APPENDIX H

LINE MARKING TECHNICAL MEMO

TECHNICAL MEMO

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TO: Richard Dekker, R.E.T.
Supervisor, Technical Services & Special Projects

DATE: June 30, 2009

FROM: Gerard Kennedy, P.Eng.
Senior Project Engineer

FILE: E32101162

SUBJECT: **Strathcona County Sustainable Rural Roads Master Plan 2009**
Review of Municipal Policy SER-009-017 "Traffic Control Devices" with respect to Pavement Line Marking

1.0 PURPOSE OF THIS TECHNICAL MEMO

The purpose of this memo is to review Strathcona County's policy and practice with respect to line marking on paved Class I and II roads. Conclusions are drawn from published guidelines (national and other), and from consultation with selected jurisdictions and transportation professionals. Recommendations for revisions to the County's policy and practice are included in this memo. At the present time, this memo can be utilized as a stand alone document. The submission of this memo is part of the overall assignment to undertake the update of the Strathcona County Sustainable Rural Roads Master Plan, and the information presented will be included in the overall updated plan.

2.0 EXISTING POLICY AND FOCUS OF THIS REVIEW

The Municipal Policy SER-009-017 "Traffic Control Devices" has been reviewed in its entirety with particular attention being paid to those sections that apply to or refer directly to line marking on rural roads in the Rural Service Area. In general, the policy is consistent, thorough, and well written. It is easy to follow, reflects the intent of national guidelines, and provides guidance for the use of engineering judgement and further study for situations that are unique and cannot be covered by a broader policy.

Although many sections in the policy are applicable to line marking, of specific interest in this review are the following two sections and/or subsections:

E. Traffic Control Device Placement

The cardinal principle for the placement of traffic control devices is that they must:

- *Fulfill a need*
- *Command attention*
- *Convey a clear, simple meaning*
- *Command respect of road users*
- *Give adequate time for proper response*

And

O. Pavement Line Marking

1) In the Rural Service Area, line marking decisions will consider:

- *Road width*
- *Posted speed*
- *Site specific conditions*

Rural roads with posted speeds of 80 km/hr or more and widths of less than 8.0 m are not normally good candidates for centre-line pavement marking. Under special circumstances centre-line marking may be considered without shoulder marking where the surface width is a minimum 7.5 m.

3) Centre-line marking may be appropriate in conjunction with traffic-calming initiatives or at other locations where collision experience suggests that a centre-line is desirable.

Section O of the policy (provided in part above) is for the most part related to centre-line pavement marking with some reference to edge lines or shoulder markings. What is not clearly specified is lane and shoulder width. The County's geometric standard for Class I Rural Grid Roads (Drawing Number B-1 Rural) shows a lane width of 3.5 m for a 9.0 m wide roadway providing 1.0 m paved shoulder. From this we understand that desired lane width is 3.5 m and desired paved shoulder width is 1.0 m. It is expected that in practice, taking all geometric elements into consideration, County roads that are 9.0 m wide receive centre-line and shoulder lines (3.5 m lanes and 1.0 m shoulders); roads that are 8.0 m wide receive centre-lines only but are likely only to receive edge lines if the experience of run-off-road collisions is high enough to outweigh the risks of a paved shoulder of less than 1.0 m; and roads that are less than 8.0 m but greater than 7.5 m may be considered for centre-line marking if head on or opposite direction sideswipe collisions are present, but would not receive edge lines because of insufficient road width to accommodate a paved shoulder. There are, of course, exceptions to this practice within the existing County road network. This is typical of the historical evolution of roadway networks in most jurisdictions. For example, roadways that had been previously improved to an approximate road width of 9.0 m with a cold mix surface, that have received subsequent cold mix overlays and then ultimately a hot mix ACP surface, may have a resulting road width as narrow as 8.0 m. In these cases, Strathcona County will paint the 8.0 m wide hot mix ACP surface with 3.5 m lanes and 0.5 m shoulders. Sections of Township Road 530 and Township Road 520 exhibit this condition.

