts to reduce conflicts through physical, geometric features has been demonstrated to be more effective than the reliance on driver obedience of traffic control devices.
- The installation of a roundabout does not specifically address rear-end collisions and there is likelihood that run-off-road or sideswipe collisions may increase.

- One of the reasons attributed to an overall improvement in safety performance at roundabouts when compared to conventional intersections is due to the reduction in vehicle operating speed on all approaches providing drivers with more time to react to potential conflicts. This reduction in operating speed decreases the speed disparity between intersecting roads, which produces a reduction in collision severity.
- The guide also states that the central island of a roundabout presents a hazard that may result in an over-representation of single-vehicle crashes that tend to occur during periods of low traffic volumes.

The FHWA also states that the three safety design features of a roundabout are (2):

- Yield control of entering traffic;
- Channelized approaches that deflect traffic into the proper one-way, counter-clockwise flow; and
- Geometric curvature of the circular road and angles of entry to slow the speed of vehicles.

The first rural roundabout in Alberta is to be built at the intersection of two provincial highways, Highway 8 and Highway 22, west of the City of Calgary. The first stage of construction has been scheduled to commence in 2007.

A roundabout at the intersection of Highway 11A and Highway 20 is also planned to be constructed. This intersection is located on the outskirts of the Town of Sylvan Lake, a popular tourist destination. Construction of this roundabout is scheduled to commence in 2007 or 2008.

As the construction of these roundabouts in Alberta commence, the opportunity to install additional roundabouts within the province may become more popular. One such location may be at the intersection of Highway 13 and Highway 21.

SAFETY ASSESSMENT AT INTERSECTION OF HIGHWAY 13 AND HIGHWAY 21

As part of the Preliminary Road Engineering Assessments, EBA was assigned to undertake a safety assessment at the intersection of Highway 13 and Highway 21 in 2006. The purpose of the assessment was to examine the safety performance and operation of this intersection and provide recommendations for identified improvements. The study was prompted by AIT due to the number of reported collisions at the intersection.

Background Information

Highway 13 is a major two-lane, undivided highway. It is an east-west roadway located south of Edmonton. Highway 13 provides access to local communities, provincial parks and tourist attractions within the Central Region of the province as well as providing access to the City of Camrose (population of 15,850; 2006) and the City of Wetaskiwin (population of 11,154; 2001) (3).

Highway 21 is a major two-lane, undivided highway. It is a north-south roadway located on the east sides of Calgary, Red Deer and Edmonton. Highway 21 provides access to local communities, provincial parks and recreation areas throughout the province.

The intersection of Highway 13 and Highway 21 is located approximately 8 km west of Camrose and approximately 85 km southeast of Edmonton.

Highway 13 between Wetaskiwin and Camrose is identified as a long combination vehicle route.

The intersection treatment includes:

East Leg – WB channelized right turn lane and approach taper, WB through lane, WB through and left turn lane, painted median, 2 EB through lanes.

West Leg – EB channelized right turn lane, EB through lane and approach taper, EB through and left turn lane, painted median, 2 WB through lanes and return taper.

North Leg – SB channelized right turn lane, SB through lane and approach taper, SB through and left turn lane, NB through lane.

South Leg – NB channelized right turn lane and approach taper, NB through and left lane, 2 SB through lanes and return taper.

There are a number of horizontal curves on the approaches to the intersection. The start of a horizontal curve with radius 1,340 m is located along Highway 13 approximately 500 m east of the intersection. Two horizontal curves with radius 510 m and 720 m are located on the south leg of Highway 21. The end of the 510 m radius curve is located at the intersection and the end of the 720 m curve is located approximately 350 m south of the intersection. The vertical profiles of Highway 13 and Highway 21 are generally rolling terrain within the vicinity of the intersection.

The posted speed limit on Highway 13 and on Highway 21 is reduced from 100 km/h to 80 km/h on each of the approaches to the intersection. This reduction occurs approximately 400 m to 750 m in advance of the intersection.

The intersection is controlled by traffic control signals, which were installed in 1995. Overhead signal and side mounted signal heads are located facing approaching vehicles on each leg of the intersection. Overhead Advance Warning Flashers are located above the approaching travel lane(s) on each leg approximately 135 m in advance of the intersection. All channelized right turn lanes are controlled by Yield Signs.

