

1.0 Project Overview and Background

Highway 3, the Crownsnest Highway, is a major route on Canada's National Highway System, originating in Hope, BC and terminating at Medicine Hat, AB. It is one of only three continuous east-west routes through Alberta, and is the spine of the provincial highway network in the southern region of the province. In the mid-2000s, Alberta Transportation (AT) identified the entirety of Highway 3 as part of the newly-designated freeway system.

This Functional Planning Study considered requirements for an ultimate freeway-standard route on Highway 3 within the County of Forty Mile, from west of Burdett to west of Seven Persons. The study includes a bypass route for the urban area of Bow Island, interchange configurations, and staging strategies to first upgrade the highway to a divided arterial standard on an interim basis.

1.1 Existing Conditions

The existing Highway 3 is a rural, two-lane undivided highway through the arid prairie of southeast Alberta. It generally parallels the Canadian Pacific Railway (CPR) between Taber and Bow Island. East of Bow Island, the alignment of the CPR veers north, before turning back to the south through a highway overpass west of Seven Persons. Highway 3 passes through or is directly adjacent to a number of communities, including Grassy Lake, Burdett and the Town of Bow Island. Bow Island is a commercial and agricultural center serving much of the surrounding region.

Two other provincial highways intersect with Highway 3 within the study area. Highway 879 is the only crossing of the South Saskatchewan River between Taber and Medicine Hat, and lies about equidistant from Burdett to the west and Bow Island to the east. The other intersecting highway is Highway 885, located 14 km east of Bow Island.

2.0 Study Parameters

Functional planning for Highway 3:14 was completed to current Alberta Transportation guidelines. Highway 3 was protected as an ultimate eight (8) lane rural freeway facility with a 130 km/h design speed. As the highway lies in an area of high agricultural value, the future twinned roadways will have a median separation of 40 m, rather than 55 m. Interim widening to 55 m has been recommended at all roadways that will be connected by interchanges in future, ensuring longer storage for Long Combination Vehicles (double tractor trailers and the like) at the key intersections, particularly the other provincial highways. This interim widening is readily accommodated within the footprint of the future interchanges, with no additional land requirements.

2.1 Technical Review Committee

The study was administered by Alberta Transportation, Southern Region, with input and direction provided by a Technical Review Committee (TRC). The TRC was comprised of members from Alberta Transportation, the Town of Bow Island, County of Forty Mile, M.D. of Taber, and ISL Engineering and Land Services.

3.0 Traffic Forecasting and Analysis

Existing traffic on Highway 3:14 is in the order of 3,000 to 4,000 vehicles per day, with typical growth rates and no major new development nodes contemplated at this time. Simplistic Interim and Ultimate horizon traffic projections were developed based upon historical growth rates. Analysis was completed only at the highest-traffic intersection, Highway 879, and was taken to be representative of the corridor as a whole. The ultimate (40-year) horizon had forecast volumes in the order of 6,000 to 7,000 vehicles

per day along Highway 3. This is outside the typical range of 10,000 to 12,000 vpd at which twinning is normally considered by Alberta Transportation, suggesting that economic or policy factors would also need to be considered when evaluating the need for twinning in future.

The following summarizes the basic geometric scenarios assumed for analysis:

- Interim Horizon – divided 4-lane arterial highway with at-grade intersection and stop control on the Highway 879 approaches
- Ultimate Horizon – divided 4-lane freeway with spread diamond interchange and stop-control at diamond ramp terminals on Highway 879

As a two lane undivided facility, Highway 3 would operate at LOS “C” through the Ultimate horizon. The analysis considered level terrain, however a sensitivity analysis was also completed for the two lane undivided sections with rolling terrain to account for sections of Highway 3 east of Bow Island. The sensitivity analysis suggested passing lanes would be required in the rolling sections to maintain a LOS better than “D”.

