Memorandum

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File: Sturgeon SRIS

To: Bob Stephen, C.E.T.
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Re: **Briefing Note – SRIS - Existing State of the Infrastructure**

Background

As part of the Sustainable Roadways Improvement Strategy (SRIS) project, a condition inspection was completed for the County roadway system. This information has been input to a lifecycle optimization model. The model will work through various scenarios in optimizing the County's capital renewal program.

As a precursor to completing the lifecycle optimization analysis, this report summarizes the existing roadway condition state. Discussion around this report will aid in running the modeling scenarios. The overall objective of the modeling analysis to follow is to "*maximize the value for taxpayers while ensuring infrastructure sustainability over time*".

Condition Rating Process

The condition rating was completed for the following condition/distress types within each of the three surface types.

Pavement	**Oil**	**Gravel**
Rutting	Rutting	Surface Condition
Fatigue Cracking	Fatigue Cracking	Surface Gravel
Surface Condition	Surface Condition	Dust
Lineal Cracking		Crown
Curb and Gutter		Drainage
		Width

For each of the above condition types, a condition rating was developed around four severity levels (none, minor, moderate, major). The field condition rating computed the extent (i.e. % of road surface) within each of the severity levels. In addition, the field condition rating identified the number of intersection quadrants that had had substandard sight distance.

The optimization model develops indices and condition states which are used in selecting and evaluating treatment options used in the lifecycle analysis. These indices are based on compiling the condition measurements against defined threshold levels for each severity level. These threshold levels are defined for each functional classification (i.e. arterial, collector, local) for each condition type (i.e. fatigue cracking). This provides the opportunity to provide a higher level of service for the arterial roadways in comparison to the local class roadways.

$$\text{INDEX} = \frac{\%major}{\mathbf{MaTH}} + \frac{\%moderate}{\mathbf{MoTH}} + \frac{\%minor)}{\mathbf{MiTH}}$$

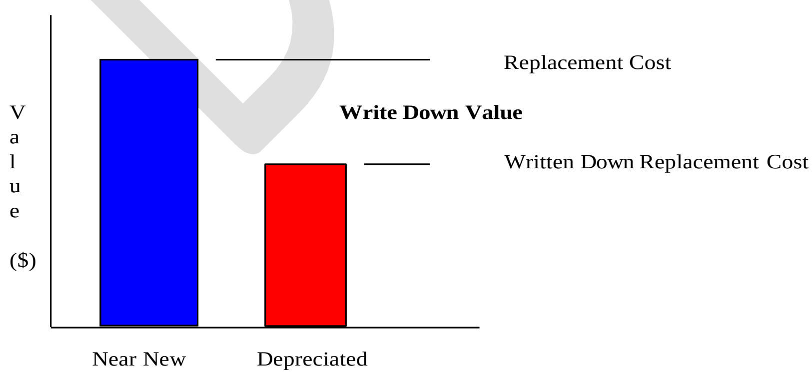
Where:

%major =	major condition extent
%moderate =	moderate condition extent
%minor =	minor condition extent
MaTH =	major threshold level of extent
MoTH =	moderate threshold level of extent
MiTH =	minor threshold level of extent

Then the resulting condition state ranges are grouped into five condition states. These five condition states (1=very good and 5=very poor) define the state of the infrastructure. However actual lifecycle modeling and performance prediction is based on working with the raw severity-extent condition data in its original form. Condition states are used only to define treatment options at different stages in the infrastructure lifecycle and illustrating the state of the infrastructure.

