Analysis and Recommendations for Street Network

Interlaken Town

August 2019

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Introduction

One of Interlaken Town's most valuable infrastructure assets is the approximately 5 miles of local streets within its network. Maintaining the street network at a high level of service will promote the prosperity of Interlaken's entire community. Many state and local transportation agencies currently use a pavement management system and/or a maintenance management system to cost effectively preserve and improve their street network. The Utah Local Technical Assistance Program (LTAP) assists local agencies in the state of Utah and surrounding states to implement and use pavement management software to maintain, preserve, and enhance their road and street assets and more effectively manage the allocation of funding as it pertains to the existing street network.

The Town of Interlaken contacted the Utah Local Technical Assistance Program (LTAP) on June 6, 2019 requesting a survey of Interlaken's road network. A proposal was written up by Utah LTAP and sent to Interlaken's Town Government on June 21, 2019.

The Town of Interlaken asked the Utah LTAP to develop a pavement management system that could be used in their transportation plan. This report describes the system's major elements, the processes, and the work accomplished to facilitate its implementation in Interlaken. The pavement management system provides:

- A complete GIS-based physical inventory and condition survey of the street network
- A needs assessment process
- Analyses of root causes of pavement deterioration
- Analysis of current street maintenance programs
- Recommended maintenance and preservation treatments
- Treatment costs and budget proposals
- A method to evaluate alternate funding scenarios to maximize the average remaining service life (RSL) of the street network

Figure 1 outlines the major elements and processes incorporated in Interlaken's Pavement Management System. The following sections of this report describe each step of the process in detail, the results of field surveys and analyses, and the conclusions and recommendations offered to assist in the full implementation of the system in Interlaken.

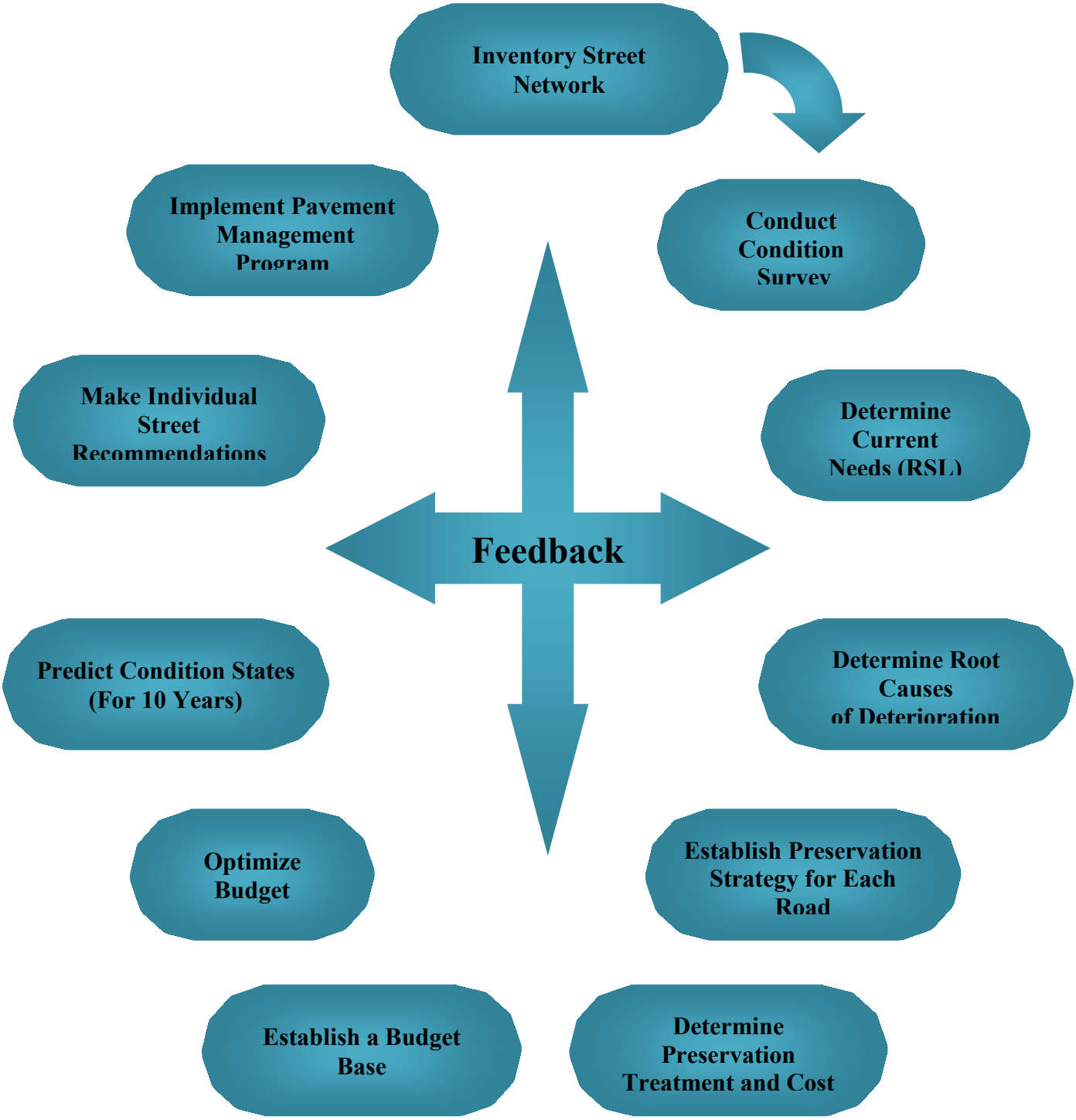


Figure 1. Pavement Management Process Diagram

Inventory of Road Network

The first step in the process of inventorying Interlaken's local street network involved assigning a functional classification to each street. Utah Department of Transportation (UDOT) public road maps and data assisted in making these classifications. Excluding the state routes, the inventory identified the functional classifications of all roads to be residential.

The second step in the inventory process involved a GIS map with shape files of the road network previously developed by UDOT. In addition to using the existing centerline shape file for the street network a measuring wheel was used to measure the street widths. Data from the GPS mapping process was used to calculate the lengths of all street segments. Measured widths and lengths were used to calculate the street surface areas.

A complete condition survey of Interlaken's local road network was conducted during July of 2019. Employees from the Utah LTAP (Local Technical Assistance Program) Center used the Strategic Highway Research Program (SHRP) Distress Manual as a guide to conduct the pavement distress survey

Appendix A contains the complete results of the inventory processes. Inventory details include street name, starting and ending addresses of the segment, functional classification, segment width and length, estimated remaining service life (RSL), surface area of the pavement in square yards, and the percent of network area represented by each segment. Table 1 contains a sample of the inventory of roads as found in Appendix A.

Table 1. Excerpt Showing Details in the Inventory Process of the Local Street Network

ID	Street Name	From	To	Class	Width (ft)	Length (ft)	RSL	%Area	Area (sq yd)
16	Big Matterhorn Way	Big Matterhorn Way	Big Matterhorn Cir	Residential	12	296	10	1.31%	394.67
8	St. Mortiz St	St. Mortiz St	Dead End	Residential	12	585	12	2.58%	780.00
27	Interlaken Dr	Interlaken Dr	Edelweiss Ln	Residential	14	657	8	3.39%	1022.00
33	Luzern Rd	Luzern Rd	Dead End	Residential	12	404	10	1.78%	538.67
39	Interlaken Dr	Interlaken Dr	Dead End	Residential	14	444	12	2.29%	690.67
37	Eiger Point Rd	Eiger Point Rd	Jung Frau Hill Rd	Residential	12	385	10	1.70%	513.33
24	Bern Way	Bern Way	Dead End	Residential	12	316	14	1.40%	421.33

This inventory excludes pavement structure details regarding date of initial construction, layer thickness, and pavement design criteria of each street. This information can be obtained from historical records, maintenance personnel, or sampling and testing of the pavement structure. This information should be incorporated through further implementation efforts and by working closely with Interlaken's Town Government.

Pavement Condition Survey

Road Network

A complete condition survey covering pavement distress of Interlaken's road network was conducted during July of 2019. Employees from the Utah LTAP (Local Technical Assistance Program) Center used the Strategic Highway Research Program (SHRP) manual, Distress Identification Manual for the Long-Term Pavement Performance Project as a guide to conduct the pavement distress survey.

The principal focus of the asphalt condition survey was to identify and determine the severity level and extent of each distress type. Each asphalt street segment was closely surveyed for the presence of potholes/utility cuts, transverse cracking, longitudinal cracking, block cracking, edge cracking, and fatigue (alligator) cracking. The severity level and extent of each distress type were evaluated in accord with the condition survey evaluation sheet shown in Appendix B. Appendix C shows the detailed distress information for each road segment.

Pavement Design & Performance

Typically, asphalt pavements, designed in accord with the AASHTO Guide for Design of Pavement Structures, ought to provide for twenty years of traffic loading (18 kip ESAL's) before reaching a terminal serviceability level at which point reconstruction is required (RSL = 0). Conventional practice usually provides for a preventative maintenance treatment and rehabilitative treatment to be applied to the asphalt pavement during its 20-year service life. Timing is critical in the placement of the preventative maintenance and the rehabilitative treatment to achieve the best level of service at the least amount of cost.

Figure 3 shows a typical pavement performance curve for asphalt pavements. This figure emphasizes the time relationship between street pavement condition and the cost of repair.

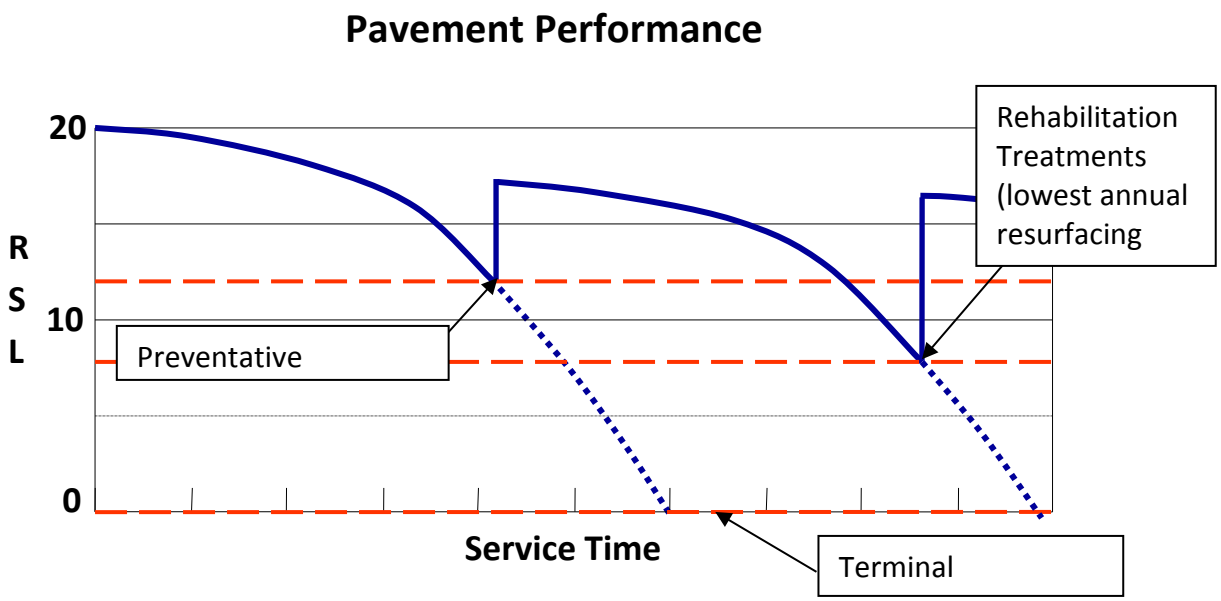


Figure 2. Pavement Performance Curve

After eight years of service (RSL = 12), most asphalt pavements will deteriorate to a "good" condition category. This relates to a thirty-three percent (33%) drop in the service life of the pavement and is the optimal point in time at which a preventative maintenance treatment should be placed. After twelve years of service (RSL = 8), most asphalt pavements will deteriorate to a “fair” condition rating. This represents a sixty percent (60%) drop in the service life of the pavement and is the best point in time at which to consider a rehabilitation treatment. If no renovation action occurs at this point, the street will likely deteriorate to the "poor" category within three years (RSL = 5). Cost comparisons show that reconstruction will cost two to three times more than rehabilitation strategies. The cost to maintain a pavement with preventative maintenance strategies relates to about one-fifth the cost of rehabilitation strategies, or one-tenth the cost of reconstruction.

