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Pierce County Transportation Plan

Road Maintenance and Operations

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Introduction

Pierce County's roads serve a fundamental community need by providing for the movement of people and goods. Our citizens need roads in order to get to their places of employment, to have access to emergency services, businesses, retail outlets, schools and for recreational activities. Pierce County's economy is dependent on the transportation system to move equipment and raw materials and to ship products to market. In short, a well maintained and operated road system is an essential element in the development and the sustainability of a livable community and a high quality of life.

We immediately appreciate the value of a well maintained and operated roadway when they become impassable due to ice, flooding or other emergencies. Roads have become even more important as Pierce County's population has grown and traffic volumes have increased. As our county is developed and becomes more urbanized, our road network not only experiences additional usage, it becomes increasingly more complex, and consequently more expensive to maintain. Our county road inventories that were once comprised primarily of narrow two-lane roads that followed the section lines of agricultural land and the natural geography of our county are rapidly being replaced by high volume arterials, curvilinear residential roads and cul-de-sacs.

Why Is Road Maintenance Important?

Pierce County Public Works, Road Operations Division is responsible for the maintenance, operation, and preservation of the county's 3,100 lane miles of public road. Rapid population and economic growth in Pierce County has resulted in unprecedented increases in traffic volumes. Consequently, this rapid growth has led to a steep increase in transportation related needs that could easily outpace available resources if programs are not well prioritize and managed. Maintaining and operating a large road network is very expensive, and as we have learned from the unfortunate examples set in other counties and cities in the region, it can be tempting to prioritize improvement projects ahead of sound maintenance and operations programs. The long-term outcomes of deferred road maintenance are often financially devastating and always result in the need to expend more dollars exponentially than were saved in order to return the assets to a condition that can be efficiently maintained and operated. We are familiar with an old saying, "Pay now, or pay more later."

Program Description

Maintenance

Maintenance activities comprise the largest portion of the responsibilities of the Road Operations Division, representing \$12.4M or 51% of the annual Road Operations Division budget. Maintenance activities include:

- routine pothole and other pavement repair
- storm drainage repair
- bridge, guardrail and sidewalk repair
- shoulder and gravel road grading; and,
- roadside vegetation control

It is critically important that annual road maintenance programs not only produce the desired service level outcomes for each asset, but these programs must also be appropriately scheduled, balanced and coordinated with preservation programs within the life cycles of all road assets. An imbalanced program leads to inconsistent highs and lows in budgets and resource requirements that are very hard to manage and are not as cost effective. A well balanced program is cost efficient, less prone to risk factors, provides for more efficient contracts when outsourcing work, and provides for better employee development and retention when in-house forces are used.

Operations

Operations and emergency response functions account for just under \$5.28M or 22% of the Road Operation Division's annual expenditures yet are some of the most important activities within the Division's realm of responsibility. Operations services provided by the Division include:

- snow and ice removal
- road flooding response
- hazardous materials spill response in the road right-of-way
- wind storm response
- mudslide removal
- volcanic disaster, earthquake, and other emergency related response

Other important non-emergency operational functions include:

- street sweeping
- roadside mowing
- storm drain cleaning; and,
- removal of roadside litter and dead animals from the road right-of-way.

Many of the operational needs of Pierce County's roads result from unpredictable disasters and weather related emergencies. As a result, historic averages must be utilized when preparing long range-plans. Well-balanced maintenance, operations and preservation programs improve the Division's ability to optimize response efforts when these events are the most severe. This is true because balanced programs result in consistent baseline staffing levels over time. This then affords the Division's leaders the ability to better prepare plans which optimize the overall output and coverage produced by full-time staff, and to determine when it is most beneficial to augment forces with seasonal staffing and rental equipment.

Pavement Preservation

Pavement preservation is a critically important component of the Road Operations Division's mission, accounting for \$6.85M or 28% of the annual budget. Pavement preservation is covered in detail separately in the Department's Preservation White Paper. Pavement preservation services provided by the Division include:

- annual pavement condition inspection and assessment
- pavement management planning
 - asphalt overlay program development
 - chip sealing program development
 - liquid asphalt surface treatment program development
 - pavement management research and development to constantly improve methods and means

Service Level Goals

Emergency Operations

The safety of the traveling public and Road Operation's personnel are the Division's highest priorities and shall be given primary consideration at all times. For this reason, response to emergencies that affect the roadway is to take precedence over all other non-emergency work.

The Division has developed a National Incident Management System (NIMS) compliant Continuity of Operations Plan (COOP). The Division's COOP contains detailed objectives and emergency response plans for the emergencies and disasters that are most likely to affect Pierce County's road network. The table below outlines these threats by type, probability and potential impact to the roadway.

