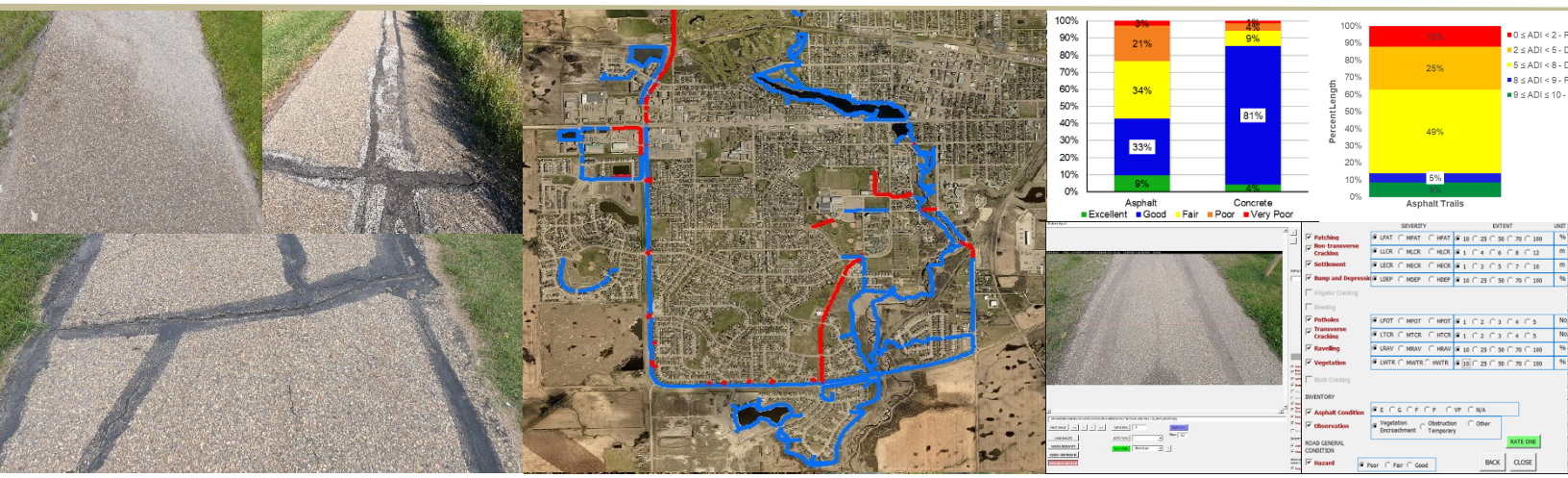
TETRA TECH

Trails Condition Assessment Report



PRESENTED TO

City of Camrose

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TABLE OF CONTENTS

LIST OF TABLES IN TEXT

LIST OF FIGURES IN TEXT

APPENDIX SECTIONS

APPENDICES

ACRONYMS & ABBREVIATIONS

Acronyms/Abbreviations	Definition
Tetra Tech Canada Inc.	Tetra Tech
the City	the City of Camrose
GIS	Geographic Information System
TAC	Transportation Association of Canada
ADI	Asset Damage Index

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the City of Camrose (the City) and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the City of Camrose (the City), or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in Appendix E or Contractual Terms and Conditions executed by both parties.

1.0 INTRODUCTION

1.1 General

Tetra Tech Canada Inc. (Tetra Tech) was retained by the City of Camrose (the City) to provide a paved trail condition assessment throughout the City.

The report documents the methodology for trails data collection, methodology for condition rating of trail sections, present condition status with graphical display and a prioritized trail rehabilitation program.

1.2 Background

The trail present condition information is required to maintain and preserve the current condition of assets efficiently. This information is also useful to identify locations within the network where assets have deteriorated due to a lack of resources or capital budget. The data collected through this project is used to create a multi-year activity plan for these assets.

The trails within the City are primarily paved with asphalt, concrete and brick. The scope of this project was limited to paved asphalt trails. Before the start of the project, it was identified by the City that the trail network consisted of approximately 28.9 km of paved asphalt trail.

1.3 City Supplied Information

The City provided trail centreline alignments (Shapefile) with trails type information which was used to define trail network for the data collection. The City provided polyline shapefile for the trails to Tetra Tech. The City trail shapefile indicated approximately 29.5 km of asphalt trails and approximately 5.7 km of concrete trails.

2.0 NETWORK DEFINITION AND GIS INTEGRATION

Tetra Tech considers correctly referenced data as one of the most important aspects of data management. Location referencing is the method whereby the distress data are referenced to the basic trail inventory.

Tetra Tech used a standardized method (PolylineM) for linear referencing on the pavement sections in a GIS (Geographic Information System). These special polylines called “Routes”, allow data defined by a linear distance from the origin of the line to be linked to the correct location along the polyline. Tetra Tech developed the routes layer using the City’s trail centreline geometry files which were provided for the project. Figure 2-1 shows the City trail routes in ArcGIS.

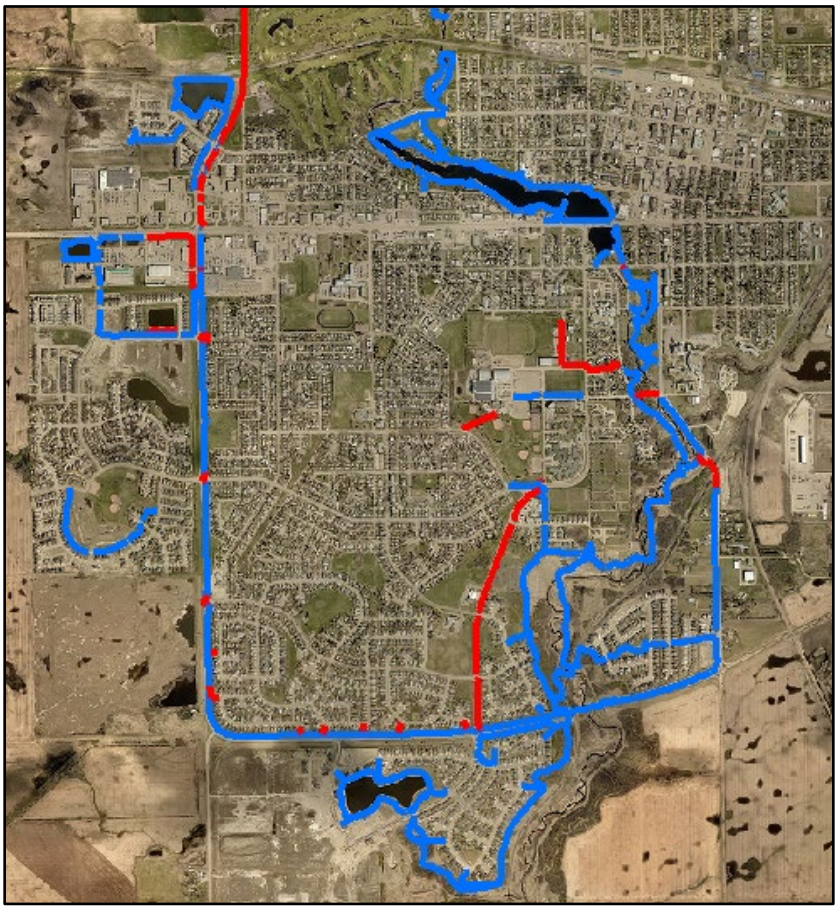

Figure 2-1: Example of the City Trail Routes in GIS

Before data collection, Tetra Tech developed a complete list of trails for use in the field as a “Master List” including the necessary location descriptions and lengths, so that the collection would be complete and accurate.

3.0 TRAILS DATA COLLECTION

3.1 Trail Data collection Platform

Tetra Tech has developed a unique data collection platform and assessment methodology specifically for collecting condition data for paved trails. The collection unit is a trail/sidewalk legal, a motorized platform that incorporates multiple high-resolution cameras and an onboard handheld mapping tool to track and capture different aspects of the trail corridor.

Tetra Tech's propriety software tools allow us to convert the videos into high resolution still images at regularly spaced intervals. These high-resolution still images permit the accurate office-based identification and rating of distresses.

Office-based rating removes the biases and diminishing accuracy associated with the fatigue experienced by field surveyors performing walking surveys all day. This methodology significantly speeds up the rate of collection, which is often a limiting factor that may require significant field resources depending on the size of the network.

The trail data collection vehicle conducted all surveys as continuous operation at a safe speed of approximately 10 km/h.

Figure 3-1: Trail Data Collection Platform

3.2 Data Collection Extent

Tetra Tech has collected images on approximately 28.7 km of the 29. 5 km trails that were identified as asphalt in the City's shapefile.

A few 50 m to 100 m sections of trails were not collected because of the following reasons:

- Restricted access to the trails;
- Trail does not exist at the location on the route; and
- Trail section is part of the sidewalk network.

The 28.5 km for which data was collected were identified by type as asphalt, concrete and brick paver. Table 3-1 shows the approximate extent of the collected trails. The trail type is identified in the sample unit condition table provided as part of the GIS deliverables to the City.

Table 3-1: Approximate Extent of Data Collection

Trail Type	Approximate Length (m)	Approximate Percent
Asphalt	25,092	87.3
Concrete	3,616	12.6
Brick	32	0.1

4.0 CONDITION RATING METHODOLOGY

Tetra Tech used an in-house asset condition rating methodology. The asset rating methodology is based on the paper titled "*Development of Cross-Asset Comparative LOS Condition Index*" published in *the 2017 Conference of the Transportation Association of Canada (TAC).* Appendix A provides a copy of this article. The trail condition rating methodology is provided in the following sections. Generally, the assessment of trail condition rating involved the following steps:

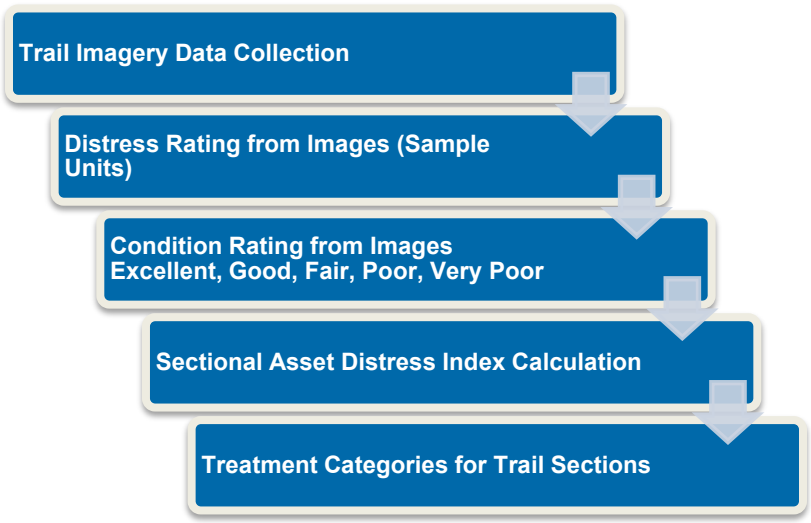

Figure 4-1: Trails Condition Rating Methodology

4.1 Trails Imagery Data Collection

Tetra Tech used the electric trail condition survey platform for the collection of the entire paved trail network. The trail data collection platform is a trail/sidewalk legal, integrated data collection platform capable of simultaneously collecting high-resolution digital images from multiple sources and GPS geospatial positions. The high-resolution imagery collected for the entire trail network was used to during office-based condition assessment.

Tetra Tech also used the direct linking of the surface imagery into the project GIS as a data quality control tool. It provides users with the ability to "virtually drive down the trail" while sitting at their desks.

4.2 Distress Rating from Images

The sample units (images) of trail assets are rated manually in-house by trained personnel. The asset imagery is evaluated to identify the existence of an asset, type of asset structure (asphalt, concrete or brick), condition of asset and type of distresses and severity for the trail asset. The condition rating of the trail sample unit (Image) was carried out to identify the following distresses and observations:

1. Hazard

2. Distress

i. Bump and Depression
ii. Patching
iii. Non-transverse Cracking
iv. Vegetation
v. Potholes
vi. Transverse Cracking
vii. Raveling
viii. Settlement Cracking

3. Observations

i. Vegetation Encroachment
ii. Obstruction Temporary
iii. Other

The condition was assessed using a Tetra Tech image rating application, and Figure 4-2 shows a sample view of the in-house image rating application used in the project. The rating application was customized to meet the City's requirements for collecting hazards, distresses, and observation data. A trained condition rater rated the trail condition in an office environment.

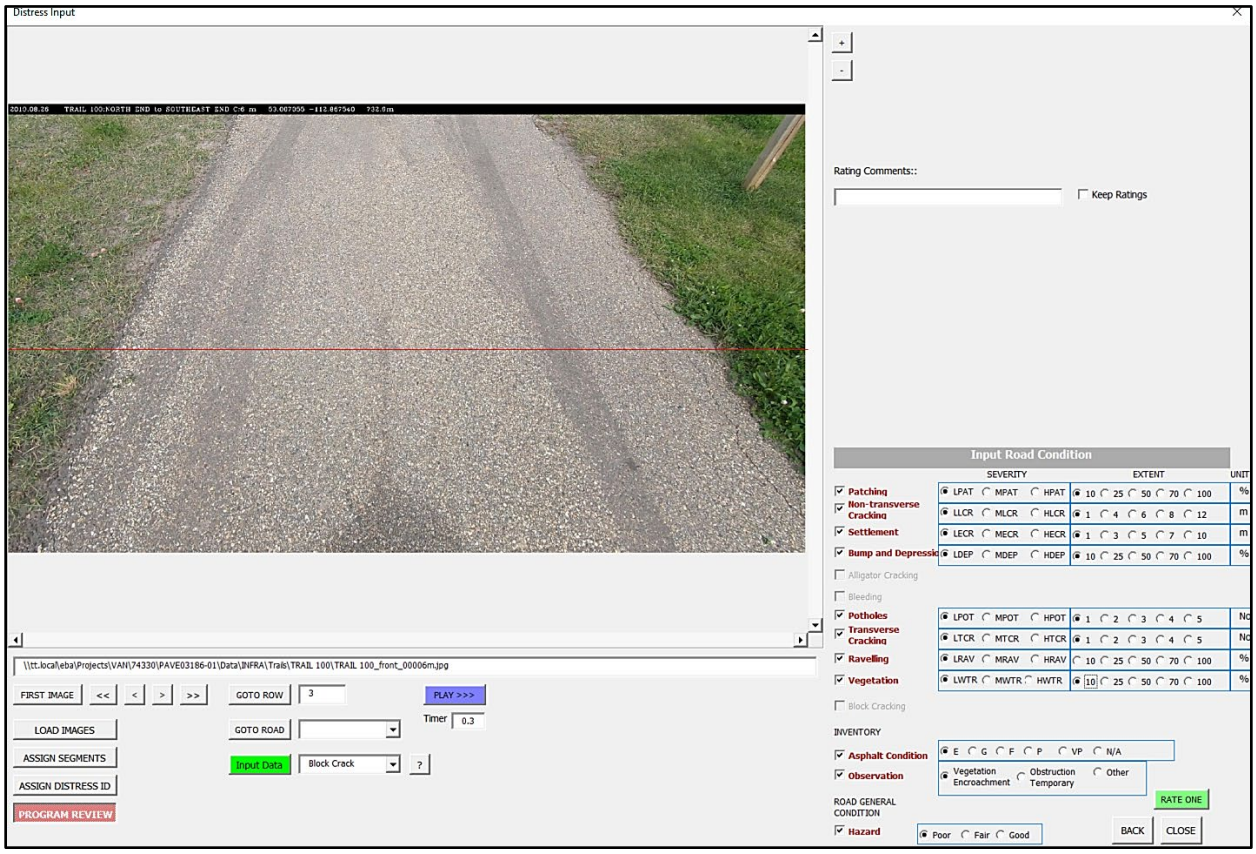

Figure 4-2: Trail Image Rating Application

Figure 4-3 shows the interface of our rating application, which was used to rate distresses for this project.

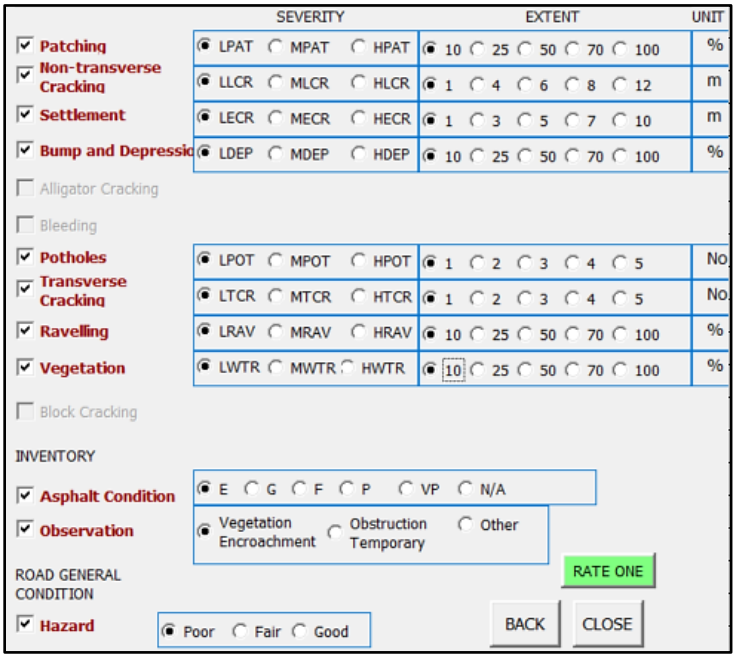

Figure 4-3: Rating Application Interface

4.3 Condition Rating from Images

Condition assessment of the trail sample unit (Image) is carried out following the condition classification provided in Table 4-1.

Table 4-1: Description of Asset Condition

Asset Condition (Trails)	Description
Excellent	Asset appears in new condition with no visible distresses
Good	Asset appears relatively aged and has no visible distresses
Fair	The distress is visible but in the rater's opinion, the distress does not affect the function of the asset and no repair can, (or needs), to be done (e.g. a just visible crack).
Poor	The distress has progressed to the point where a maintenance repair, could be readily and cost-effectively applied to maintain the serviceability of the asset.
Very Poor	The Sample unit has deteriorated to the point where maintenance repairs will be insufficient to economically re-establish proper function of the asset.

The condition rating on each sample unit was assigned subjectively based on the descriptions provided in Table 4-1.

4.4 Sectional Asset Distress Index

4.4.1 Asset Damage Index Definition

Asset Damage Index (ADI) is a multilevel numerical rating developed by Tetra Tech to establish the extent and severity of distress damage to assets along a roadway.

An ADI index of between 0 and 2 means that greater than 30% of the rated sample units within an asset section need replacement and/or greater than 60% of the sample units within an asset section need maintenance repair; therefore, the entire asset would be more economically replaced than repaired. The Treatment category for these assets is "Reconstruction", a replacement of the asset. These assets are more likely to have a significant safety and/or mobility issues. The relative position of an asset within the 0 to 2 range indicates the relative extent of the asset's length needing replacement. A value of 1.9 means just over 30% and/or 60% of the asset's length is sufficiently damaged to require replacement/repair while a value of 0 means the entire asset is damaged. In all cases within this range, it is not considered worth salvaging the asset and replacement is suggested.

An ADI of between 2 and 5 means that at least some sample units within an asset section, but less than 30%, would need replacement and some sample units within an asset section would need repairs. A value closer to 2 indicates that almost 60 % of the asset needs replacement and/or repairs. A value closer to 5 means only a small portion of the asset length needs replacement and/or repairs. The treatment category for these assets is called rehabilitation. This means that some portions of the asset are replaced and some are repaired. Any asset segment rated between 2 and 5 has at least one sample unit in need of replacement. The Treatment category for these assets is "Rehabilitation", a combination of repairs and sample unit sized replacements. These sections are judged to have at least some likelihood of safety or mobility issues for trails.

An ADI between 5 and 8 means that no sample units within an asset section need replacement but some portions need repair. An ADI closer to 5 means that almost 60% of the asset section needs repair while an ADI closer to 8 means that very little repair is required. However, any section rated between 5 and 8 has at least one sample unit in need of repair. The Treatment category for these assets is “Maintenance”, maintenance repairs. These sections are also judged to have at least some likelihood of safety or mobility issues but localized repairs might address these issues.

ADI values between 8 and 9 indicate that an asset section has at least one sample unit within the asset section with visible distress that is not yet sufficiently advanced to warrant repairs. It has no distresses that currently warrant repairs. An ADI closer to 8 means there are a large number of such distresses while an ADI closes to 9 means almost no such distresses. The treatment category for these assets is “Inspect”, conduct a physical field inspection to confirm these distresses do not pose safety and mobility problems.

ADI’s over 9 are judged to be distress free with little probability of safety, mobility or drainage issues.

The condition of the asset is quantified by associating a deduct value to the type and severity of distress observed in each sample unit within the section. ADI is a function of the densities of sample unit conditions in each asset section.

ADI is developed to directly inform Asset Managers of which sectional treatment category to select. ADI is a multilevel index to prioritize the sections in the network to identify the sections which need the most urgent attention irrespective of the length of the sections.

The sectional treatment categories and deduct values used in the calculation of ADI describe in the sections below.

4.4.2 Deduct Values

Deduct values in ADI quantify the extent of deterioration of a sample unit based on an overall scale of 10. A deduct value of 0 reflects a sample unit in excellent condition, whereas a deduct value 10 means the sample unit needs to be replaced.

All sample units in an asset section are assigned a Deduct Value based on their current condition. Each sample is assigned the highest deduct value among all the observed distresses conditions in a single sample unit. The distress in the worst condition dictates the deduct value for the sample unit. The deduct values associated with each type of condition observed in the sample unit are provided in Table 4-2.

Table 4-2: Description of Asset Condition and Deduct values

Asset Condition (Trail)	Sample Unit Deduct Value	Description
Excellent	0	Entire Sample Unit is assigned a deduct value of Zero, all other distress deduct values are set at Zero.
Good	1	The entire Sample Unit is assigned a deduct value of One, all other distress deduct values are set at Zero.
Fair	2	The distress is assigned a deduct value of Two.
Poor	5	The distress is assigned a deduct value of Five.
Very Poor	10	The Sample Unit needs to be replaced. The Sample Unit is assigned a Deduct Value of Ten.

4.4.3 ADI Calculation

ADI directly uses the density of Deduct Value assigned to each sample unit in a section. Sectional density accounts for both the extent of the distress and the extent of the asset class that was measured for this distress. The section density is calculated using the following expression:

$$Sectional\ Density\ of\ the\ Condition\ (\mathrm{D}_0, \mathrm{D}_1, \mathrm{D}_2, \mathrm{D}_5, \mathrm{D}_{10}) = \frac{Number\ of\ Sample\ Units\ Rated\ in\ the\ Condition\ (n_{D_i})}{Total\ Number\ of\ Rated\ Sample\ Units\ in\ a\ Section\ (N_D)}$$

The sum of all densities in a section is always equal to 100%.

The five densities for the conditions/deduct values in a section are given below.

D_0 = density of sample units in excellent condition (deduct value = 0)

D_1 = density of sample units in good condition (deduct value = 1)

D_2 = density of sample units in fair condition (deduct value = 2)

D_5 = density of sample units in poor condition (deduct value = 5)

D_{10} = density of sample units in very poor condition (deduct value = 10)

ADI for asset sections is calculated using the multi conditional formula for densities below:

Order	Condition	ADI	ADI Range	EQ.
1	$0 < \mathrm{D}_{10} \leq 100$	$Max\left\{0, Min\left[\frac{(50 - \mathrm{D}_{10})}{10}, \left\lvert\frac{(80 - \mathrm{D}_5)}{10}\right\rvert\right]\right\}$	$[0, (0-5, 0-8)]$	1
2	$\mathrm{D}_{10} = 0$ and $0 < \mathrm{D}_5 \leq 100$	$\left\lvert\frac{(80 - \mathrm{D}_5)}{10}\right\rvert$	(0 - 7.9)	2
3	$\mathrm{D}_{10} = 0$, $\mathrm{D}_5 = 0$ and $0 < \mathrm{D}_2 \leq 100$	$\frac{\left(90 - \frac{\mathrm{D}_2}{10}\right)}{10}$	(8 - 8.9)	3
4	$\mathrm{D}_{10} = 0$, $\mathrm{D}_5 = 0$, $\mathrm{D}_2 = 0$ and $0 < \mathrm{D}_1 \leq 100$	$\frac{\left(100 - \frac{\mathrm{D}_1}{10}\right)}{10}$	(9 - 10)	4
5	$\mathrm{D}_{10} = 0$, $\mathrm{D}_5 = 0$, $\mathrm{D}_2 = 0$, $\mathrm{D}_1 = 0$, and $\mathrm{D}_0 = 100$	10	10	-

4.5 Treatment Categories for Trail Sections

4.5.1 Sectional Treatment Categories

ADI is used to categorize trail sections on the trail network into five treatment categories. These five sectional treatment categories depend on the value of ADI. Table 4-3 describes these section level treatment categories.