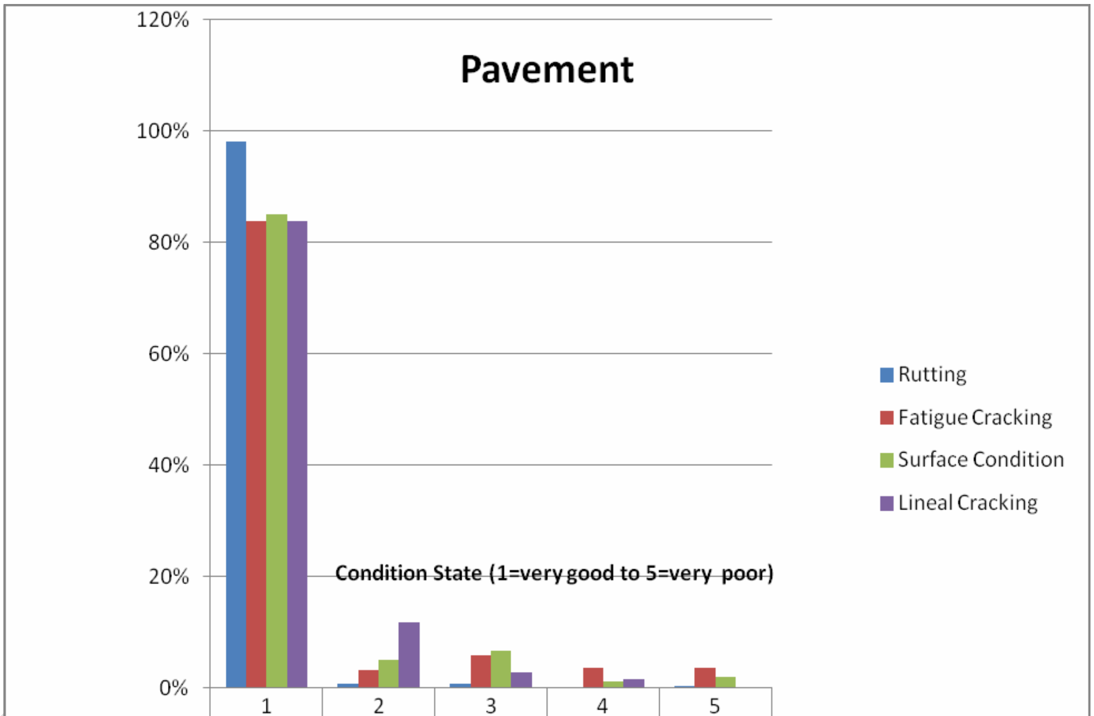
Condition State	Lower Index Range	Upper Index Range
1 (Very Good)	0.00	0.50
2 (Good)	0.50	1.00
3 (Fair)	1.00	2.00
4 (Poor)	2.00	4.00
5 (Very Poor)	>4.00	

The modeling analysis also computes the monetary performance, in terms of the write down value (WDV). This is a measure of depreciation. It determines the cost to return the asset to a near new condition state. The asset WDV changes with the condition state. The better the condition state, the lower the WDV.

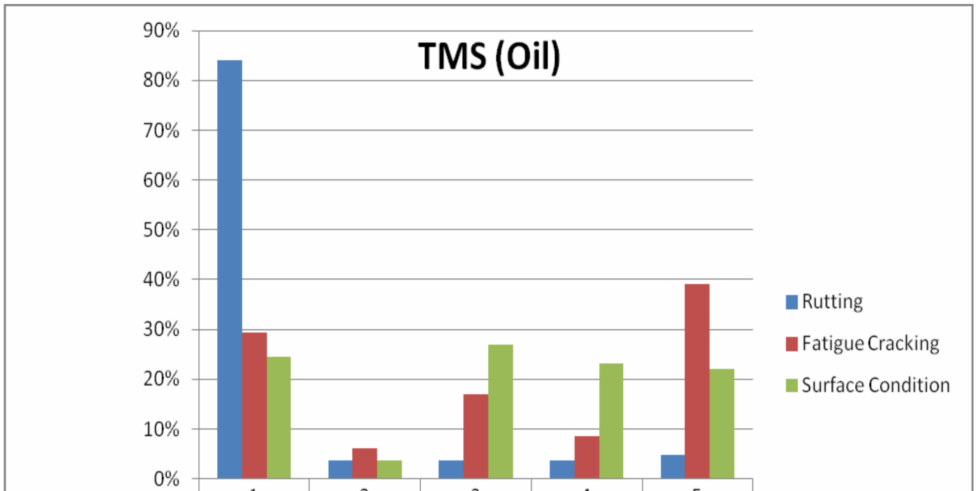


Existing Condition State

Based on formulation around the field level condition assessments, the following summarize the current state of the infrastructure for the three road surfaces (Pavement, Oil, and Gravel). Each of the following graphs illustrate the proportion of the roadway within each of the five condition states (i.e. condition state 1=very good to condition state 5=very poor). This is further broken down by the condition/distress type (i.e. fatigue cracking, rutting, etc.).