Threat and Vulnerability Assessment

Hazard/Threat	Probability			Impact		
	Low	Med	High	Low	Med	High
Snow & Ice			X			X
Flooding & Mudslide			X			X
Windstorm		X				X
HazMat Release		X				X
Emergency Traffic Disruption		X				X
Earthquake	X					X
Volcano	X					X
Terrorism, CBRNE	X					X

Emergency Response level of service objectives:

- Reduce loss of life, minimize damage and losses respective to the transportation network;
- Execute as required, successful succession of the department’s management with accompanying authorities in the event a disruption renders the division’s leadership unable, unavailable, or incapable of assuming and performing their essential operational responsibilities;
- Reduce or mitigate disruptions to routine operations;
- Ensure that the division has alternate facilities from which to continue to perform their essential functions during a COOP event;
- Protect essential facilities, equipment, vital records, and other assets;
- Achieve a timely and orderly recovery from an emergency and reconstitution of normal operations that allows resumption of the delivery of essential services; and
- Ensure and validate the Division’s readiness to respond to emergencies through training, and exercise programs to support the implementation of the COOP when needed.

Maintenance and Operations

Maintenance and Operational level of service goals are derived from lowest lifecycle cost philosophy. In other words, each asset must receive the amount of attention and service that will result in its operating safely and at full function for the least cost over time. These levels of service are meant to provide guidance to a road supervisor when evaluating work accomplishments, and to establish a level of consistency of maintenance services throughout the County coincident with an identified lowest lifecycle cost. Customer expectations can also affect service level goals.

For example, roadside landscaping and other roadside features which provide aesthetic value may require a level of service that exceeds that suggested by a lowest lifecycle cost model.

Changes in available funds, equipment, or personnel will require that the level of service be adjusted from time to time by trained maintenance personnel. Consequently, level of service goals do not establish legal standards, as they are meant to function primarily as a guide in the delivery of road maintenance and operations services. The judgment of trained maintenance personnel must be relied upon as to what methods and materials are most proper to achieve the Division's mission.

Pavements

The paved roadway is the improved or traveled portion of a public road designed for vehicular traffic. The maintenance and operations of pavements includes the upkeep and repair of the portion of the roadway designated for the movement of vehicles, exclusive of shoulders and auxiliary non-motorized lanes. The level of service goal for pavement surfaces is that the features will be cleaned, sealed and repaired in order to maintain as nearly as practicable their original "as-constructed" or subsequently improved condition.

Shoulders

Shoulders are those portions of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses. The service level goal for road shoulders includes:

- ruts along the pavement edge should be eliminated periodically by light blading or pavement widening with stabilized materials.
- ruts or depressions in excess of three (3) inches in depth should be repaired by filling with stabilized materials as soon as practicable after the condition is observed or reported.

Storm Drainage

Water, either liquid or frozen, is the greatest natural destructive force affecting roads. To control water on the right-of-way, a drainage system, including ditches of all types, gutters, drains, culverts, storm sewers, and other miscellaneous drainage structures, is provided as part of the road facility. The system is designed and constructed to collect and remove water from the roadway prism and must be properly maintained to permit the maximum use of the roadway, to prevent damage to the roadway structure, and to protect the abutting property from damages.

The level of service for drainage facilities is that the features will be inspected, cleaned and repaired as needed to retain their original as-constructed condition and functional capacity. Actual patterns of usage and/or function may lead to levels of service being increased or decreased as needed.

The entire drainage system is to be inspected at least once a year and deficiencies corrected as soon as is practicable. Additional inspections during heavy storms and periods of high runoff are required to determine the effectiveness of the system, to observe high water marks, and to discover conditions that threaten damage to the drainage facility or roadway.

Retaining Walls, Guardrails & Bridges

Maintenance and operation of retaining walls, guardrails and bridges includes:

- cleaning and graffiti removal
- repair and replacement of failed or damaged asset elements, e.g. – bolts, handrails, wooden posts, etc.
- erosion and scouring repair
- areas near these assets shall be kept free and clean of vegetation and debris.

The service level goals for retaining Walls, guardrails & bridges are that these features will be maintained and operated in as nearly as practicable their original “as-constructed” or subsequently improved condition.

Roadside Vegetation and Landscaping

Roadside vegetation may exist in areas between the outside edges of the shoulders and right-of-way boundaries, and/or within traffic islands/round-a-bouts. Natural or artificially established growth within the right-of-way must be controlled to prevent obstruction of sight distance or unwanted shading of the roadway.

The level of service for roadside vegetation is that established foliage will be cut, trimmed, mowed or chemically controlled in a manner that supports a safe and clear roadway corridor, controls erosion, limits damage from vegetation to other roadway features, and minimizes fire hazards.

Snow and Ice Removal

Removal of snow and ice from the roadway is considered to be work of such importance that it is classified as an emergency operation and is to take precedence over all other non-emergency work.

Snow and ice emergencies are unique in that they can affect the entire road network simultaneously. Because snow and ice events are not predictable and can have a wide range of intensity, outcome and duration, the level of service for this core function is to optimize the use of available resources in support of keeping the County’s road network functioning as safely as possible throughout the snow and ice event. The Division delivers this level of service by following a detailed snow and ice response plan. It is understood that this plan cannot eliminate all the impacts or effects of a snow and/or ice emergency. Rather, the intent of this plan is to maximize the use of available resources in order to reduce the threat to public safety from a snow and ice emergency.