Table 4-3: Sectional Treatment Categories for Assets

Treatment Categories	Description
No-Activity	At the section level, no action required.
Field Inspection	At the Section level where distresses exist, but no maintenance repairs are suggested. The field inspection validates the distress rater's judgement and provides for inspection of the entire asset, including portions that were not visible from the digital images.
Maintenance	Repairs to a Section where no Sample Unit replacements are suggested. Repairs are defined by distress type as recorded in poor condition by the rater. This treatment also includes a full review of the section to validate the rater's opinion and to review those portions of the asset not readily visible in the digital images.
Rehabilitation	Repairs to a Section where some Sample Unit replacements are suggested by the rater. This treatment also includes a full review of the section to validate the rater's opinion and to review those portions of the asset not readily visible in the digital images.
Reconstruction	Reconstruction of a Section where so many Sample Units are suggested for replacement or that so many sample units are suggested for maintenance repair, that it becomes more economical to reconstruct the entire Sectional Asset. In this case, defined as either more than 30% of Sample Units within a Section require replacement or the combination of Sample Units within a Section that need repair and/or replacement exceeds 60%.

The ADI values calculated from the expression in Section 4.4.3 are used to develop an inspection/maintenance activity program for the network. Five possible options based on a range of ADI values that are used in developing a rehabilitation program are provided in Table 4-4.

Table 4-4: Treatment Activities for ADI Values

ADI Range	Distress	Activity
$9 \leq ADI \leq 10$	No Distress	Do-Nil
$8 \leq ADI < 9$	Some Distress Exists	Field Inspection
$5 \leq ADI < 8$	Some Maintenance Repairs Suggested	Maintenance Program
$2 \leq ADI < 5$	Less than 30% of Sample Units need Replacement and/or greater than 30 % of Samples need Maintenance Repair	Rehabilitation Program
$0 \leq ADI < 2$	More than 30% of Sample Units need Replacement and/or greater than 60 % of Sample Units need Maintenance Repair	Replace Asset

4.5.2 Cost Estimate for Trail Sections

The cost estimate is applied based on the repairs needed for each sample unit and the activity assigned to each section. The unit cost estimates were prepared based on the review of asphalt and concrete construction cost calculators available on-line from various locations within North America.

Table 4-5 provides the unit costs used in the calculation of a cost estimate for trails. These unit costs were applied to distress collected in all sample units.

Table 4-5: Unit Costs for Distress Repair

Distress	Severity	Unit Cost	Units
Crack Sealing (Longitudinal Cracking / Transverse Cracking)	Low	$ 5	per meter
	Moderate	$ 10	per meter
	High	$ 25	per meter
Asphalt patch (Settlement Cracking, Potholes, Patch, Depression, Ravelling and Vegetation)	Moderate	$ 50	per Sqm
Concrete patch (Settlement Cracking, Potholes, Patch, Depression, Ravelling and Vegetation)	Moderate	$ 150	per Sqm
Asphalt Sample Unit Replacement (Settlement Cracking, Potholes, Patch, Depression, Ravelling and Vegetation)	High	$ 150	per Sqm
Concrete Sample Unit Replacement (Settlement Cracking, Potholes, Patch, Depression, Ravelling and Vegetation)	High	$ 350	per Sqm

The cost to repair distress in all sample units were summed together to calculate the total cost to repair each section. The cost estimate for sections was further recalculated based on the activity assigned to sections. The cost for sections that were assigned a “replace asset” activity was recalculated based on the total length of the section using the unit cost provided in Table 4-6. Similarly, the cost for sections that were assigned a “Field Inspection” activity was supplemented by the field Inspection labour cost provided in Table 4-6.

Table 4-6: Unit Cost for Section Activity

Section Replacement	Unit Cost	Units
Asphalt Section Replacement	$ 65[1]	per Sqm
Concrete Section Replacement	$ 150[2]	per Sqm
Field Inspection (Labor Cost)	$ 50	per km

[1] Unit replacement costs are lower than sample unit replacement costs due to economies of scale
[2] Unit replacement costs are lower than sample unit replacement costs due to economies of scale

The cost estimate for activities represent the following:

- **Replace Asset:** It is the cost to replace the asphalt or concrete trail section.
- **Rehabilitation Plan:** It is the cost to carry out the treatments of crack sealing, patching and replacing sample units within the trail section.
- **Maintenance Plan:** It is the cost to carry out the treatments of crack sealing, patching within the asphalt or concrete trail section.
- **Field Inspection:** It is the cost to carry out the treatments of crack sealing, patching within the asphalt or concrete trail section, including the cost to carry out a field inspection by the City based on the provided Labour cost.

5.0 TRAILS CURRENT CONDITION STATUS

The trail condition of sample units and trail type data were transformed and consolidated into segments using dynamic data transfer. The analysis segments are generally based on the material type and homogeneity of the sample unit condition. The following sections describe the condition of the trail, as collected in 2019.

5.1 2019 Trail Condition

The condition rating descriptions provided in Table 4-1 were used to provide a breakdown of network conditions. The sample unit was classified as per colour codes provided in Table 5-1 into five categories as excellent, good, fair, poor, very poor.

Table 5-1: Sample Unit Condition Color Codes

Rating	Color Code
Excellent	
Good	
Fair	
Poor	
Very Poor	

Figure 5-1 provides the percentage of sample units corresponding in all five conditions.

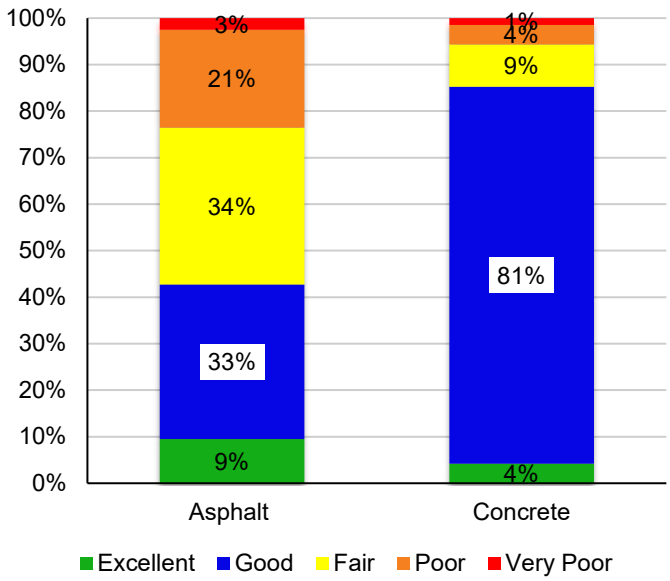

Figure 5-1: 2019 Trail Condition of Collected Trails

Figure 5-1 shows that about a quarter of the asphalt trail is in very poor to poor condition while three quarters are in fair to excellent condition. Approximately 9% of the asphalt trail network is in new condition.

Similarly, the sample units identified with concrete trails were also categorized separately; the figure shows that 95% of the concrete trails with the collected data were in fair to excellent condition.

In addition to condition, the sample unit tables also identify the sample units which contain hazards within the network. These locations on trails are identified based on the rater opinion; these locations can be a safety concern for the public. The areas with the following issues are also identified within the Sample Unit table with a comment:

- Trails with drainage issues
- Trails with gravel or dirt accumulated
- Trails with tree root causing distress

Appendix B provides the following sample unit condition table maps based on ArcGIS.

- Figure B1: Asphalt Trail Sample Unit Condition Map
- Figure B2: Concrete Trail Sample Unit Condition Map
- Figure B3: Collected Trails Material Type Map
- Figure B4: Sample Unit Hazard Map

6.0 PRIORITY ACTIVITY PLAN FOR TRAILS

The priority plan was prepared based on the methodology described in Section 4.0. The ADI value, rehabilitation activity, priority and cost estimate assigned to each section. The first priority was assigned to any section containing a hazard then the remaining sections were assigned priority based on their ADI value from worst condition to the best condition. Table 6-1 provides the cost estimate and treatment length of trails designated to each activity.

Table 6-1: Priority Activity Plan for Trails

Activity	Asphalt Trail			Concrete Trail		
	Length (m)	Percent	Cost	Length (m)	Percent	Cost
9 ≤ ADI ≤ 10 - Do Nill	2,171	9%	-	944	29%	-
8 ≤ ADI < 9 - Field Inspection	1,308	5%	$3,162	372	11%	$702
5 ≤ ADI < 8 - Maintenance Program	12,320	49%	$35,478	978	30%	$16,179
2 ≤ ADI < 5 - Rehabilitation Program	6,265	25%	$69,688	899	27%	$45,974
0 ≤ ADI < 2 - Replace Asset	3,028	12%	$492,037	95	3%	$35,675

Table 6-1 represents the total costs to address all aspects of inspection, maintenance, rehabilitation and replacements activities in current year. The City should create trails multi-year rehabilitation program based on the available annual budget. Depending on the available funding in each year, a portion of this work could be selected on an annual basis using the Hazard/ADI based prioritization.

Figure 6-1 provides the activity distribution of asphalt trails throughout the trail network.

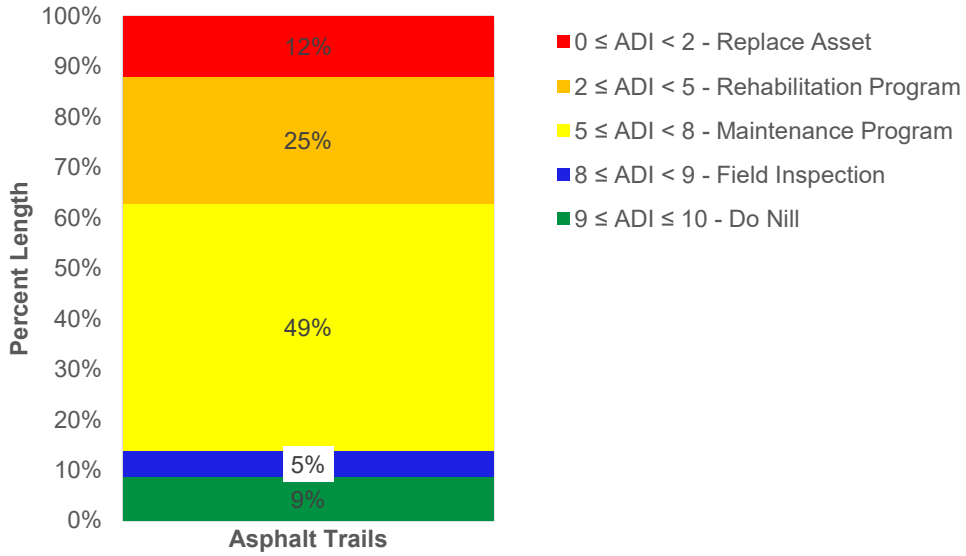

Figure 6-1: Priority Activity Plan for Asphalt Trails

Figure 6-1 shows that approximately 12% of the paved trail assets need to be replaced. Similarly, a quarter of the asphalt trail assets are triggered for the development of a rehabilitation program. Approximately half of the paved trail assets are triggered for development of a maintenance program. Approximately 5% of the assets are triggered for field inspection. Remaining 9% of the asphalt trail assets are in good condition and do not require any activity.

Figure 6-2 provides the activity distribution of concrete trails throughout the trail network.

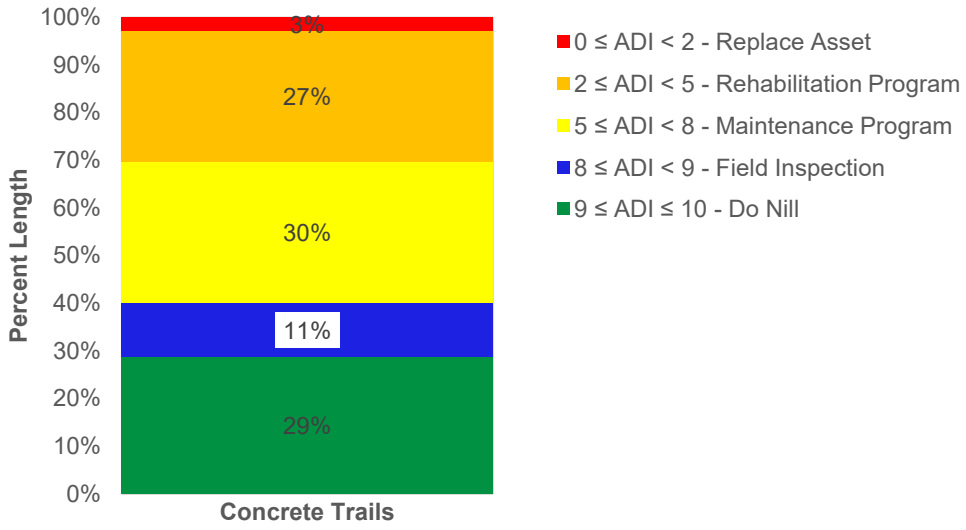

Figure 6-2: Priority Activity Plan for Concrete Trails

Figure 6-2 shows that approximately 3% of the collected concrete trail assets need to be replaced. Similarly, more than a quarter of the collected concrete trail assets are triggered for the development of a rehabilitation program. Approximately one-third of the collected concrete trail assets are triggered for development of a maintenance program. Approximately 11% of the assets are triggered for field inspection. The remaining quarter of the collected concrete trail assets are in good condition and do not require any activity.

Appendix C provides the priority plan for the collected asphalt and concrete trails.

Figure 6-3 and Figure 6-4 provides the cost estimate for sections categorized based on the activity assigned to the section.

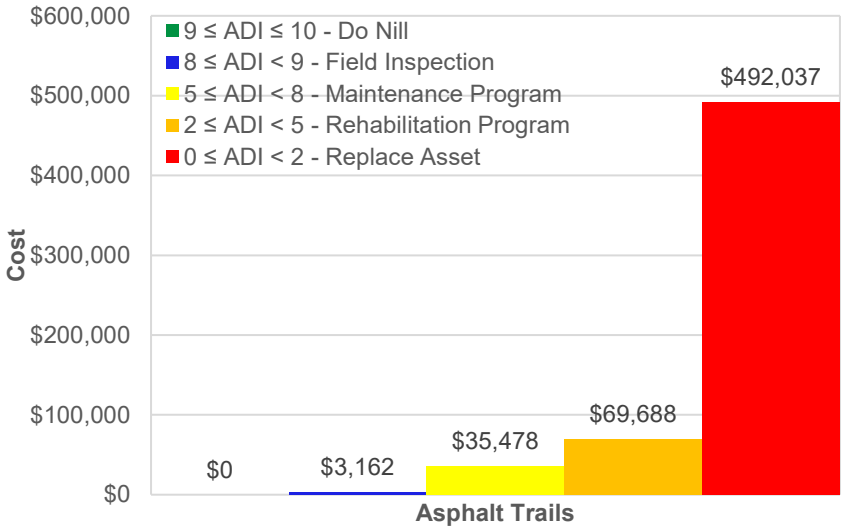

Figure 6-3: Cost Estimate for Asphalt Trails

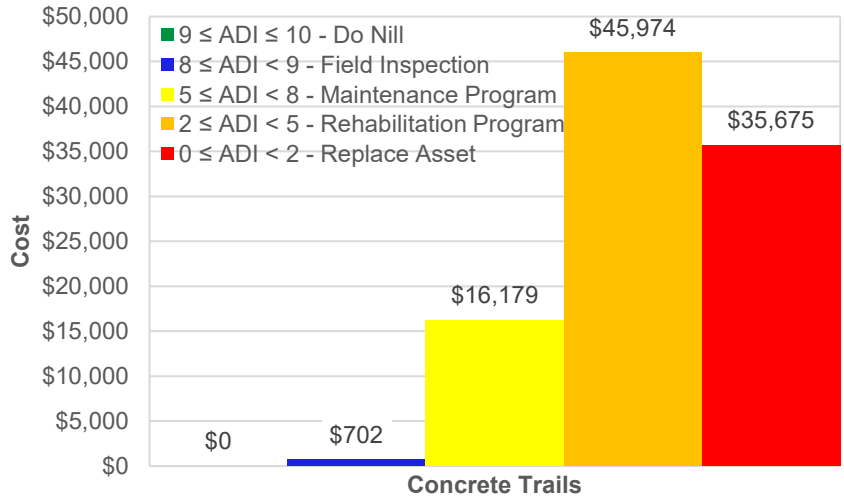

Figure 6-4: Cost Estimate for Concrete Trails

Appendix D shows the trail condition section which provides the detailed priority lists of collected asphalt and concrete trail segments suggested for rehabilitation. The priority condition sections list provides the following types of data for trails:

- **Hazards, Repair Length and Area, and Reconstruct Length:**

  The trail condition sections identify the hazard, length of crack sealing, area of patching and length of reconstruction required in each trail section.

- **Asphalt/Concrete Trail Condition Sample Units:**

  The number of sample units in each section in Excellent, Good, Fair, Poor, Very Poor condition.

- **Asphalt/Concrete Trail Density:**

  The density of sample units Excellent, Good, Fair, Poor, Very Poor condition in a section.

- **Asphalt/Concrete Trail ADI Condition, Priority, Activity, Cost:**

  The ADI, Priority and assigned Activity e.g. Replace Asset, Rehabilitation Plan, Maintenance Plan, Field Inspection and Do Nil for a section.

- **Asphalt/Concrete Trail Sample Unit Inventory, Trail Length, Percent:**

  The number of sample units / length / percentage of the section with asphalt and concrete type material.

7.0 CLOSURE

We trust this document meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

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APPENDIX A

TRAILS ASSET CONDITION ASSESSMENT PAPER

Development of Cross-Asset Comparative LOS Condition Index

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ABSTRACT

Comparing Level of Service (LOS) across infrastructure asset classes is difficult because of a lack of a common asset condition indicator. Some expert practitioners have suggested various types of asset value index as a common measure for comparing asset health but such an index, on its own, might mask the underlying level of service. In addition, quantifying risk and reliability is becoming ever more important when managing infrastructure assets.

Asset Condition Indices are often composites of several measured or estimated asset attributes. Pavement Condition Indices, for example, are often derived by deducting values representing many different pavement distresses from a perfect score. However, when a composite index is used, the underlying nature of the severity of distress or its extent is not evident directly from the index. One must refer to the underlying individual distress data to determine why the index got its ultimate value.

The magnitude of the deduct values are often somewhat subjective based on expert judgement relating to the relative severity of a given distress. In pavement, for instance, alligator cracking is seen to be more costly to repair than transverse cracking and is therefore given a larger deduct value resulting in a lower condition index. Although this may be reasonable for pavements, any mathematics behind the quantitative relationships between deduct values is not well documented in the literature. Quantifiable damage indices for pavements such as those used in the Highway Development and Management (HDM) framework have been in widespread use outside of North America and with the introduction of Mechanistic-Empirical Pavement Design Guide (MEPDG), are now gradually being adopted in North America providing a more consistently defined structure for quantifying pavement distress.

This paper briefly discusses the evolution of the classes of pavement indices from the traditional composite class indices through to damage indices and into those developed or now being developed to manage some other infrastructure classes including Infrastructure Value Indices.

The paper then puts forward a framework for incorporating risk and reliability with asset value indices in such a manner that both of these performance indicators could be compared across asset classes. Finally the paper describes a recently developed, damage based, LOS Index that can readily be applied to virtually any infrastructure asset class and that conveys not only the condition of the asset but allows Asset Managers to gauge the severity and density of distress through a single index number. The index can be readily implemented at any level of agency experience and requires no sophisticated data collection technology. The paper demonstrates the application of the technique through a municipal transportation infrastructure example.

Introduction

With a growing demand for management of varied assets across an enterprise, there is a need for an equitable method to compare the relative LOS on an equivalent basis. Asset classes are very different and the Key Performance Indicators (KPI) used to measure LOS are therefore also very different. A pavement's LOS is often judged by smoothness, while a water supply system might be judged by water quality and distribution reliability.

An obvious choice for a common performance indicator is an asset value indicator; a ratio of current asset value to replacement value. However in order to be useful for managing assets, the indicator must be able to be used to express not only current but future performance. An excellent treatise on the use of an asset valuation indicator for asset management was advanced in 2005[i] . Readers are urged to review that document as background.

Since then however, the concept of risk, combining likelihood and consequences, as another indicator of asset[ii] performance has gained increasing acceptance. This paper proposes a framework whereby the different Key

Performance Indicators (KPI) for various asset classes could be passed through what might be termed a "universal translator" to arrive at single comparative Asset Condition Indicator (ACI) that represents an asset's LOS, condition depreciated value, reliability and level of risk.

This paper first describes some of the types of performance indicators that have been developed and the perceived benefit or advantages of each type is outlined. The paper goes on to describe a framework for the proposed multi-purpose rating and follows up with an example application using municipal curb/gutter and sidewalk assets.

Types of Performance Indicators

The following is not intended to be an exhaustive list of types of performance indicators, but rather to illustrate the benefits or strong points of the different types in order to highlight what attributes a multi-purpose rating would, ideally, possess. The indicators demonstrate an evolution of thinking regarding, in particular, the consideration of asset value and risk and reliability.

Present Serviceability Rating

The serviceability is rated subjectively by a panel made up of people selected to represent several important groups of asset users. Rating is typically in terms of good, fair or poor or based on a numerical scale 1 – 5 or 1 - 10. An example of this methodology is the Present Serviceability Rating (PSR) developed as part of the 1950's American Association of State Highway Officials (AASHO) road test[iii]. Another example is the Riding Comfort Index (RCI) developed in the early 1970's[iv]. The main benefit of this type of rating is it reflects the level of service as perceived by users. Predicting future serviceability would need to be based on historical ratings used to develop empirical models.

Present Serviceability Index

The Serviceability Index measures physical Key Performance Indicators (KPI) of an asset (roughness or cracking on pavements for example), and uses multiple regression analysis of the various KPI's to derive and validate a mathematical index through which the PSR can be satisfactorily estimated from objective measurement of an asset's KPI's. An example of the serviceability index called the Present Serviceability Index[ii] (PSI) was also developed as part of the AASHO Road Test. The benefit of this index is it removes the subjectivity of a rating panel. If the KPI's used to derive the index can be modeled, the future PSI can be predicted. Alternatively the PSI could be directly predicted empirically from historical data.

Condition Index

One widely used index is the US Army Corps of Engineers (USACE) Pavement Condition Index[v] (PCI). An American Society for Testing Materials (ASTM) standard, defined by ASTM D5340 for Airport Pavements and ASTM D6433 for Roadway Pavements. Developed by the United States Army Corps of Engineers in the late seventies, it uses a statistical sampling technique to rate the condition based on visible distresses. "The distresses differ in type, severity and extent. Because of the large number of conditions possible, producing one index that would take into account all three factors was a considerable problem", overcome by the introduction of the concept of "Deduct Values", derived from expert opinion [Shahin]. Using a somewhat complex iterative process, the deduct values for each distress, severity and extent are subtracted from a perfect score of 100 to arrive at a composite distress index. Another example of a composite distress index is the Surface Distress Index[vi] (SDI) also called a Visual Distress Index or Visual Condition Index.

These condition indices result in a repeatable measure calibrated to expert opinion and has the additional benefit in that the entire asset's surface need not be evaluated. The PCI is measured using a sampling technique whereby only a statistically significant number of "sample units" of an asset's surface need be measured to

arrive at a repeatable measure for the whole asset. As with the PSI, if the KPI's used to derive the index can be modeled, the future PSI can be predicted. Similar to PSI, PCI can be directly predicted empirically from historical data.