As a four lane divided arterial facility, Highway 3 will operate at LOS “A” through the Ultimate horizon, and could be expected to maintain a high performance level in any foreseeable growth scenario.

4.0 Freeway Routing and Access Management

Under the freeway system guidelines, Highway 3 will accommodate a design speed of 130 km/h with no stopping, which facilitates its primary function of providing safe, high speed, free-flowing, long-distance travel on a regional and national level. Limiting highway access to a few interchange locations is a key safety feature of a freeway system. Interchanges ensure that all traffic can enter and exit the freeway in a safe manner without "mixing" low-speed and high-speed traffic, and without any cross-road movements or risk of crossing collisions.

The existing Highway 3 corridor was found to be unsuitable for this purpose for a number of reasons including proximity of the CPR tracks, impact on existing urban development in Bow Island, skewed intersection crossings, and curvilinear routing. Within Bow Island, the highway has many characteristics that are inappropriate for freeway upgrading including reduced speed limits, frequent intersections, traffic signals, direct property access, and pedestrian / cyclist activity.

4.1 General Routing Evaluation

As the first step in determining a suitable alignment for Highway 3, a general routing evaluation was completed. From this initial review, it was evident that routing the freeway around the south side of Bow Island is the only viable option. Routing to the north would require multiple, skewed CPR grade separations, and has limited flexibility in the narrow zone between Bow Island and the South Saskatchewan River valley. Routing through Bow Island itself would have fundamental and irrevocable impacts on the Town, which is neither a realistic nor a desirable outcome. Routing Highway 3 to the south of Bow Island offers the greatest flexibility in route selection, will maintain the integrity of Bow Island and the vitality of future growth opportunities, and favors high geometric design standards without crossing the CPR line.

4.2 Highway 3 Network and Access

Potential access locations were considered at a number of intersections along the Highway 3 corridor. From review of the options and input by the TRC, a network of interchanges was recommended for Highway 3 in the County of Forty Mile. The

recommended Option 3D (refer to Plan 4.4) will provide three interchanges within the study area, as follows:

- Highway 879
- Highway 3A, east of Bow Island
- Highway 885

These locations meet provincial guidelines, with average spacing of 12 km, minimum spacing of 10 to 11 km, and maximum spacing of 14 to 15 km between interchanges. The locations also balance priorities for all stakeholders, providing connections to the provincial highway network and allowing for a high quality parallel access system on Highway 3A, connecting the Town of Bow Island between two adjacent interchanges along the existing alignment of Highway 3.

5.0 Routing Options and Evaluation

A grid of potential bypass routes was developed around Bow Island, respecting the following principles:

- 1) Highway 3 should follow a prevailing east / north-east alignment, without significant backtracking.
- 2) Routing should be limited to east-west alignments along quarter sections lines, or 45 degree alignments in a north-easterly direction, through the center of quarter sections, to minimize impact to irrigation pivots that are prevalent in the area.

Based on the above, a grid network of possible routes was established, and then screened against major constraints such as irrigation canals, homesteads and agricultural buildings, wetlands, and major utilities. While it is not possible to avoid these constraints entirely, the screening helped eliminate routes that would be particularly problematic. The grid screening is indicated on Plan 5.2.

A buffer zone of about 1.0 km was established around Bow Island, within which highway alignments were not evaluated. The buffer zone allows adequate space for urban expansion without “leap-frogging” the highway, and provides sufficient separation for safety, traffic noise, etc. It was strongly desired by the Town of Bow Island that potential routes be close enough to the Town to provide reasonable business access and visibility from the highway. Although more distant routing options may have provided an opportunity to reduce impacts to irrigated agricultural lands, there was concurrence by all TRC stakeholders that some impacts to irrigated sections would be justified by the need to maintain reasonable proximity to Bow Island.

