

City of Bothell - 2021 Pavement Management Program State of the Streets Report



**Northwest Management Systems
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City of Bothell™

Purpose

The purpose of this report is to assist policy makers in utilizing the results of the City of Bothell's Pavement Management System (PMS). Specifically, this report links the PMS recommended repair program costs to Bothell's current and projected budget to improve overall maintenance and rehabilitation strategies. This report assesses the adequacy of current and projected revenues to meet the maintenance needs recommended by the PMS program. It also maximizes the return from expenditures in the following methods:

- Implementation of a multi-year road rehabilitation and maintenance program,
- Development and refinement of a preventative maintenance program, and
- Selection of the most cost effective repairs.

This report assists the City of Bothell with identifying maintenance priorities specific to the needs of the city. This study examines the overall condition of the road network and highlights options for improving the current network-level Pavement Condition Index (PCI). These options are developed by conducting speculative analyses using the City of Bothell's PMS database. By varying the budget amounts available for pavement maintenance and repair, different funding strategies are introduced which can impact the city's roads over the next twenty years.

Pavement Condition (2021)

The Pavement Condition Index, or PCI, is a measurement of pavement grade or condition and ranges from 0 to 100. A newly constructed road would have a PCI of 100, while a failed road would have a PCI of 25 or less. Bothell's current average Pavement Condition Index is 66, placing it in the top of the "Good" Condition Category, with Arterials at 70 and Local Roads at 63.

Present Cost to Repair the Road Network Decision Tree

The goal of the City's Pavement Management System (PMS) is to identify the most cost-efficient way to maintain the City's roadway system. To achieve a sustainable, long-term preservation program, the maintenance backlog of expensive road repairs should be eliminated as much and as soon as possible. Then the PMS over the long-term can be focused on lower cost pavement preservation techniques such as sealing and patching. These techniques can extend the life of a pavement by correcting minor faults and reducing further deterioration. However, preventative maintenance treatments have to be applied before pavement deterioration has become severe. The City has decided to use some of the low-cost techniques up front to try to prevent more roads becoming "backlog" roads, while the City addresses other expensive repairs.

To achieve this goal a target PCI has been set for the low 80's, which is in the "Excellent Condition" category. Once the roadway system is in the low 80's, the system will be at the optimal point where the focus of the PMS can be on a more cost effective approach of maintaining the system, instead of more expensive rehabilitation or reconstruction to provide improvements.

At the current funding levels the PMS will be primarily focused on bringing the Arterial System to a PCI in the low 80's. Minimal funds are available to address the local roadway system and it is expected that the PCI of the local roadways will decrease.

58% of all Bothell's roads have a PCI between 70 and 100, which are in the "Excellent to Very Good Condition" category. Why then, does it cost so much to repair the city's roads, and why bother improving them?

The cost to maintain and repair pavement depends on its current PCI. In the "Excellent to Very Good Category", it costs very little to apply a preventive maintenance treatment such as Crack Sealing, spot patching or slurry seals for local streets, which can extend the life of a pavement by correcting minor faults and reducing further deterioration. Treatments of this sort are applied before pavement deterioration has become severe.

11% of the city's road network falls into the "Good Condition" category. Pavements in this range show some form of distress or wear that require more than a life-extending treatment. By this point, a well-designed pavement will have served at least 75% of its life and the quality of the pavement has dropped by about 40%. The road surface may require a 2" Mill and Fill Overlay, or on local streets a slurry seal, that may include some patching.

The remaining 31% of Bothell's road network falls into the "Fair to Poor Condition" or "Very Poor Condition" PCI ranges. These pavements are near the end of their service lives and often exhibit severe forms of distress such as potholes, extensive cracking, etc. At this stage, a roadway usually requires either a minimum 2" Mill and Fill Overlay with patching or reconstruction, in the worst case scenario, depending on condition. The costs for these treatments range from about \$63 per sq. yd. to \$115 per sq. yd.

Decision Tree for the City of Bothell (2021)

PCI Range	Treatment	Cost Per Sq. Yd.
70 – 100*	Spot Patching, Crack Seals or Slurry Seals	\$2.30 to \$6.35
69 – 50***	Slurry or Cape Seals	\$6.35 to \$10.35
69 – 50	2" Mill and Fill Overlay or Slurry Seal with patching	\$11.50 - \$63.25
49 – 25	2" Mill and Fill Overlay with patching	\$69 - \$74.25
24 – 0**	Reconstruction	\$109.25 - \$115

*Spot Patching or Crack Sealing can be both applied in this Range. Slurry Seals will only be applied on Local Streets.

