# MEETING THE DUAL CHALLENGE OF BUDGET CONSTRAINT AND ENVIRONMENTAL SUSTAINABILITY: A CASE STUDY OF THE RURAL ROAD NETWORK OF STRATHCONA COUNTY, ALBERTA

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## ABSTRACT

**BACKGROUND:** Strathcona County, situated east of Edmonton, Alberta, is responsible for a 1,302 km rural road network. The road surface types are: cold mix asphalt (55% of the network length), hot mix asphalt (17%), dust-suppressed gravel (18%) and gravel (10%). The traffic volumes range from 20 vehicles per day on some gravel roads to 13,000 vehicles per day on some hot mix paved roads. The six functional design classifications into which the network is classified each have design standards for width, surface type, etc. A significant proportion of the network does not meet the current surface type standards, and a majority of the network does not meet the current width standards. A large proportion of the annual capital (rehabilitation) budget has historically been allocated to overlays on cold mix roads, based on a policy of fixed overlay cycles (i.e. a fixed number of kilometres per year). The result has been significant narrowing of road widths, and given the constrained budgets, a relative lack of spending on higher volume roads.

**OBJECTIVE:** This paper presents the results of some aspects of the Strathcona County's Sustainable Rural Roads Master Plan 2010, updated and developed by EBA Engineering Consultants Ltd. (EBA). The major objectives were to make recommendations regarding: the County's road rehabilitation (overlay) and maintenance policies and practices for various functional design classes; and future budget allocations among rehabilitation, maintenance and reconstruction activities. Three overarching guidelines were: 1) Environmental sustainability (with respect to the environmental footprint of the County's rural road works); 2) Budget sustainability (reallocation within existing budget levels); and 3) Feedback from the County's rural residents.

**METHODOLOGY:** The main steps were: 1) Summarize the current state of the rural road network in terms of traffic volumes, surface types, road widths, and related characteristics; 2) Assess the County's historical expenditures, policies and practices regarding road rehabilitation, maintenance and reconstruction; and their impacts on road width, surface condition, etc.; 3) Develop a "budget and environmental sustainability framework" to guide the analyses and recommendations; 4) Survey 8,800 rural residences to gauge their satisfaction with current roads, and to obtain their feedback on priorities and budget and environmental sustainability measures; and 5) In the light of the above assessments, complete the analyses and provide recommendations regarding the County's road rehabilitation (overlay) and maintenance policies and practices, and identify net savings that could be allocated to high traffic volume roads.

**CONCLUSIONS:** A "budget and environmental sustainability framework" was developed to guide the analyses and recommendations. The most important issues identified in the public consultation process were narrow widths and the need to improve high traffic volume Class I roads. The main recommendations of the study are:

1. Implement strategies to preserve road width or delay width loss; the paper provides a list of the various strategies and their advantages and disadvantages.
2. Discontinue the practice of fixed overlay cycles, and instead determine overlay priorities based on annual condition ratings. This is expected to produce net cost savings.
3. Undertake a Life Cycle Cost Analysis of the paved rural road network, and apply pavement management principles to identify the most cost-effective treatments and the schedule of their application, with a view to obtaining the optimum balance between deferred overlays and increased maintenance costs.
4. Within the existing budget levels, reallocate the net savings (achieved by discontinuing the fixed overlay cycles) to the widening and reconstruction of higher volume, un-improved Class I roads.

**PURPOSE AND SCOPE OF THE STUDY**

Strathcona County, situated east of Edmonton, is Alberta's fourth largest rural municipality with a population of over 88,000. It is one of the five Specialized Rural Municipalities in the province, and as such it includes a large Urban Service Area (Sherwood Park, population 62,000) which would be the fifth largest city in Alberta if it were an incorporated "city" in its own right. The County's Rural Service Area (population 26,000) includes farms, numerous country residential subdivisions and eight Hamlets, and the largest portion of "Alberta's Industrial Heartland", a five-municipality special area zoned for heavy industrial development mainly related to heavy oil refining and upgrading. Providing efficient, safe and effective transportation infrastructure and services to the extremely varied land uses in the County (low density farmland, numerous country residential subdivisions, a large urban area and heavy industry) is challenging but essential for the social and economic well-being of the County residents. In addition to the usual transportation functions of a typical rural municipality (such as access to employment, shopping, medical, educational, and farming and other services, and social interaction needs of the residents) Strathcona County must also look after special transportation needs of, to give two examples, the extensive medium and heavy industries in the County, and the daily commuters to/from the cities of Edmonton and Fort Saskatchewan. All this must of course be done in view of the needs, preferences, and opinions of the County residents, as well as within the framework of environmental and fiscal sustainability.

The management of the County's rural road network have been guided by the County's Rural Roads Master Plan (RRMP) 1995 (Strathcona County, 1995), as updated by the various administrative reviews prepared by County staff, the latest of which was the Rural Roads Master Plan – Extension Report (RRMPER) 2003 (Strathcona County, 2003). In June 2009, the County retained the services of EBA Engineering Consultants Ltd. to update the 1995 RRMP and 2003 RRMPER, and to develop the Sustainable Rural Roads Master Plan (SRRMP) 2010 related to the County's 1,302 km rural road network. Note that the roads within the Urban Service Area of Sherwood Park were not part of the study.

This paper presents the results of selected aspects of the SRRMP 2010 study. The major objectives of the study reported in this paper pertain to rural road rehabilitation (overlay) and maintenance policies and practices for various functional design classes, and future budget allocations among rehabilitation, maintenance and reconstruction activities. Three overarching guidelines were: 1) Environmental sustainability (with respect to the environmental footprint of the County's rural road works); 2) Budget sustainability (reallocation within existing budget levels); and 3) Feedback from the County's rural residents.

