Lindon Pavement Management Plan

November 2015

Adopted by Lindon City Council
11/17/2015

J-U-B ENGINEERS, INC.

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LINDON CITY

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Executive Summary

A road network is generally the most valuable asset to a municipality. The need to maintain this asset is essential. In this report, J-U-B Engineers, the Lindon City Engineers, recommends an approach to managing pavement that will make the most of available funding, and provides the City Council with information that will help them know the effect of different funding amounts in the future.

Pavement inevitably deteriorates over time. J-U-B inventoried the condition of roadways in Lindon in 2007 and 2014, and calculated the pavement condition index (PCI) for each street. The condition has declined from having 89% of roads in good, satisfactory or fair condition in 2007, to 55% of roads being in good, satisfactory or fair condition in 2015.

The Lindon Public Works Department employs a number of different pavement treatments to preserve pavement condition, and to rehabilitate or reconstruct it when necessary. By applying the right treatment at the right place at the right time, Lindon City can make the most of the money spent to maintain roadways. This requires a disciplined approach that includes keeping the good roads good, even if it means letting some of the roads fall into disrepair. The alternative is letting all roads decline together into an eventual state of disrepair.

The data we collected in 2007 and 2014 allowed us to establish the rate at which roads deteriorate in Lindon. Using this information, the data collected, and following the “keep the good roads good” philosophy, we modeled the Lindon roads using a proprietary model, PavementPlan.

The result is recommended treatments in the next 5 years using the limited anticipated funding available ($30,000 to $50,000 per year). The plan also provides detailed information about the long-term effect of funding on the condition of the roads, as well as the effect of delaying the adequate funding of roadway maintenance. Depending on when adequate funding becomes available, in our opinion it will cost $1.5 to $3 million annually (in 2015 dollars) for 25 to 50 years to get all of the existing Lindon roads into the maintenance cycle. After all the roads are in the cycle it will cost about $1.3 million annually to maintain them.

We recommend securing additional funding as soon as possible, establishing a “keep the good roads good” policy, implementing the pavement management program, accounting for construction cost increases and growth, making sure that infrastructure is properly constructed in streets, and maintaining the pavement model and pavement inventory.

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Lindon Pavement Management Plan

Introduction

The road network is the single most valuable asset of most municipalities. Pavements can last 20 to 30 years. However, by maintaining the asphalt on a road that has been properly constructed, we can extend the life of the asphalt by many years.

Pavement consists of aggregate, asphalt binder (a by-product of refining crude oil), and additives to improve its performance. The asphalt binder naturally deteriorates over time due to environmental factors such as ultraviolet rays, oxidation, and freeze/thaw cycles. Deterioration accelerates from penetration of water into the asphalt layer, penetration of water into the soil under the pavement and roadway, traffic loading, and physical damage such as utility cuts and trenching.

There are a variety of treatments available to preserve the condition of pavement and extend its life; the condition of the asphalt and the adequacy of the base & sub-base materials under the asphalt determine which treatment is appropriate. The treatments that are suitable when a road is in good condition are much less expensive than the treatments that are required when a road has deteriorated significantly.

Determining the most cost effective way of managing pavement is not a simple task when there is inadequate funding. Since pavement deteriorates over time, which treatments are done where and when makes a very big difference in what it costs to get the same results. There are always competing interests – spend available funding doing more inexpensive treatments on a lot of roads, or more expensive treatments on a few roads, or some combination of both?

Failure to apply the right treatment at the right time inevitably results in needing more expensive treatments more frequently. Therefore, the most cost effective approach to maintaining roads is to keep them in good condition, thereby delaying the need and reducing the frequency of the more expensive treatments. Not only is this approach more cost effective, it also results in a much better overall condition of the road network from year to year.

Lindon City asked J-U-B Engineers to recommend how to put available maintenance funding to best use, and to estimate how much funding would be required long-term to maintain pavement in the city. We have used a proprietary computer model to simulate pavement treatments and condition over time.

Pavement Management Principles

Pavement Condition Index

The condition of pavement is measured using a Pavement Condition Index (PCI). ASTM International is a long-standing international standards organization that publishes a standard practice document (designation D6433) for determining the PCI of an asphalt pavement surface. The method establishes the procedure for determining the PCI by identifying the quantity and severity of various types of surface defects.

The PCI varies from 100 to 0. A new road has a PCI of 100; a failed road has a PCI of 0. The ASTM method establishes a standard PCI rating scale, as shown in Figure 1.

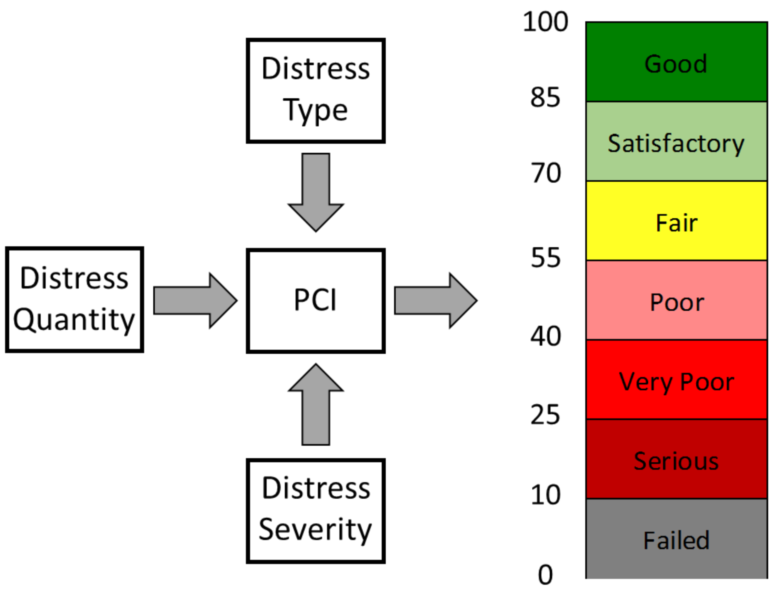


Figure 1. Pavement condition index.

Appendix A contains photographs of roads in Lindon having various PCI values with the associated grade.

Pavement Deterioration

Asphalt pavement naturally deteriorates over time, so the PCI of a new road begins to drop as time passes. The relationship between PCI and time is a pavement deterioration curve. With each year that passes, the PCI declines along the curve. Treatments performed increase the PCI, moving up the curve, as if turning back the clock and adding more life to the pavement. Some activities affect the PCI more than others. For instance, an asphalt overlay increases the PCI (adds life to the pavement) much more than does sealing cracks. However, each treatment is only appropriate for a certain range of PCI values. For example it doesn't make sense to apply a thin seal coat that prevents ultraviolet rays from damaging the asphalt to a roadway filled with "alligator" cracking.

Treatment Activities

There are many different activities that make up the full "toolbox" of pavement management, ranging from surface treatments that help preserve the asphalt pavement from surface distresses and extend the life of the pavement to full replacement of the pavement and base. The common element to nearly all pavement management activities is that they use varying types and combinations of sand, aggregate, and asphalt. For this report we have established categories for the activities preferred in Lindon.

The following categories are listed in order of least expensive to most expensive. Variations in the listed costs are the result of the differences in bid prices due to fluctuations in the bidding environment, the condition of the road, and other work that may be needed – this could be stabilizing subgrade soil, raising manhole covers, drainage improvements, curb ramp replacements, striping, etc.