** Slurry Seals will be applied on Local Streets, while Cape Seals may be applied on Arterials and Collectors.

***Some local streets might be candidates for thin overlay with patching at this PCI range. Extensive sub-base and structural analysis would need to be performed on these candidates to ensure that the correct treatment is being selected

To provide more detail to street condition and respective repairs the photos below provide examples of pavement deficiencies from streets and the appropriate repair methods.

Preventive Maintenance



Crack Seal or Slurry Seal- The Street has a PCI of 85.

This pavement is generally in good condition and would benefit from crack sealing to prevent water from entering the sub base and causing further deterioration.

Overlay & Reconstruction



Overlay – This Street has a PCI of 64

This pavement is in good condition with a few areas of alligator cracking that should be structurally patched before it is resurfaced with a 2" Mill and Fill overlay.



Overlay – This Street has a PCI of 42

This pavement is in very poor condition with areas of alligator cracking that should be structurally patched before it is resurfaced with a 2 inch Mill and Fill overlay with patching.



Reconstruction – The Street has a PCI of 17



Reconstruction – The Street has a PCI of 17 (Close Up View)

This pavement is in very poor condition with severe alligator cracking, potholes, and areas of settlement. This street should be rubblized, regraded, and reconstructed with new sub base material and asphalt pavement.

Future Expenditures for Pavement Maintenance

It is estimated that the City of Bothell will spend \$3 million a year or \$60 Million on pavement rehabilitation and reconstruction during the next twenty years (2022 - 2041), assuming current funding levels. Spending on Arterials will be \$54 Million, with Locals getting \$6 Million

Impacts of Projected Funding Levels

With the existing budget over the next twenty-year period, the condition of the network deteriorates, with the average PCI decreasing from 66 to 47. Arterials will increase to 80, while Local streets will decrease to 30. The amount of "deferred" maintenance increases from \$47.2 million to \$132.7 million.

Deferred maintenance consists of pavement maintenance that is needed, but which cannot be allocated due to lack of funding. Shrinking budgets have forced many Puget Sound Area cities and counties to defer much-needed road maintenance. By deferring maintenance, not only does the frequency of citizens' complaints about the condition of the network increase, but the cost to repair these roads rises as well.

Budget Needs

Based on the principle that it costs less to maintain roads in the "Excellent to Very Good Condition" than to repair those that are in the "Fair to Poor Condition", the City of Bothell' Pavement Management System strives to develop a maintenance strategy that

will first improve the overall condition of the network to an optimal PCI level. This PCI level is dependent upon the City's maintenance and rehabilitation policies as delineated in the predetermined preventative maintenance and rehabilitation decision trees. Bothell's decision trees are described in more detail on page 3. These decision trees systematically assign a specific treatment dependent on the PCI and types of distress found on the pavement. For Bothell, this optimum PCI level is in the 80's. Although the average PCI for the city is 66, which is in the top of the "Good Condition" category, a portion of the network suffers from load-related distresses. These sections suffer from potholes, extensive cracking, etc. and the cost to repair these increases.

The first step in developing a cost-effective Maintenance and Rehabilitation (M&R) strategy is to determine, assuming unlimited revenues, the M&R "needs" of Bothell's road network. Using the PMS analysis module, maintenance needs over the next twenty years were estimated at over \$156.8 million if Bothell follows the strategy recommended by the PMS program to increase the average network PCI to 80. Of the total \$156.8 million, \$66.5 million will be needed on the Arterials, while \$90.3 million will be needed on the Local Streets. If however, no maintenance is applied over the next twenty years, already distressed roads will continue to deteriorate, and the network PCI will drop to 23. The results of the budget needs analysis are summarized in the table below.

Table 2 - Summary of Results from Budget Needs Analysis (\$ Millions)

Year	2022 -2026	2027-2031	2032 - 2036	2037 -2041
Annual PCI with Treatment	79 79 80 80 80	81 80 80 79 80	81 80 79 80 78	79 78 79 79 80
Annual PCI without Treatment	64 61 59 57 55	53 50 48 46 44	41 39 37 34 32	30 29 27 25 24
Budget Needs (\$) for each of a five year period.	\$75.3	\$33.8	\$19.5	\$28.2

Table 2 (above) shows the level of expenditures required to raise Bothell' pavement condition to an optimal network PCI of 80 and eliminate the current maintenance backlog. The results of the budget needs analysis represent the ideal funding strategy recommended by the City of Bothell's PMS. Of the \$156.8 million in M&R needs shown, \$37.7 million is earmarked for preventative maintenance or life-extending treatments, while \$119.1 million is allocated for light and heavy rehabilitation and reconstruction treatments.