The main source of data for this study was the County's comprehensive rural road inventory system (COTRIS) which contains detailed historical information on almost all aspects of the road network. The invaluable assistance provided by the County staff in tapping COTRIS's capabilities and in providing additional information is gratefully acknowledged. Other published and unpublished sources utilized are referenced in the text and listed in alphabetical order in the References Section at the end of this report.

Note that all tables are grouped at the end of the paper, followed by Figure 1.

**ENVIRONMENTAL, ECONOMIC/FISCAL & SOCIAL SUSTAINABILITY FRAMEWORK**

## Introduction

An overarching imperative and governing concept for EBA's work for the SRRMP 2010 was the "sustainability" of the County's road network from social, environmental and budget viewpoints. To achieve that objective, this section describes the "sustainability framework" which guided the technical analyses and the resulting recommendations throughout the entire study.

Strathcona County's Strategic Plan commits the County to consciously move toward creating a sustainable community. The Strategic Plan emphasizes a balanced, triple-bottom-line approach to encourage a balance of social, environmental and economic elements to sustain a health and vibrant community.

To realize the goals of the Strategic Plan, the County has developed three frameworks:

1. The Social Sustainability Framework was approved by Council in March 2007 as the first step in endorsing a sustainable community that balances social, economic and environmental components.
2. The Environmental Sustainability Framework, a guide to assess environmental factors and impacts in the County's planning and decision making, was approved in June 2009.
3. The Economic Sustainability Framework, a guide to decision making toward fostering a healthy economy that benefits residents, business and industry, is currently being developed.

In a practical sense, Strathcona County's Municipal Development Plan, Bylaw 1-2007 (MDP), makes sustainability a cornerstone of the County's future growth management. Section 4 of the MDP titled "Sustainability and Growth", sets down the principles, objectives and policies that will govern the County's practices in 12 sustainable development themes, including "transport". In terms of encouraging its residents to practice environmentally sustainable lifestyles, the County is already actively promoting green living through its various initiatives.

Transportation infrastructure (e.g. roads, railways, airports, sea ports) and services are a derived demand, in that they are never built for their own sake but rather to serve the needs of land use and economic developments, which in turn determine the scope, standards and level of service and safety that the transportation infrastructure is expected to provide. Transportation of course also helps improve community interconnectivity and social interaction, and provides the necessary access to recreational, medical, educational, shopping, employment and other services and activities. In other words, it's the land use and development policies and practices that govern the demand and supply for transportation.

In terms of environmental impacts of transportation, recently the greatest attention has been paid to the emission of greenhouse gases by vehicles (cars, trucks, railway trains, airplanes and ships, and road construction equipment). This is understandable because the transportation sector is the largest emitter of greenhouse gases in Canada, accounting for over 26% of all greenhouse gases emitted Canada in 2006 (Environment Canada web site).

However, other aspects of the transportation sector also contribute to its environmental footprint; these include consumption of land for roads, lanes and parking lots; use of building materials like gravel, cement and asphalt; disturbance of natural habitats by roads and railways; noise; smog; visual intrusion.

Much literature is available on the subject of transportation vis-à-vis the environment, spanning a very broad range of environmental adaptation, mitigation and reduction measures. In terms of road infrastructure, these cover the entire spectrum of road planning, design, construction, reconstruction, rehabilitation/overlays and maintenance activities. (Selected recent references about the road mode include: Haichert, 2009; Sloan 2009).

## SUSTAINABILITY CONSIDERATIONS

Certain means of reducing the environmental footprint of road transportation, such as mandating better fuel efficiency of road vehicles, and better thermal efficiency of fuels are in the purview of the federal government, which has issued recent directives in both respects.

Municipal jurisdictions like Strathcona County do have many other means of lessening the negative environmental impacts of transportation infrastructure and use. In the urban Hamlet of Sherwood Park, the County has implemented measures of reducing the environmental footprint of roads and travel, such as transit, walking, biking, traffic signal coordination, and other demand management and traffic engineering techniques.

Because of the low population density in rural areas of the County, the high car ownership and nearly complete reliance on private cars, it is not practicable to implement on rural roads the above mentioned "urban" measures of reducing the environmental footprint of roads and travel. Fortunately, however, there are many other measures that the County can utilize in the construction, rehabilitation and maintenance of the rural road network.

The following are some of the considerations and guidelines that were employed in EBA's analyses of the various elements of this study with a view to achieving the twin goals of environmental and fiscal sustainability of the County's rural road network:

1. Base spending decisions on objective criteria, such as surface condition, rather than on a fixed annual number of kilometres of overlays.

2. Utilize design standards that will satisfy the level of service and safety requirements while minimizing the environmental footprint of the transportation infrastructure.

3. Recycle existing hot mix and cold mix pavement surfaces; this may help postpone the need for widening. Other environmental benefits of recycling include conservation of non-renewable resources.

4. Utilize techniques that use less material (e.g. crack filling, seal coats and other maintenance measures rather than overlays).

5. If cost is not significantly different, use pavement types with a longer life (e.g. hot mix instead of cold mix).

6. Find efficiencies in the existing rural road budget levels to fund un-met high priority needs.

To validate EBA's sustainability concepts and to obtain feedback from the County's rural residents, the respondents to the public consultation survey questionnaire were asked to rate the four budget and environmental sustainability measures, which they rated in the following order of priority (details are discussed in Section 5):

1. Schedule maintenance and overlay decisions based on annual road condition assessments rather than overlaying a fixed annual number of kilometres.
2. Establish road surface type and/or width based on safety and type of use.
3. Increase the recycling of existing pavements to reduce the narrowing effect of successive overlays.
4. Increase spot repairs (e.g. crack filling, seal coats) rather than full road resurfacing.