Based on our initial steps in the overall study that include review of available information and field investigation, we understand that the immediate need for information with respect to pavement line marking in the County is focused on centre-line and edge line (or shoulder line) markings for the narrower roadways with traffic volumes of less than 1,000 vehicles per day (vpd) that are posted and/or gazetted at 80 km/h.

3.0 WHAT IS A NARROW ROAD?

In the field of Transportation Engineering, there is no specific and accepted road width that is defined as "narrow". Narrow is a relative term that relates to the road use, and road use is

described by classification. The standards or guidelines for the local road authority define the desired or minimum road width (including lane width and shoulder width) as well as surface type for the particular classification. Ultimately, if the width of a road that has a particular classification or use is less than the desired or minimum as described by the accepted standards, then the road would be considered narrow.

The County's geometric standard for Class II Rural Grid Roads (Drawing Number B-2 Rural) shows a road width of 7.5 m. For the purpose of this review, a rural grid road of less than 7.5 m is considered narrow.

4.0 OUTLINE OF RESEARCH TASKS UNDERTAKEN TO SUPPORT THIS MEMO

The following was undertaken to support the preparation of this memo:

- Consultation with selected provincial and municipal jurisdictions to obtain documented policies and an understanding of practices.
- Review of national guidelines from Canada and the U.S. and selected studies.
- Consultation with selected transportation professionals who are current or past members of the Transportation Association of Canada Road Safety, Geometric Design and Traffic Operations and Management Standing Committees.

A list of references is attached to this memo.

5.0 SUMMARY OF INPUT FROM SELECTED PROVINCIAL AND MUNICIPAL JURISDICTIONS

The following table outlines agencies that were contacted by email and telephone and which provided input.

AGENCIES CONTACTED AND INPUT RECEIVED

Agency	Input Received
Alberta Transportation	Highway Pavement Marking Guide was obtained from the department website.
Saskatchewan Highways and Transportation	Relevant sections of the Design Manual were provided by department staff.
British Columbia Ministry of Transportation	General practices and the Pavement Markings Standard Manual were provided by department staff.
Red Deer County, Alberta	General practices were described in a telephone conversation with County Engineering Staff.
Wheatland County, Alberta	General practices were described in a telephone conversation with County Engineering Staff.
Municipal District of Rocky View, Alberta	Did not receive a response.
Regional Municipality of Wood Buffalo, Alberta	Relevant sections of the Engineering Servicing Standards were obtained from documents in EBA's library.

Parkland County, Alberta	Policy for Traffic Lines on Municipal Roadways provided by County Engineering Staff.
Mountain View County, Alberta	Did not receive a response.
Rural Municipality of Gray, Manitoba	Did not receive a response.
Rural Municipality of Prosser, Manitoba	Did not receive a response.
Ontario Good Roads Association	Did not receive a response.

The information received from the agencies is summarized below:

Alberta Transportation[(1)]

- On rural two-lane roadways not normally under the jurisdiction of Alberta Transportation, carrying low traffic volumes (where marking is not normally carried throughout the length of the roadway), it is desirable to mark on approaches to the crest of a hill, in advance of and beyond any curve (in both cases where sight distance or a clear view ahead is restricted), on the approach to an arterial highway, and in advance of level railway crossings.
- Purpose is to position vehicle in the most advantageous location.
- Road width is not specifically referenced.
- To delineate the shoulder where the shoulder is paved.
- Road width is not specifically referenced.

Saskatchewan Highways and Transportation[(2)]

- Limitations of pavement markings include not being visible when worn or when the pavement is wet or snow covered.
- They have the advantage under favourable conditions of conveying warning or information to drivers without diverting attention from the roadway.
- Directional dividing lines shall be applied throughout the entire length of the surfaced portions on all numbered provincial highways.
- No reference to road width for directional dividing lines.
- Edgeline shall be used on all other highways where the total road surface is equal to or greater than 8.0 m.