Based on the field investigation, available stopping sight distance for all vehicles on approach to the intersection is unrestricted on all legs.

The land in all quadrants of the intersection is generally undeveloped or in agricultural use with exception in the northeast quadrant. Commercial developments are located in the northeast quadrant. A Canadian Pacific Railway crossing is located approximately 210 m north of the intersection which is controlled by automated protection signals.

In accordance with the guidelines presented in the TAC *Illumination of Isolated Rural Intersections* (4), full illumination is provided at this intersection. Luminaires illuminate the Stop lines, yielding positions and channelized right turns at the intersection. Delineators are also located off the edge of pavement along the tapers, channelized right turn lanes, depressed islands, and on the outside of the horizontal curves on the south leg of Highway 21.

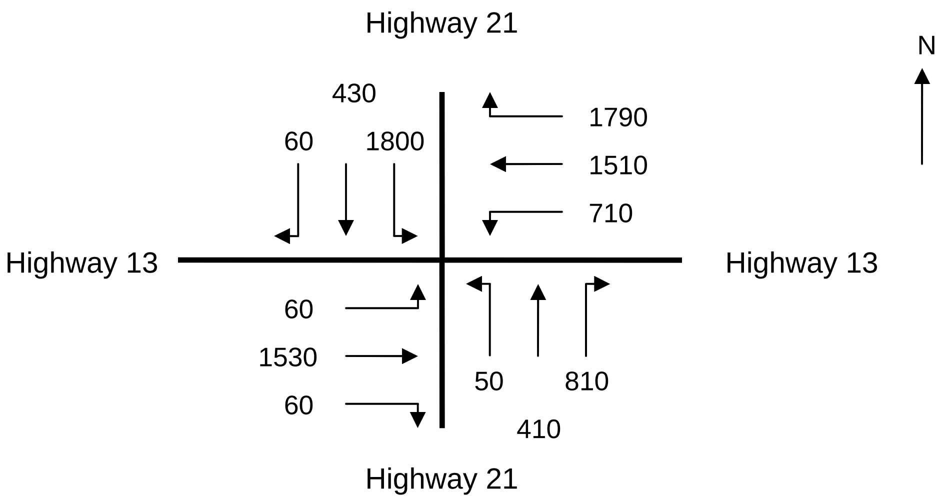
Traffic Volumes

Average Annual Daily Traffic (AADT) for 2004 and the proportion of the volume that is truck traffic (single and tractor-trailer units) on all legs of the intersection are as follows:

Table 1: Traffic Volumes

Intersection Leg	2004 AADT	% Trucks
Hwy 13, east of intersection	8,150 vpd	10.7%
Hwy 13, west of intersection	3,270 vpd	11.9%
Hwy 21, north of intersection	4,550 vpd	20.3%
Hwy 21, south of intersection	2,470 vpd	20.1%

The proportion of the volume on Highway 13 that is truck traffic is lower than the 15.1% provincial average and on Highway 21 is higher than this average.



Significant turning movements at this location include:

- over 44% of westbound vehicles turn north from Highway 13 onto Highway 21;
- over 37% of westbound vehicles continue west on Highway 13;
- over 92% of eastbound vehicles continue east on Highway 13;
- over 63% of northbound vehicles turn east from Highway 21 onto Highway 13; and
- 78% of southbound vehicles turn east from Highway 21 onto Highway 13.

Safety Performance

A summary of the collisions reported at this intersection for the period 2000 to 2004 was provided by AIT. During this period, there have been a total of 44 collisions reported at this intersection. This data is illustrated in Figure 1 (collision diagram).

The following is a list of the types of collisions that occurred at the intersection:

Table 2: Collision Frequency

Type of Collision	Number of Collisions Reported	Proportion of Overall Collisions
Animal	2	4.5%
Backing	1	2.3%
Left turn across path	22	50.0%
Passing left turn	1	2.3%
Rear-end	11	25.0%
Right angle	4	9.1%
Run-off-road	2	4.5%
Sideswipe	1	2.3%

The following table shows the breakdown of fatal or injury collisions by type:

Table 3: Collision Severity

Type of Collision	Number of Injury Collisions	Number of Fatal Collisions	Number of Persons Injured	Number of Persons Killed
Animal	0	0	0	0
Backing	0	0	0	0
Left turn across path	9	0	21	0
Passing left turn	0	0	0	0
Rear-end	5	0	8	0
Right angle	0	1	7	1
Run-off-road	0	0	0	0
Sideswipe	0	0	0	0

Fourteen collisions were reported as injury collisions with a total of twenty-nine people injured. One collision was reported as a fatal collision with one fatality and seven injured.