Structural Adequacy

If assets are newer and/or have no visible distress they can be assessed for robustness by comparing the load carrying capacity to the demand load for structures, in terms of the capacity/demand ratio. An example of this index type applicable to pavements is the Structural Adequacy Index (SAI) [TAC 1997]. This index is intended to evaluate the current adequacy of a pavement structure relative to its ability to withstand expected traffic loadings. When appropriately used these types of indices provide a forecast of remaining life of an asset, as well quantification of current and future reliability.

Composite Quality Index

A short coming of the PCI is that it does not directly consider the users experience (perceived LOS), as do the PSR/PSI and the RCI. None of these indices provide an indication of future reliability like the SAI. These short comings lead to the development of a composite indicator called the Pavement Quality Index (PQI) [TAC 1997]. For this index, the panel rated riding comfort is converted to an index (RCI) and combined with a PCI/SDI and an SAI. Each of the three component indices is weighted based on asset owner's perception of importance. Ride might not be as important on lower speed municipal roads versus high speed highways for example. Each of the indices comprising the composite index might in themselves be an aggregation of other measurements. Each level of aggregation leads to loss of information. Also, because of the adjustable weighting factors, the PQI is not standardized between agencies.

The concept of including perceived level of service and reliability as well as condition in an overall index is an important benefit. It leads to the concept that a multi-purpose asset condition indicator might be derived from either a single or multiple input information sources. It is the resultant asset condition indicator that should be common across asset classes, not the inputs.

Asset Valuation Index (AVI)

The current value of an asset is often expressed in terms of its replacement cost depreciated to current condition of the asset called its Written Down Replacement Cost[vii] (WDRC). For comparisons between values of a portfolio of assets the WDRC is converted to an index. In the context of facilities such as buildings it is called the Facility Condition Index. The Facility Condition Index[viii] (FCI) is a standard facility management benchmark that is used to objectively assess the current and projected condition of a building asset. By definition, the FCI is defined as the ratio of current year required renewal cost to current building replacement value. Building condition is often defined in terms of the FCI as follows:(Good) 0 to 5 percent FCI,(Fair) 5 to 10 percent FCI (Poor) 10 to 30 percent FCI, (Critical) greater than 30 percent FCI. The purpose of the FCI is to provide a means for objective comparison of facility or building condition as well as allowing senior decision makers to understand building renewal funding needs and comparisons.

Another indicator of asset value is Transport Canada's Net Salvage Value (NSV) [Cowe Falls et al 2005]. Transport Canada has suggested that NSV, which is the difference between the rehabilitation costs and the replacement cost, is a method appropriate for railways.

Quantifiable damage indices (such as the Transportation Research Board's (TRB) Mechanistic Empirical Pavement Design Guide's (MEPDG) top-down fatigue cracking, bottom up fatigue cracking, rut, roughness and pavement strength or the Highway Development and Management's (HDM-4)[ix] All structural Cracking (ACA), Wide Structural Cracking (ACW), rut, roughness and Modified Structural Number (SNP)) are based on either structured-empirical models or mechanistic-empirical models and are therefore, by definition predictable, so can be used directly to calculate future repair and rehabilitation cost. The damage indices also provide a firm

basis for Life-Cycle Cost Analysis (LCCA) in that different rehabilitation intervention triggering levels can be explored to obtain an optimal Life Cycle Cost.

The authors have used these damage indicators to formulate a pavement specific Net Salvage Value index called the Pavement Asset Value Index (PAVI). With this methodology, individual surface/visual distresses such as fatigue cracking, thermal cracking, rutting, roughness and measured structural weakness are assigned maintenance and repair treatments and quantities on a unit cost basis. The ratio of NSV to the replacement cost of the pavement asset expressed as a percentage produces the PAVI.

The creation of a reliable damage index, herein after referred to as an Asset Damage Index (ADI), is fundamental to the requirement for prediction of cost information into the future as is required by an LCCA but also useful in predicting the future AVI. The key concept here is that predictable damage (predicted cracking), predictable reliability (predicted SN relative to traffic forecasts), predicted LOS (predicted roughness) and predicted user safety (predicted rutting) is used to forecast the amount of maintenance and rehabilitation, and hence costs to bring the asset to as-new condition, in any year into the future. An LCCA using damage indices can be applied to any asset, a road, a bus, a BBQ, etc.

Safety Index

An example of a Safety Index is Utah State Department of Transportation's (UDOT) Safety Index[x]. The UDOT Safety Index is a value that combines multiple safety statistics into a single, zero to ten scale number. UDOT uses the Safety Index for project prioritization and roadway safety assessment. To develop the Safety Index, individual, zero to five scores are derived for four safety factors by comparing the value of an individual road segment against the statewide distribution for roadways of similar volume and functional class. The scoring breakdown is:

0 – segment with no crashes
1 – segment below the 50th percentile
2 – segment from the 51st to the 75th percentile
3 – segment from the 76th to the 90th percentile
4 – segment from the 91st to the 95th percentile
5 – segment above the 95th percentile.

After each factor receives a score, the scores are summed. The summation results in a zero to 20 value, which is then divided by two to create the final zero to ten Safety Index. The Safety Index brings a measure of risk to asset comparisons.

Asset Health Index

As an example of the introduction of risk, reliability and criticality a KPI advanced by Deloitte[xi] for use in the Canadian Electricity Association is the Asset Health Index (AHI) comprised of five components:

1. Asset identification
2. Condition
3. Usage
4. Failure modes
5. Criticality/risk information

There is no standard way of calculating Asset Health Indices, as each organization will place different values on the various factors involved. As a basic example, one utility[1] considers the end of life of a pole to be based on the "effective" circumference; that being determined by a combination of measured circumference, the un-compromised shell thickness and the amount of deterioration due to insect infestation (Woodpecker rating) of

[1] The Company's identity was described as confidential in the document.

the pole. A pole's strength is expressed as a percentage in terms of its remaining effective circumference relative to the required circumference. A relationship is then developed between effective circumference and remaining life. The company plans replacement of poles with a remaining strength of 60% or less and prioritizes these projects based on risk. This is an example of combining a Capacity Demand calculation (like the SAI) with a criticality/risk information to arrive at the AHI. Interestingly, the process does not include an asset value.

Risk Matrix

The AHI was by no means the first example of including risk and reliability as an indicator of LOS. The British Columbia Auditor General for Local Governments (AGLG) identified benefits associated with a risk-based approach[ii] stating it,

> "*helps you prioritize your resources, optimize your budget, avoid unnecessary costs and achieve a higher return on your local government's investments in capital assets. By identifying and assessing the level of risk associated with each potential asset failure, you can target scarce resources to ensure vital services remain available and critical assets are appropriately inspected, monitored and covered by preventative maintenance.*
>
> *"Risk analysis is about determining the likelihood and consequence of asset failure, each rated for criticality from low to extreme. Consequences are typically classified as economic, operational, social and environmental and public health and safety. The risk rating diagram can give a good idea of the methodology used by many public sector organizations. As risk likelihood and consequence increase, the rating moves from low to extreme.*
> *It's best to carry out risk modeling before assessing asset condition. In fact, risk assessment should direct how and when you assess condition. Assets with an extreme criticality rating should receive detailed condition assessment, engineering reviews and field monitoring*."

Figure 1 shows the risk rating matrix identified by the AGLG as methodology used by many public sector organizations, for assigning a risk index in terms of low, medium, high or extreme risk. The Likelihood score multiplied by the Consequence score defines a risk index on a scale of 1 to 25.

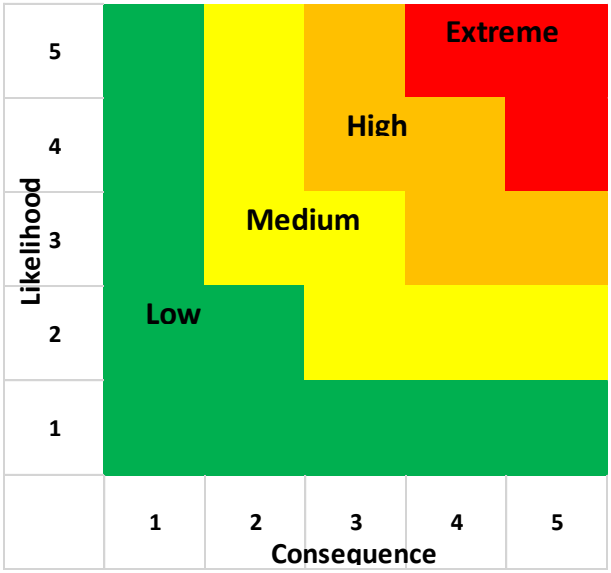


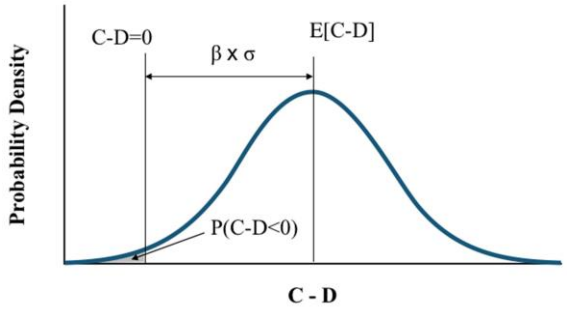
Figure 1 – BC AGLG Risk Matrix

The document does not provide a methodology for determining either the Likelihood or the Consequence although assignment of an asset's "Likelihood" score is presumably deduced from its stage within its life-cycle. The AGLG provides a simple gauge or standard for lifecycle costing as developed by the Public Sector Digest:

0-25% through the asset's lifespan – minor maintenance
25-50% through the asset's lifespan – major maintenance
50-75% through the asset's lifespan – rehabilitation
75-100% through the asset's lifespan – replacement

Reliability Index

With the reliability approach, much is left to the judgement, preferences and priorities of the individual. In 2011 the United States Army Corps of Engineering documented a Reliability Index[xii] to be used for reliability analysis of structural assets such as drainage structures and bridges. With this method, the demand D and the capacity C are the uncorrelated random variables. Both variables are represented by normal distributions with their means and standard deviations. Therefore, the safety margin C-D has a normal distribution, by which P(C-D<0) can be obtained from a closed form solution as illustrated in Figure 2, where β is the reliability index, E(C-D) is the expected (mean) value of C-D, and σ is the standard deviation. Greater values of β represent greater structural reliability or lower probability of failure.



$$\beta = E[C\text{-}D] / \sigma$$
$$\sigma = (\sigma_C^2 + \sigma_D^2)^{1/2}$$
$$\beta = E[C\text{-}D] / (\sigma_C^2 + \sigma_D^2)^{1/2}$$

Figure 2[xiii] – Reliability Index

The inverse of the Reliability Index is the Risk Index representing the Probability of Unsatisfactory Performance (Pup) which in turn quantifies, in terms of percentage, the chance or likelihood of loss of reliability. This Pup multiplied by the monetized consequences of unsatisfactory performance defines the risk [USACE 2011]. The authors have developed[xiv] methodology for the use of this technique for managing highway drainage culverts considering climate change risk. The advantage in using this approach is that so long as the consequences can be appropriately quantified [USACE 2011], it is possible to compare risk across asset classes. Since risk encompasses safety it negates the need for a separate safety index. The capacity versus demand concept combined with risk satisfies the objectives of the Asset Health Index. The risk assessment is asset independent.

Development of a Cross Asset Multi-Purpose Asset Condition Index

The authors propose of a common measure of asset status that combines many of the benefits of existing types of reporting measures, while at the same time providing a basis for compatible comparison between asset classes.

The benefits of the previously discussed, existing reporting measures are seen to be as follows:

- Provides an indication of users' perceived level of service;
- Indicates condition relative to measurable deterioration;
- Indicates remaining life;
- Places a current value on the asset;
- Defines triggering levels for applying interventions;

- Forms the basis for cost benefit analysis;
- Defines the level of risk;
- Can be applied to any infrastructure asset.

The authors are proposing a framework for development of this type of asset status rating by combining the concept of asset valuation using a Net Salvage Value index (called an Asset Value Index) with a Reliability Index whereby the two indices are mathematically inter-related. That is, if an asset manager can determine either index the other can be mathematically computed.

The premise for this framework is that it be risk-based, and that the quantification of the consequences of unsatisfactory asset performance are determined in a consistent manner across all assets and asset classes.

The asset's reliability is defined by the probability that the asset will perform satisfactorily through to the next scheduled inspection. The key to development of the framework is establishing a relationship between an asset's reliability and its remaining value. In this proposed framework remaining value, expressed as a percentage, is defined as the cost to replace the asset minus the cost to bring the asset in its current condition back to "as-new" condition divided by the cost of asset replacement.

Current Asset Value (%) = (Asset Value – Cost to Bring Asset to As-new Condition)/Asset Value

It is proposed that Current Asset Value (%) = Asset Condition Index (ACI)

The asset's current value expressed as a percentage of the asset's current replacement cost is then related to the asset's reliability using a suitable numeric expression whereby the 0% – 100% remaining asset value range is expressed in terms of a 0% - 100% probability/reliability range. This can be done as a separate exercise for each asset class or a generic relationship such as that shown in the illustrative framework given in Figure 3 could be used directly.

In either case, once the Asset Value – Reliability relationship is established, the asset's current status can be assessed either by inspection to determine its current asset value or estimating the probability that the asset will perform satisfactorily through to its next inspection.

The inspection/asset valuation process is further simplified by providing treatment intervention triggering ranges related to maintenance, preservation, rehabilitation and replacement. In this framework the LOS is aligned with the condition ranges. The inspector defines what work needs be done, the work is assigned a cost and the ACI is calculated. The repair costs can be defined as a percentage of asset replacement value to simplify the ACI calculation.

Alternatively, the inspector might conduct a risk/reliability analysis similar to that described in the USACE document EC 1110-2-6062 "Risk and Reliability Engineering for Major Rehabilitation Studies" to determine the reliability or simply estimate the reliability based on expert knowledge.

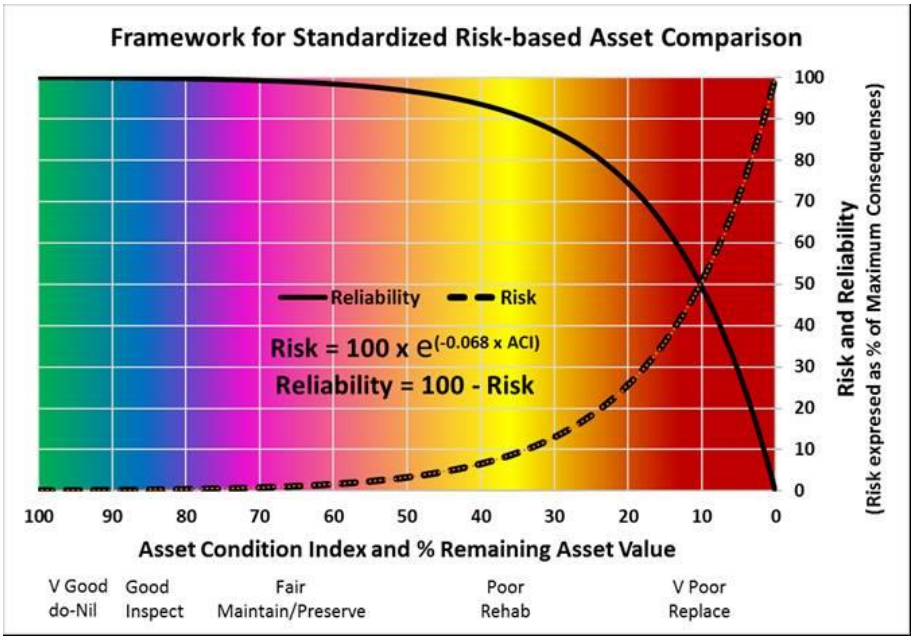


Figure 3 – Proposed Multi-Purpose Asset Condition Indicator

Once the reliability/asset value relationship has been established for a given asset class, the ACI can be determined either by direct measurement of asset condition or by first determining reliability directly from the asset's point within its life-cycle or a reliability analysis.

The concept is that no matter how an asset is currently being rated it can be translated through the proposed framework illustrated in Figure 3 into these standardized ACI/AVI and Risk and Reliability indicators.

It must be stressed that the ACI/AVI is only an indicator of the asset's condition state at a point in time it is not a predictive model in and of itself. The prediction of AVI is done through underlying asset specific damage indices or by predicting asset specific reliability by whatever measures are available and converting mathematically to ACI. Alternatively ACI might be modeled empirically directly from historical ACI values for a given asset.

Life-cycle cost Analysis is best done using the underlying damage model indices but now the future risk can be considered as a cost, (or risk reduction as a benefit), in the LCCA [Stmichel et al 2017].

Example Asset Evaluation

An example is provided using Curb/Gutter and sidewalk assets. In this example the assets are to be visually rated from digital images of the assets captured at 5 meter intervals along the length of these linear assets. An asset is defined as a **Section** which encompasses the entire length of the asset from one intersection to the next (generally block – to block) and one on either side of the street where they exist.

Sample Unit is defined as the 5m visible length, of these linear assets represented by the central portion of each digital image. However, not all images have Sample Units visible in each image. In some cases, an asset may not exist at a given location or may not be visible due to parked cars, other obstructions, or camera angle. A Sample Unit only exists, for an asset, if it is readily visible in the central portion of an image.

On each Sample Unit, several distresses are rated in each of the following severity levels, subjectively by the rater:

- **Excellent** = Asset Appears relatively New and has no visible distresses – Entire Sample Unit is assigned a deduct value of **Zero**, all other distress deduct values are set at **Zero**.
- **Good** = Asset appears relatively Old and has no visible distresses – Entire Sample Unit is assigned a deduct value of **One**, all other distress deduct values are set at **Zero**.

- **Fair** = The distress is visible but in the rater's opinion, the distress does not affect the function of the asset and no repair can, (or needs), to be done (e.g. a just visible crack). The distress is assigned a deduct value of **Two**.
- **Poor** = The distress has progressed to the point where a maintenance repair, could be readily and cost effectively applied to maintain the functionality of the asset. The distress is assigned a deduct value of Five.
- **Very Poor** = The Sample Unit has deteriorated to the point where, maintenance repairs will be insufficient to economically re-establish proper function of the asset. The Sample Unit needs to be replaced. The Sample Unit is assigned a Deduct Value of **Ten**.

A matrix of deduct values, Sample Unit level treatments and distress/damage based triggers is given in Table 1.

								Sample Unit Based					
Sample Unit Deducts								Field Inspections		Maintenance Repairs		Rehabilitation	
	Severity Level Deduct Values							Sample Unit Level Triggers for Works Program Development					
Asphalt Sidewalk	**Excellent**	**Good**	**Fair**	**Poor**	**Very Poor**		**Trigger**	**Deduct = 2**	**Trigger**	**Deduct = 5**	**Trigger**	**Deduct = 10**	
Cracking	0	1	2	5	10			Field Inspection (Section)		Crack fill (Sample)		Replace (Sample)	
Cross Slope			2	5				Field Inspection (Section)		Shim Lift (Sample)		Replace (Sample)	
Faulting			2	5				Field Inspection (Section)		Fillet (Sample)		Replace (Sample)	
Ravelling			2	5				Field Inspection (Section)		Spray Patch (Sample)		Replace (Sample)	
Obstruction			2	5				Field Inspection (Section)		Remove (Obstruction)		Re-align (Sample)	
Ponding			2	5				Field Inspection (Section)		Shim Lift (Sample)		Replace (Sample)	
Settlement			2	5				Field Inspection (Section)		Shim Lift (Sample)		Replace (Sample)	
Utility Cuts			2	5				Field Inspection (Section)		Re-Patch (Sample)		Replace (Sample)	
Concrete Sidewalks	**Excellent**	**Good**	**Fair**	**Poor**	**Very Poor**			**Deduct = 2**	**Trigger**	**Deduct = 5**	**Trigger**	**Deduct = 10**	
Cracking	0	1	2	5	10			Field Inspection (Section)		Crack fill (Sample)		Replace (Sample)	
Cross Slope			2	5				Field Inspection (Section)		Shim Lift (Sample)		Replace (Sample)	
Faulting			2	5				Field Inspection (Section)		Fillet (Sample)		Replace (Sample)	
Obstruction			2	5				Field Inspection (Section)		Remove (Obstruction)		Re-align (Sample)	
Ponding			2	5				Field Inspection (Section)		Shim Lift (Sample)		Replace (Sample)	
Settlement			2	5				Field Inspection (Section)		Shim Lift (Sample)		Replace (Sample)	
Utility Cuts			2	5				Field Inspection (Section)		Re-Patch (Sample)		Replace (Sample)	
Spalling			2	5				Field Inspection (Section)		Parge (Sample)		Replace (Sample)	
Fillets			2	5				Field Inspection (Section)		Re-Fillet (Sample)		Replace (Sample)	
Curb & Gutter	**Excellent**	**Good**	**Fair**	**Poor**	**Very Poor**			**Deduct = 2**	**Trigger**	**Deduct = 5**	**Trigger**	**Deduct = 10**	
Cracking	0	1	1	5	10			Field Inspection (Section)		Crack fill (Sample)		Replace (Sample)	
Faulting			1	5				Field Inspection (Section)		Shim Lift (Sample)		Replace (Sample)	
Spalling			1	5				Field Inspection (Section)		Fillet (Sample)		Replace (Sample)	
Joints			1	5				Field Inspection (Section)		Parge (Sample)		Replace (Sample)	

Table 1 – Sample Unit Based: Distresses, Deduct Values, Trigger Values, and Treatments

Development of a Generic Asset Damage Index

The premise behind this Asset Damage Index (ADI), is that one damage definition be suitable for any asset class and that the ADI value directly informs the Asset Manager as to which Sectional Treatment Category is suggested.

Sectional Treatment Categories

The proposed treatments fall into five sectional treatment categories:

- **Do-nil** – At the section level, no action required.
- **Field Inspection** – At the Section level where distresses exist but no maintenance repairs are suggested. The field inspection validates the distress rater's judgement and provides for inspection of the entire asset including portions that were not visible from the digital images.

- **Maintenance** – Repairs to a Section where no Sample Unit replacements are suggested. Repairs are defined by distress type as recorded in poor condition by the rater. This treatment also includes a full review of the section to validate the rater's opinion and to review those portions of the asset not readily visible in the digital images.
- **Rehabilitation –** Repairs to a Section where some Sample Unit replacements are suggested by the rater. This treatment also includes a full review of the section to validate the rater's opinion and to review those portions of the asset not readily visible in the digital images.
- **Reconstruction –** Reconstruction of a Section where so many Sample Units are suggested for replacement or that so many sample units are suggested for maintenance repair, that it becomes more economical to reconstruct the entire Sectional Asset. In this case defined as either more than 30% of Sample Units within a Section require replacement or the combination of Sample Units within a Section that need repair and/or replacement exceeds 60%.

Sectional density accounts for both the extent of the distress and the extent of the asset class that was measured for this distress.

Sectional Densities = number or Sample Units containing a given deduct value/Total Number of Sample Units rated on a given asset Section. Each Sample Unit is assigned the highest Deduct Value rated, either a 0, 1, 2, 5 or 10. Total of all Deduct Densities = 100%. There are five density calculations for each section.

D_0	D_1	D_2	D_5	D_10
Density_0	Density_1	Density_2	Density_5	Density_10
% Deduct Values =0	% Deduct Values =1	% Deduct Values =2	% Deduct Values =5	% Deduct Values =10

The ADI is on a scale of 0 – 10 and is based on the lowest value of either 50 minus the D_10 density or 80 minus the D_5 density. If no D_5 or D_10 densities exist on a Section the ADI is derived from the proportion of either D_2 density or D_1 density yielding the lowest ADI. The calculation is as follows:

Asset Damage index (ADI) = IF(**D_5** + **D_10** > 0, IF(**D_10** > 0, MIN(50-**D_10**,80-**D_5**), 80 - **D_5**), IF(**D_2** > 0, 90 - **D_2**/10, 100 - **D_1**/10))/10

The ADI is set to zero if the equation results is less than zero. The ADI is also rounded to one decimal place.

In this way the resulting ADI directly informs the asset manager regarding the treatment category for the Section. The extent of the damage is also immediately evident through the damage index, an index of 5 has requires significant maintenance but no rehabilitation while an index of 7.9 requires only a very little maintenance.