Budget Scenarios

Having determined the maintenance needs of the city's road network, the next step in developing a cost-effective maintenance and rehabilitation strategy is to conduct a what-if analysis. Using the PMS budget analysis module, the impacts of two budget "scenarios" can be evaluated. The program projects the effects of the different scenarios on pavement condition (PCI) and deferred maintenance (backlog). By examining the effects on these indicators, the advantages and disadvantages of

different funding levels and maintenance strategies become clear. The following two scenarios were run for the purposes of this report:

Scenario 1 (\$156.8 million over 20 years) All Streets Program - Bring PCI to 80 in 20 years - The budget for each year is identified in the budget needs analysis. This scenario will allow the city to reasonably improve the condition of the network to a PCI of 80, assuming that existing repair and renovation practices as described in the maintenance and rehabilitation decision trees are utilized. \$42.1 Million would need to be spent in the first year of the analysis period. The remaining \$114.7 million need would be spent in the next 19 years to maintain the PCI in the mid to low 80s. The \$114.7 million varies by year from \$500K to \$15.2 million depending upon need.

Scenario 2 (\$156.8 million over 20 years spread evenly \$7.84 million a year) - - The budget for each year would be \$7.84 million. This scenario will allow the city to improve the condition of the network to a PCI of 75 at the end of 20 years. All arterials would be repaired. A high percentage of local roads would also be in the very good condition category.

Scenario 3 (\$60 million over 20 years) Current Budget - The current budget program would maintain spending at \$3,000,000 per year and focus those funds primarily on arterial pavements. Remaining funds would go toward local streets. \$54 Million will be devoted to Arterial Streets, while the remainder \$6 Million will be utilized on Locals. At the end of 20 years the PCI would drop to 47 with Arterials at 80 and Locals at 30.

Discussion and Recommendations

Figure 1 (below) illustrates the change in PCI over time for the three budget scenarios. Note that Scenario 1, which represents the ideal funding strategy, ultimately achieves a PCI of 80 after twenty years. By comparison, Bothell' projected current budget, Scenario 3 results in a drop in PCI to 47. Figure 2 illustrates the change in PCI for Arterial streets, by scenario, while Figure 3 reviews each scenario impact on local streets.

