Council Meeting Date: May 14, 2018 **Agenda Item:** 8(b)

CITY COUNCIL AGENDA ITEM

CITY OF SHORELINE, WASHINGTON

AGENDA TITLE:	Discussing the City's Pavement Management System
DEPARTMENT:	Public Works
PRESENTED BY:	Bob Earl, Engineering manager Eduardo Aban, Project Manager
ACTION:	____ Ordinance ____ Resolution ____ Motion __X_ Discussion ____ Public Hearing

PROBLEM/ISSUE STATEMENT:

Each year, through the Capital Improvement Plan (CIP) and Annual Road Surface Maintenance (ARSM) Program, the City invests between $1.1 and $2.3 million (averaging $1.65 million/year) in maintaining and managing its road system – one of its largest and most valuable assets, currently worth hundreds of millions of dollars. As a part of its transition to an asset management approach to maintaining the City's infrastructure, Public Works has initiated a formal Pavement Management System to assist in this effort.

Like most asset management practices, pavement management is characterized by periodic collection and analysis of asset condition data which is then combined with historic and generic data about the asset(s) such as asset age, use, average service life, etc. to analyze asset performance and build a performance data model. The performance model is a tool that assists managers with pavement performance analysis and data for decision support.

As the pavement management process of data collection and analysis continues over time, patterns of physical performance (level of service) and financial performance emerge that managers can use to better understand and predict pavement condition, and optimize construction and maintenance practices. Asset management and pavement management depend upon regular, periodic collection of asset condition data for their success.

In 2014, as a first step in inaugurating the PMS, the City engaged TransMap, Inc. to provide an inventory and condition evaluation of all 168 miles of the City's arterial, collector and residential streets, and an analysis of funding required to eliminate the City's deferred-maintenance backlog while continuing to maintain the City's road network at the current level of service. Staff then developed a prioritized maintenance and preservation program for the period 2018-2023, based on the condition data provided by TransMap, Inc. Attachment A shows planned pavement preservation activity for this time period.

Tonight's update on the Pavement Management System provides information on the status and progress of program, along with a summary of the current condition of the roadway network.

RESOURCE/FINANCIAL IMPACT:
There is no financial impact associated with tonight's discussion.

RECOMMENDATION

This item is for discussion purposes only. Staff recommends the Council ask questions of staff regarding the Pavement Management System and the Annual Road Surface Maintenance Program.

Approved By: City Manager ***DT*** City Attorney ***MK***

INTRODUCTION

Each year, through the Capital Improvement Plan (CIP) and Annual Road Surface Maintenance (ARSM) Program, the City invests between $1.1 and $2.3 million (averaging $1.65 million) in maintaining and managing its road system – one of its largest and most valuable assets, currently worth hundreds of millions of dollars. As a part of its transition to an asset management approach to maintaining the City's infrastructure, Public Works has initiated a formal Pavement Management System (PMS) to assist in this effort.

Like most asset management practices, Pavement Management is characterized by periodic collection and analysis of asset condition data which is combined with historic and generic data about the asset(s) such as asset age, average service life, etc. to build a data model, or performance model, of pavement conditions. The performance model is used to analyze asset condition and predict performance over time. This assists managers in selecting and adjusting maintenance practices to best preserve the asset(s) at an optimum level of service over a selected time period at the least cost.

Tonight's update on the PMS provides information on the status and progress of program, along with a summary of the current condition of the roadway network.

BACKGROUND

On August 11, 2014 Council approved Contract #7644 with TransMap, Inc., as a first step in developing the City's PMS. TransMap was tasked with collecting pavement condition data City-wide and providing an inventory and condition evaluation of all of the City's arterial, collector and residential streets. TransMap was also tasked with providing an analysis of the funding required to maintain the City's road pavement network at current levels of service while eliminating the City's road maintenance backlog within 5 years.

DISCUSSION

A PMS is a data-driven tool that assists Public Works managers in selecting and implementing the best maintenance and rehabilitation strategies to fit the City's operating conditions. The PMS concept is not to provide pavement in a constant "like new" condition, but to maintain pavements in serviceable condition that is neither new nor unacceptably worn. Industry research and experience has shown that maintaining and repairing roads when they are still in "fair" condition costs less over their lifetime than completely replacing road pavements that have degraded to an unserviceable condition.

