

## Executive Summary

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### STUDY BACKGROUND

Both Highways 1 and 3 are classified as core routes in the NHS. As part of the NHS, a set of roadway standards have been identified, which includes a minimum posted speed of 90 km/h under free flow conditions (no traffic signals allowed). Currently, through the Town of Redcliff and the City of Medicine Hat, neither Highways 1 nor 3 meet NHS standards as the speed limit drops to between 50 and 80 km/h in some locations, and numerous signalized intersections exist along the corridors.

To bring Highways 1 and 3 through the City of Medicine Hat up to NHS standards would be extremely disruptive and costly to achieve due to the amount of adjacent development. Even if upgraded to meet NHS standards, Highway 1 would experience capacity issues as there is not enough room to construct additional travel lanes. Based on this knowledge, Alberta Transportation retained Stantec Consulting Ltd. in May 2005 to develop realignment plans for Highways 1 and 3. Stantec Consulting Ltd. was also retained to develop an interim improvement strategy for the existing Highways 1 and 3 through the City of Medicine Hat, but this work is ongoing, and will be addressed in a separate report.

### STUDY AREA

Figure 1.2 illustrates the overall study area for this project, which is approximately 1000 km<sup>2</sup> in size. Located within the study area are three municipalities:

- The Town of Redcliff;
- The City of Medicine Hat; and
- Cypress County, which includes the Hamlet of Dunmore.

Also included in the study area are major features such as the South Saskatchewan River, Seven Persons Creek, Bullshead Creek, Highway 1, Highway 3, Highway 524, Highway 523, Highway 41, and Highway 41A.

The majority of the lands south of the South Saskatchewan River are irrigated agricultural and country residential, while north of the river is a significant amount of gas related activity in undeveloped dry land conditions.

## **STUDY PURPOSE**

Below is a brief summary of the study objectives:

- Develop environmental, historical, and geotechnical constraint plans;
- Develop and evaluate highway realignment alternatives;
- Identify recommended alignment;
- Develop preliminary profile for recommended alignment;
- Identify future interchange locations;
- Develop conceptual interchange plans;
- Identify right-of-way requirements; and
- Undertake public consultation process.

## **EXISTING INFRASTRUCTURE**

### **Highway 1**

The existing highway travels through the Town of Redcliff, the City of Medicine Hat, and the Hamlet of Dunmore. Overall, Highway 1 is a four-lane divided highway; however, within those communities the roadway cross-section and speed limit varies. Outside the urban areas the design speed is 130 km/h with a posted speed limit of 110 km/h and the right-of-way varies between 90 m and 115 m.

Currently, traffic signals exist along Highway 1 at Broadway Avenue, Mitchell Street and Boundary Road in Redcliff, and 6 Street, 16 Street, and Dunmore Road in Medicine Hat. In addition, there are five interchanges along Highway 1 within the study area. They are located in the City of Medicine Hat at Box Springs Road, 3 Street, Gershaw Drive/ Highway 3, College Avenue, and 13 Avenue.

Traffic volumes on Highway 1 are 8,650 vehicles per day (vpd) west of the Town of Redcliff, and increase significantly inside the City of Medicine Hat peaking at College Avenue with 32,400 before reducing to 6,550 vpd east of the Hamlet of Dunmore.

### **Highway 3**

South of the City of Medicine Hat, Highway 3:16 is a two-lane undivided rural cross section with a 13 m surface top and a 60 metre right-of-way. Along this portion of Highway 3 the posted speed is 100 km/h. Within the city, the highway transitions to a 4-lane undivided semi-rural cross-section that includes a 6 m raised median, and a reduced speed limit of 70 km/h.

Highway 3 currently has eight unsignalized intersections and one signalized intersection (10 Avenue SW) within the city limits. No interchanges currently exist, except at the junction of Highways 1 & 3.

The traffic volumes on Highway 3 increase from 3,330 vpd at Township Road 120, and steadily increase to 11,910 vpd at Highway 1 in the City of Medicine Hat.

### **South Saskatchewan River**

Within the study area, the South Saskatchewan River flows east from the west study limits into the City of Medicine Hat, and then flows north to the north study limits. Regardless of whether a realignment is developed north or south of Medicine Hat, a new crossing of the South Saskatchewan River will be required. The banks of this river, specifically within the study area, are prone to geotechnical issues (i.e. slides, slumps), which will limit the number of suitable crossing locations.

