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Pierce County Transportation Plan

Transportation System Preservation Discussion

May 8, 2008

Pierce County

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Introduction

Pierce County has an extensive transportation infrastructure consisting of a 1500-mile county road system, a ferry system serving two islands, a public transit system, and a public airport. These transportation systems represent a large investment over many years and are relied upon every day by residents and visitors to Pierce County to provide them with reliable transportation service. It is unfortunately easy to overlook that elements of these roads, ferries, transit system, and airport wear out over time and need to be refurbished or replaced so that these transportation services can continue to be reliable. Ultimately the cost of replacing and refurbishing these systems needs to be identified in the update of the County Transportation Plan so that the total investment in transportation can be identified and trade offs can be made between priorities to fund with limited resources.

This paper will support the development of objectives and strategies in preserving the roadway system and the ferry system.

Preservation verses Maintenance

Replacing or refurbishing some element of a transportation system can sometimes be accomplished most effectively as part of what is often considered daily maintenance of the system. For this reason, it is important for the following discussion that we distinguish between preservation and maintenance for the purposes of updating the transportation plan and to assure that costs of maintenance addressed in a separate paper are not double counted as preservation.

Maintenance is considered a routine activity associated with repairing a physical asset or keeping the physical asset functional **during the asset's useful life**. Maintenance of the roadways includes such activities as repairing potholes, cleaning streets and culverts, or repairing a sign that is knocked down.

Preservation is the **replacement or repair of an asset after it has reached its useful life** to accomplish the same overall function. Some good examples of preservation are the replacement of a bridge, the repaving of a roadway, or the replacement of a sign when it is worn and faded and no longer adequately visible.

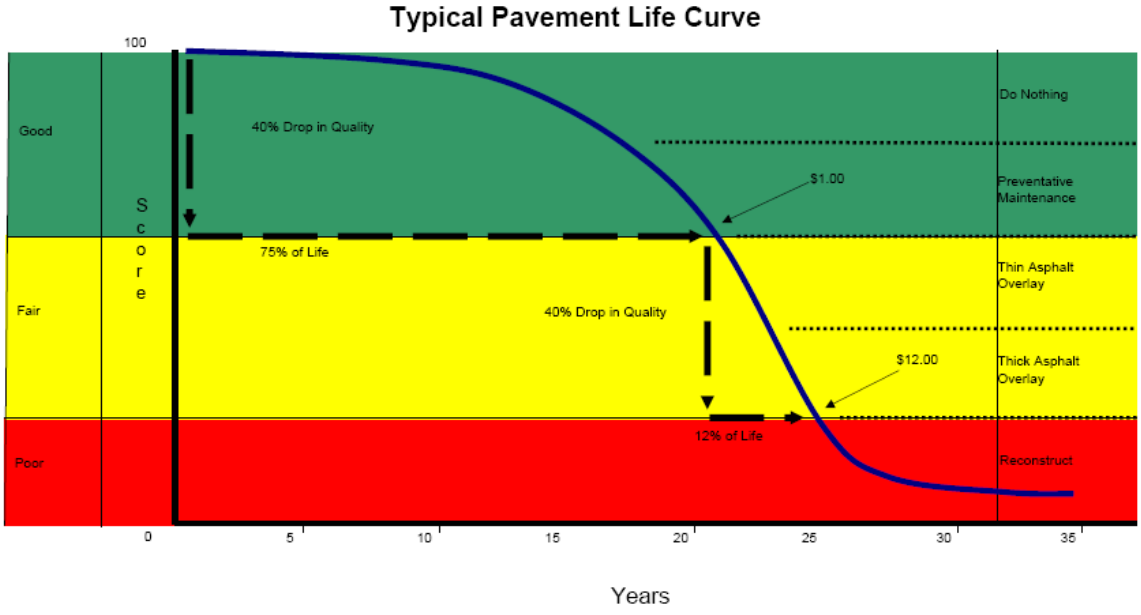
It is important to understand the strong relationship between maintenance of an asset and the cost of preserving or replacing the asset. If the asset is well maintained, it will maximize the useful life of the asset and minimize the cost of keeping the asset functional when it comes time to replace it. We all understand this relationship for our automobiles where regular changing of the oil and good maintenance can lengthen the life of the car and reduce our cost of having transportation. A familiar phrase is “pay me now, or pay me more later.”

