Office of the City Auditor
Ann-Marie Hogan, City Auditor

CONSENT CALENDAR
November 15, 2011

To: Honorable Mayor and Members of the City Council

From: Ann-Marie Hogan, City Auditor

Subject: Failing Streets: Time to Change Direction to Achieve Sustainability

RECOMMENDATION

Request the City Manager report back by September 11, 2012, and every six months thereafter, regarding the status of the audit recommendations until reported fully implemented.

SUMMARY

We conducted this audit to determine what it would take financially to raise Berkeley's average street condition to the mid-range of "good," which is a regional goal for the nine-county San Francisco Bay Area. Currently, the average Berkeley street is in an "at risk" condition: it has deteriorated to the point where more costly rehabilitation is needed because less costly preventive maintenance work is no longer effective.
Reconstruction of a failed street can be 32 times the cost of timely maintenance!

More than 62 percent of Berkeley's 216 linear miles of streets need to be resurfaced or reconstructed at an estimated cost of $54 million. Berkeley's current annual streets rehabilitation budget of $3.66 million a year is not enough to allow Public Works to repair the City's failing streets. Given Berkeley's limited funding and the competing needs of the City's failing infrastructure and direct services, a new revenue source is needed to fill the funding gap. Options exist, such as local sales tax increases, bonded debt, general taxes, or assessment districts, but each requires a Council policy decision, and support and approval from Berkeley voters. City management must also explore the legal, financial, and implementation challenges of each option.

FISCAL IMPACTS OF RECOMMENDATION

Under the current budget of $3.66 million a year, the City's unfunded needs for street maintenance and repair will be $41.7 million by the end of 2011. In just five years, those unmet needs will grow to $70.8 million. Additional funding is needed to stop this rapid growth and reverse the trend.

RATIONALE FOR RECOMMENDATION

Implementing our recommendations will establish long-term strategies for improving the overall quality of city streets while reducing the unfunded need to a sustainable level.

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Attachments:
1: Failing Streets: Time to Change Direction to Achieve Sustainability

City of Berkeley

Failing Streets: Time to Change Direction to Achieve Sustainability

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Presented to Council November 15, 2011

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I. EXECUTIVE SUMMARY

The average Berkeley street is in an "at risk" condition, meaning it has deteriorated to the point where resurfacing or reconstruction is needed because preventive maintenance work, such as crack and slurry sealing, is no longer effective. We conducted this audit to determine what it would take financially to raise the average street condition to the mid-range of "good," which is a regional goal for the nine-county San Francisco Bay Area.

Preventive maintenance prolongs pavement life and the community's investment in its streets.

At "good," Berkeley's streets can be sealed for about $36,000 per mile. Streets that have deteriorated to "fair" or "poor" condition require resurfacing, at an average cost of $126,000 to $309,000 per mile, or ***3.5 to 8.6 times the cost of preventive maintenance.*** Streets in "failed" condition require reconstruction, which Berkeley contracts out. The average cost of $1.15 million per mile is ***almost 32 times the cost of timely maintenance.*** About 134 (62 percent) of Berkeley's 216 linear miles of streets need to be resurfaced or reconstructed at an estimated cost of $54 million. Collector streets are in the worst condition, with 68 percent in substandard or failed condition.

Berkeley's Five-Year Street Plan budgets about $3.66 million per year for major street rehabilitation. The average street would be in "fair" condition in five years, but the unfunded need would grow 70 percent – from $41.7 million to $70.8 million – because more streets will have failed. In contrast, more than 85 percent of the City's streets would be in "very good-excellent" condition if the City spent $46 million for repairs in just one year, but it is not feasible to do that much work in one year. Spending about $12.5 million annually would improve the average street condition to the low end of "good" in five years and to "very good-excellent" condition by the end of ten years. At $12.5 million annually, street conditions are sustainable over the long term, but only if sufficient funds for preventive maintenance and minor rehabilitation are continued in subsequent years.

Deteriorated streets are a growing unfunded need that is a liability for the City now and in the future.

The obstacle to improving Berkeley's street conditions is lack of funds. Given the economic struggles Berkeley faces and the competing needs of failing infrastructure and direct services, there is no easy solution. Options exist, such as local sales tax increases, bonded debt, general taxes, or assessment districts, but each requires a Council policy decision, and support and approval from Berkeley voters. City management must also explore the legal, financial, and implementation challenges of each option. Berkeley's streets are failing. Without action now, we have to ask, "If we can't afford to fix our streets now, how are we going to be able to afford to fix them in the future when the cost will be millions more?"

II. AUDIT OBJECTIVE

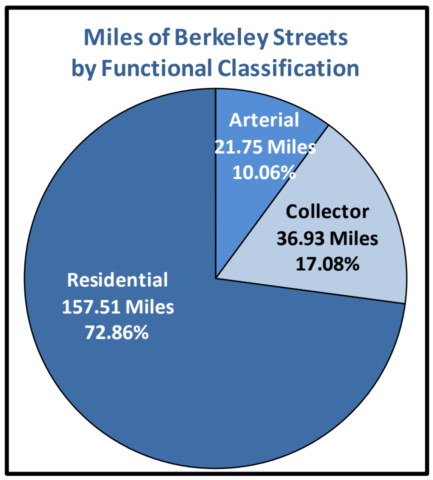
The objective of the audit was to determine what it would take to raise the City's Pavement Condition Index from "at risk" to the mid-range of "good." At "good," streets can be maintained at a much lower cost than if they are allowed to deteriorate and require more costly repairs. The deteriorated streets are a growing unfunded need that is a liability for the City now and in the future.

III. BACKGROUND

216 Miles of Streets in Berkeley

Berkeley maintains approximately 216 linear miles of paved streets within the city limits, which include:

- Arterials, 21.75 miles – Streets that carry the most car and heavy vehicle traffic, e.g., trucks and buses, and typically provide an outlet onto state highways or freeways. They also function as alternatives to highways and freeways to relieve traffic congestion. Examples are Adeline Street and most of University and Telegraph Avenues.
- Collectors, 36.93 miles – Streets that serve to "collect" traffic from the residential streets and deposit them onto arterials. Examples are Grizzly Peak Boulevard, Durant Avenue, and La Loma Avenue.
- Residential/Local Streets, 157.51 miles – Streets and roads that run through neighborhoods and carry few heavy vehicles, other than solid waste management vehicles. Examples are Addison Street, Channing Way, and Grant Street.



Certification of Pavement Conditions Required for State Funding

Funding for pavement maintenance and repair comes from a combination of federal, state, and local sources (see funding discussion on page 9). Local governments must be certified under an approved pavement management program in order to receive state funding for pavement maintenance and rehabilitation projects, and federal legislation encourages use of these management programs. Metropolitan planning organizations (MPOs), which are federally required bodies designated by governors, certify local governments that meet certain requirements. The Metropolitan Transportation Commission (MTC) is the MPO for the nine-county San Francisco Bay Area.

One of the certification requirements is for local governments to maintain data on the condition of all paved streets within their jurisdiction. The MTC developed a federally recognized online pavement management program – *StreetSaver®* – that all nine[1] counties in the San Francisco Bay Area use to track their Pavement Condition Index (PCI). The PCI is a numerical indicator of the ride quality of sections of paved streets on a scale of 100 (excellent) to 0 (failed). The score is based on the smoothness of the pavement's surface, which also indicates its structural integrity. The U.S. Army Corps of Engineers developed the PCI, which the American Public Works Association has verified and adopted. The MTC has established a PCI of 75 – the mid-range of "good" – as a target for street quality in the San Francisco Bay Area.

A PCI of 75 – the mid-range of "good" – is the target for street quality in the San Francisco Bay Area.

Pavement Distresses Are Inspected and Measured to Determine Condition

To determine the PCI score, an inspector visually inspects, measures, and records the distress type, severity, and amount present in each section of street inspected. The table in Appendix B describes the types of distress typically found to be significant in the San Francisco Bay Area and used to determine PCI scores. The table below describes the PCI rating scale.

Pavement Condition Index (PCI) Rating Scale

Very Good – Excellent (PCI = 100-80)	**Pavements are newly constructed or resurfaced and have few, if any, signs of distress.**
Good (PCI = 79-70)	**Pavements require mostly preventive maintenance and have only low levels of distress, such as minor cracks or spalling, which occur when the top layer of asphalt begins to peel or flake off because of water permeation.**
Fair (PCI = 69-60)	**Pavements at the low end of this range have significant levels of distress and may require a combination of rehabilitation and preventive maintenance to keep them from deteriorating rapidly.**
At Risk (PCI = 59-50)	**Pavement has deteriorated and requires immediate attention, including rehabilitative work. Ride quality is significantly inferior to better pavement categories.**
Poor (PCI = 49-25)	**Pavements have extensive amounts of distress and require major rehabilitation or reconstruction. Pavements in this category affect the speed and flow of traffic significantly.**
Failed (PCI = 24-0)	**Pavements need reconstruction and are extremely rough and difficult to drive.**

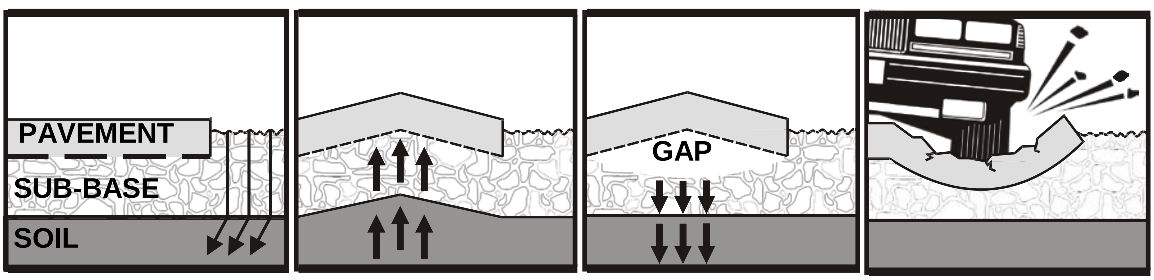
Source: Metropolitan Transportation Commission, *The Pothole Report: Can the Bay Area Have Better Roads?,* June 2011

[1] The nine counties are Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma.

