

## **SECTION 6 - PRELIMINARY ENGINEERING**

### **6.1 GENERAL**

The Consultant shall revise/update and/or undertake any of the following preliminary engineering tasks as stipulated in the Terms of Reference for the project:

#### **6.1.1 BRIDGE PLANNING**

Bridge Planning (sometimes referred to as Preliminary Engineering) for bridges is a distinct and different process compared to roadway preliminary engineering. This function is described in Bridge Planning Section 10.10 and Appendix J1 and it is generally independent of preliminary engineering. The timing and complexity of bridge planning is dependent on the type of bridge and crossing under consideration, however when the construction costs are expected to exceed \$1 million, it is normally undertaken 3 – 5 years in advance of the programmed construction date.

#### **6.1.2 PROJECT SET-UP AND REVIEW EXISTING INFORMATION**

The Consultant shall assemble and review all relevant information (i.e. existing design and project data) available from Alberta Transportation and shall plan a Preliminary Engineering Strategy based on this information. All acquired data from sources at Alberta Transportation and for this Preliminary Engineering phase shall be assessed with respect to its impact on the design.

#### **6.1.3 INITIALIZATION MEETING**

Prior to commencement of the work, the Consultant will attend a meeting with the Project Sponsor to discuss with him/her their work plan, scheduling, evaluation criteria and to review project files.

#### **6.1.4 PRELIMINARY SURVEY**

##### **6.1.4.1 General Requirements**

The Consultant shall complete a preliminary survey that will include:

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- Title search
- Horizontal and vertical survey
- survey control points
- DTM modeling
- Survey transit notes

All surveys are to be tied to the Alberta Survey System NAD83 3TM Coordinates and survey closure accuracy shall be as follows:

- For general roadway work, the following survey closure accuracy shall apply:
  - vertical level circuit closure accuracy  
allowable error (mm) = 12 x square root [distant of circuit (km)]
  - horizontal linear closure to within 1 in 5000
- For sensitive (critical) locations with very high accuracy requirements (e.g. bridge structures, curb & gutter, etc.), survey closure accuracy shall be suitably precise to comply with construction tolerances.

All surveys shall be carried out according to the Department's current procedures as shown in the latest manuals. At the time of writing the latest documents are the 1988 Survey Manual and the 1996 Guide to Electronic Survey and Data Management. The 1996 Guide provides specific information on work methods, procedures and practices which are to be followed for electronic survey activities required for highway work. In particular, the modules on Establishing a Control Network, Stake-Out, Data Pickup, Data Processing, Data Management and Final Quantities shall be followed by all Consultants unless an alternative method has been proposed by the Consultant and accepted by the Project Sponsor in advance of commencement of the survey.

### **6.1.4.2 Chainages**

Chainages will begin on the south end of projects running in a general south-north direction and on the west end of projects running in a west-east direction. The chainage at the beginning of a project shall match the control section kilometre value at the same location. For example, if the km value is 10, the initial chainage is 10+000.

Twinning projects may require special chainage e.g. along centreline or independently along each roadway if they are independent alignments, however the same general convention should be followed where feasible.

*NOTE: The 'km' is defined as the length along centreline from the beginning of the control section, with the south end of each control section being '0' on north-south alignments and the west end being '0' on east-west alignments. Alberta*

*Transportation Control Section Numbering System and Kilometre Datum Measurement must be used.*

#### **6.1.4.3 Construction Control Points**

Control points, as references for future stages of construction, shall (as required) be established at locations that will provide protection from damage or loss. The construction, location and marking of these control points shall be appropriate to ensure their integrity for the duration of the project. Steel pins (min 45cm in length) are considered sufficient as control points. Brass caps shall not be used for construction control points due to possible confusion with legal survey markers.

The Consultant shall follow the procedure of establishing a three dimensional control network as described in the “Electronic Surveying and Data Management Guide”. The Consultant shall also use standardized descriptor codes for all data pickup, and the guidelines related to naming conventions and data handling, to ensure the integrity, validity and security of all data.

#### **6.1.4.4 Elevations**

Elevations during bench mark leveling are to be recorded to the nearest 0.001m (the third decimal figure is usually estimated).

#### **6.1.4.5 Bridge Surveys**

Bridge Surveys shall be conducted in accordance with the following:

- Appendix J – Example of a Bridge Report of “A Guide to Electronic Surveying and Data Management”.
- Section 1.3.3 “Site Survey Requirements” of Bridge Size Culverts – Design and Drafting Guidelines.

#### **6.1.5 DRAINAGE REVIEW (NON-BRIDGE SIZED CULVERTS)**

Condition of all culverts shall be checked and inventoried. The sizing of the culverts should be checked to ensure it is appropriate. If any culverts are deteriorated, they shall be checked for excessive deformation to see if condition is suitable for installation of a plastic liner. If the culvert is deformed too much to install a liner, then the Consultant shall recommend an alternative to rehabilitate/replace existing culverts.