Routine Maintenance

Routine maintenance includes sealing cracks and filling potholes.

It is work performed on a routine basis to maintain and preserve the condition of the asphalt, which can slow aging and restore serviceability of a roadway.

Cost: $0.05 to $0.10 per square foot

Preventative Maintenance

Preventative maintenance includes surface treatments consisting of thin coats of material such as high density mineral bond seal coats, frictional mastic surface treatments, and micro-surfacing.

These treatments often require performing routine maintenance activities prior to the surface treatment, and may include patching damaged areas of asphalt. These treatments retard future deterioration without increasing its structural capacity.

Cost: $0.25 to $0.40 per square foot

Minor Rehabilitation

Minor rehabilitation is the placement of a thin structural overlay (usually no more than 2-inches) over existing asphalt.

This activity is appropriate on asphalt with a high level of deterioration that requires increased structural capacity. An asphalt overlay increases the ability of the pavement to withstand the forces of traffic loading, thus adding to the life of the pavement. It also restores serviceability and provides a finished look to the road.

An asphalt overlay may include major patching, as well as a geotextile under the overlay.

Cost: $2.00 to $3.00 per square foot

Major Rehabilitation

Major rehabilitation may be a thicker overlay, or it may be removing a part of the existing asphalt thickness by milling, then placing an asphalt overlay on the milled surface.

This is similar to minor rehabilitation except that it includes milling, and provides the same benefits as the minor rehabilitation. After multiple overlays have been placed on a road the cross slope becomes undesirably steep, and milling off some of the old asphalt allows placing of the new overlay at a normal cross slope.

Cost: $2.50 to $4.00 per square foot

Minor Reconstruction

Minor reconstruction is full replacement of the asphalt, and replacement of isolated pockets of unstable subgrade soil and base course.

This is necessary when the asphalt has deteriorated beyond the point of providing a suitable surface for an overlay, but when the base course is deep enough and the subgrade is stable. It may be accomplished by removing and replacing the asphalt, or by pulverizing the asphalt with the base course, removing excess material, reshaping and compacting the pulverized materials to comprise the new base course layer, and placing a new asphalt layer. It is effectively equivalent to a new road.

Cost: $3.00 to $5.00 per square foot

Major Reconstruction

Major reconstruction is removal and replacement of asphalt, base course, and areas of unstable subgrade soil.

It is an extreme measure needed on roads that have deteriorated to a point where the road is irreparable. It can be necessary in order to resolve underlying causes of asphalt failure, such as inadequate base thickness or unstable subgrade soils. The cost is considerably variable, since reconstruction may involve excavating at depths where utilities are buried, may require stabilizing large areas of subgrade soil, and may include correction of drainage problems that contributed the premature failure. This results in a new road.

Cost: $4.00 to $7.00 per square foot.

Table 1 in Appendix B contains costs from actual bids and projects. These, in addition to our professional opinion and judgment, form the basis of our opinion of likely pavement management treatment costs.

Table 2 in Appendix C shows PCI ranges in which it is appropriate to conduct the various activities described above, as well as their effect on PCI, as used in our model.

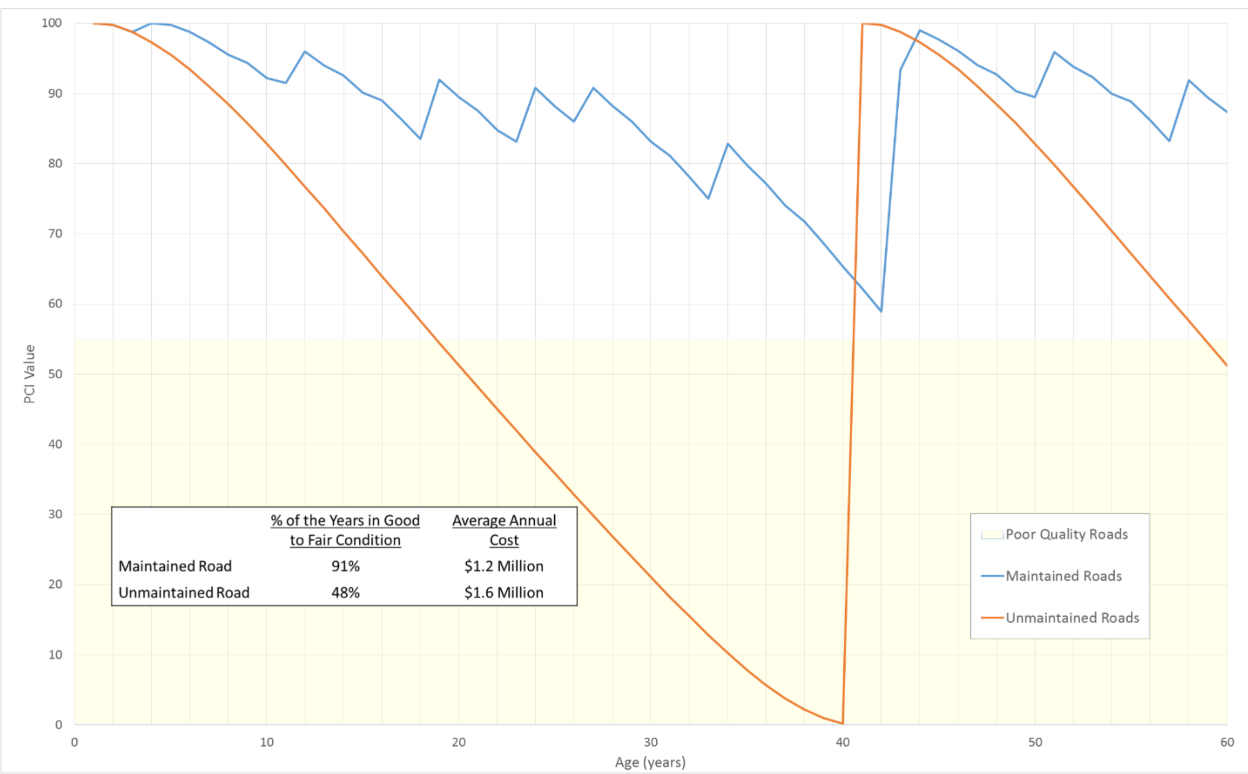
Pavement Management Philosophy

Right Treatment at the Right Place at the Right Time

The philosophy of pavement management begins with the premise that it is less expensive to keep good roads good than to repair or reconstruct roads that have deteriorated.

Pavement on city streets is typically designed for a 20 year life. That means the pavement thickness is designed based on traffic loadings anticipated in the next 20 years. It also means that using the established design method should result in a pavement that provides structural support and a comfortable riding surface for 20 years.

In Figure 1 the orange line represents the PCI of pavement that receives no treatments. The blue line represents the PCI of pavement that receives treatments according to the cycle we have modeled. Note that the maintained pavement is kept in good-fair condition (PCI > 55), while the unmaintained pavement is in good-fair condition less than one-half of the time. Also note the difference in average annual cost using the two different pavement management methods.



	% of the Years in Good to Fair Condition	Average Annual Cost
Maintained Road	91%	$1.2 Million
Unmaintained Road	48%	$1.6 Million

Figure 2. Preservation based management model results.