There are some activities that are actually the replacement of refurbishment of the asset but occur frequently and are more effectively accomplished during routine maintenance. The preservation of such assets usually occur annually or even more frequently. For the purposes of developing a complete County Transportation Plan, while not double counting the cost of some preservation activities, below lists those activities that are accomplished in the maintenance of the transportation system.

Roadway striping
Raised pavement markers
Reshaping ditches
Grading gravel shoulders
Grading gravel roads

Goal is Lowest Cost in the Life-Cycle

In developing the awareness and discussion of how to preserve the existing transportation infrastructure, it is important to propose a goal of how we should preserve this system. All assets of these type deteriorate over time with use and the affects of time and weather. There is a point in that life-cycle of the asset that is becomes more cost effective to replace or refurbish the asset than to continue to maintain it. This can be described in the chart below which shows initial cost, salvage value, maintenance and operations cost, and preservation cost.



It would seem prudent to propose the following goals for preserving the system:

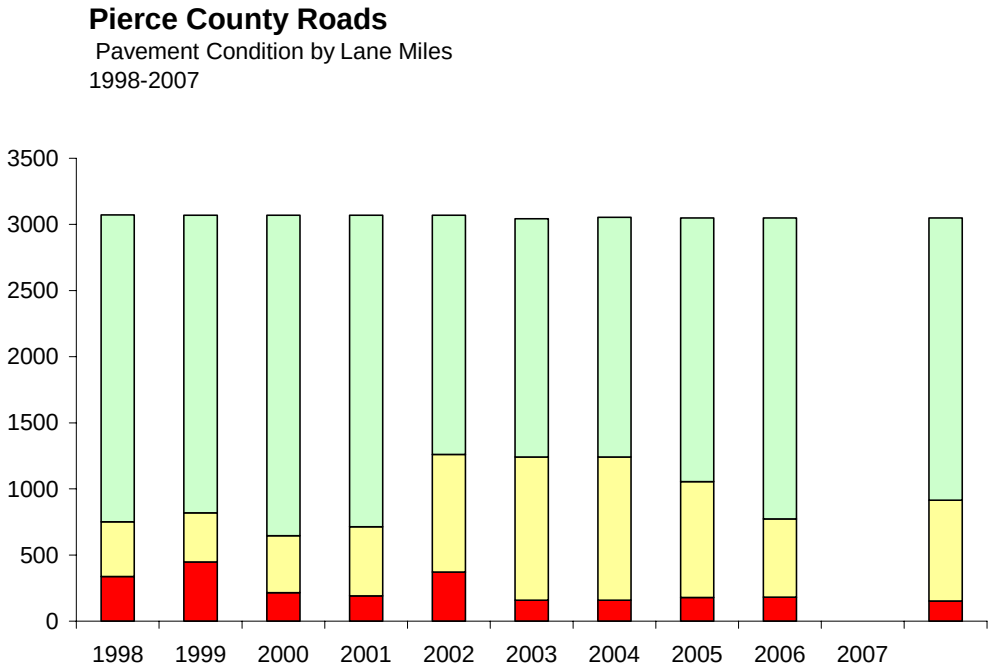
1. The transportation system should be preserved to providing for the continued use of nearly the whole system. While there may be very minor portions of the transportation system that are no longer useful, it does not seem reasonable, although possible, to not replace or refurbish a portion of the system. By doing so you would lose the use of the system which would be unacceptable to the public relying on the service.
2. Elements of the transportation system should be replaced or refurbished at the point of lowest long-term cost in the life-cycle of the element.

Trends in Preservation

The County road and ferry systems represent a huge investment over many years and keeping this transportation system in good working order has been a priority for these same years. The following discussion is a look at trends in the condition of roadways and the ferry system.