The RSL of a road is not affected by the appearance of the road. A road may be rough on the surface or have some small bumps and cracks, but this does not necessarily mean that the road is in poor condition. The RSL is based on the structural integrity of the road. A responsible maintenance program will be built around maintenance strategies that improve the service life of the roadway, not simply applying treatments to improve the appearance or smoothness of the road.

Major Causes of Pavement Distress

The predominant asphalt pavement distresses affecting Interlaken's streets were determined from the pavement distress survey information. Analysis of this information showed that there were four of the seven major distress types prevalent in the street network. Pavement roughness results from these distresses. Fatigue cracking was the major distress type found occurring most frequently in the asphalt street network.

The root causes of each of the seven main distress types are described as follows, along with respective suggestions on how to mitigate the development of each:

Transverse cracking in asphalt pavements is normally attributed to thermal changes in the pavement structure. As seasonal temperatures change, the pavement expands and contracts beyond the limits that asphalt can tolerate, thus causing transverse cracking. If these transverse cracks are not sealed early in their development, they will continue to grow in terms of both severity and extent, and they will allow surface moisture to enter the pavement causing further distress to develop. Recent developments in asphalt technology known as the Superpave System have shown the potential to preclude the development of transverse cracking if used in new asphalt pavements. Use of performance graded (PG) asphalt cements and the Superpave mix design system, along with good quality control and good hot mix asphalt construction practice can potentially eliminate this type of distress from occurring. Using the Superpave System on newly constructed or reconstructed streets that serve a relatively high volume of traffic is recommended.

Longitudinal cracking is related to two different causes. The first is poor construction. When a street is constructed, it is normally built in two or more sections. Problems, such as poor compaction or segregation in the asphalt mix, will cause longitudinal cracks along the construction seam. The second cause of longitudinal cracks is load related. These longitudinal cracks are found in the wheel paths of the travel lanes. These cracks are due to early fatigue

failure and should be treated as fatigue cracks. On some street segments that are extremely wide, longitudinal cracking may be caused by thermal changes as with transverse cracks.
Block cracking is a combination of transverse and longitudinal cracking that occurs when the transverse and longitudinal cracks intersect. The combination of these two distresses allows greater opportunity for surface water to enter the pavement structure, thus decreasing the load carrying capacity of the pavement. Once a block forms, water enters and softens the base. As the base softens, normal traffic loading progressively breaks the pavement into smaller and smaller blocks. This leads to the development of fatigue cracking.

Utility cuts are man-made cuts and have been shown to reduce the service life of a street by as much as five to seven years. Although utility cuts are sometimes inevitable, good planning and coordination of utility work can reduce the number of utility cuts made in newer streets.

Only limited rutting of the pavement surface was observed in Interlaken's street network. This form of distress typically occurs in the wheel paths and is a result of deformation in the pavement structure or subgrade. This deformation comes from heavy axle loads acting in combination with moisture to deform and rut the pavement. Inadequate compaction during construction can also result in deformation. Rutting may also occur in hot weather when the asphalt is less viscous and has less shear strength. In this case, rutting usually results from the use of poor materials, poor asphalt mix design, poor quality control, or poor construction.

Edge cracking was generally found in street segments where pavement edges had little or no support. Those segments that had no paved shoulders or supporting curb and gutter sections were more prone to this type of distress.

Fatigue cracking is the main governing distress in the majority of the streets and affects sixty-six percent (65.96%) of the network surface area. Fatigue cracking in asphalt pavements is largely caused by loss of base and subgrade support due to moisture infiltrating the pavement. Once moisture softens the base and subgrade layers, the asphalt pavement can no longer effectively carry the traffic loading. This results in pavement cracking and breakup. The fatigue cracking prevalent in the streets of Interlaken is most likely caused by water saturating the base and

subgrade layers. With the subgrade saturated, the road structure flexes and gives under the weight of a vehicle that drives over the street.

Heavy vehicle traffic on the streets also causes fatigue cracking, by applying greater stresses to the pavement than it is designed to support. In those areas of the town where new homes are being constructed, concrete trucks or other heavy vehicles can cause major damage to the streets. Heavy commercial trucks fall within the heavy vehicle traffic designation.

Pavement Distress Survey & Analysis

The first step in the analysis of the pavement distress survey information involves determining the governing distress type for each street segment. A governing distress is one that is most detrimental to the condition of the pavement, and so should be the focus of treatment. Each rating for each distress is associated with an RSL value; a higher distress rating results in a lower RSL rating. To analyze a segment, find the lowest RSL value associated with any of the distresses assigned to the segment. This value becomes the RSL for the entire segment and the corresponding distress is the governing distress.

Figure 4 shows an example rating sheet for a road segment and Table 3 shows the RSL values associated with fatigue cracking ratings. The distress rating of 5 for fatigue cracking corresponds with an RSL of 6. Similar tables would be used for the other distresses reported on the segment. An analysis of the distresses shown below shows that fatigue cracking is the governing distress because it gives the lowest RSL value (besides being the highest numerical rating).

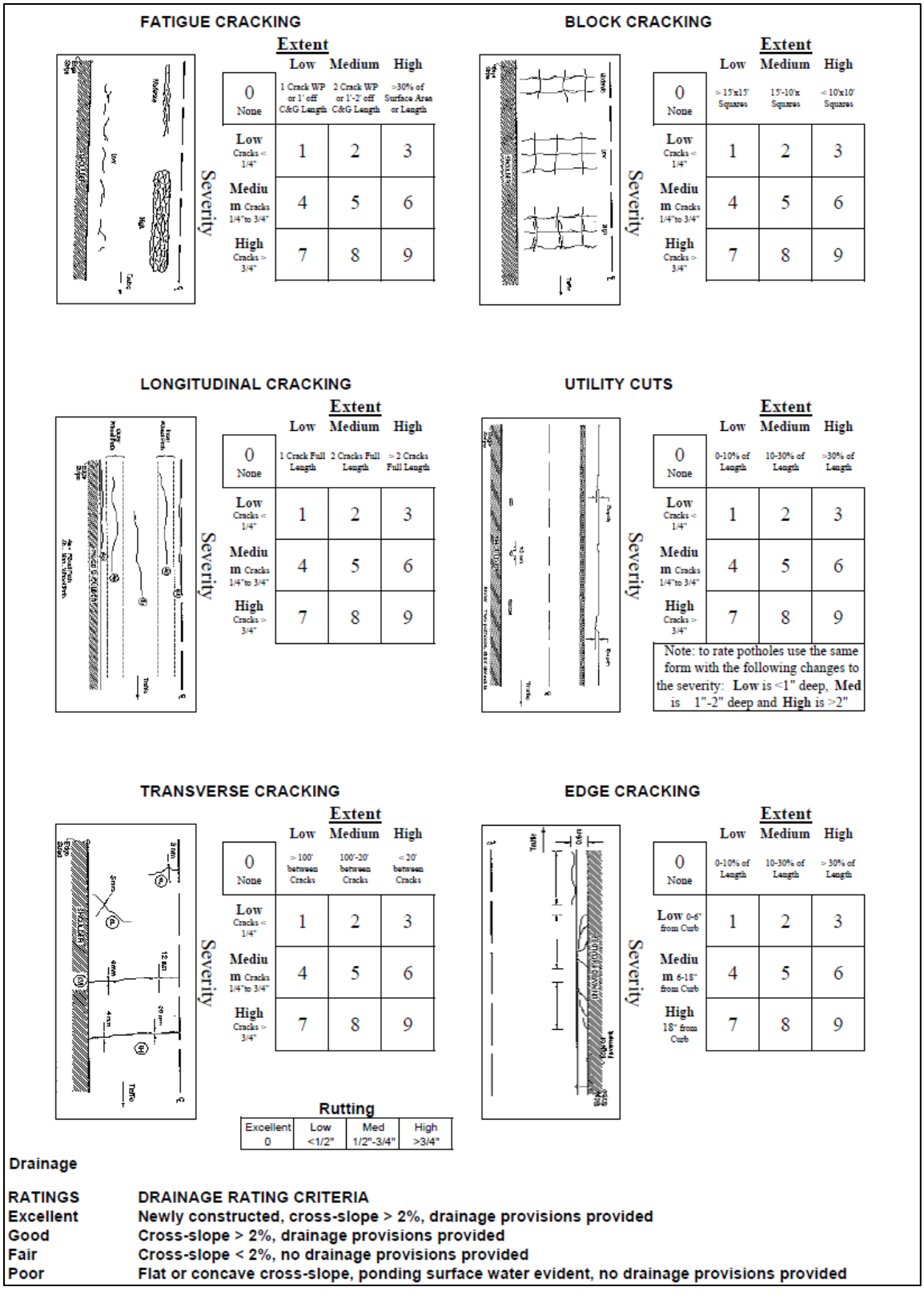


Figure 3. Condition Rating Sheet

Table 2. Fatigue Cracking Distress Table

RATING	SEVERITY & EXTENT	RSL
0	No Alligator Cracking	20
1	Low, Low	10
2	Low, Medium	8
3	Low, High	6
4	Medium, Low	8
5	Medium, Medium	6
6	Medium, High	4
7	High, Low	6
8	High, Medium	2
9	High, High	0

The governing distress is the distress most likely to cause the pavement to deteriorate the soonest and reduce the serviceability of the street. Appendix D contains the deterioration tables for the other distress types. These tables can be adjusted by experienced personnel to more accurately reflect the effects of local environmental and traffic loading conditions.