### **Existing Developments**

In general, the lands in the north half of the study area comprises of grazing lands and a mixture of heavy oil and gas related activities. These lands are not irrigated and typically not suitable for crops. There is also very few residences in the north study area.

The lands in the south half of the study area comprises of irrigated agricultural lands and country residential developments. The irrigated lands are contained mainly in the southwest quadrant of the study area, with water supply coming from a system of irrigation canals which are part of the St. Mary's River Irrigation District (SMRID). Over recent years, Cypress County has seen an increase in country residential developments, which are dispersed throughout the south study area.

### **Existing Utilities**

In addition to the typical utilities found such as water and power, the landscape surrounding Medicine Hat is riddled with gas pipelines ranging in size from 88.9 to 273.1 mm. There is also a large number of irrigated agricultural lands southwest of Medicine Hat, with water supplied via a series of canals operated by SMRID.

## **PRELIMINARY ASSESSMENTS**

At the front end of this study, environmental, historical, and geotechnical desktop overviews were conducted to assist in the development of realignment options.

### **Environmental**

Within the study area are four identified Environmental Significant Areas (ESAs), including:

- South Saskatchewan River – Medicine Hat West;
- South Saskatchewan River – Medicine Hat North;
- Ross Creek; and
- Chappice – Sam Lakes

A site designated as an ESA is not a legislatively mandated protected area; however, the designation of an ESA does indicate the value of both biotic and abiotic resources within a site.

The preliminary desktop assessment identified 23 known wildlife species within the study area. As of December 18, 2007, Alberta Sustainable Resource Development listed two species as endangered (Burrowing Owl, Ferruginous Hawk), one as threatened (Northern Leopard Frog), and four as species of special concern (Sprague's Pipit, Loggerhead Shrike, Long-billed Curlew, Prairie Falcon).

Using information from the Alberta Natural Heritage Information Centre (AHNIC), there are 18 rare plant species within the study area. As of December 18, 2007, the Tiny Cryptanthe, which can be found in the north half of the study area, was listed as an endangered species.

### **Historical Resources**

Based on information from Alberta Community Development (ACD), there are 132 known archaeological sites in the study area, with the majority of these being located adjacent the South Saskatchewan River, Seven Persons Creek and Bullshead Creek. In addition, there are 14 sections of land that have known historical sites on them, with 9 of those occurring in the Town of Redcliff, the City of Medicine Hat, and the Hamlet of Dunmore.

ACD also provides a listing of lands with Historical Resource Values (HRVs), which indicates the type of sensitivity a property possesses. HRV-4 indicates a known site, while HRV-5 indicates a site with high potential. These two classifications are the most common listing by ACD, and do not necessarily mean that the entire parcel has high heritage value. Within the study area there are 22 HRV-4 sites, 10 of which are known archaeological sites, and 12 that are known archaeological and palaeontological sites. There are also 36 HRV-5 sites, which

include 6 archaeological, 15 archaeological/palaeontological, and 15 palaeontological sites with high potential for historical resources.

### **Preliminary Geotechnical**

Initially, nine potential crossing locations were identified from a bridge planning perspective, with three other variations added at a later date. Although these locations appeared to work from a bridge planning perspective, it was necessary to review these locations from a geotechnical perspective to ensure suitable crossings were identified.

From a geotechnical perspective only crossing locations 3 and 9 appear feasible, as they do not appear to be subject to severe erosion or slope stability hazards.

### **ALIGNMENT ALTERNATIVES**

With the completion of the preliminary assessments, Stantec developed numerous alignment alternatives for Highways 1 and 3 in the Medicine Hat area.

#### **Design Criteria**

As part of the NHS, Highways 1 and 3 must ultimately meet NHS standards, which include a minimum posted speed of 90 km/h under free flow conditions (no traffic signals allowed); however, Alberta Transportation strives for a higher standard of roadway, and therefore seeks to protect the future Highways 1 and 3 for a 130 km/h design speed (110 km/h posted speed).