Each of the four geographic road operations districts have a pre-established priority listing of roadways to sand, plow and anti/de-ice. Priorities are established by the following designations:

- Major arterials and collectors
- Life Line Emergency routes
- Pierce Transit and school bus snow routes
- Access roads to highways, freeways and park and ride lots

Four Phases of Response

Pierce County Road Maintenance and Operations Division will mobilize road crews based upon the severity of a snow and ice event. There are four phases of response, procedures, resource allocation, and coordination efforts crafted to address major storm events as listed below:

- Phase 1 A significant storm is forecast. Measurable snow accumulation and/or a severe black ice condition with temperatures below 30 degrees are predicted. The following steps are implemented:
 - 1) Division Manager is alerted.
 - 2) Each area is checked for snow or freezing conditions.
 - 3) Supervisors may schedule applications of anti-icing agents.
 - 4) Maintenance crews prepare equipment for snow and ice operations.
 - 5) Supervisors will adjust initial response schedules as the weather event unfolds.
 - 6) Citizen and emergency services requests for action will be assimilated into response schedules as priority calls in Phase 1.
 - 7) Crews are on 8-hour shifts during this phase unless the event occurs after hours at which time the on call Supervisor will dispatch personnel as conditions warrant. Personnel may be required to work more hours if the response phase is upgraded, or if conditions warrant.
- Phase 2 Snow or freezing conditions have occurred. The need for response is widespread due to compact snow or ice accumulations. The following steps are implemented during this phase:
 - 1) Public Works Director is alerted.
 - 2) All maintenance crews are divided into 8 hour day and night shifts (which may be expanded to 12 hour shifts at the Superintendent's discretion) to provide 24-hour coverage for commuters.
 - 3) Snow and ice teams are assigned specific areas within each division and provide maintenance and support to the established priority routes within those specific areas.

- 4) Citizen and emergency services requests for action will be noted and incorporated into the pre-established lifeline and arterial routes as applicable.
 - 5) All personnel keep detailed records of the response activities performed during each shift.
- Phase 3 The long-range forecast calls for hazardous conditions to continue. The following steps are implemented during this phase:
 - 1) Crews adjust to 12-hour shifts for 24-hour per day coverage.
 - 2) The Road Operations Manager is continuously updated and advised of maintenance progress and/or problem areas.
 - 3) Status reports are provided to the Director of Public Works once daily, and as significant changes occur.
 - 4) Additional departments within Pierce County are requested to provide support to crews.
 - Phase 4 The long-range forecast calls for no additional snow accumulations and/or warmer temperatures. The following steps are implemented during this phase:
 - 1) Shifts will be adjusted as conditions and priorities dictate.
 - 2) As priority lists are completed, focus will turn to collector and local access roads as resources allow.
 - 3) Large accumulations of snow and ice will be removed from the traveled way and drainage courses.
 - 4) Sand removal operations will begin immediately following conclusion of emergency response efforts.

Litter and Debris Removal

Litter and debris includes all materials placed, dumped or discarded by the public within the public road right-of-way. The level of service for litter and debris removal is that these materials will be removed as follows:

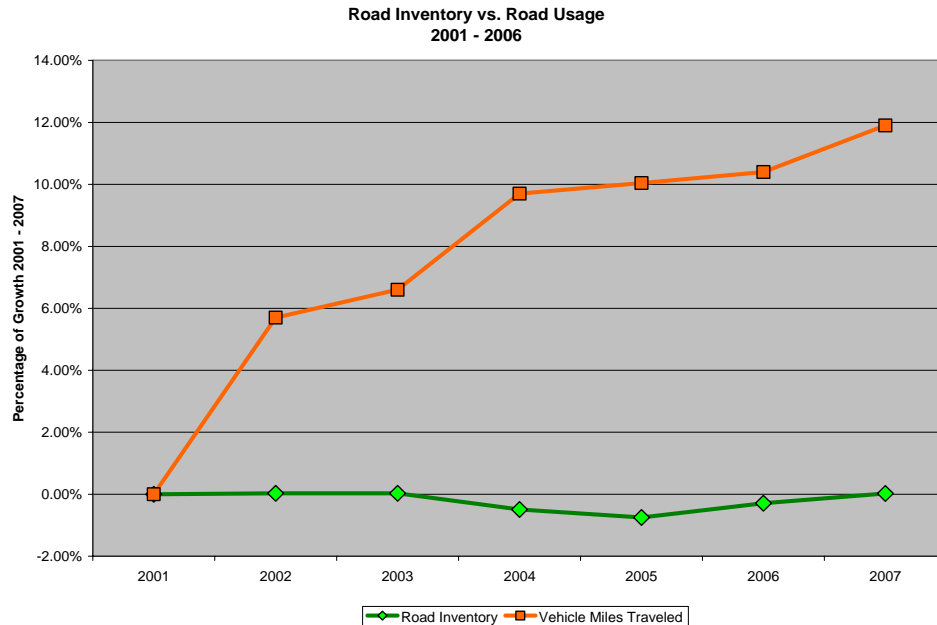
- Large deposits of litter or debris that create a safety or health hazard will be responded to immediately once the Division becomes aware of the condition.
- Large deposits of litter or debris that do not pose an immediate safety or health hazard will be removed as soon as is practicable once the Division becomes aware of the condition.
- Scattered litter or diffuse accumulations of litter and debris along the roadway will be collected and bagged by Pierce County Corrections crews and volunteer Adopt-A-Road litter control crews as resources allow. Once the litter and debris is collected and bagged, Road Operations will dispose of the material within 24 hours or the next business day.