Sectional Trigger Values

- **ADI > 9** No Distress ----> (Do-Nil),
- **ADI 8 - 9** Some Distress Exists ----> (Field Inspection)
- **ADI 5 - 8** Some Maintenance Repairs Suggested (Develop Maintenance Program)
- **ADI 2 - 5** Less than 30% of Sample Units need Replacement and/or greater than 30 % of Samples need Maintenance Repair ----> (Develop Rehabilitation Program)
- **ADI < 2** More than 30% of Sample Units need Replacement and/or greater than 60 % of Sample Units need Maintenance Repair ----> (Replace Asset)

Decision Trees (Triggers)

At the Sample Unit and individual distress level, by definition, the trigger levels are defined by the deduct values. A deduct value of 5 for any distress triggers its Maintenance repair. There are however further decisions to be made for the treatment of the overall Section. If no distress exists on a section, i.e., all Sample Units have Deduct values of either a Zero or a One, it would be assigned a "Do-Nil" treatment. In other words, no further action required at this time.

If there are any recorded distresses and if all recorded distresses in all Sample Units on a section have a rating of Two, there is no repair action suggested, however the Section would be assigned a "Field Inspection" treatment.

If there are any repairable distresses or suggested Sample Replacements at all on any Sample Unit within a Section, the Section is flagged for a Work Program Development process as shown in Figure 4.

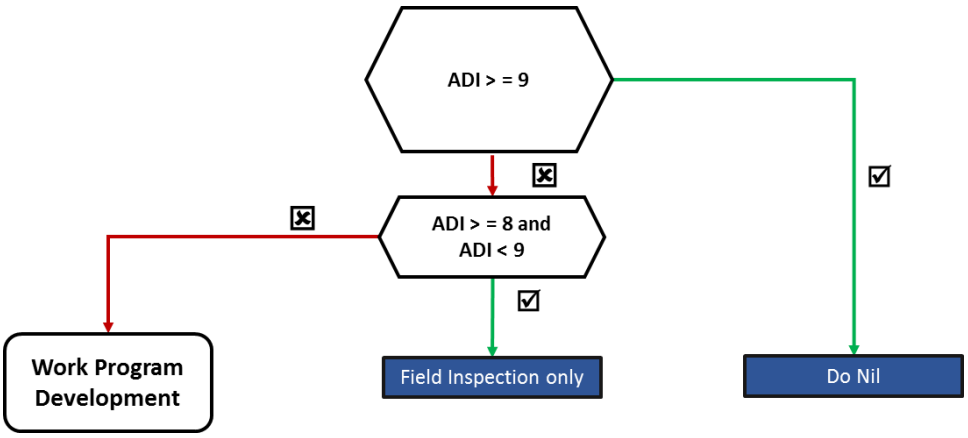


Figure 4 – Work Plan Development Decision

Once enough maintenance repair or Sample Unit replacement is required on a section it becomes more economical to replace the asset through reconstruction. It is proposed that if more than 30% of the Samples Units in a given Section require replacement or that more than 60% of the Sample Units require either replacement or some maintenance repairs, the entire Section be considered for replacement. Assets which are not candidates for full replacement are divided in to those that need partial replacement and those which require maintenance repairs only. (Figure 5)

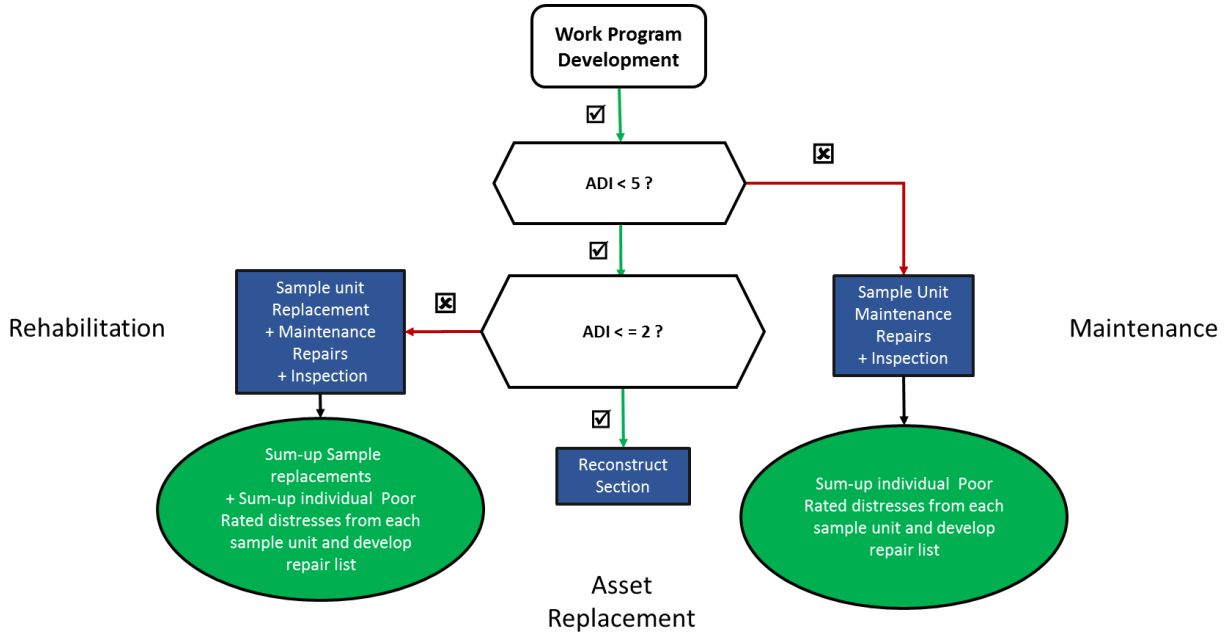


Figure 5 – Work Plan Development Process

Sample Unit Level: Quantity and Cost Development

Developing the work plan consists of deriving a count of each individual, repairable distresses from each sample unit within a Section for each asset. That count, divided by the number of the valid sample units in the Section, provides an individual distress density for each distress. The density is multiplied by 5 (five meters is the approximate length of the Sample Unit) and then divided by the asset's length. This provides a percentage of asset length in need of repair for each individual distress. A unit cost, per 5m length, for each repair type listed in Table 1 is applied to each individual Sectional distress density to arrive at cost estimates, by repair type, expressed as a percentage for each Section.

Calculating Asset Condition/Asset Value Index

By definition, an ADI of 10 has no cost to bring it to "as-new" condition. Also by definition an ADI of < than 2 has a cost equal to 100% of the replacement value of the asset therefore an AVI of 0. ADIs of between 9 and 10 need no repairs, ADIs between 8 and 9 will need varying degrees of inspection, those between 5 and 8 will increasingly intensive maintenance repairs and ADI between 2 and 5 will require increasingly intensive combinations of Sample Unit replacements and maintenance repairs. These asset costs can be calculated directly by summing density based unit costs derived above or alternatively by prorating based on judgement.

An example using judgement might be that defects that are not yet in need of maintenance should not be valued at more than 10% of an asset's value and maintenance should not be more than 30% of its value prior to initiating a rehabilitation. Prorating costs between 100% and 30% (ADI from 2 to 5) for increasingly expensive rehabilitation, 30% and 3% (ADI from 5 – 8) for increasingly expensive maintenance and between 3% and 0% for increasingly expensive inspections. These costs subtracted from 100 give the AVI/ACI value.

Conclusions

An asset value index based on net salvage value enables cross asset comparison of tangible capital assets. The combination of damage indices to assess repair costs as used to derive a Net Salvage Value based Asset Value Index makes provides a cross asset performance indicator possible.

If the Asset Damage Index is constructed in such a way as to readily define overall condition state in terms of repair requirements, it will make the ADI directly useful for assessing Asset condition because very little of the underlying condition information is lost in the conversion from damage measurements to damage indices and consequently to value index.

If it can be agreed that LOS is defined by perceived condition and reliability, then both are required to define it. The two could be measured and tracked independently, or a mathematical relationship developed such that one index and an associated equation is developed for each asset class.

This framework is intended to spark some discussion around these concepts. The example damage index and framework provided by the authors, is believed to be a reasonable starting point for developing a multi-purpose asset comparison indicator, and the beginning of a replicable and defensible approach to comparing apples and bananas.

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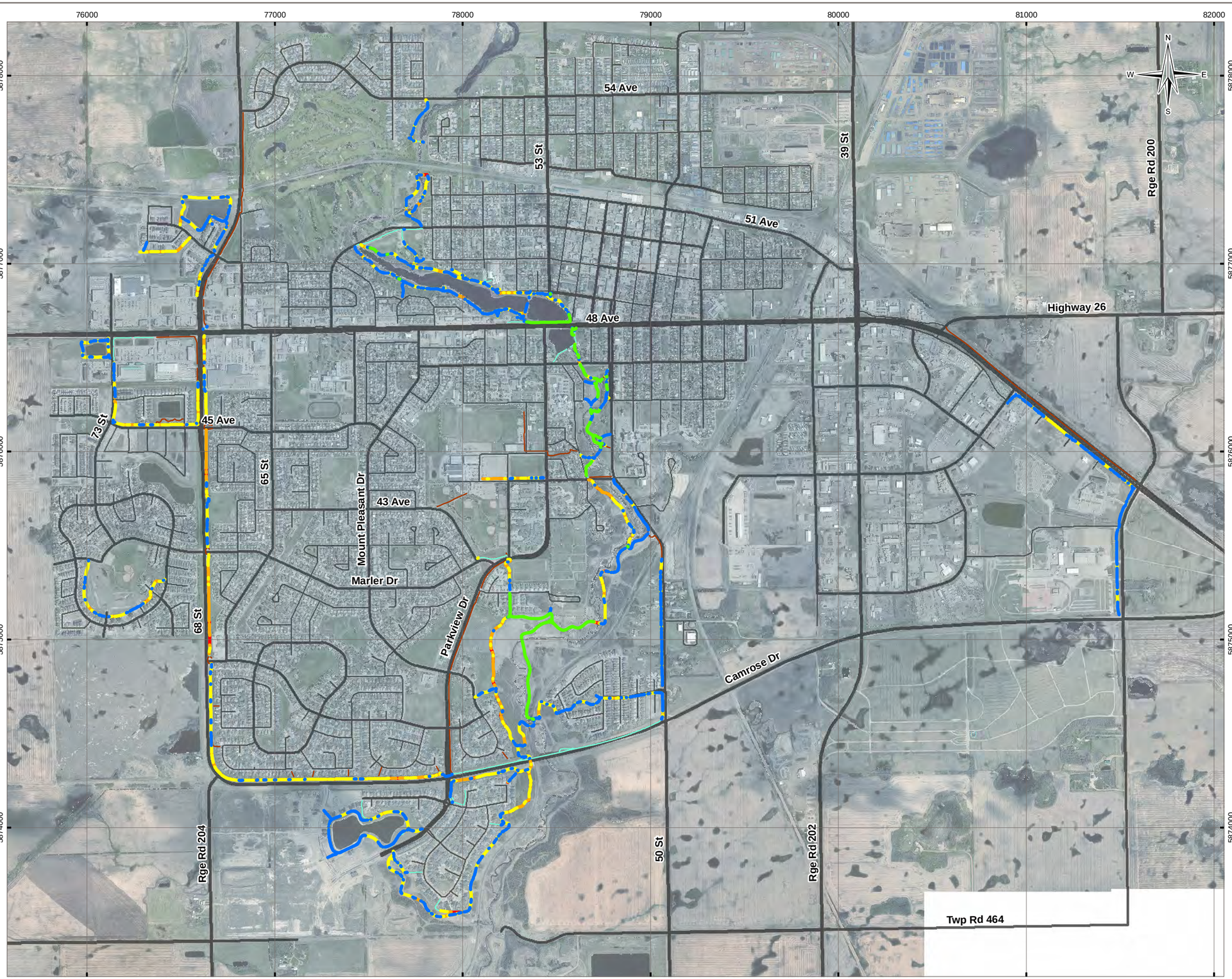
APPENDIX B

SAMPLE UNIT CONDITION MAPS

- Figure B1: Asphalt Trail Sample Unit Condition Map
- Figure B2: Concrete Trail Sample Unit Condition Map
- Figure B3: Collected Trails Material Type Map
- Figure B4: Sample Unit Hazard Map



LEGEND

- Brick
- Concrete
- Trail Not Collected

Rated_Images_4m Events

- Excellent
- Good
- Fair
- Poor
- Very Poor

NOTES
Base data source:
Imagery from City of Camrose (2017)

STATUS
ISSUED FOR USE

CITY OF CAMROSE
TRAIL CONDITION ASSESSMENT

Asphalt Trail Sample Unit Condition Map

PROJECTION	DATUM	CLIENT
3TM 114	NAD83	City of Camrose

Scale: 1:20,000
200 100 0 200
Meters

TETRA TECH

FILE NO.
PAVE03186-01_FigB1_AsphaltTrailCondition.mxd

OFFICE	DWN	CKD	APVD	REV
Tt-VANC	DL	YL	AW	0

DATE	PROJECT NO.
December 17, 2019	TRN.PAVE03186-01

Figure B1

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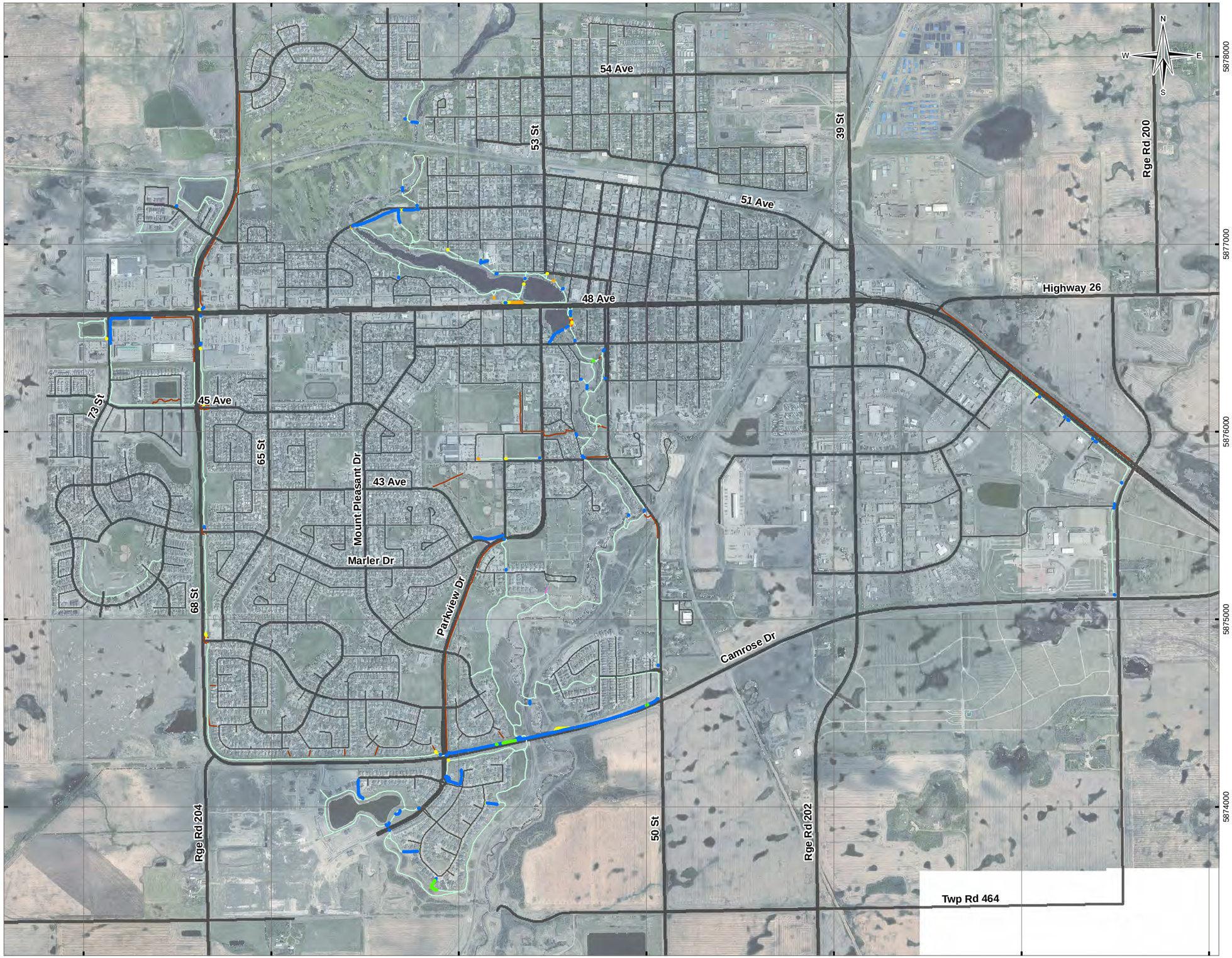

LEGEND

- Asphalt
- Brick
- Trail Not Collected

Concrete Trail Rating

- Excellent
- Good
- Fair
- Poor
- Very Poor

NOTES
Base data source:
Imagery from City of Camrose (2017)

STATUS
ISSUED FOR USE

CITY OF CAMROSE
TRAIL CONDITION ASSESSMENT

Concrete Trail Sample Unit Condition Map

PROJECTION	DATUM	CLIENT
3TM 114	NAD83	City of Camrose

Scale: 1:20,000
200 100 0 200
Meters

TETRA TECH

FILE NO. PAVE03186-01_FigB2_ConcreteTrailCond.mxd

OFFICE	DWN	CKD	APVD	REV
Tt-VANC	DL	YL	AW	0

DATE December 17, 2019
PROJECT NO. TRN.PAVE03186-01

Figure B2

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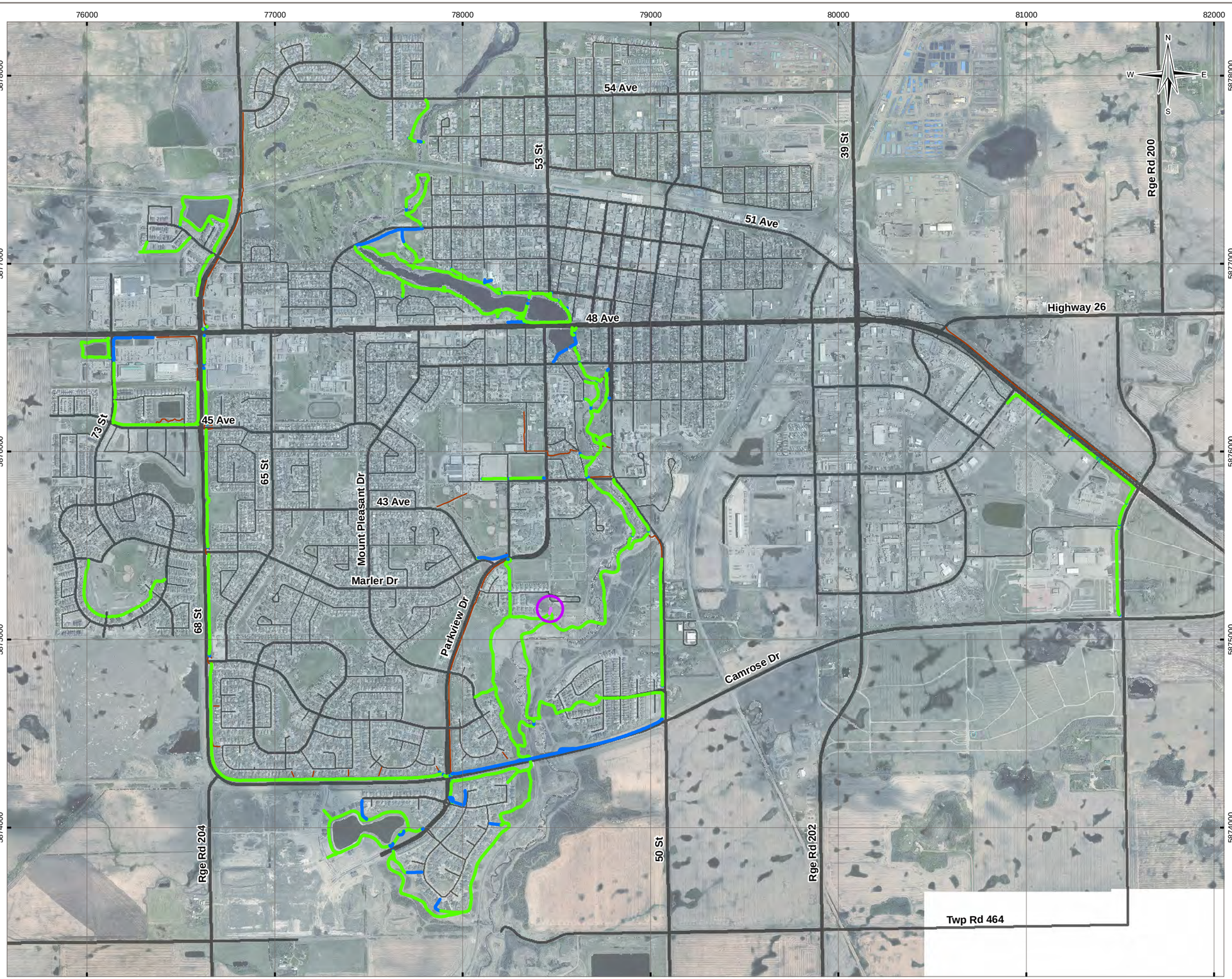

LEGEND

- Trail Not Collected

Trail Material Type

- Asphalt
- Brick
- Concrete

NOTES
Base data source:
Imagery from City of Camrose
(2017)

STATUS
ISSUED FOR USE

CITY OF CAMROSE
TRAIL CONDITION ASSESSMENT

Collected Trails Material Type

PROJECTION 3TM 114			**DATUM** NAD83		**CLIENT** CITY OF Camrose
Scale: 1:20,000 200 100 0 200 Meters					TETRA TECH
FILE NO. PAVE03186-01_FigB3_TrailType.mxd					
OFFICE Tt-VANC	**DWN** DL	**CKD** YL	**APVD** AW	**REV** 0	**Figure B3**
DATE December 17, 2019	**PROJECT NO.** TRN.PAVE03186-01				