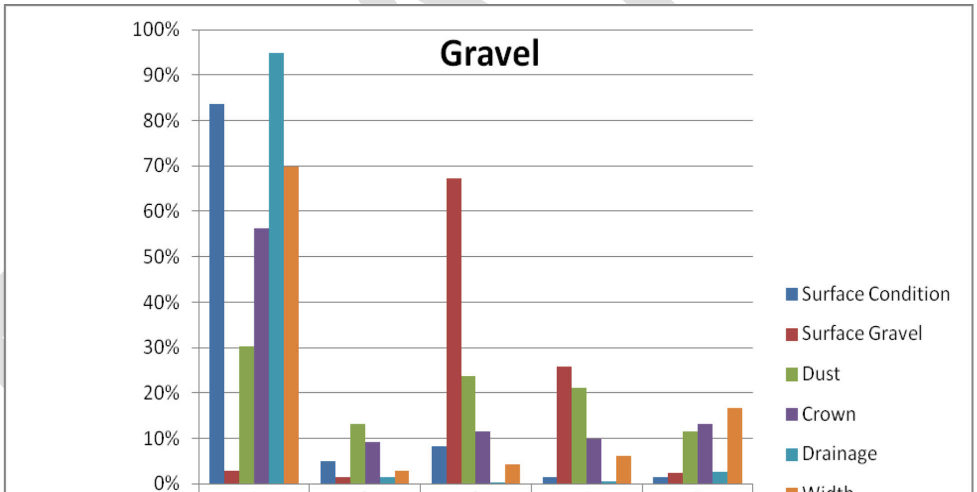


	1	2	3	4	5
Rutting	98%	1%	1%	0%	0%
Fatigue Cracking	84%	3%	6%	4%	4%
Surface Condition	85%	5%	7%	1%	2%
Lineal Cracking	84%	12%	3%	2%	0%



	1	2	3	4	5
Rutting	84%	4%	4%	4%	5%
Fatigue Cracking	29%	6%	17%	9%	39%
Surface Condition	24%	4%	27%	23%	22%

Condition State (1=very good to 5=very poor)



	1	2	3	4	5
Surface Condition	84%	5%	8%	1%	1%
Surface Gravel	3%	1%	67%	26%	2%
Dust	30%	13%	24%	21%	12%
Crown	56%	9%	12%	10%	13%
Drainage	95%	1%	0%	1%	3%
Width	70%	3%	4%	6%	17%

Condition State (1=very good to 5=very poor)

Based on the physical condition assessments, the oiled roads (i.e. thin membrane structures) are in the worst condition state. The paved (i.e. asphalt concrete) are relatively in the best condition state. The primary concern for both these roadway types is the fatigue cracking, followed by the surface condition (i.e. open surface texture and raveling
For the gravel roads, the issues are more widely spread out among numerous condition types. This would include the application and effectiveness of dust suppression, the amount of gravel, and the roadway geometry (i.e. crown and width). Drainage was not seen as a significant issue. However, only obvious conditions were noted in the assessment. Due to vegetation growth, drainage conditions could have gone unidentified

Existing Write-Down Value (Monetary Performance)

The exiting write-down value (WDV) was computed during the model calibration. Similar to the physical assessment, it provides a measure of performance in monetary terms. The value is based on the dollar value it would take to address the existing condition distresses and restore the roadway to a near new condition state. It provides an indication of depreciation. The better the condition state, the lower the WDV. The following table summarizes the existing WDV in comparison to historic (i.e. 2014-16 Average) annual budget allocations. The budget allocations are derived from operating and capital allocations specific to capital renewal related activities (i.e. maintenance and rehabilitation).

Surface Type	Length (km)	Historic Capital Renewal Budget (M$/yr)	Existing WDV (M$)	Historic Capital Renewal Budget ($(1000)/km/yr)	Existing WDV ($(1000)/km)
Pavement	212	$ 7.34	$ 5.83	$ 34.62	$ 27.50
TMS (Oil)	83	$ 0.38	$ 4.26	$ 4.58	$ 51.33
Gravel	1440	$ 12.59	$ 32.28	$ 8.74	$ 22.42

In line with the condition assessments the oiled (i.e. TMS) road surfaces exhibit the poorest monetary performance depicted by the highest WDV/km (i.e. $51,330/km). This would be largely attributed to the practice of applying a non-structural hard surface, which undergoes accelerated deterioration in comparison to a hard-surface roadway that is designed for the traffic loading that uses it.