Trends

Year	Lane Miles	Vehicle Miles Traveled (Millions)	Number of Fulltime Employees	Lane Miles per Employee	O & M Budget (Millions)	O & M \$ per Lane Mile	O & M \$ per Capita (unincorporated)
2001	3069	991.8	165	18.6	\$14.27	\$4,649	\$44.07
2002	3070	1048.2	163	18.8	\$14.65	\$4,774	\$44.53
2003	3070	1057.7	158	19.5	\$15.05	\$4,904	\$45.20
2004	3054	1088.1	159	19.2	\$15.46	\$5,063	\$45.54
2005	3046	1091.4	161	18.9	\$15.78	\$5,181	\$45.61
2006	3060	1095	163	18.7	\$16.31	\$5,330	\$45.93
5 yr % of Change	0%	10%	-1%	1%	14%	15%	4%

The number of lane miles of road in the county's inventory has changed little over the last decade. Though new roads are being constructed every day, annexations and incorporations from the 24 cities that are in Pierce County keep the inventory totals nearly static.

What has changed steadily over time is the usage and composition of our road inventory. The usage of Pierce County's road system has increased at a rate of over 2% each year. The annual Vehicle Miles Traveled (VMT) was 991.8 million in 2001, and is projected to have risen to over 1.1 billion in 2007. Increased road usage results in accelerated pavement deterioration.

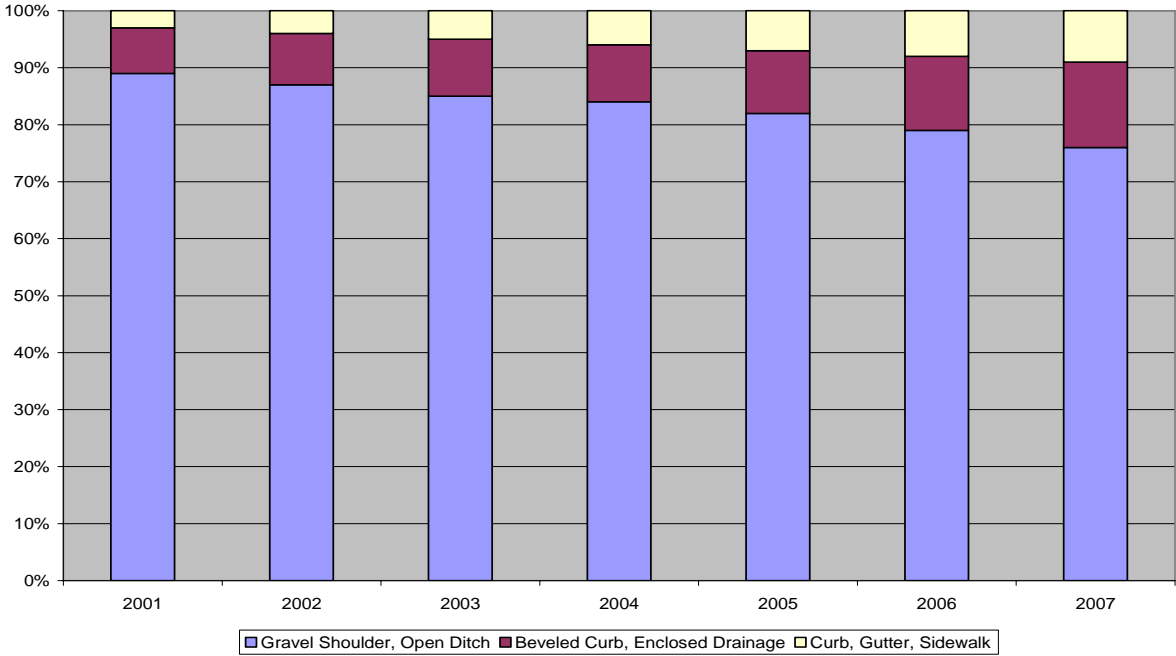


With increased population densities in unincorporated Pierce County comes the urbanization of our road system. A typical rural county road is generally two lanes with a gravel shoulder, open ditches and driveway culverts providing ingress/egress at each adjacent property. Maintaining and operating these types of roads is fairly simple and comes at a relatively low cost. Open drainage systems require low maintenance, and can be visually inspected in entirety from the road edge. Roadside vegetation is usually comprised of native species and can be inexpensively trimmed or controlled with herbicides. These types of roads can be swept by broadcasting materials onto the road shoulder mitigating the costs of capturing, transporting and processing sweeping tailings.

