

November 28, 2003

File: 5110

Alberta Transportation

Southern Region, Calgary
2nd Floor, 803 Manning Road NE
Calgary, AB T2E 7M8

**Attention: Jerry Lau, P.Eng.
Planning Engineer**

Dear Sir:

**Re: Highway 8:06 and Range Road 31 (149 Street S.W)
Future Interchange Planning Study**

The purpose of this study was to develop Preliminary Functional Plans for a future interchange at the junction of Highway 8:06 and Range Road 31 (149 Street S.W.) and identify long-range right-of-way (R/W) requirements for the ultimate stage facility. Functional plans were prepared to achieve a high confidence level of accuracy in order to protect minimum R/W at this time, but also to assure that sufficient R/W would be available when the interchange is required.

Study Area

The project is located at the intersection of Highway 8 and RR 31 (149 Street S.W.) in MD of Rocky View, west of Calgary City boundary. The Study Area is illustrated on Key Map - Study Area – Exhibit 1.

Background

Highway 8 is a major east-west corridor connecting Highway 22 with the City of Calgary. Currently Highway 8 is a 2 lane undivided highway, providing one of the main accesses to the City from the west. In future, Highway 8 will become a Highway Penetrator to the Calgary Ring Road and a high standard route potentially to support Highway 1 as an alternate access to the City of Calgary from the west.

Highway 8 is bounded on the north by Elbow River and the Tsuu T'ina Nation land to the south. Areas along the Highway 8 corridor are experiencing high residential growth, westerly from Calgary.

Existing Highway 8 traffic is composed of commuter, inter-regional and provincial traffic. Due to increasing traffic volumes, the existing 2 lane highway will require twinning in the medium term to 4 lanes and ultimately to 6 lanes. Based on the McElhanney Access Management Study Report, the future highway will be classified as an expressway and, to accommodate traffic at a desirable Level of Service (LOS), a number of interchanges were

identified along the Highway 8 corridor. The Highway 8 and RR 31 (149 Street) intersection is identified as a future interchange.

The interchange configuration proposed by McElhanney for the Study Area is a typical diamond, which results in spacing considerations between the ramp terminal intersections, and the intersections on RR 31 to Elbow River Drive and Lott Creek Drive, north and south of Highway 8, respectively.

Study Objectives

The purpose of this study was to review interchange options and to determine an interchange configuration based on safety, traffic demand at full development of the area, and topographical site conditions. The interchange configuration should be compatible and cost-effective, with intermediate staging of Highway 8 improvements. Due to the rapid development occurring in the vicinity of the future interchange, the footprint of the interchange with right-of-way requirements was deemed to be required to protect the integrity of the Highway 8 corridor and its access management objectives for the future.

Road Network

As illustrated on Exhibit 2, existing Highway 8 is supported by Lott Creek Drive, Elbow River Drive, and Elbow River Road, which is a service road network connecting consecutive accesses to the highway with at-grade intersections at:

- RR 32 (165 Street) – T intersection to south to be removed in the future,
- Elbow River Road – T intersection to north to be closed in the future,
- RR 31 (149 Street) – All directional intersection,
- RR 30 (133 Street) – T intersection to north, and
- RR25 (117 Street) – All directional intersection.

Land Use

North of Highway 8, the RR 31 (149 Street) intersection provides access to the Elbow River Estates community, located along Elbow River Drive east and west of RR 31, and to Glencoe Golf and Country Club. It is expected that Stone Pine and Elbow Valley Community, located north of Highway 8 and east of RR 31, will contribute only marginally to the RR 31 traffic.

South of Highway 8, RR 31 is terminated by lands of the Tsuu T'ina Nation and future extension of the road to the south is not expected. The intersection provides access for the residential areas of West Meadows, Braemar Estates and part of Elbow Valley Community, located south-east of RR 31. New residential development, Elbow Valley West Residential Community, and two schools west of RR 31, are being proposed and will utilize Lott Creek Drive and RR 31 to access Highway 8.

It was assumed that traffic generated by any development occurring west and south of RR 32 (165 Street), will use RR 31 to access Highway 8. At this time there is no Area

Structure Plan for the area north and west of RR 32, and no connection to Highway 8 at RR 32 planned due to the abrupt grades. It was therefore assumed the area will develop as country residential, similar to the area immediately to the east. The majority (75%) of traffic generated by the area is expected to use RR 31 (149 Street) Interchange.