5.1 Detailed Routing Evaluation

From the remaining grid of possible routes, three detailed routes were established for evaluation – a northerly route (closest to Bow Island), a “southerly” route (farthest from Bow Island), and an intermediate route between the two. Potential interchange and crossing-road locations were identified for each option, as shown on Plan 5.4.

Initial evaluation of the routes confirmed that the southerly route did not satisfy project objectives, particularly since it included additional backtracking on the highway network and was at an increased distance from Bow Island. The northern (Route 1B) and central (Route 2B) routes were then further refined to address some of the negative aspects identified for each in the initial evaluation, as shown on Plan 5.11.

Detailed evaluation was completed for both options, on the basis of evaluation criteria agreed by the TRC. Both options were found to be comparably good for many of the evaluation factors, including environmental impacts, accommodation of urban growth,

canal and pipeline crossings, continuity of the provincial network, CPR impacts and constructability.

Key differentiators remaining between the routes included land impacts, route length and quality, functionality of the east interchange, and proximity to Bow Island, as follows:

- Route 2B had moderately higher impact to buildings, including a Telus Tower, but it would sever significantly fewer productive quarter sections than Route 1B.
- Route 2B provides a shorter, more direct alignment than Route 1B.
- Route 2B provides a more functional east interchange for the County of Forty Mile, in close proximity to their primary route on Range Road 103. The interchange location also works favorably for the Town of Bow Island, providing a logical terminus point for a parallel Highway 3A route through the Town.
- Route 2B is more distant from Bow Island than Route 1B. However, travel distances from the interchanges to Bow Island differ by only 100 m, and review of the interchange sites confirms that the Route 2B location would provide a highly visible access point for the Town.

Based on the above factors, Route 2B was confirmed as the recommended route for Highway 3 in the vicinity of Bow Island, and formed the basis for the Technically Recommended Route, as shown on Plan 5.13.

5.2 Routing at Burdett

Highway 3 also passes closely to the hamlet of Burdett, west of Bow Island. The urban area straddles Highway 3, with residential areas to the north (across the CPR tracks) and agricultural and service businesses to the south.

Realignment of Highway 3 just to the south of Burdett, as shown on Plan 5.12, is also recommended. The realignment provides the following benefits:

- Maintains the existing Highway 3 as separate roadway, providing primary long-term service road access back to Burdett from the Highway 879 interchange.
- Provides additional separation to the CPR tracks for interim at-grade accesses at Range Roads 122 and 121.
- Protects existing businesses, and allows continued development, along the existing Highway 3 alignment.
- Ties well to the main freeway alignment near Highway 879, continuing south near Bow Island.

5.3 Twinning of Existing Sections

Beyond the new highway routes at Burdett and Bow Island, the rest of the existing Highway 3 alignment within the study area was found to be largely suitable for upgrading to a freeway standard route. A final aspect of the routing evaluation was to consider side-of-twinning for these retained sections.

West of Burdett, the highway closely parallels the CPR tracks, although some separation is developed near Range Road 124. Given the proximity of the tracks and lack of other major constraints, twinning the highway to the south is the only possible solution. On review, it was found that the existing carriageway / right-of-way for Highway 3 is not consistent with even the basic cross-section requirements of the future freeway. The westbound lanes of the future freeway require a centerline offset of 30 m from the ROW, whereas the existing centerline varies and is as close as 10 m in places. Therefore, in addition to twinning south, the existing highway will also need to be shifted south, with little of the existing carriageway ultimately retained. There may be value in retaining the existing lanes on an interim basis, which could be assessed as a value-engineering approach at the future design stage.