Roadway pavements

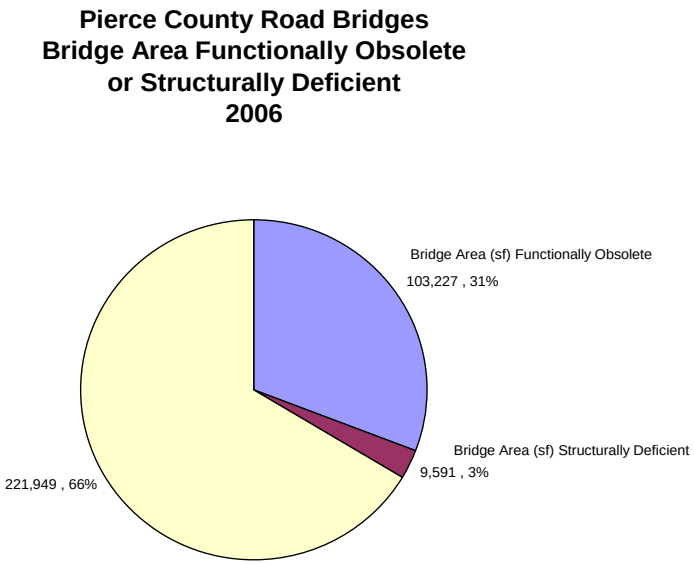
The most effective and systematic process for determining when an asset should be refurbished is for roadway pavement as part of the Pavement Management System which has been used by Pierce County for more than 15 years. Pavement condition is evaluated every other year for all roads (half of the roads each year) and pavement are evaluated for the depth of pavement ruts and the severity and amount of pavement distress. The optimal amount of the system in good, fair and poor condition is shown on the right of the graph as 70% good, 25% fair and 5% poor.



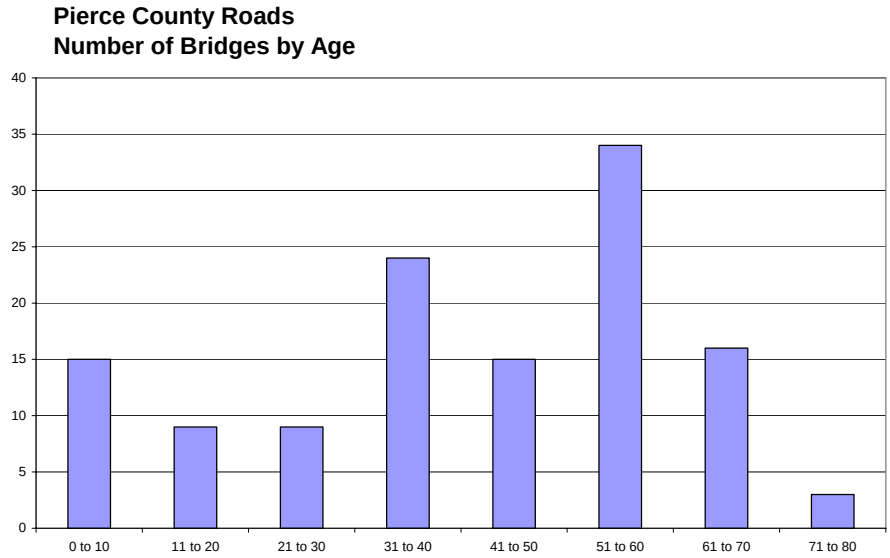
Data above shows a recent turn around in pavement condition which correlates to more investment in repaving of roadways and a more effective chip seal program by Road Maintenance. There is always a lag in pavement condition from when the investment occurs. The deterioration of pavement condition in 2002 and 2003 is a result of less investment in repaving during the preceding 3 years.

County Bridges

Another portion of the county road system that is analyzed regularly and has been the focus of much evaluation to know when it is time to refurbish or replace the asset is the county bridges. The State mandates a biannual review of all bridges to determine their condition. The result of this analysis is a rating of bridges to determine if they are functionally obsolete or structurally deficient. The graph below shows this rating for Pierce County bridges.



Also useful to understand is the age of our bridges. Bridges are designed to last 75 years. While structurally they may last longer, it is usually the case that bridges lasting longer than 75 years are functionally obsolete and still in need of replacement.