How to Prioritize Projects

Prioritization of pavement work is critical as historically there has not been enough funding for cities to maintain all of their roads. There are two primary approaches to prioritizing which roads get available funding:

- Worst First – This means spending available funding on the worst roads first. The money doesn't go very far, and in the meantime the roads that were in good condition decline to the point that they also require expensive treatments. Over time the condition of a larger and larger percentage of the roads gravitate toward the bottom of the PCI scale. It is politically popular, since those people most unhappy with the roads in front of their home or business get them fixed. However it is the most expensive way to manage pavement. This is generally the approach that emerges in the absence of a management plan supported by city officials.
- Best First – This gives roads that are in better condition a higher priority than those that are beyond repair. The result is that those roads in good-fair condition stay that way, and those roads that are already in poor condition get worse. This is the most economical method of managing pavement. Over long periods of time it also results in the largest percentage of roads in good-fair condition. It is also politically challenging, since it means spending money on roads that look perfectly fine to users, while allowing roads that are clearly in need go without any attention.

There are also other considerations when prioritizing where to put funding. All other things being equal, do we put money on busier roads before those that experience less traffic? Do we pick the roads eligible for less expensive treatments that will soon require more expensive treatments, rather than starting at the very best roads? Do we coordinate road maintenance work with utility work, so that we can avoid cutting into newly refurbished roads, even if it means changing the ideal timing of treatments?

Existing Conditions

The pavement condition inventory conducted in 2007 provided PCI values for the roads throughout the city. The ASTM inventory method calls for identifying sections of streets with similar pavement characteristics, then into a number of random sample units which will be enough to provide a statistically significant result. An inspector identifies the type and quantifies the severity of distresses at the sample units. The PCI of all streets within the section equals the weighted average PCI of the sample units within it.

In 2007 J-U-B Engineers performed a pavement condition inventory in Lindon consisting of 70 sections containing 285 sample sites. In late 2014 we performed inspections at the same sample sites, as well as some additional locations on streets constructed between 2007 and 2014. The 2014 PCI values are shown in Figure 3. Recognize that Figure 3 shows a snapshot of PCI values at the time they were measured.

Lindon City currently owns and maintains over 54 miles of paved roadways. In 2007 89% of Lindon's roads were in good-fair condition. In 2014 65% of Lindon's roads were still in good-fair condition. We estimate that in 2015 only 55% of Lindon's roads were still in good-fair condition. This is a result of there being many roads that have fallen from fair to poor condition.

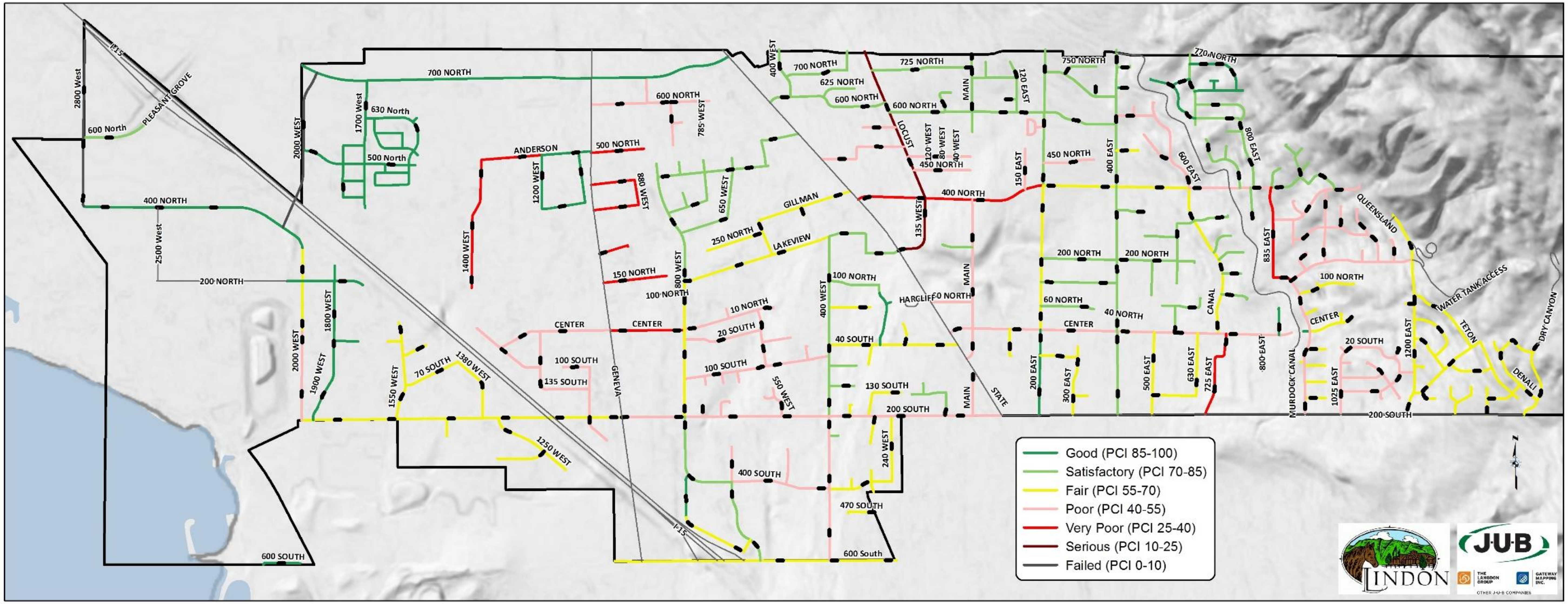


Figure 3. Inventory of roadway conditions in 2014

Analysis & Findings

Model

Traditional pavement management models use pavement distress type and PCI values; a roadway deterioration curve; protocols that establish how to prioritize different roads for funding; protocols that establish the effect of treatments on PCI; which treatments are to be used and when they are appropriate; and available funding amounts. The models identify which treatments are appropriate for each road and the right time to apply them. They may also recommend a funding amount needed to maintain a roadway network. They are a good tool for performing the many calculations necessary to recommend appropriate upcoming treatments and provide a good graphical interface. A limitation of the traditional models is that they are typically only used to make short term recommendations, since they have a hard time predicting roadway conditions long term. In the case of Lindon we needed not only short-term recommendations, but also long-term funding analysis.

We had the ability to develop a deterioration curve specific to Lindon streets, given the PCI measurements at the same locations in 2007 and 2014. We believe that this deterioration curve much more accurately predicts the rate of deterioration of roads in Lindon than a default deterioration curve developed from data on all kinds of roads built on all kinds of soils in all kinds of climates throughout the United States. The Lindon deterioration curve is the curve shown in Figure 2 representing a roadway receiving no maintenance.

J-U-B used PavementPlan, a proprietary model that uses input similar to traditional models, but offers the following advantages:

- It not only identifies recommended short-term treatments, but projects the theoretical deterioration and maintenance cycles of every roadway for 100 years. While the timing of appropriate treatments decades away is certainly not accurate to the year, it gives a long-term view of funding required to maintain the roadway network.
- It has the ability to establish protocols with unlimited flexibility to establish how to prioritize use of funding
- It keeps track of how many times each treatment has been applied and when it was used, providing the ability to customize the variable effect of treatments depending on previous treatment history.

- It illustrates the long-term effect of different funding amounts, and can model multiple protocol scenarios and funding amounts simultaneously
- It has the ability to consider roadways as assets with depreciating value and to calculate the asset value of every road segment or the system as a whole in any year based on the modeling results
- Displays results not only in terms of PCI, but in terms of the percentage of roads that are in good-fair condition. We have found this to be a measure of roadway condition that is more meaningful to city officials and the public.