Figure 1 Pavement Condition Index per Scenario by Year For all Bothell Streets

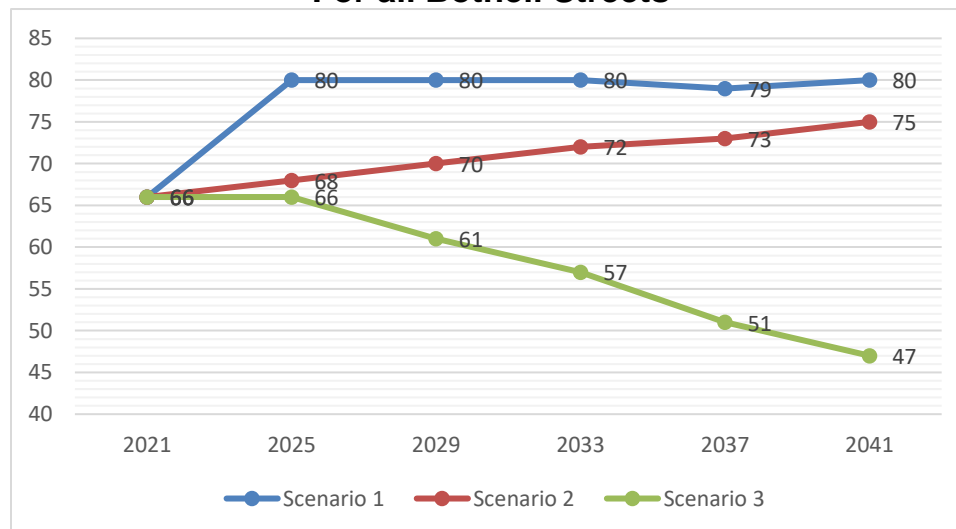


Figure 2 Pavement Condition Index per Scenario by Year For Arterial Streets

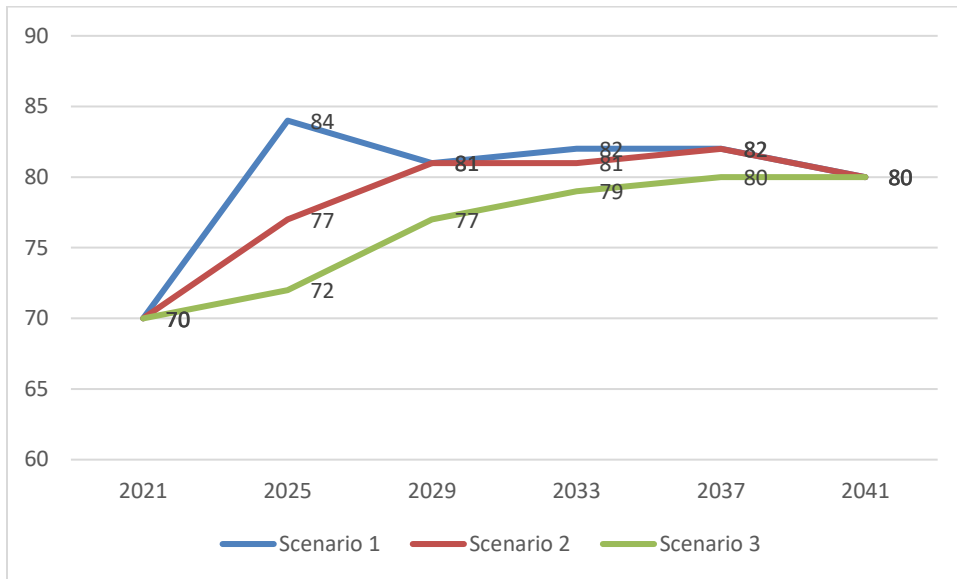


Figure 3 Pavement Condition Index per Scenario by Year For Local Streets

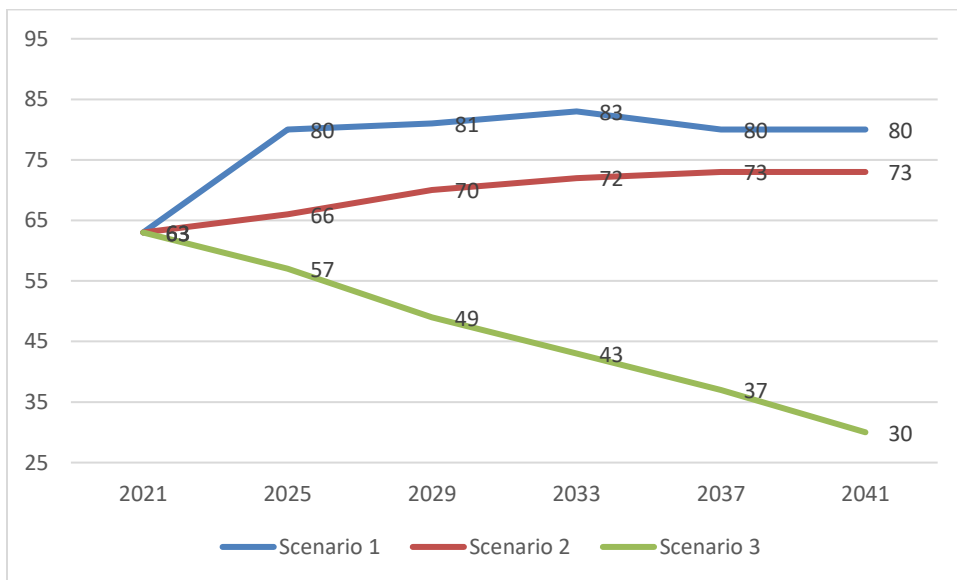


Figure 4 Deferred Maintenance per Scenario by Year

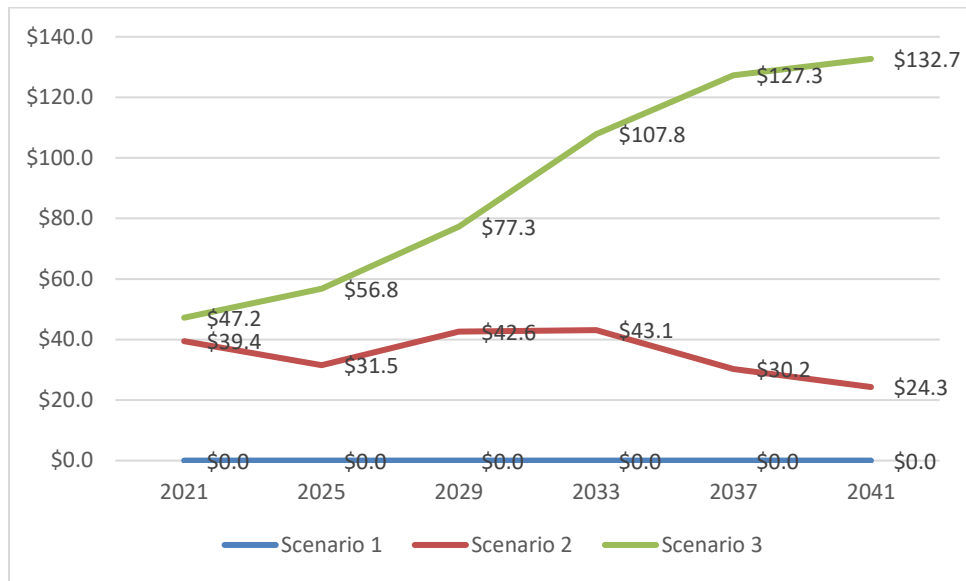


Figure 4 illustrates the change in deferred maintenance over time for the three budget scenarios. Note that Scenario 1 has no backlog of maintenance. The entire backlog for Scenario 3 is found in the Local Streets. There is no backlog for the Arterial streets at the end of the 20 year period. For Scenario 2, there is a decreasing backlog with the entire \$24.3 million at the end of the analysis in local streets.

Figures 1 through 4 illustrate that Bothell’s projected budget as outlined in Scenario 3, though increased by the passage of the voter initiative, is still insufficient to preserve the local street network at its current condition. Even with currently funding preventative maintenance alternatives on the local streets, candidate sections will soon run out, leaving the City with only more expensive overlay and reconstruction options. This in turn will result in higher costs to repair the local streets in the future.

Summary

In summary, the City of Bothell has a substantial investment in their roadway network. Overall, 58% of the City's network is in the "Excellent to Very Good Condition" category. However, the remaining 42% of the streets require a significant amount of money to bring them into the "Excellent to Very Good Condition" category. With Bothell's projected budget of \$60 million for the next twenty years, the average PCI of the network is expected to decrease, with a steadily increasing deferred maintenance backlog on the local streets, while the Arterials will have no backlog. The high maintenance backlog on local streets will result in increased future costs because revenue intensive treatments (reconstruction) will unfortunately be necessary when less expensive feasible treatments (crack, slurry or cape seals or overlays) could have prevented further deterioration.

Recommendations