All collisions were reported to have occurred between 7 a.m. and 9 p.m. with 17 of the 44 collisions between 3 p.m. and 6 p.m.

Of the 22 left turn across path collisions, the following observations are made:

- two collisions involved a northbound vehicle making a left turn across the path of a southbound vehicle;
- eight collisions involved a westbound vehicle making a left turn across the path of an eastbound vehicle;
- seven collisions involved a southbound vehicle making a left turn across the path of a northbound vehicle; and
- five collisions involved an eastbound vehicle making a left turn across the path of a westbound vehicle.

A high proportion of the collisions are related to left turn across path, but not any one direction is more significant than the other. This may be considered typical at an intersection with these volumes but the overall frequency of collisions is still high.

Rear-end collisions are not unexpected at a signalized intersection and the frequency of this collision type is not that significant given the traffic volume at this location.

Three of the right angle collisions were reported to occur due to vehicles running the red light and it is likely that other angle collision was also the result of a vehicle running the red light.

Considering the number of vehicles entering the intersection, the collision rate is 2.61 collisions per million vehicles entering the intersection. This collision rate seems high for a rural intersection; however, it is not unusual for a signalized intersection.

IMPROVEMENT OPTIONS

Considering a review of the available traffic count information, analysis of reported collisions, on-site observations, and comparison of the existing conditions with established geometric design and traffic control guidelines, improvement options identified at this intersection included:

- signal phasing modifications;
- intersection modifications;
- roundabout installation;

- interchange installation; and
- traffic control modifications.

For the purposes of this paper, the following discussion addresses and presents considerations for the improvement option of installing a roundabout at the intersection of Highway 13 and Highway 21.

ROUNDABOUT CONSIDERATIONS

The Appropriate Design Vehicle

Considering the 2004 volumes at the intersection of Highway 13 and Highway 21, the proportion of the volume on Highway 13 that is truck traffic is approximately 11% to 12% and on Highway 21 is approximately 20%. Although the volume of truck traffic does not constitute the largest proportion by vehicle type, the design of a roundabout must accommodate truck traffic while maintaining low speeds for passenger vehicles. According to the FHWA's guide (1), a roundabout with an inscribed circle diameter ranging from 35 m to 40 m is adequate to accommodate WB-21 and WB-23 design vehicles (tractor-trailer combinations).

The largest vehicle allowed to operate on Alberta's provincial highway system without a permit must not exceed 25 m in length. Vehicles in excess of 25 m must operate under permit on highways designated to accommodate such vehicles. The section of Highway 13 between Wetaskiwin and Camrose is identified as a long combination vehicle route and designated to allow vehicles over 25 m in length to operate under permit. Therefore, the design of a roundabout at this location must consider the appropriate design vehicle and inscribed circle diameter to accommodate this vehicle.

The proposed roundabout at the intersection of two provincial highways, Highway 8 and Highway 22 located west of the City of Calgary, would be the first highway-to-highway roundabout in Canada. The design of this roundabout considers WB-36 design vehicles and provides an inscribed circle diameter of 108 m. The road safety audit team for the roundabout design noted that providing such a large diameter was selected to reduce the size of the mountable apron around the central island and discourage vehicles from traversing across the apron (5).

Other road safety audit professionals have noted that the height of truck aprons on roundabouts should be approximately 100 mm to discourage use of the apron by SUV's, but not higher so as to affect truck stability (6). During the design, trade-offs between inscribed circle diameters with or without truck aprons must be given to ensure all vehicles are accommodated as well as an enhanced safety performance is achieved.

The design of a roundabout considers a deflection to the right by vehicles entering followed by a circulatory path required to exit. Turning templates for long combination vehicles are provided in AIT's *Highway Geometric Design Guide* (7); however, these templates do not consider such deflections and circulatory paths. When designing a roundabout it is more appropriate to consider the smooth curve provided to manoeuvre around the central island instead of a 90-degree turn at a standard intersection. The appropriate geometric characteristics including the inscribed circle diameter should consider long combination vehicles through the curve of a roundabout at low speeds.