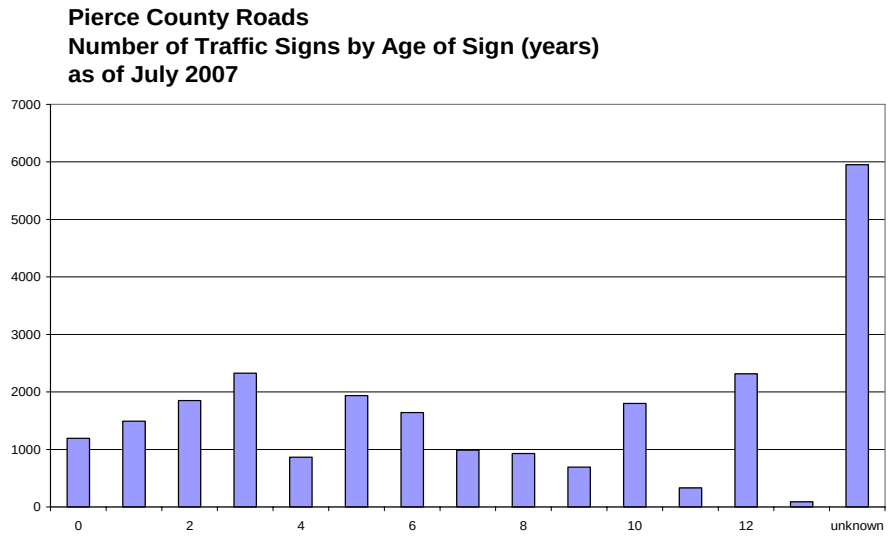


Traffic Signs

The County has done a good job at keeping a detailed inventory of traffic signs and reviews each sign regularly. It has just recently become a federal requirement that signs be replaced when the visibility of the sign at night falls below a prescribed visibility. There is a choice on how the County will determine when signs need to be replaced and it will likely be based on the average visibility of a sign based on the age of the sign. Different sign material fades at different rates. This

deterioration in visibility may look as shown below.

The age of signs on county roads is shown below.



In looking at the age of county road signs it is clear that replacing old signs is a priority and has been addressed in the county's road maintenance budget. There are large number of street name signs where the current inventory does not include the installation date. This will be added.

<u>Other Elements of County Roads</u>

There are many other elements of county roads including shoulders, drainage features, walls, guardrail, lights, and many more. Most of these elements have not had a systematic method of evaluating condition over time and a proactive method of replacing them when they reach their useful life or fail. The recent efforts in developing an Asset Management System for all roadway elements will close this gap and provide a scientific way of knowing the most cost effective time and method to replace or refurbish such elements.

County Ferries

County ferry system assets consist of the ferries, docks, terminal buildings, and a parking lot. The docks, or landings, are considered county road bridges and thus, deteriorate over time as any bridge would deteriorate. These bridges are inspected every other year and given a sufficiency rating along with other bridges. The Anderson Island landing was rebuilt in 1983, and the Ketron Island and Steilacoom landings were rebuilt in 1998. All three have a design life of 40 years so the Anderson Island landing, while still in good condition, is expected to require refurbishment within the 20 years of this plan. All three docks are in good condition.

The terminal buildings, or waiting facilities, at Anderson Island and Steilacoom were rebuilt in 1987 and 1986 respectively. Portions of these facilities will need refurbishment in the next 20 years as their currently fair condition deteriorates.

The ferries are handled differently due to Coast Guard requirements. The Christine Anderson and the Steilacoom II were built in 1994 and 2006 respectively. These ferries are required to undergo a dry dock repair every other year. This repair requirement is covered under the maintenance of the vessels, but the Coast Guard requires that the ferry be repaired to a condition equal to when it was constructed. This is for safe purposes, so while a ferry has a design life of 50 years, it is not allowed to deteriorate as other assets do. Therefore, the condition of ferries is always maintained as good.

The Extent of the System

The table below provides an overall view of the 20 year cost of preserving County roads and ferries. As can be seen, this estimate is based on a full inventory of the current assets and the average lifecycle and replacement/refurbishment cost.