Today, nearly all new roads are constructed or reconstructed to include enclosed storm drainage systems with raised or beveled curbs. Additionally, on arterial roads, new construction includes sidewalks and landscaped traffic islands.

These urbanized roads are 5 to 10 times more expensive to maintain and operate per lane mile compared to typical rural roads. Storm drainage systems are enclosed and must be cleaned with specialized equipment. Enclosed storm drainage is not easily inspected and requires the use of camera equipment. When enclosed storm drainage fails, repairs involve expensive excavation which requires that pavements at the surface be removed and restored in order to gain access. Sweeping costs are much higher because materials cannot be broadcast to the road shoulder and must be collected, hauled, and processed at permitted street waste disposal facilities. Additionally, the raised curb and gutter configuration constrains virtually all the materials within the traveled way increasing the frequency requirements of road sweeping.

Percentage of Road System by Type



Key Issues and Challenges

Over the course of the last decade, several key issues have emerged which together significantly increase and compound the resource requirements and costs associated with the maintenance and operation of Pierce County’s road system.

Competition for Available Funding

The competition for road fund dollars has and will continue to increase at a very high rate. As the county’s population has increased, so has traffic congestion and pavement wear. Many of the county’s primary arterials have failed concurrency, or are projected to fail in the near future. The resulting high cost improvement projects are in direct competition with maintenance and preservation programs for available road fund dollars.

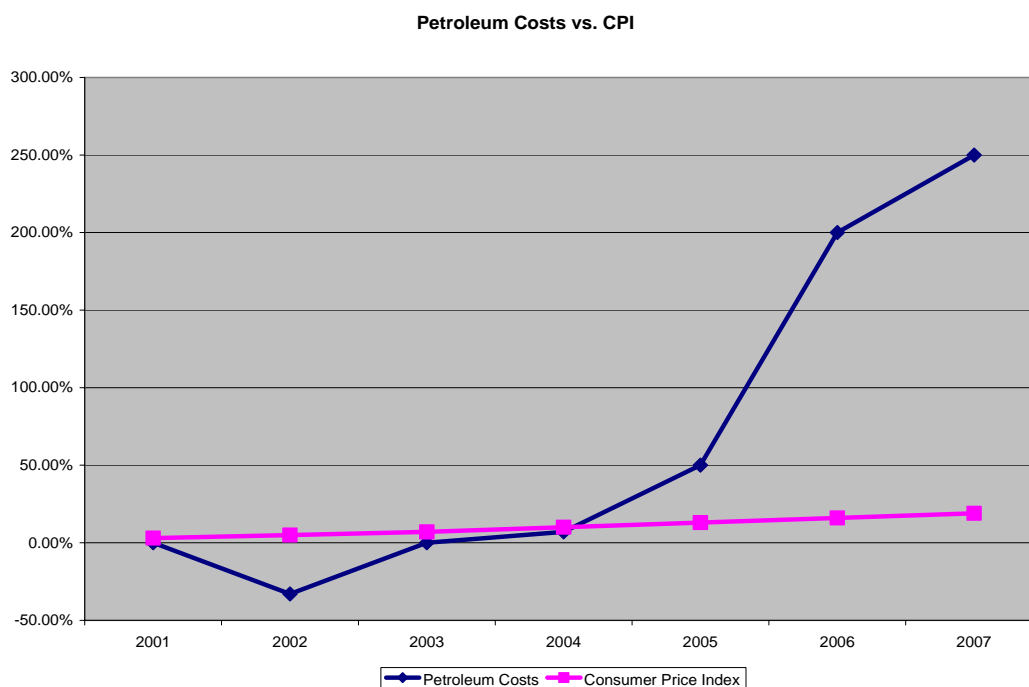
Usage and Deterioration

Very heavy road usage not only causes traffic congestion, these same roads deteriorate at a faster rate and consequently experience abbreviated pavement life cycles. These facts translate into significantly higher pavement maintenance, operations and preservation costs over time. Though to a somewhat lesser degree, these same factors also amplify the resources required to maintain, operate and preserve the assets outside of the pavements including: roadside storm drainage; roadside vegetation and landscaping; sidewalks, curbs, and traffic islands; guardrails and bridges; and road shoulders.

Increasing Costs of Resources

Significant increases in OSHA requirements, combined with increased traffic volumes, have resulted in traffic control resource requirement increases from 200% to 500% over the last decade.