Wheatland County[(3)]

- All sealed roads are painted with a centre-line according to AT standards for passing zones, ACP (Asphalt Concrete Pavement) surfaces also have shoulder lines, roads over 1,000 AADT have stop ahead and stop pavement markings at stop conditions.
- Roads in the inventory are generally greater than 7.0 m wide, and typically 8.6 m wide. These roads receive centre-line only because the edge of the road surface (predominantly chipseal or oil bound) does not support shoulder line painting.

- Roads that are less than 7.0 m wide do not have lines as this is thought to create a travel lane which is less than desirable in width and may cause vehicles to travel too close to the edge of the road surface, which may not be of sufficient structural support.

Red Deer County[4]

- All roads of greater than 500 vpd have or will get a centre-line painted in accordance to TAC and AT guidelines.
- They currently have only two former Provincial Highways that have edge lines but are now looking at adding edge lines to all roads of greater than 500 vpd.
- The chipseal roads are 7.5 m wide and ACP roads are 8.0 m wide so they all will accommodate a centre-line and edge lines. They don't have roads that would be considered for line marking that are less than 7.5 m in width. Red Deer County personnel advise that for roads less than 7.5 m in width, it would be difficult to accommodate line markings without unduly raising the expectations for the driver.

Parkland County[5]

- Standard centre-line and no passing markings are provided for all ACP; asphalt surfaced base course and cold mix surfaced roads of at least 7.0 m in width, posted speed limit of 60 km/h and greater than 300 vehicles per day.
- A single solid centre-line is provided on ACP and cold mix surfaced roads adjacent to Provincial Highways, providing the surface is uniform and in adequate condition for the centre-line to be properly applied, so that it will last for a minimum of two years.
- Shoulder lines (edge lines) are placed on ACP surfaced roads of at least 8.0 m in width, posted speed limit of 60 km/h and greater than 1,000 vehicles per day.

British Columbia Ministry of Transportation[6,7,8]

- Ministry staff advise that the current Manual of Standard Traffic Signs and Pavement Markings (September 2000) does not provide comment or guidance on line marking for narrow roads. The Pavement Marking Standards Manual (July 1990) includes some information to this regard, and may be referred to the Ministry from time to time; the information is intended to be included in a future update of the new manual.
- Side roads are painted if they are major feeder routes; non-feeder routes are rarely painted.
- No directional dividing lines are painted if pavement widths are consistently less than 6.0 m on rural roads.
- Lane widths for painting single solid centre-lines are typically greater than 3.3 m; older guidelines may indicate a minimum lane width of 3.0 m, but this is not practical for paint trucks.
- Generally a lane edge line is painted only where the resulting paved or stabilized shoulder is more than 300 mm.

- Classification, width, volume and posted speed should be considered along with practical considerations such as the operation of the paint truck.

6.0 SUMMARY OF REVIEW OF NATIONAL GUIDELINES AND SELECTED STUDIES

Manual of Uniform Traffic Control Devices for Canada[9]

- Directional dividing lines are normally applied throughout the entire length of the pavement on major rural roads.
- On other rural roads, where a continuous directional dividing line is neither necessary or practical, it is desirable to mark on approaches to the crest of a hill, in advance of and beyond any curve (in both cases where sight distance or a clear view ahead is restricted), on the approach to an arterial highway, and in advance of level railway crossings.
- When used, directional dividing lines assist in warning of any unusual or hazardous condition and serves to organize and control traffic.
- For narrow rural roads, guidelines with respect to two-lane pavement widths and two-way peak hour traffic volume are provided for situations where collision records indicate a need for defining the division of the road between traffic travelling in opposite directions; and in areas where the road is likely to be obscured frequently by atmospheric conditions.
- Pavement markings may be used to indicate the limits of the traveled lane, such as to separate the traveled lane from a paved shoulder.
- Line markings to delineate the edge of the traveled lane may be used at the following locations: (a) where the shoulder is paved and is of similar texture and colour to the pavement on the traveled lane…(g) where unusual physical conditions exist where fog occurs frequently.