Cracking is usually the first sign of pavement distress. Water leaks into untreated cracks through the surface layer to the sub-base, eroding pavement strength. The cracks lengthen and multiply to the point where the pavement no longer sustains the weight of traffic. The cracked pavement disintegrates, forming depressions more familiarly known as potholes. Pothole repairs improve pavement smoothness, which keeps streets safer for motorists and prevents the streets from getting significantly worse immediately. Pothole repairs also reduce the likelihood of further water infiltration damage that occurs when a pothole is not filled. However, because the sub-base is damaged, a street with a repaired pothole continues to deteriorate until it fails. The following graphic shows how a pothole is formed.

> ***"Since potholes result from damage to the sub-base, once they appear – regardless of whether they are patched – the roadway continues to deteriorate until it fails."***
>
> **Metropolitan Transportation Commission, "The Pothole Report: Can the Bay Area Have Better Roads?"**

"Birth of a Pothole"



Potholes begin after rain or snow seeps into cracks and down into the soil below the road surface. The soil turns into mud and with no support, a hole can form under the pavement.	Repeated freezing and thawing or heavy traffic causes the ground to expand, pushing the pavement up.	As temperatures rise, the ground returns to a normal level but the pavement often remains raised. This creates a gap, or hollow space between the pavement and the ground below it.	When vehicles drive over this cavity, the pavement surface cracks and falls into the hollow space, leading to the birth of another pothole.

Source: *Rough Roads Ahead: Fix Them Now or Pay for it Later,* AASHTO and TRIP, with courtesy reference to the Michigan Department of Transportation

Repair Costs Increase Exponentially When Maintenance Is Deferred

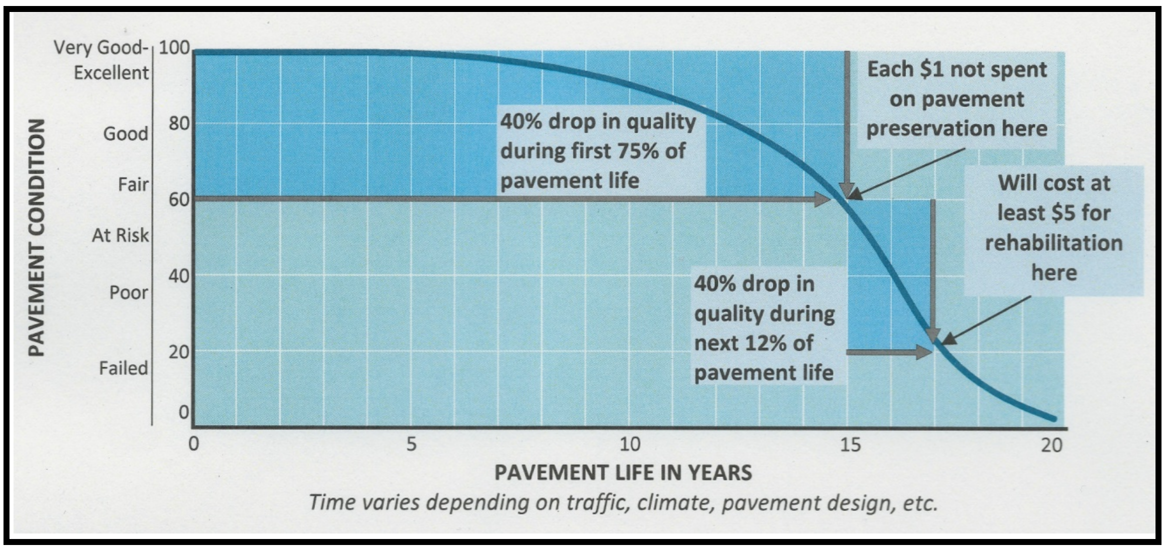
The type of work required and the cost to raise the PCI to "good" or "very good-excellent" for a pavement section depends on its current PCI rating. Performing maintenance on pavement reduces aging and restores serviceability of the pavement. According to the MTC, it is five to ten

> ***"Just as regular oil changes are far less expensive than a complete engine rebuild, it is five to 10 times cheaper to properly maintain streets than to allow them to fail and then pay for the necessary rehabilitation."***
>
> **Metropolitan Transportation Commission, "The Pothole Report: Can the Bay Area Have Better Roads?"**

times less expensive to properly maintain streets than to allow them to fail and then pay for the necessary rehabilitation. Thus, to spend taxpayer's money cost-effectively, it makes more sense to preserve and maintain our streets in good condition than to let them deteriorate and pay millions more to repair them in the future.

The following graphic is the MTC's depiction of the pavement life cycle. It shows that pavement quality deteriorates 40 percent during the first 15 years after construction. Without maintenance, the pavement would rapidly deteriorate another 40 percent during years 16 and 17. It also shows that repair costs increase rapidly if maintenance is not performed while the pavement is still in "good" to "fair" condition. Each dollar not spent for maintenance when the pavement condition index is 60 or better – usually before year 15 – will cost at least $5 for repairs just two years later.

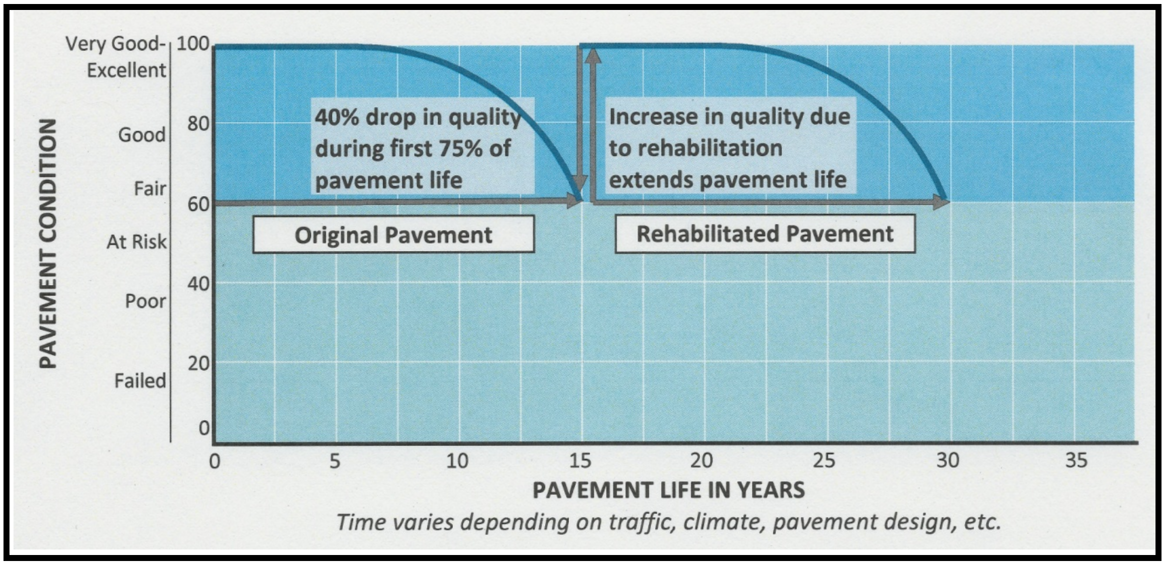
Pavement Life Cycle:
Deterioration Timeline and Rehabilitation Costs



Source: Metropolitan Transportation Commission, *The Pothole Report: Can the Bay Area Have Better Roads?,* June 2011

However, the pavement condition index increases and pavement life is extended when comprehensive maintenance, such as crack sealing, slurry sealing, or thin overlay, is performed while the pavement condition index is 60 or better. A comprehensive maintenance program helps ensure that streets stay in "good" to "very good-excellent" condition, which allows them to be preserved at a much lower cost than if they are allowed to deteriorate to the point of needing to be reconstructed. The following graphic shows how the pavement life cycle is extended when timely pavement preservation is performed.

Pavement Life Cycle:
Deterioration Timeline Before and After Pavement Preservation



Sources: 1. Metropolitan Transportation Commission, *The Pothole Report: Can the Bay Area Have Better Roads?,* June 2011

2. American Concrete Pavement Association, *R&T Update: Concrete Pavement Research & Technology,* Number 3.02, February 2002

StreetSaver® Uses a Decision Tree to Estimate Costs

One advantage of using *StreetSaver®* is that it can build five-year scenarios to project how much of a jurisdiction's available funds should be spent to maintain or rehabilitate streets in various PCI ranges and the specific streets to repair. *StreetSaver®* uses a built-in decision tree to create the scenarios. The decision tree considers the current PCI, the type of surface (e.g., asphalt concrete, asphalt concrete over asphalt concrete) the number of years since the last treatment, and the type of treatment previously applied. The decision tree estimates the cost of maintenance or repairs based on cost data that users enter into *StreetSaver®* for the treatments used within their jurisdictions. For each scenario, the user inputs the jurisdiction's estimated annual expenditures for maintenance and repair; an inflation factor; and repair priorities based on functional class, i.e., arterials, collectors, and residential streets. The scenarios show how completed work will change the average PCI; the percentage of arterial, collector, and residential streets in each PCI range; and the estimated future cost of deferred maintenance and rehabilitation work.