All of these measures have been incorporated in the appropriate discussions and recommendations of the study.

There may be some practical difficulties and impediments in implementing some of the above measures, including the following:

1. We understand that the County uses its own work force for cold mix overlays and other road work activities. Some of the above measures (e.g. more recycling, which is specialized private sector work) or substitution of maintenance for overlays, would mean less work for the County's own work forces.
2. Recycling is a specialized type of work and several technologies are available in Alberta. Economies of scale may require a certain contract size (in terms of no. of kilometres), which may not be available on County roads at a given location because of the potentially scattered distribution of relatively small recycling candidate projects. The County may want to undertake a pilot recycling project to assess its costs and benefits of the most promising of these technologies.

## SALIENT FEATURES OF THE COUNTY'S RURAL ROAD NETWORK

Background information and data regarding the various aspects of the County's 1,302 km rural road network are presented below. The map in Figure 1 shows the County's rural grid roads, as well as the provincial highways traversing the County.

### Rural Road Functional Classification

Listed below are the definitions of the County's functional rural road classifications and the current geometric and surfacing standards associated with them. Table 1 provides a summary of the selected key elements for the various functional road classifications, such as traffic volume criteria for functional classification, design speed, posted speed, road width, design life, surface type and right-of-way requirements, etc. Table 2 shows the existing surface types and traffic volumes for the various functional road classes.

Class I Grid Roads: typically carry over 1,000 vehicles per day (vpd); 9.0 m top width; current surface standard is hotmix; ROW 40.0 m.

Class II Grid Roads: typically carry between 250 vpd and 1,000 vpd; 7.5 m top width; current surface standard is coldmix; ROW 40.0 m (minimum 30.0 m).

Class III and Class IV Grid Roads: typically carry less than 250 vpd; 7.5 m top width; ROW 30.0 m.

Class III Grid Roads: typically carry less than 100 vpd; and a have gravel surface.

Class IV Grid Roads: typically carry between 100 and 250 vpd; and receive oil-based dust-suppression.

Rural Hamlet Roads: located within the boundaries of rural hamlets, are subdivided into two categories: roads in "high density parcel development" have 9.0 m gutter-to-gutter width, and 18.0 m ROW; while roads in "low density parcel development" (also described as country residential or rural density) have 8.5 m top width, and a 30.0 m ROW. There is no typical traffic volume requirement for rural hamlet roads, and the current surface standard is hot mix.

Country Residential Subdivision (CRS) Roads: have a top width of 8.5 m, and 30.0 m ROW. There is no typical traffic volume requirement for CRS roads, and the current surface standard is hot mix.

Ten Provincial Highways (No.'s 14, 15, 16, 21, 38, 216, 628, 630 and 830 as well as the un-numbered Sherwood Park Freeway) traverse the County; these are under the jurisdiction of Alberta Transportation (AT). Of these, Highway No.'s 628, 630 and 830, previously known as Secondary Highways, were in the County's jurisdiction under a cost shared arrangement with AT until 2001, at which time AT took them into the provincial highway system.

## Traffic Volumes

Traffic volume in terms of vehicles per day (vpd) is the most important determinant of the functional classification, design and surfacing standards, and related elements of a road. The County regularly updates the traffic counts on its roads. Figure 1 shows the two-way vpd counts taken during the last few years at various points on the rural road network. Table 2 shows the overall averages and ranges of traffic volumes for each of the six road classifications: Grid road Classes I, II, III and IV; CRS roads and Hamlet roads. The main conclusion regarding traffic volumes on the County's rural road network is that, not surprisingly, Class I roads carry the highest traffic volumes because they funnel rural traffic to and from Sherwood Park, Fort Saskatchewan, Edmonton, the Industrial Heartland area, and major provincial highways. Most rural residents in the County, regardless of where they live, end up using Class I roads in their daily travels, which carry five times the average traffic volumes of Class II roads: 2,180 vpd compared to 440 vpd.

## Surface Types

Table 2 shows the kilometres by surface type for each of the six functional road classifications in 2008. The main conclusion is that a significant proportion of Class I and CRS roads need improvement in surface type to meet the current standards. The County has an ongoing program of rehabilitation for CRS roads at which time the current surfacing standard of hot mix is provided. See below for recommendations regarding bringing the currently cold mix Class I roads up to hot mix standard.

## Road-top Width

Table 3 summarizes the road width statistics as of November 2008; for each road classification it shows the number of kilometres in various road width bands.

Many rural roads were originally constructed to a previous narrower road width standard. In addition, a main reason for narrow road widths, particularly for Class II cold mix roads, is that repeated overlays have further narrowed the road width. The result is that currently large proportions of the County's rural roads in the various functional road classes are narrower than the current design road-top width for their design class. The overall narrow width statistics, as shown for each functional road class below, may sound alarming; but when we look at how many kilometres are narrower by how much when compared to the current width standards, the conclusion is that the picture is not as bad as it looks at first glance.

When discussing the narrow road widths, it should be kept in mind that an analysis conducted by EBA of a sample of Strathcona County rural road crashes found no evidence that narrow width is directly correlated with higher crash frequencies. In general, road width becomes a problem if a narrow road carries relatively high traffic volumes and has other geometric or alignment deficiencies.