East of Bow Island (beyond Range Road 103), Highway 3 is on a due east-west alignment through the rest of the County of Forty Mile. Much of the existing carriageway can be maintained through to the ultimate freeway stage. The CPR is widely separated from the highway in this area, and there are few other constraints that would preclude twinning on either side. The most significant infrastructure is the Telus tower near Range Road 102, though as discussed above, this is not considered a permanent constraint. On review, it is recommended that Highway 3 in this region be twinned to the north, for the following reasons:

- The number of affected quarter sections is equal, regardless of the side of twinning
- North twinning would affect fewer farmstead sites
- North twinning is compatible with the twinning plan for Highway 3:16 at Seven Persons
- North twinning is compatible with the planned Safety Rest Area near Range Road 101
- North twinning is technically feasible throughout the study area, and particularly across Whitla Coulee, east of Highway 885

6.0 Recommended Functional Plans

Following evaluation of routing and access management options for Highway 3:14 and selection of a technically recommended route, detailed functional planning was prepared for the ultimate and interim stages.

6.1 Ultimate Plan

At the ultimate stage, Highway 3 will be an eight-lane freeway corridor with full access management through interchanges. Although eight lanes are not warranted by traffic, under Alberta Transportation policy the basic freeway cross section nonetheless reflects this as an ultimate option, to maintain and ensure flexibility for a range of scenarios. The wider ultimate section is also of benefit at the time of initial twinning, as it provides additional median storage for large trucks at all at-grade intersections.

The recommended ultimate plan is shown on Plans 6.1 through 6.18, and includes new local roads or service road connections to maintain local access in the vicinity of interchanges at Highway 879, Highway 3A (east of Bow Island) and Highway 885.

Large spread diamond interchanges are recommended at each of the ultimate access points, which provides for flat ramp grades, long sightlines, and future flexibility for the addition of loop ramps, if required. East of Highway 879, the existing alignment of Highway 3 will be renamed as Highway 3A, providing a parallel provincial highway connection through Bow Island. A roundabout has been recommended on the east side of Bow Island, to accommodate the skewed alignment of the east interchange connector.

Highway 3 is generally flat through much of the study area, with the exception of an upgrade east of Bow Island, the crossing of Whitla Coulee near Highway 885, and a downgrade near the CPR Overpass at the east study limit. Grades can be maintained under 3.0% throughout, with additional fills of up to 4.0 m through Whitla Coulee.

6.2 Interim Plan

Following initial upgrades, it is expected that Highway 3 could operate for a considerable period of time as a divided arterial highway, with a total of four lanes, and interim at-grade intersections. This is consistent with typical implementation strategies for other future freeway corridors in Alberta, including Highway 3 from Fort Macleod to Taber and Highway 1 from Calgary to Medicine Hat. The interim functional plan provides details of the corridor at the divided arterial stage, as shown on Plans 6.19 through 6.28.

The divided arterial highway will consist of the center lanes of each ultimate four-lane carriageway, providing space to add one lane each on the outside and median side of the carriageway, in each direction. The centerline spacing on Highway 3 will widen to 55 m at each of the three future interchange locations. The interim widening falls within the footprint of the future interchanges, with no additional property impacts.

6.3 Interim Access Management

Staged initially with at-grade access, the divided arterial stage of Highway 3 will accommodate direct access at a significantly higher number of locations than the ultimate plan. Access management guidelines at the interim stage are reflective of typical Alberta Transportation policy for expressway facilities.

To consider which accesses can be accommodated at the interim stage, a comprehensive evaluation of all public road accesses was completed on the following basis:

- Access provided for public roadways only, with no direct property or field access.
- Minimum spacing of 1.6 km between intersections
- Intersections preferentially cross at 90 degrees, without a skew
- Intersections are preferentially located on a tangential section of highway, rather than a curve
- Intersections will be provided at all future interchange locations
- Intersections should consider function of the local road (community access, truck haul routes, connectivity, etc.)
- Intersections must have adequate sightlines for safe operation
- Intersections must have adequate separation to the CPR tracks

A particularly challenging area to retain intersection spacing is the section east of Bow Island, where a correction line results in staggered offsets in the Range Roads to the north and south. If retained as-is, none of the intersections would meet Alberta Transportation spacing requirements. To address this, the plan has generally recommended that one or the other leg of each roadway pair would access via a single consolidated intersection with its opposite counterpart, via a partially developed service road network.