The *StreetSaver®* scenario builder can and should be used as a planning tool to identify the maintenance strategy that will have the most impact on improving overall street conditions within a jurisdiction, considering the available funding.

Berkeley's Costs by Type of Maintenance or Repair

The MTC's report on road conditions in the San Francisco Bay Area identifies the six pavement condition categories listed in the Pavement Condition Index Rating Scale on page 3. However, *StreetSaver®* groups the categories slightly differently, based on the type of maintenance or repair needed. The table below shows the condition categories that the *StreetSaver®* decision tree uses, the recommended treatment for each condition category, and Berkeley's average cost per mile for the treatments used for each PCI range. The treatments listed in the table below are effective strategies for sustaining the life of a street. Pothole repair is not listed as one of the treatment types because it is considered a temporary fix that covers up an underlying problem that can only be fully addressed through rehabilitation.

Berkeley's Average Cost of Rehabilitation by Condition Category

Condition Category	Rating Category and PCI Range	Treatment	Average Cost Per Mile
I	**EXCELLENT (100-90)**	Crack Seal and Slurry Seal – Comprehensive maintenance used to repair distress and reinforce weakened pavement	$36,065
I	**GOOD (89-70)**		
II/III	**FAIR (69-50)**	Thin Asphalt Concrete Overlay – Grind surface layer, repair base, and replace surface with a thin (1½") overlay	$125,657
IV	**POOR (49-25)**	Thick Asphalt Concrete Overlay – Grind surface layer, repair base, and replace surface with a thick (2½") overlay	$309,464
V	**VERY POOR/FAILED (24-0)**	Reconstruction – Excavate entire roadway and replace pavement structure (surface layer and base)	$1,153,181

Sources: 1. Metropolitan Transportation Commission, *Pavement Management Program Final Report for the City of Berkeley,* April 2011.
2. Audit staff calculations based on the *StreetSaver®* PCI data, treatment types, and unit costs by condition category.

It is 32 times more costly for Berkeley to reconstruct a road than it is to perform timely maintenance!

The escalating costs from one PCI range to the next confirm that the most cost-effective way to keep streets in "good" to "very good-excellent" condition is to address pavement cracks as soon as they appear. If the City does not perform maintenance when streets show the first signs of distress, the streets will continue to deteriorate until they need to be resurfaced – ***at 3.5 to 8.6 times the***

expense of what maintenance would have cost. If resurfacing is not done, the streets will continue to deteriorate until they need to be reconstructed – ***at almost 32 times the expense of what timely maintenance would have cost and 3.7 to 9.2 times the expense of what timely resurfacing would have cost.***

Poor Pavement Conditions: Hidden Costs to Drivers and Air Quality

In addition to the direct costs of maintenance and repair, rough road conditions increase motorists' costs to operate a vehicle. TRIP,[2] a nonprofit transportation research organization, reports that driving on rough roads increases stress on vehicles. This results in accelerated tire wear and fuel consumption, as well as other repair and ownership costs. Greenhouse gas emissions are also higher due to motorists' reduced fuel economy, as well as the additional materials and number of heavy truck trips needed to repair rather than maintain roads.

Poor road conditions cost motorists in the San Francisco-Oakland urban area an average of $706 annually, which is 76 percent more than the national average.

In September 2010, TRIP reported that roads needing repair cost urban motorists in the United States an average of $402 annually in additional vehicle operating costs. However, TRIP also reported that in the San Francisco-Oakland urban area, which includes Berkeley and other surrounding suburban cities, the average cost is $706 annually. This was the third highest cost nationally in urban areas with populations of 500,000 or more. TRIP estimates that improving overall pavement conditions in the area by 25 percent would reduce the average additional cost to motorists to $546 annually.

Berkeley's Street Maintenance and Rehabilitation Programs

Public Works divides its streets work between its *Engineering: Street Paving Division* and its *Operations: Streets and Utilities Division.* Public Works management reported that staff from the two divisions meet regularly to discuss and coordinate repairs, scope, and current and future paving projects for the City's streets.

- **Engineering: Street Paving.** Under this program, contractors pave about five miles of City streets each year, primarily by either overlay or reconstruction. The scope of paving work includes construction of access ramps, valley gutters, and cross drains to address drainage concerns; upgrading existing roadway signs and traffic calming devices; and striping.

[2] TRIP stands for "The Road Information Program." However, the organization generally uses only the acronym and refers to itself as a transportation research organization.

- **Streets and Utilities: Operations and Maintenance.** This program includes crack sealing in areas where sewer trench and other utility cuts have been made, emergency pothole repairs where a quick response is needed, and temporary repairs for potholes that could become hazardous to vehicular or pedestrian traffic. Operations crews also conduct street cut and plug repairs in areas where pavement failure is new, and where removal and replacement of pavement and subgrade is necessary to stop further water infiltration into the subgrade.

City Street Expenditures and Funding Forecasts

Public Works – Engineering prepares a Five-Year Street Plan (Plan) that identifies street rehabiliation projects and estimates costs to complete them. The Plan is based on the City's street repair policy and identifies streets that require resurfacing (overlay) or reconstruction. However, Public Works reports that the number of rehabilitation projects selected each year is limited because the funds available are insufficient to address much of the City's needs. The following table shows the City's annual expenditures for street rehabilitation projects for the past five fiscal years:

Expenditures for Street Rehabilitation Projects
Fiscal Years 2007 Through 2011

2007	$2,883,389
2008	$4,036,728
2009	$6,789,039
2010	$4,730,016
2011	$4,579,842
TOTAL	**$23,019,014**

Source: City of Berkeley Department of Public Works staff

From 2009 through 2011, the City used nearly $5 million in both federal American Recovery and Reinvestment Act and state Proposition 1B Transportation Bond funds to complete overlay and reconstruction projects. The City received final payments from these one-time sources in fiscal years 2011 and 2010, respectively.

University Avenue Rehabilitation Project: Completed Using One-Time Funds

University Avenue
Rehabilitated to improve traffic flow, safety, and ride quality.

Public Works relies heavily on one-time funding sources, such as federal grants and bonds, to complete major rehabilitation projects. The recent work done on University Avenue is an example of the use of those funds. Public Works also uses ongoing funding sources, such as gas and sales taxes and the Capital Improvement Fund, to complete street improvement projects.

Public Works staff forecast expected funding for street projects from both one-time and ongoing sources based on past trends, the current economic climate, and public-policy changes. Forecasted funding sources include:

- **State Highway User Taxes 2107.5, 2105, and 2103.** California imposes a number of excise taxes on transportation fuels that are commonly referred to as "gas taxes." These tax revenues are used on transportation projects, including local street and road improvements. Public Works staff do not anticipate a significant decline in revenues from these sources in the near future and have budgeted more than $3.3 million in gas tax revenues for street projects during 2012 through 2015, including $775,000 a year in State 2103 funds.

  Berkeley may lose Transportation Tax Swap revenue of $775,000 a year.

  However, other transportation stakeholders in Alameda County have expressed concern over the reliability of State 2103. In March 2010, California enacted a Transportation Tax Swap (Swap) that replaced the sales tax on gas with an excise tax increase. Later that year, voters passed two propositions that may invalidate the Swap funding. The MTC and other public agencies are currently working with the state legislature and Governor's Office to save the Swap funding, but its future is unknown.

- **Measure B – County Sales Tax, supplemented by Berkeley's General Fund.** In November 2000, Alameda County voters approved Measure B to continue the county's half-cent transportation sales tax through 2022. The revenues from the sales tax are for use on a range of transportation projects, some voter-approved and others based on the needs of the local jurisdictions receiving regular allocations. The City is budgeting $500,000 a year in Measure B funding for street rehabilitation projects through fiscal year 2015, which is consistent with Measure B allocations of half-a-million dollars a year since 2008.

  Annual transfers of $224,000 from the General Fund to the Measure B fund for street rehabilitation projects were temporary.

  In May 2010, the City reported that the Alameda County Transit Improvement Authority (ACTIA) projected Berkeley's Measure B funding would decline in fiscal year 2011. To offset the expected loss, the City planned to subsidize the Measure B Fund for three years with annual transfers from the General Fund of $224,000. Although the loss was not realized, the transfers continue in fiscal years 2012 and 2013.

Prior to receiving Measure B funding, Berkeley entered into a funding agreement with the Alameda County Transportation Commission (Alameda CTC). The agreement outlines funding use and reporting requirements, and is set to expire in 2012. The Alameda CTC is proposing a new ten-year agreement that may include a policy requiring all local jurisdictions receiving Measure B funding to submit a corrective action plan to improve its PCI should it fall below 60, i.e., "good condition."

- **Capital Improvement Fund.** The City established the Capital Improvement Fund to pay for infrastructure improvements and specific, large-scale recurring purchases. The amount available for street projects each year is dependent on other City programs' capital improvement project needs. However, Public Works expects to receive $1.88 million a year from the Capital Improvement Fund from 2012 through 2015 to fund street rehabilitation projects. The City does not plan to reduce this funding and recognizes that past limitations have led to an aging infrastructure in great need of repair.