Measure of Roadway Network Condition

While PCI is a great way to measure the condition of individual roadway segments, *average* PCI for the entire roadway network can give an unrepresentative picture of the condition of the network as a whole. An *average* PCI consists of some roads having a PCI that is higher than the average and some roads having a PCI that is lower than the average.

For example, if Lindon City were to make the best possible use of $1,200,000 per year for many, many years, we estimate that the resulting *average* PCI would 69. However, it doesn't really tell us how many of the roads are being maintained, and how many are receiving no maintenance.

Rather than describe the condition of the overall roadway network in terms of average PCI, instead we describe it in terms of what percentage of the roads are in good, satisfactory and fair condition – or what percentage have a PCI over 55. Using a "best first" philosophy, this also tells us how many of the roads are getting treatments, since the vast majority of them are maintaining a PCI greater than 55. In the same funding example, 91% of the roads would be in good-fair condition. Obviously that means that 9% of them are getting no attention at all. This is a much clearer picture of what the roadway network really looks like.

Protocols

We used the following protocols to prioritize which roads get treatments:

1. Higher functionally classified roads (collector streets) have priority over lower functionally classified roads (local streets).
2. Roads that are within 3 years of requiring a more expensive treatment are prioritized over others.

3. Roads not included in item 2 above are prioritized so that those more at risk of requiring a more expensive treatment are before those less at risk, with those in better condition ahead of those in worse condition.
4. Roads requiring less expensive treatment types are ahead of roads requiring more expensive treatment types.
5. All other things being equal, larger sized projects are funded before smaller sized projects.

The criteria are applied in order, generating a discrete prioritization each year. Projects are funded in order until the available funding runs out.

Effect of Annual Funding Level

We understand that the funding for roadway maintenance for the next 5 years is likely to be under $50,000/year. By using that funding level for 5 years and analyzing multiple budget scenarios thereafter, we see the effect of different funding levels on the percentage of roads in a good-fair condition. As indicated by Figure 4, it would require around $1.3 million to maintain all of the Lindon streets in good-fair condition. Lower levels of funding would result in being able to fund a lesser number of roads in good-fair condition.

Figure 4 shows what percent of roads would still have a PCI over 55 (meaning they would be in the good-fair condition categories) over the next 100 years with different levels of funding.

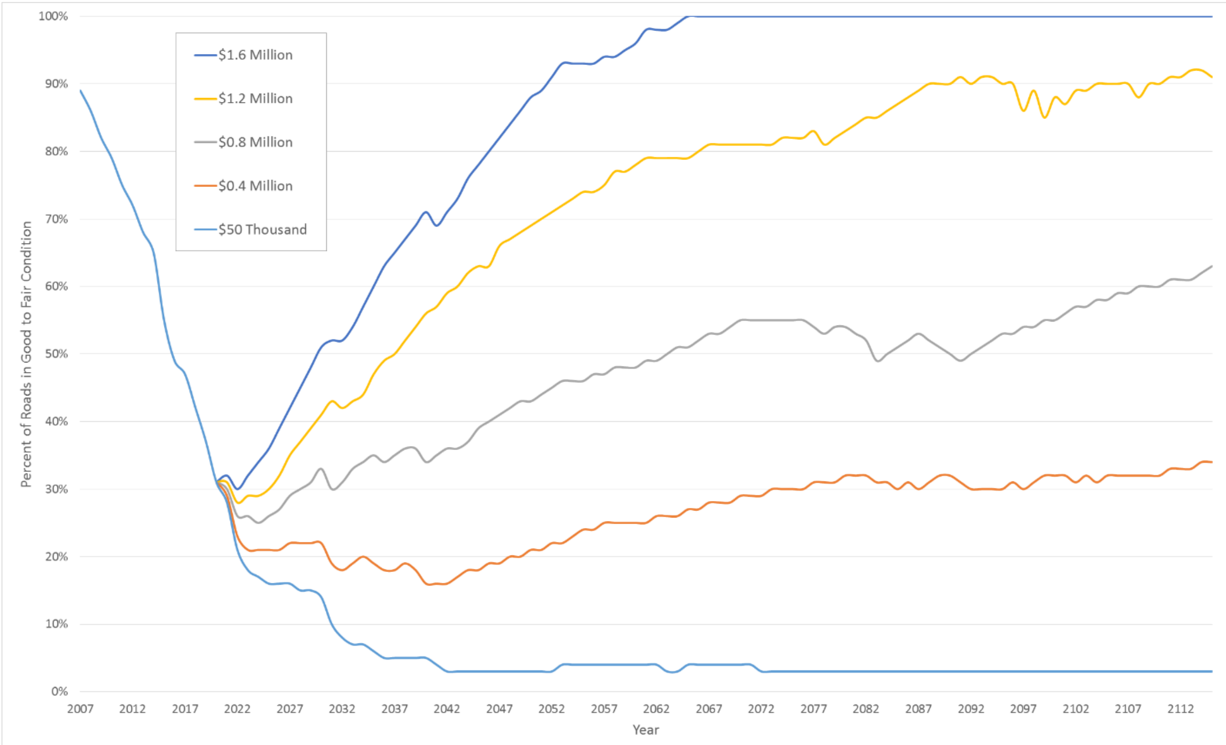


Figure 4. Effect of Annual Funding Level

Effect of Delayed Funding Increases

Delaying increases in pavement maintenance funding results in the condition of roadways continuing their sharp decline. The sooner additional funding is available, the less it will cost in the long run to get the roadway network back up to the condition it was in just a few years ago. It is the same principal that applies to someone having a large high-interest credit card debt and only making the minimum payments – the interest overwhelms the payments and the balance grows quickly. The sooner the debtor can start making substantial payments, the less time and money it will take for him to get out from under the debt.

Figure 5 illustrates this effect. It shows what the annual road maintenance cost would need to be for Lindon to be able to maintain all of its roads in 25 years (grey bars) or 50 years (blue bars). For instance, if Lindon stays at current funding levels until 2025, it would take about $2.3 million every year to get to the point of being able to properly maintain all of Lindon's roads within 25 years (by 2050); or it would take about $1.6 million every year to get to the point of being able to property maintain all of Lindon's roads within 50 years (by 2075).