Manual of Uniform Traffic Control Devices for Streets and Highways[10]

- Centre-line markings should be placed on all rural arterials and collectors that have a traveled way of 5.5 m or more in width and an ADT of 3,000 vehicles per day or greater.
- Centre-line markings should also be placed on other traveled ways where an engineering study indicates such a need.
- Engineering judgment should be used in determining whether to place centre-line markings on traveled ways that are less than 4.9 m wide because of the potential for traffic encroaching on the pavement edges, traffic being affected by parked vehicles, and traffic encroaching into the opposing traffic lane.
- Edge line markings shall be placed on paved streets or highways when they are rural arterials and collectors with a traveled way of 6.1 m or more in width and an daily traffic volume of 3,000 vehicles per day or greater, and at other paved streets and highways where an engineering study indicates a need for edge line markings.

Geometric Design Guide for Canadian Roads[11]

- For two-lane rural roadways that operate as collector roadways, and have a design speed of 90 km/h (posted speed of 80 km/h), lane widths range from 3.5 to 3.7 m and shoulder widths range from 2.0 to 2.5 m.

Use of Edge Line Markings on Rural Two-Lane Highways[12]

- Based on a review of collision data (before and after application of edge line markings) for rural two-lane highways in Kentucky and Texas, the study concludes that overall crash rates decrease as lane width increases. The study also concludes that an edge line with no centre-line can be placed on narrow low volume roads without increasing crashes and without causing a problem with opposite direction crashes, but does not provide comment on whether or not, edge lines on narrow roads function to decrease run-off-road collisions.

Leduc County, Passing/No-Passing Study[13]

- Based on review of the paved surface widths, posted speed limit and operating conditions of selected roadways in Leduc County, this study concludes that there should not be dividing lines on narrow sections without shoulders as dividing lines will force drivers to the edge of pavement, which may cause edge failure and runoff road incidents.

7.0 SUMMARY OF INPUT FROM SELECTED TRANSPORTATION PROFESSIONALS

In preparation of this memo, transportation professionals who are recognized in the industry for their expertise in road safety, traffic operations and roadway geometry were contacted. The following points summarize the input received:[6, 7,14,15,16, 17]

- Edge lines or shoulder lines are understood to provide some form of delineation to guide the driver as to the edge of the travel lane. Although there are examples in rural Alberta where the edge line is right along the edge of the roadway, and no driveable shoulder exists, the perception of most drivers is that the edge line delineates where the travel lane ends and the shoulder starts, and the expectation is that they could move to the right, over the line at least with the wheels on the passenger side of the vehicle.
- Traffic control devices are most effective where there is a need to guide or inform drivers, but can become ineffective or even increase the risk of collision if drivers are not likely to respond to the message or if the physical conditions don't support the intended action. For example, on narrow rural roads where the edge of pavement is sharp, the road surface is rounded and ditch sideslopes are perceived to be steep, drivers will naturally migrate towards the middle of the road as this is the more comfortable position within the cross section on which to drive. Drivers in the opposite direction, because there is a centre-line, may be less likely to expect a vehicle to be "riding the centre-line" and even if there is adequate sight distance, the risk of a head-on or sideswipe opposite direction collision is increased. The overall physical and geometric conditions of the

roadway must be taken into account when considering traffic control devices for roads that do not currently meet the minimum standards or desirable guidelines.