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All drainage patterns along and adjacent to the roadway alignment shall be determined and surveyed (if necessary). The Geometric Assessment Report (when one is available) will be reviewed and additional verification of condition of various drainage structures will be completed as needed.

### **6.1.6 RIGHT-OF-WAY COORDINATION / PERMISSION TO ENTER & TEST**

Prior to the commencement of roads, bridges, utility or soil preliminary surveys on private or crown land, written permission shall be obtained to survey and test from the property owners or renters, land management agency and/or utility company where required. Permission must be obtained for cutting down of any trees, brushing or clearing.

### **6.1.7 SOIL SURVEY**

Please refer to Section 7 – Geotechnical Considerations.

### **6.1.8 UTILITY SURVEY**

#### **6.1.8.1 Utility Search**

The Consultant shall search and locate all utilities during the Utility Survey stage. The Consultant shall contact all affected utility companies to gather detailed information and inform them of the proposed design and construction schedules.

This shall include, but is not limited to, the following:

- “Alberta One-Call” at 1-800-242-3447 (for buried utility locations). Consent from the utility companies shall be obtained prior to surveying over the utility easements. A minimum of two (2) full working days are required for the locates.

**NOTE:** *Consultants should be aware that not all utility companies subscribe to “Alberta One-Call” and therefore additional searching may be required.*

- Energy Utilities Board (EUB). The EUB can provide high and low pressure location plans in township format (“Township Platf”s”) in the area of the project.
- Planning mosaic plans
- Land Titles (ownership, easements, caveats, etc.)
- Registered Pipeline Utility Plans are available at the Land Titles office. The plan numbers are usually shown on the roadway legal plans.
- Preliminary field survey.
- Alberta Transportation Pipeline Crossing Plan archives (microfiche and electronic; see Terry Gullekson @ 415-1026).

- Land Agents (when right-of-way is required).
- Landowner contact (i.e. private water lines). Contact with the landowners can best be done through the land agent during right-of-way and/or borrow negotiations. Obtaining “Permission to Enter and Test” approvals are also opportunities to inquire about utilities.
- Local Municipality

The Consultant shall complete a thorough search for all utilities. Searching all sources available as shown above as well as searching the site for signs of the utilities will demonstrate due diligence on the part of the Consultant.

The results of any initial contact made by the Department will be made available to the Consultant.

#### **6.1.8.2 Notification Letter**

The Consultant’s first contact with each utility company should be done at the preliminary survey stage, in writing, and indicating:

- the Consultant name and contact personnel.
- that the Consultant is representing the Department for this project.
- the project description, scope and type of work.
- the tentative design completion and tender advertising dates.

A set of preliminary mosaic plans or township plans should accompany the letter, with each of the applicable utilities highlighted. The letter should request the Utility Company to identify all of its utilities within the project limits and to provide the company’s contact personnel for field and design coordination.

#### **6.1.8.3 Pipelines**

The Consultant shall make arrangements with the field representative of each affected company to locate and flag the alignment of each pipeline for the purpose of obtaining survey data.

The Consultant shall obtain exact locations of all buried pipelines in the highway right-of-way. This shall include the horizontal alignment and vertical depth of the utilities (by hand exposing or hydrovac) and then recording the elevations (generally at the proposed ditch locations and right-of-way boundaries). This requirement is normally used for major pipelines (high pressure), and may not be necessary for low pressure gas lines. Because adjustment to buried pipelines is required in most cases when the highway horizontal/vertical alignment and/or cross-section elements are improved, it may be more cost effective for Consultants to simply arrange for utility adjustments on low pressure gas lines based on

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highway design information rather than undertaking a full (hand-exposure) survey. This practice is acceptable provided that the low pressure gas line depth information is not needed at the design stage and provided that utility adjustments can be scheduled so that they do not adversely affect construction operations and safety. When a low pressure pipeline's adjustment/relocation is perceived to be expensive (e.g. pipeline parallel to the highway), a full exposure at the preliminary survey stage is generally required.

Where it has been determined by the Consultant that a full survey of a pipeline is required, the exposure of the pipeline shall be undertaken by the Pipeline Company or a Contractor hired by the Consultant for the Department. With the presence of field representatives of the Pipeline Company, the pipeline shall be hand exposed, and elevations taken both left and right in the proposed ditch areas and right-of-way boundaries. These four elevations are critical to the roadway design and assessment of any potential pipeline alterations. The company field representative shall be present during backfilling operations. Backfilling with acceptable materials and appropriate compaction shall be done as per the applicable utility agreement. The Consultant shall monitor the backfill operation to ensure that the disturbed area is left in a neat and tidy condition.