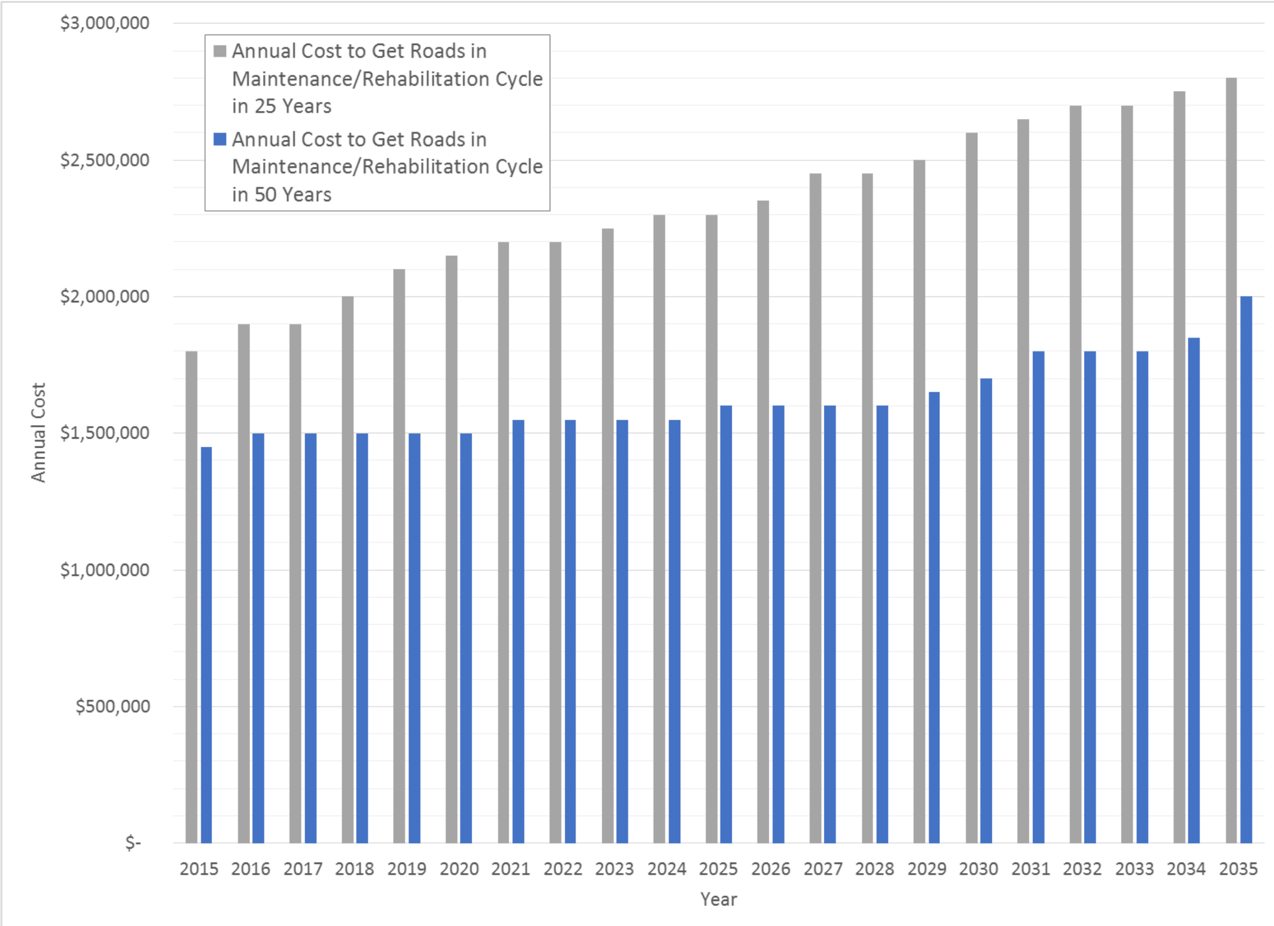


Figure 5. Effect of Delayed Funding Increases

Premature Deterioration

Although this study is based on observed data, it is still somewhat idealistic. In reality, true roadway performance will differ from that in the analysis for the following reasons:

1. We use the same deterioration curve for all roads. In practice some roads deteriorate faster than others.
2. We did not evaluate the adequacy of soil conditions under existing roads, since that was beyond the scope of this analysis. This analysis depends upon road design having accounted for existing underlying soil conditions. However, some older roads were probably never designed, but just evolved over the years as roads were graveled, then chip sealed, then paved. Also, soil conditions are variable and some roads, or sections of roads, may be built on soil that does not provide adequate stability.

3. Sometimes roads do not get built as they were designed, either because of inadequate compaction of roadbase or asphalt, placement of thinner layers of roadbase or asphalt, low quality asphalt, failure to compact well around manholes, placement of asphalt in poor weather, inadequate seam adhesion and compaction, etc.
4. Water accelerates roadway deterioration when it gets under the road due to cracks in the asphalt. The analysis assumes that there are no other sources of water that will compromise the roadway. In reality water damage tends to affect some roads in other ways, due to leaking water lines, low points in roadways, inadequate drainage along roadway shoulders, etc.
5. Nearly all roadways have buried utilities under the asphalt. When the backfill material in utility trenches is inadequately compacted, the utility trench settles, causing the asphalt surface to settle and crack. While existing settling would have been observed and accounted for in the PCI inventories, settling is something that can occur over time, so new areas of settling can show up at any time. Such settling results in premature failure of roadways.
6. Utility trenches in existing roadways lead to premature failure of roadways. This occurs for several reasons: cuts in the asphalt result, which provide a path for water to get under the asphalt; soil on each side of the trench is susceptible to settling due to the loss of lateral support when the soil in the trench is excavated; the potential exists for pavement failures related to inadequate compaction of trench backfill, roadbase and asphalt.

As a result of the many things that can go wrong with pavement, there will inevitably be some accelerated deterioration and premature failures of roadways that will require work not anticipated in our model.

On the positive side, advances in pavement formulations and pavement management technology are accelerating, resulting in better asphalt and ways of maintaining it.

Recommendations

We make the following recommendations:

Secure Additional Funding

As soon as possible, increase funding for preservation and rehabilitation treatments to the greatest extent practical. Even if there were $1,900,000 (in 2015 dollars) available per year, every year, beginning in 2016, it would still take 25 years to get all of the roads into a maintenance cycle. The number of good roads the city can maintain is proportional to commensurate funding.

Establish a “Keep the Good Roads Good” Policy

Establish and follow a policy of “keep the good roads good”. This will help Lindon residents and business owners get the most benefit from money spent.

Implement Pavement Management Program

Implement a pavement management program beginning with the treatments shown on the roads in Figure 11 through Figure 15 in Appendix D as a guide. These reflect the results of the “keep the good roads good” approach at funding levels of $30,000 to $50,000 per year. Lindon City Public Works Staff will need to exercise judgment as to the grouping and timing of the maintenance activities, and should coordinate utility replacement work with pavement maintenance activities.

Account for Construction Cost Increases

Since this evaluation is in 2015 dollars, future year amounts indicated in this report will need to be increased to account for construction cost increases.

Account for Growth

This evaluation is of existing Lindon roads. Future maintenance funding will need to increase as a result of additional roads being constructed in the city.

Careful Review of Utility Compaction in Streets and Paving

Take care in requiring and reviewing pavement designs for new roads, and take great care in performing thorough inspections of utility and roadway construction, particularly related to compaction testing. Always require that results from all compaction testing performed be disclosed to the city.

Maintain the Pavement Model

Perform yearly updates to the model so that the newly constructed and reconstructed roadways are added to the model and receive the proper maintenance activities.

Re-inventory

Re-inventory roadways at least every 5 years, incorporate better ways of managing pavement as they are developed, and update construction costs and funding levels. Use the condition history that accumulates to refine the model to more accurately predict deterioration.

Appendix A. Photo Examples of Pavement Conditions

The photographs in Figure 6 through Figure 10 show examples of roads in Lindon at each of the 5 categories of pavement condition.