Road Asset	Inventory Quantity	Unit	Life-Cycle	Replacement Cost	Cost/Year Per Unit	Annual Cost	20 -Year Cost
Pavement							
Urban - Primary Arterial	**173.39**	**lane-mile**	**18**	**$95,000**	$5,278	$915,114	$18,302,278
Urban - Secondary Arterial	**427.46**	**lane-mile**	**20**	**$99,650**	$4,983	$2,129,819	$42,596,389
Urban - Collector	**332.86**	**lane-mile**	**20**	**$112,935**	$5,647	$1,879,577	$37,591,544
Urban - Local Access	**1,174.27**	**lane-mile**	**21**	**$17,715**	$844	$990,581	$19,811,612
Rural - Arterial	**121.84**	**lane-mile**	**20**	**$101,975**	$5,099	$621,232	$12,424,634
Rural - Primary Collector	**257.86**	**lane-mile**	**7**	**$9,300**	$1,329	$342,585	$6,851,709
Rural - Secondary Collectors	**118.86**	**lane-mile**	**7**	**$9,300**	$1,329	$157,914	$3,158,280
Rural - Local Access	**446.48**	**lane-mile**	**8**	**$10,629**	$1,329	$593,204	$11,864,090
Delayed repaving due to other projects	**10.00**	**lane-mile**			-$95,000	-$950,000	-$19,000,000
Shoulders							
Paved (Total)	**111.73**	**miles**					
Asphalt	**72**	**miles**	**20**	**$43,000**	$2,575	$287,705	$5,754,095
BST	**40**	**miles**	**10**	**$4,250**			
Sidewalks	**493,633**	**sq yd**	**40**	**$90**	$2	$1,110,674	$22,213,485
Drainage Systems							
Catch Basins	**18,174**	**each**	**100**	**$1,725**	$17	$313,502	$6,270,030
Culverts (open ended pipe <50')	**941,516**	**lineal feet**	**50**	**$30**	$1	$564,910	$11,298,192
Dry Wells	**2,965**	**each**	**30**	**$3,800**	$127	$375,567	$7,511,333
Closed Storm Drains (pipe >50' and/or connected to CB)	**2,035,339**	**lineal feet**	**100**	**$65**	$1	$1,322,970	$26,459,407
Walls							
Soldier Pile	**4,416**	**sq ft**	**40**	**$75**	$2	$8,280	$165,600
Concrete	**26,074**	**sq ft**	**100**	**$70**	$1	$18,251	$365,029
Gabion	**12,834**	**sq ft**	**50**	**$65**	$1	$16,684	$333,684
Rock	**97,951**	**sq ft**	**40**	**$30**	$1	$73,463	$1,469,265
***R/R Tie Wood**	***3,604***	***sq ft***	***15***	***$63***	*$11*	*$402,171*	*$8,043,420*
***Concrete Bag Wall**	***34,698***	***sq ft***	***10***				
Guardrail	**160,100**	**lineal feet**	**75**	**$65**	$1	$138,753	$2,775,067
Bridges (125)	**399,941**	**square foot**	**75**	**$300**	$4	$1,599,764	$31,995,280
Luminaries	**473**	**each**	**30**	**$3,500**	$117	$55,183	$1,103,667
Traffic Signals							
Display Systems	**84**	**each**	**30**	**$150,000**	$5,000	$420,000	$8,400,000
Control Systems	**84**	**each**	**15**	**$20,000**	$1,333	$112,000	$2,240,000
Flashers and Beacons	**25**	**each**	**30**	**$35,000**	$1,167	$29,167	$583,333
Communication Systems	**63,360**	**lineal feet**	**30**	**$5**	$0	$10,560	$211,200
Traffic Signs	**25,323**	**each**	**15**	**$60**	$4	$101,292	$2,025,840
Pavement Markings	**4,387**	**unit**	**7**	**$120**	$17	$75,206	$1,504,114
Detention Ponds	**2**	**each**	**15**	**$10,000**	$667	$1,333	$26,667
Boat Launches	**7**	**each**	**50**	**$450,000**	$9,000	$63,000	$1,260,000
Ferries	**2**	**each**	**50**	**$12,000,000**	$240,000	$480,000	$9,600,000
Ferry Docks	**3**	**each**	**40**	**$2,860,000**	$71,500	$214,500	$4,290,000
Ferry Terminals	**2**	**each**	**40**	**$622,500**	$15,563	$31,125	$622,500
Ferry Parking	**1**	**each**	**40**	**$690,000**	$17,250	$17,250	$345,000
Ferry Ticket Systems	**1**	**each**	**10**	**$100,000**	$10,000	$10,000	$200,000
				TOTAL		**$14,533,337**	**$290,666,744**

Obsolete Construction Application (Not to be used for future replacements). Replacment cost determined by equal percentage of Soldier Piling, Concrete and Gabion wall future construction costs.