Table 4 includes several recommended preservation strategies and treatments, the estimated cost of each treatment, and the estimated remaining service life the road is expected to gain after the treatment is applied.

Table 3. Maintenance Performance Table

Treatment Type	Maint. Category	Cost	0	1-3	4-6	7-9	10-12	13-15	16-18	19-21
Crack Seal	Routine	$0.52	0	0	0	0	1	2	3	2
Cold Patch	Routine	$0.52	0	0	0	0	0	0	0	0
Digout and Hot Patch	Routine	$0.78	0	0	0	0	0	0	0	0
High Perf. Cold Patch	Routine	$1.04	0	0	0	0	0	0	0	0
Fog Coat	Routine	$0.78	0	0	0	1	1	2	2	2
High Mineral Asphalt Emulsion	Preventative	$2.07	0	0	0	1	2	3	5	5
Sand Seal	Preventative	$1.12	0	0	0	1	2	2	2	2
Scrub Seal	Preventative	$1.73	0	1	3	5	5	5	5	5
Single Chip Seal	Preventative	$2.24	0	1	3	5	5	5	5	5
Slurry Seal	Preventative	$3.02	0	1	3	5	5	5	5	5
Microsurfacing	Preventative	$4.14	0	2	3	5	7	7	7	7
Plant Mix Seal	Rehabilitation	$9.66	0	3	4	5	7	7	7	7
Cold In-place Recycling (2 in with chip seal)	Rehabilitation	$8.63	0	3	4	5	6	7	7	7
Thin Hot Mix Overlay (<2 in)	Rehabilitation	$11.64	0	4	6	7	7	7	7	7
HMA (leveling) & Overlay (<2 in.)	Rehabilitation	$12.94	0	4	6	8	8	8	8	8
Hot Surface Recycling	Rehabilitation	$8.63	0	3	5	7	8	8	8	8
Rotomill & Overlay (<2 in)	Rehabilitation	$14.49	0	4	7	8	8	8	8	8
Cold In-place Recycling (2/2 in.)	Reconstruction	$17.77	15	15	15	15	15	15	15	15
Thick Overlay (3 in.)	Reconstruction	$17.25	12	12	12	12	12	12	12	12
Rotomill & Thick Overlay (3 in.)	Reconstruction	$18.98	12	12	12	12	12	12	12	12
Base Repair\Pavement Replacement	Reconstruction	$20.70	16	16	16	16	16	16	16	16
Cold Recycling & Overlay (3/3 in.)	Reconstruction	$19.23	14	14	14	14	14	14	14	14
Full Depth Reclamation& Overlay (3/3 in.)	Reconstruction	$22.86	20	20	20	20	20	20	20	20
Base/Pavement Replacement (3/3/6 in.)	Reconstruction	$32.78	20	20	20	20	20	20	20	20

***Fit the current RSL into a category along the top row and then move downward to the applied treatment to find the additional RSL that will be achieved from the selected treatment.**

(2/2 in.) Means 2" overlay with 2" recycle

The previous procedure was used to determine the governing distress and the RSL for each asphalt segment. Figure 5 shows the governing distress types in the asphalt street network along with the percent of the total asphalt street network area affected by each type.

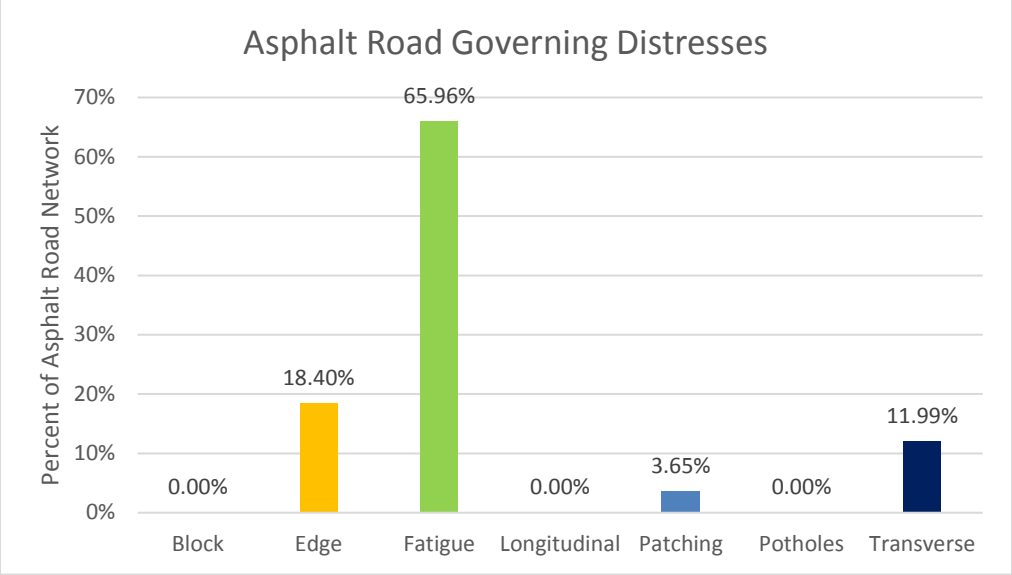


Figure 4. Governing Distress Rating Distribution for Asphalt Roads

As a reference, one percent (1%) of Interlaken's asphalt street network represents approximately 0.05 miles in length. Figure 5 also illustrates that some governing distress types are more common to the street network. Fatigue is the most common governing distress types in Interlaken's asphalt street network.

The governing distress type of each segment provided the means of calculating the average RSL for the street network. For management purposes, the estimated RSL values are grouped incrementally in three-year categories. Figure 6 shows the current RSL distribution for Interlaken's street network in terms of percent of surface area of the network.

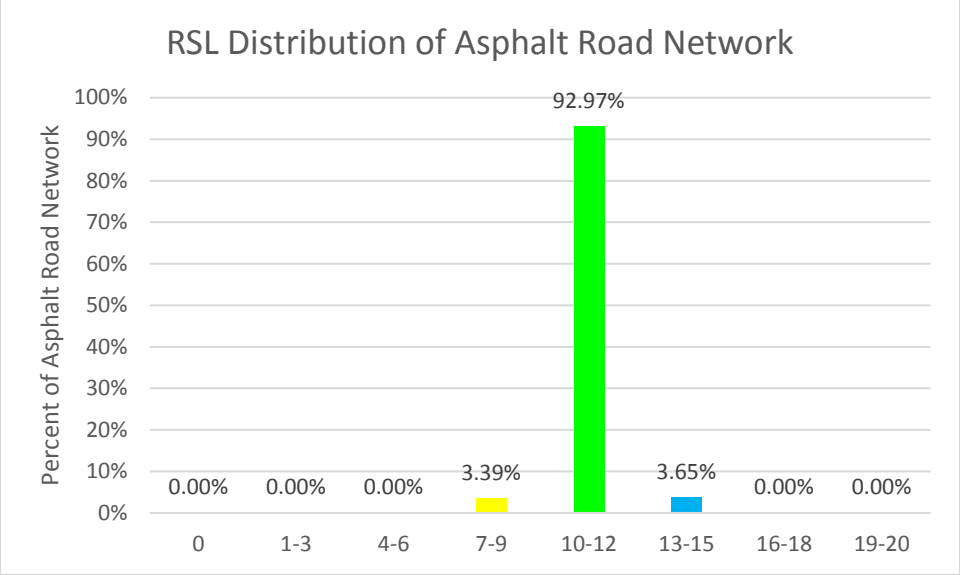


Figure 5. Current RSL Distribution for Asphalt Street Network

The estimated average RSL of Interlaken's street network is 10.54 years. The average RSL value for Interlaken is slightly below the average RSL value of 10.89 years for all Utah cities surveyed since 2002 by the Utah LTAP Center. Table 5 shows this same information along with the corresponding subjective condition ratings of failed, poor, fair, good, very good, and excellent.

Table 4. Subjective Condition Rating of Asphalt Street Network

SUBJECTIVE CONDITION RATING OF STREET NETWORK								
	FAILED	POOR		FAIR	GOOD	VERY GOOD		EXCELLENT
RSL (Years)	0	1-3	4-6	7-9	10-12	13-15	16-18	19-20
% of Network	0.00%	0.00%	0.00%	3.39%	92.97%	3.65%	0.00%	0.00%

Zero percent (0%) of the paved street network in Interlaken is considered to be in a failed condition. Zero percent (0.00%) is considered to be in poor condition. Three percent (3.39%) is rated to be in fair condition, ninety-three percent (92.97%) is in good condition, four percent (3.65%) is in very good condition, and zero percent (0.00%) of the street network is rated to be in excellent condition.

For further illustrative purposes, the following photographs show examples of the condition ratings of fair, good, and very good and their respective RSL estimates.

Photo 1. Fair Condition – Interlaken Dr from Interlaken Dr to Edelweiss Ln (RSL = 8 years)

Photo 2. Good Condition – Interlaken Dr from Interlaken Dr to Luzern Rd (RSL = 10 years)

Photo 3. Very Good Condition – Luzern Rd from Luzern Rd to Luzern Rd (RSL = 14 years)

Currently, Interlaken's paved street network is in "good" condition. Zero percent (0.0%) of the network is at a terminal serviceability level as shown in Table 5.

On average, each street segment will most likely lose one year of service life per year without some preservation work being done. Within three years, if no pavement preservation is performed, about 3.39% of the asphalt paved network will probably deteriorate to a poor condition. This could place a major financial burden on the town to reconstruct these segments to provide adequate roads, as well as reduce the amount of public satisfaction with the street network. If a systematic pavement management program is continued now, a balanced set of preservation strategies (e.g., routine maintenance, preventative maintenance, rehabilitation, and reconstruction) can be used to preclude the development of a backlog of needs and the overall decline in the service life of the network.

Development of Preservation Strategies and Recommended Treatments

After determining the governing distress types for each street segment, pavement preservation strategies and treatments that can effectively correct or remove the root causes were identified. Frequently, more than one strategy or treatment can be used to cost effectively remedy the governing distress and other accompanying distresses that may exist. As an example, the distress deterioration table for fatigue cracking is shown in Table 6. This table shows the various combinations of severity and extent (rating) levels that may occur, along with their preservation strategies and recommended treatments. The corresponding estimated RSL of each rating level is also shown.

Table 5. Fatigue Cracking Preservation Strategies and Treatments

RATING	SEVERITY & EXTENT	RSL	STRATEGY	TREATMENT
0	No Alligator Cracking	20	No Maintenance	No Maintenance
1	Low, Low	10	Routine	Slurry Seal
2	Low, Medium	8	Rehabilitation	Thin Hot Mix Overlay (<2 in)
3	Low, High	6	Rehabilitation	Thin Hot Mix Overlay (<2 in)
4	Medium, Low	8	Rehabilitation	Thin Hot Mix Overlay (<2 in)
5	Medium, Medium	6	Reconstruct	Thick Overlay (3 in)
6	Medium, High	4	Reconstruct	Rotomill & Thick Overlay
7	High, Low	6	Reconstruct	Thick Overlay (3 in)
8	High, Medium	2	Reconstruct	Cold Recycle & Overlay (3 in)
9	High, High	0	Reconstruct	Full Depth Reclamation (3/3 in.)