Figure 6. PCI = 97 (Good condition)

Figure 7. PCI = 75 (Satisfactory condition)

Figure 8. PCI = 67 (Fair condition)

Figure 9. PCI = 42 (Poor condition)

Figure 10. PCI = 14 (Serious condition)

Appendix B. Treatment Cost Samples

Table 1. Sample of Treatment Costs from Past Projects

City	Treatment	Year of Construction	Project Cost Range		2015 Cost Projection	
			Low	High	Low	High
Lindon	Crack Seal	2015	$ 0.37	$ 0.37	$ 0.37	$ 0.37
Pleasant Grove	HA5	2013	$ 0.17	$ 0.17	$ 0.18	$ 0.18
Lindon	HA5	2015	$ 0.17	$ 0.17	$ 0.17	$ 0.17
Pleasant Grove	Overlay	2009	$ 1.26	$ 1.43	$ 1.50	$ 1.71
Lindon	Overlay	2015	$ 1.56	$ 2.02	$ 1.56	$ 2.02
Lindon	Overlay	2010	$ 1.61	$ 2.04	$ 1.87	$ 2.36
Lindon	Patching	2015	$ 3.00	$ 3.00	$ 3.00	$ 3.00
Lindon	Reconstruct	2015	$ 1.56	$ 1.79	$ 1.56	$ 1.79
Lindon	Reconstruct	2015	$ 2.54	$ 2.74	$ 2.54	$ 2.74
Lindon	Reconstruct	2011	$ 2.95	$ 4.34	$ 3.32	$ 4.88
Lindon	Reconstruct	2007	$ 3.24	$ 3.87	$ 4.10	$ 4.90
Pleasant Grove	Seal Coat	2013	$ 0.16	$ 1.43	$ 0.17	$ 1.52
American Fork	Seal Coat	2015	$ 0.25	$ 0.25	$ 0.25	$ 0.25
Lindon	Seal Coat	2015	$ 0.25	$ 0.25	$ 0.25	$ 0.25

Appendix C. Treatment Characteristics

Table 2. Treatment Characteristics

Treatment Type	Treatments	PCI Range when Used	Effect on PCI: Increase PCI to X	Effect on PCI: Increase PCI by X	Effect on PCI: Increase PCI by X% towards 100	Maximum Resulting PCI	Likely Cost per SF
Routine Maintenance	Seal cracks	65-96		1		99	$0.05 - $0.10
Routine Maintenance	Seal cracks, fill potholes	60-93		2		99	$0.05 - $0.10
Preventive Maintenance	Seal coats, micro-surfacing, fill potholes	70-92			80%	96	$0.25 - $0.35
Preventive Maintenance	Seal coats, micro-surfacing, major patching	70-85			85%	92	$0.30 - $0.40
Minor Rehabilitation	Thin overlay	40-70			85%	98	$2.00 - $3.00
Major Rehabilitation	Mill and thin overlay, thick overlay	40-70			95%	98	$2.50 - $4.00
Minor Reconstruction	Replace asphalt	10-40	100			100	$3.00 - $5.00
Major Reconstruction	Full reconstruction	0-10	100			100	$4.00 - $7.00

Appendix D. Maps of Projects in 5 Year Plan

The maps of projects on the following pages should be considered a guide. In order to preserve the objectivity and in the interest of efficiency, we have preserved the model's recommendations of roadway improvements by year, rather than grouping them in logical projects. Lindon City Public Works Staff will need to exercise judgement as to the grouping and timing of maintenance activities, and should coordinate utility replacement work with pavement maintenance activities.

The recommended treatments are in categories of treatments and not specific treatments. Public Works Staff should choose the specific treatment within the category that they feel would be most suitable for each given road.

The recommendations are based on the following funding in 2015 dollars:

2016	$35,000
2017	$35,000
2018	$40,000
2019	$45,000
2020	$50,000

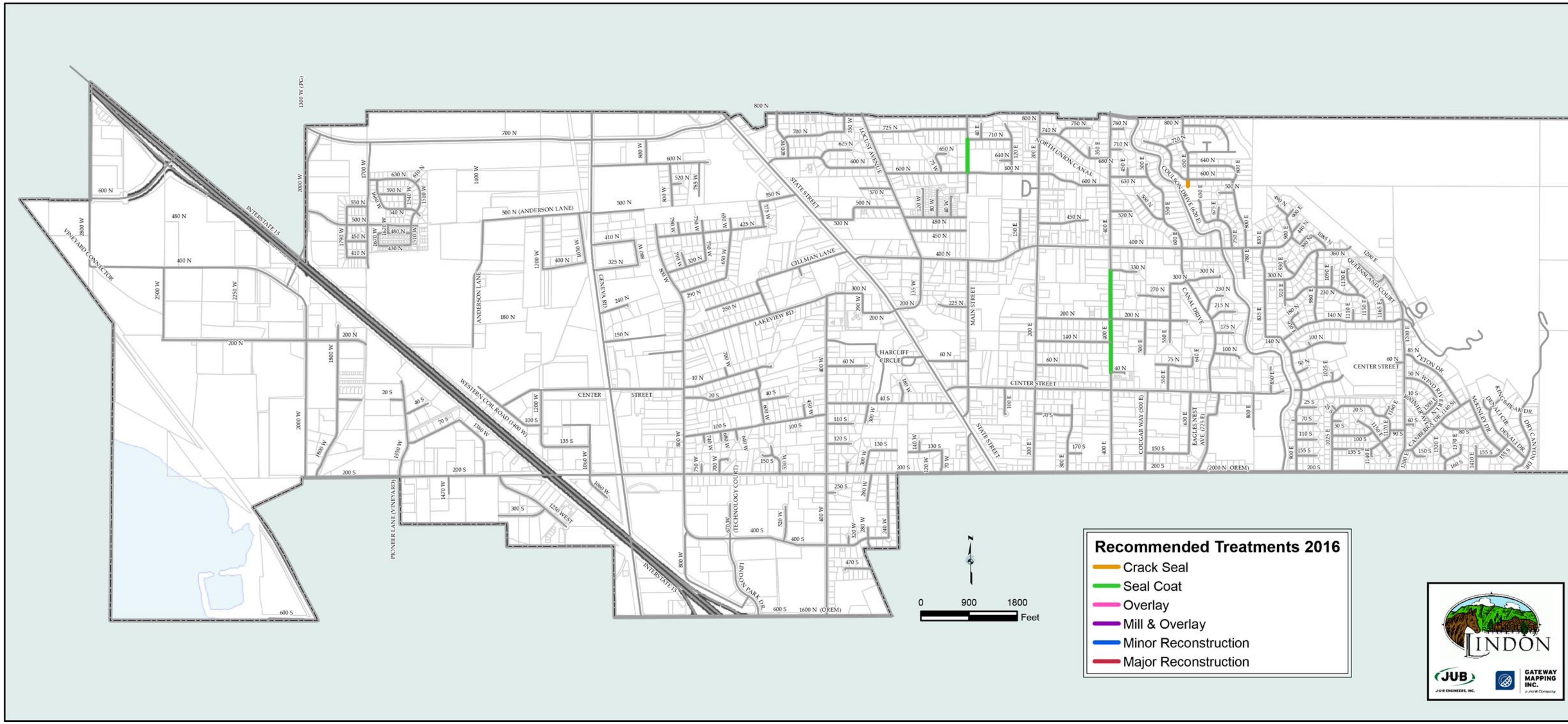


Figure 11. Recommended pavement treatments in 2016.