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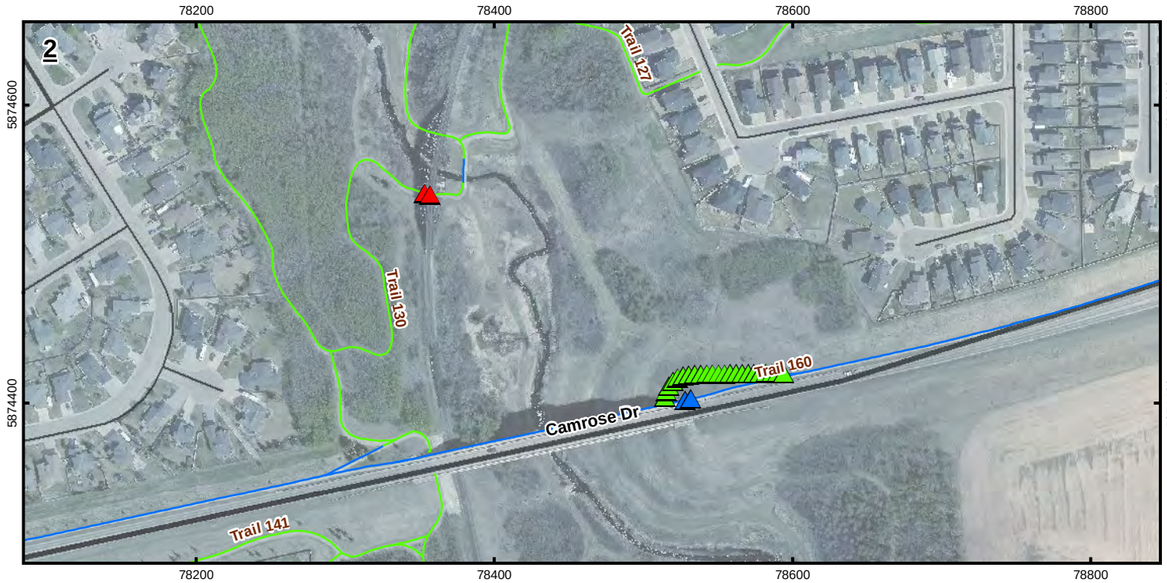
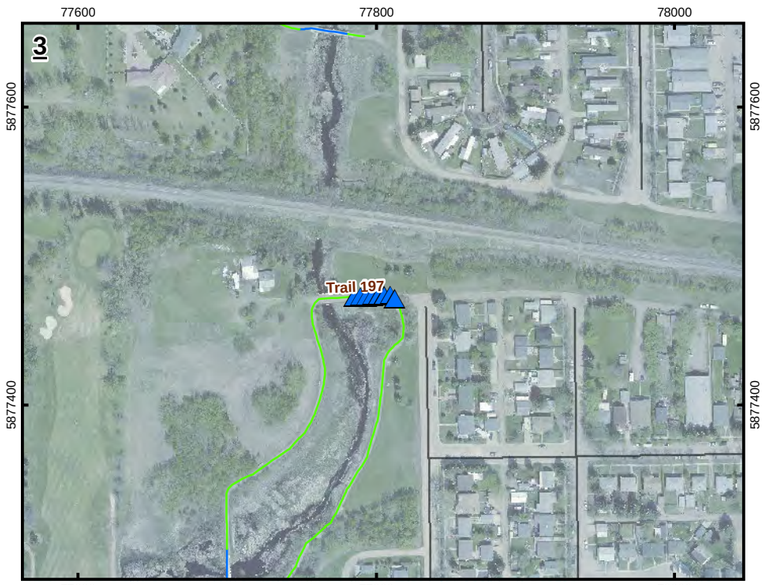
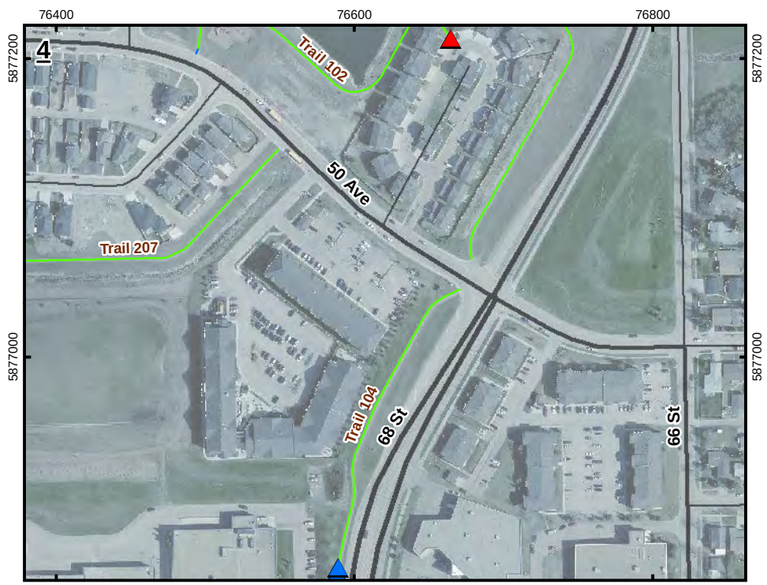






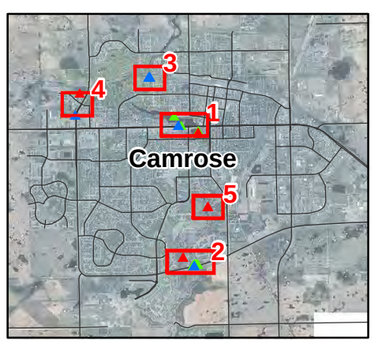
LEGEND

Hazard

- High
- Moderate
- Low

Trail Material Type

- Asphalt
- Brick
- Concrete



NOTES
Base data source:
Imagery from City of Camrose (2017)

STATUS
ISSUED FOR USE

CITY OF CAMROSE
TRAIL CONDITION ASSESSMENT

Sample Unit Hazard Map

PROJECTION 3TM 114		**DATUM** NAD83			**CLIENT** CITY OF Camrose
Scale: 1:4,000 — 80 40 0 80 Meters					TETRA TECH
FILE NO. PAVE03186-01_FigB4_Hazard.mxd					
OFFICE Tt-VANC	**DWN** DL	**CKD** YL	**APVD** AW	**REV** 0	**Figure B4**
DATE December 17, 2019	**PROJECT NO.** TRN.PAVE03186-01				

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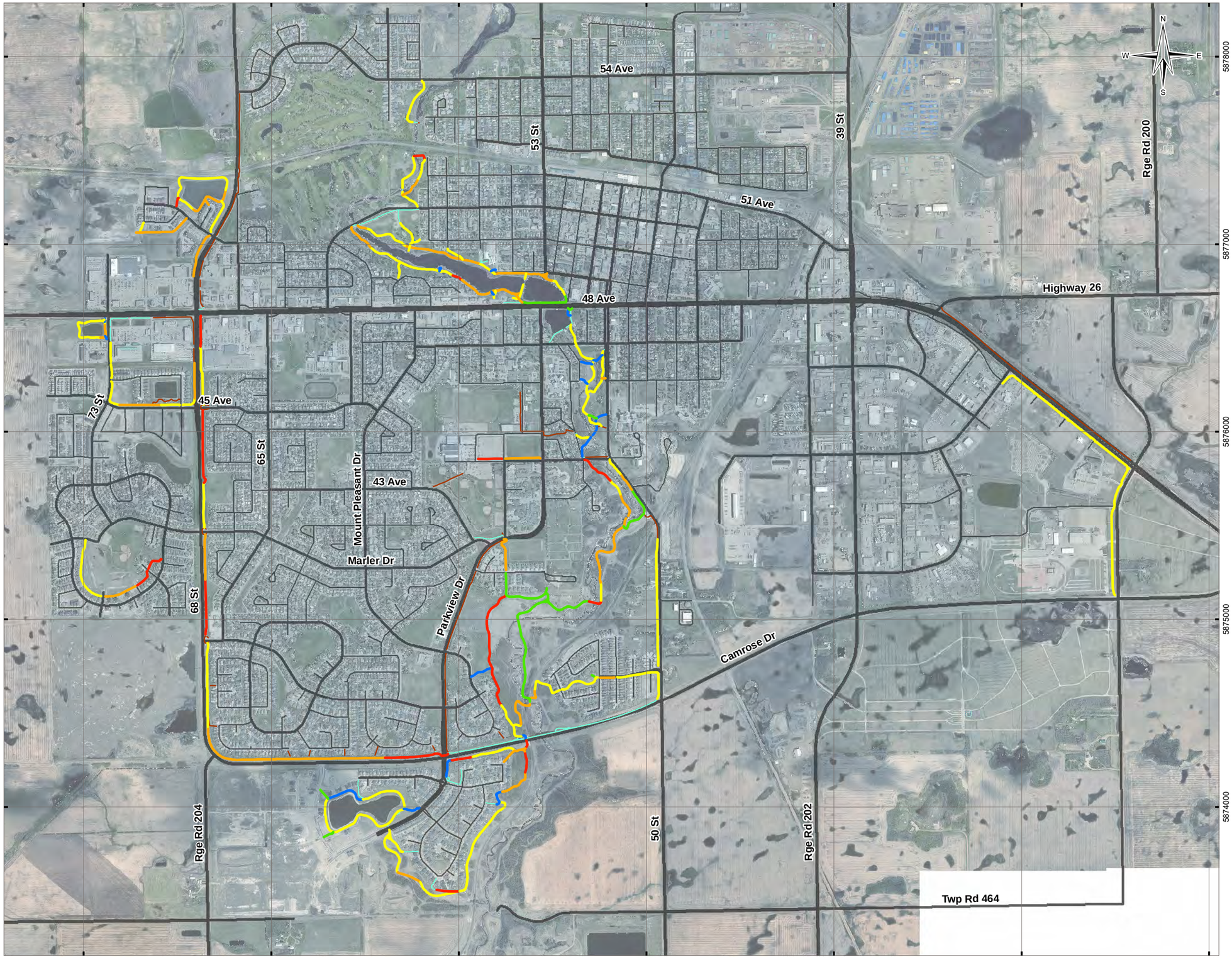
APPENDIX C

PRIORITY ACTIVITY PLAN MAPS

- Figure C1: Asphalt Trail Sections Activity Plan
- Figure C2: Concrete Trail Sections Activity Plan



LEGEND

- Brick
- Concrete
- Trail Not Collected

Asphalt Trail Activity Plan

- 9 ≤ ADI ≤ 10 Do Nill
- 8 ≤ ADI < 9 Field Inspection
- 5 ≤ ADI < 8 Maintenance Program
- 2 ≤ ADI < 5 Rehabilitation Program
- 0 ≤ ADI < 2 Replace Asset

NOTES
Base data source:
Imagery from City of Camrose
(2017)

STATUS
ISSUED FOR USE

CITY OF CAMROSE
TRAIL CONDITION ASSESSMENT

Asphalt Trail Sections Activity Plan

PROJECTION 3TM 114			**DATUM** NAD83		**CLIENT** City of Camrose
Scale: 1:20,000 200 100 0 200 Meters					TETRA TECH
FILE NO. PAVE03186-01_FigC1_AsphaltTrailPlan.mxd					
OFFICE Tt-VANC	**DWN** DL	**CKD** YL	**APVD** AW	**REV** 0	**Figure C1**
DATE December 17, 2019	**PROJECT NO.** TRN.PAVE03186-01				

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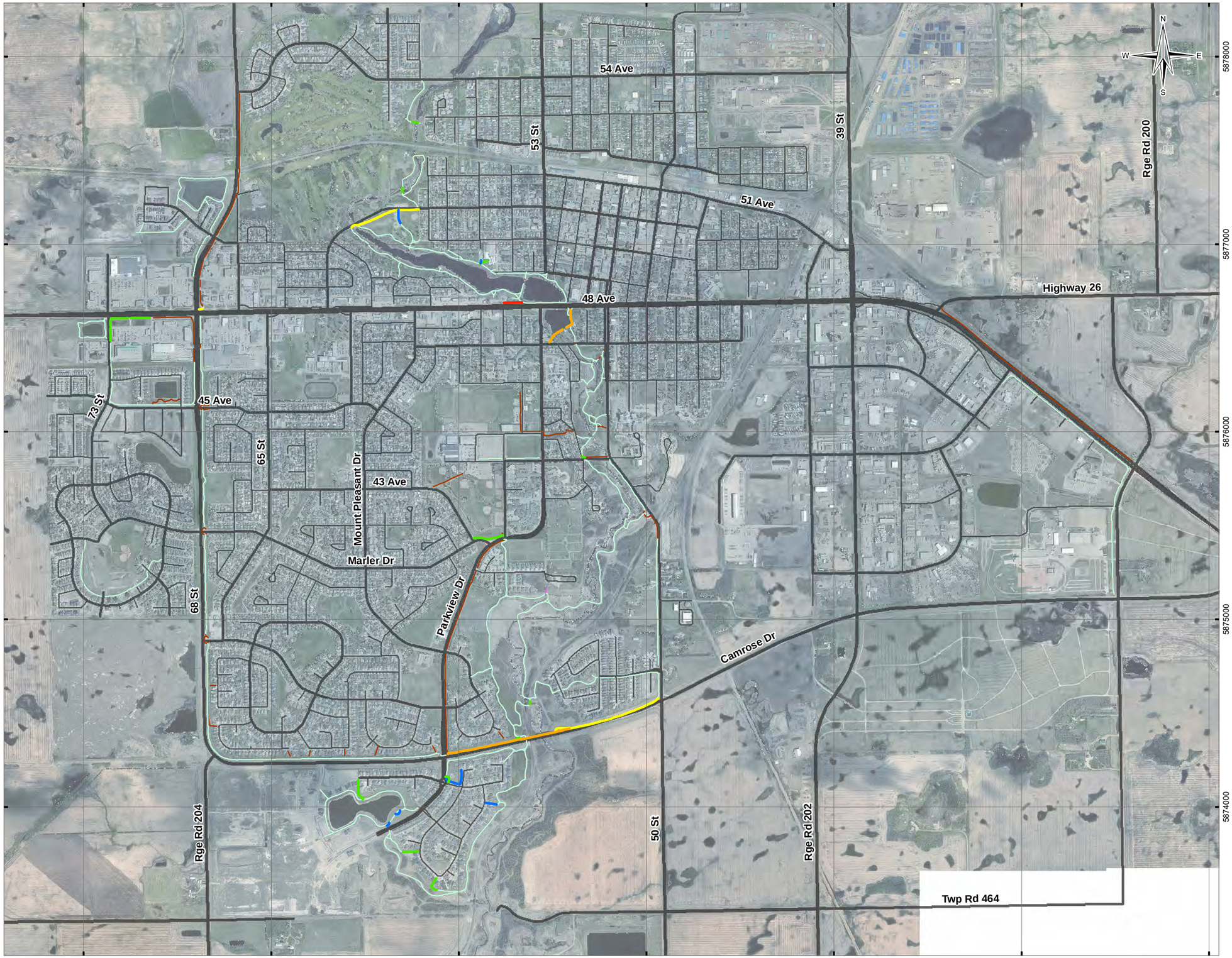

LEGEND

- Asphalt
- Brick
- Trail Not Collected

Concrete Trail Activity Plan

- 9 ≤ ADI ≤ 10 Do Nill
- 8 ≤ ADI < 9 Field Inspection
- 5 ≤ ADI < 8 Maintenance Program
- 2 ≤ ADI < 5 Rehabilitation Program
- 0 ≤ ADI < 2 Replace Asset

NOTES
Base data source:
Imagery from City of Camrose (2017)

STATUS
ISSUED FOR USE

CITY OF CAMROSE
TRAIL CONDITION ASSESSMENT

Concrete Trail Sections Activity Plan

PROJECTION 3TM 114			**DATUM** NAD83	**CLIENT** City of Camrose
Scale: 1:20,000 200 100 0 200 Meters				TETRA TECH
FILE NO. PAVE03186-01_FigC2_ConcreteTrailPlan.mxd				
OFFICE Tt-VANC	**DWN** DL	**CKD** YL	**APVD** AW	**REV** 0
DATE December 17, 2019	**PROJECT NO.** TRN.PAVE03186-01			**Figure C2**

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APPENDIX D

TRAIL CONDITION SECTIONS

- Table D1: Asphalt Trail Condition Sections
- Table D2: Concrete Trail Condition Sections
- Trails Data Dictionary

Trail Inventory					Hazards, Repair Length and Area, and Reconstruct Length				Asphalt Trail Condition Sample Units						Asphalt Trail Density						Asphalt Trail ADI, Priority, Activity, Cost				Trail Inventory			Rated Trail Length			Percent Trail	
Section	Trail_Name	From_m	To_m	Length_m	Hazards	Crack_Sealing_Length_m	Patch_Area_Sqm	Reconstruct_Length_m	AT_E	AT_G	AT_F	AT_P	AT_VP	Rat_AT_Inv	AT_D_0	AT_D_1	AT_D_2	AS_D_5	AT_D_10	AT_D_Tot	AT_ADI	AT_Priority	AT_Activity	AT_Cost	AT_Inv	CT_Inv	TT_Inv	AT_Len_m	CT_Len_m	Rated_Len_m	Percent_AT	Percent_CT
TRAIL	TRAIL	0	2096	2096					0	0	0	0	0							**0**												
TRAIL 100-1	TRAIL 100	0	358	358		146	4		0	21	51	17	0	89	0	24	57	19	0	**100**	6.1	62.0	Maintenance Program	$1,250	89		89	356		356	100	
TRAIL 100-2	TRAIL 100	358	531	173		31	5	4	0	16	22	5	1	44	0	36	50	11	2	**100**	4.8	52.0	Rehabilitation Program	$595	44		44	175		173	100	
TRAIL 100-3	TRAIL 100	531	733	202				202	0	4	15	28	4	51	0	8	29	55	8	**100**	1.9	13.0	Replace Asset	$32,787	51		51	205		202	100	
TRAIL 101-1-C	TRAIL 101	0	289	289					0	0	0	0	0							**0**						72	72		290	289		100
TRAIL 101-2	TRAIL 101	289	480	191		45	11		0	24	14	9	0	47	0	51	30	20	0	**100**	6.0	61.0	Maintenance Program	$882	47	1	48	190	2	191	99	1
TRAIL 101-3	TRAIL 101	480	626	146		7	3		0	2	33	2	0	37	0	5	90	4	0	**100**	7.6	106.0	Maintenance Program	$200	37		37	146		146	100	
TRAIL 101-4	TRAIL 101	626	848	222		125	29		0	8	21	26	0	55	0	14	38	48	0	**100**	3.2	29.0	Rehabilitation Program	$2,572	55		55	222		222	100	
TRAIL 101-5	TRAIL 101	848	1033	185		116	4		0	1	41	5	0	47	0	2	88	10	0	**100**	7.0	84.0	Maintenance Program	$791	47		47	186		185	100	
TRAIL 101-6	TRAIL 101	1033	1222	189		46	31	4	0	6	24	16	1	47	0	13	51	34	2	**100**	4.6	48.0	Rehabilitation Program	$1,853	47		47	189		189	100	
TRAIL 101-7	TRAIL 101	1222	1655	433		3			0	0	1	0	0	1	0	0	100	0	0	**100**					1		1	3		3	100	
TRAIL 102-1	TRAIL 102	0	144	144		80	3		0	8	17	10	0	35	0	23	49	28	0	**100**	5.2	59.0	Maintenance Program	$800	35		35	142		142	100	
TRAIL 102-2	TRAIL 102	144	408	264		37	11	4	0	53	6	6	1	66	0	81	8	9	2	**100**	4.8	53.0	Rehabilitation Program	$995	66		66	264		264	100	
TRAIL 102-3	TRAIL 102	408	793	385		278	2		0	15	65	17	0	96	0	15	67	18	0	**100**	6.2	64.0	Maintenance Program	$1,877	96		96	385		385	100	
TRAIL 103	TRAIL 103	0	35	35	1	21	3	8	0	1	5	1	2	9	0	11	54	11	23	**100**	2.7	1.0	Rehabilitation Program	$1,909	9		9	35		35	100	
TRAIL 104-1	TRAIL 104	0	241	241	2	184	9	12	0	19	23	15	3	60	0	32	38	25	5	**100**	4.5	1.0	Rehabilitation Program	$4,648	60		60	240		240	100	
TRAIL 104-2	TRAIL 104	241	427	186		62			0	28	8	10	0	46	0	61	17	22	0	**100**	5.8	60.0	Maintenance Program	$745	46		46	186		186	100	
TRAIL 105	TRAIL 105	0	8	8		0			0	1	1	0	0	2	0	49	49	2	0	**100**					2		2	8		8	100	
TRAIL 106	TRAIL 106	0	5	5					0	0	0	0	0							**0**												
TRAIL 107-C	TRAIL 107	0	95	95	23		103		0	0	0	0	0							**0**						24	24		95	95		100
TRAIL 108	TRAIL 108	0	123	123		20			0	14	17	0	0	31	0	45	55	0	0	**100**	8.5	126.0	Field Inspection	$198	31		31	123		123	100	
TRAIL 109	TRAIL 109	0	47	47				47	0	0	1	10	0	11	0	0	9	91	0	**100**	0.0	2.0	Replace Asset	$7,565	11	1	12	43	4	47	91	9
TRAIL 110	TRAIL 110	0	11	11		3			0	1	2	0	0	3	0	27	73	0	0	**100**					3		3	11		11	100	
TRAIL 111	TRAIL 111	0	4	4					0	0	0	0	0							**0**												
TRAIL 112-1	TRAIL 112	19	1152	1133					0	1	0	0	0	1	0	100	0	0	0	**100**					1	0	1	4	1	5	84	16
TRAIL 112-2-C	TRAIL 112	0	19	19					0	0	0	0	0							**0**						5	5		19	19		100
TRAIL 113-1	TRAIL 113	0	260	260		36			0	39	25	1	0	65	0	60	38	2	0	**100**	7.8	110.0	Maintenance Program	$200	65		65	258		258	100	
TRAIL 113-2	TRAIL 113	260	649	388		19			0	87	8	2	0	97	0	89	9	2	0	**100**	7.8	111.0	Maintenance Program	$135	97		97	388		388	100	
TRAIL 113-3	TRAIL 113	649	868	220					0	44	11	0	0	55	0	80	20	0	0	**100**	8.8	132.0	Field Inspection	$100	55		55	220		220	100	
TRAIL 113-4	TRAIL 113	868	1187	319		97	7		0	20	46	13	0	80	0	26	58	16	0	**100**	6.4	70.0	Maintenance Program	$1,064	80		80	319		319	100	
TRAIL 114	TRAIL 114	0	91	91		31			0	8	13	0	0	21	0	38	62	0	0	**100**	8.4	124.0	Field Inspection	$255	21	2	23	84	7	91	92	8
TRAIL 115-C	TRAIL 115	0	12	12					0	0	0	0	0							**0**						2	2		10	10		100
TRAIL 116	TRAIL 116	0	63	63					0	16	0	0	0	16	0	100	0	0	0	**100**	9.0	140.0	Do Nill		16		16	63		63	100	
TRAIL 117	TRAIL 117	0	60	60					0	14	0	0	0	14	0	100	0	0	0	**100**	9.0	141.0	Do Nill		14		14	58		58	100	
TRAIL 118-C	TRAIL 118	0	19	19		4			0	0	0	0	0							**0**						5	5		19	19		100
TRAIL 119	TRAIL 119	0	9	9					0	2	0	0	0	2	0	100	0	0	0	**100**					2		2	9		9	100	
TRAIL 120-C	TRAIL 120	0	37	37		2			0	0	0	0	0							**0**						9	9		37	37		100
TRAIL 121-C	TRAIL 121	0	114	114					0	0	1	0	0	1	0	0	100	0	0	**100**					1	28	29	4	110	114	3	97
TRAIL 122-1	TRAIL 122	0	313	313		393	1		0	15	47	12	0	74	0	20	64	16	0	**100**	6.4	71.0	Maintenance Program	$2,438	74	2	76	296	8	304	97	3
TRAIL 122-2	TRAIL 122	313	477	164				164	0	1	11	24	0	36	0	3	31	67	0	**100**	1.3	6.0	Replace Asset	$26,728	36	3	39	144	10	154	93	7
TRAIL 123-1	TRAIL 123	0	239	239		126			0	21	32	6	0	59	0	35	54	10	0	**100**	7.0	85.0	Maintenance Program	$745	59	1	60	235	4	239	98	2
TRAIL 123-2	TRAIL 123	239	521	282				282	0	8	9	44	9	71	0	12	13	63	13	**100**	1.7	12.0	Replace Asset	$45,884	71		71	282		282	100	
TRAIL 123-3	TRAIL 123	521	634	112				112	0	0	0	28	0	28	0	0	0	100	0	**100**	0.0	2.0	Replace Asset	$18,215	28		28	112		112	100	
TRAIL 124-1-C	TRAIL 124	0	25	25		8			0	0	0	0	0							**0**						2	2		8	8		100
TRAIL 124-2	TRAIL 124	25	318	293				293	0	0	3	50	19	72	0	0	4	70	26	**100**	1.0	5.0	Replace Asset	$47,610	72	1	73	289	4	293	99	1
TRAIL 124-3	TRAIL 124	318	559	240		403		32	0	0	16	36	8	60	0	0	27	59	13	**100**	2.1	19.0	Rehabilitation Program	$3,677	60		60	240		240	100	
TRAIL 125	TRAIL 125	0	76	76		79			0	1	11	7	0	19	0	5	58	37	0	**100**	4.3	39.0	Rehabilitation Program	$568	19		19	76		76	100	
TRAIL 126	TRAIL 126	0	25	25					0	6	0	0	0	6	0	100	0	0	0	**100**	9.0	142.0	Do Nill		6		6	23		23	100	
TRAIL 127-1	TRAIL 127	0	82	82		84			0	10	2	8	0	20	0	49	10	41	0	**100**	3.9	34.0	Rehabilitation Program	$786	20		20	82		82	100	
TRAIL 127-2	TRAIL 127	82	173	92		108			0	2	20	1	0	23	0	9	89	2	0	**100**	7.8	112.0	Maintenance Program	$545	23		23	92		92	100	
TRAIL 127-3	TRAIL 127	173	509	336		152			0	49	25	10	0	84	0	59	29	12	0	**100**	6.8	80.0	Maintenance Program	$1,059	84		84	336		336	100	
TRAIL 127-4	TRAIL 127	509	869	360		147			0	54	26	10	0	90	0	60	29	11	0	**100**	6.9	82.0	Maintenance Program	$1,110	90		90	360		360	100	
TRAIL 128-1-C	TRAIL 128	0	42	42					0	0	0	0	0							**0**						10	10		42	42		100
TRAIL 128-2	TRAIL 128	42	87	45		32			0	3	8	0	0	11	0	26	74	0	0	**100**	8.3	123.0	Field Inspection	$270	11	1	11	43	2	45	95	5
TRAIL 129	TRAIL 129	0	89	89		58			0	9	12	1	0	22	0	40	55	4	0	**100**	7.6	107.0	Maintenance Program	$309	22		22	89		89	100	
TRAIL 130-01	TRAIL 130	0	298	298				298	4	2	11	44	13	74	5	3	15	59	18	**100**	1.9	14.0	Replace Asset	$48,405	74		74	298		298	100	
TRAIL 130-02	TRAIL 130	298	494	196				196	0	2	4	30	13	49	0	4	8	61	27	**100**	1.9	15.0	Replace Asset	$31,838	49		49	196		196	100	
TRAIL 130-03	TRAIL 130	494	657	164				164	0	2	5	27	7	41	0	5	12	67	16	**100**	1.3	7.0	Replace Asset	$26,581	41		41	164		164	100	
TRAIL 130-04	TRAIL 130	657	831	174		89	1		0	14	27	3	0	43	0	32	62	6	0	**100**	7.4	99.0	Maintenance Program	$577	43		43	174		174	100	
TRAIL 130-05	TRAIL 130	831	1047	216	2	193		8	0	20	16	16	2	54	0	37	30	30	4	**100**	4.6	1.0	Rehabilitation Program	$4,505	54		54	216		216	100	
TRAIL 130-06-C	TRAIL 130	1047	1062	15					0	0	0	0	0	0	0	100	0	0	0	**100**					0	3	4	1	14	15	7	93
TRAIL 130-07	TRAIL 130	1062	1097	35					2	6	0	0	0	8	24	76	0	0	0	**100**	9.2	148.0	Do Nill		8	1	9	33	2	35	94	6
TRAIL 130-08	TRAIL 130	1097	1372	275					68	1	0	0	0	69	99	1	0	0	0	**100**	10.0	150.0	Do Nill		69		69	275		275	100	
TRAIL 130-09	TRAIL 130	1372	1553	180					45	0	0	0	0	45	100	0	0	0	0	**100**	10.0	151.0	Do Nill		45		45	180		180	100	
TRAIL 130-10	TRAIL 130	1553	1716	164		3			40	0	1	0	0	41	98	0	2	0	0	**100**	9.0	143.0	Do Nill		41		41	164		164	100	
TRAIL 130-11	TRAIL 130	1716	1991	275					68	0	1	0	0	69	99	0	1	0	0	**100**	9.0	144.0	Do Nill		69		69	275		275	100	
TRAIL 130-12	TRAIL 130	1991	2117	126					31	0	0	0	0	31	100	0	0	0	0	**100**	10.0	152.0	Do Nill		31		31	126		126	100	
TRAIL 131-BRICK	TRAIL 131	0	31	31					0	8	0	0	0	8	0	100	0	0	0	**100**	9.0	145.0	Do Nill		8		8	31		31	100	
TRAIL 132	TRAIL 132	0	25	25					6	0	0	0	0	6	100	0	0	0	0	**100**	10.0	153.0	Do Nill		6		6	25		25	100	
TRAIL 133-1	TRAIL 133	0	272	272					67	0	0	0	0	67	100	0	0	0	0	**100**	10.0	154.0	Do Nill		67		67	270		270	100	
TRAIL 133-2	TRAIL 133	272	348	77				77	1	8	1	5	5	19	3	39	5	26	26	**100**	1.9	16.0	Replace Asset	$12,458	19		19	77		77	100	
TRAIL 133-3	TRAIL 133	348	445	96		99			0	0	24	0	0	24	0	2	98	0	0	**100**	8.0	119.0	Maintenance Program	$493	24		24	96		96	100	
TRAIL 133-4	TRAIL 133	445	630	185	2	141	5	8	0	7	17	20	2	46	0	15	37	43	4	**100**	3.7	1.0	Rehabilitation Program	$4,247	46		46	185		185	100	
TRAIL 133-5	TRAIL 133	630	854	224	1	45	3	4	0	37	8	10	1	56	0	66	14	18	2	**100**	4.8	1.0	Rehabilitation Program	$1,892	56		56	224		224	100	
TRAIL 133-6	TRAIL 133	854	1031	177		105	11	4	0	9	18	15	1	43	0	21	41	35	2	**100**	4.5	44.0	Rehabilitation Program	$1,346	43	1	44	174	4	177	98	2
TRAIL 133-7	TRAIL 133	1031	1123	92		98			0	1	20	2	0	23	0	4	89	7	0	**100**	7.3	95.0	Maintenance Program	$519	23		23	92		92	100	
TRAIL 133-8	TRAIL 133	1123	1306	183				183	0	1	6	29	10	46	0	2	12	64	22	**100**	1.6	11.0	Replace Asset	$29,698	46		46	183		183	100	
TRAIL 134	TRAIL 134	0	151	151		3			1	36	1	0	0	38	3	95	3	0	0	**100**	9.0	146.0	Do Nill		38		38	151		151	100	