Without access to objective physical condition and financial performance data, Public Works managers tended to gravitate toward "repairing the worst roads first" based on driver complaints and other anecdotal information. Consequently, a PMS is designed to provide objective information for analysis so that Public Works managers can make consistent, cost-effective and defensible decisions related to the long-term maintenance and preservation of the City's road/pavement network.

Getting Started

In 2014, as a first step in inaugurating the PMS, the City engaged TransMap, Inc. to:

1. Inventory of the City's road network by road segment: Identify all roadways in the City's network by location, dimensions, pavement type and road classification.
2. Field survey/inspection of the pavement condition of all street segments, based on severity and type of surface distress. This is accomplished primarily through visual inspection.
3. Analysis and reporting of pavement condition, expressed as Pavement Condition Index (PCI). PCI is a 100-point scale with 100 equivalent to new pavement. The PCI for well maintained, serviceable pavement typically falls between 50 and 85.

Based on TransMap's 2014 data, Shoreline's current, average PCI is 80.8 for all Shoreline roads. This equates to a general "very good" condition rating. However, observations of pavement condition of arterial and collector road segments, and having only one condition assessment data point for each road segment leads staff to believe that TransMap's average may be overstated.

Following completion of TransMap's data collection work, TransMap developed a performance model and a prioritized maintenance and rehabilitation plan for the City's road network using MicroPaver, a software package developed and distributed by the American Public Works Association (APWA). MicroPaver allows easy access to pavement inventory and inspection information, provides analysis of current and future conditions, provides for graphical presentations of reports through the link with GIS software, and allows the optimization of pavement maintenance and rehabilitation within given budget constraints.

Pavement Performance Models

Attachment B shows a generic pavement performance model or performance curve. As you can see, pavement condition begins to degrade as soon as the road is placed into service. Degradation of the surface continues at a fairly constant rate until the pavement's service lifetime reaches about the 50 percent point where the rate increases fairly dramatically until it begins to bottom out at about 90 percent of the pavement's service life span. At this point the pavement is no longer serviceable and will continue to quickly deteriorate until the only option for pavement maintenance is to reconstruct it completely.

This characteristic curve is the product of monitoring and analysis of pavement wear in both research and real-world environments. Overall, pavements that are kept in good repair beginning early in their service life spans ultimately extend the upper (relatively flat) part of the curve over a longer time and thus provide an overall higher level of service at all times and lower life cycle costs than pavements that are maintained further down the curve or run to failure.

The City's current Pavement Performance Model, or curve, is shown on Attachment C. As you can see here, also, the City's performance model does not conform to the characteristic shape of the generic curve. This results from having only one, or at most a few, data points for any given roadway segment in the network.

The City's current model also shows that the PCI of 98.85 percent of the city roadway network is above 40, which is considered "fair" condition. This result indicates that the City's pavement network is fairly new and is performing well. However, with limited data the information is not as reliable as we would like and additional data collection at consistent intervals and with consistent methods is necessary to verify that our performance model accurately represents the pavement network. The table below shows the condition data distribution in percent the total network:

Pavement Condition	Percent of Network
Very Good (80 - 100)	50.95
Good (60 - 80)	38.48
Fair (40 - 60)	9.42
Poor (20- 40)	1.10
Very Poor (0 - 20)	0.05

Funding

The City's funding for pavement maintenance comes from Vehicle License Fees (VLF), Real Estate Excise Taxes (REET), and grant funding. Attachment D shows the current status of the ARSM in the Road Capital Fund.

TransMap's Pavement Management Report indicated that an annual budget of $2.24 million is required to allow the City to eliminate its current maintenance backlog within five years, while maintaining a level of service of an average PCI of 80.

Beginning in 2019, the ARSM program's annual budget will average $1.65 million per year through 2023. If unchanged, the gap in funding will result in deferring maintenance, which will eventually result in a reduction in the average PCI and a significantly higher cost to return the pavement network to its current "very good" condition.

Next Steps

The objective of developing a PMS is to provide a consistent stream of objective data for analysis and decision support. To achieve this over time, staff recommends the following steps:

1. Perform pavement field inspection on a consistent, regular basis. Pavement condition data for Arterials and Collector roads should be collected every two years beginning in 2019. Additionally, pavement condition data for Local (residential) streets should be collected every other cycle, or every four years.