The Capital Improvement Fund is the largest funding source for street projects, with more than $7.5 million budgeted for street projects from 2012 through 2015.

- **Safe, Accountable, Flexible, and Efficient Transportation Equity Act – A Legacy for Users (SAFETEA-LU),[3] which is a federal grant.** This grant authorizes funding for federal surface transportation programs. The SAFETEA-LU program originally expired in September 2009, but Congress has kept it active using short-term extensions. The current six-month extension expires in March 2012. Berkeley's future funding from this source is dependent on Congress passing additional short-term extensions or a multi-year bill that authorizes long-term federal funding for surface transportation programs.

The future of federal funding for street rehabilitation projects is unknown. Public Works relies on this funding to complete major streets rehabilitation projects.

From 2007 through 2011, Public Works used more than $1.5 million in federal surface transportation grant funds to complete major street rehabilitation

[3] Public Works accounts for SAFETEA grants in the Intermodal Surface Transportation Efficient Act (ISTEA) Fund. ISTEA expired in 1997 but is program structure was carried forward to the SAFETEA legislation.

projects. The potential loss or reduction of SAFETEA grants would negatively impact Public Works' ability to complete future street projects.

Most of the funding sources cited above are not restricted, that is, Public Works may use the funds for work on arterials, collectors, and residential streets. The exception is federal grants, which Public Works may not use for work on residential streets. Because 73 percent of Berkeley's street network consists of residential streets, this use restriction hinders Public Works' ability to improve the City's overall PCI score.

Public Works cannot use federal grant funds on residential streets.

Public Works is budgeting a total of $14.3 million in one-time and ongoing funds for street rehabilitation projects for 2012 through 2015. The following table shows Public Works' budgeted amounts, by fiscal year and funding source, for the next four years.

Funding Allocations* for Street Rehabilitation Projects

Source	Type	Fiscal Year			
		2012	2013	2014	2015
Highway User Tax, State 2107.5	State Gas Tax	$39,707	$40,431	$40,700	$41,507
Highway User Tax, State 2105	State Gas Tax	$20,000	$20,000	$20,000	$20,000
Highway User Tax, State 2103	State Gas Tax	$775,303	$775,303	$775,303	$775,303
Measure B	County Sales Tax	$500,000	$500,000	$500,000	$500,000
General Fund	Berkeley General Fund	$224,000	$224,000	N/A	N/A
Capital Improvement Fund	Berkeley General Fund	$1,881,875	$1,881,875	$1,881,875	$1,881,875
Safe, Accountable, Flexible, and Efficient Transportation Equity Act – A Legacy for Users	Federal Grant	$955,000	To be determined	To be determined	To be determined
	Total	**$4,395,885**	**$3,441,609**	**$3,217,878**	**$3,218,685**

* The allocations include funding for related drainage improvements.

Source: City of Berkeley Department of Public Works. At the time we prepared this report, Public Works staff had not yet prepared projections for fiscal year 2016.

- **Measure F – Vehicle Registration Fee.** In November 2010, voters approved Measure F, which imposes a $10 per year fee on each registered vehicle. The fee will fund transportation programs similar to those supported by Measure B. City staff estimate that Berkeley will receive $3 million in Measure F funds over the next five years, with distributions starting in February 2012. However, because this is such a new revenue source, it is not yet included in the street rehabilitation funding allocations.

Streets Work: Operations and Maintenance Budget

Operations and maintenance work are not included in the Five-Year Street Plan budget. However, the work is funded using some of the same sources used for street rehabilitation, including gas and sales tax revenues. From 2007 through 2011, the Streets and Utilities Division spent an average of $1.22 million a year to complete routine maintenance and emergency repairs. The following table shows the City's annual expenditures for street operations and maintenance for the past five fiscal years:

The Five-Year Street Plan does not include pothole fills, which are temporary rather than permanent fixes of city streets that need major rehabilitation.

Expenditures for Routine Street Maintenance and Emergency Repairs
Fiscal Years 2007 Through 2011

2007	$1,294,121
2008	$1,429,198
2009	$1,170,397
2010	$1,104,619
2011	$1,097,620
TOTAL	**$6,095,955**

Source: City of Berkeley Department of Public Works staff

Achieving the Regional Pavement Condition Goals Will Take Cooperation – Berkeley's Efforts Will Help

As the metropolitan planning organization for the San Francisco Bay Area, the MTC regularly updates the Regional Transportation Plan, which is a comprehensive blueprint for developing mass transit, highway, airport, seaport, railroad, bicycle, and pedestrian facilities. In the most recent edition of this 25-year, long-range plan, known as *"Transportation 2035,"* the MTC advocates preventive maintenance as the most cost-effective way to extend the serviceability of local streets through a "fix-it-first" maintenance policy rather than a "worst-first" repair policy.

All cities and counties in the nine-county San Francisco Bay Area will have to contribute their fair share to achieve the *Transportation 2035* goal of an average PCI of 75 for the region.

El Cerrito: A Street Success Story

In 2006, El Cerrito's PCI for its 68 miles of streets was 53 and its backlog of road maintenance and repair was $21.5 million. Just two years earlier, the PCI was 63 and the backlog was $7 million. It would have cost $1.3 million annually to keep the PCI from falling even lower, but the pavement maintenance budget was only $250,000 per year.

In 2007, El Cerrito's citizens rated poor road conditions as the city council's highest priority. In response, the city developed a ballot measure for a half-cent local sales tax to pay for a roads improvement plan. The city launched a public information campaign about the measure, which passed with a 71 percent majority vote.

El Cerrito fast tracked its bidding process and was able to take advantage of low prices in the construction market. By 2010, El Cerrito had spent $14.4 million to resurface 68 percent of its streets, build more than 400 curb ramps, and replace 50 storm drain crossings. The street improvement project focused mostly on residential streets because that was the promise the City made to its voters. The result was that the average PCI increased to 85 and the backlog dropped to $500,000!

Recognizing the long-term importance of street maintenance, El Cerrito now budgets $500,000 a year for street maintenance.

IV. FINDING AND RECOMMENDATIONS

Finding: 134 (62 Percent) of Berkeley's 216 Linear Miles of Streets Need to Be Resurfaced or Reconstructed at an Estimated Cost of $54 Million

With an average pavement condition index of only 58, more than 62 percent of Berkeley's streets are rated in a substandard to failed condition. Slightly less than 38 percent of Berkeley's streets are in good to excellent condition.

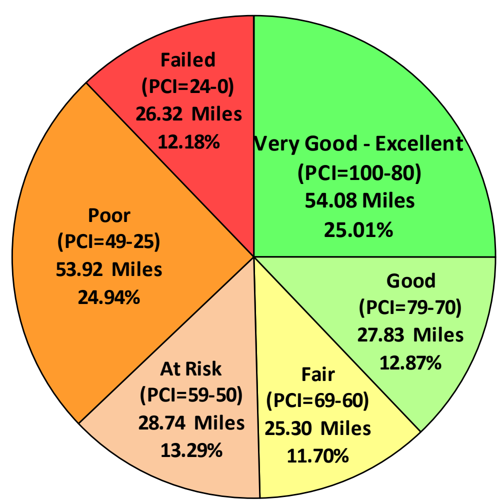
- 26.32 miles (12.2 percent) have a PCI of less than 25 and need to be reconstructed, at an estimated cost of $30.4 million.
- Another 108 miles (49.9 percent) of pavement have a PCI of 70 to 25 and need to be resurfaced, at an estimated cost of $23.5 million.
- Another 81.91 miles (37.9 percent) of pavement have a PCI of 100 to 70 and need to be appropriately maintained (e.g., crack sealing and slurry sealing) to prevent them from deteriorating to a level where more costly repairs are needed. The estimated maintenance cost for these streets is $3 million.

The Condition of an "Average" Berkeley Street: Pavement Condition Index = 58

The following graphic shows the breakdown of Berkeley's pavement conditions as of April 2011.