Distress deterioration tables with their preservation strategies and recommended treatments similar to this were developed for each distress type and are given in Appendix D.

The preservation strategies and recommended treatments given in Appendix F are grouped in the general preservation strategies of routine maintenance, preventative maintenance, rehabilitation, and reconstruction. Each major preservation strategy represents a particular level of work effort and a specific goal with regard to preserving or restoring the pavement.

Routine maintenance is primarily proactive and includes the work items of crack sealing, fog sealing, dig-outs, and patching.

Preventative maintenance is designed to slow pavement deterioration, as well as preserve and improve the functional condition of the pavement. Preventative maintenance strategies do not substantially increase structural capacity. Treatments in the category of preventative maintenance include sand seals, fog seals, chip seals, scrub seals, cape seals, slurry seals, and microsurfacing.

Rehabilitation serves to correct or remove root causes of distress and to add structural capacity and service life to the pavement. Rehabilitation treatments include thin hot mix asphalt overlays, hot surface recycling, bonded wearing courses, and combinations of leveling courses or rotomilling with overlays.

Reconstruction covers all types of work involved in totally reconstructing or replacing the pavement structure, thus providing a completely new pavement.

A detailed listing of all preservation strategies and their associated treatments with unit costs are given in Appendix F. The unit costs, separately provided by Road Science, L.L.C., are based on the average costs per square yard. A special inventory form built within the Transportation Asset Management System (TAMS) computer program facilitates the analysis process and allows engineering judgment to be exercised at any point. An example of this form is shown in Figure 7. The program uses the previously entered distress information to determine appropriate treatments. For the segment shown in Figure 7, the recommended treatment is Microsurfacing.

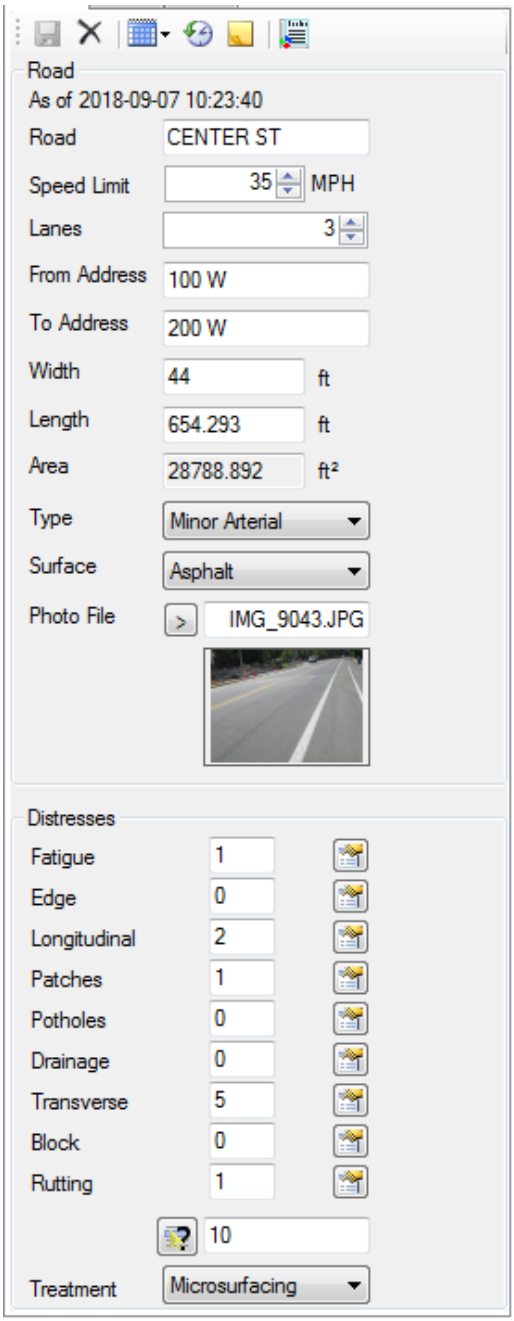


Figure 6. TAMS Inventory Form

At the top of the form, inventory information pertaining to the street segment is shown. This information includes the address and location of the segment, surface type, number of lanes, length, width, area, posted speed limit, and date inventoried. At the bottom, the distress ratings, RSL value, and recommended preservation treatment are listed.

Appendix E shows the initial recommended pavement preservation strategies to be used on each street segment. Table 7 gives an example of the information contained in Appendix E. This information is sorted by treatment type and street name.

Table 6. Recommended Preservation Treatments for Each Segment (Appendix E)

ID	STREET NAME	FROM	TO	CLASS	TREATMENT	AREA (YD^2)
42	Bern Way	Jung Frau Hill Rd	Bern Way	Residential	Slurry Seal	875
16	Big Matterhorn Way	Big Matterhorn Way	Big Matterhorn Cir	Residential	Slurry Seal	395
27	Interlaken Dr	Interlaken Dr	Edelweiss Ln	Residential	Rotomill and Thin Overlay	1,022
31	St Mortiz St	Jung Frau Hill Rd	St Moritz Rd	Residential	Slurry Seal	287
33	Luzern Rd	Luzern Rd	Dead End	Residential	Rotomill and Thin Overlay	539
22	Edelweiss Ln	Edelweiss Ln	Interlaken Dr	Residential	Slurry Seal	629

Assessment of Current Street Maintenance Program Funding

Asphalt Road Network

Maintaining and preserving Interlaken's street network at a high service level is vital to the well-being of the community. It is helpful for elected official to understand that the cost of construction and pavement preservation has increased significantly in the last ten years. Since cities have had little increase in the B & C gas tax fund, they can preserve only a fraction of the roads that they could in the past with the same money. This is putting road departments in the position of not being able to stay up with cost effective pavement preservation in the early years of a pavement's life. The only solution is to find other sources of funds or let some of the lower functional class roads go, hoping that low volume roads will last a little longer than the higher volume arterials and collectors. Segments in Appendix G were selected and prioritized based on of their level of functional importance to the road network so that the highly trafficked roads could be done first.

Systematic and balanced pavement preservation programs providing for routine and preventative maintenance, rehabilitation, and reconstruction, will enable Interlaken to cost effectively maintain the street network. A pavement preservation program recommended for cities and towns is one that maintains an estimated average RSL of 10 years with no more than three percent (3%) of the street network at the terminal serviceability level (i.e. RSL = 0). Interlaken's 2019 RSL distribution is shown in Figure 8.

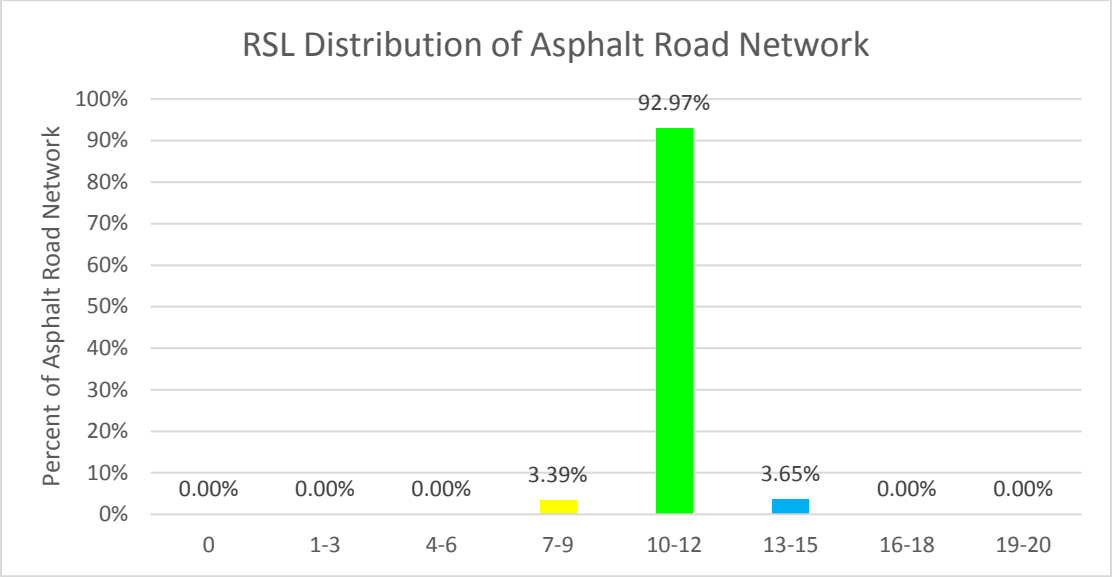


Figure 7. Current RSL Distribution for Asphalt Street Network

The average RSL for Interlaken's asphalt street network for 2019 is estimated at 10.54 years with zero percent (0.0%) of the road network at a terminal service level. The current condition of Interlaken's asphalt street network meets the given recommended standards by having an estimated average RSL value above 10 years with less than three percent of the street network at the terminal serviceability level. This illustrates that Interlaken has been maintaining its road network at a satisfactory level.

Figure 9 and Figure 10 illustrate the estimated RSL distribution for 2024 and 2029 if no maintenance is performed on the street network. The number of streets at a terminal service level (RSL = 0) would increase from 0.0 % to 73.08% by 2029.