   Because of the special equipment required, this work will be outsourced to TransMap or a similar consultant at an average cost of approximately $95,000 per cycle, in 2018 dollars which will be part of the ARSM budget.

2. Continue to populate the pavement management system's database with historical data such as as-built data from completed CIP projects and development projects.

3. Continue analysis and development of the City's pavement performance model.

4. Continue analysis and adjustment of the City's maintenance and repair practices and materials as informed by changes in the pavement performance model.

Looking Ahead

Beginning in 2016, staff moved to an annual rotation between asphalt overlay and Bituminous Surface Treatment (BST). Attachment A shows the prioritized maintenance and rehabilitation plan for the period 2018 – 2023 with overlays occurring in even years and BST in odd years. This plan will be updated annually with as-built project information, and with data from future pavement condition assessment cycles. During this time staff will also investigate and possibly try a few advanced paving materials, and techniques such as rubberized BST with the plan of applying this technique to collector roads.

Road Surface Materials/Treatment

Bituminous Surface Treatment: Along with asphalt overlays, the City uses Bituminous Surface Treatment (BST) to maintain and rehabilitate pavements, primarily on local, residential streets, which have lower traffic volumes than arterials and collector roads. Assuming that structural defects in the paving are repaired before BST application, BST can extend the life of asphalt paving seven to ten years per application. Public Works' experience with BST began in 2010 so the results of the first applications are just becoming known. At this time it appears that BST is a good preservation method for these low-volume streets; however, BST is generally not a good approach to maintaining higher-volume roads such as primary arterials Later data collection will confirm whether this is objectively so.

BST treatment ranges in cost from $25,800 to $29,700 per lane-mile, based on an 11-foot lane width. Asphalt Concrete overlays vary in cost from $277,500 to $296,800 per lane-mile, also based upon an 11-foot lane width.

Asphalt Concrete Pavement: Asphalt Concrete Pavement (AC) is a *flexible* pavement that deforms under loads, regardless of temperature or thickness, and is quite sensitive to compaction defects or excess moisture in the subgrade below the paving. Most of the city streets are AC pavement. Maintenance of AC pavement is generally done with either an AC overlay or a bituminous surface treatment.

Portland Cement Concrete Pavements: Portland Cement concrete (PCC) and asphalt concrete (AC) have differing physical characteristics. PCC pavement makes up less than one percent of Shoreline's pavement network.

PCC is a *rigid* pavement that deforms very little under loads. Overloading causes fracturing and differential settlement and tipping or rocking at the edges causing a rougher ride than AC pavement. PCC is also less sensitive to compaction defects or excess moisture in the soil or rock layer below the paving slab (the subgrade).

Public Works' maintenance strategy for PCC is to repair small defects in place with either PCC or AC patching and repair large defects by removing the PCC paving and replacing it with either PCC or AC paving. In either case a key maintenance focus is on

the interface joint between PCC and AC paving, such as at the “ends” of PCC slabs that join with AC paving.

PCC/AC Interface

PCC/AC interface joints are formed in a traffic lane where one material butts against the other. These can be difficult to maintain and often have adverse effects on pavement condition and ride quality because of the different physical characteristics of the materials. An example of a PCC/AC interface is N 185th Street, near Midvale Ave. N.

Because the AC paving tends to peel away at the interface joint under traffic loads, water infiltrates into and softens the road base below the joint. This causes the flexible AC paving to settle, or deform, downward at the joint. The adjacent PCC paving is rigid and is able to withstand traffic loads for a limited time even without good base support and so remains at the same level. When driving over the joint, drivers perceive it as a pothole that is worsening over time. Eventually, the AC paving does form a wet pothole at the interface joint and must be removed, and the road base and paving replaced.

There are some PCC road segments in Shoreline where the PCC paving was overlaid with AC paving. Today this is regarded as an undesirable practice because over time, the industry has found that cracks and panel joints in the PCC paving are reflected up through the asphalt concrete overlay, causing water intrusion and delamination (peeling) of the asphalt mat from the PCC surface. In the long term it is almost always more cost-effective to remove the deteriorated PCC paving and replace it with AC paving or new PCC.