Total Linear Miles by PCI Category

PCI Category	Linear Miles	Percentage of Total
Very Good-Excellent (100-80)	54.08	25.01%
Good (79-70)	27.83	12.87%
Fair (69-60)	25.30	11.70%
At Risk (59-50)	28.74	13.29%
Poor (49-25)	53.92	24.94%
Failed (24-0)	26.32	12.18%
TOTAL	216.19	100.00%



Source: Audit staff analysis of Berkeley's PCI data in *StreetSaver®*

Pictures provide a visual understanding of what the PCI ranges mean. The following table shows a picture of a Berkeley street for each PCI range and the number and percentage of miles in each range:

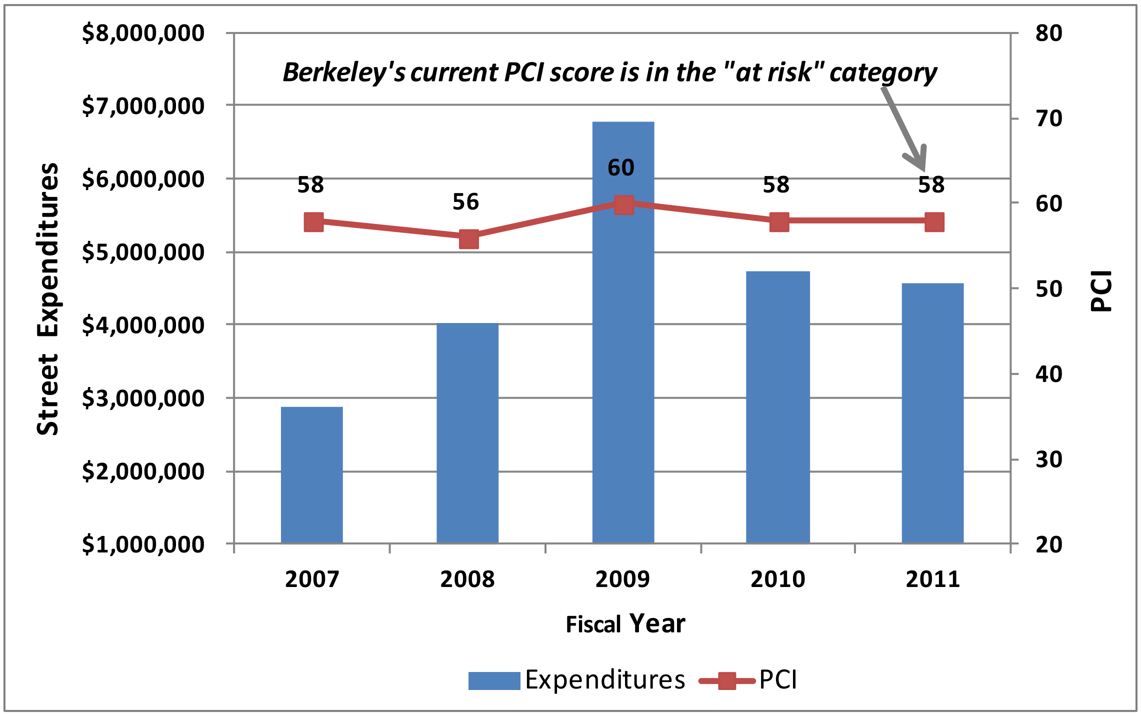
Examples of Berkeley Streets by PCI Category

Very Good/ Excellent	Good	Fair
PCI Score: 100-80 Miles: 54.08 % of Total Miles: 25.01%	PCI Score: 79-70 Miles: 27.83 % of Total Miles: 12.87%	PCI Score: 69-60 Miles: 25.30 % of Total Miles: 11.70%
		
At-risk	**Poor**	**Failed**
PCI Score: 59-50 Miles: 28.74 % of Total Miles: 13.29%	PCI Score: 49-25 Miles: 53.92 % of Total Miles: 24.94%	PCI Score: 24-0 Miles: 26.32 % of Total Miles: 12.18%
		

Source: Audit staff analysis of Berkeley's PCI data in *StreetSaver®*. Pictures of Berkeley streets taken by audit staff.

For fiscal years 2007 through 2011, Berkeley spent an average of $4.6 million a year on street rehabilitation projects. The City spent an average of another $1.22 million a year for minor maintenance and emergency repairs, including pothole repairs. Unfortunately, these expenditures have done little to improve the City's overall PCI score, which was in the "at risk" condition category for four of those five years. In 2009, Public Works' street expenditures were just over $6.7 million, and the PCI score increased from 56 to 60. However, the rapid deterioration of the City's other streets has pulled the score back down to 58, the "at-risk" category, as of September 2011. The following graph shows that rapid deterioration of roads requiring major rehabilitation continues to cause the City's PCI to decline because limited funding does not allow Public Works to keep up with the need.

Five-Year Street Expenditures Compared to Changes in Pavement Condition Index



Source: City of Berkeley Department of Public Works (Expenditure Detail) and *StreetSaver®* (PCI Scores). Expenditure data does not include money spent on routine maintenance, e.g., pothole patching.

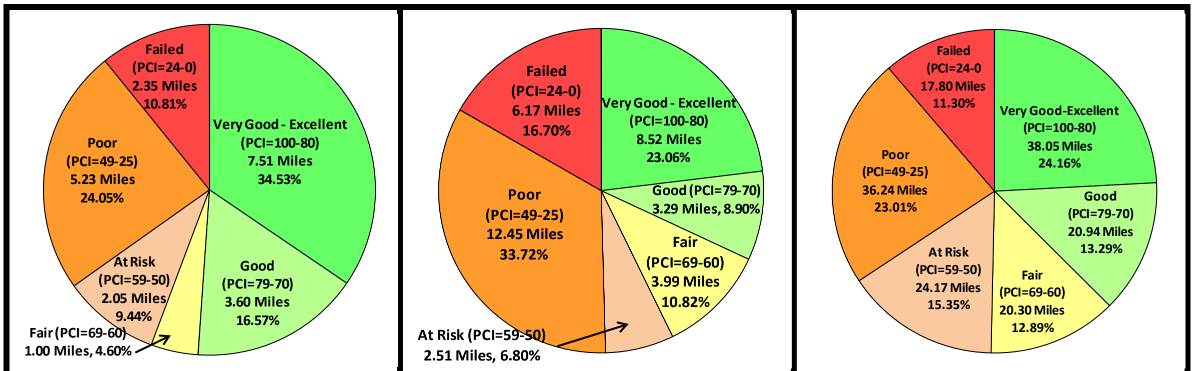
Collector Streets Are in the Worst Condition

Although 73 percent of Berkeley's streets are residential, arterials and collectors are the streets that give the first impression of Berkeley to residents, tourists, and those visiting the City for business reasons. Arterials and collectors get the most traffic and thus, the most wear and tear. Since arterials and collectors help contribute to Berkeley's economy, it is important that the City appropriately maintain them and even give them higher priority for maintenance and repair over residential streets. The City's approach has generally been to allocate nonfederal funding in the Five-Year Street Plan to collectors (50 percent), residential streets (25 percent), arterials (10 percent), and concrete/discretionary (15 percent). However, some streets are given priority over others for safety concerns and other reasons, such as known utility work or streets with bus or bicycle routes.

68% of collector and almost 50% of arterial streets in Berkeley are in a substandard or failed condition.

The graphic below shows PCI ratings by the streets' functional classifications. It shows that collector streets are in the worst condition, with more than 68 percent in a substandard or failed condition. Almost 50 percent of arterials are in a substandard or failed condition.

Total Miles by PCI Category and Functional Classification



ARTERIALS			COLLECTORS			RESIDENTIAL/LOCAL		
PCI Category	Linear Miles	% of Total	PCI Category	Linear Miles	% of Total	PCI Category	Linear Miles	% of Total
Very Good-Excellent	7.51	34.53%	Very Good-Excellent	8.52	23.06%	Very Good-Excellent	38.05	24.16%
Good	3.60	16.57%	Good	3.29	8.90%	Good	20.94	13.29%
Fair	1.00	4.60%	Fair	3.99	10.82%	Fair	20.30	12.89%
At Risk	2.05	9.44%	At Risk	2.51	6.80%	At Risk	24.17	15.35%
Poor	5.23	24.05%	Poor	12.45	33.72%	Poor	36.24	23.01%
Failed	2.35	10.81%	Failed	6.17	16.70%	Failed	17.80	11.30%
TOTAL	**21.75**	**100.00%**	**TOTAL**	**36.93**	**100.00%**	**TOTAL**	**157.51**	**100.00%**

Source: Audit staff analysis of Berkeley's PCI data in *StreetSaver®*

Berkeley's PCI Tied it for 86th Place Among 109 Bay Area Jurisdictions

MTC's *"The Pothole Report: Can the Bay Area Have Better Roads?"* showed that Berkeley's average PCI of 60 in 2010 tied it for 86th place among the 109 cities and counties in the San Francisco Bay Area. This "fair" score was based on a 3-year moving average.[4] However, Berkeley's current PCI is only 58, which places the City's streets in the "at-risk" category. If no maintenance and repair work were done during the next five years, pavement conditions would continue to deteriorate to the point where Berkeley's average PCI would drop to 50 – just one point above the "poor" category.

Pay Now or Pay Millions More Later

About $46 million is needed to increase the average PCI to 80 - but only if all the streets were repaired within one year!

Berkeley's Five-Year Street Plan budgets an average of $3.66 million per year for street repairs. To demonstrate

[4] The PCI scores in *The Pothole Report* are based on a weighted average over three years, which results in a slightly different score than a PCI identified at a specific point in time.

how continuing to defer maintenance would affect Berkeley's current PCI, we ran two opposing scenarios through *StreetSaver®*:

- If the City were to front-load its expenditures and spend $46 million in a single year, the average PCI would increase to 80 – a "very good-excellent" rating – in just one year and there would be no unfunded need. However, it would be important to allocate sufficient funds in subsequent years for maintenance and repairs to ensure the streets remained in a "good" to "very good-excellent" condition.
- In contrast, if the City spends only its currently budgeted amount of $3.66 million annually, it will spend a total of $18.3 million over five years, and the average PCI would only increase to 63 – a "fair" rating – at the end of that period. The backlog of unfunded maintenance and repair work would be $41.7 million at the end of the first year but would grow to $70.8 million at the end of the fifth year because many streets would continue to deteriorate and therefore need more costly repairs.

With the current budget, the PCI would increase 5 percentage points – from 58 to 63, the low end of a "fair" rating. However, the unfunded need would grow from $41.7 million to $70.8 million - a 70% increase in just five years!