The proposed cross-section consists of a four-lane divided highway with a 38 metres centreline separation in the initial stages. In total, the right-of-way is to be protected at 160 metres, which will allow for the construction of fronting service roads, if required. The proposed right-of-way and centreline separation will ultimately allow flexibility for the roadway to be upgraded to an 8-lane divided highway.

Early in the development of alternatives, Alberta Transportation indicated that it is imperative that the realignment of Highways 1 and 3 provide “good” connectivity between the two facilities. By “good” meaning a high speed, free flow and direct connection between Highways 1 and 3 that minimizes overall travel time and distance.

#### **Development of Alternatives**

Taking into consideration the design criteria, and preliminary assessments, realignment alternatives were developed north and south of Medicine Hat (see Figure 4.2). In total, thirteen corridor options were developed.

In general, the main benefit of a south alignment is that it naturally provides “good” connectivity between Highways 1 and 3 without the relocation or reconstruction of Highway 3. A north realignment certainly has some advantages, mainly in the reduction of impacts to irrigated farm lands and country residential developments; however, a north alignment on its own does not provide “good” connectivity, let alone any connectivity between Highways 1 and 3.

With a north realignment of Highway 1, there are two basic options available for maintaining “good” connectivity between Highways 1 and 3:

1. Construct a south route in conjunction with the north route.
2. Construct a partial realignment of Highway 3 running north/south between the Town of Redcliff and the City of Medicine Hat (see Figure 4.3).

The option of constructing a south route in addition to a north route would improve overall travel distances from Highway 3 to Highway 1 east and west, but is not considered a fiscally responsible or viable alternative. If a south route is required to make a north route viable, then it would make more sense to simply construct a south route.

A more reasonable option would be to construct a partial Highway 3 realignment as illustrated in Figure 4.3; however, this did not address all aspects of “good” connectivity. This would provide a high speed, free flow connection between Highways 1 and 3, but it does not successfully minimize overall travel time and distance. Other issues were raised by the Technical Review Committee that further complicated the viability of a partial Highway 3 realignment. Ultimately, a north realignment was not considered a viable realignment alternative, and was removed from further consideration.

### **Evaluation of Alternatives**

The Technical Review Committee agreed to a set of evaluation criteria to be used in the analysis of alternatives. The criteria included:

- Preliminary Construction Costs;
- Road User Costs;
- Agricultural Impacts;
- Development Impacts;
- Potential Historical/ Archaeological/ Environmental Impacts
- Highway Geometrics; and
- Potential for Geotechnical Issues.

Based on the above evaluation criteria, the combination of alignments S-N2 and S-S6 were identified as the technically preferred alternative. In addition, potential interchange locations were included at:

- Existing Highway 1 West (Systems)
- Highway 524 (Service)
- Highway 523 (Service)
- Highway 3 (Systems)
- Range Road 55/ 13 Avenue (Service)
- Eagle Butte Road (Service)
- Existing Highway 1 East (Systems)

## **PUBLIC CONSULTATION**

This project included three public open houses, two sets of individual stakeholder/landowner meetings, and three rounds of council presentations. Between the three open houses, a total of 503 people attended and 216 questionnaires/comment forms were returned. Landowner meetings were conducted prior to the second and third open houses. In total, 202 invitations were issued, and 86 meetings were conducted. Overall, no significant issues arose from either the open houses or landowner meetings that would preclude the implementation of the recommended improvement strategy.

Presentations were made to each of the local municipal councils prior to taking the recommended improvement strategy to the public. The Town of Redcliff, the City of Medicine Hat, and Cypress County have all issued letters of support for the recommendations.

## **RECOMMENDED IMPROVEMENT STRATEGY**

Figure 6.1 illustrates the ultimate stage recommended improvement strategy that was endorsed by the municipalities and presented to the public at the final open house. Figures 6.2.1 to 6.2.7 illustrate the ultimate stage plans including access management, interchange configurations, storm water requirements, right-of-way requirements and preliminary profiles.