Due to the fragile nature of plastic pipelines, extra care and attention is required during their exposure.

The Consultant shall make allowance for the cost of hand exposing the pipeline or other means of locating utilities in their engineering proposal. The Consultant shall also be responsible for preparing utility crossing plans as required.

### **6.1.8.4 Power Lines**

During the survey of power lines, the exact location of poles and/or structures shall be noted by chainage and offset from the proposed centerline (it is important at this stage to determine whether the poles and lines are within the existing right-of-way due to relocation cost implications). The number of wires, voltage and ownership shall be noted. Information concerning voltage shall be obtained from the local power company representative. Detailed plans are required for any location where power lines cross the highway or other roadways which will be constructed, improved or obliterated.

Detailed plans shall be prepared at all major intersections (for only the intersections that will be impacted by construction) that contain power poles, power lines, traffic signals and streetlighting.

In the case of buried power facilities, the power company representative will locate and flag their cable alignment and provide all relevant data. The exact location of the buried lines shall be noted by offset from the proposed centerline and crossings by the chainage.

#### **6.1.8.5 Telephone Facilities**

Owners of telephone lines will establish the location and flag the horizontal alignment of buried cables. The exact location of telephone cables, fibre optic lines, manholes, and pedestals shall be noted. The size and type of cables shall be recorded and any special features shall be noted.

Overhead telephone lines running parallel to the highway right-of-way are to be noted giving exact locations of poles, chainage and offset from proposed centerline, and number of wires. Lines crossing the right-of-way shall be noted by chainage. The exact location of poles and anchors located beyond right-of-way boundaries, which may be affected by construction, shall be noted.

#### **6.1.8.6 Railway Crossings**

At those locations where the proposed roadway alignment crosses a railway, or where it is proposed to widen an existing railway crossing, a special survey shall be completed to provide details of any railway crossing signals, control boxes or power sources present. The complete details of survey requirements and typical plans for railway crossings are shown in Section 1 (Instrument person's Railway Survey Guide) in the Department "Drafting Guidelines (CB4)". All railway coordination shall be in accordance with the Department's "Road / Railway Crossing Guidelines for At-Grade Crossings and Grade Separations" manual.

#### **6.1.8.7 Other Cables**

Other cables include television, telecommunication, pipeline company instrumentation, telegraph, railway operating cables, traffic counters, traffic light sensors, cathodic protection and high impact fibre optics. Television cables shall be referenced in detail in the survey field books. Overhead telegraph and railway operating cables shall be referenced with exact location of poles and number of wires.

Traffic counter locations shall be coordinated with the Department through Highway Asset Management (Peter Kilburn: (780) 415-1359). Highway Asset Management shall be advised of the type of work to be done and the tentative scheduling.

Traffic lights (including sensor loops), pedestrian crosswalk lights, and all warning beacons (amber and red) are owned by the Department and shall be coordinated through the Project Sponsor.

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Cathodic protection cables are usually associated with a bridge-sized culverts and shall be coordinated through AT's Regional bridge section.

### **6.1.8.8 Illumination Assessment**

The assessment of the need for illumination and/or determining the extent of illumination that is warranted (i.e. partial or full etc) will normally be done in advance of detailed design under an Engineering Assessment. Where this is the case, the Consultant will discuss the recommendations with the Project Sponsor to obtain additional direction as required. Refer to Section 5.2.4 for details.

### **6.1.8.9 Reporting Requirements**

The Consultant shall provide mylar and digital copies of the completed drawings showing detailed information on utilities. For pipelines, "Pipeline Crossing Plans" must be completed. For all other utilities, the mosaic and/or intersection drawings can be used to show survey details. Utility survey information shall be recorded in the Survey Field Books and shall be submitted to the Department at the completion of the project. See Appendix "K".

### **6.1.9 REVIEW ACCESS MANAGEMENT**

The Consultant shall review the access management for the project as outlined in the Access Management Guidelines in the Highway Geometric Design Guide. Proper access management on highways enhances safety for all road users.

### **6.1.10 SIGN INVENTORY**

Existing signage on the project and signs adjacent to the project which may be affected by the proposed improvements shall be inventoried. The information collected shall include size, number, location and type of all signs (public and private). The condition of existing sign mounts, structures and sign faces shall be noted. Faces that are damaged or non-reflective shall be identified. Refer to Section 8.9 for information on Sign Design.

### **6.1.11 ENVIRONMENTAL REVIEW**

The Consultant shall undertake an environmental overview of the project area. This requirement for the overview is normally included within the Terms of Reference. Biophysical resources to be examined generally included the following: fisheries, vegetation,

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noxious weeds, wildlife/waterfowl/other avian species, wetlands, surface/groundwater, historic resources, soils and species at risk.