**Rural Roads Budget**

In 2009 the rural roads were allocated 5.8% ($13.5 million) of the County's total budget of $232 million. (This proportion is up from the 2005 rural roads budget of 3.6% ($7.09 million) of the County's total budget of $194.6 million). The 2009 rural roads budget of $13.5 million comprised $9.0 million for capital works (mainly rehabilitation of Class II and CRS roads), and $4.6 million for maintenance. For reasons discussed below, Class I roads are relatively underfunded.

## OVERVIEW OF THE COUNTY'S HISTORICAL REHABILITATION/OVERLAY PRACTICES

The County's budget allocations for the various functional road classes have been guided mainly by the recommendations in the 1995 RRMP as amended by the 2003 RRMPER.

With a view to ensuring improvement of a majority of the rural roads, the 1995 RRMP had recommended that the 491 km Class II coldmix network should be rehabilitated (overlaid) on a fixed 7.5 year cycle. Under this guideline approximately 65 km per year were cold mix overlaid. The 2003 RRMPER changed the overlay cycles from 7.5 years to 10 years (or 65 km to 49 km per year). Starting in 2009, a 12 year overlay cycle (i.e. 40 km per year) has been implemented.

Similarly, for CRS roads the County has a program to improve the cold mix CRS roads to the hot mix standard by carrying out 100% base stabilization and paving with hot mix. This is done on a fixed 15 year cycle from 2005 onwards; the previous cycle was 10 years.

The result is that the surface condition of the Class II cold mix network and the CRS roads has steadily improved over the years and is now excellent.

However, this policy of overlaying a fixed number of kilometres per year of Class II and CRS roads has created some unwanted effects:

1. Repeated overlays may improve the road surface condition, but they create or exacerbate the narrow road-top width problems because they produce a permanent loss in width. That in turn gives rise not only to safety risks on relatively high volume roads, but also to much more expensive future widening/reconstruction required to restore the road to proper width standards. It should be noted that each 50 mm coldmix overlay causes a road-top width loss of about 0.2 m, assuming a 2:1 sideslope of the overlay layer.

2. Although the overlay projects are prioritized annually based on condition (worst first) by utilizing a formula that gives weights to the percentages of base failure, surface failure, surface patching and riding quality, the inevitable consequence of a "mandated" minimum number of kilometres per year based on a fixed overlay cycle is that some roads in good condition are being overlaid.

3. Given that the total capital budget for rural roads in a given year is fixed, Class II and CRS roads overlays on the basis of a fixed number of km per year mean that insufficient funds are available for relatively high traffic volumes Class I roads.

**PUBLIC CONSULTATION WITH RURAL RESIDENTS**

Public consultation for the SRRMP 2010 study consisted of two phases:

1. A mail out questionnaire survey of nearly 9,000 rural residences in the County was conducted in September 2009. The questionnaire asked the rural residents to rate each of the functional road classes that they frequently use, and rate the factors used to determine priorities, the types of improvements and environmental sustainability measures. The response rate was nearly 9%, which is considered representative.

2. Three open houses (October 13, 14 and 15, 2009) to present the results of the questionnaire survey and obtain additional feedback; and

Among the many issues identified in the analysis of the ratings provided in answers to specific items in Questions 1 to 9 of the survey questionnaire, the more than one thousand narrative comments and suggestions in Question 11, and the feedback received at the three public open houses, the following four issues are considered to be the top priorities for the rural residents who use the County's rural roads.

It is interesting to note that the public's priorities are in line with the conclusions reached by EBA based on a technical analysis of the rural road network's characteristics and needs.

**1. Widen narrow roads**

Narrow road-top width is the top concern of Strathcona County rural residents. While the rural residents like the smooth riding quality provided by frequent overlays, they are very concerned with the narrowing effect of the overlays on road width. In the narrative comments, there were many that alluded to: the roads becoming narrow pyramids if we keep overlaying them without widening; money "being wasted on overlaying roads that are in good condition"; etc.

**2. Complete improvements to the Class I network**

The public's high priority for completing the improvements to the Class I network is not surprising because most rural residents end up on the high traffic volume Class I roads as they travel to and from Sherwood Park, Fort Saskatchewan and Edmonton, or connect to the provincial highways.

**3. Make roads with high traffic volumes and/or safety issues a priority**

This reflects the public's priority for safety, which is rightly perceived to be more of a problem on high traffic volume roads (and, per the width issue raised above, also with narrow roads).

### 4. Keep maintenance levels high

In terms of sustainable budgets, the public is aware that capital investments (reconstructions, overlays) are expensive, and that a high level of maintenance is a cost-effective alternative. Also, in general the public wants the County to keep up with the routine maintenance, such as crack filling, pothole repairs, snow clearing, etc.

## CONCLUSIONS

The relevant conclusions of the study are presented below.

### OVERLAY CYCLES

The County's historical and current overlay practices and the resulting width reductions caused by successive overlays have been discussed above. This section presents some overall ideas regarding overlay cycle lengths and how to deal with width reductions.

1. The practice of overlaying a fixed number of kilometres (based on a fixed cycle) each year (of Class II cold mix pavements and of CRS cold mix road improvement to hot mix) should be discontinued. Instead, overlay priorities should be based on annual condition ratings. In other words, pavements should be overlaid only when required. It is expected that in many cases, maintenance would suffice for a few years instead of overlay, thus extending the pavement life.
2. To obtain the optimum balance between deferred overlays and increased maintenance costs, it is recommended that the County should undertake a Life Cycle Cost Analysis of the paved rural road network, and apply pavement management principles to identify the most cost-effective treatments and the schedule of their application.
3. Alternative rehabilitation strategies, as discussed below under width loss preservation, should be explored and implemented. Pilot projects for the more promising of these strategies should be implemented to assess their feasibility and cost.