The recommended improvement strategy varies from the technically preferred alternative in the following:

- **Revising Option S-N2** – This option was revised to eliminate impacts to the approved industrial lot in the SE 27-13-7-4. Right-of-way will still be required from the SE 27-13-7-4 to accommodate the interchange at Highway 524, but the 40 acre industrial development remains untouched;
- **Relocating Service Interchange at Eagle Butte Road** – Through discussions with Alberta Transportation, it was requested that this interchange be moved approximately 1.6 km to the east to line up with Highway 41. In doing so, the portion of the Highway 1 realignment east of the interchange was adjusted to pull the horizontal curve beyond the structure.
- **Service Interchange at Highway 3 & Range Road 70 (Y-Ber Road)** – Alberta Transportation requested Stantec identify the first viable location for a service interchange on Highway 3 west of the Highways 1 and 3 interchange. This review focused on existing Range Roads and Township Roads, and Range Road 70 was determined to be the closest location that a service interchange could be constructed without interfering with the operations of the Highways 1 and 3 interchange.
- **Staging of Highways 1 & 3 Interchange** – The systems interchange at Highways 1 & 3 has been modified slightly to allow the interchange to be constructed in two stages.

### **Highways 1 & 3 Interchange**

It is envisioned, that on the day the Highway 1 realignment is opened, the major movements at the junction of Highways 1 and 3 will be the northbound and southbound through movements to/from the City of Medicine Hat. Highway 1 will need to remain free flow; therefore, some form of interchange will need to be constructed at the initial stage. At a cost of \$127M, the recommended interchange was revised to allow construction in at least two stages, while minimizing throw away costs.

Illustrated in Figure 6.3 is the recommended first stage interchange plan at the junction of Highways 1 and 3. In the first stage, the interchange could be constructed as a typical diamond service interchange, with minimal throw away costs as the majority of the ramps are utilized in the ultimate stage. At the ultimate stage, a Highway 3 southbound to Highway 1 eastbound loop ramp would be constructed, and the diamond ramp in the southeast quadrant would be removed. In addition, the intersection connection between the Highway 1 WB exit ramp and the Highway 1 WB entrance ramp could be removed.

## **Systems Interchange Splits**

Systems splits have been developed where the realigned Highway 1 separates from the existing Highway 1. The function of these facilities is to provide a high-speed connection between highways, and is recommended for first stage construction. When the realignment is constructed, roadway priority will shift to the new alignment, and the function of the existing Highway 1 between the two systems splits will be reduced.

These facilities do not provide for all movements. At the west systems split located at station 41+000 (see Figure 6.2.1), it is not envisioned that people wishing to head east on the realigned highway will backtrack several kilometres west on old Highway 1 to do so, therefore the westbound to southbound movement has not been provided. Similarly, at the east systems split located at station 84+000 (see Figure 6.2.7), it is not envisioned that people wishing to head west on the realigned highway will backtrack several kilometres east on old Highway 1 to do so, therefore, the eastbound to southbound movement has not been provided. In both cases, all movements entering or exiting Highway 1 have been developed as right hand exits.

## **Service Interchanges**

In the ultimate stage, service interchanges are recommended at the following locations:

- Highway 1 & Highway 524
- Highway 1 & Highway 523
- Highway 1 & Range Road 55/13 Avenue
- Highway 1 & Highway 41
- Highway 3 & Range Road 70/Y-Ber Road

At the planning stage, these interchanges have all been protected as a Parclo A configuration to allow the vehicle movements onto Highways 1 and 3 to operate under free flow conditions. Using 90 m radius loop ramps, the spacing between ramp intersections is 530 m.

These interchanges have been assumed as fully rural, with traditional highway entrance and exit ramps on the minor road. As such, it is recommended that the first access off the minor road should be located a minimum of 400 metres beyond the end of the entrance tapers. This will provide separation between the merge and whatever intersection treatments are required at the first access point. Should a location be designed as a more urban interchange, the merge tapers on the minor road will be reduced, and the first access point can be located closer to the interchange.

Traffic analysis was not conducted to determine the optimal configuration of these interchanges, as it is impossible to determine how this area will develop and what the traffic conditions will be

at the time of interchange construction. Further review will be required at the detailed design stage.

**Access Closures**

The recommended realignment of Highway 1 crosses several existing roads. All at-grade intersections will be removed in the ultimate stage, and access to/from the highway will be limited to the five identified service interchange locations. However, in the initial stages, some of these at-grade intersections can remain until they experience operational or safety issues. Table E.1 provides a summary of the crossing roads and which intersections can remain open in the initial stages.