8.0 CONCLUSIONS

Based on the information above, the following conclusions relevant to the network and operating conditions in Strathcona County can be drawn:

- Although the national guidelines speak to the application of directional dividing lines (centre-lines) on narrow rural roads, where geometric features are less than the minimum standards or desirable guidelines, the intention of the national guidelines is to apply directional dividing lines where there is a need. Such need is evident where collision records indicate a need for defining the division of the road between traffic travelling in opposite directions; where the road is likely to be obscured frequently by atmospheric conditions; and in cases where the sight distance or clear view ahead is restricted (i.e. on approaches to the crest of a hill, in advance of and beyond any curve on the approach to an arterial highway, and in advance of level railway crossings).
- Most drivers will perceive edge lines or shoulder lines as the edge of the travel lane beyond which a driveable shoulder exists.
- In general, Strathcona County's policy and practice for application of directional dividing lines (centre-lines) and/or edge lines (shoulder lines) on narrow rural grid roads is consistent with guidelines and practices in other jurisdictions. There is opportunity to improve the information presented in Municipal Policy SER-009-017, "Traffic Control Devices" to more clearly reflect the intent of the policy and practices.

9.0 RECOMMENDATIONS

Based on the wide ranging review of the line marking aspects of traffic control and design guidelines, practices in other jurisdictions, and professional opinions discussed above, EBA recommends that the County's current policy regarding line marking as contained in the Municipal Policy SER-009-017, "Traffic Control Devices" should be retained, with the following amendments:

1. In Section E, Traffic Control Device Placement, an additional note should be added that reflects the importance of roadway geometry, driver expectation and increased risk in the addition of placement of traffic control devices of any kind. An example of such wording is:

   "The introduction of any traffic control device must consider classification, operation, width, traffic volume, posted speed and other practical considerations for the specific area to ensure that drivers do not develop false expectations of the physical conditions or the actions of other drivers."

2. For greater emphasis, the statement "Roads with less than 7.5 m width should not normally receive centre-line or shoulder markings" could be added at the end of Section O.1 as shown below:

O. Pavement Line Marking

1) In the Rural Service Area, line marking decisions will consider:

- *Road width*
- *Posted speed*
- *Site specific conditions*

Rural roads with posted speeds of 80 km/hr or more and widths of less than 8.0 m are not normally good candidates for centre-line pavement marking. Under special circumstances centre-line marking may be considered without shoulder marking where the surface width is a minimum 7.5 m. Roads with less than 7.5 m width should not normally receive center-line or shoulder markings.

Traffic control devices other than line marking are important features of narrow rural roads. Warning signs in advance of critical areas or in advance of where the roadway conditions change (i.e. curve ahead, intersection ahead, narrow road ahead) are recommended where there is a need. Warning signs such as Chevron alignment signs, speed reduction advisory signs, and reflective delineator posts along the edge of pavement through curves on narrow roads are also recommended.

10.0 CLOSURE

This memo has been prepared within the quality requirements of EBA Engineering Consultants Ltd. This information is intended for the immediate consideration of the addressee and will be incorporated into the overall assignment with Strathcona County.

Sincerely,
EBA Engineering Consultants Ltd.

Prepared by:
Robyn V. McGregor, M.Sc., P.Eng.
Senior Transportation Engineer & Principal Consultant
Transportation Practice
Direct Line: 403.723.3269
rmcgregor@eba.ca

Reviewed by:
Gerard Kennedy, P.Eng.
Senior Project Engineer
Highways Practice
Direct Line: 780.451.2130 x62
gkennedy@eba.ca

Attachments – References

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(1) Alberta Transportation, "Highway Pavement Marking Guide", Government of Alberta, March 2003.

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(4) Campbell, Marty, Red Deer County, June 22 and 24, 2009. Personal communication via telephone.

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(9) Transportation Association of Canada, "Manual of Uniform Traffic Control Devices for Canada", Transportation Association of Canada, December 2002.

(10) Federal Highways Administration, "Manual of Uniform Traffic Control Devices for Streets and Highways", U.S. Department of Transportation, 2003.

(11) Transportation Association of Canada, "Geometric Design Guide for Canadian Roads", Transportation Association of Canada, September 1999.

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