Extending the overlay cycle by overlaying as needed, or implementing in-place recycling technologies contributes to sustainability and provides several benefits, by: (1) maintaining the width, or reducing width loss, and delaying future widening, (2) being more environmentally friendly by reducing quantities of non renewable aggregate and asphalt materials incorporated into County roads, (3) reducing damage to other grid roads used to haul materials, and (4) producing budget savings that can be allocated to higher traffic volume roads in need of improvement.

### How to preserve width or delay width loss

As discussed earlier, an overlay of an existing road reduces the pavement surface because of the constructed sideslope of the overlay. For a Class II road based on a 50 mm cold mix overlay and 2:1 overlay sideslope, each overlay will result in a pavement width loss of about 0.2 m. For a Class I road based on a 50 mm hot mix overlay and 4:1 overlay sideslope, each overlay will result in a pavement width loss of about 0.4 m.

Some comments regarding preservation of road width in various road operations are provided below:

**Reconstruction**

As a matter of course, any new construction or reconstruction of an existing road should be to the current road width standards. It should be noted that the County's design standards for new road construction/reconstruction provide road-top width sufficient for two overlays. For example, the road-top width standard for Class I hotmix roads is 9.0 m; and therefore a new or reconstructed Class I hot mix road is built with a 10 m road-top width so that the top width would be greater than 9.0 m even after two overlays.

**Overlays**

Preservation of road width should be a prime objective during pavement overlays. Several strategies for width preservation when designing and placing overlays are included in Table 9 discussed below.

**Safety Improvement Projects**

Implementation of spot safety improvement projects offers a good opportunity to address the width issue, at least within the limits of the safety improvement project. Widening the road to current standards as part of safety improvements should normally be a cost-effective proposition.

**Routine Maintenance**

All attempts should be made to retain the existing road width when carrying out routine maintenance operations.

Table 4 lists various strategies that can help preserve or delay pavement width loss, or at least slow down the rate of width reduction. It is recommended that pilot projects for the more promising of these strategies should be implemented to assess their feasibility and cost. It is recognized that these strategies may need some modifications to successfully address specific conditions that may be unique to the County's rural road network.

## FRAMEWORK FOR NEED PRIORITIZATION AND SUSTAINABLE BUDGET ALLOCATION

This section discusses the framework and assumptions utilized to estimate savings within the current overall rural roads budget levels, reallocation of the savings on the basis of need, and the general principles and guidelines to prioritize the needs.

Since budgets in most road agencies are normally limited and are not sufficient to meet all needs in a given year, prioritization of needs is necessary. The following is a recommended scheme to prioritize the needs and expenditures for Strathcona County rural roads. It should be noted that this prioritization scheme is a logical general guideline. The Council and County staff will of course consider and respond to other factors, such as public complaints, unexpected urgent or important non-urgent events, industry's emerging requirements, in determining priorities in a given year. Indeed, a side benefit of doing away with fixed overlay cycles (which result in a fixed number of kilometres of overlays each year) is to give the Council and County staff the flexibility to respond to emerging needs.

**1. Preservation of Investment**

This is done in two ways:

a. Maintenance according to the County's maintenance standards and practices for the various functional classes. It should be noted that proper maintenance can help delay the more expensive overlays or reconstruction, and therefore are the backbone of an environmentally and fiscally sustainable road management system. It is recommended that adequate maintenance should be kept up even on the road sections that may appear to be candidates for overlays.

b. Overlays as needed on the basis of condition ratings help to preserve the road surface, and thus delay more costly reconstruction.

**2. Safety Improvements**

Road safety improvements in conjunction with rehabilitation, reconstruction and widening projects are an obvious and effective means of implementing the needed safety improvements. In addition, the County should give a high priority to redressing localized safety problems as discrete projects.

**3. Re-allocation of Budget Savings to Address the Narrow Width Problem**

The net budget savings from measures suggested above could be utilized in the following rough priority order. The recommendations assign the highest priority to Class I roads that are narrow and/or need surface improvement, followed by Class II roads that need width improvement. It is understood that the County already has programs for dealing with the Country Residential roads and Hamlet roads.

Provided below are general guidelines that the County can apply to determine project priorities for the annual capital programs. In general, to determine priorities of individual projects within each category, consideration should be given to the road width, volume and type of traffic, safety issues (collision history), and other emerging needs as discussed above.

Priority 1: Reconstruct un-improved Class I roads requiring improvement in both width and surface type

Priority 2: Reconstruct Class I roads requiring improvement in width

Priority 3: Reconstruct Class II roads requiring improvement in width

It is anticipated that the County will have the flexibility to decide, for example, whether the highest rated Class II road under Priority 3 above has for other reasons a better case than the lowest rated Class I road under Priority 2 above. EBA believes that a prioritization scheme should not be so rigid as to restrict the discretion and flexibility of the County Staff or Council to decide on the basis of emerging factors that cannot be captured in a rigid prioritization scheme.

## CONCLUSIONS AND RECOMMENDATIONS

The main recommendations of the study are:

1. Implement strategies to preserve road width or delay width loss; the paper provides a list of the various strategies and their advantages and disadvantages.
2. Discontinue the practice of fixed overlay cycles, and instead determine overlay priorities based on annual condition ratings. This is expected to produce net cost savings.
3. Undertake a Life Cycle Cost Analysis of the paved rural road network, and apply pavement management principles to identify the most cost-effective treatments and the schedule of their

application, with a view to obtaining the optimum balance between deferred overlays and increased maintenance costs.