It is recommended that the City of Bothell continue to increase funding for street maintenance and implement more rigorous preventative maintenance strategies and adopt Scenario 2. With the passage of the voter initiative in November 2016, the City has begun to adopt a more proactive response to the growing pavement maintenance need. With the road work that has been performed in 2017 - 2021 the City has begun to see small short term improvements in its Arterial street condition network. This increase in PCI will continue with the projected work for 2022. The slurry seal program that was performed in 2018 and 2020 and 2021 on local streets has benefitted the City in the present. The City should try and increase funding for additional candidate local streets for the slurry seal program in the next five years. This will decrease the future deferred maintenance costs on local streets. However, the list of candidate sections for local streets may be diminished, as many streets may be beyond the condition where a slurry seal application will work. The City may have to begin to evaluate performing light rehabilitation treatments on local roads, such as overlays.

It is also important to begin to plan for Preventative Maintenance on Arterials. It is anticipated that with current funding levels on Arterials, that are supplemented with grants, the Bothell Arterial street network will average a PCI of 80 with little to no deferred maintenance within 10 years. As the initial overlays are performed on these streets in 2017 - 2021, preventative maintenance, beyond crack sealing should be considered in 7 – 10 years. This would include a full seal of the street similar to what is being performed on local streets in Bothell currently.

However, the PMS results show that total expenditures of \$60 million over the next twenty years will result in the City dropping an overall PCI from the current 66 to 47. Arterials will increase to 80, while Locals will drop to 30. This is an improvement from prior years because of the additional investment of \$6 million over 20 years that is devoted to preventative maintenance by the passage of the voter initiative. This is the current Budget Option. However, the result of this scenario continues to show a decreasing PCI on Local Streets and an increasing deferred maintenance cost. It is important for the city to adopt Scenario 2, as this will improve all Streets in the City of Bothell.