In total, 26 at-grade intersections will be provided to Highway 3 within the study area, with selective development of the ultimate service road network.

6.4 Corridor Staging Opportunities

The upgrading of the entire Highway 3 corridor from the B.C. border to Medicine Hat will ultimately constitute a major undertaking by the Government of Alberta, on par with such initiatives as the North-South Trade Corridor (NSTC) and the metropolitan Ring Roads for Edmonton and Calgary. Given the scale and complexity of this long-term project, effective staging strategies will be important on all segments of the corridor. Spreading the necessary financial resources over time, while minimizing throwaway costs, can maximize the benefit gained from selected improvements in the nearer term.

Although staging has not been planned in detail, a brief review of staging opportunities has confirmed that the recommended corridor plan will provide a great deal of flexibility, both in terms of the geographic extent of improvements and in terms of the type of facility that is provided at a given time.

Geographically, the highway could be staged in four sections:

- A West segment from east of Burdett to Range Road 103 (possibly in conjunction with twinning in the M.D. of Taber) (4.5 km)

- A Burdett segment from Range Road 123 to Range Road 102 (5.5 km)
- A Central segment around Bow Island (16.5 km)
- An East segment, east of Range Road 103 (21.7 km), which can in turn be broken into any number of sub-segments

From a facility perspective, the staging and function of the highway could vary over time. Focussing on the Central segment around Bow Island, the possible evolution of the route could be as follows:

- 1) RAU-2 – initial construction of a two-lane arterial highway
- 2) RAD-4 with Intersections – initial twinning of the highway, to four lanes, with at-grade intersections
- 3) RAD-4 with Roundabouts – capacity enhancements at key intersections, retaining a divided arterial standard
- 4) RFD-4 – construction of interchanges, and associated access management
- 5) RFD-6 – widening of the corridor to six lanes
- 6) RFD-8 – widening of the corridor to eight lanes

Depending on future funding and provincial priorities, staging could proceed logically through each of these stages, or could proceed through several steps simultaneously.

7.0 Structural Planning

There are two existing bridge files on Highway 3 in the study area, carrying the highway over the St. Mary River Irrigation District (SMRID) Canal (BF 75061) and the CPR line (BF 77847,) respectively. Bridges required for the ultimate corridor include:

- A new crossing of the main SMRID Canal, approximately 3 km east of Bow Island. Various bridge types were evaluated, with a box culvert recommended. This is consistent with the existing crossing structure.
- The CPR Overpass will need to be twinned and/or replaced. The current bridge is scheduled for life-cycle replacement by 2024.
- New bridges will be required over Highway 3 at each of the three future interchange locations. Two-span structures are recommended in all cases.

8.0 Stormwater Drainage Planning

Stormwater Management Guidelines for the Province of Alberta (Alberta Environmental Protection, 1999) were utilized for functional planning purposes. The drainage plans focused on the following criteria to safely convey major storm event flows while protecting highway infrastructure:

- Control release of runoff to drainage outlets at pre-development rates
- Provide sufficient detention storage to maintain proposed release rates
- Identify areas where erosion protection is recommended
- Prevent ditch and roadway overtopping
- Prevent saturation of highway subgrade for extended time periods
- Control release rates of runoff onto private lands and natural water courses

The twinning and realignment of Highway 3:14 will ultimately create approximately 219 hectares of new pavement area, requiring management of the resulting increased rate, volume and intensity of runoff. The proposed alignment intercepts multiple overland drainage basins, potentially redirecting existing overland flows with the roadway embankment acting as a diversion structure. Redirected basin flows will need to be routed via highway ditches and released at multiple discharge locations to ensure the existing overall basin flow patterns are maintained and the release rates occurring under pre-developed conditions are not exceeded. These have been selected to maintain, to

the extent possible, current basin flow directions and patterns and to incorporate flows into the existing drainage runs, receiving courses and infrastructure in the area.