**Table E.1**  
 Highway 1 Intersections  
 Initial Stage Access Management

<b>Location</b>	<b>Station</b>	<b>Note</b>
Range Road 73	42+300	Requires closure due to proximity to the west systems split
Highway 524	45+100	Operate as an at-grade intersection until interchange is required
Range Road 72	46+800	Possible at-grade intersection if skew angle is improved
Range Road 70/ Y-Ber Road	52+400	Y-Ber Road will be realigned and underpass Highway 1
Township Road 130	53+000	Requires closure due the elevation difference between Highway 1 and Township Rd 130
Highway 523	56+400	Operate as an at-grade intersection until interchange is required
Township Road 122	59+700	Requires closure due to location on Highway 1 curve & poor intersection skew angle
Range Road 65	60+100	Requires closure due to location on Highway 1 curve
Range Road 64	62+000	Requires closure due to proximity to first stage Highways 1 & 3 interchange
Range Road 63	63+800	Requires closure due to proximity to first stage Highways 1 & 3 interchange
Range Road 62	65+700	Requires closure based on elevation difference between Highway 1 and RR 62
Township Road 120/ Range Road 61A	66+500	Poor intersection skew angle. Recommend closure unless intersection skew angle is improved.

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**Table E.1**  
Highway 1 Intersections  
Initial Stage Access Management

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<b>Location</b>	<b>Station</b>	<b>Note</b>
Range Road 61	67+500	Requires closure due to railway grade separation located just east of intersection
Range Road 60	69+200	Operate as an at-grade intersection until safety or operational issues arise
Range Road 55	70+800	Operate as an at-grade intersection until interchange is required
Black & White Trail	72+500	Operate as an at-grade intersection until safety or operational issues arise
Range Road 53	74+100	Existing road is not much more than a trail. Could operate as an at-grade intersection until safety or operational issues arise
Eagle Butte Road	77+400	Operate as an at-grade intersection until safety or operational issues arise
Range Road 50	79+000	No existing road at this location, but will be an interchange in the ultimate phase
Range Road 43	84+800	Requires closure due to proximity to the east systems split

## **STORMWATER MANAGEMENT**

The natural flow pattern has been maintained as much as possible. As the realignment will consist of a rural cross-section, the stormwater runoff will be conveyed via ditches and carried through a series of culverts discharging to follow the natural flow pattern.

Stormwater management ponds are recommended in the northwest and southeast quadrants of the South Saskatchewan River crossing, in order to control potential contamination from the bridge and provide water quality treatment before flowing into the river at a regulated discharge rate.

## **ENVIRONMENTAL ASSESSMENT**

### **Vegetation**

The current study has identified the potential for rare plant species and ecological communities to be present along the proposed alignment, along with potential regulatory implications under

the *Wildlife Act* and/or *Species at Risk Act*. Rare plant assessments are advisable, at least in areas the alignment crosses natural vegetation with the highest potential to provide habitat for rare plant species or communities. Two assessments (early summer and mid to late summer) are normally needed to provide a complete understanding of rare plant occupation at a given location.

A few small wetlands may be affected by the project, but this cannot be confirmed until permission to access alignment lands is in place and a field assessment is completed. If wetlands cannot be avoided, mitigation or compensation planning as well as an approval will be required under the *Water Act*. Federal wetland compensation requirements for no net loss of wetland function also will come into play through *CEAA*. Unless there is a change in such requirements, they likely will be addressed satisfactorily by meeting provincial requirements.

### **Wildlife**

The highway relocation will remove some and alter other available habitat types used by endemic and migratory species in the subject area. Lands providing natural habitat types are often associated with drainage features. The alignment crosses the South Saskatchewan River Valley, Bullhead Creek, Seven Persons Creek, and native grassland areas that contain the highest quality and least disturbed habitat in an area otherwise occupied by intensive agricultural activities.

A thorough wildlife assessment of the alignment and the necessary surrounding lands extending to 500 m per side will be needed. Access permission to the above mentioned lands are required to properly conduct this assessment. The wildlife assessment is to be completed during the appropriate season (April 01 to Aug 30) and should include: species at risk, assessment of breeding, denning, nesting and over-wintering point features identified based on ASRD Sensitive Species Inventory Guidelines (ASRD 2005) and general wildlife considerations. Timing and setback requirements may apply to active or protected species and their habitat point features as provided in the ASRD Land Use Guidelines (ASRD 2001). The application of these guidelines will take into consideration site specific conditions, project design, and should only apply after consultation with ASRD.