4. Within the existing budget levels, reallocate the net savings (achieved by discontinuing the fixed overlay cycles) to the widening and reconstruction of higher volume, un-improved Class I roads.

## DISCLAIMER

The opinions expressed in this paper are of the authors and do not necessarily represent the opinions or policies of Strathcona County.

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| TABLE 1: SUMMARY OF SELECTED ELEMENTS OF CURRENT RURAL ROAD DESIGN STANDARDS | | | | | | | |
|---|---|---|---|---|---|---|---|
| Functional Classification | Traffic Volume (vpd) | Design Speed | Posted Speed | Road Width | Design Life | Surface Type | Right-of-Way |
| Rural Grid Road – Class I | Greater than 1,000 vpd | 100 km/h | 80 km/h (in some cases 50 km/h) | 9m (3.5m lanes, 1.0m shoulder) | 20 years | Hotmix Asphalt | 40m |
| Rural Grid Road – Class II | 250 vpd to 1,000 vpd | 90 km/h | 80 km/h (in some cases 50 km/h) | 7.5m (3.75m lanes) | 10 years | Coldmix Asphalt | 40m (30m min.) |
| Rural Grid Road – Class III | Less than 250 vpd | 90 km/h | 80 km/h (in some cases 50 km/h) | 7.5m (3.75m lanes) | N/A | Gravel with Spot Dust Suppressant | 30m |
| Rural Grid Road – Class IV | Less than 250 vpd | 90 km/h | 80 km/h (in some cases 50 km/h) | 7.5m (3.75m lanes) | N/A | Dust Suppressant | 30m |
| Rural Hamlet Road – High Density Parcel Development | Refer to Urban Engineering Services Standards (2005) Section B Roads | | | | | | |
| Rural Hamlet Road – Low Density Parcel Development | Not Defined | Not Specified | Not Specified | 8.5m (3.5m lanes, 0.75m shoulders) | 20 years | Type ACR Asphalt Surface Course with Type III Asphalt Base Course | 30m |
| Rural Residential Subdivision Road (Country Residential Subdivision) | Not Defined | Not Specified | Not Specified | 8.5m (3.5m lanes, 0.75m shoulders) | 20 years | Type ACR Asphalt Surface Course with Type III Asphalt Base Course | 30m (with a 3.5m easement on either side) |
| Rural Commercial Developments | Not Defined | Not Specified | Not Specified | Not Specified | Not Specified | Not Specified | Not Specified |
| Rural Industrial Local Roadway | Not Defined | Not Specified | Not Specified | 9.0m | Not Specified | Type ACO Asphalt Surface Course with Type III Asphalt Base Course | 30m (with a 3.5m utility easement on either side) |
| Rural Industrial Collector Roadway | Not Defined | Not Specified | Not Specified | 11.5m | Not Specified | Type ACO Asphalt Surface Course with Type III Asphalt Base Course | 30m (with a 3.5m utility easement on either side) |

Source: Strathcona County

| TABLE 2: KILOMETRES BY SURFACE TYPE & AVERAGE TRAFFIC VOLUMES ON VARIOUS RURAL ROAD CLASSES (2008) | | | | | | |
|---|---|---|---|---|---|---|
| Functional Road Classification | Vehicles/day Average (Range) | Kilometres by Existing Surface Type (%) | | | | |
| | | Paved Hotmix Asphalt | Paved Coldmix Asphalt | Dust-Suppressed Gravel | Gravel | TOTAL |
| Class I Grid | 2,180 (500 – 13,000) | 43.30 (54.4%) | 35.70 (45.6%) | 0 | 0 | 79.00 (100%) |
| Class II Grid | 440 (60 – 1,400) | 2.60 (0.6%) | 481.98 (98.2%) | 0 | 5.90 (1.2%) | 490.48 (100%) |
| Class III Grid | 40 (20 - 100) | 1.25 (0.7%) | 1.10 (0.7%) | 10.80 (8.1%) | 121.90 (90.4%) | 135.05 (100%) |
| Class IV Grid | 130 (40 - 450) | 0.40 | 1.60 (0.9%) | 230.00 (98.7%) | 1.00 (0.4%) | 233.00 (100%) |
| Subtotal Class I to IV Grid Roads | | 47.55 (5.0%) | 520.38 (55.5%) | 240.80 (25.7%) | 128.80 (13.8%) | 937.53 (100%) |
| Country Residential | N/A (40 - 180) (est.) | 147.84 (44.4%) | 185.66 (55.6%) | 0 | 0 | 333.50 (100%) |
| Hamlet | N/A (40 - 300) (est.) | 20.49 (67.7%) | 7.96 (25.8%) | 0.20 | 1.97 (6.5%) | 30.62 |
| TOTAL RURAL ROADS | | 216 (16.6%) | 714 (54.8%) | 241 (18.5%) | 131 (10.1%) | 1,301.65 (100%) |