Traffic Projections

1. Trip Generation

Based on Land Use Plans (existing and future) from the Elbow Valley Traffic Impact Study Report (TIA), trips generated at full development of the area were estimated. Similarly, as in the TIA, ITE (Institute of Transportation Engineers) rates were used to estimate the number of trips. Table 1 summarizes existing and assumed future developments, trip generation rates, directional split, and trips generated by these developments for areas north and south of Highway 8 for AM and PM Peak Hours.

2. Trip Distribution

It was assumed that residential developments north of Highway 8 will generate only external trips with 90% trips to Calgary and 10% trips to the west.

Development south of Highway 8, which includes traffic generated by residential areas and schools would create somewhat different distribution of trips, 80% to Calgary, 15% to the west and the remaining 5% of trips as internal, all of which is summarized in Table 2.

3. Trip Assignment

Traffic was assigned based on the shortest and most convenient route, i.e. Highway 8 as a high speed road would provide the fastest route to Calgary or to the west. Assigning all trips via Highway 8 / RR 31 interchange makes the estimate somewhat conservative (higher than actual).

Exhibit 3, assuming a roundabout interchange intersection configuration, illustrates estimated traffic turning movements for AM and PM Peak Hours at full development of the area between RR 32 (165 Street) and RR 25 (Lott Creek Boulevard).

4. Traffic Analysis

Highway Capacity Model 2000 provides methods for traffic analysis of roundabouts. Sidra software (aaSidra 2), based on this method, was used to analyze both roundabouts and shows that Level of Service (LOS) for all approaches at AM and PM Peak is A. Intersection and Movement Summaries are attached in Appendix A.

Interchange Configuration Alternatives

Based on projected traffic volumes, the following interchange types were considered:

1. Single Point Diamond Interchange

Single Point interchange configuration is often considered in urban environments, within very restricted right-of-way conditions, and with specific traffic turning movement demands.

The Single Point Diamond option was not considered a viable option for the following reasons:

- very expensive bridge structure;
- wide area of pavement required for turning vehicles, creates driver confusion and higher than typical collision occurrence; and
- not warranted by expected traffic volumes. Intersection would have to be signalized resulting in additional costs.

2. Tight Diamond Interchange

Four options were considered, with a variety of profile of Highway 8 and RR 31 (149 Street) alternatives.

1. Tight Diamond with Highway 8 at current elevation and RR 31 overpass. Based on RR 31 constraints, the possible gradeline that would accommodate reasonable fills would be designed to 80 km/h, with crest K value of 35. Intersection sight distance analysis shows that allowable speeds within the interchange area should be limited to 50 km/h.

Based on TAC intersection spacing guidelines, the closest collector road intersection should be located at least 200 m away from the interchange ramp intersections. This places the intersection of RR 31 and Elbow River Drive on an 8% grade, which is not acceptable. Lott Creek Drive, the intersection to the south, would also require relocation. Profile of the option is illustrated on Exhibit P1.

2. Diamond Interchange with Highway 8 at existing elevation and RR 31 lowered. The alternative required cuts of up to 8 m. Drainage in the area of interchange would be difficult and deep piping may be required to direct storm water by gravity to outfall to natural channels either along RR 31 or Highway 8. In this case the intersection of Elbow River Drive would be located on an 8% grade – which is not acceptable.
3. Tight Diamond with Highway 8 elevated and RR 31 lowered compared with existing elevations or reversed when Highway 8 is lowered and RR 31 elevated. Even though the profile of RR 31 may achieve higher speeds, Elbow River Drive intersection still would have to be located on the 8% steep grade.

All considered options suggest that RR 31 intersection with Elbow River Drive should be consolidated with ramp intersections and placed in a location minimizing impact on the adjacent properties. The roundabout intersection configuration provides an opportunity to join all legs of the two intersections (ramp intersection and Elbow River Drive) into one system at a more desirable location.

Based on the assumption that a typical diamond interchange configuration was not appropriate, all further options analyzed involved diamond interchanges with roundabout intersections. Alternative profiles of Highway 8 and RR 31, the compatibility with first stage Highway 8 improvements, constructability, drainage issues, and accommodation of vehicle and pedestrian traffic, were all considered in the analysis.

Design Criteria and Road Standards

1. Highway 8

Proposed ultimate Highway 8 design standard: UAD-616.6-120 with 15.2 m median width.