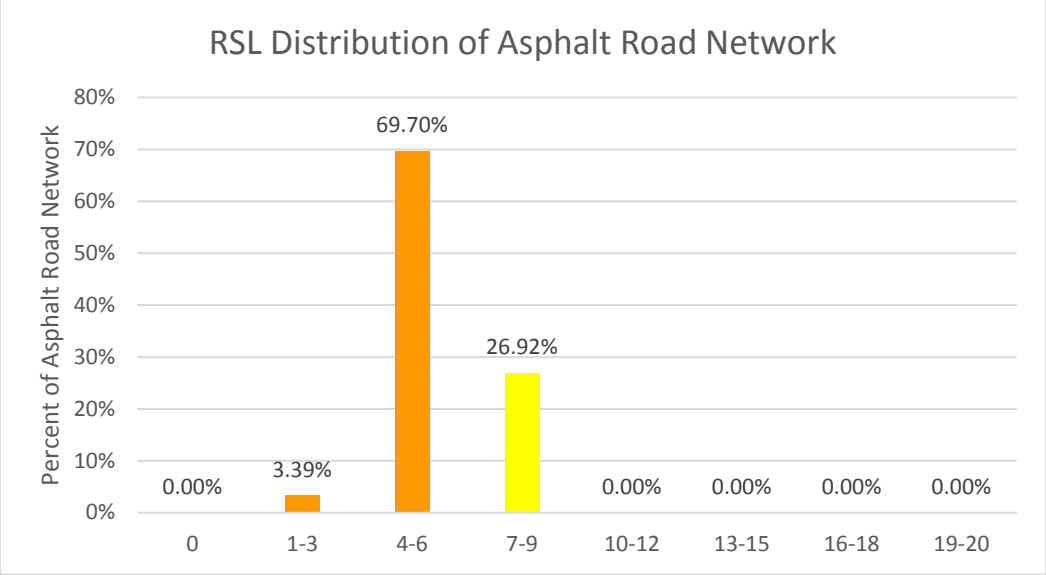


Figure 8. Estimated RSL Distribution for 2024 with No Maintenance

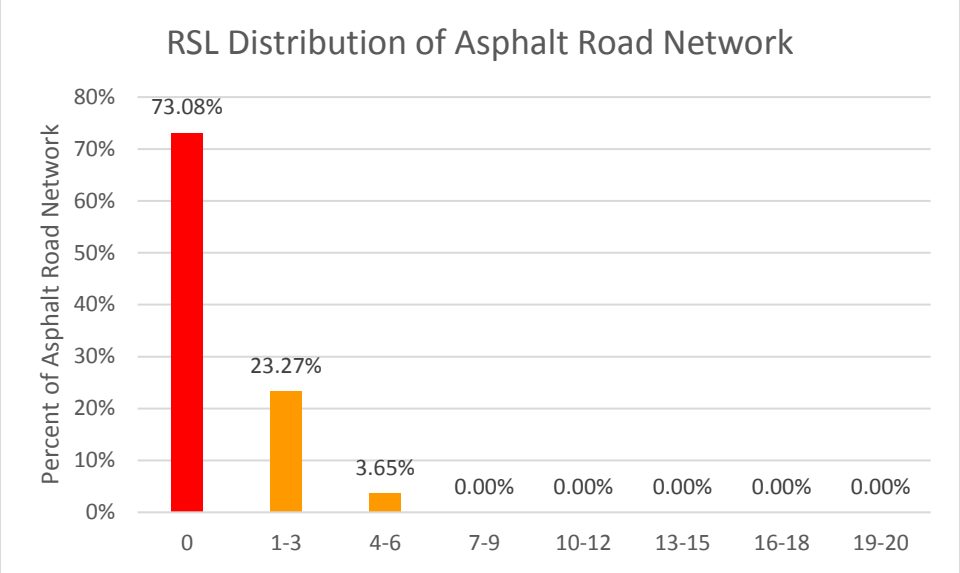


Figure 9. Estimated RSL Distribution for Year 2029 with No Maintenance

The resulting estimated average RSL for the year 2024 is 5.54 years, and for the year 2029 is 0.61 years.

Figure 11 illustrates the estimated RSL distribution for 2024 for the current funding allocation of $30,000 per year on average.

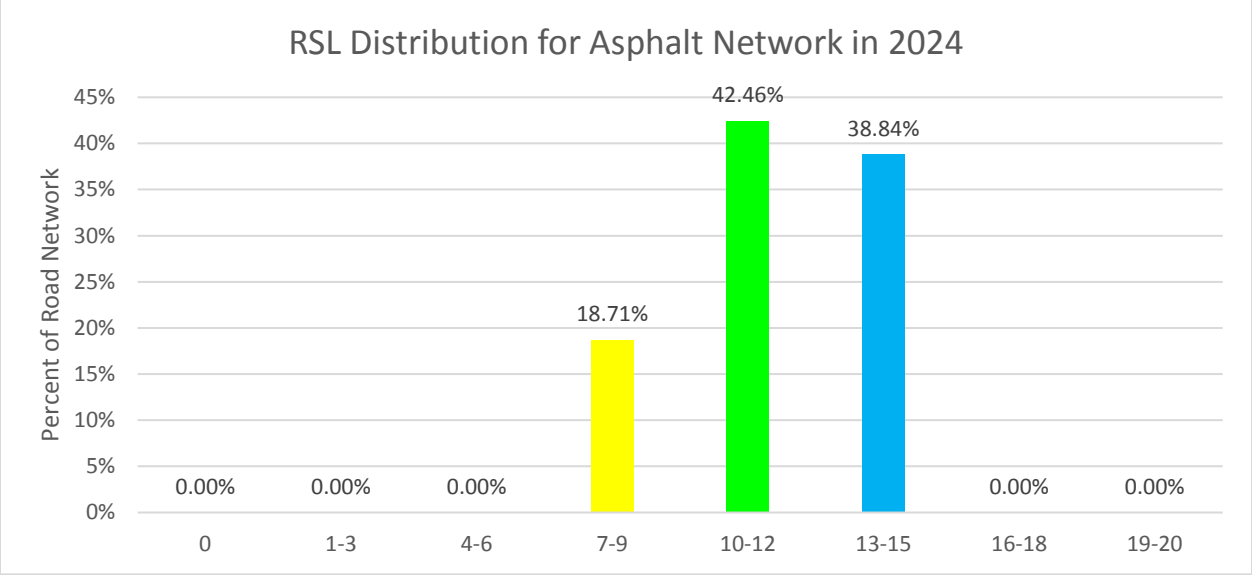


Figure 10. Estimated RSL Distribution for Year 2024 Continuing with Existing Allocation

The estimated number of streets at a terminal service level (RSL = 0) will remain at 0.0% in 2024. The resulting estimated average RSL for the year 2024 is 11.63 years which is an increase from 10.54 years in 2019. These resulting values meet the recommended standard of less than three percent (3%) of streets at the terminal service level and an average RSL of above 10 years. The overall RSL distribution of the road network has also improved.

Development of Recommended Pavement Preservation Program

Asphalt Road Network

A five-year pavement preservation program is recommended to increase the level of service of Interlaken's road network. This approach is estimated to increase the average RSL of the road network from 10.54 to 11.63 years over the five-year program. The first two years of the program focuses on rehabilitation treatments on the residential roads and the last three years put more focus on preservation treatments on the residential roads. The focus of the treatment plan is the preventative maintenance strategy of a slurry seal to help preserve the life of the road network with the most cost effective methods. This will result in lower future maintenance costs for these roads thus leaving additional funding to be used in rehabilitation and reconstruction methods on the roads needing those treatments.

A five-year plan was chosen as opposed to a ten-year plan because of the high degree of uncertainty in predicting what will occur over such a long period of time. After 3 or 4 years, a new condition survey should be performed to see how the roads have deteriorated throughout the plan to produce an updated five-year treatment plan.

The first year of the program, 2020, focuses on rehabilitation of highly trafficked residential roads. The main treatments suggested for this part of the program are slurry sealing and rotomilling with a 2 inch overlay. The estimated cost of road maintenance work for 2020 is $31,897. The recommended funding distribution for the three pavement preservation strategies is given in Table 8.

Table 7. Paved Road Funding Distribution for 2020

Treatment Category	Funding
Routine/Preventative	$ 3,744.80
Rehabilitation	$ 28,152.46
Reconstruction	$ -
TOTAL	$ 31,897.26

The second year of the program, 2021, also focuses on rehabilitation of highly trafficked residential roads. The main treatment suggested for this part of the program is rotomilling with a 2 inch overlay. The estimated cost of road maintenance work for 2021 is $31,038. The recommended funding distribution for the three pavement preservation strategies is given in Table 9.

Table 8. Paved Road Funding Distribution for 2021

Treatment Category	Funding
Routine/Preventative	$ -
Rehabilitation	$ 31,037.58
Reconstruction	$ -
TOTAL	$ 31,037.58

The third year of the program, 2022, focuses on preventative treatments of residential roads. The main treatments suggested for this part of the program are slurry seal and rotomilling with a 2 inch overlay. The estimated cost of road maintenance work for 2022 is $26,606. The recommended funding distribution for the three pavement preservation strategies is given in Table 10.

Table 9. Paved Road Funding Distribution for 2022

Treatment Category	Funding
Routine/Preventative	$ 18,801.18
Rehabilitation	$ 7,805.28
Reconstruction	$ -
TOTAL	$ 26,606.46

The fourth year of the program, 2023, focuses on preventative treatments of residential roads. The main treatment suggested for this part of the program is slurry sealing. The estimated cost of road maintenance work for 2023 is $28,649. The recommended funding distribution for the three pavement preservation strategies is given in Table 11.

Table 10. Paved Road Funding Distribution for 2023

Treatment Category	Funding
Routine/Preventative	$ 28,649.06
Rehabilitation	$ -
Reconstruction	$ -
TOTAL	$ 28,649.06

The fifth and final year of the program, 2024, also focuses on preventative treatments of residential roads. The main treatment suggested for this part of the program is slurry sealing. The estimated cost of road maintenance work for 2024 is $25,997. The recommended funding distribution for the three pavement preservation strategies is given in Table 12.

Table 11. Paved Road Funding Distribution for 2024

Treatment Category	Funding
Routine/Preventative	$ 25,996.83
Rehabilitation	$ -
Reconstruction	$ -
TOTAL	$ 25,996.83

The list of streets within the road network that are recommended to be treated each year of the five-year maintenance plan can be found in Appendix G. The resulting RSL values for the road network in 2024 after the treatment plan has been completed can be found in Figure 13.

Implementation of Pavement Management System

A fully implemented pavement management system can be a useful tool to a city, town, or county in cost effectively maintaining their street or road networks at a high service level.

A majority of the work necessary to implement a pavement management system has been done by the Utah LTAP Center. As described in this report, a full inventory and condition survey of Interlaken's street network has been made. This provided the basis for the analysis of the street network's current conditions. In addition, a pavement preservation program and recommendations have been made that will enable Interlaken to maintain and enhance the service life of its street network.

The following steps are suggested to facilitate the implementation of the pavement management system and assure its beneficial use:

1. Conduct briefings with appropriate personnel to explain the details and procedures of the pavement management system.
2. Train the appropriate personnel on how to implement the recommended pavement preservation program.
3. Develop a pavement structure history database including dates of initial construction and subsequent maintenance and rehabilitation actions.
4. Develop a traffic database and incorporate traffic counts, classifications, and axle load data.
5. In cooperation with the personnel responsible for the maintenance of the street network, conduct site reviews of street segments recommended for treatment.

The Utah LTAP Center is available and can assist in this implementation effort. Further fieldwork and support is available on an as needed actual cost basis. This can be arranged and scheduled by contacting Nick Jones at the Utah LTAP Center.

Importance of Feedback

The pavement management system set forth in this report is systematic in nature. Therefore, special steps and efforts should be taken to assure that everyone involved has an opportunity and a means to provide both input and feedback in the pavement management process. As shown in Figure 1 of the introduction to this report, feedback among all elements of the pavement management process is essential for the system to be dynamic and useful to the town. Effective feedback has been accomplished by several agencies by establishing a pavement management team or group. This team is comprised of representatives from each operating element involved in the process within the organization. Typically, this team is led by someone from the Public Works Department or Town Government who assigns specific duties to each team member commensurate with their role in the pavement management process.