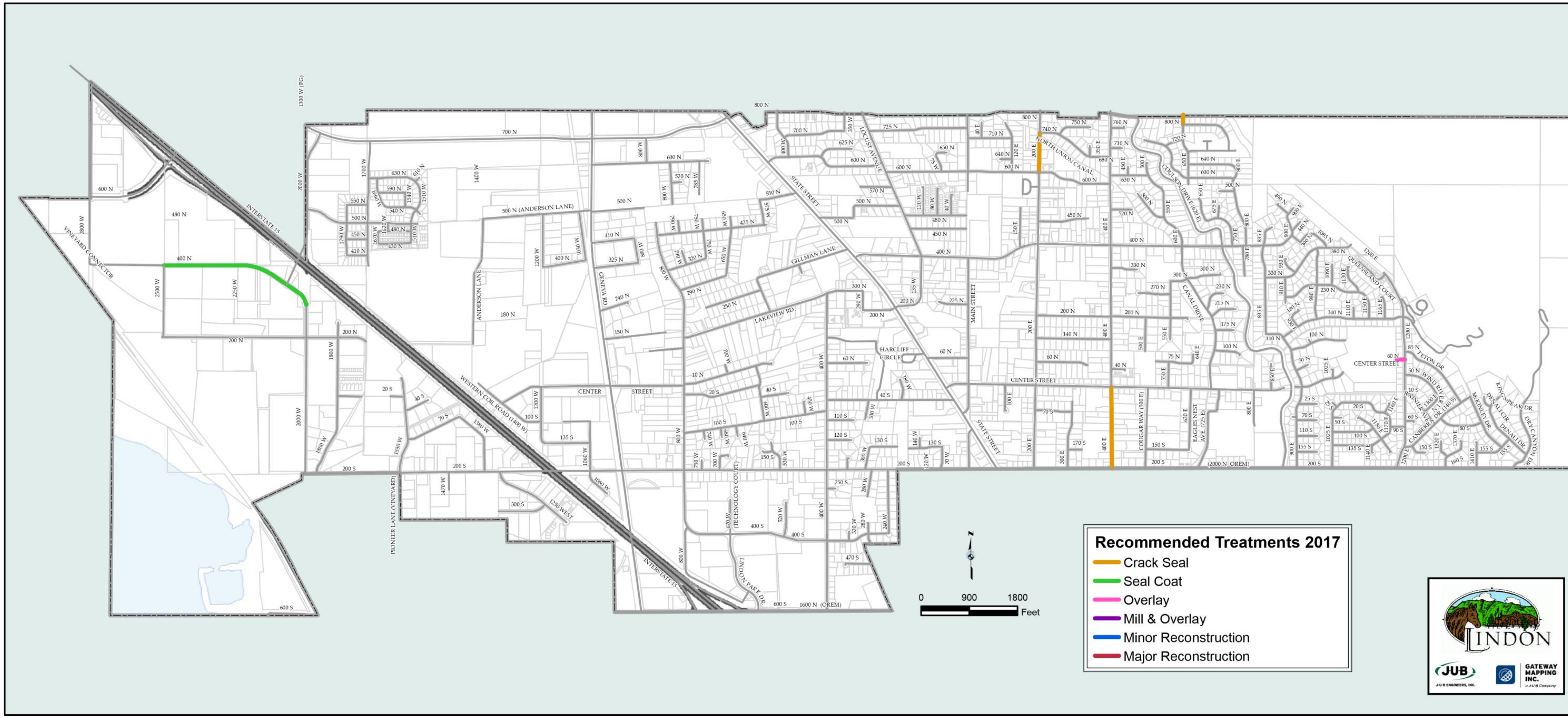


Figure 12. Recommended pavement treatments in 2017.

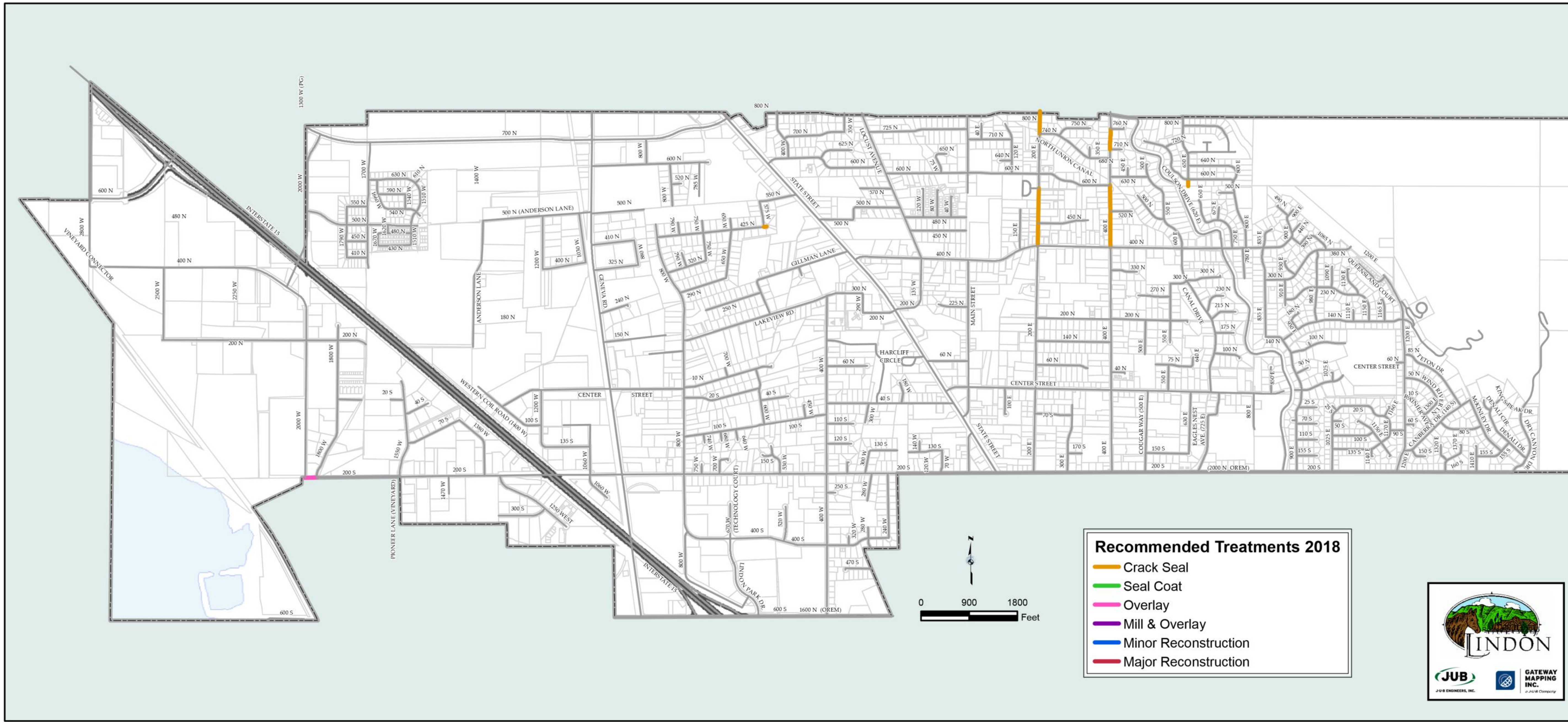


Figure 13. Recommended pavement treatments in 2018.