Estimated Life-Cycle of Transportation System Elements

The table above includes an estimate of the life cycle, for different elements of the transportation system, for the purposes of developing a 20 year estimate of the preservation needs of the transportation system. These design life values are based on both years of experience maintaining theses assets as well as investigation the experience of others across the country through literature reviews. The actual determination of when to replace an asset is based on the individual performance of that asset and a calculation of when is the most cost effective time to replace or refurbish the asset. This is done through a comprehensive Asset Management System. The preservation of assets is also not uniform over the 20 years and the overall targeted amount

for preservation should be balanced with the need for that year, while keeping in mind the need for subsequent years. In some cases, a preservation account will be needed since an asset replacement will come due all at once, such as a ferry.

Strategies for Replacing and Refurbishing Transportation System Elements

Asset management

The development of complete and comprehensive asset management systems for all road assets is a key strategy for being able to accomplish the goal of lowest life-cycle cost for these assets. A comprehensive asset management system includes setting levels of service goals, which for the preservation of an asset is lowest life-cycle cost; regularly collecting asset condition; developing and maintaining a complete inventory of assets; tracking all costs; collecting usage data; developing a method for valuing risk; developing a method for evaluating when and how to replace or refurbish the asset; and performance measures that provide information to best manage the resources used to manage the asset. Once all of these elements of a system are in place to manage an asset, program managers can confidently justify and allocate the resources needed to effectively preserve the assets. The cost to complete these asset management systems is estimated at $x with an annual cost of $y to collect the information and keep the systems current.

Pavements

The strategies for preserving the roadway pavement is a carefully developed combination of thin surfacing treatments including chip sealing with a variety of materials and slurry sealing, which while not rebuilding the structural strength of the pavement it does effectively prolongs the life of the pavement; pavement replacement at selected locations where a pavement patch can restore the structural strength of the pavement which is followed by a thin surface treatment chip sealing over that entire section of roadway; and repaving of heavier traveled arterials where a thin surface treatment will not effectively prolong the life of the pavement due to the heavy traffic breaking down the pavement. The miles of roadway treated as described can be seen in more detail in the table above which shows each category, treatment life-cycle, and costs.

As traffic grows, miles of county roads will need to be shifted to a higher level of treatment to be able to preserve the pavement. Roads that could be preserved with a chip seal application will experience increasing traffic to the point when only a repaving project will suffice. Given this reality, the cost for pavement preservation above shown as $133.6 million, in 2006 dollars, is expected to grow over the 20 year period of this plan. These costs are anticipated to be paid using primarily County Road Funds. About 10 miles of arterial roadways are repaved each year when a road is widened, augmented by a private development, or impacted by a utility. The preservation costs avoided by the County are reduced in the costs calculated to preserve the pavements as shown in the table above.

Shoulders and Sidewalks

Soft surface (gravel) shoulders are included in the daily maintenance of the roadway system and not considered in the preservation discussion above. Hard surface (paved) shoulders are included in the County's Pavement Management System and the shoulder condition is evaluated when the pavement in the lanes are evaluated. The same pavement condition rating system applies to these hard surface shoulders although the life span may be different than the pavement in the lanes.

The preservation of sidewalks needs to begin on a proactive basis, rather than relying on the current

system of reactive repair that is more costly in the long-term. Sidewalks need to be inspected every three years for condition and safety (Spaulling, cracking, settlement, or heaving). A threshold of sufficiency will indicate when sidewalks should be evaluated for replacement or refurbishment.

It is estimated that a preservation program for shoulders and sidewalks will cost $28 million over the next 20 years.