Trail Inventory					Hazards, Repair Length and Area, and Reconstruct Length				Asphalt Trail Condition Sample Units						Asphalt Trail Density						Asphalt Trail ADI, Priority, Activity, Cost				Trail Inventory			Rated Trail Length			Percent Trail	
Section	Trail_Name	From_m	To_m	Length_m	Hazards	Crack_Sealing_Length_m	Patch_Area_Sqm	Reconstruct_Length_m	AT_E	AT_G	AT_F	AT_P	AT_VP	Rat_AT_Inv	AT_D_0	AT_D_1	AT_D_2	AS_D_5	AT_D_10	AT_D_Tot	AT_ADI	AT_Priority	AT_Activity	AT_Cost	AT_Inv	CT_Inv	TT_Inv	AT_Len_m	CT_Len_m	Rated_Len_m	Percent_AT	Percent_CT
TRAIL 135-1	TRAIL 135	0	346	346		56			0	63	20	2	0	85	0	74	24	2	0	**100**	7.8	113.0	Maintenance Program	$306	85	1	86	342	4	346	99	1
TRAIL 135-2	TRAIL 135	346	674	328		80			0	47	26	9	0	82	0	58	31	11	0	**100**	6.9	83.0	Maintenance Program	$557	82		82	328		328	100	
TRAIL 135-3	TRAIL 135	674	874	201					0	1	0	0	0	1	0	100	0	0	0	**100**					1		1	2		2	100	
TRAIL 135-4	TRAIL 135	874	1010	136					0	32	0	0	0	32	0	100	0	0	0	**100**	9.0	147.0	Do Nill		32	1	33	130	4	134	97	3
TRAIL 135-5	TRAIL 135	1010	1114	104		75	0		0	9	8	9	0	26	0	33	31	36	0	**100**	4.4	42.0	Rehabilitation Program	$663	26		26	104		104	100	
TRAIL 135-6	TRAIL 135	1114	1212	98		10	1		0	21	3	1	0	25	0	85	12	2	0	**100**	7.8	114.0	Maintenance Program	$104	25		25	98		98	100	
TRAIL 136-1-C	TRAIL 136	0	9	9					0	0	0	0	0							**0**						2	2		9	9		100
TRAIL 136-2	TRAIL 136	9	86	77		29			0	8	10	1	0	19	0	41	54	5	0	**100**	7.5	102.0	Maintenance Program	$168	19	1	19	74	3	77	96	4
TRAIL 137-1	TRAIL 137	0	123	123					0	0	0	0	0							**0**												
TRAIL 137-2-C	TRAIL 137	123	136	14					0	0	0	0	0							**0**						3	3		12	12		100
TRAIL 137-3	TRAIL 137	136	225	89		20			16	0	5	0	0	21	76	0	24	0	0	**100**	8.8	133.0	Field Inspection	$198	21	1	22	85	4	89	96	4
TRAIL 137-4	TRAIL 137	225	409	183		50			5	26	15	0	0	46	10	57	33	0	0	**100**	8.7	130.0	Field Inspection	$395	46		46	183		183	100	
TRAIL 138	TRAIL 138	0	57	57					0	0	0	0	0							**0**												
TRAIL 139	TRAIL 139	0	4	4					0	0	0	0	0							**0**												
TRAIL 140	TRAIL 140	0	6	6					0	1	0	0	0	1	0	100	0	0	0	**100**					1		1	6		6	100	
TRAIL 141-1-C	TRAIL 141	0	171	171		7			0	0	0	0	0							**0**						43	43		171	171		100
TRAIL 141-2	TRAIL 141	171	274	103		22			0	18	7	0	0	25	0	71	29	0	0	**100**	8.7	131.0	Field Inspection	$211	25	0	26	102	1	103	99	1
TRAIL 141-3	TRAIL 141	274	386	112				112	0	2	1	18	7	28	0	7	2	66	25	**100**	1.4	9.0	Replace Asset	$18,193	28		28	112		112	100	
TRAIL 141-4	TRAIL 141	386	621	235		186	3		0	8	46	5	0	59	0	14	78	8	0	**100**	7.2	92.0	Maintenance Program	$1,120	59		59	235		235	100	
TRAIL 141-5	TRAIL 141	621	703	83		30	15	3	0	10	4	6	1	21	0	48	19	28	4	**100**	4.6	50.0	Rehabilitation Program	$2,275	21		21	83		83	100	
TRAIL 142-1	TRAIL 142	0	223	223		32	2		0	40	11	4	0	55	0	73	20	7	0	**100**	7.3	96.0	Maintenance Program	$333	55		55	221		221	100	
TRAIL 142-2	TRAIL 142	223	418	195		95	8		0	8	31	8	0	47	0	16	66	17	0	**100**	6.3	69.0	Maintenance Program	$909	47	2	49	187	8	195	96	4
TRAIL 142-3	TRAIL 142	418	617	199		46			0	32	7	7	0	46	0	70	15	15	0	**100**	6.5	73.0	Maintenance Program	$376	46	4	50	183	16	199	92	8
TRAIL 142-4	TRAIL 142	617	877	260		127			0	32	18	11	0	61	0	52	30	18	0	**100**	6.2	65.0	Maintenance Program	$918	61	4	65	244	16	260	94	6
TRAIL 143-1	TRAIL 143	0	487	487		59	3		0	88	31	1	0	120	0	73	26	1	0	**100**	7.9	118.0	Maintenance Program	$430	120	2	122	479	8	487	98	2
TRAIL 143-2	TRAIL 143	487	704	216		29			0	42	9	1	0	52	0	81	17	2	0	**100**	7.8	115.0	Maintenance Program	$163	52	2	54	208	8	216	96	4
TRAIL 144-C	TRAIL 144	0	44	44					0	1	0	0	0	1	0	100	0	0	0	**100**					1	10	11	4	38	42	9	91
TRAIL 145-C	TRAIL 145	0	47	47		9			0	0	1	0	0	1	0	0	100	0	0	**100**					1	2	3	4	8	12	33	67
TRAIL 146-C	TRAIL 146	0	7	7					0	0	1	0	0	1	0	0	100	0	0	**100**					1	1	2	3	4	7	42	58
TRAIL 147	TRAIL 147	0	46	46					0	0	0	0	0							**0**												
TRAIL 148	TRAIL 148	0	2	2					0	1	0	0	0	1	0	100	0	0	0	**100**					1		1	2		2	100	
TRAIL 149	TRAIL 149	0	1306	1306					0	0	0	0	0							**0**												
TRAIL 150-1	TRAIL 150	0	132	132		69			0	11	19	3	0	33	0	33	57	9	0	**100**	7.1	88.0	Maintenance Program	$390	33		33	132		132	100	
TRAIL 150-2-C	TRAIL 150	132	213	81		0			0	1	0	0	0	1	0	100	0	0	0	**100**					1	19	20	4	77	81	5	95
TRAIL 151-1	TRAIL 151	0	277	277		236			0	16	46	6	0	68	0	24	67	9	0	**100**	7.1	89.0	Maintenance Program	$1,285	68	1	69	273	4	277	99	1
TRAIL 151-2	TRAIL 151	277	409	132		117			0	7	10	16	0	33	0	20	31	49	0	**100**	3.1	28.0	Rehabilitation Program	$969	33		33	132		132	100	
TRAIL 151-3	TRAIL 151	409	648	240		120			0	29	20	11	0	60	0	48	33	18	0	**100**	6.2	66.0	Maintenance Program	$972	60		60	240		240	100	
TRAIL 152	TRAIL 152	0	3	3					0	0	0	0	0							**0**												
TRAIL 153	TRAIL 153	0	28	28		30			0	0	6	0	0	6	0	0	92	8	0	**100**	7.2	93.0	Maintenance Program	$155	6		6	26		26	100	
TRAIL 154-1-C	TRAIL 154	0	86	86					0	0	0	0	0							**0**						22	22		86	86		100
TRAIL 154-2	TRAIL 154	86	208	122				122	0	0	7	9	14	30	0	0	23	30	47	**100**	0.3	4.0	Replace Asset	$19,812	30	0	30	120	2	122	99	1
TRAIL 154-3	TRAIL 154	208	522	314		161	3		0	35	33	10	0	78	0	45	42	13	0	**100**	6.7	78.0	Maintenance Program	$1,224	78		78	314		314	100	
TRAIL 154-4	TRAIL 154	522	802	280		190			0	24	42	4	0	70	0	34	61	6	0	**100**	7.4	100.0	Maintenance Program	$1,086	70		70	280		280	100	
TRAIL 155	TRAIL 155	0	7	7		3			0	1	1	0	0	2	0	57	43	0	0	**100**					2		2	7		7	100	
TRAIL 156-1-C	TRAIL 156	0	59	59		1			0	0	0	0	0							**0**						14	14		57	57		100
TRAIL 156-2	TRAIL 156	59	160	101		35			0	15	10	0	0	25	0	61	39	0	0	**100**	8.6	129.0	Field Inspection	$276	25	1	25	98	3	101	97	3
TRAIL 156-3	TRAIL 156	160	338	178		295	4	8	0	0	16	26	2	44	0	0	37	58	4	**100**	2.2	22.0	Rehabilitation Program	$2,530	44		44	178		178	100	
TRAIL 156-4	TRAIL 156	338	513	175				175	0	0	16	27	1	44	0	0	37	61	2	**100**	1.9	17.0	Replace Asset	$28,381	44		44	175		175	100	
TRAIL 157	TRAIL 157	0	60	60		92			0	1	8	6	0	15	0	7	54	40	0	**100**	4.0	36.0	Rehabilitation Program	$682	15		15	60		60	100	
TRAIL 158	TRAIL 158	0	23	23		29			0	1	3	2	0	6	0	18	47	35	0	**100**	4.5	45.0	Rehabilitation Program	$226	6		6	23		23	100	
TRAIL 159	TRAIL 159	0	200	200		196	1		0	8	15	26	0	49	0	16	31	53	0	**100**	2.7	25.0	Rehabilitation Program	$1,670	49	1	50	196	4	200	98	2
TRAIL 160-1	TRAIL 160	0	460	460		252	1		0	23	74	17	0	114	0	20	65	15	0	**100**	6.5	74.0	Maintenance Program	$1,587	114		114	458		458	100	
TRAIL 160-2	TRAIL 160	460	676	216		320	1	4	0	0	30	23	1	54	0	0	55	43	2	**100**	3.7	33.0	Rehabilitation Program	$2,267	54		54	216		216	100	
TRAIL 160-3	TRAIL 160	676	924	249		210	10	4	0	12	28	22	1	62	0	19	44	35	2	**100**	4.5	46.0	Rehabilitation Program	$1,816	62		62	249		249	100	
TRAIL 160-4	TRAIL 160	924	1216	292		280	6		0	3	42	27	0	73	0	4	58	38	0	**100**	4.2	38.0	Rehabilitation Program	$4,369	73		73	292		292	100	
TRAIL 160-5	TRAIL 160	1216	1508	292		343	5		0	6	35	32	0	73	0	8	48	44	0	**100**	3.6	31.0	Rehabilitation Program	$6,172	73		73	292		292	100	
TRAIL 160-6	TRAIL 160	1508	1852	344				344	0	10	12	48	11	81	0	13	15	59	14	**100**	1.9	18.0	Replace Asset	$55,920	81	5	86	324	20	344	94	6
TRAIL 160-7-C	TRAIL 160	1852	2206	355		12			0	1	0	0	0	1	0	100	0	0	0	**100**					1	88	89	2	352	355	1	99
TRAIL 160-8-C	TRAIL 160	2206	2537	331	2	18	2		0	0	0	0	0							**0**						83	83		331	331		100
TRAIL 160-9-C	TRAIL 160	2537	3029	492		22			0	0	0	0	0							**0**						123	123		492	492		100
TRAIL 161	TRAIL 161	0	1192	1192					0	0	0	0	0							**0**												
TRAIL 162-C	TRAIL 162	0	161	161		9			0	0	1	0	0	1	0	0	100	0	0	**100**					1	39	40	4	157	161	2	98
TRAIL 163	TRAIL 163	0	128	128				128	0	0	3	25	3	31	0	0	10	81	10	**100**	0.0	3.0	Replace Asset	$20,735	31	1	32	124	4	128	97	3
TRAIL 164	TRAIL 164	0	187	187		147			0	9	21	14	0	44	0	20	48	32	0	**100**	4.8	55.0	Rehabilitation Program	$1,114	44	2	46	176	9	185	95	5
TRAIL 165-1	TRAIL 165	106	440	334		81	5		0	34	48	2	0	83	0	40	57	2	0	**100**	7.8	116.0	Maintenance Program	$655	83		83	334		334	100	
TRAIL 165-2	TRAIL 165	0	18	18		19			0	0	4	0	0	4	0	0	100	0	0	**100**	8.0	120.0	Maintenance Program	$97	4		4	18		18	100	
TRAIL 165-3	TRAIL 165	18	106	88		46	1		0	9	6	7	0	22	0	43	25	32	0	**100**	4.8	56.0	Rehabilitation Program	$450	22		22	88		88	100	
TRAIL 166	TRAIL 166	0	17	17		10			0	1	2	0	0	3	0	39	61	0	0	**100**	8.4	125.0	Field Inspection	$150	3	1	4	13	4	17	77	23
TRAIL 167	TRAIL 167	0	17	17		4			0	2	2	0	0	4	0	46	54	0	0	**100**	8.5	127.0	Field Inspection	$121	4		4	17		17	100	
TRAIL 168	TRAIL 168	0	12	12		3			0	0	3	0	0	3	0	0	100	0	0	**100**	8.0	121.0	Maintenance Program	$15	3		3	12		12	100	
TRAIL 169-1	TRAIL 169	0	36	36		11			2	2	3	1	0	8	29	24	35	12	0	**100**	6.8	81.0	Maintenance Program	$68	8		8	34		34	100	
TRAIL 169-2	TRAIL 169	36	187	151		17			31	0	5	2	0	38	82	0	13	5	0	**100**	7.5	103.0	Maintenance Program	$108	38		38	151		151	100	
TRAIL 169-3	TRAIL 169	187	324	137		9			7	23	2	1	0	32	21	70	6	3	0	**100**	7.7	109.0	Maintenance Program	$65	32	2	34	129	8	137	94	6
TRAIL 169-4	TRAIL 169	324	563	239		38			41	2	10	2	0	55	74	4	18	4	0	**100**	7.6	108.0	Maintenance Program	$230	55	1	56	222	4	226	98	2
TRAIL 169-5	TRAIL 169	563	661	98		15			12	6	2	3	0	23	51	26	10	13	0	**100**	6.7	79.0	Maintenance Program	$120	23	1	24	93	4	97	96	4
TRAIL 170	TRAIL 170	0	49	49					12	0	0	0	0	12	100	0	0	0	0	**100**	10.0	155.0	Do Nill		12		12	49		49	100	
TRAIL 171-1	TRAIL 171	0	272	272		71			20	27	17	4	0	68	29	40	25	6	0	**100**	7.4	101.0	Maintenance Program	$430	68		68	272		272	100	