Unfunded needs occur when the funding level is insufficient to reconstruct all streets in a "failed" condition. The *StreetSaver®* scenario builder eliminates the "unfunded need" when the average PCI reaches the *optimal* level of 80 or higher, which is also the point at which all streets in "failed" condition will have been reconstructed. However, some streets may still be in "poor," "at risk," or "fair" condition and need a less-costly form of rehabilitation.

We built several other scenarios in *StreetSaver®* to see how changes in the budget would affect the average PCI during a five-year period. The following table summarizes the results of three scenarios, and Appendix C provides more details. The table shows the level of funding needed annually to move the average rating of Berkeley's streets into a "good" to "very good-excellent" condition within five years, based on Public Works' current estimates of the costs to maintain and repair streets. Each scenario assumes a three percent annual inflation rate and that:

- Five percent of the funds would be allocated first to preventive maintenance and the remainder to repairs.
- First priority is given to arterials, then collectors, and then residential streets. As the condition of arterials improves, *StreetSaver®* automatically shifts excess funds to collectors, and as the condition of collectors improves, *StreetSaver®*

automatically shifts excess funds to residential streets. This increases the amount allocated to collectors and residential streets in the later years.

Annual Expenditures Required to Bring Berkeley Streets into an Average Condition of "Good" or "Very Good"

	$12.5 Million			$15 Million			$17.5 Million		
	Amount Spent (in millions)	Unfunded Need	Average PCI	Amount Spent (in millions)	Unfunded Need	Average PCI	Amount Spent (in millions)	Unfunded Need	Average PCI
Year 1	$12.50	$32.86	64	$15.00	**$30.36**	65	**$17.50**	**$27.86**	66
Year 2	$12.88	$30.61	65	$15.45	**$25.46**	67	**$18.03**	**$20.32**	70
Year 3	$12.88	$28.97	68	$15.45	**$21.34**	71	**$18.02**	**$13.65**	74
Year 4	$12.88	$24.07	71	$15.45	**$14.08**	75	**$17.81**	**$4.22**	79
Year 5	$12.88	$19.41	73	$15.45	**$7.07**	79	**$12.80**	**$0**	82
Total	**$64.00**			**$76.80**			**$84.16**		

Note: The cells highlighted in yellow represent average PCIs of "good" (79-70) or "very good" (89-80).
Source: Scenarios created in *StreetSaver®* by audit staff

These results reinforce the importance of acting sooner rather than later to improve the condition of Berkeley's streets. Competing priorities for scarce budget dollars in the past have limited the funding available for street improvements. However, this leads to the question, "If we can't afford to fix our streets now, how are we going to be able to afford to fix them in the future when the cost will be millions more?"

Filling the Funding Gap

Given the economic struggles Berkeley faces and the competing needs of its failing infrastructure and direct services, there is no easy solution for how to fix the City's failing streets. However, the table below identifies five possible funding options, including the choice El Cerrito made that resulted in its PCI increasing from 53 to 85 in less than four years. Each option requires Council support and approval by Berkeley voters because the options are all tax related. City management must also explore the legal, financial, and implementation challenges of each option. Regardless of which option(s) is considered, the funding will be used to improve City roadways, which in turn will contribute to Berkeley's economic health and benefit the community as a whole.

Potential Funding Solutions to Fill the Funding Gap for Street Rehabilitation

	Funding Option	Funding Summary
1.	Local Sales Tax Increase and Bonded Debt *(Option used by El Cerrito)*	Increase Berkeley sales tax by a predetermined amount, e.g., one-half cent, and issue bonds to accelerate the street improvements. Dedicate the proceeds from the sales tax to pay off the debt and for street improvements.
2.	Local Sales Tax Increase	Increase Berkeley sales tax by a predetermined amount and dedicate the proceeds for street improvements.
3.	General Tax	Collect a general tax, e.g., parcel or utility tax, that requires the City to invest in street improvement projects.
4.	Citywide Benefit Assessment District	Create a citywide benefit assessment district for street improvements and levy the assessment on Berkeley property bills. Invest the proceeds in street improvement projects citywide.
5.	Separate Benefit Assessment Districts	Create separate benefit assessment districts for street improvements that are defined by neighborhoods or areas. Levy the assessment on Berkeley property tax bills for properties in each area where the owners approved the benefit assessment. Invest the proceeds for street improvement projects within those areas.

Sources: 1. Metropolitan Transportation Commission, *The Pothole Report: Can the Bay Area Have Better Roads?,* June 2011

2. The City and County of San Francisco, *Between a Pothole and a Hard Place: Funding Options for San Francisco's Street Resurfacing Program,* July 2010

Recommendations

1.1 The City Manager should recommend options to the City Council to improve the City's pavement condition index to a certain level over a specified timeframe. The recommendation should include:

- The desired average citywide PCI and timeframe within which to achieve it.
- Potential funding strategies to meet the PCI goal within the desired timeframe.
- A commitment to provide to the commissions and Council an annual progress report on the PCI as part of the Five-Year Street Plan.

1.2 The Department of Public Works should use *StreetSaver®* to develop strategies for meeting the target PCI. To ensure the reliability of the *StreetSaver®* scenarios, staff should:

- Update the *StreetSaver®* unit costs annually, including soft costs, such as administrative costs.
- Ensure the Five-Year Street Plan includes strategies that will achieve the Council-adopted PCI goal.
- Include annual costs for preventive maintenance in the Five-Year Street Plan.

City Manager's Response

Agree; recommendation 1.1 will be implemented by July 2012 and recommendation 1.2 will be implemented by April 2012.

V. FISCAL IMPACT

If we can't afford to fix our streets now, how are we going to be able to afford to fix them in the future when the cost will be millions more?

> ***"Sustainable communities cannot function without a well-maintained local street and road system."***
> **Nichols Consulting Engineers, Chtd., "California Statewide Local Streets and Roads Needs Assessment"**

By the end of 2011, the City's unfunded needs for street maintenance and repair will be $41.7 million. Berkeley's current annual street rehabilitation budget of $3.66 million a year is not enough to allow Public Works to rehabilitate the majority of the City's streets, which continue to deteriorate at a rapid rate. In just five years, those unmet needs will grow to $70.8 million, an increase of more than $29 million. The longer this work is deferred, the more costly the repairs become. If the streets are allowed to continue to deteriorate, Berkeley could become a less desirable place for residents, visitors, and businesses alike. We are unable to quantify the potential affect on the City's local economy. Finding new revenue sources, such as local sales tax increases and bonds, could help fill the funding gap.

VI. CONCLUSION

The City Council should make policy decisions for strategies and funding to increase the City's average pavement condition index from "at risk" to "good." The obstacle in achieving this goal is lack of funds. Given the economic struggles Berkeley faces and the competing needs of failing infrastructure and direct services, there is no easy solution. Options exist: local sales tax increases, bonded debt, general taxes, or assessment districts. Each requires a Council policy decision, and support and approval from Berkeley voters. City management must also explore the legal, financial, and implementation challenges of each option. The City's streets are failing. The sooner we take action to fix them, the less it will cost to achieve long-term sustainability.

We would like to thank staff from the Metropolitan Transportation Commission, TRIP, the City of Fremont, AMS Consulting, and Nichols Consulting, as well as the El Cerrito Public Works Director for providing information for this audit. We would also like to thank the Department of Public Works for their cooperation and timely response to our requests for information. We could not have completed our report without their assistance.

APPENDIX A

SCOPE AND METHODOLOGY

We audited the City of Berkeley's Pavement Condition Index (PCI) and built budget scenarios for improving the City's pavement conditions overall and by functional class (i.e., arterials, collectors, and residential streets). We focused on the level of funding needed to raise the City's PCI to "good" while also implementing a preventive maintenance plan that will allow the City to maintain that condition.

We gained an understanding of Berkeley's street maintenance and rehabilitation activities and its pavement conditions through interviews with program management and staff, as well as staff of the Metropolitan Transportation Commission (MTC). We reviewed the City's street repair policy, external audits, and other reports on pavement quality and transportation needs, and professional guidance for pavement distress inspections. We used the *StreetSaver®* Pavement Management Program to collect and analyze Berkeley street information, including lane miles and PCI scores. We obtained funding and expenditure information from the Department of Public Works. We also interviewed El Cerrito's Director of Public Works to gain an understanding of the strategies El Cerrito used to improve its pavement conditions.

We assessed the reliability of the data in *StreetSaver®* by reviewing them for reasonableness and completeness. To determine the accuracy of the PCI scores, we visually inspected twenty sections of Berkeley streets. We determined that pavement conditions generally reflected the PCI scores recorded in *StreetSaver®* and that the data in *StreetSaver®* were sufficiently reliable for the purposes of our audit.

The Department of Public Works inputs the cost data that *StreetSaver®* uses to build budget scenarios. During an interview with Department staff, we learned that the unit costs were outdated. Prior to conducting our analyses, Department staff updated the unit costs in *StreetSaver®* by increasing each unit price by 40 percent. The Department did not have information available that would allow us to independently verify the reliability of this data prior to completing the audit. However, knowledgeable Department staff stated that the updated costs are the same as those they used to prepare the Five-Year Street Plan (budget) and that actual costs have been within about 10 percent of the budget. Based on this information, we determined that the *StreetSaver®* cost data were sufficiently reliable for the purposes of our audit.

We also obtained and reviewed revenue and expenditure data for street repairs. Because we used this data only to demonstrate that the current funding levels are not sufficient to improve the long-term condition of the City's streets and their reliability was not significant to our audit objective, we did not assess their reliability.