Staff is still developing a long-term strategy for managing PCC pavement such as removing and replacing it with AC paving through development or capital project activity.

COUNCIL GOAL(S) ADDRESSED

The Pavement Management System addresses 2017-2019 Council Goal 2: Improve Shoreline’s infrastructure to continue the delivery of highly valued public Services.

RESOURCE/FINANCIAL IMPACT

There is no financial impact associated with tonight’s discussion.

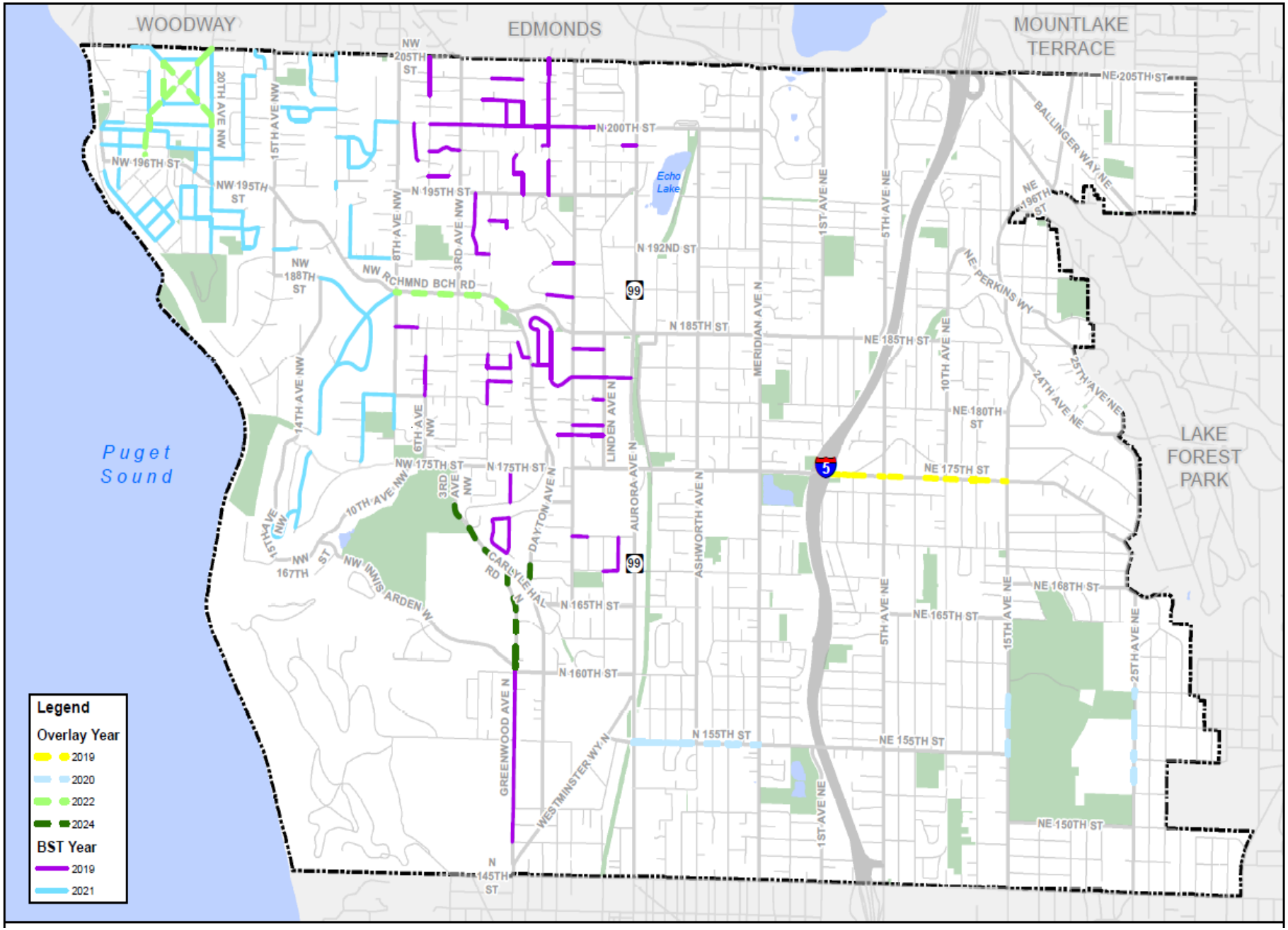
RECOMMENDATION

This item is for discussion purposes only. Staff recommends the Council ask questions of staff regarding the Pavement Management System and the Annual Road Surface Maintenance Program.