Approach and Circumnavigating Speeds

The alignment of the intersecting roads on approach to the intersection plays a vital role in reducing operating speeds of vehicles. For safety purposes, it is crucial to design in sufficient deflection on the approach. The idea is to slow vehicles down before they reach the yield line (6). Many of the safety benefits associated with roundabouts can be attributed to a reduction of vehicle speed on approach to and circumnavigating the roundabout (5). Therefore, the design of a roundabout is intended to force drivers to negotiate a set of curves at a reduced speed lower than the posted speed of the approach roads.

A reduction in speed provides road users additional opportunity to react to any potential conflicts or situations that may arise resulting in a collision. Providing more time for road users to react assists to reduce the severity and frequency of collisions.

Speed differentials between vehicles are also typically reduced at roundabouts since traffic on each approach is required to slow to the same speed. Decreasing the speed differential between vehicles at a point of conflict typically reduces the frequency and severity, particularly for rear-end and sideswipe collisions (5).

One approach to maintaining the desired speed differential is to design the alignment of the centrelines of the intersecting roads to pass through the centre of the central island. This alignment makes it possible to balance the speeds in the roundabout. If this ideal alignment is not achievable, the entrance lanes must be shifted to the left of the centre, to deflect the vehicles entering the roundabout (8).

Most literature on roundabouts suggests that splitter islands are also considered to assist in controlling approach speeds. These islands deflect traffic at reduced speeds as well as encourage drivers to decelerate prior to entering the roundabout.

On high-speed rural intersections, it is critical to reduce the speed of approaching vehicles to maintain the safety benefits offered by roundabout installation. This reduction in operating speed can be achieved by providing approach and entry geometry that is designed to make drivers feel comfortable travelling at lower speeds while making it difficult to exceed a certain speed (9).

Types of Collisions Mitigated

As can be seen from the safety performance at the intersection of Highway 13 and Highway 21, the largest proportion of collisions by type is angle (left turn across path and right angle) and rear-end collisions.

The safety benefits of roundabouts compared to conventional intersections have been well documented. Several before-and-after studies in countries worldwide have found that the installation of roundabouts have decreased the number of fatal and injury collisions by as much as 76% (10). Angle (right angle and left turn across path) collisions are significantly reduced if not eliminated.

A number of rear-end collisions were reported to occur at the intersection of Highway 13 and Highway 21 resulting from a vehicle failing to stop at a red light following a vehicle that had previously stopped or slowed down. Three of the four angle collisions were reported to occur due to vehicles failing to stop at a red light. There are advanced warning flashers installed over the approaching travel lanes on each leg of the intersection. These flashers are activated seven seconds before the start of the amber period, which is typical for signalized intersections, located in high-speed areas. Given this, it is likely that these rear-end collisions occurred due to late arrivals speeding up rather than slowing down and stopping, in an attempt to make the green light.

As noted by one study (5), reducing the speed of vehicles approaching a roundabout and decreasing the speed disparity between vehicles at a conflict point typically reduces the frequency and severity especially when considering rear-end collisions.

Given the types of collisions reported at the intersection of Highway 13 and Highway 21, the installation of a roundabout at this location would likely reduce or eliminate the number of angle collisions resulting in injury or fatality, as well as reduce the severity of rear-end collisions.

Traffic Volumes Accommodation

According to the American Association of State Highway and Transportation Officials' (AASHTO) *A Policy on Geometric Design of Highways and Streets*, entry width is the largest determinant of a roundabout's capacity (11). With reference to the Highway Capacity Manual 2000, the performance of each leg of a roundabout can be analyzed independently of the other legs. The entry or approach capacity is related to the circulating flow of vehicles in the roundabout. Intersection turning movements can be converted to provide a circulating flow. For example, the circulating flow for the entry of a vehicle from the south leg of a roundabout consists of through and left turning vehicles on the west leg, and left turning vehicles on the north leg. Should a circulating flow exceed 1,800 vehicles per hour, it may be necessary to provide additional lanes for exiting vehicles.

When considering the current traffic volumes at the intersection of Highway 13 and Highway 21, the highest circulating flow is less than 500 vehicles per hour. Therefore, a single lane configuration appears adequate at this location.