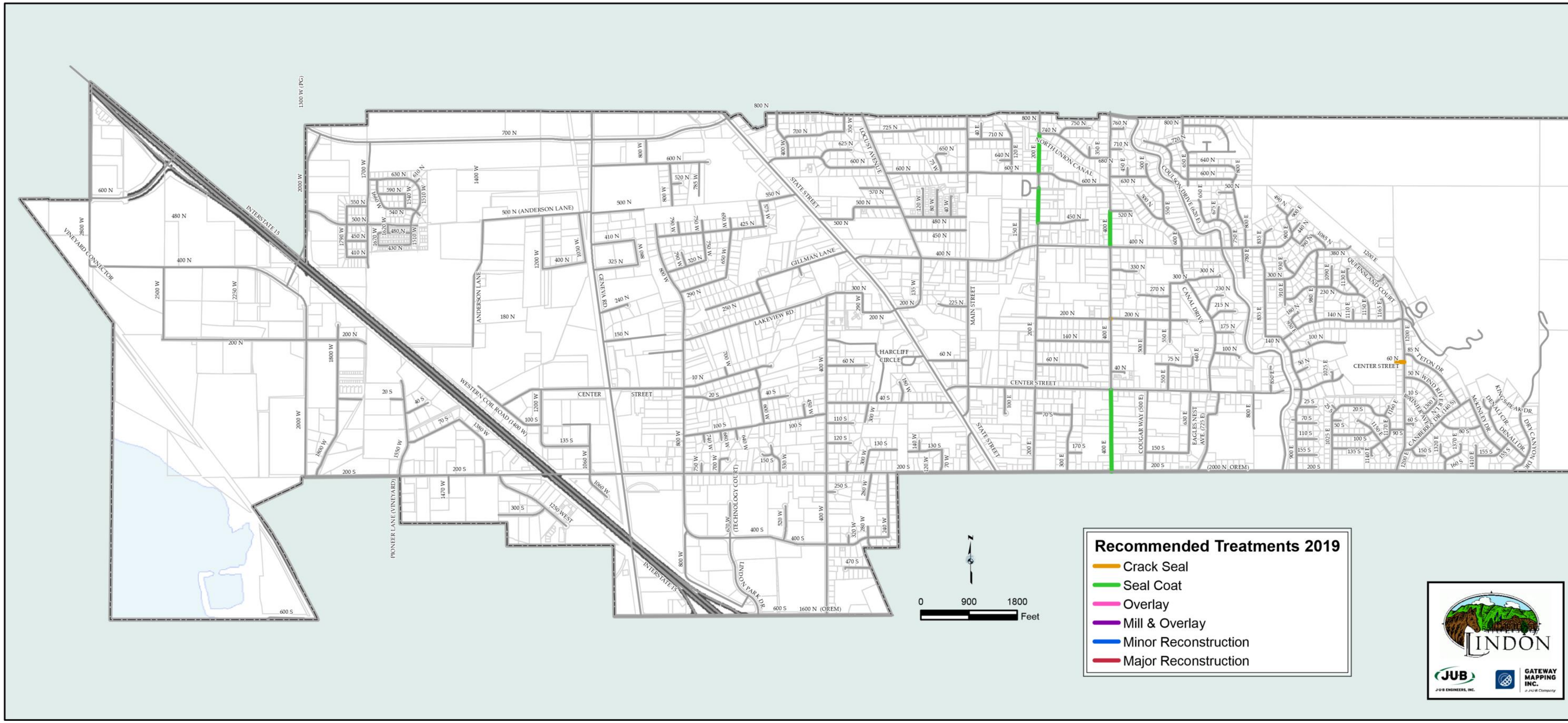


Figure 14. Recommended pavement treatments in 2019.

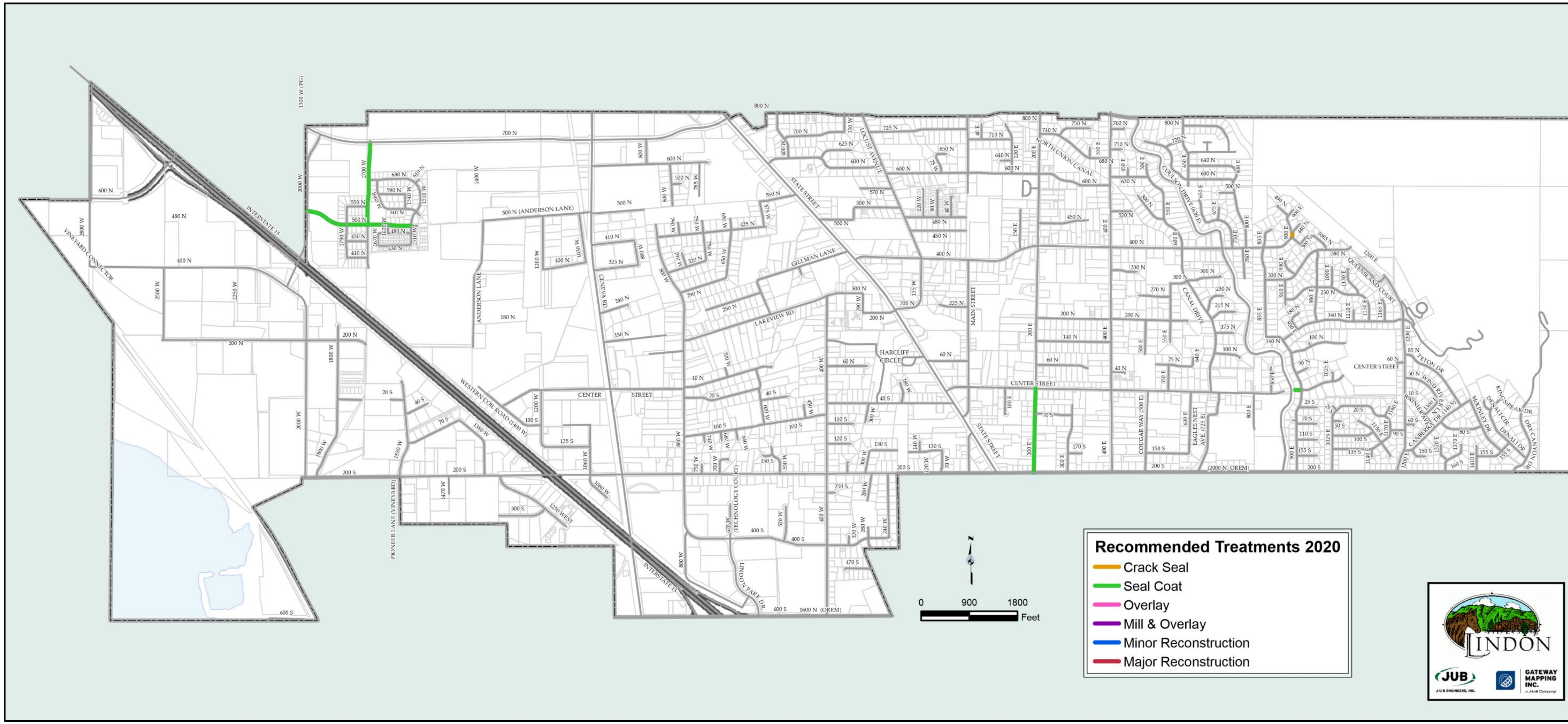


Figure 15. Recommended pavement treatments in 2020.