Trail Inventory					Hazards, Repair Length and Area, and Reconstruct Length				Asphalt Trail Condition Sample Units						Asphalt Trail Density						Asphalt Trail ADI, Priority, Activity, Cost				Trail Inventory			Rated Trail Length			Percent Trail	
Section	Trail_Name	From_m	To_m	Length_m	Hazards	Crack_Sealing_Length_m	Patch_Area_Sqm	Reconstruct_Length_m	AT_E	AT_G	AT_F	AT_P	AT_VP	Rat_AT_Inv	AT_D_0	AT_D_1	AT_D_2	AS_D_5	AT_D_10	AT_D_Tot	AT_ADI	AT_Priority	AT_Activity	AT_Cost	AT_Inv	CT_Inv	TT_Inv	AT_Len_m	CT_Len_m	Rated_Len_m	Percent_AT	Percent_CT
TRAIL 171-2-C	TRAIL 171	272	286	13					0	1	0	0	0	1	0	100	0	0	0	**100**					1	2	3	4	10	13	26	74
TRAIL 172	TRAIL 172	0	19	19		13			0	1	1	2	0	4	0	25	25	50	0	**100**	3.0	27.0	Rehabilitation Program	$105	4	1	5	16	3	19	84	16
TRAIL 173	TRAIL 173	0	46	46		6			0	9	12	5	0	26	0	34	47	19	0	**100**	6.1	63.0	Maintenance Program	$428	26	1	27	103	4	107	96	4
TRAIL 174	TRAIL 174	0	62	62		3			0	10	12	15	0	36	0	27	32	41	0	**100**	3.9	35.0	Rehabilitation Program	$997	36		36	145		145	100	
TRAIL 175	TRAIL 175	0	6	6					0	6	9	24	1	40	0	15	23	59	2	**100**	2.1	1.0	Rehabilitation Program	$4,781	40	2	42	160	8	168	95	5
TRAIL 176	TRAIL 176	0	60	60		4			0	11	14	1	0	26	0	42	53	5	0	**100**	7.5	104.0	Maintenance Program	$270	26		26	104		104	100	
TRAIL 177-C	TRAIL 177	0	213	213	10	155	6		0	37	20	24	0	81	0	46	25	30	0	**100**	5.0	58.0	Rehabilitation Program	$1,695	81		81	324		324	100	
TRAIL 178	TRAIL 178	0	47	47		7			0	4	6	11	0	21	0	19	30	51	0	**100**	2.9	26.0	Rehabilitation Program	$633	21		21	84		84	100	
TRAIL 179-C	TRAIL 179	0	10	10		3			11	27	21	1	0	61	18	44	35	2	0	**100**	7.8	117.0	Maintenance Program	$321	61		61	243		243	100	
TRAIL 180	TRAIL 180	0	33	33		10			0	2	3	7	0	12	0	17	24	59	0	**100**	2.1	21.0	Rehabilitation Program	$381	12		12	47		47	100	
TRAIL 181	TRAIL 181	0	27	27		18			0	0	1	0	0	1	0	0	100	0	0	**100**					1	8	9	3	34	37	8	92
TRAIL 182	TRAIL 182	0	10	10					0	17	8	13	0	38	0	44	21	35	0	**100**	4.5	47.0	Rehabilitation Program	$968	38	1	39	154	2	155	99	1
TRAIL 183	TRAIL 183	0	27	27					2	21	15	4	0	42	5	51	36	9	0	**100**	7.1	90.0	Maintenance Program	$311	42		42	167		166	100	
TRAIL 184-01-C	TRAIL 184	0	95	95	3			95	0	40	29	4	0	73	0	55	40	5	0	**100**	7.5	105.0	Maintenance Program	$565	73		73	292		292	100	
TRAIL 184-02	TRAIL 184	95	374	279		5			68	1	0	0	0	69	99	1	0	0	0	**100**	10.0	156.0	Do Nill		69	1	70	274	5	279	98	2
TRAIL 184-03	TRAIL 184	374	481	107		65			0	2	0	6	0	8	0	63	0	38	0	**100**	4.3	40.0	Rehabilitation Program	$95	8	0	8	32	1	33	98	2
TRAIL 184-04	TRAIL 184	481	626	145		118			0	9	12	5	0	26	0	34	47	19	0	**100**	6.1	63.0	Maintenance Program	$428	26	1	27	103	4	107	96	4
TRAIL 184-05	TRAIL 184	626	795	168	1	140		4	0	10	12	15	0	36	0	27	32	41	0	**100**	3.9	35.0	Rehabilitation Program	$997	36		36	145		145	100	
TRAIL 184-06	TRAIL 184	795	899	104		50			0	6	9	24	1	40	0	15	23	59	2	**100**	2.1	1.0	Rehabilitation Program	$4,781	40	2	42	160	8	168	95	5
TRAIL 184-07	TRAIL 184	899	1223	324		218			0	11	14	1	0	26	0	42	53	5	0	**100**	7.5	104.0	Maintenance Program	$270	26		26	104		104	100	
TRAIL 184-08	TRAIL 184	1223	1306	84		71			0	37	20	24	0	81	0	46	25	30	0	**100**	5.0	58.0	Rehabilitation Program	$1,695	81		81	324		324	100	
TRAIL 184-09	TRAIL 184	1306	1550	243		64			0	4	6	11	0	21	0	19	30	51	0	**100**	2.9	26.0	Rehabilitation Program	$633	21		21	84		84	100	
TRAIL 184-10	TRAIL 184	1550	1597	47		41			11	27	21	1	0	61	18	44	35	2	0	**100**	7.8	117.0	Maintenance Program	$321	61		61	243		243	100	
TRAIL 184-11-C	TRAIL 184	1597	1634	37		8			0	2	3	7	0	12	0	17	24	59	0	**100**	2.1	21.0	Rehabilitation Program	$381	12		12	47		47	100	
TRAIL 184-12	TRAIL 184	1634	1789	155		104			0	0	1	0	0	1	0	0	100	0	0	**100**					1	8	9	3	34	37	8	92
TRAIL 184-13	TRAIL 184	1789	1955	166		51			0	17	8	13	0	38	0	44	21	35	0	**100**	4.5	47.0	Rehabilitation Program	$968	38	1	39	154	2	155	99	1
TRAIL 184-14	TRAIL 184	1955	2247	292		100			2	21	15	4	0	42	5	51	36	9	0	**100**	7.1	90.0	Maintenance Program	$311	42		42	167		166	100	
TRAIL 184-15	TRAIL 184	2247	2303	56				56	0	40	29	4	0	73	0	55	40	5	0	**100**	7.5	105.0	Maintenance Program	$565	73		73	292		292	100	
TRAIL 184-16	TRAIL 184	2303	2661	359		162		4	0	2	0	9	3	14	0	13	0	66	22	**100**	1.4	10.0	Replace Asset	$9,020	14		14	56		56	100	
TRAIL 185-1	TRAIL 185	0	109	109		37			0	48	28	13	1	90	0	54	31	14	1	**100**	4.9	57.0	Rehabilitation Program	$1,300	90		90	359		359	100	
TRAIL 185-2-C	TRAIL 185	109	117	8					0	17	5	5	0	27	0	63	18	18	0	**100**	6.2	67.0	Maintenance Program	$288	27		27	109		109	100	
TRAIL 185-3	TRAIL 185	117	145	28		8			0	1	0	0	0	1	0	100	0	0	0	**100**					1	1	2	3	6	8	31	69
TRAIL 186	TRAIL 186	0	43	43		22			0	1	5	1	0	7	0	15	70	15	0	**100**	6.5	75.0	Maintenance Program	$45	7	1	7	26	2	28	93	7
TRAIL 187	TRAIL 187	0	20	20		3			0	6	3	1	0	10	0	58	31	10	0	**100**	7.0	86.0	Maintenance Program	$153	10	1	11	39	4	43	91	9
TRAIL 188	TRAIL 188	0	27	27		9			0	4	1	0	0	5	0	80	20	0	0	**100**	8.8	134.0	Field Inspection	$113	5		5	20		20	100	
TRAIL 189-C	TRAIL 189	0	45	45		4			0	3	3	0	0	6	0	47	53	0	0	**100**	8.5	128.0	Field Inspection	$146	6		6	25		25	100	
TRAIL 190-C	TRAIL 190	0	9	9					0	1	1	0	0	2	0	50	50	0	0	**100**					2	9	11	8	37	45	18	82
TRAIL 191-C	TRAIL 191	0	17	17		1			0	0	0	0	0							**0**						2	2		9	9		100
TRAIL 192	TRAIL 192	0	101	101		96														**0**						4	4		17	17		100
TRAIL 193	TRAIL 193	0	6	6					0	2	18	4	0	24	0	8	76	16	0	**100**	6.4	72.0	Maintenance Program	$532	24	1	25	95	4	99	96	4
TRAIL 194	TRAIL 194	0	86	86		9			0	1	0	0	0	1	0	100	0	0	0	**100**					1		1	6		6	100	
TRAIL 195	TRAIL 195	0	33	33		3			0	18	1	2	0	21	0	85	5	10	0	**100**	7.0	87.0	Maintenance Program	$78	21	1	22	82	4	86	95	5
TRAIL 196-C	TRAIL 196	0	336	336		18			0	2	6	0	0	8	0	24	76	0	0	**100**	8.2	122.0	Field Inspection	$114	8		8	33		33	100	
TRAIL 197-1	TRAIL 197	0	120	120		42			0	1	0	0	0	1	0	100	0	0	0	**100**					1	83	84	4	333	336	1	99
TRAIL 197-2-C	TRAIL 197	120	141	21		4			0	21	3	5	0	29	0	72	10	18	0	**100**	6.2	68.0	Maintenance Program	$375	29	1	30	116	4	120	97	3
TRAIL 197-3	TRAIL 197	141	342	201		123			0	0	0	1	0	1	0	0	0	100	0	**100**					1	4	5	4	17	21	17	83
TRAIL 197-4	TRAIL 197	342	418	75	8			75	0	17	29	4	0	50	0	34	58	8	0	**100**	7.2	94.0	Maintenance Program	$680	50	1	50	198	3	201	99	1
TRAIL 197-5	TRAIL 197	418	538	120		116			0	7	1	3	7	19	0	39	7	16	37	**100**	1.3	1.0	Replace Asset	$12,208	19		19	75		75	100	
TRAIL 197-6	TRAIL 197	538	653	116		76		8	0	4	24	2	0	30	0	12	81	7	0	**100**	7.3	97.0	Maintenance Program	$630	30		30	120		120	100	
TRAIL 198	TRAIL 198	0	8	8		9			0	10	10	7	2	29	0	36	33	24	7	**100**	4.3	41.0	Rehabilitation Program	$1,200	29		29	116		116	100	
TRAIL 199	TRAIL 199	0	62	62		32			0	1	0	0	0	1	0	100	0	0	0	**100**					1	1	2	4	4	8	48	52
TRAIL 200	TRAIL 200	0	21	21		4			0	9	0	6	0	15	0	58	3	39	0	**100**	4.1	37.0	Rehabilitation Program	$316	15		15	62		62	100	
TRAIL 201	TRAIL 201	0	93	93		50			0	4	1	0	0	5	0	81	19	0	0	**100**	8.8	135.0	Field Inspection	$120	5		5	21		21	100	
TRAIL 202-1	TRAIL 202	0	134	134		56			0	8	10	3	0	21	0	38	47	14	0	**100**	6.6	77.0	Maintenance Program	$365	21		21	84		84	100	
TRAIL 202-2-C	TRAIL 202	134	204	70		11			0	14	16	3	0	33	0	42	48	9	0	**100**	7.1	91.0	Maintenance Program	$320	33		33	132		132	100	
TRAIL 203-1	TRAIL 203	0	9	9		0			0	1	0	0	0	1	0	97	3	0	0	**100**					1	16	17	4	66	70	6	94
TRAIL 203-2-C	TRAIL 203	9	40	32		1			0	2	0	0	0	2	0	93	7	0	0	**100**					2		2	9		9	100	
TRAIL 203-3	TRAIL 203	40	310	269		61			0	0	1	0	0	1	0	0	100	0	0	**100**					1	7	8	3	28	32	11	89
TRAIL 204	TRAIL 204	0	13	13					0	39	23	4	0	66	0	59	35	7	0	**100**	7.3	98.0	Maintenance Program	$372	66	1	67	266	4	269	99	1
TRAIL 205	TRAIL 205	0	11	11					0	2	0	0	0	2	0	100	0	0	0	**100**					2	1	3	9	4	13	69	31
TRAIL 206	TRAIL 206	0	57	57		20			2	0	0	0	0	2	100	0	0	0	0	**100**					2		2	9		9	100	
TRAIL 207-1	TRAIL 207	0	191	191		99	4		0	9	3	2	0	14	0	64	21	15	0	**100**	6.5	76.0	Maintenance Program	$142	14		14	57		57	100	
TRAIL 207-2	TRAIL 207	191	301	109		125	1	4	0	0	31	16	0	47	0	0	66	34	0	**100**	4.6	51.0	Rehabilitation Program	$991	47		47	189		189	100	
									0	0	12	15	1	27	0	0	43	54	4	**100**	2.6	23.0	Rehabilitation Program	$1,251	27		27	109		109	100	

Trail Inventory					Hazards, Repair Length and Area, and Reconstruct Length				Concrete Trail Condition Sample Units						Concrete Trail Density						Concrete Trail ADI, Priority, Activity, Cost				Trail Inventory			Rated Trail Length			Percent Trail	
Section	Trail_Name	From_m	To_m	Length_m	Hazards	Crack_Sealing_Length_m	Patch_Area_Sqm	Reconstruct_Length_m	CT_E	CT_G	CT_F	CT_P	CT_VP	Rat_CT_Inv	CT_D_0	CT_D_1	CT_D_2	CT_D_5	CT_D_10	CT_D_Tot	CT_ADI	CT_Priority	CT_Activity	CT_Cost	AT_Inv	CT_Inv	TT_Inv	AT_Len_m	CT_Len_m	Rated_Len_m	Percent_AT	Percent_CT
TRAIL	TRAIL	0	2096	2096					0	0	0	0	0							0												
TRAIL 100-1	TRAIL 100	0	358	358		146	4		0	0	0	0	0							0					89		89	356		356	100	
TRAIL 100-2	TRAIL 100	358	531	173		31	5	4	0	0	0	0	0							0					44		44	175		173	100	
TRAIL 100-3	TRAIL 100	531	733	202				202	0	0	0	0	0							0					51		51	205		202	100	
TRAIL 101-1-C	TRAIL 101	0	289	289					0	72	0	0	0	72	0.0	100.0	0.0	0.0	0.0	100	9.0	16.0	Do Nill			72	72		290	289		100
TRAIL 101-2	TRAIL 101	289	480	191		45	11		0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	100					47	1	48	190	2	191	99	1
TRAIL 101-3	TRAIL 101	480	626	146		7	3		0	0	0	0	0							0					37		37	146		146	100	
TRAIL 101-4	TRAIL 101	626	848	222		125	29		0	0	0	0	0							0					55		55	222		222	100	
TRAIL 101-5	TRAIL 101	848	1033	185		116	4		0	0	0	0	0							0					47		47	186		185	100	
TRAIL 101-6	TRAIL 101	1033	1222	189		46	31	4	0	0	0	0	0							0					47		47	189		189	100	
TRAIL 101-7	TRAIL 101	1222	1655	433		3			0	0	0	0	0							0					1		1	3		3	100	
TRAIL 102-1	TRAIL 102	0	144	144		80	3		0	0	0	0	0							0					35		35	142		142	100	
TRAIL 102-2	TRAIL 102	144	408	264		37	11	4	0	0	0	0	0							0					66		66	264		264	100	
TRAIL 102-3	TRAIL 102	408	793	385		278	2		0	0	0	0	0							0					96		96	385		385	100	
TRAIL 103	TRAIL 103	0	35	35	1	21	3	8	0	0	0	0	0							0					9		9	35		35	100	
TRAIL 104-1	TRAIL 104	0	241	241	2	184	9	12	0	0	0	0	0							0					60		60	240		240	100	
TRAIL 104-2	TRAIL 104	241	427	186		62			0	0	0	0	0							0					46		46	186		186	100	
TRAIL 105	TRAIL 105	0	8	8		0			0	0	0	0	0							0					2		2	8		8	100	
TRAIL 106	TRAIL 106	0	5	5					0	0	0	0	0							0												
TRAIL 107-C	TRAIL 107	0	95	95	23		103		0	1	22	1	0	24	0.0	2.7	93.1	4.2	0.0	100	7.6	1.0	Maintenance Program	$15,780		24	24		95	95		100
TRAIL 108	TRAIL 108	0	123	123		20			0	0	0	0	0							0					31		31	123		123	100	
TRAIL 109	TRAIL 109	0	47	47				47	0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	100					11	1	12	43	4	47	91	9
TRAIL 110	TRAIL 110	0	11	11		3			0	0	0	0	0							0					3		3	11		11	100	
TRAIL 111	TRAIL 111	0	4	4					0	0	0	0	0							0												
TRAIL 112-1	TRAIL 112	19	1152	1133					0	0	0	0	0	0	0.0	100.0	0.0	0.0	0.0	100					1	0	1	4	1	5	84	16
TRAIL 112-2-C	TRAIL 112	0	19	19		17			0	1	3	1	0	5	0.0	16.8	62.4	20.8	0.0	100	5.9	5.0	Maintenance Program	$110		5	5		19	19		100
TRAIL 113-1	TRAIL 113	0	260	260		36			0	0	0	0	0							0					65		65	258		258	100	
TRAIL 113-2	TRAIL 113	260	649	388		19			0	0	0	0	0							0					97		97	388		388	100	
TRAIL 113-3	TRAIL 113	649	868	220					0	0	0	0	0							0					55		55	220		220	100	
TRAIL 113-4	TRAIL 113	868	1187	319		97	7		0	0	0	0	0							0					80		80	319		319	100	
TRAIL 114	TRAIL 114	0	91	91		31			0	2	0	0	0	2	0.0	100.0	0.0	0.0	0.0	100					21	2	23	84	7	91	92	8
TRAIL 115-C	TRAIL 115	0	12	12					0	2	0	0	0	2	0.0	100.0	0.0	0.0	0.0	100						2	2		10	10		100
TRAIL 116	TRAIL 116	0	63	63					0	0	0	0	0							0					16		16	63		63	100	
TRAIL 117	TRAIL 117	0	60	60					0	0	0	0	0							0					14		14	58		58	100	
TRAIL 118-C	TRAIL 118	0	19	19		4			0	4	1	0	0	5	0.0	78.7	21.3	0.0	0.0	100	8.8	10.0	Field Inspection	$120		5	5		19	19		100
TRAIL 119	TRAIL 119	0	9	9					0	0	0	0	0							0					2		2	9		9	100	
TRAIL 120-C	TRAIL 120	0	37	37		2			0	8	1	0	0	9	0.0	89.3	10.7	0.0	0.0	100	8.9	12.0	Field Inspection	$110		9	9		37	37		100
TRAIL 121-C	TRAIL 121	0	114	114					0	28	0	0	0	28	0.0	100.0	0.0	0.0	0.0	100	9.0	17.0	Do Nill		1	28	29	4	110	114	3	97
TRAIL 122-1	TRAIL 122	0	313	313		393	1		0	0	2	0	0	2	0.0	0.0	100.0	0.0	0.0	100					74	2	76	296	8	304	97	3
TRAIL 122-2	TRAIL 122	313	477	164				164	0	3	0	0	0	3	0.0	100.0	0.0	0.0	0.0	100					36	3	39	144	10	154	93	7
TRAIL 123-1	TRAIL 123	0	239	239		126			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	100					59	1	60	235	4	239	98	2
TRAIL 123-2	TRAIL 123	239	521	282				282	0	0	0	0	0							0					71		71	282		282	100	
TRAIL 123-3	TRAIL 123	521	634	112				112	0	0	0	0	0							0					28		28	112		112	100	
TRAIL 124-1-C	TRAIL 124	0	25	25		8			0	0	2	0	0	2	0.0	0.0	100.0	0.0	0.0	100						2	2		8	8		100
TRAIL 124-2	TRAIL 124	25	318	293				293	0	0	1	0	0	1	0.0	0.0	100.0	0.0	0.0	100					72	1	73	289	4	293	99	1
TRAIL 124-3	TRAIL 124	318	559	240		403		32	0	0	0	0	0							0					60		60	240		240	100	
TRAIL 125	TRAIL 125	0	76	76		79			0	0	0	0	0							0					19		19	76		76	100	
TRAIL 126	TRAIL 126	0	25	25					0	0	0	0	0							0					6		6	23		23	100	
TRAIL 127-1	TRAIL 127	0	82	82		84			0	0	0	0	0							0					20		20	82		82	100	
TRAIL 127-2	TRAIL 127	82	173	92		108			0	0	0	0	0							0					23		23	92		92	100	
TRAIL 127-3	TRAIL 127	173	509	336		152			0	0	0	0	0							0					84		84	336		336	100	
TRAIL 127-4	TRAIL 127	509	869	360		147			0	0	0	0	0							0					90		90	360		360	100	
TRAIL 128-1-C	TRAIL 128	0	42	42					0	10	0	0	0	10	0.0	100.0	0.0	0.0	0.0	100	9.0	18.0	Do Nill			10	10		42	42		100
TRAIL 128-2	TRAIL 128	42	87	45		32			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	100					11	1	11	43	2	45	95	5
TRAIL 129	TRAIL 129	0	89	89		58			0	0	0	0	0							0					22		22	89		89	100	
TRAIL 130-01	TRAIL 130	0	298	298				298	0	0	0	0	0							0					74		74	298		298	100	
TRAIL 130-02	TRAIL 130	298	494	196				196	0	0	0	0	0							0					49		49	196		196	100	
TRAIL 130-03	TRAIL 130	494	657	164				164	0	0	0	0	0							0					41		41	164		164	100	
TRAIL 130-04	TRAIL 130	657	831	174		89	1		0	0	0	0	0							0					43		43	174		174	100	
TRAIL 130-05	TRAIL 130	831	1047	216	2	193		8	0	0	0	0	0							0					54		54	216		216	100	
TRAIL 130-06-C	TRAIL 130	1047	1062	15					0	3	0	0	0	3	0.0	100.0	0.0	0.0	0.0	100	9.0	19.0	Do Nill		0	3	4	1	14	15	7	93
TRAIL 130-07	TRAIL 130	1062	1097	35					0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	100					8	1	9	33	2	35	94	6
TRAIL 130-08	TRAIL 130	1097	1372	275					0	0	0	0	0							0					69		69	275		275	100	
TRAIL 130-09	TRAIL 130	1372	1553	180					0	0	0	0	0							0					45		45	180		180	100	
TRAIL 130-10	TRAIL 130	1553	1716	164		3			0	0	0	0	0							0					41		41	164		164	100	
TRAIL 130-11	TRAIL 130	1716	1991	275					0	0	0	0	0							0					69		69	275		275	100	
TRAIL 130-12	TRAIL 130	1991	2117	126					0	0	0	0	0							0					31		31	126		126	100	
TRAIL 131-BRICK	TRAIL 131	0	31	31					0	0	0	0	0							0					8		8	31		31	100	
TRAIL 132	TRAIL 132	0	25	25					0	0	0	0	0							0					6		6	25		25	100	
TRAIL 133-1	TRAIL 133	0	272	272					0	0	0	0	0							0					67		67	270		270	100	
TRAIL 133-2	TRAIL 133	272	348	77				77	0	0	0	0	0							0					19		19	77		77	100	
TRAIL 133-3	TRAIL 133	348	445	96		99			0	0	0	0	0							0					24		24	96		96	100	
TRAIL 133-4	TRAIL 133	445	630	185	2	141	5	8	0	0	0	0	0							0					46		46	185		185	100	
TRAIL 133-5	TRAIL 133	630	854	224	1	45	3	4	0	0	0	0	0							0					56		56	224		224	100	
TRAIL 133-6	TRAIL 133	854	1031	177		105	11	4	0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	100					43	1	44	174	4	177	98	2
TRAIL 133-7	TRAIL 133	1031	1123	92		98			0	0	0	0	0							0					23		23	92		92	100	
TRAIL 133-8	TRAIL 133	1123	1306	183				183	0	0	0	0	0							0					46		46	183		183	100	
TRAIL 134	TRAIL 134	0	151	151		3			0	0	0	0	0							0					38		38	151		151	100	
TRAIL 135-1	TRAIL 135	0	346	346		56			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	100					85	1	86	342	4	346	99	1