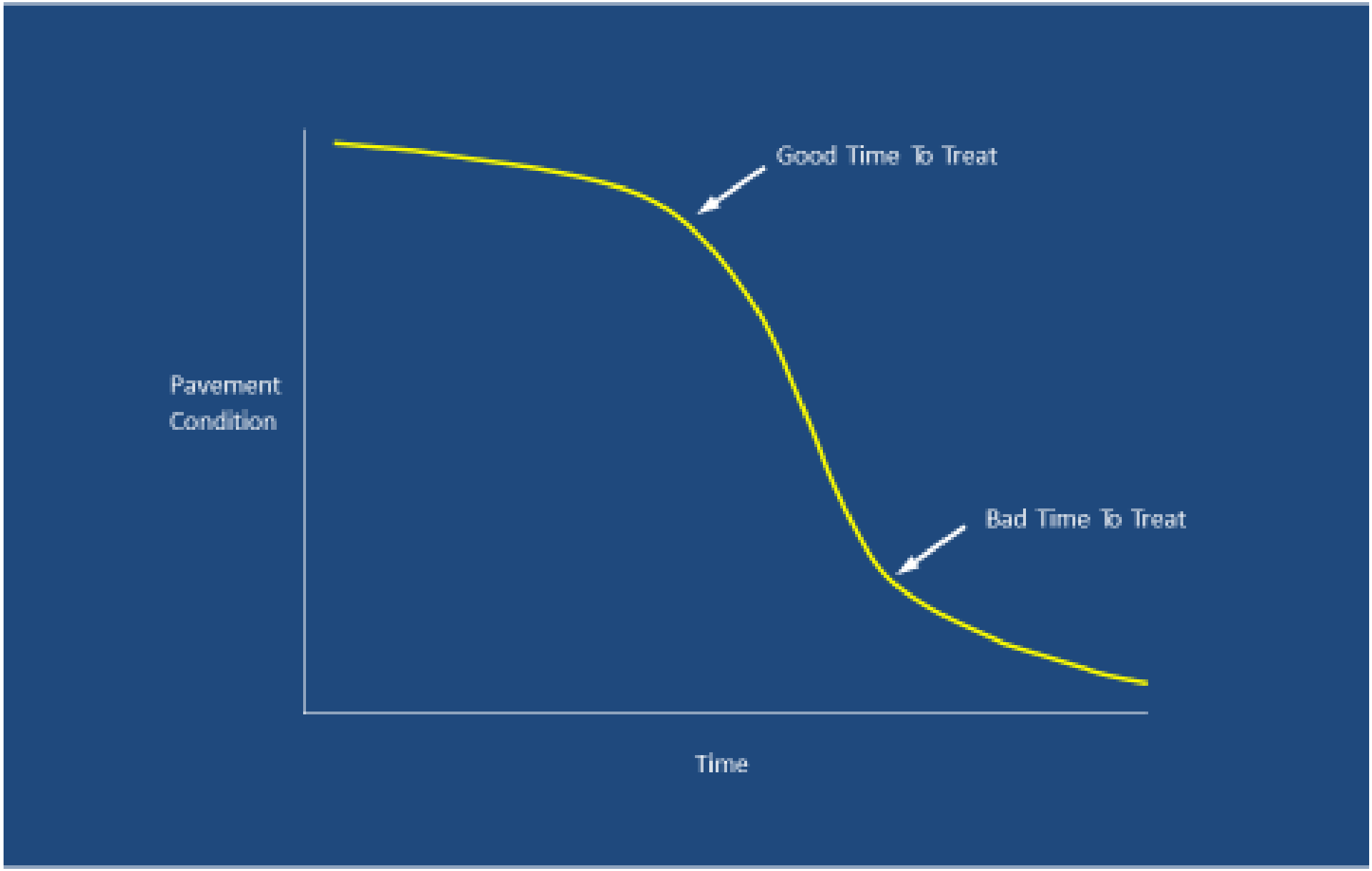
ATTACHMENTS

Attachment A – Map of Prioritized Maintenance and Rehabilitation Plan 2018 – 2023
Attachment B – Generic Pavement Performance Model Curve
Attachment C – City of Shoreline Pavement Performance Model Curve
Attachment D – Annual Road Surface Maintenance Program Budget 2018 – 2023