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

We initiated this performance audit as part of the Auditor's Office Fiscal Year 2012 Audit Plan, which we presented to Council on July 12, 2011.

APPENDIX B

Typical Pavement Distress Conditions Found in the San Francisco Bay Area

Type of Distress	Description
Alligator Cracking 	Cracking that begins at the bottom of an asphalt surface and moves toward the surface, eventually creating a series of interconnecting cracks that develop a pattern resembling chicken wire or alligator skin. Alligator cracking is a major structural distress that occurs only in areas subjected to repeat traffic loads, such as wheel paths. Potholes, which create bowl-shaped depressions in the pavement surface, are a form of highly severe alligator cracking.
Block Cracking 	A series of interconnected cracks that divide the pavement into approximately rectangular pieces, ranging in size from 1 foot by 1 foot to 10 feet by 10 feet. Because block cracking is usually a result of significant asphalt hardening rather than traffic, it normally occurs over large pavement areas and in nontraffic areas (i.e., not in wheel paths).
Distortions 	Localized, abrupt upward or downward displacements in the pavement surface that affect ride quality. They are caused by corrugations, bumps, sags, and shoving in the pavement.
Longitudinal and Transverse Cracking  	Longitudinal cracks run parallel to the pavement's centerline or lay-down direction. Transverse cracks run across the pavement at approximate right angles to the pavement centerline. These cracks may be caused by poor construction, shrinkage of the asphalt concrete surface due to temperature changes or asphalt hardening, cracks beneath the surface, or decreased support or thickness near the pavement edge.

Patching and Utility Cut Patching 	An area of pavement that has been replaced with new material to repair existing pavement. Patches usually do not perform as well as an original pavement section and are always considered a defect.
Rutting and Depressions 	Depressions are localized areas where the pavement surface is lower than the surrounding area, but the transition is not abrupt enough to be considered a distortion. Ruts are surface depressions in the wheel paths.
Weathering and Raveling 	Wearing of pavement due to loss of asphalt or tar binder and dislodged aggregate particles. It is caused by hardening of the asphalt binder, poor quality mixture, softening of the surface due to oil or fuel spillage, surface seal loss, or traffic from certain types of vehicles.

Sources: Metropolitan Transportation Commission, *Pavement Condition Index Distress Identification Manual for Asphalt and Surface Treatment Pavements*, Second Edition, 1986

Federal Highway Administration, *Pavement Distress Identification Manual for the NPS Road Inventory Program*, Cycle 4, 2006-2009

Audit staff pictures of Berkeley streets, with distress types verified by Department of Public Works staff

APPENDIX C

FIVE-YEAR EXPENDITURES AND RESULTING PAVEMENT CONDITION INDEX (PCI)

StreetSaver® Budgeting Scenarios Overview

The following pages present seven *StreetSaver®* budgeting scenarios for street maintenance and rehabilitation work. Each scenario provides an example of how changes in funding affect the City's average pavement condition index and unfunded need. When *StreetSaver®* determines there is no unfunded need, that does not mean there are no streets requiring rehabilitation. Rather, it means the City has reached the optimal *overall* PCI of 80 and there are no streets in "failed" condition.

The results of each scenario are based on the recommended treatments determined by *StreetSaver®* within the funding constraints of each budget. Each scenario is based on *StreetSaver®* estimates of the cost of maintenance or rehabilitation needed to bring the City's street network to an optimal level, and provides a maintenance and rehabilitation plan for each year of the analysis. It is important to note that the scenarios do not include other priorities that may affect actual strategies for streets improvement work. For example, there may be safety concerns or bus and bicycle route priorities that would require City staff to shift recommended treatments from one year to another. Although *StreetSaver®* allows a user to build such projects into the scenarios, we have not done that here because the purpose is to show what is possible at various levels of funding, with all else being equal.

Assumptions

The *StreetSaver®* scenarios were designed with the following assumptions:

- A base budget with a three percent inflation factor for each subsequent year, except for scenario one, which is based on an average of $3.66 million a year to correlate to the City's Five-Year Street Plan.
- Five percent of budget allocated to a comprehensive preventive maintenance program (i.e., crack seals, slurry seals, and resurfacing).
- Weighted repairs by functional class: arterials first, then collectors, then residential streets.

Reading the Results

Each scenario provides a summary stating the base budget amount and the average PCI after five years of treatment. Actual results depend on the accuracy of unit costs data in *StreetSaver®*.

The scenario then provides the results of the five years of treatment, broken down by arterials, collectors, and residential streets. These results are shown graphically and numerically in a table below the pie chart. In some instances, the percentages shown do not exactly total 100 percent to due rounding.

The next section shows the expenditures by year for rehabilitation and preventive maintenance, along with the unfunded need, which is the amount needed to reconstruct all streets remaining in a "failed" condition. It also shows the average PCI after each year of treatment.

The final section provides a brief analysis of what the results mean, primarily in terms of whether the presented level of funding results in an average pavement condition index that is sustainable over the long term, assuming sufficient funding is provided in subsequent years to perform ongoing pavement preservation maintenance.

The table below summarizes the results at the end of five years for each scenario, showing total expenditures, average PCI, and the remaining unfunded need.

Summary of Results of Funding and Rehabilitation Scenarios Created in *StreetSaver®*

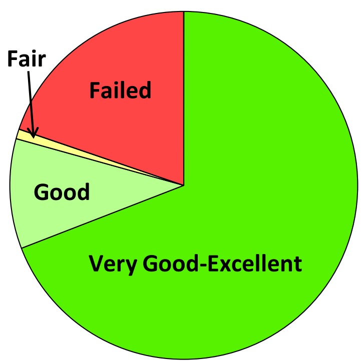
Scenario and Base Budget	Total 5-Year Expenditures	Average PCI at End of 5 Years	Unfunded Need at End of 5 Years
Scenario 1: $3.66 million base budget *(current funding level)*	$18,298,982	63	$70,767,524
Scenario 2: $46 million base budget *(front-loaded budget)*	$87,310,557	85	$0
Scenario 3: $7.5 million base budget	$38,400,194	63	$45,594,008
Scenario 4: $10 million base budget	$51,200,296	68	$32,231,418
Scenario 5: $12.5 million base budget	$64,000,421	73	$19,405,372
Scenario 6: $15 million base budget	$76,800,003	79	$7,072,403
Scenario 7: $17.5 million base budget	$84,164,570	82	$0

Source: Funding and rehabilitation scenarios created by audit staff in *StreetSaver®*

SAMPLE SCENARIO 1: $3.66 million base budget
(Average annual budget in the Five-Year Street Plan for FY 2012-2016)

AVERAGE PCI AFTER FIVE YEARS OF TREATMENT: 63

ARTERIALS
Total 5-Year Costs: $3,578,337
Average PCI at Year 5: 71



PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	15.03	69.12%
Good (79-70)	2.22	10.21%
Fair (69-60)	0.20	0.91%
At Risk (59-50)	0.00	0.00%
Poor (49-25)	0.00	0.00%
Failed (24-0)	4.30	19.76%
TOTAL	**21.75**	**100.00%**

COLLECTORS
Total 5-Year Costs: $2,771,174
Average PCI at Year 5: 51

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	14.11	38.20%
Good (79-70)	4.35	11.78%
Fair (69-60)	1.68	4.54%
At Risk (59-50)	1.26	3.41%
Poor (49-25)	1.75	4.74%
Failed (24-0)	13.78	37.32%
TOTAL	**36.93**	**100.00%**

RESIDENTIAL
Total 5-Year Costs: $11,949,471
Average PCI at Year 5: 64

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	66.96	42.51%
Good (79-70)	31.77	20.17%
Fair (69-60)	3.64	2.31%
At Risk (59-50)	5.89	3.74%
Poor (49-25)	20.93	13.29%
Failed (24-0)	28.32	17.98%
TOTAL	**157.51**	**100.00%**

TOTAL EXPENDITURES AND AVERAGE PCI BY YEAR

Year	Rehabilitation	Preventive Maintenance	Total Expenditures	Unfunded Need	Average PCI
Year 1	$3,476,258	$183,715	$3,659,973	$41,698,808	61
Year 2	$3,474,754	$185,172	$3,659,926	$48,819,492	62
Year 3	$3,475,004	$184,901	$3,659,905	$57,530,209	62
Year 4	$3,474,871	$185,116	$3,659,987	$63,884,047	62
Year 5	$3,474,877	$184,314	$3,659,191	$70,767,524	63
TOTAL	**$17,375,764**	**$923,218**	**$18,298,982**	**N/A**	**N/A**

What do these results mean? At the end of five years, the average PCI would increase by 5 percentage points over the current average PCI of 58. However, the rapid annual growth in the unfunded need (a 70 percent increase at the end of five years) means the average PCI is not sustainable with this limited level of funding. Within a few years, the average PCI would decline while the unfunded need would continue to grow. This is because the number of "failed" streets continues to increase. At this level of funding, the percentage of "failed" linear miles would increase from the current 12 percent to 21 percent at the end of five years.