Alternatively, the gravel network has some poorly performing roadways. However, this is not indicated by the WDV (i.e. monetary performance). The reason is that soft surface (i.e. gravel) roadways are more easily (cost effectively) renewed that a hard surface (i.e. pavement and oil) roadways. So even though the gravel roadways show greater deterioration than the pavements, they restore easier.

Intersection Stopping Sight Distance

During the field condition assessment, in addition to the condition/distresses described above, an assessment was completed for visibility around intersection sight triangles. The following table summarize the number of intersection quadrants with insufficient sight distance to the intersecting roadway. This assessment was provided only for interesting roadways and not private approaches to yards and farm lands. This information will not be used in the lifecycle modeling process as it does not reflect roadway renewal activities. However, as it does impact operations and budget needs, an annual costing allocation will be made in correcting the identified deficiencies.

# of Sight Triangle Deficiencies

Pavement	Oil (TMS)	Gravel
79	35	486

Lifecycle Optimization Model Calibration

The lifecycle optimization model is prepared with the condition data for Pavement, Oiled (i.e. TMS), and Gravel road surfaces input to the model. In addition, various model parameters including deterioration rates, treatment options, unit costs, etc. are in place.

The model for each of the surface types is calibrated to match existing budgets, roadway performance, and treatment practices. This is based the previous existing (2014-2016 average) operations and capital budget allocations related to capital renewal activities (i.e. patching, sealing, regarding, resurfacing, reconstruction, etc.).

Moving Forward Strategy

Based on the model calibration and December 9, 2016 discussion around the existing state of the infrastructure, our intent is to move forward with running alternative lifecycle modeling scenarios. The overall objective will be to identify the optimal scenario that will "*maximize the value for taxpayers, while ensuring infrastructure sustainability over time*". Then following acceptance of the optimal program strategy for each road surface type, we will develop a detailed works program for each roadway segment in the network.

The following are some key points that will be considered during the lifecycle optimization modeling process.

- For all roadway surfaces, introduce new treatments to meld with existing county practices that will work towards overall effectiveness in attaining infrastructure sustainability over time.
- Hard surface roadways that do not have an appropriate surfacing structure (i.e. oil surface), will include provision in the modeling scenarios to upgrade to a paved road standard as budget allocations permit.

- The availability of sufficient quantity and quality of gravel is a challenge; especially as gravel is a non-renewable resource. The appropriate quality and quantity of gravel is required for both surface-gravel needs as well the base course material within hard (pavement) surfaces. The practice of surface gravel requires continuous replacement, whereas hard surface structures hold the gravel within the life of the structure. Surface graveling is not a sustainable operation. Where surface gravel needs are a requirement (i.e. “Local’ class roadways), to minimize traffic gravel needs, “Local” class gravel roadways need to have through traffic movements diverted to “Collector” and “Arterial” class roadways to minimize the traffic on the local roadway class system. Then the “Collector” and “Arterial” class roadways have to be upgraded to support the traffic that will be using these roadways now and into the future.
- Gravel roadways will include a provision to first transition “Arterial” and “Collector” class roadways to a continuous dust suppression surface (i.e. $CaCl_2$). Then to transition select “Arterial” and “Collector” status roadways to a pavement (i.e. hard) surface. This will be based on the latest revision of the County’s functional classification map. The priority for upgrade will be given first to gravel “Arterial” class roadways, followed by “gravel “Collector” class roadways. The amount of upgrade will be based on budget availability.
- The existing County practice of road stabilization will be enhanced to include an appropriate granular surfacing structure and a hard surface (i.e. seal coat or AC surface). This will be an appropriate structure suitable to carry the traffic load as subgrade stabilization alone does not provide the strength to carry the traffic loading. The existing practice of “Stabilization” will be evolved to “Upgrading”, for which stabilization may be a component of the upgrade to a structurally sound hard surface roadway.
- The existing maintenance practice of roadways will include provision to enhance gravel road cross slope and surface gravel needs. Both gravel (quantity and quality) and cross slope components are required to provide a stable road surface as well as preparation needs to support dust suppression.
- The first lifecycle optimization runs will be presented at the January 5, 2017 SRIS meeting. This meeting will discuss the findings and direction moving forward to testing alternative scenarios. The intent will be to optimize within existing 2017 (Target) Operating and Capital budget allocations ($36.2 Million/year excluding bridges) as provided by County Administration.