Drainage Systems

While drainage systems are currently inspected regularly to ensure that the operating condition is adequate and water can flow appropriately, the review of structural sufficiency of the drainage structures needs to begin on a proactive basis, rather than relying on the current system of reactive repair that is more costly in the long-term. Drainage structures need to be inspected on a periodic basis for structural condition and rated for structural sufficiency. A threshold of sufficiency will indicate when these drainage structures should be evaluated for replacement or refurbishment. It is estimated that a preservation program for drainage elements of roadways will cost $51.5 million over the next 20 years.

Bridges

Bridges are the third most expensive element of the roadway system and often the most difficult to budget for replacement because of the large expense comes in a single contract for each bridge rather than being able to spread the costs evenly over each year as can be done with preserving pavements. Bridges are typically only replaced when they have a Sufficiency Rating below 50 and are structurally deficient or functionally obsolete. Because of the large expenses, the County usually relies on federal bridge funding distributed by the state. The County's match for these funds is 10%. While as of late this federal funding has become increasingly hard to get, the County will still rely on this resource. The cost to the County for bridge replacement is estimated at $3.6 million over the next 20 years with $32.7 million in federal funding assumed for this plan.

Ferry docks are also considered county road bridges. That portion of the docks including the dock, transfer span, pontoon, apron, fenders and dolphins are all considered federally eligible bridges. The County will treat these docks as other county bridges and request federal funding to replace them when needed. The costs are included above.

Walls

The preservation of walls needs to begin on a proactive basis, rather than relying on the current system of reactive repair that is more costly in the long-term. Walls need to be inspected semi-annually for structural condition and rated for structural sufficiency. A threshold of sufficiency will indicate when walls should be evaluated for replacement or refurbishment. It is estimated that a preservation program for walls will cost $10.4 million over the next 20 years.

Guardrail

Guardrail is currently inspected every other year to detect unreported damage. The replacement of guardrail occurs when guardrail is upgraded to the newest standards, which may occur with a roadway improvement or preservation project, or may occur as part of the County's guardrail improvement program. While the guardrail improvement program is usually focused on installing guardrail on county roads at new locations warranting guardrail, some of the older sections of

guardrail that are furthest from meeting current guardrail standards are also replaced. Some state grants may be obtained for updating guardrail but this is sporadic and although it should be pursued, it was not assumed in this plan. The estimated cost to upgrade guardrail in these projects is $2.8 million over the next 20 years and should be added to the guardrail improvement program covered in the safety portion of this plan.

Electrical Systems

The County has a significant investment in electrical systems that facilitate the effective and safe operation of roadways including traffic signals, communication systems, illumination, beacons, and electronic signs. These electrical systems are increasingly more sophisticated and include computer systems to control them. As with any information technology, these computerized control systems need to be upgraded and/or replaced more often than the other portions of the electrical systems such as a pole or wiring. While the cost of upgrading systems is included in the Maintenance and Operations costs discussed elsewhere, the replacement of control systems is estimated to be needed every 10 years at a cost of $2.2 million over the next 20 years. While it is largely assumed that the number of roadway miles will not substantially increase for the County over the next 20 years, the number of electrical systems is assumed to grow by 120 traffic signals (an increase of 230%) and 2240 luminaries (an increase of 370%), so the cost to preserve this system is also increased over this time period. This replacement cost is assumed to be fully covered by the Count Road Fund as it has been for many years.

The other, more expensive portions of the electrical systems are monitored as would any other element of the roadway through an asset management system that determines the most cost effective time and method to replace the element. A good example of this is the yearly inspection of traffic signal poles to evaluate their structural integrity.
$10.3 million

Pavement Markings

Pavement markings that are replaced each year by maintenance crews, such as striping, while technically “preservation”, are not included in this discussion but are included in the discussion on Maintenance and Operations. Pavement markings that have a multiyear life, such a crosswalk, stop bars, arrows, letters, etc. are replaced when a significant portion of the marking wears away or loses its legibility. Each pavement marking is evaluated yearly to determine when it needs to be replaced. While this work is accomplished by maintenance forces, it is considered a preservation cost rather than a maintenance cost. It is estimated to cost $1.5 million over the next 20 years for preserving pavement markings and it is assumed to be fully covered by the Count Road Fund as it has been for many years.