Fourteen discharge locations are proposed, of which eleven intercept overland basin flows. These are then routed through the proposed Highway 3 ditches.

Stormwater quality for the project area is addressed through the utilization of stormwater management facilities, particularly ditch blocks and ponds. These facilities promote settling of suspended solids. Also, the length of flow through grassed ditches promotes extensive sediment removal. Consistent with Alberta Environment guidelines and past Alberta Transportation practice, special provisions for additional treatment of stormwater, such as mechanical treatment, are not expected to be required for this project.

9.0 Utilities / Geotechnical / Environmental

9.1 Utilities

A preliminary review of potential utility conflicts was performed and confirmed that only typical utility relocations such as power poles and Telus lines will be necessary, with no transmission facilities in the area. There is extensive irrigation infrastructure in the study area, managed by the SMRID. The highway route will cross or impact numerous parts of the system, which will require mitigation. These areas are concentrated on the west side of the main SMRID Canal, with few impacts further east. Pivots and valves at individual farms will need to be revised in conjunction with the land acquisition process.

The most significant impact on Telus infrastructure will be the twinning of Highway 3 near Range Road 102, which will require removal or relocation of a microwave communications tower site. Although options to route the highway around the site were considered, on discussion with Alberta Transportation it was agreed that the ultimate plans should provide for a consistent, high standard freeway route, regardless of this constraint. The long-term status of the tower is not known, and it is possible that the infrastructure could be abandoned or relocated prior to highway development.

9.2 Geotechnical and Environmental Overview

A geotechnical and environmental review was conducted for the project. The review identified four areas of saline or sodic soil conditions. While not expected to constrain highway construction, they do suggest potential drainage concerns, as various areas throughout the proposed twinning alignment were occupied by wetlands or temporarily flooded ditches. These items may warrant consideration prior to construction, primarily from a logistics perspective (i.e. stripping, stockpiling and replacing top cover may be more challenging in these areas.)

9.3 Hydrological Environmental Assessment

A review of surface drainage features was conducted for the project, which provided hydrotechnical information related to the minor watercourse crossings in the project area, including SMRID Canal crossings and natural draws such as Whitla Coulee. Effects on the channel morphology, drainage channels and areas of standing water are expected to be negligible in all cases. Impacts to the wetlands, ephemeral pools and the ability for the land to accumulate water and release it into the atmosphere or infiltrate it into the ground are also predicted to be negligible. The ephemeral pools and intermittent wetlands may change location, however there will be new ditches and depressions created during the construction process to replace these temporary water bodies.

9.4 Historical Resources Overview

An overview of historical resources was completed for the study. Highway 3 will be developed in an area that has been heavily disturbed by agricultural activity. An HRIA is recommended at the time of detailed design in just five undisturbed sections, mostly west of Highway 885.

10.0 Cost Estimates

Order of magnitude cost estimates were prepared for each segment of the project, as follows. Costs include contingencies, engineering and land acquisition.

Interim Stage (4-Lane Divided Arterial)	\$172 Million
Ultimate Stage (8-lane Freeway w/ Interchanges)	<u>\$220 Million</u>
TOTAL	\$392 Million

11.0 Public Engagement

Public engagement for the project was completed in three phases, including two public information sessions, direct one-on-one discussions with affected landowners, and numerous presentations to the Councils of the Town of Bow Island and County of Forty Mile. Generally, the landowners understood the intent and rationale for the selected route, and obtained information on future steps related to land acquisition, development, etc. Some landowners expressed interest in selling their land in the short-term.

12.0 Closure

The recommended functional plans for Highway 3:14 provide a basis for Alberta Transportation to ensure that right-of-way protection, development access and capital programming can be conducted in a manner consistent with ultimate implementation of the Highway 3 freeway corridor.