Source: Strathcona County

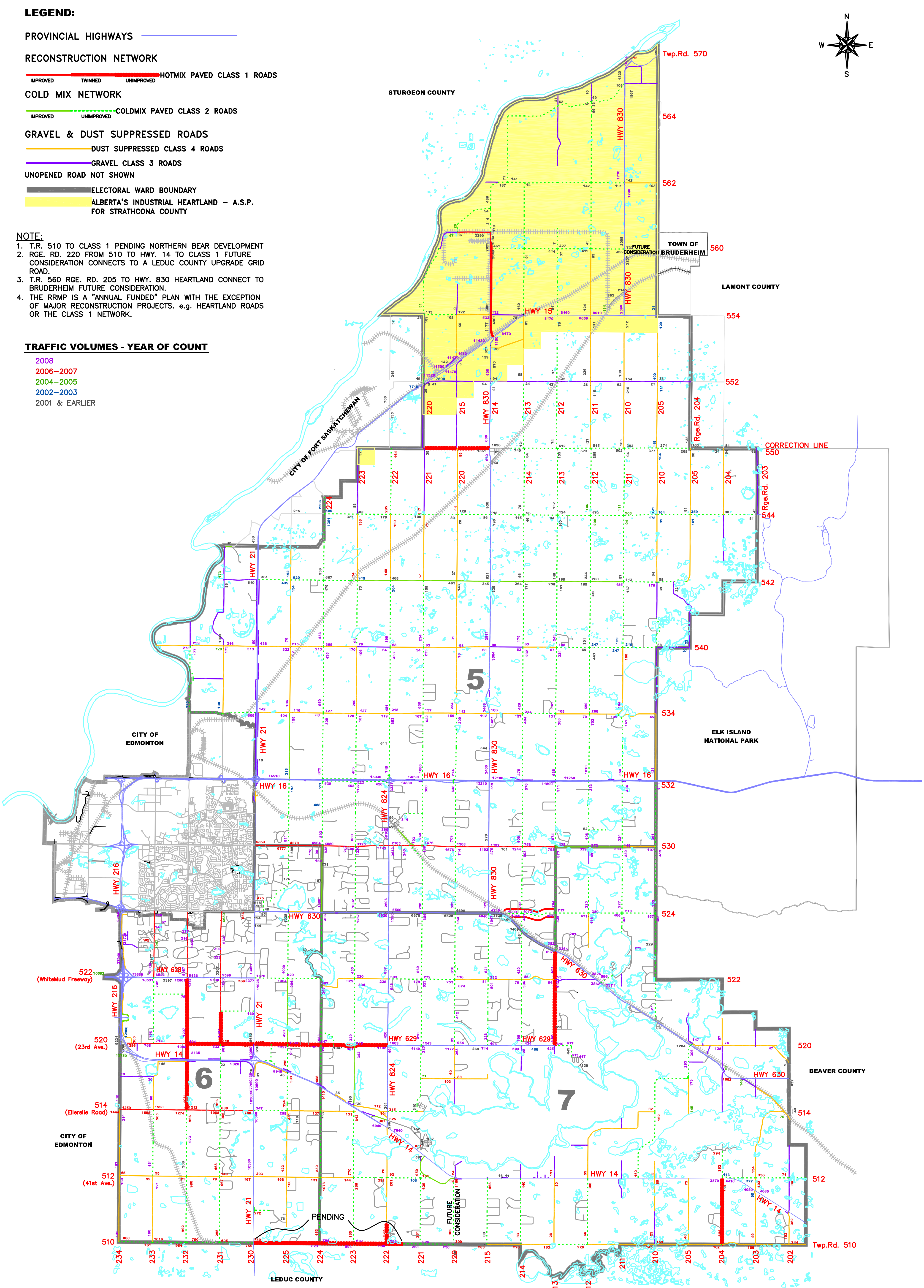
| TABLE 3: RURAL ROAD KILOMETRES BY ROAD CLASSIFICATION IN VARIOUS ROAD-TOP WIDTH RANGES (2008) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Road Classification | Current Design Road-top Width (m) | No. of Kilometres by Road-top Width Range (m) | | | | | | | | | | |
| | | Less than 5.0 m | 5.0-5.4 m | 5.5-5.9 m | 6.0-6.4 m | 6.5-6.9 m | 7.0-7.4 m | 7.5-7.9 m | 8.0-8.4 m | 8.5-8.9 m | 9.0- 9.9 m | 10.0 or more m | Total Km |
| Class I (km) | 9.0 | 0 | 0 | 0 | 0 | 9.6 | 15.1 | 12.1 | 10.9 | 3.2 | 17.6 | 9.9 | 79.0 |
| % | | 0.0% | 0.0% | 0.0% | 0.0% | 12.2% | 19.1% | 16.1% | 13.8% | 4.1% | 22.3% | 12.5% | 100.0% |
| Class II (km) | 7.5 | 0.1 | 1.6 | 52.7 | 102.2 | 205.0 | 83.0 | 28.5 | 11.4 | 1.4 | 4.4 | 0.2 | 490.5 |
| % | | 0.0% | 0.3% | 10.% | 20.8% | 41.8% | 16.9% | 5.8% | 2.3% | 0.3% | 0.9% | 0.0% | 100.0 % |
| Class III (km) | 7.5 | 9.9 | 8.1 | 24.2 | 23.2 | 31.0 | 17.7 | 11.4 | 1.7 | 4.2 | 2.5 | 1.3 | 135.1 |
| % | | 7.3% | 6.0% | 17.% | 17.2% | 22.9% | 13.1% | 8.4% | 1.3% | 3.1% | 1.9 % | 1.0 % | 100.0 % |
| Class IV (km) | 7.5 | 0.2 | 1.0 | 17.6 | 48.9 | 104.6 | 39.8 | 9.6 | 8.0 | 3.3 | 0 | 0 | 233.0 |
| % | | 0.1% | 0.4% | 7.6% | 21.0% | 44.9% | 17.1% | 4.1% | 3.4% | 1.4% | 0.0 % | 0.0 % | 100.0 % |
| Total Class I to IV (km) | | 10.2 | 23.6 | 91.7 | 232.2 | 317.0 | 138.2 | 63.1 | 32.6 | 8.9 | 24.5 | 11.4 | 937.5 |
| % | | 1.1% | 1.1% | 10.% | 18.6% | 37.3% | 16.6% | 6.6% | 3.4% | 1.3% | 2.6 % | 1.2 % | 100.0 % |
| CRS (km) | 8.5 | 1.2 | 0 | 0.4 | 20.3 | 158.1 | 103.2 | 1.5 | 17.7 | 16.9 | 14.1 | 0 | 333.5 |
| % | | 0.4% | 0.0% | 0.1% | 6.1% | 47.4% | 30.9% | 0.4% | 5.3% | 5.1% | 4.2% | | 100.0 % |
| Hamlet (km) | 9.0 | 3.8 | 1.6 | 3.0 | 3.5 | 7.2 | 5.2 | 4.7 | 0 | 0.2 | 1.0 | 0.6 | 30.6 |
| % | | 12.4 % | 5.2 % | 9.8 % | 11.4 % | 23.5 % | 17.0% | 15.4% | 0.0 % | 0.7 % | 3.3 % | 2.0 % | 100.0 % |
| TOTAL RURAL ROADS | | 15.2 | 24.2 | 95.1 | 256.0 | 482.3 | 246.6 | 69.3 | 50.3 | 26.0 | 39.6 | 12.0 | 1301.6 |
| % | | 1.2 % | 1.8 % | 7.3 % | 19.7 % | 37.0 % | 18.9% | 5.3 % | 3.8 % | 2.0 % | 3.0 % | 0.9 % | 100.0 % |