Signs

Traffic signs have extensive history of tracking condition over time and new regulations from the federal government requires that a comprehensive program of sign replacement be establish by all jurisdictions. These regulations require that a sign be replaced when it has fallen below a prescribed legibility. While there are several ways to manage the visibility of signs, the County has selected a method of sampling the visibility of signs based on the type of material used on the sign, the color of the sign and the age of the sign. These are the factors that overwhelmingly determine the visibility performance of a sign. Given this method the age of signs will be the most significant indicator of

condition. Pierce County has a long history of effectively monitoring and replacing each traffic sign at the most cost effective time. This effort will be further refined through asset management system development. The cost to replace these signs is assumed to be fully covered by the Count Road Fund as it has been for many years and is estimated to cost $2 million over the next 20 years.

Detention Ponds

Most detention ponds have been turned over to another part of Pierce County Public Works and Utilities in Water Programs. The two remaining ponds will be rehabilitated as needed based on their need to retain their full functionality. Since these ponds will be part of the asset management system developed by Water Programs, the most cost effective time and method to rehabilitate these ponds will be determined along with the other 400+ ponds owned by Pierce County. The current estimate to rehabilitate these ponds one time during the next 20 years is $27,000.

Boat Launches

Since boat launches are actually an extension of the County Road into the Puget Sound, they are included and treated as a portion of the roadway in the Pavement Management System. This means that they are inspected annually to look for the same signs of deterioration as other pavements are, even though they are concrete, which means they will last much longer than asphalt pavements. These assets are assigned a pavement Condition Rating, and as with pavements, when that rating falls below 70, they are considered for rehabilitation. The cost estimated to rehabilitate or replace these launches is $1.3 million over the next 20 years.

Ferries

The two ferries owned by Pierce County have been funded by a combination of County Road Funds and Public Works Trust Fund loans that are being repaid by state funding. While it is difficult to know if this source of funding will be available in 40 to 50 years when the ferries need to be replaced, it is reasonable to assume that half of the cost of replacing the ferries will be paid by a loan. If the state funding is not available to repay the loan at that time, it is assumed that ferry users will pay higher fares or other fees, such as a ferry district fee, to cover the repayment of the loan. The other half of the ferry replacement cost will be covered each year in the budget process to form a replacement fund. It is assumed that this fund will gain interest over time and be fully available when the ferries need to be replaced. It is estimated to cost the County Ferry Fund $3,940,00 over the next 20 years toward this preservation expense that will occur in 40 to 50 years.

Terminals

There are two ferry terminals which need elements replaced at different times just as any building needs. An asset management system will monitor the condition of each element of the terminals and determine the most cost effective time and method to replace them. Unlike the docks, these facilities are not eligible for bridge funding and the County is unlikely to receive state fund for these buildings. The cost of replacing or rehabilitating these facilities will be annualized and included fully in the budget. As with the ferries, a preservation fund will be built up over time and is assumed to collect interest so that the full cost of replacing or rehabilitating these facilities is covered by the preservation fund. The 20 year cost for these terminals is estimated to be $640,000.

Ferry Ticket System

A new ticket system for the ferries was purchased and implemented in 2007. As with any significant

information technology system, hardware and software need to be upgraded and replaced at periodical intervals to maintain the ability to operate in the global information technology environment. While it is estimated that yearly maintenance and operations costs will cover any upgrades, it is estimated that the system will need to be replaced in entirety every 10 years or at least once during the 20 year time period of this plan. The estimated cost is $125,000, based on the cost of the new system.

Policies

The following policies are proposed for the Update of the Transportation Plan to address transportation system preservation:

- To maximize County funding resources , transportation assets should e replaced or rehabilitated at the point of lowest cost in the life-cycle of the asset.
- The cost effective preservation of the existing and future transportation system will be a priority for funding ahead of expanding the system.
- The preservation of transportation assets should be managed in the most cost effective way through comprehensive asset management systems.
- Accounts established for the future preservation of a transportation asset in the County's financial system should keep interest earnings to ensure that the purchasing power of these accounts keep up with inflation.

Key Performance Measures

The condition of transportation assets is measured as in integral part of an asset management system. Each element of the transportation system defined in table 1 above will be evaluated at established intervals and an overall condition of each element will be developed and reported yearly in preparation of the annual budget. An example of this performance measurement is shown in the pavement condition graph above.