Exit Terminal from Highway 8 (Design Speed 120 km/h) - Taper – min. 275 m @ 25:1 Taper

Ramp Approaches to Roundabouts – Design Speed 40 - 70 km/h.

Entrance Terminal to Highway 8 (Design Speed 120 km/h) – Taper – min. 500 m @ 50:1 Taper

Exhibit 4 illustrates Typical Highway 8 and Ramp Cross-Section.

Highway 8 Decision Sight Distance provided by the design for eastbound and westbound is more than 500 m, where 360 – 470 m is required for 120 km/h design speed.

Proposed ramp profiles provide greater than 300 m of decision sight distance, which is important for high speed traffic exiting Highway 8 to decelerate comfortably in advance of the roundabout intersection.

2. RR 31

To be able to provide appropriate tie-ins to existing roads and to avoid excessive earthworks and right-of way impacts, the proposed Design Standard of RR 31 is UCU210-60 through the interchange area. Roundabout entry speed of 40 km/h is recommended for rural type roundabouts. Typical Cross-Section Exhibit (Exhibit 5) shows two possible options for cross-section under the Highway 8 structure; an urban section with curb and gutter, or rural section with ditches. Considering the relatively low traffic volumes, slow speeds, local nature of the road, and ability to surface drain; an urban cross-section is recommended and allows a reduced bridge length. No oversized vehicles are expected to travel on this road, so reduced 4.5 m vertical clearance may be appropriate.

3. Roundabouts

Both roundabouts were designed similarly.

Roundabouts were designed through iterative process, which involved finding the minimum diameter of roundabout that would accommodate a WB 19 and Highway Bus design vehicle for all possible turning movements. Typically a four legged rural single lane roundabout diameter is 40 m, but in this six approach case, the diameter required is 60 m. Autoturn (Version 4) off-tracking simulation is illustrated on Exhibit 6.

The roundabout operation control requires all vehicles entering the roundabout to yield to vehicles already traveling in the roundabout. Due to geometry, vehicle speeds traveling in roundabouts are typically 25 – 30 km/h. The speed differential of vehicles approaching roundabout and vehicles already in it is a factor that influences the severity of potential collisions, so it was important to design approaches to roundabouts with geometry requiring drivers to slow down. The recommended approach speed is 40 km/h.

The roundabout approach entry and exit flaring (40 m) was used to achieve:

1. speed reduction through entry / exit curves (max. R30 m), and
2. throat width to accommodate design vehicle.

The circulatory roadway width required for a single lane roundabout to accommodate Design Vehicle WB 19 is 7 m and busses is 5 m. A very wide lane in the roundabout may create driver confusion and short-cutting and, therefore, it is recommended to construct a 5 m wide circulatory lane with an additional 2 m wide inside apron allowing larger vehicles to traverse, but discouraging smaller vehicles from using it.

All two-way approaches to roundabouts provide splitter islands between entrance and exit. Where the pedestrian crossing is proposed, the splitter island has a 3 m wide break, to allow for level pedestrian crossing, or possible refuge.

Stopping sight distance for 40 km/h speed is 45 m, which should be provided on the circulatory roadway and every entrance and exit of the roundabouts. Based on proposed vertical and horizontal alignments, intersectional sight distance at each approach is achieved.

Summary of Design Criteria Used in Interchange Design

Main Road - Highway 8	
Design Speed	120 km/h
Entrance Ramp Terminal	min. 500 m @ 50:1 Taper
Exit Ramp Terminal	min. 275 m @ 25:1 Taper
Highway Decision Sight Distance (gore visibility)	> 500 m – adequate
Ramp Decision Sight Distance (roundabout visibility)	> 300 m – adequate
Minor Road – RR 31	
Design Speed	60 km/h
Stopping Sight Distance (SDD)	> 85 m - adequate
Roundabout	
Design Speed	40 km/h
Stopping Sight Distance	> 45 m - adequate

Functional Plan

Preliminary Functional Plan of the Recommended Option of Highway 8 and RR 31 Interchange is shown on Plan P-3257-1. The plan illustrates the ultimate stage of interchange configuration with service road connections. Limits of construction were estimated using RoadCalc software and are shown on the drawing. Based on these limits, right-of-way was established allowing for a minimum of 5 m flexibility.