The capacity of roundabouts is greater than the capacity of signalized and stop control intersections. This is due in large part to the change in traffic control allowing vehicles to yield as opposed to stopping before entering the intersection, which increases delay to vehicles required to stop. Removal of the amber and all-red phases of signalization also reduces the delay experienced by vehicles.

Roundabouts can be designed to accommodate vulnerable road users including cyclists and pedestrians. Considering the rural Alberta context, very few cyclists and even fewer pedestrians are observed on high-speed highways. However, vulnerable road users should be taken into account to accommodate them where appropriate while providing overall safety benefits to all users.

Public Education

Roundabouts are typically installed in urban areas as opposed to rural areas. At a rural location such as this intersection, the presence of a roundabout will be unexpected and may perform more poorly than the existing signalized intersection. Long distance drivers and drivers unfamiliar with the area tend to expect not to have to stop and will not be expecting to have to yield. It is possible that drivers may fail to yield the right-of-way to vehicles circulating in a roundabout, traverse the apron, insufficiently reduce their speed prior to entering, or make unpredictable movements if uncertain how to proceed.

The installation of a roundabout in a rural environment should be introduced to the public through education. It is possible that by continuing to install roundabouts, the public will become familiar and experienced with its operation and roundabouts will become less unexpected in rural areas; but candidate locations must be carefully selected. Selection should consider factors including the improvement to safety performance, the surrounding topography, the proximity to urban centres, and the current educational programs. However, these factors are not comprehensive of all factors that should be considered. Selection should be determined on a site-specific basis.

Many jurisdictions throughout North America (including British Columbia, Arizona, Maryland, Iowa, Alaska, and New York) that have installed roundabouts on their road network have adopted an educational program to promote the safety benefits and instructional use of these intersections. Such programs include:

- Guidance signing placed in advance on each approach;
- Interactive websites allowing the public to drive an online roundabout or through the use of animation to illustrate navigation procedures;

- Instructional leaflets and brochures; and
- Media advertisements.

Other programs that could be adopted include:

- Driver education through classroom instruction;
- Community open houses and forums;

Divided / Undivided Highways

In 2006 the total length of highways within Alberta was 30,860 kilometres (12). The majority of this figure comprises paved undivided highways. Therefore, it is more likely that roundabouts will be installed on undivided highways as opposed to divided highways.

The design of the roundabout at Highway 8 and Highway 22 west of Calgary considers the existing undivided intersecting highways; however, the design also gives consideration to the future twinning of both highways.

It is expected that a single lane roundabout can accommodate all traffic operation requirements for an undivided highway and that there will be little need to provide a second circulating lane in most cases. Divided highways will; however, require a multi-lane roundabout configuration due to the higher traffic volumes on these roads. Multi-lane roundabouts introduce additional conflict points and safety concerns when compared to those on undivided highways.

Multi-lane roundabouts introduce weaving manoeuvres that can lead to a higher frequency of same direction vehicles collisions (sideswipes). One study suggests that the curvature of the entry path (the fastest possible path taken by a vehicle proceeding straight through the intersection) is vital to establishing entry travel lanes to prevent conflicts between parallel streams of traffic (5). In other words, providing the appropriate geometric features of a roundabout to achieve reductions in speed and sufficient deflection of vehicles, can maintain an improved safety performance as achieved by single lane roundabouts.

CONCLUSIONS

Given the findings from the literature research as discussed above, the installation of a roundabout at the intersection of Highway 13 and Highway 21 was not specifically recommended due to relative unfamiliarity of drivers with their use which could increase the risk of other types of collisions including run-off-road and sideswipe collisions. Drivers could fail to yield or not reduce their speed significantly when entering the roundabout. To reduce the risk of his occurring:

- a public education program should be launched to promote the safety benefits and provide instructions on use; and
- selected locations for initial introduction throughout the province should be near the more densely populated urban centres where the drivers are more likely to be attentive to and prepared for the need to stop or slow down when approaching a junction.