The Consultant shall undertake a provincial interdepartmental referral as detailed in Section 4.2.2.

### **6.1.12 GEOMETRIC AND SAFETY ASSESSMENT, AND SURFACING STRATEGY**

In the event that these activities have not been done in the planning or engineering assessment stages, these activities may be included as part of the preliminary engineering tasks at the discretion of the Project Sponsor. Refer to Section 5 – Engineering Assessment for details.

Where this work has been completed previously, the Consultant responsible for preliminary engineering is required to review the previously compiled data, engineering guidelines/warrants used and the recommendations made.

Repetition of the original analysis and assessment undertaken at the planning or engineering assessment stages is not required unless new information has become available or some design guidelines or technical needs have changed.

Consultants shall strive to achieve highly cost-effective designs while providing the standards which are appropriate for the highway according to Alberta Transportation's "Highway Geometric Design Guide". When pavement rehabilitation and/or geometric improvements are considered on existing paved roadways, designers shall use the information contained in Chapter G - 3R/4R Geometric Design Guidelines of the Department's Design Guide. Where various options are being considered, for example for horizontal or vertical alignments, the guidelines contained in the Department's "Benefit-Cost Analysis (Summary, Guide and User Manual)" shall be followed to ensure that total societal cost and benefits are considered in a uniform way. Through the use of a consistent set of guidelines it will be possible to compare the merits of various alternatives on a particular project and to rank various projects according to economic indicators.

- Any changes proposed to the original reports will be documented and verified by the Project Sponsor and Technical Standards Branch
- Where a Geometric Assessment, Safety Assessment, Surfacing Strategy or other engineering assessment task must be completed at the Preliminary Engineering Stage, the reporting requirements are as shown in Section 5. In the event that an Engineering Assessment was completed in advance of Preliminary Engineering, the Consultant is required to document any changes that are proposed to the previously accepted recommendations. These changes should

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be supported by a suitably detailed rationale / analysis which may include a life-cycle economic analysis.

### **6.2 REPORTING REQUIREMENTS**

- An ASCII geographic coordinate file (xyz values such as latitude, longitude, elevation) is required for roads and bridge site surveys to be submitted to the Project Sponsor upon completion of the preliminary survey. In cases where horizontal alignments are being improved or new alignments constructed and there is no planning study, an ASCII file of the alignment shall be submitted by the Consultant to the Project Sponsor as soon as the horizontal alignment has been finalized in the field. The purpose of this submission is to facilitate the Project Sponsor sending the information to the highway Geomatics Section of Program Management Branch to keep the inventory up to date. This digital ASCII file shall also include raw and processed data of survey, including geodetic datum, and any other survey specific information.
- All titles, survey data (hard copy and electronic data), copies of all pertinent correspondence and the original or all permits and approvals (e.g. permission from landowner to survey and/or enter land, and/or clear vegetation for survey purposes), shall be submitted to the Project Sponsor as part of the project documentation at the completion of the project.

A written report and an appropriate construction cost estimate is required for Geometric and Safety Assessment, and Surfacing Strategy of each construction project. Refer to Section 5 for details. The estimate for Surfacing Strategy should be a type “B” estimate. The estimate for Geometric/Safety improvements should be a “B” type if grading quantities have been calculated. If grading quantities have not been run, an estimate that is in the format of an “A” estimate but with more accuracy (due to knowledge of the geometric improvement requirements) is required.

Refer to Appendix “K” for more information on records management. The Consultant shall keep copies of all permits and approvals for their records. Any information that might affect the cost of the survey or incur liability to the Department shall be included.

### **Current References for Section 6:**

Note that the references are in addition to those listed in Section 5.

A Guide to Electronic Surveying and Data Management, 1996, Alberta Transportation.

Benefit Cost Analysis (Summary Guide and User Manual), 1991, Alberta Transportation.

Drafting Guidelines (CB4), 1990, Alberta Transportation.

Excavation and Construction near Pipelines, January 1997, National Energy Board.

Highway Geometric Design Guide, 1999, Alberta Transportation.

Land Surveyor's Manual of Standard Practice, April 1996, Alberta Land Surveyor Association.

Manual for Test Procedures, 1997, Alberta Transportation.

Pavement Design Manual, 1997, Alberta Transportation.

Pipeline Act; Pipeline Regulation (Alberta Regulation 122/87), 1995; 1999, Province of Alberta.

Public Highways Development Act, 1994, Province of Alberta.

Railway Act, 1996, Province of Alberta.

Road/Railway Crossing Guidelines, May 1997, Alberta Transportation.

Surveys Act; Survey Regulation (Alberta Regulation 94/2000), 1999, Province of Alberta.

Survey Manual, 1988, Alberta Transportation.

Traffic Control Standards Manual, 1995, Alberta Transportation.

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