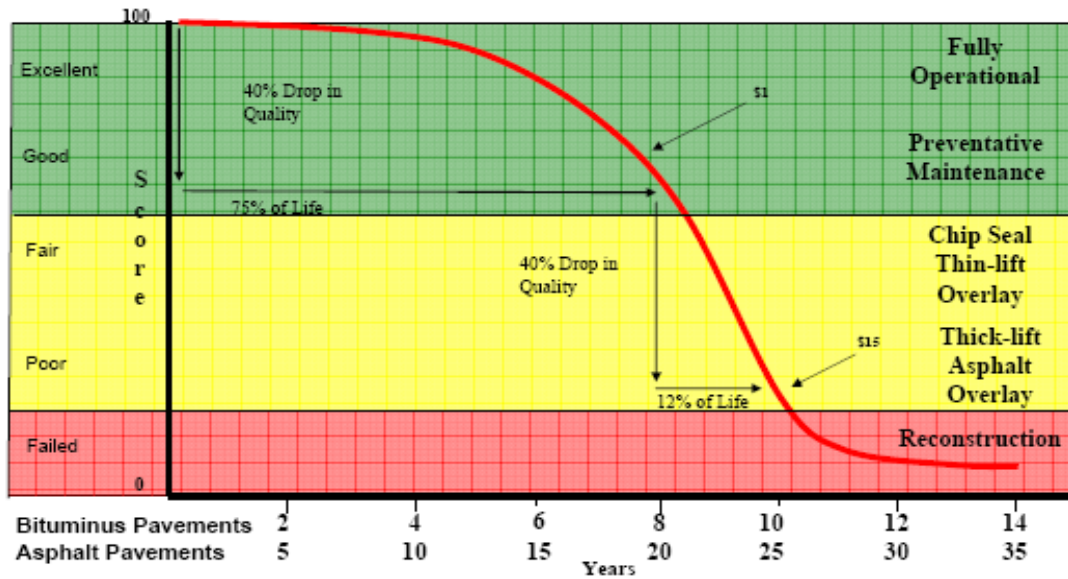
Cost increases for fuel and other petroleum based materials have significantly exceeded the average rate of inflation each year since 2003. Diesel cost increases have resulted in escalated equipment rental rates of 7% in 2006 and 8% in 2007. Concrete asphalt products (HMA) costs have increased 31% since 2005. Liquid asphalt products more than doubled in price since 2003.



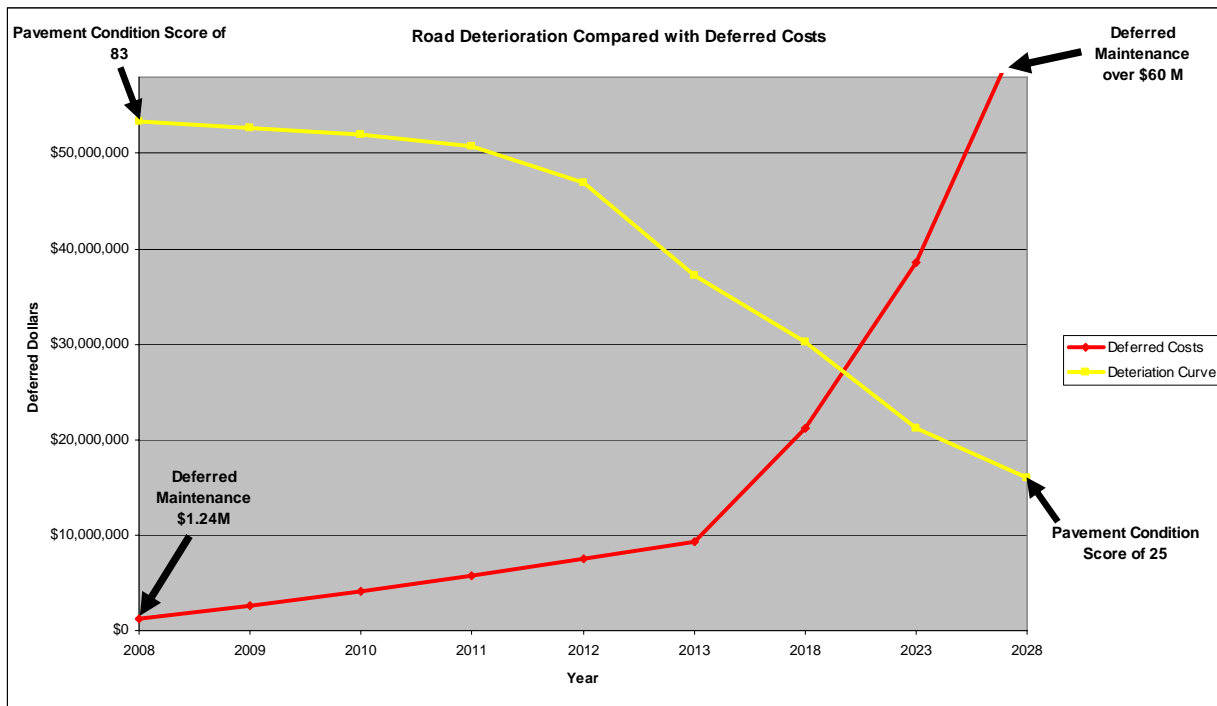
Deferred Maintenance and Preservation

Many large cities and counties in the Pacific Northwest have made decisions to defer road maintenance, operations and preservation programs resulting in nearly insurmountable consequences. A well maintained road system looks good and operates well. To an uninformed person, intuition may lead to a belief that road maintenance and preservation funding may be temporarily re-appropriated with little downstream consequence. The reality is that pavements are relatively affordable to maintain, but are very expensive to reconstruct.