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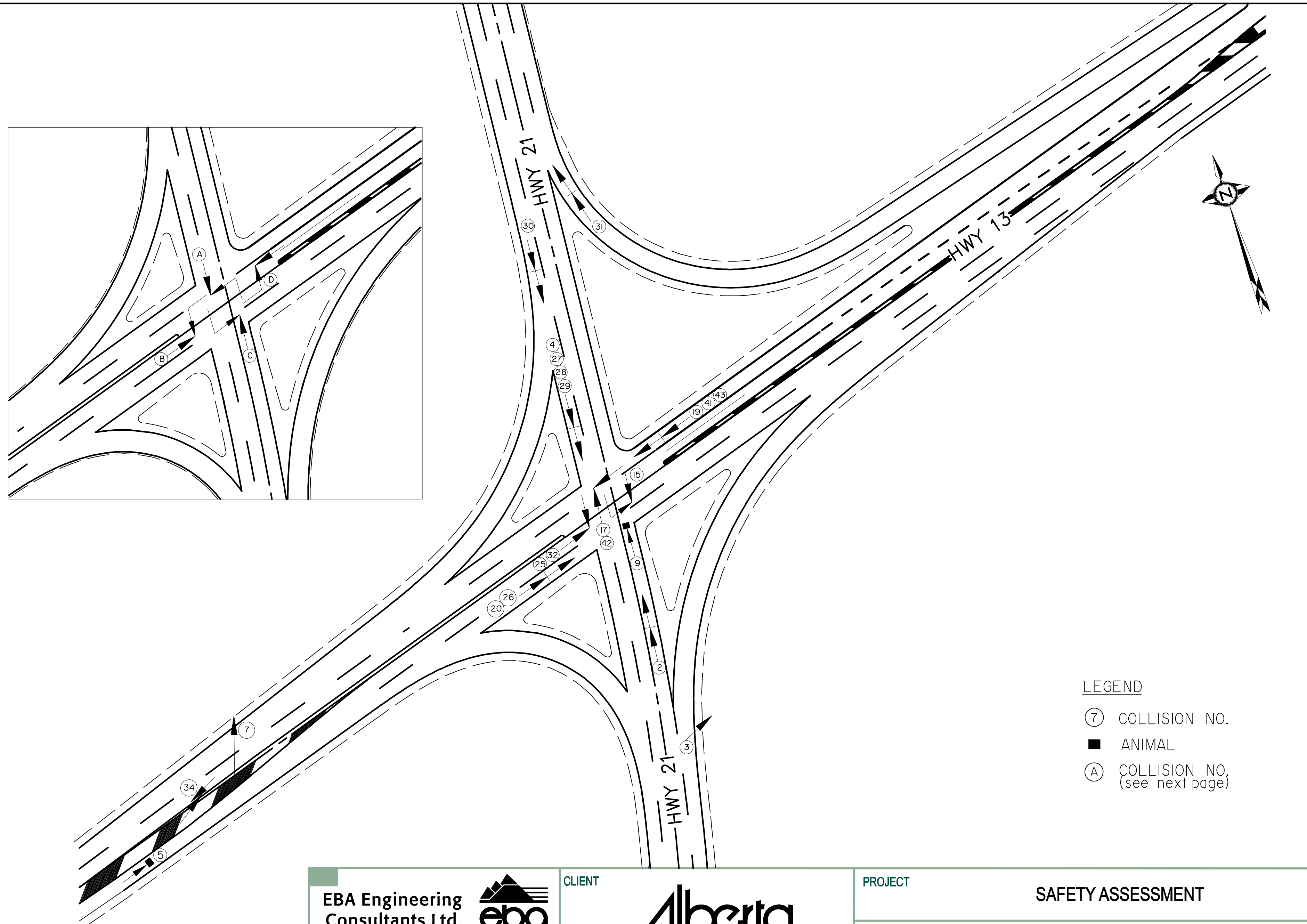

N.T.S.

EBA Engineering Consultants Ltd. eba	CLIENT Alberta INFRASTRUCTURE AND TRANSPORTATION	PROJECT SAFETY ASSESSMENT
DWN. AD / CHKD. PHS		TITLE COLLISION DIAGRAM HIGHWAY 13:10 AND HIGHWAY 21
EBA JOB NO. 9700508	FILE: collision diagram.dgn / REVISION NO.:	DATE: April 2006 / Figure 1

COLLISION DIAGRAM LEGEND

A: Northbound left turn across path of Southbound	**C: Southbound left turn across path of Northbound**
Collision numbers 10, 39	Collision numbers 1, 8, 11, 13, 33, 36, 37
B: Westbound left turn across path of Eastbound	**D: Eastbound left turn across path of Westbound**
Collision numbers 6, 12, 18, 22, 23, 24, 38, 44	Collision numbers 14, 16, 21, 35, 40