The pavement preservation program requires accurate and timely feedback on all decisions and actions taken with respect to preservation (routine maintenance, preventative maintenance, rehabilitation maintenance, and reconstruction) of each street segment. This feedback should include such information as type of work performed, unit costs of work items, amount and quality of work performed, date of completed work, additional pavement structure added, and any other design related information. In addition, periodic condition surveys should be made to keep track of the condition of each street and the network as a whole. These periodic condition surveys should be conducted every three to four years.

Summary of Findings and Recommendations

Findings

Currently the streets network classifications in Interlaken is classified 100% as residential.

Analyses of the distress information of the paved street network showed that there were four distress types prevalent in the asphalt paved streets network. Of these distress types, fatigue cracking occurred most frequently in the asphalt streets network. The percent areas of the asphalt street network affected by these distress types were previously shown in Figure 6.

Currently, the average remaining service life (RSL) for Interlaken's entire asphalt paved street network is estimated to be 10.54 years. The current percent of street network surface area with no service life left (terminal serviceability or RSL = 0) is 0.0%.

Recommendations

Using the pavement preservation program presented in this report, the estimated average RSL of Interlaken's streets network can be increased to approximately 11.63 years by the year 2024. The percent of street network surface area at the terminal serviceability level will be 0.00%. In addition, the RSL distribution of the street network in terms of RSL distribution categories is improved. With the improved RSL distribution, the most cost-effective strategies and treatments can be used to maintain the street network. Interlaken's street network is currently in a "good" condition.

A five-year maintenance plan is recommended for preserving the asphalt street networks at a high level of service. Costs of expanding the network are not included in the given recommended budget. Future funding needs will likely increase due to inflation, increased pavement surface areas, increased traffic volumes, and increased material costs. All Road Funds should be allocated to pavement preservation. Additional funds required for personnel, capital improvements, and capacity improvements should come from other funding sources such as impact fees and mill levies. The details of this recommended pavement preservation program are given in Appendix G.

It has been a pleasure working with Interlaken Town to provide the information included in this report. Interlaken's Town Government has been extremely supportive of the work that has been done in preparing the pavement preservation program. The pavement management program can be used to maintain and improve the streets network for several years to come.

Table 12. Summary of Findings and Recommendations

2019 Average RSL	10.54
2019 Terminal Serviceability	0.00%
2024 Estimated Average RSL	11.63
2024 Estimated Terminal Serviceability	0.00%
2019-2024 Average Recommended Annual Funding	$30,000

Appendix A

Inventory of Street Network

Appendix A - Asphalt

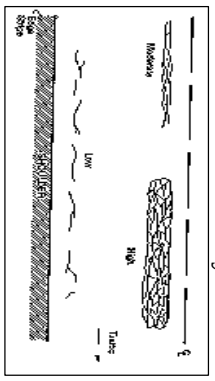
Functional Class: Residential

ID	Road Name	From	To	Width	Length	RSL	Area (Sq. Yards)	Area %
7	BERN WAY	BERN WAY	BERN WAY	12	601	12	801.33	2.65%
13	BERN WAY	BERN WAY	BERN WAY	12	451	12	601.33	1.99%
24	BERN WAY	BERN WAY	DEAD END	12	316	14	421.33	1.40%
42	BERN WAY	JUNG FRAU HILL RD	BERN WAY	12	656	10	874.67	2.90%
43	BERN WAY	BERN WAY	BERN WAY	12	499	10	665.33	2.20%
15	BERN WAY ACCESS	BERN WAY	INTERLAKEN DR	12	468	10	624.00	2.07%
12	BIG MATTERHORN CIR	BIG MATTERHORN WAY	DEAD END	12	183	10	244.00	0.81%
16	BIG MATTERHORN WAY	BIG MATTERHORN WAY	BIG MATTERHORN CIR	12	296	10	394.67	1.31%
19	BIG MATTERHORN WAY	BIG MATTERHORN CIR	BIG MATTERHORN WAY	12	446	12	594.67	1.97%
29	BIG MATTERHORN WAY	BIG MATTERHORN WAY	DEAD END	12	212	12	282.67	0.94%
30	BIG MATTERHORN WAY	ST MORTIZ ST	BIG MATTERHORN WAY	12	417	12	556.00	1.84%
22	EDELWEISS LN	EDELWEISS LN	INTERLAKEN DR	12	472	10	629.33	2.09%
26	EDELWEISS LN	DEAD END	EDELWEISS LN	12	458	10	610.67	2.02%
6	EIGER POINT RD	EIGER POINT RD	DEAD END	12	411	10	548.00	1.82%
37	EIGER POINT RD	EIGER POINT RD	JUNG FRAU HILL RD	12	385	10	513.33	1.70%
4	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	12	674	12	898.67	2.98%
5	INTERLAKEN DR	ST MORITZ RD	INTERLAKEN DR	14	974	10	1515.11	5.02%
9	INTERLAKEN DR	LUZERN RD	ST MORITZ RD	14	403	10	626.89	2.08%
17	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	14	867	10	1348.67	4.47%
27	INTERLAKEN DR	INTERLAKEN DR	EDELWEISS LN	14	657	8	1022.00	3.39%
28	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	14	592	10	920.89	3.05%
39	INTERLAKEN DR	INTERLAKEN DR	DEAD END	14	444	12	690.67	2.29%
40	INTERLAKEN DR	INTERLAKEN DR	LUZERN RD	14	1033	10	1606.89	5.32%
41	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	14	613	10	953.56	3.16%
3	JUNG FRAU HILL RD	BERN WAY	JUNG FRAU HILL RD	14	906	10	1409.33	4.67%
11	JUNG FRAU HILL RD	EIGER POINT RD	DEAD END	12	479	12	638.67	2.12%
21	JUNG FRAU HILL RD	JUNG FRAU HILL RD	EIGER POINT RD	14	796	10	1238.22	4.10%
35	JUNG FRAU HILL RD	JUNG FRAU HILL RD	ST MORITZ RD	14	372	10	578.67	1.92%
36	JUNG FRAU HILL RD	JUNG FRAU HILL RD	JUNG FRAU HILL RD	14	574	12	892.89	2.96%
38	JUNG FRAU HILL RD	JUNG FRAU HILL RD	BERN WAY	14	461	10	717.11	2.38%
2	LUZERN RD	LUZERN RD	LUZERN RD	12	921	10	1228.00	4.07%
14	LUZERN RD	LUZERN RD	LUZERN RD	12	558	10	744.00	2.46%
32	LUZERN RD	INTERLAKEN DR	LUZERN RD	14	513	10	798.00	2.64%
33	LUZERN RD	LUZERN RD	DEAD END	12	404	10	538.67	1.78%
34	LUZERN RD	LUZERN RD	LUZERN RD	12	510	14	680.00	2.25%
20	ST MORITZ RD	JUNG FRAU HILL DR	INTERLAKEN DR	16	485	10	862.22	2.86%
8	ST MORTIZ ST	ST MORTIZ ST	DEAD END	12	585	12	780.00	2.58%
18	ST MORTIZ ST	ST MORTIZ ST	BIG MATTERHORN WAY	12	635	10	846.67	2.81%
31	ST MORTIZ ST	JUNG FRAU HILL RD	ST MORITZ RD	12	215	12	286.67	0.95%
					Totals	10.72	30183.78	100.00%

Appendix B

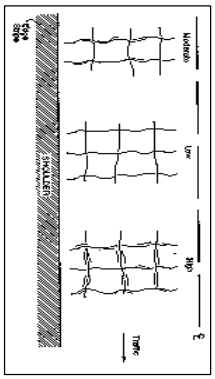
Condition Survey Evaluation Sheet

FATIGUE CRACKING



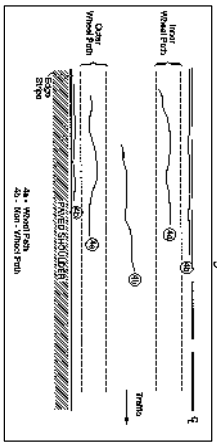
Severity \ Extent	Low	Medium	High
0 None	1 Crack WP or 1' off C&G Length	2 Crack WP or 1'-2' off C&G Length	>30% of Surface Area or Length
Low Cracks < 1/4"	1	2	3
Mediu m Cracks 1/4"to 3/4"	4	5	6
High Cracks > 3/4"	7	8	9

BLOCK CRACKING



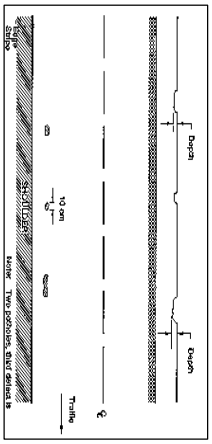
Severity \ Extent	Low	Medium	High
0 None	> 15'x15' Squares	15'-10'x Squares	< 10'x10' Squares
Low Cracks < 1/4"	1	2	3
Mediu m Cracks 1/4"to 3/4"	4	5	6
High Cracks > 3/4"	7	8	9

LONGITUDINAL CRACKING



Severity \ Extent	Low	Medium	High
0 None	1 Crack Full Length	2 Cracks Full Length	> 2 Cracks Full Length
Low Cracks < 1/4"	1	2	3
Mediu m Cracks 1/4"to 3/4"	4	5	6
High Cracks > 3/4"	7	8	9

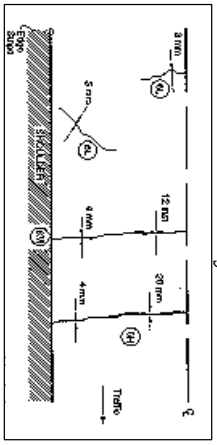
UTILITY CUTS



Severity \ Extent	Low	Medium	High
0 None	0-10% of Length	10-30% of Length	>30% of Length
Low Cracks < 1/4"	1	2	3
Mediu m Cracks 1/4"to 3/4"	4	5	6
High Cracks > 3/4"	7	8	9

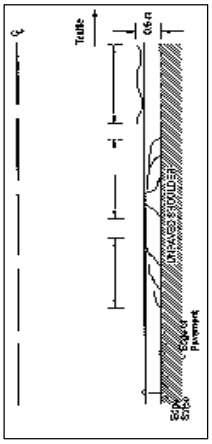
Note: to rate potholes use the same form with the following changes to the severity: **Low** is <1" deep, **Med** is 1"-2" deep and **High** is >2"

TRANSVERSE CRACKING



Severity \ Extent	Low	Medium	High
0 None	> 100' between Cracks	100'-20' between Cracks	< 20' between Cracks
Low Cracks < 1/4"	1	2	3
Mediu m Cracks 1/4"to 3/4"	4	5	6
High Cracks > 3/4"	7	8	9

EDGE CRACKING



Severity \ Extent	Low	Medium	High
0 None	0-10% of Length	10-30% of Length	> 30% of Length
Low 0-6" from Curb	1	2	3
Mediu m 6-18" from Curb	4	5	6
High 18" from Curb	7	8	9

Rutting

Excellent	Low	Med	High
0	<1/2"	1/2"-3/4"	>3/4"