Typical Pavement Life Curve



For example, the graphic below illustrates what is projected to occur if road maintenance and preservation programs were not funded at the levels that keep up with relevant inflation trends. The county would accumulate virtually insurmountable deferred costs in only a few years. The chart below depicts current 20 year projections if maintenance and preservation levels of service were underfunded by only 3% per year.



In only five years, deferred costs will have risen by nearly ten times. By the year 2028, virtually every road in the County will require full reconstruction.

Program Goals and Key Measures

The goals of Pierce County Public Works, Road Operations Division road maintenance, operations and preservation programs are to maintain, operate and preserve the county's transportation network at full functionality in the safest and most efficient manner possible. In order to do this we set and meet service level goals which support balanced, lowest life cycle models for the pavements and all other road system related infrastructure. Such an approach is intended to keep Pierce County's road system well maintained and operating 24/7 as cost effectively and safely as possible.

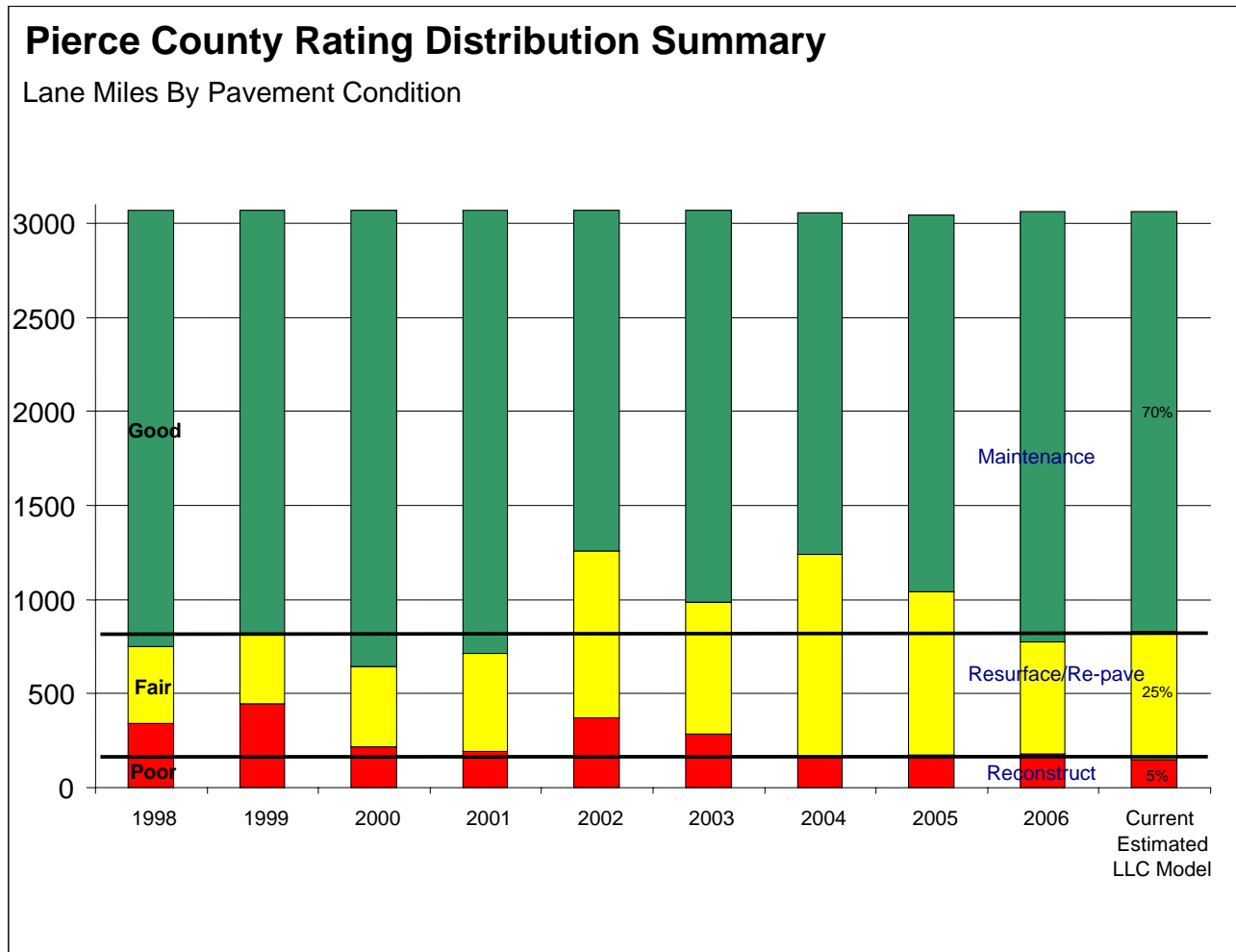
Pierce County Road Operations Division Management estimates its road system assets are valued at approximately \$4.5 Billion. Our road system is the County's most valuable public asset and must be properly maintained, operated and preserved in order to retain this value while minimizing long-term costs to the public.

The Division utilizes an Asset Management approach in order to achieve this goal. All assets within the public road right-of-way are inventoried. Service level goals are established, each with the objective of reaching and sustaining a lowest life cycle cost model for each asset category. These features are then inspected and actual condition data is utilized to develop annual maintenance and operations plans. In short, the goal is to deliver the right work, in the right place, at the right time in order to keep the road system fully functional for the least amount of dollars over time.