Source: Strathcona County

| TABLE 4: ALTERNATIVE STRATEGIES FOR PRESERVING OR DELAYING PAVEMENT WIDTH LOSS | | | |
|---|---|---|---|
| Strategy | Effect on Width Loss | Technical Aspects | Cost Implications |
| 1. Use maintenance to delay overlay | Existing width is maintained for a longer period of time; this can lead to longer overlay cycles. | Increased maintenance required for the delay period. | Modest increase in ongoing maintenance costs; high cost for overlay is deferred. |
| 2. Reduce coldmix overlay thickness from 50mm to 40mm | Very slight reduction in width loss of less than 0.04m (2:1 side slope assumed). | May be more difficult to restore crown and may result in inadequate overlay thicknesses in some locations. | 20% reduction in coldmix material cost. |
| 3. In-place Recycling – Full depth reclamation (FDR) | Reuses existing granular and asphalt bound material. Can only maintain/reduce width loss if the subgrade is reshaped during subgrade preparation or if the overlay thickness can be reduced significantly. Removes existing crack history and mitigates reflection cracking. | Requires a granular layer for recycling. Fine grained subgrade soils can not be incorporated into the FDR. Requires an asphalt bound wearing surface. FDR material needs to be engineered. | Potential cost savings only if the overlay thickness can be reduced due to the increased load carrying capacity of the stabilized FDR. |
| 4. In-place Recycling - Cold In-Place Recycling (CIR) | Can only reduce width loss if the overlay thickness can be reduced significantly. Reuses a portion of the existing asphalt bound layer. Removes existing crack history and mitigates reflection cracking. | Requires an asphalt bound wearing surface. CIR material needs to be engineered. | Potential cost savings only if the overlay thickness can be significantly reduced. |
| 5. Cold Mill 40mm and overlay 40mm | Existing width is not changed. | Does not add strength to the pavement structure. Opportunity to recycle cold millings. | Increased cost due to cold milling. Recycling of cold millings may reduce costs. |

| | | | |
|---|---|---|---|
| 6. Base stabilization and overlay | Can only maintain/reduce width loss if the subgrade is reshaped during subgrade preparation or if the overlay thickness can be reduced significantly. Reuses existing granular and asphalt bound material. Removes existing crack history and mitigates reflection cracking. | Experience and judgment required to determine locations for stabilization and to determine moisture conditioning requirements. Reshaping of the subgrade results in a lower road profile and potential for weaker subgrade support conditions. | Modest additional cost to double handle the scarified material and reshape the subgrade during subgrade preparation. |
| 7. Longer overlay cycles | Existing width is maintained for a longer period of time. Comparing a 10 year to a 14 year coldmix cycle over a 40 year period, an 10 year cycle (50mm and 2:1 sideslopes) would result in a total width loss of 1.0m vs. 0.6m for a 14 year cycle. | Increased maintenance required for the delay period. | Modest increase in ongoing maintenance costs; can result in the reduction of 1 or 2 overlays; high cost for overlay is deferred |
| 8. Grade widening | Pavement width is reconstructed to meet present standards with an allowance for future overlays. | May require purchase of Right-of-Way. | Very high capital cost. Lowest maintenance cost of all strategies. |
| 9. Overlay with subgrade sideslope improvement | Maintains existing pavement width. | Sidesloping may reduce ditch bottom width. | Additional cost. |
| 10. Surface treatment (graded aggregate or double seal) to replace asphalt bound surface course following Base Stabilization | Maintains existing width. | Would require improved workmanship of stabilized layer to provide a smooth and proper cross-section; cycle to next overlay would be reduced to 6 to 8 years. | Graded aggregate seal coat is less expensive than coldmix. |

# FIGURE 1: STRATHCONA COUNTY GRID ROAD NETWORK SHOWING TRAFFIC COUNTS




# STRATHCONA COUNTY SUSTAINABLE RURAL ROADS MASTER PLAN
## October - 2009