Drainage

RATINGS	DRAINAGE RATING CRITERIA
Excellent	**Newly constructed, cross-slope > 2%, drainage provisions provided**
Good	**Cross-slope > 2%, drainage provisions provided**
Fair	**Cross-slope < 2%, no drainage provisions provided**
Poor	**Flat or concave cross-slope, ponding surface water evident, no drainage provisions provided**

Appendix C

Condition Survey of Street Network

Appendix C - Asphalt

ID	Road Name	From Address	To Address	Fatigue	Long	Trans	Edge	Patch	Pot	Block	RSL
7	BERN WAY	BERN WAY	BERN WAY	0	4	1	1	0	0	0	12
13	BERN WAY	BERN WAY	BERN WAY	0	0	1	1	0	0	0	12
24	BERN WAY	BERN WAY	DEAD END	0	1	1	0	1	0	0	14
42	BERN WAY	JUNG FRAU HILL RD	BERN WAY	1	0	1	4	0	0	0	10
43	BERN WAY	BERN WAY	BERN WAY	0	1	7	1	0	0	0	10
15	BERN WAY ACCESS	BERN WAY	INTERLAKEN DR	1	1	0	1	0	0	0	10
12	BIG MATTERHORN CIR	BIG MATTERHORN WAY	DEAD END	0	0	7	0	0	0	0	10
16	BIG MATTERHORN WAY	BIG MATTERHORN WAY	BIG MATTERHORN CIR	1	0	1	1	0	0	0	10
19	BIG MATTERHORN WAY	BIG MATTERHORN CIR	BIG MATTERHORN WAY	0	0	1	1	0	0	0	12
29	BIG MATTERHORN WAY	BIG MATTERHORN WAY	DEAD END	0	0	1	1	0	0	0	12
30	BIG MATTERHORN WAY	ST MORTIZ ST	BIG MATTERHORN WAY	0	0	1	1	0	0	0	12
22	EDELWEISS LN	EDELWEISS LN	INTERLAKEN DR	0	0	7	0	0	0	0	10
26	EDELWEISS LN	DEAD END	EDELWEISS LN	0	0	7	0	0	0	0	10
6	EIGER POINT RD	EIGER POINT RD	DEAD END	1	0	1	1	0	0	0	10
37	EIGER POINT RD	EIGER POINT RD	JUNG FRAU HILL RD	1	0	1	0	0	0	0	10
4	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	0	0	1	1	0	0	0	12
5	INTERLAKEN DR	ST MORITZ RD	INTERLAKEN DR	1	1	1	1	1	1	0	10
9	INTERLAKEN DR	LUZERN RD	ST MORITZ RD	1	1	1	0	0	1	0	10
17	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	1	1	1	0	0	0	0	10
27	INTERLAKEN DR	INTERLAKEN DR	EDELWEISS LN	2	2	2	1	1	0	0	8
28	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	1	1	1	0	0	0	0	10
39	INTERLAKEN DR	INTERLAKEN DR	DEAD END	0	1	4	0	0	0	0	12
40	INTERLAKEN DR	INTERLAKEN DR	LUZERN RD	1	1	1	1	0	0	0	10
41	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	1	0	1	1	1	0	0	10
3	JUNG FRAU HILL RD	BERN WAY	JUNG FRAU HILL RD	1	1	1	1	1	1	0	10
11	JUNG FRAU HILL RD	EIGER POINT RD	DEAD END	0	1	4	1	0	0	0	12
21	JUNG FRAU HILL RD	JUNG FRAU HILL RD	EIGER POINT RD	1	0	1	1	0	0	0	10
35	JUNG FRAU HILL RD	JUNG FRAU HILL RD	ST MORITZ RD	1	1	1	1	0	0	0	10
36	JUNG FRAU HILL RD	JUNG FRAU HILL RD	JUNG FRAU HILL RD	0	0	1	1	1	0	0	12
38	JUNG FRAU HILL RD	JUNG FRAU HILL RD	BERN WAY	1	0	4	1	0	0	0	10
2	LUZERN RD	LUZERN RD	LUZERN RD	1	0	7	2	0	0	0	10
14	LUZERN RD	LUZERN RD	LUZERN RD	1	1	0	0	0	0	0	10
32	LUZERN RD	INTERLAKEN DR	LUZERN RD	1	0	4	1	1	0	0	10
33	LUZERN RD	LUZERN RD	DEAD END	1	1	0	1	0	0	0	10
34	LUZERN RD	LUZERN RD	LUZERN RD	0	1	1	0	1	0	0	14
20	ST MORITZ RD	JUNG FRAU HILL DR	INTERLAKEN DR	1	1	1	0	1	0	0	10
8	ST MORTIZ ST	ST MORTIZ ST	DEAD END	0	1	4	0	1	0	0	12
18	ST MORTIZ ST	ST MORTIZ ST	BIG MATTERHORN WAY	1	0	4	1	0	0	0	10
31	ST MORTIZ ST	JUNG FRAU HILL RD	ST MORITZ RD	0	1	1	1	0	0	0	12

Appendix D

Distress Deterioration Table and Recommended Preservation Strategies

Asphalt

Fatigue_id	Severity & Extent	RSL_Fatigue	Strategy
0	No Fatigue Cracking	20	Routine
1	Low,Low	10	Routine
2	Low, Medium	8	Preventative
3	Low, High	6	Rehabilitation
4	Medium, Low	8	Preventative
5	Medium, Medium	6	Preventative
6	Medium, High	4	Rehabilitation
7	High, Low	6	Preventative
8	High, Medium	2	Rehabilitation
9	High, High	0	Reconstruct

Transverse_id	Severity & Extent	RSL_Transverse	Strategy
0	No Cracking	20	Routine
1	Low,Low	14	Routine
2	Low, Medium	12	Routine
3	Low, High	10	Preventative
4	Medium, Low	12	Preventative
5	Medium, Medium	10	Preventative
6	Medium, High	8	Preventative
7	High, Low	10	Preventative
8	High, Medium	6	Rehabilitation
9	High, High	2	Reconstruct

Longitudinal_id	Severity & Extent	RSL_Longitudinal	Strategy
0	No Cracking	20	Routine
1	Low,Low	14	Routine
2	Low, Medium	12	Preventative
3	Low, High	10	Preventative
4	Medium, Low	12	Preventative
5	Medium, Medium	10	Preventative
6	Medium, High	8	Preventative
7	High, Low	10	Preventative
8	High, Medium	8	Preventative
9	High, High	6	Rehabilitation

Patch_id	Severity & Extent	RSL_Patch	Strategy
0	No Cracking	20	Routine
1	Low,Low	14	Routine
2	Low, Medium	12	Preventative
3	Low, High	10	Preventative
4	Medium, Low	12	Preventative
5	Medium, Medium	10	Preventative
6	Medium, High	8	Preventative
7	High, Low	10	Preventative
8	High, Medium	6	Preventative
9	High, High	2	Rehabilitation

Asphalt

Edge_id	Severity & Extent	RSL_Edge	Strategy
0	No Cracking	20	Routine
1	Low,Low	12	No Maintenance
2	Low, Medium	10	Preventative
3	Low, High	8	Preventative
4	Medium, Low	10	Preventative
5	Medium, Medium	8	Preventative
6	Medium, High	6	Rehabilitation
7	High, Low	8	Preventative
8	High, Medium	6	Rehabilitation
9	High, High	4	Rehabilitation

Block_id	Severity & Extent	RSL_Block	Strategy
0	No Cracking	20	Routine
1	Low,Low	12	Routine
2	Low, Medium	10	Preventative
3	Low, High	8	Preventative
4	Medium, Low	10	Preventative
5	Medium, Medium	8	Preventative
6	Medium, High	6	Rehabilitation
7	High, Low	8	Preventative
8	High, Medium	6	Rehabilitation
9	High, High	2	Reconstruct

Appendix E

Recommended Preservation Strategies for Each Street Segment

Treatment Recommendations - Asphalt

ID	Road Name	From Address	To Address	Functional Class	Recommended Treatment	Area
7	BERN WAY	BERN WAY	BERN WAY	Residential	Slurry Seal	801.33
13	BERN WAY	BERN WAY	BERN WAY	Residential	Slurry Seal	601.33
24	BERN WAY	BERN WAY	DEAD END	Residential	Slurry Seal	421.33
42	BERN WAY	JUNG FRAU HILL RD	BERN WAY	Residential	Slurry Seal	874.67
43	BERN WAY	BERN WAY	BERN WAY	Residential	Slurry Seal	665.33
15	BERN WAY ACCESS	BERN WAY	INTERLAKEN DR	Residential	Slurry Seal	624.00
12	BIG MATTERHORN CIR	BIG MATTERHORN WAY	DEAD END	Residential	Slurry Seal	244.00
16	BIG MATTERHORN WAY	BIG MATTERHORN WAY	BIG MATTERHORN CIR	Residential	Slurry Seal	394.67
19	BIG MATTERHORN WAY	BIG MATTERHORN CIR	BIG MATTERHORN WAY	Residential	Slurry Seal	594.67
29	BIG MATTERHORN WAY	BIG MATTERHORN WAY	DEAD END	Residential	Slurry Seal	282.67
30	BIG MATTERHORN WAY	ST MORTIZ ST	BIG MATTERHORN WAY	Residential	Slurry Seal	556.00
22	EDELWEISS LN	EDELWEISS LN	INTERLAKEN DR	Residential	Slurry Seal	629.33
26	EDELWEISS LN	DEAD END	EDELWEISS LN	Residential	Slurry Seal	610.67
6	EIGER POINT RD	EIGER POINT RD	DEAD END	Residential	Slurry Seal	548.00
37	EIGER POINT RD	EIGER POINT RD	JUNG FRAU HILL RD	Residential	Slurry Seal	513.33
4	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	Residential	Slurry Seal	898.67
5	INTERLAKEN DR	ST MORITZ RD	INTERLAKEN DR	Residential	Rotomill and Thin Overlay	1515.11
9	INTERLAKEN DR	LUZERN RD	ST MORITZ RD	Residential	Rotomill and Thin Overlay	626.89
17	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	Residential	Slurry Seal	1348.67
27	INTERLAKEN DR	INTERLAKEN DR	EDELWEISS LN	Residential	Rotomill and Thin Overlay	1022.00
28	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	Residential	Rotomill and Thin Overlay	920.89
39	INTERLAKEN DR	INTERLAKEN DR	DEAD END	Residential	Slurry Seal	690.67
40	INTERLAKEN DR	INTERLAKEN DR	LUZERN RD	Residential	Slurry Seal	1606.89
41	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	Residential	Slurry Seal	953.56
3	JUNG FRAU HILL RD	BERN WAY	JUNG FRAU HILL RD	Residential	Slurry Seal	1409.33
11	JUNG FRAU HILL RD	EIGER POINT RD	DEAD END	Residential	Slurry Seal	638.67
21	JUNG FRAU HILL RD	JUNG FRAU HILL RD	EIGER POINT RD	Residential	Slurry Seal	1238.22
35	JUNG FRAU HILL RD	JUNG FRAU HILL RD	ST MORITZ RD	Residential	Slurry Seal	578.67
36	JUNG FRAU HILL RD	JUNG FRAU HILL RD	JUNG FRAU HILL RD	Residential	Slurry Seal	892.89
38	JUNG FRAU HILL RD	JUNG FRAU HILL RD	BERN WAY	Residential	Slurry Seal	717.11
2	LUZERN RD	LUZERN RD	LUZERN RD	Residential	Slurry Seal	1228.00
14	LUZERN RD	LUZERN RD	LUZERN RD	Residential	Slurry Seal	744.00
32	LUZERN RD	INTERLAKEN DR	LUZERN RD	Residential	Slurry Seal	798.00
33	LUZERN RD	LUZERN RD	DEAD END	Residential	Rotomill and Thin Overlay	538.67
34	LUZERN RD	LUZERN RD	LUZERN RD	Residential	Slurry Seal	680.00
20	ST MORITZ RD	JUNG FRAU HILL DR	INTERLAKEN DR	Residential	Slurry Seal	862.22
8	ST MORTIZ ST	ST MORTIZ ST	DEAD END	Residential	Slurry Seal	780.00
18	ST MORTIZ ST	ST MORTIZ ST	BIG MATTERHORN WAY	Residential	Slurry Seal	846.67
31	ST MORTIZ ST	JUNG FRAU HILL RD	ST MORITZ RD	Residential	Slurry Seal	286.67