### **Wildlife Movement Corridors**

Wildlife movement corridors are important as they provide species passage across the landscape influenced by life cycle requirements and seasonal habitat availability. Based on existing background information, there are two primary areas where large mammal movements cross the proposed alignment. These are located at the South Saskatchewan River valley, and at the eastern end of the alignment. Other wildlife movements that occur are anticipated to be associated with drainageways and areas of native vegetation.

Several options exist to minimize the potential for larger wildlife-vehicle collisions. These options must take into consideration site specific conditions and project design characteristics. Mitigation considerations for other wildlife may also be required. Mitigation options include:

- Road side reflectors;
- Warning signs and / or flashing lights;
- Crossing structures such as underpasses or overpasses;
- Wildlife fencing to funnel movement in conjunction with a crossing structure; and
- Wildlife fencing to funnel or restrict movement.

### **Fisheries**

The *Code of Practice for Watercourse Crossings* requirements under the *Water Act* include a fish habitat assessment covering at least 100 m upstream and 300 m downstream of each crossing location.

The field information required to obtain authorization for stream crossings under the *Fisheries Act* will be similar to that noted above. If lake sturgeon is listed under the *Species at Risk Act*, a joint *Fisheries Act* – *SARA* authorization will be needed and additional supporting fisheries studies in the South Saskatchewan River may be required. Additional *Fisheries Act* requirements at each crossing may include:

- HADD risk assessment;
- Habitat loss mitigation plan; and
- Habitat compensation plan.

### **HISTORICAL RESOURCE OVERVIEW**

Approximately 60% of the recommended alignment crosses agricultural land, the valley of the South Saskatchewan River, and several of its tributaries. The remainder of the alignment will cross native prairie.

Eight archaeological sites were previously recorded within 500 m of the recommended alignment. Three of these were recorded within 150 m of the alignment. None of these sites should be directly impacted by the proposed alignment. Proximity to these sites, however, suggests higher potential for additional archaeological resources in the surrounding areas.

Twenty-three Historic Period sites were previously identified in the sections surrounding the recommended alignment. Two of these, the Medicine Hat Railway Coal Mine and the Bullshead Creek Shale Mine, are potentially located within the development zone.

Ten quarter sections crossed by the recommended alignment are listed as having high sensitivity for palaeontological resources, owing the presence of the South Saskatchewan River valley.

Based on examination of the background review, aerial photographs and the predictive model of historical resources potential, several areas are identified as possessing higher potential for archaeological, Historic Period and/or palaeontological resources.

A Historical Resources Impact Assessment (HRIA) is recommended for all areas assessed as having higher potential for historical resources. These areas include those locations within approximately 200 m of the river, streams and coulee margins, quarter sections that have been included in the *Listing of Significant Historical Sites and Areas* (ATPRC 2007), and areas within 200 m of a previously recorded archaeological or Historic Period site. In addition, any farmyards traversed by the proposed alignment should be subject to a field inspection, to assess the age and significance of any structures on those properties. An HRIA may be required for those structures predating ca. 1960 that will be impacted by the recommended alignment. A Palaeontological Impact Assessment is also recommended.

#### **PLANNING STAGE ROAD SAFETY AUDIT**

A functional planning road safety audit was completed by Opus Hamilton on the recommended plans, which is a formal safety performance examination of an existing or future road or intersection by an independent team.

The proposed Highway 1 realignment is expected to improve traffic operations and provide a higher level of safety than currently exists. Some of the benefits of the proposed alignment include:

- The new highway will provide a high speed route around Redcliff, Medicine Hat and Dunmore, reducing the potential for high speed right angle collisions on the old Highway 1;
- There is good access management along the new highway, which is more consistent with the function of this highway;
- There are few at-grade intersections in the initial stages, and none in the ultimate stage, therefore the risk of right-angle collisions is low;
- The grade separated crossings of the Canadian Pacific Railway eliminates the potential for train/vehicle collisions;
- The wide median provided along the entire length of the Highway 1 realignment reduces the potential for cross-median collisions;

- All interchanges within the study area, with the exception of the Highways 1 and 3 interchange have the same configuration, providing consistency for motorists, and reducing the potential for late or erratic lane changes or wrong-way movements;
- The horizontal curves along the realignment exceed minimum requirements for a 130 km/h design speed, therefore, the potential for off-road and cross-median collisions is low.