Measuring performance is critical component of asset management. Key performance measures for road maintenance and operations include: Pavement condition; shoulder and sidewalk condition; storm drainage condition; bridge condition; guardrail condition; and, roadside vegetation and landscape condition.

Table A is an example of how outcome and progress toward such a goal is measured over time. The chart depicts the percentage of pavements in *Good, Fair or Poor* condition. *Good* condition is defined as a pavement that shows minimal to no deterioration and requires no immediate maintenance or preservative application. A *Fair* pavement shows moderate deterioration and will need regular preventative maintenance and a preservative application within one to two years to be returned to *Good* condition. A *Poor* pavement shows significant deterioration and will require regular preventative maintenance and significant rehabilitation in order to be returned to *Good* condition.

Table A



The Division has determined that the lowest life cycle cost model for pavements is optimally balanced and delivered when 70% of the system is in *Good* condition, 25% is in *Fair* condition, and 5% of pavements are in *Poor* condition.

Though it might seem counterintuitive to accept any volume of the system reaching a *Poor* condition, we have determined that approximately 5% of pavements provide diminishing to no returns to public benefit when resources are invested to establish a *Good* condition rating. For example, there are a moderate volume of rural local access roads in the inventory which are of sub-standard construction, and which provide access to uninhabited portions of the county. In these cases it is not cost effective to invest in preventative maintenance and preservation until usage levels justify reconstruction and rehabilitation to a condition that can then be cost effectively sustained. Another example of when it is beneficial to tolerate pavements in *Poor* condition is when a large improvement project is imminent.

When a significant road improvement project is being planned, it is important that managers invest enough resources to keep the obsolete pavement safe and operable, while not spending money on features that will soon be demolished and reconstructed. This scenario sometimes results in pavement conditions scoring in the *Poor* column for the right reasons.

Long-Term Solutions and Costs

It will be critically important to plan well to meet the future road maintenance and operational needs as Pierce County continues to grow and urbanize. Completing an Asset Management system for road maintenance, operations and preservation will help refine the most cost effective way to meet level of service goals. Ongoing cost and risk assessments will be essential so that planners, policy makers, and the public can anticipate and support the needs of the county's transportation network.

It will be very important that transportation managers reach out to the public to communicate the criticality of planning, funding, and delivering an adequate and balanced road maintenance and operations program. History has shown that local governments that have faced rapid growth and competing needs are often tempted to defer road maintenance in order to fund improvement projects. These decisions always cost exceptionally more money in the long run than is saved in the short-term. It is the responsibility of public works leaders to effectively communicate this message to our public, the business community, and elected officials.

Strategies

- Meet level of service goals
- Measure performance of programs and core functions
- Measure condition of assets
- Communicate accomplishments, outcomes and future needs
- Complete development of robust Asset Management System for road maintenance and operations

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Below is a table depicting the current and estimated 20-year costs of maintaining and operating Pierce County's roads.

Core Function	Cost Per Lane Mile	Annual Cost	20yr Cost
Maintenance			
Pavement Maint	\$ 1,395.55	\$ 4,313,655.17	\$ 86,273,103.38
Shoulder Maint	\$ 1,027.99	\$ 3,177,502.75	\$ 63,550,055.06
Storm Drain Maint	\$ 776.24	\$ 2,399,364.60	\$ 47,987,292.01
Bridge Maint	\$ 24.88	\$ 76,917.32	\$ 1,538,346.40
Retaining & Sea Wall Maint	\$ 9.36	\$ 28,930.80	\$ 578,616.02
Guardrail Maint	\$ 61.20	\$ 189,161.89	\$ 3,783,237.76
Roadside Veg Maint	\$ 873.27	\$ 2,699,278.10	\$ 53,985,561.99
Total Maintenance	\$ 4,168.49	\$ 12,884,810.63	\$ 257,696,212.62
Operations			
Roadside Mowing	\$ 174.89	\$ 540,583.54	\$ 10,811,670.76
Storm Drain / Flooding Ops	\$ 245.35	\$ 758,371.71	\$ 15,167,434.16
Snow & Ice Response	\$ 399.72	\$ 1,235,541.66	\$ 24,710,833.11
Street Sweeping	\$ 497.16	\$ 1,536,725.77	\$ 30,734,515.45
Windstorm / Vegetation Ops	\$ 227.79	\$ 704,096.69	\$ 14,081,933.70
Litter & Debris Removal	\$ 193.33	\$ 597,585.75	\$ 11,951,714.93
Mud/Rock Slide Resposne	\$ 40.75	\$ 125,972.88	\$ 2,519,457.64
Total Operations	\$ 1,779.00	\$ 5,498,877.99	\$ 109,977,559.75
Total M & O Costs	\$ 5,947.49	\$ 18,383,688.62	\$ 367,673,772.37

Sources:

<http://www.ofm.wa.gov>

<http://www.bls.gov/cpi/>

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