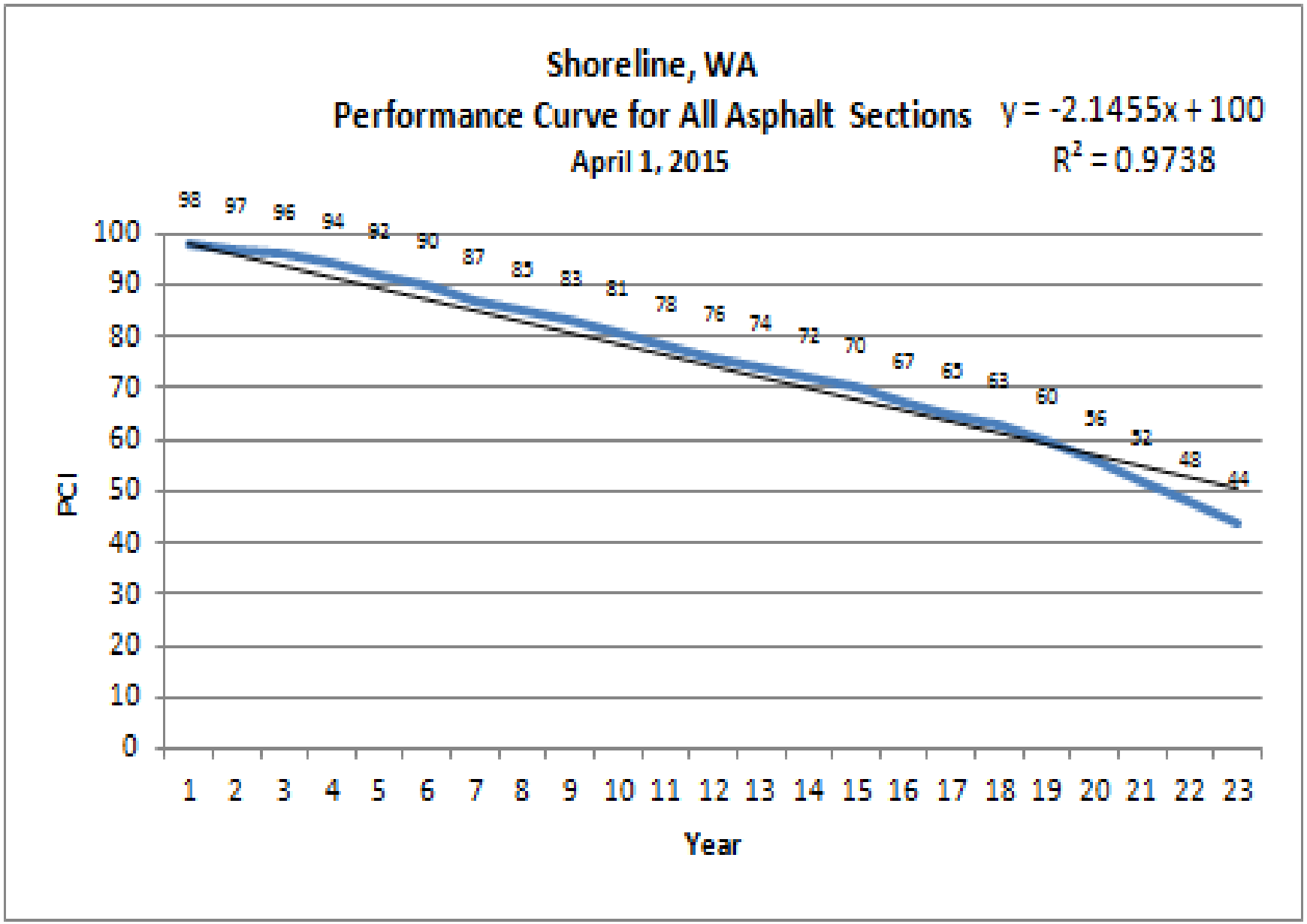
ATTACHMENT A



ATTACHMENT B

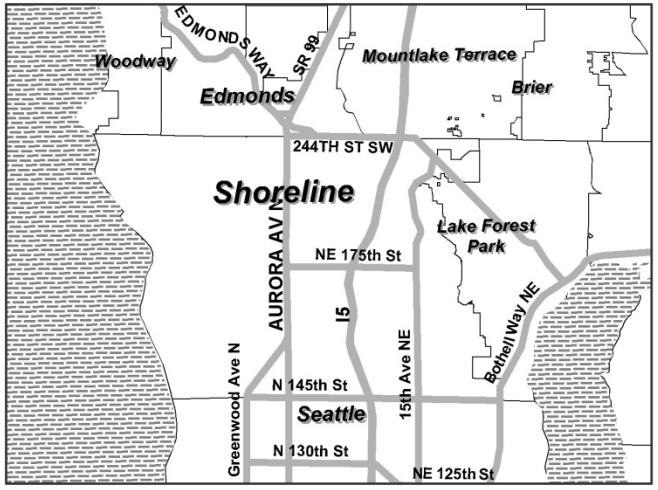


ATTACHMENT C



ATTACHMENT D

ANNUAL ROAD SURFACE MAINTENANCE PROGRAM



Project Description: The City's long-term road surface maintenance program is designed to maintain the City's road system to the highest condition rating with the funds available using various thicknesses of asphalt overlay and bituminous surface treatments (BST).

Service Impact: BST applications typically extend the useful life of local streets by 7 to 10 years, increase skid resistance and improve ride quality. In addition to providing increased skid resistance and improving ride quality, asphalt overlays generally return the street to full structural capacity and can extend the service life of the road by 15 to 20 years.

Changes from 2017-2022 CIP: The new cost estimate includes the addition of funding for projects in 2023.

ANNUAL ROAD SURFACE MAINTENANCE PROGRAM ORGKEY: 2918151 J.L.# Multiple PHASE	PRIOR-YRS	2017CB	2017E	2018E	2019E	2020E	2021E	2022E	2023E	6-YEAR TOTAL	TOTAL PROJECT
PROJECT EXPENDITURES:											
1-PROJECT ADMINISTRATION	2,142,841	250,000	310,800	300,000	120,000	250,000	120,000	200,000	150,000	1,140,000	3,593,641
2-REAL ESTATE ACQUISITION	1,227										1,227