Proposed school sites will be located on the west side of RR 31, hence the proposed trail for pedestrian circulation is also proposed on the west side of the road. Typical cross-sections of Highway 8, RR 31, and ramps are captioned on the plan. Profile sheets P-3257-2 and P-3257-3 show existing and proposed profiles of Highway 8, RR 31 and ramps.

The profile of Highway 8 is to be raised (max. 1.5 m) for approximately 600 m to accommodate RR 31 profile. The proposed RR 31 underpasses Highway 8 with a minimum 4.5 m clearance and a 2 m structure depth was assumed. Alignment of RR 31 is skewed to the west, so properties north of Elbow River Drive will not be affected (Lot 38, Lot 40) by the north roundabout.

RR 31, including both roundabouts, are located in cut section. The design profile provides parameters (grades, K values) accommodating at least 60 km/h design speed.

Both roundabouts are located on vertical crest curves (K25) with sag curve (K20) under the overpass structure. The proposed profile is designed to contain Highway 8 and RR 31 drainage along the Highway 8 corridor. Options of lowering the RR 31 profile to avoid raising Highway 8, will result in the inability to drain run-off water in the highway corridor. In this case facilities such as retention ponds and / or deep pipes would be required to properly treat run-off from the highway.

Service road connections to roundabouts require some realignment of Elbow River Drive illustrated on the Functional Plan. Profiles of Elbow River Drive, Lott Creek Drive, and the proposed service road are shown on drawing P-3257-4.

Expected first stage of Highway 8 improvements will involve 4 laning of Highway 8. At that time, Highway 8 should be raised to accommodate the future underpass of RR 31. Proposed RR 31 first stage profile is illustrated in drawing P-3257-2. Some preliminary works (bridge deck, supports) could be undertaken during first stage construction to allow uninterrupted Highway 8 operation during future underpass construction.

Geotechnical Conditions

The proposed interchange would require significant excavation to grade separate RR 31 under Highway 8. A review of test logs for the Highway 8 reconstruction (1980) indicates that insitu soils are generally favorable for excavation and no significant constraints to construction are anticipated.

Soil profiles in the vicinity generally consist of organic and silty clays in upper layers, transitioning to clay to depths of at least 7 meters. No bedrock was indicated in any of the test logs. Detailed Geotechnical Investigation at the proposed grade separation should be conducted during the next stage of Highway 8 upgrade.

Public Consultation

A number of meetings took place to present the proposed functional plan to MD of Rocky View.

During the first meeting on June 26, 2003 between Alberta Transportation, MD of Rocky View Planning Branch, and Al-Terra Engineering, it was decided that the plan would be presented to the MD of Rocky View Transportation Committee. In addition, Al-Terra was to contact all affected landowners to present the plan.

On July 24, 2003, the proposed interchange plan was presented to MD of Rocky View Transportation Committee and was accepted. The Committee was to recommend the plan to MD of Rocky View Council to accept the concept. The Transportation Committee requested Alberta Transportation conduct a Public Open House for the interchange.

On September 30, 2003, Al-Terra Engineering conducted two meetings:

1. Private meetings (3) with affected landowners to present the plan and discuss issues and concerns.
2. Public Open House – to present proposed preferred option to the public. In addition to presenting the interchange plan, roundabout educational materials were presented.

Attendees of both the private meetings and Open House session had an opportunity to voice their concerns and opinions through conversations and a questionnaire.

A summary of Open House communicated issues is attached in Appendix B.

In general, the Preferred Option Plan was accepted by stakeholders. Stakeholder concerns gathered during the Open House were reviewed and responded to.

Right-of-Way Requirements

Based on limits of construction determined during preliminary interchange design, proposed right-of-way boundaries were determined and are illustrated in Exhibits 7 and 8. Coordinates in 3TM NAD 83 system, defining the boundary and areas required, are shown.

Other Issues

Neither an Environmental nor an Historical Resources Overview was conducted for this Interchange Planning, since Highway 8:06 Access Management Study Report by McElhanney addresses both issues.

Respectfully Submitted,
AI-Terra Engineering Ltd.

Reviewed By,
AI-Terra Engineering Ltd.

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Corry G. Broks, P.Eng.

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Attachments:

- Tables (2)
- Exhibits (8)
- Preliminary Functional Plans (4)
- Appendix A – Traffic Analysis Report
- Appendix B – Public Consultation