Trail Inventory					Hazards, Repair Length and Area, and Reconstruct Length				Concrete Trail Condition Sample Units						Concrete Trail Density						Concrete Trail ADI, Priority, Activity, Cost				Trail Inventory			Rated Trail Length			Percent Trail	
Section	Trail_Name	From_m	To_m	Length_m	Hazards	Crack_Sealing_Length_m	Patch_Area_Sqm	Reconstruct_Length_m	CT_E	CT_G	CT_F	CT_P	CT_VP	Rat_CT_Inv	CT_D_0	CT_D_1	CT_D_2	CT_D_5	CT_D_10	CT_D_Tot	CT_ADI	CT_Priority	CT_Activity	CT_Cost	AT_Inv	CT_Inv	TT_Inv	AT_Len_m	CT_Len_m	Rated_Len_m	Percent_AT	Percent_CT
TRAIL 135-2	TRAIL 135	346	674	328		80			0	0	0	0	0							**0**					82		82	328		328	100	
TRAIL 135-3	TRAIL 135	674	874	201					0	0	0	0	0							**0**					1		1	2		2	100	
TRAIL 135-4	TRAIL 135	874	1010	136					0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					32	1	33	130	4	134	97	3
TRAIL 135-5	TRAIL 135	1010	1114	104		75	0		0	0	0	0	0							**0**					26		26	104		104	100	
TRAIL 135-6	TRAIL 135	1114	1212	98		10	1		0	0	0	0	0							**0**					25		25	98		98	100	
TRAIL 136-1-C	TRAIL 136	0	9	9					0	2	0	0	0	2	0.0	100.0	0.0	0.0	0.0	**100**						2	2		9	9		100
TRAIL 136-2	TRAIL 136	9	86	77		29			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					19	1	19	74	3	77	96	4
TRAIL 137-1	TRAIL 137	0	123	123					0	0	0	0	0							**0**												
TRAIL 137-2-C	TRAIL 137	123	136	14					0	3	0	0	0	3	0.0	100.0	0.0	0.0	0.0	**100**	9.0	20.0	Do Nill			3	3		12	12		100
TRAIL 137-3	TRAIL 137	136	225	89		20			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					21	1	22	85	4	89	96	4
TRAIL 137-4	TRAIL 137	225	409	183		50			0	0	0	0	0							**0**					46		46	183		183	100	
TRAIL 138	TRAIL 138	0	57	57					0	0	0	0	0							**0**												
TRAIL 139	TRAIL 139	0	4	4					0	0	0	0	0							**0**												
TRAIL 140	TRAIL 140	0	6	6					0	0	0	0	0							**0**					1		1	6		6	100	
TRAIL 141-1-C	TRAIL 141	0	171	171		7			0	40	3	0	0	43	0.0	93.0	7.0	0.0	0.0	**100**	8.9	13.0	Field Inspection	$120		43	43		171	171		100
TRAIL 141-2	TRAIL 141	171	274	103		22			0	0	0	0	0	0	0.0	100.0	0.0	0.0	0.0	**100**					25	0	26	102	1	103	99	1
TRAIL 141-3	TRAIL 141	274	386	112				112	0	0	0	0	0							**0**					28		28	112		112	100	
TRAIL 141-4	TRAIL 141	386	621	235		186	3		0	0	0	0	0							**0**					59		59	235		235	100	
TRAIL 141-5	TRAIL 141	621	703	83		30	15	3	0	0	0	0	0							**0**					21		21	83		83	100	
TRAIL 142-1	TRAIL 142	0	223	223		32	2		0	0	0	0	0							**0**					55		55	221		221	100	
TRAIL 142-2	TRAIL 142	223	418	195		95	8		0	1	1	0	0	2	0.0	50.0	50.0	0.0	0.0	**100**					47	2	49	187	8	195	96	4
TRAIL 142-3	TRAIL 142	418	617	199		46			0	3	1	0	0	4	0.0	75.0	25.0	0.0	0.0	**100**					46	4	50	183	16	199	92	8
TRAIL 142-4	TRAIL 142	617	877	260		127			0	3	1	0	0	4	0.0	75.0	25.0	0.0	0.0	**100**					61	4	65	244	16	260	94	6
TRAIL 143-1	TRAIL 143	0	487	487		59	3		0	2	0	0	0	2	0.0	100.0	0.0	0.0	0.0	**100**					120	2	122	479	8	487	98	2
TRAIL 143-2	TRAIL 143	487	704	216		29			0	2	0	0	0	2	0.0	100.0	0.0	0.0	0.0	**100**					52	2	54	208	8	216	96	4
TRAIL 144-C	TRAIL 144	0	44	44					0	10	0	0	0	10	0.0	100.0	0.0	0.0	0.0	**100**	9.0	21.0	Do Nill		1	10	11	4	38	42	9	91
TRAIL 145-C	TRAIL 145	0	47	47		9			0	0	2	0	0	2	0.0	0.0	100.0	0.0	0.0	**100**					1	2	3	4	8	12	33	67
TRAIL 146-C	TRAIL 146	0	7	7					0	0	1	0	0	1	0.0	0.0	100.0	0.0	0.0	**100**					1	1	2	3	4	7	42	58
TRAIL 147	TRAIL 147	0	46	46					0	0	0	0	0							**0**												
TRAIL 148	TRAIL 148	0	2	2					0	0	0	0	0							**0**					1		1	2		2	100	
TRAIL 149	TRAIL 149	0	1306	1306					0	0	0	0	0							**0**												
TRAIL 150-1	TRAIL 150	0	132	132		69			0	0	0	0	0							**0**					33		33	132		132	100	
TRAIL 150-2-C	TRAIL 150	132	213	81		0			0	19	0	0	0	19	0.0	98.2	1.8	0.0	0.0	**100**	9.0	22.0	Do Nill		1	19	20	4	77	81	5	95
TRAIL 151-1	TRAIL 151	0	277	277		236			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					68	1	69	273	4	277	99	1
TRAIL 151-2	TRAIL 151	277	409	132		117			0	0	0	0	0							**0**					33		33	132		132	100	
TRAIL 151-3	TRAIL 151	409	648	240		120			0	0	0	0	0							**0**					60		60	240		240	100	
TRAIL 152	TRAIL 152	0	3	3					0	0	0	0	0							**0**												
TRAIL 153	TRAIL 153	0	28	28		30			0	0	0	0	0							**0**					6		6	26		26	100	
TRAIL 154-1-C	TRAIL 154	0	86	86					19	3	0	0	0	22	86.1	13.9	0.0	0.0	0.0	**100**	9.9	27.0	Do Nill			22	22		86	86		100
TRAIL 154-2	TRAIL 154	86	208	122				122	0	0	0	0	0	0	100.0	0.0	0.0	0.0	0.0	**100**					30	0	30	120	2	122	99	1
TRAIL 154-3	TRAIL 154	208	522	314		161	3		0	0	0	0	0							**0**					78		78	314		314	100	
TRAIL 154-4	TRAIL 154	522	802	280		190			0	0	0	0	0							**0**					70		70	280		280	100	
TRAIL 155	TRAIL 155	0	7	7		3			0	0	0	0	0							**0**					2		2	7		7	100	
TRAIL 156-1-C	TRAIL 156	0	59	59		1			0	13	1	0	0	14	0.0	92.9	7.1	0.0	0.0	**100**	8.9	14.0	Field Inspection	$105		14	14		57	57		100
TRAIL 156-2	TRAIL 156	59	160	101		35			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					25	1	25	98	3	101	97	3
TRAIL 156-3	TRAIL 156	160	338	178		295	4	8	0	0	0	0	0							**0**					44		44	178		178	100	
TRAIL 156-4	TRAIL 156	338	513	175				175	0	0	0	0	0							**0**					44		44	175		175	100	
TRAIL 157	TRAIL 157	0	60	60		92			0	0	0	0	0							**0**					15		15	60		60	100	
TRAIL 158	TRAIL 158	0	23	23		29			0	0	0	0	0							**0**					6		6	23		23	100	
TRAIL 159	TRAIL 159	0	200	200		196	1		0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					49	1	50	196	4	200	98	2
TRAIL 160-1	TRAIL 160	0	460	460		252	1		0	0	0	0	0							**0**					114		114	458		458	100	
TRAIL 160-2	TRAIL 160	460	676	216		320	1	4	0	0	0	0	0							**0**					54		54	216		216	100	
TRAIL 160-3	TRAIL 160	676	924	249		210	10	4	0	0	0	0	0							**0**					62		62	249		249	100	
TRAIL 160-4	TRAIL 160	924	1216	292		280	6		0	0	0	0	0							**0**					73		73	292		292	100	
TRAIL 160-5	TRAIL 160	1216	1508	292		343	5		0	0	0	0	0							**0**					73		73	292		292	100	
TRAIL 160-6	TRAIL 160	1508	1852	344				344	0	4	1	0	0	5	0.0	80.0	20.0	0.0	0.0	**100**					81	5	86	324	20	344	94	6
TRAIL 160-7-C	TRAIL 160	1852	2206	355		12			13	71	3	0	1	88	14.8	80.6	3.4	0.0	1.1	**100**	4.9	4.0	Rehabilitation Program	$3,515	1	88	89	2	352	355	1	99
TRAIL 160-8-C	TRAIL 160	2206	2537	331	2	18	2		3	73	5	0	2	83	3.5	88.3	5.7	0.0	2.4	**100**	4.8	1.0	Rehabilitation Program	$7,069		83	83		331	331		100
TRAIL 160-9-C	TRAIL 160	2537	3029	492		22			2	115	2	4	0	123	1.6	93.3	1.9	3.3	0.0	**100**	7.7	8.0	Maintenance Program	$141		123	123		492	492		100
TRAIL 161	TRAIL 161	0	1192	1192					0	0	0	0	0							**0**												
TRAIL 162-C	TRAIL 162	0	161	161		9			0	38	1	0	0	39	0.0	97.5	2.5	0.0	0.0	**100**	9.0	23.0	Do Nill		1	39	40	4	157	161	2	98
TRAIL 163	TRAIL 163	0	128	128				128	0	0	0	1	0	1	0.0	0.0	0.0	100.0	0.0	**100**					31	1	32	124	4	128	97	3
TRAIL 164	TRAIL 164	0	187	187		147			0	1	1	0	0	2	0.0	42.7	57.3	0.0	0.0	**100**					44	2	46	176	9	185	95	5
TRAIL 165-1	TRAIL 165	106	440	334		81	5		0	0	0	0	0							**0**					83		83	334		334	100	
TRAIL 165-2	TRAIL 165	0	18	18		19			0	0	0	0	0							**0**					4		4	18		18	100	
TRAIL 165-3	TRAIL 165	18	106	88		46	1		0	0	0	0	0							**0**					22		22	88		88	100	
TRAIL 166	TRAIL 166	0	17	17		10			0	0	1	0	0	1	0.0	0.0	100.0	0.0	0.0	**100**					3	1	4	13	4	17	77	23
TRAIL 167	TRAIL 167	0	17	17		4			0	0	0	0	0							**0**					4		4	17		17	100	
TRAIL 168	TRAIL 168	0	12	12		3			0	0	0	0	0							**0**					3		3	12		12	100	
TRAIL 169-1	TRAIL 169	0	36	36		11			0	0	0	0	0							**0**					8		8	34		34	100	
TRAIL 169-2	TRAIL 169	36	187	151		17			0	0	0	0	0							**0**					38		38	151		151	100	
TRAIL 169-3	TRAIL 169	187	324	137		9			0	2	0	0	0	2	0.0	100.0	0.0	0.0	0.0	**100**					32	2	34	129	8	137	94	6
TRAIL 169-4	TRAIL 169	324	563	239		38			1	0	0	0	0	1	100.0	0.0	0.0	0.0	0.0	**100**					55	1	56	222	4	226	98	2
TRAIL 169-5	TRAIL 169	563	661	98		15			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					23	1	24	93	4	97	96	4
TRAIL 170	TRAIL 170	0	49	49					0	0	0	0	0							**0**					12		12	49		49	100	
TRAIL 171-1	TRAIL 171	0	272	272		71			0	0	0	0	0							**0**					68		68	272		272	100	
TRAIL 171-2-C	TRAIL 171	272	286	13					0	2	0	0	0	2	0.0	100.0	0.0	0.0	0.0	**100**					1	2	3	4	10	13	26	74
TRAIL 172	TRAIL 172	0	19	19		13			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					4	1	5	16	3	19	84	16
TRAIL 173	TRAIL 173	0	46	46		6			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					10	1	11	42	4	46	91	9

Trail Inventory					Hazards, Repair Length and Area, and Reconstruct Length				Concrete Trail Condition Sample Units						Concrete Trail Density						Concrete Trail ADI, Priority, Activity, Cost				Trail Inventory			Rated Trail Length			Percent Trail	
Section	Trail_Name	From_m	To_m	Length_m	Hazards	Crack_Sealing_Length_m	Patch_Area_Sqm	Reconstruct_Length_m	CT_E	CT_G	CT_F	CT_P	CT_VP	Rat_CT_Inv	CT_D_0	CT_D_1	CT_D_2	CT_D_5	CT_D_10	CT_D_Tot	CT_ADI	CT_Priority	CT_Activity	CT_Cost	AT_Inv	CT_Inv	TT_Inv	AT_Len_m	CT_Len_m	Rated_Len_m	Percent_AT	Percent_CT
TRAIL 174	TRAIL 174	0	62	62		3			0	0	0	0	0							**0**					16		16	62		62	100	
TRAIL 175	TRAIL 175	0	6	6					0	0	0	0	0							**0**					2		2	6		6	100	
TRAIL 176	TRAIL 176	0	60	60		4			0	0	0	0	0							**0**					9		9	36		36	100	
TRAIL 177-C	TRAIL 177	0	213	213	10	155	6		0	30	6	8	8	52	0.0	57.7	11.5	15.4	15.4	**100**	3.5	1.0	Rehabilitation Program	$35,390	2	52	54	6	208	213	3	97
TRAIL 178	TRAIL 178	0	47	47		7			0	0	1	0	0	1	0.0	0.0	100.0	0.0	0.0	**100**					11	1	12	43	4	47	91	9
TRAIL 179-C	TRAIL 179	0	10	10		3			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					1	1	2	4	6	10	40	60
TRAIL 180	TRAIL 180	0	33	33		10			0	0	0	0	0	0	0.0	0.0	100.0	0.0	0.0	**100**					8	0	8	32	1	33	98	2
TRAIL 181	TRAIL 181	0	27	27		18			0	0	0	0	0							**0**					6		6	25		25	100	
TRAIL 182	TRAIL 182	0	10	10					0	0	0	0	0							**0**					2		2	10		10	100	
TRAIL 183	TRAIL 183	0	27	27					0	0	0	0	0							**0**					7		7	27		27	100	
TRAIL 184-01-C	TRAIL 184	0	95	95	3			95	0	2	5	16	1	24	0.0	8.4	21.0	66.4	4.2	**100**	1.4	1.0	Replace Asset	$35,675		24	24		95	95		100
TRAIL 184-02	TRAIL 184	95	374	279		5			0	0	0	1	0	1	0.0	0.0	0.0	100.0	0.0	**100**					69	1	70	274	5	279	98	2
TRAIL 184-03	TRAIL 184	374	481	107		65			0	0	0	1	0	1	0.0	0.0	0.0	100.0	0.0	**100**					26	1	27	103	4	107	96	4
TRAIL 184-04	TRAIL 184	481	626	145		118			0	0	0	0	0							**0**					36		36	145		145	100	
TRAIL 184-05	TRAIL 184	626	795	168	1	140		4	0	2	0	0	0	2	0.0	100.0	0.0	0.0	0.0	**100**					40	2	42	160	8	168	95	5
TRAIL 184-06	TRAIL 184	795	899	104		50			0	0	0	0	0							**0**					26		26	104		104	100	
TRAIL 184-07	TRAIL 184	899	1223	324		218			0	0	0	0	0							**0**					81		81	324		324	100	
TRAIL 184-08	TRAIL 184	1223	1306	84		71			0	0	0	0	0							**0**					21		21	84		84	100	
TRAIL 184-09	TRAIL 184	1306	1550	243		64			0	0	0	0	0							**0**					61		61	243		243	100	
TRAIL 184-10	TRAIL 184	1550	1597	47		41			0	0	0	0	0							**0**					12		12	47		47	100	
TRAIL 184-11-C	TRAIL 184	1597	1634	37		8			0	7	0	1	0	8	0.0	82.7	0.0	17.3	0.0	**100**	6.3	6.0	Maintenance Program	$33	1	8	9	3	34	37	8	92
TRAIL 184-12	TRAIL 184	1634	1789	155		104			0	0	0	1	0	1	0.0	0.0	0.0	100.0	0.0	**100**					38	1	39	154	2	155	99	1
TRAIL 184-13	TRAIL 184	1789	1955	166		51			0	0	0	0	0							**0**					42		42	167		166	100	
TRAIL 184-14	TRAIL 184	1955	2247	292		100			0	0	0	0	0							**0**					73		73	292		292	100	
TRAIL 184-15	TRAIL 184	2247	2303	56				56	0	0	0	0	0							**0**					14		14	56		56	100	
TRAIL 184-16	TRAIL 184	2303	2661	359		162		4	0	0	0	0	0							**0**					90		90	359		359	100	
TRAIL 185-1	TRAIL 185	0	109	109		37			0	0	0	0	0							**0**					27		27	109		109	100	
TRAIL 185-2-C	TRAIL 185	109	117	8					0	0	1	0	0	1	0.0	32.3	67.7	0.0	0.0	**100**					1	1	2	3	6	8	31	69
TRAIL 185-3	TRAIL 185	117	145	28		8			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					7	1	7	26	2	28	93	7
TRAIL 186	TRAIL 186	0	43	43		22			0	0	0	1	0	1	0.0	0.0	0.0	100.0	0.0	**100**					10	1	11	39	4	43	91	9
TRAIL 187	TRAIL 187	0	20	20		3			0	0	0	0	0							**0**					5		5	20		20	100	
TRAIL 188	TRAIL 188	0	27	27		9			0	0	0	0	0							**0**					6		6	25		25	100	
TRAIL 189-C	TRAIL 189	0	45	45		4			0	9	0	0	0	9	0.0	100.0	0.0	0.0	0.0	**100**	9.0	24.0	Do Nill		2	9	11	8	37	45	18	82
TRAIL 190-C	TRAIL 190	0	9	9					0	2	0	0	0	2	0.0	100.0	0.0	0.0	0.0	**100**						2	2		9	9		100
TRAIL 191-C	TRAIL 191	0	17	17		1			0	4	0	0	0	4	0.0	94.4	5.6	0.0	0.0	**100**	8.9	15.0	Field Inspection	$101		4	4		17	17		100
TRAIL 192	TRAIL 192	0	101	101		96			0	0	1	0	0	1	0.0	0.0	100.0	0.0	0.0	**100**					24	1	25	95	4	99	96	4
TRAIL 193	TRAIL 193	0	6	6					0	0	0	0	0							**0**					1		1	6		6	100	
TRAIL 194	TRAIL 194	0	86	86		9			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					21	1	22	82	4	86	95	5
TRAIL 195	TRAIL 195	0	33	33		3			0	0	0	0	0							**0**					8		8	33		33	100	
TRAIL 196-C	TRAIL 196	0	336	336		18			0	76	5	2	0	83	0.0	91.6	6.0	2.4	0.0	**100**	7.8	9.0	Maintenance Program	$115	1	83	84	4	333	336	1	99
TRAIL 197-1	TRAIL 197	0	120	120		42			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					29	1	30	116	4	120	97	3
TRAIL 197-2-C	TRAIL 197	120	141	21		4			0	4	0	0	0	4	0.0	100.0	0.0	0.0	0.0	**100**	9.0	25.0	Do Nill		1	4	5	4	17	21	17	83
TRAIL 197-3	TRAIL 197	141	342	201		123			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					50	1	50	198	3	201	99	1
TRAIL 197-4	TRAIL 197	342	418	75	8			75	0	0	0	0	0							**0**					19		19	75		75	100	
TRAIL 197-5	TRAIL 197	418	538	120		116			0	0	0	0	0							**0**					30		30	120		120	100	
TRAIL 197-6	TRAIL 197	538	653	116		76		8	0	0	0	0	0							**0**					29		29	116		116	100	
TRAIL 198	TRAIL 198	0	8	8		9			0	0	0	0	1	1	0.0	0.0	0.0	0.0	100.0	**100**					1	1	2	4	4	8	48	52
TRAIL 199	TRAIL 199	0	62	62		32			0	0	0	0	0							**0**					15		15	62		62	100	
TRAIL 200	TRAIL 200	0	21	21		4			0	0	0	0	0							**0**					5		5	21		21	100	
TRAIL 201	TRAIL 201	0	93	93		50			0	0	0	0	0							**0**					21		21	84		84	100	
TRAIL 202-1	TRAIL 202	0	134	134		56			0	0	0	0	0							**0**					33		33	132		132	100	
TRAIL 202-2-C	TRAIL 202	134	204	70		11			0	13	3	0	0	16	0.0	81.7	18.3	0.0	0.0	**100**	8.8	11.0	Field Inspection	$145	1	16	17	4	66	70	6	94
TRAIL 203-1	TRAIL 203	0	9	9		0			0	0	0	0	0							**0**					2		2	9		9	100	
TRAIL 203-2-C	TRAIL 203	9	40	32		1			0	7	0	0	0	7	0.0	100.0	0.0	0.0	0.0	**100**	9.0	26.0	Do Nill		1	7	8	3	28	32	11	89
TRAIL 203-3	TRAIL 203	40	310	269		61			0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					66	1	67	266	4	269	99	1
TRAIL 204	TRAIL 204	0	13	13					0	1	0	0	0	1	0.0	100.0	0.0	0.0	0.0	**100**					2	1	3	9	4	13	69	31
TRAIL 205	TRAIL 205	0	11	11					0	0	0	0	0							**0**					2		2	9		9	100	
TRAIL 206	TRAIL 206	0	57	57		20			0	0	0	0	0							**0**					14		14	57		57	100	
TRAIL 207-1	TRAIL 207	0	191	191		99	4		0	0	0	0	0							**0**					47		47	189		189	100	
TRAIL 207-2	TRAIL 207	191	301	109		125	1	4	0	0	0	0	0							**0**					27		27	109		109	100	

Trail Condition and Activity Sections Table Dictionary

Category	Field	Description	Units
Trail Inventory	Section	Unique Identification Section Name for the Rated Sections.	-
	Trail_Name	GIS Route and Trail Name.	-
	From_m	From measure of the Trail.	m
	To_m	To measure of the Trail.	m
	Length_m	Length of the section.	m
Repair Area	Hazards	Number of Hazards identified in the section.	No
	Crack_Sealing_Length_m	Length of Crack Sealing	m
	Patch_Area_Sqm	Length of Patch Area	Sq.m
	Reconstruct_Length	Length of Section need to be reconstructed	m
Asphalt Trail Condition Sample Units	AT_E	Number of sample units with asphalt trail rated in excellent condition.	No
	AT_G	Number of sample units with asphalt trail rated in good condition.	No
	AT_F	Number of sample units with asphalt trail rated in fair condition.	No
	AT_P	Number of sample units with asphalt trail rated in poor condition.	No
	AT_VP	Number of sample units with asphalt trail rated in very poor condition.	No
	Rat_AT_Inv	Total number of sample units rated with asphalt trail.	No
Concrete Trail Condition Sample Units	CT_E	Number of sample units with concrete trails rated in excellent condition.	No
	CT_G	Number of sample units with concrete trails rated in good condition.	No
	CT_F	Number of sample units with concrete trails rated in fair condition.	No
	CT_P	Number of sample units with concrete trails rated in poor condition.	No
	CT_VP	Number of sample units with concrete trails rated in very poor condition.	No
	Rat_CT_Inv	Total number of sample units with rated concrete trails.	No
Asphalt Trail Density	AT_D_0	Density of asphalt trail sample units in excellent condition within the section.	%
	AT_D_1	Density of asphalt trail sample units in good condition within the section.	%
	AT_D_2	Density of asphalt trail sample units in fair condition within the section.	%
	AS_D_5	Density of asphalt trail sample units in poor condition within the section.	%
	AT_D_10	Density of asphalt trail sample units in very poor condition within the section.	%
	AT_D_Tot	Total density of asphalt trail sample units.	%
Concrete Trail Density	CT_D_0	Density of concrete trail sample units in excellent condition within the section.	%
	CT_D_1	Density of concrete trail sample units in good condition within the section.	%
	CT_D_2	Density of concrete trail sample units in fair condition within the section.	%
	CT_D_5	Density of concrete trail sample units in poor condition within the section.	%
	CT_D_10	Density of concrete trail sample units in very poor condition within the section.	%
	CT_D_Tot	Total density of concrete trail sample units.	%
Asphalt Trail ADI, Priority, Activity, Cost	AT_ADI	Asset Damage Index Asphalt Trail.	-
	AT_Priority	Priority of multi-year rehabilitation plan based on ADI.	No
	AT_Activity	Activity assigned on Asphalt Trails to develop an inspection and maintenance activity program. 9 ≤ ADI ≤ 10 Do-Nil 8 ≤ ADI < 9 Field Inspection 5 ≤ ADI < 8 Maintenance Program 2 ≤ ADI < 5 Rehabilitation Program 0 ≤ ADI < 2 Replace Asset	
	Cost	Cost of Asphalt Trail Activity.	$
Concrete Trail ADI, Priority, Activity, Cost	CT_ADI	Concrete Trail Asset Damage Index.	-
	CT_Priority	Priority of multi-year rehabilitation plan based on ADI.	No
	CT_Activity	Activity assigned on Concrete Trails to develop an inspection and maintenance activity program. 9 ≤ ADI ≤ 10 Do-Nil 8 ≤ ADI < 9 Field Inspection 5 ≤ ADI < 8 Maintenance Program 2 ≤ ADI < 5 Rehabilitation Program 0 ≤ ADI < 2 Replace Asset	
	Cost	Cost of Concrete Trail Activity.	$
Trail Inventory	AT_Inv	Number of rated sample units with asphalt trail within the section.	No
	CT_Inv	Number of rated sample units with concrete trail within the section.	No
	TT_Inv	Number of total sample units within the section.	No
Rated Trail Length	AT_Len_m	Length of section rated as Asphalt Trail in the section.	m
	CT_Len_m	Length of section rated as Concrete Trail in the section.	m
	Rated_Len_m	Length of section rated in the section.	m
Percent Trail	Percent_AT	Percentage of rated asphalt trail Inventory within the section.	%
	Percent_CT	Percentage of rated concrete trail Inventory within the section.	%

APPENDIX E

LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

DESIGN REPORT

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the sole use of TETRA TECH's Client (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH.

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Where TETRA TECH has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

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1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by third parties other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary exploration, investigation, and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless so stipulated in the Design Report, TETRA TECH was not retained to investigate, address or consider, and has not investigated, addressed or considered any environmental or regulatory issues associated with the project specific design.

1.8 CALCULATIONS AND DESIGNS

TETRA TECH may have undertaken design calculations and prepared project specific designs in accordance with terms of reference that were previously set out in consultation with, and agreement of, TETRA TECH's client. These designs have been prepared to a standard that is consistent with current industry practice. Notwithstanding, if any error or omission is detected by TETRA TECH's Client or any party that is authorized to use the Design Report, the error or omission should be immediately drawn to the attention of TETRA TECH.

1.9 GEOTECHNICAL CONDITIONS

A Geotechnical Report is commonly the basis upon which the specific project design has been completed. It is incumbent upon TETRA TECH's Client, and any other authorized party, to be knowledgeable of the level of risk that has been incorporated into the project design, in consideration of the level of the geotechnical information that was reasonably acquired to facilitate completion of the design.

If a Geotechnical Report was prepared for the project by TETRA TECH, it may be included in the Design Report as appropriate. The Geotechnical Report contains Limitations that should be read in conjunction with these Limitations for the Design Report.