3-CONSTRUCTION	11,060,979	2,423,964	2,281,345	2,000,000	1,000,000	1,850,000	1,000,000	1,700,000	1,200,000	8,750,000	22,092,324
TOTAL PROJECT EXPENDITURES	**13,205,047**	**2,673,964**	**2,592,145**	**2,300,000**	**1,120,000**	**2,100,000**	**1,120,000**	**1,900,000**	**1,350,000**	**9,890,000**	**25,687,192**
REVENUE SOURCES:											
GENERAL FUND CONTRIBUTION	2,239,888										2,239,888
TRANSPORTATION BENEFIT DISTRICT	2,475,948	1,497,359	1,497,359	1,222,279	830,000	830,000	830,000	830,000	830,000	5,372,279	9,345,586
FEDERAL - STP	41,028	1,064,786	1,054,786	587,289						587,289	1,683,103
ROADS CAPITAL FUND	8,448,183	111,819	40,000	490,432	290,000	1,270,000	290,000	1,070,000	520,000	3,930,432	12,418,615
TOTAL PROJECT REVENUES	**13,205,047**	**2,673,964**	**2,592,145**	**2,300,000**	**1,120,000**	**2,100,000**	**1,120,000**	**1,900,000**	**1,350,000**	**9,890,000**	**25,687,192**
	ELIGIBLE (Y/N)										
1% FOR PUBLIC ART ELIGIBLE (Y/N)	**Y**	24,240	22,813	20,000	10,000	18,500	10,000	17,000	12,000	110,313	
PROJECT TIME LINE:			**2017E**	**2018E**	**2019E**	**2020E**	**2021E**	**2022E**	**2023E**		
PROJECT ADMINISTRATION			Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4		
CONSTRUCTION			Q3 Q4	Q3 Q4	Q3 Q4	Q3 Q4	Q3 Q4	Q3 Q4	Q3 Q4		