The safety assessment identified three potential safety issues that could be altered to further enhance safety, and should be considered at the detailed design stage. The risk assessment exercise revealed a lowest to low crash risk for all three identified issues. No major safety concerns were uncovered by this audit.

### **OPINION OF PROBABLE COST**

Table E.2 shows the opinion of probable cost of the recommended initial stage improvement strategy, while Table E.3 shows the ultimate stage strategy, which has been estimated at \$512.3M and \$344.4M, respectively. This includes 10% for miscellaneous items (i.e. signage, culverts, pavement markings) and 10% for engineering and contingency.

For the purposes of this study, it has been assumed that all property acquisition and utility impacts of the ultimate stage plan have been dealt with in the initial stages of construction. It should also be noted that the ultimate stage opinion of probable cost does not include 8-laning, as it is possible that the highway will be a freeway long before 8-lanes are required.

<b>Table E.2</b>	
Opinion of Probable Cost (2008)	
Recommended Improvement Strategy - First Stage	
<b>Roadway Construction</b>	
Highway 1 North of S. Sask. River (6.3km) (\$M)	31.5
Highway 1 South of S. Sask River (Through Valley) (2.4km) (\$M)	16.8
Highway 1 South of S. Sask. River (Beyond Valley) (33.3km) (\$M)	116.5
<b>Sub Total (\$M)</b>	<b>214.8</b>
<b>Rights-of-Way/ Development Impacts/ Agricultural Impacts</b>	
Highway Rights-of-way Value (\$M)	28.1
Service Road Rights-of-way Value (\$M)	7.2
<b>Sub Total (\$M)</b>	<b>35.3</b>
<b>Utilities</b>	
Canal Crossings (#)	0
Canal Crossings Cost (\$M)	0.0
Pipelines (\$M)	6.3
<b>Sub Total (\$M)</b>	<b>6.3</b>
<b>Structures/ Interchanges</b>	
West Hwy to Hwy Split (\$M)	11.1
South Saskatchewan River Crossing (\$M)	66.5
Y-ber Road Crossing (\$M)	6.1
Systems Interchange (Hwys. 1 & 3) (\$M)	40.0
Seven Persons Creek (\$M)	11.7
Railway Overpass (\$M)	7.3
Irrigation Reservoir Crossing (\$M)	9.5
Bullshead Creek (\$M)	8.4
East Hwy to Hwy Split (\$M)	10.0
<b>Sub Total (\$M)</b>	<b>170.6</b>
<b>Sub Total (\$M)</b>	<b>427.0</b>
10% Miscellaneous (\$M)	42.7
10% Contingency & Engineering (\$M)	42.7
<b>Total (\$M)</b>	<b>512.3</b>

<b>Table E.3</b>	
Opinion of Probable Cost (2008)	
Recommended Improvement Strategy - Ultimate Stage	
<b>Structures/ Interchanges</b>	
Service Interchange (Hwy. 524) (\$M)	40.0
Service Interchange (Hwy. 523) (\$M)	40.0
Ultimate Systems Interchange (Hwys. 1 & 3) (\$M)	87.0
Service Interchange (Range Road 55) (\$M)	40.0
Service Interchange (Range Road 50) (\$M)	40.0
Service Interchange (Hwy 3 & RR 70)	40.0
<b>Sub Total (\$M)</b>	<b>287.0</b>
10% Miscellaneous	28.7
10% Contingency & Engineering	28.7
<b>Total (\$M)</b>	<b>344.4</b>

**Unit Costs**

Highway Construction (Beyond Valley)	5	\$M/km
Highway Construction (Through Valley)	7	\$M/km
Bridge Cost	4000	\$/sq. metre
Right-of-way Cost	5,000	\$/acre
Direct Development Impact	500,000	\$/impact
Canal Crossing (Bridge)	1.5	\$/crossing