Appendix F

Preservation Strategies, Treatments, and Associated Costs

Utah LTAP Center August 2019

Maintenance Performance Table

Treatment ID	Treatment Type	Maint. Category	Cost	0	1-3	4-6	7-9'	10-12	13-15	16-18	19-21
1	Crack Seal	Routine	**$0.52**	0	0	0	0	1	2	3	2
2	Cold Patch	Routine	**$0.52**	0	0	0	0	0	0	0	0
3	Digout and Hot Patch	Routine	**$0.78**	0	0	0	0	0	0	0	0
4	High Perf. Cold Patch	Routine	**$1.04**	0	0	0	0	0	0	0	0
5	Fog Coat	Routine	**$0.78**	0	0	0	1	1	2	2	2
6	High Mineral Asphalt Emulsion	Preventative	$2.07	0	0	0	1	2	3	5	5
7	Sand Seal	Preventative	$1.12	0	0	0	1	2	2	2	2
8	Scrub Seal	Preventative	$1.73	0	1	3	5	5	5	5	5
9	Single Chip Seal	Preventative	$2.24	0	1	3	5	5	5	5	5
10	Slurry Seal	Preventative	$3.02	0	1	3	5	5	5	5	5
11	Microsurfacing	Preventative	$4.14	0	2	3	5	7	7	7	7
12	Plant Mix Seal	Rehabilitation	**$9.66**	0	3	4	5	7	7	7	7
13	Cold In-place Recycling (2 in with chip seal)	Rehabilitation	**$8.63**	0	3	4	5	6	7	7	7
14	Thin Hot Mix Overlay (<2 in)	Rehabilitation	**$11.64**	0	4	6	7	7	7	7	7
15	HMA (leveling) & Overlay (<2 in.)	Rehabilitation	**$12.94**	0	4	6	8	8	8	8	8
16	Hot Surface Recycling	Rehabilitation	**$8.63**	0	3	5	7	8	8	8	8
17	Rotomill & Overlay (<2 in)	Rehabilitation	**$14.49**	0	4	7	8	8	8	8	8
18	Cold In-place Recycling (2/2 in.)	Reconstruction	$17.77	15	15	15	15	15	15	15	15
19	Thick Overlay (3 in.)	Reconstruction	$17.25	12	12	12	12	12	12	12	12
20	Rotomill & Thick Overlay (3 in.)	Reconstruction	$18.98	12	12	12	12	12	12	12	12
21	Base Repair\Pavement Replacement	Reconstruction	$20.70	16	16	16	16	16	16	16	16
22	Cold Recycling & Overlay (3/3 in.)	Reconstruction	$19.23	14	14	14	14	14	14	14	14
23	Full Depth Reclamation& Overlay (3/3 in.)	Reconstruction	$22.86	20	20	20	20	20	20	20	20
24	Base/Pavement Replacement (3/3/6 in.)	Reconstruction	$32.78	20	20	20	20	20	20	20	20

***Fit the current RSL into a category along the top row and then move downward to the applied treatment to find the additional RSL that will be achieved from the selected treatment.**

(2/2 in.) Means 2" overlay with 2" recycle

Appendix G

Recommended Pavement Preservation Program and Proposed Funding Allocation

Year 1

Slurry Seal

ID	Road Name	From Address	To Address	Area	Functional Class	Main Distress	RSL
22	EDELWEISS LN	EDELWEISS LN	INTERLAKEN DR	629.33	Residential	Transverse	10
26	EDELWEISS LN	DEAD END	EDELWEISS LN	610.67	Residential	Transverse	10

Romomill and 2 Inch Overlay

27	INTERLAKEN DR	INTERLAKEN DR	EDELWEISS LN	1,022.00	Residential	Fatigue	8
28	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	920.89	Residential	Fatigue	10

Year 1 Cost Table

Minor Arterial	Major Collector	Minor Collector	Residential	Total
Slurry Seal				
			$ 3,744.80	$ 3,744.80
Rotomill and 2 Inch Overlay				
			$ 28,152.46	$ 28,152.46

Total:	$ 31,897.26

Year 2

Rotomill and 2 Inch Overlay

ID	Road Name	From Address	To Address	Area	Functional Class	Main Distress	RSL
5	INTERLAKEN DR	ST MORITZ RD	INTERLAKEN DR	1,515.11	Residential	Fatigue	10
9	INTERLAKEN DR	LUZERN RD	ST MORITZ RD	626.89	Residential	Fatigue	10

Year 2 Cost Table

Minor Arterial	Major Collector	Minor Collector	Residential	Total
Rotomill and 2 Inch Overlay				
			$ 31,037.58	$ 31,037.58

Total:	$ 31,037.58

Year 3

Slurry Seal

ID	Road Name	From Address	To Address	Area	Functional Class	Main Distress	RSL
2	LUZERN RD	LUZERN RD	LUZERN RD	1,228.00	Residential	Fatigue	10
14	LUZERN RD	LUZERN RD	LUZERN RD	744.00	Residential	Fatigue	10
32	LUZERN RD	INTERLAKEN DR	LUZERN RD	798.00	Residential	Fatigue	10
34	LUZERN RD	LUZERN RD	LUZERN RD	680.00	Residential	Patches	14
20	ST MORITZ RD	JUNG FRAU HILL DR	INTERLAKEN DR	862.22	Residential	Fatigue	10
8	ST MORTIZ ST	ST MORTIZ ST	DEAD END	780.00	Residential	Transverse	12
18	ST MORTIZ ST	ST MORTIZ ST	BIG MATTERHORN WAY	846.67	Residential	Fatigue	10
31	ST MORTIZ ST	JUNG FRAU HILL RD	ST MORITZ RD	286.67	Residential	Edge Cracks	12

Rotomill and 2 Inch Overlay

33	LUZERN RD	LUZERN RD	DEAD END	538.67	Residential	Fatigue	10

Year 3 Cost Table

Minor Arterial	Major Collector	Minor Collector	Residential	Total
Slurry Seal				
			$ 18,801.18	$ 18,801.18
Rotomill and 2 Inch Overlay				
			$ 7,805.28	$ 7,805.28

Total:	$ 26,606.46

Year 4

Slurry Seal

ID	Road Name	From Address	To Address	Area	Functional Class	Main Distress	RSL
7	BERN WAY	BERN WAY	BERN WAY	801.33	Residential	Edge Cracks	12
13	BERN WAY	BERN WAY	BERN WAY	601.33	Residential	Edge Cracks	12
24	BERN WAY	BERN WAY	DEAD END	421.33	Residential	Patches	14
42	BERN WAY	JUNG FRAU HILL RD	BERN WAY	874.67	Residential	Fatigue	10
43	BERN WAY	BERN WAY	BERN WAY	665.33	Residential	Transverse	10
15	BERN WAY ACCESS	BERN WAY	INTERLAKEN DR	624.00	Residential	Fatigue	10
4	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	898.67	Residential	Edge Cracks	12
17	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	1,348.67	Residential	Fatigue	10
39	INTERLAKEN DR	INTERLAKEN DR	DEAD END	690.67	Residential	Transverse	12
40	INTERLAKEN DR	INTERLAKEN DR	LUZERN RD	1,606.89	Residential	Fatigue	10
41	INTERLAKEN DR	INTERLAKEN DR	INTERLAKEN DR	953.56	Residential	Fatigue	10

Year 4 Cost Table

Minor Arterial	Major Collector	Minor Collector	Residential	Total
Slurry Seal				
			$ 28,649.06	$ 28,649.06

Total:	$ 28,649.06

Year 5

Slurry Seal

ID	Road Name	From Address	To Address	Area	Functional Class	Main Distress	RSL
12	BIG MATTERHORN CIR	BIG MATTERHORN WAY	DEAD END	244.00	Residential	Transverse	10
16	BIG MATTERHORN WAY	BIG MATTERHORN WAY	BIG MATTERHORN CIR	394.67	Residential	Fatigue	10
19	BIG MATTERHORN WAY	BIG MATTERHORN CIR	BIG MATTERHORN WAY	594.67	Residential	Edge Cracks	12
29	BIG MATTERHORN WAY	BIG MATTERHORN WAY	DEAD END	282.67	Residential	Edge Cracks	12
30	BIG MATTERHORN WAY	ST MORTIZ ST	BIG MATTERHORN WAY	556.00	Residential	Edge Cracks	12
6	EIGER POINT RD	EIGER POINT RD	DEAD END	548.00	Residential	Fatigue	10
37	EIGER POINT RD	EIGER POINT RD	JUNG FRAU HILL RD	513.33	Residential	Fatigue	10
3	JUNG FRAU HILL RD	BERN WAY	JUNG FRAU HILL RD	1,409.33	Residential	Fatigue	10
11	JUNG FRAU HILL RD	EIGER POINT RD	DEAD END	638.67	Residential	Edge Cracks	12
21	JUNG FRAU HILL RD	JUNG FRAU HILL RD	EIGER POINT RD	1,238.22	Residential	Fatigue	10
35	JUNG FRAU HILL RD	JUNG FRAU HILL RD	ST MORITZ RD	578.67	Residential	Fatigue	10
36	JUNG FRAU HILL RD	JUNG FRAU HILL RD	JUNG FRAU HILL RD	892.89	Residential	Edge Cracks	12
38	JUNG FRAU HILL RD	JUNG FRAU HILL RD	BERN WAY	717.11	Residential	Fatigue	10

Year 5 Cost Table

Minor Arterial	Major Collector	Minor Collector	Residential	Total
		Slurry Seal		
			$ 25,996.83	$ 25,996.83

Total:	$ 25,996.83