SAMPLE SCENARIO 2: $46 million base budget

(Front-loaded to do most of the rehabilitation work in a short time period)

AVERAGE PCI AFTER FIVE YEARS OF TREATMENT: 85

ARTERIALS
Total 5-Year Costs: $12,656,573
Average PCI at Year 5: 86

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	19.46	89.48%
Good (79-70)	2.09	9.62%
Fair (69-60)	0.20	0.91%
At Risk (59-50)	0.00	0.00%
Poor (49-25)	0.00	0.00%
Failed (24-0)	0.00	0.00%
TOTAL	**21.75**	**100.00%**

COLLECTORS
Total 5-Year Costs: $27,205,061
Average PCI at Year 5: 87

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	31.91	86.40%
Good (79-70)	3.00	8.14%
Fair (69-60)	1.44	3.90%
At Risk (59-50)	0.48	1.31%
Poor (49-25)	0.09	0.26%
Failed (24-0)	0.00	0.00%
TOTAL	**36.93**	**100.00%**

RESIDENTIAL
Total 5-Year Costs: $47,448,923
Average PCI at Year 5: 84

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	132.86	84.35%
Good (79-70)	15.16	9.62%
Fair (69-60)	2.74	1.74%
At Risk (59-50)	2.09	1.33%
Poor (49-25)	4.66	2.96%
Failed (24-0)	0.00	0.00%
TOTAL	**157.51**	**100.00%**

TOTAL EXPENDITURES AND AVERAGE PCI BY YEAR

Year	Rehabilitation	Preventive Maintenance	Total Expenditures	Unfunded Need	Average PCI
Year 1	$42,984,786	$2,374,202	$45,358,988	$0	80
Year 2	$10,617,144	$527,542	$11,144,686	$0	80
Year 3	$12,143,661	$174,666	$12,318,327	$0	83
Year 4	$9,562,436	$238,665	$9,801,101	$0	84
Year 5	$8,018,207	$669,248	$8,687,455	$0	85
TOTAL	**$83,326,234**	**$3,984,323**	**$87,310,557**	**N/A**	**N/A**

What do these results mean? With this level of funding, more than 85 percent of the City's streets would be in "very good-excellent" condition at the end of five years. The PCI would be sustainable, as long as sufficient funding is allocated in Year 6 and beyond to perform pavement maintenance. The factors that demonstrate this sustainability are the significant increase from the current average PCI of 58 to 80 in Year 1 and to 85 in Year 5, combined with an annual decrease in the expenditures needed to improve the PCI and elimination of the unfunded need.

SAMPLE SCENARIO 3: $7.5 million base budget

AVERAGE PCI AFTER FIVE YEARS OF TREATMENT: 63

ARTERIALS Total 5-Year Costs: $12,602,869 Average PCI at Year 5: 86	COLLECTORS Total 5-Year Costs: $24,918,461 Average PCI at Year 5: 83	RESIDENTIAL Total 5-Year Costs: $878,864 Average PCI at Year 5: 52

PCI Category	Linear Miles	% of Total	PCI Category	Linear Miles	% of Total	PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	19.46	89.48%	Very Good-Excellent (100-80)	30.14	81.62%	Very Good-Excellent (100-80)	35.02	22.23%
Good (79-70)	2.09	9.62%	Good (79-70)	3.04	8.23%	Good (79-70)	17.12	10.87%
Fair (69-60)	0.20	0.91%	Fair (69-60)	1.44	3.90%	Fair (69-60)	15.89	10.09%
At Risk (59-50)	0.00	0.00%	At Risk (59-50)	0.48	1.31%	At Risk (59-50)	14.59	9.26%
Poor (49-25)	0.00	0.00%	Poor (49-25)	0.09	0.26%	Poor (49-25)	46.63	29.61%
Failed (24-0)	0.00	0.00%	Failed (24-0)	1.73	4.70%	Failed (24-0)	28.26	17.94%
TOTAL	**21.75**	**100.00%**	**TOTAL**	**36.93**	**100.00%**	**TOTAL**	**157.51**	**100.00%**

TOTAL EXPENDITURES AND AVERAGE PCI BY YEAR

Year	Rehabilitation	Preventive Maintenance	Total Expenditures	Unfunded Need	Average PCI
Year 1	$7,124,517	$375,526	$7,500,043	$37,858,724	63
Year 2	$7,338,280	$386,761	$7,725,041	$40,914,930	63
Year 3	$7,337,679	$387,359	$7,725,038	$44,726,812	63
Year 4	$7,337,864	$387,178	$7,725,042	$45,089,441	63
Year 5	$7,336,985	$388,045	$7,725,030	$45,594,008	63
TOTAL	**$36,475,325**	**$1,924,869**	**$38,400,194**	**N/A**	**N/A**

What do these results mean? At the end of the first year, the average PCI would increase 5 percentage points over the current average PCI of 58. Although it would remain steady during the five-year period, the annual increase in unfunded need (20.4 percent from Year 1 to Year 5) means the average PCI is not sustainable at this level of funding. Within a few years, the average PCI will decline because less than half of the City's streets would have been improved to a "very good-excellent" condition, and the linear miles of "failed" streets would continue to increase - from the current 12 percent to 14 percent at the end of five years.

SAMPLE SCENARIO 4: $10 million base budget

AVERAGE PCI AFTER FIVE YEARS OF TREATMENT: 68

ARTERIALS
Total 5-Year Costs: $12,656,573
Average PCI at Year 5: 86

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	19.46	89.48%
Good (79-70)	2.09	9.62%
Fair (69-60)	0.20	0.91%
At Risk (59-50)	0.00	0.00%
Poor (49-25)	0.00	0.00%
Failed (24-0)	0.00	0.00%
TOTAL	**21.75**	**100.00%**

COLLECTORS
Total 5-Year Costs: $27,667,855
Average PCI at Year 5: 87

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	31.91	86.40%
Good (79-70)	3.00	8.14%
Fair (69-60)	1.44	3.90%
At Risk (59-50)	0.48	1.31%
Poor (49-25)	0.09	0.26%
Failed (24-0)	0.00	1.00%
TOTAL	**36.93**	**100.00%**

RESIDENTIAL
Total 5-Year Costs: $10,875,868
Average PCI at Year 5: 58

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	53.60	34.03%
Good (79-70)	17.34	11.01%
Fair (69-60)	10.77	6.84%
At Risk (59-50)	13.90	8.82%
Poor (49-25)	41.41	26.29%
Failed (24-0)	20.49	13.01%
TOTAL	**157.51**	**100.00%**

TOTAL EXPENDITURES AND AVERAGE PCI BY YEAR

Year	Rehabilitation	Preventive Maintenance	Total Expenditures	Unfunded Need	Average PCI
Year 1	$9,499,455	$500,589	$10,000,044	$35,358,729	63
Year 2	$9,784,944	$515,106	$10,300,050	$35,764,785	64
Year 3	$9,784,907	$515,132	$10,300,039	$36,839,630	65
Year 4	$9,784,366	$515,722	$10,300,088	$34,501,866	66
Year 5	$9,784,058	$516,017	$10,300,075	$32,231,418	68
TOTAL	**$48,637,730**	**$2,562,566**	**$51,200,296**	**N/A**	**N/A**

What do these results mean? At the end of the first year, the average PCI would increase 5 percentage points over the current average PCI of 58, and another 5 percentage points at the end of five years. The combination of stabilized annual expenditures and a declining unfunded need indicates that this level of annual funding would achieve a sustainable PCI. With this level of funding, the linear miles of pavement in the “at risk,” “poor,” and “failed” categories would all decline, while almost 33 more linear miles would be in “fair” to “very good-excellent” condition than are currently in those conditions.

SAMPLE SCENARIO 5: $12.5 million base budget

AVERAGE PCI AFTER FIVE YEARS OF TREATMENT: 73

ARTERIALS
Total 5-Year Costs: $12,656,573
Average PCI at Year 5: 86

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	19.46	89.48%
Good (79-70)	2.09	9.62%
Fair (69-60)	0.20	0.91%
At Risk (59-50)	0.00	0.00%
Poor (49-25)	0.00	0.00%
Failed (24-0)	0.00	0.00%
TOTAL	**21.75**	**100.00%**

COLLECTORS
Total 5-Year Costs: $27,432,261
Average PCI at Year 5: 87

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	31.91	86.40%
Good (79-70)	3.00	8.14%
Fair (69-60)	1.44	3.90%
At Risk (59-50)	0.48	1.31%
Poor (49-25)	0.09	0.26%
Failed (24-0)	0.00	0.00%
TOTAL	**36.93**	**100.00%**

RESIDENTIAL
Total 5-Year Costs: $23,911,587
Average PCI at Year 5: 66

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	76.64	48.66%
Good (79-70)	15.58	9.89%
Fair (69-60)	8.29	5.26%
At Risk (59-50)	12.54	7.96%
Poor (49-25)	33.71	21.40%
Failed (24-0)	10.75	6.83
TOTAL	**157.51**	**100.00%**

TOTAL EXPENDITURES AND AVERAGE PCI BY YEAR

Year	Rehabilitation	Preventive Maintenance	Total Expenditures	Unfunded Need	Average PCI
Year 1	$11,874,459	$625,598	$12,500,057	$32,858,721	64
Year 2	$12,230,337	$644,724	$12,875,061	$30,614,989	65
Year 3	$12,230,454	$644,635	$12,875,089	$28,965,809	68
Year 4	$12,230,077	$645,037	$12,875,114	$24,072,392	71
Year 5	$12,230,700	$644,400	$12,875,100	$19,405,372	73
TOTAL	**$60,796,027**	**$3,204,394**	**$64,000,421**	**N/A**	**N/A**

What do these results mean? At the end of Year 5, the average PCI would increase 15 percentage points over the current average PCI of 58. This rate of change, combined with the stabilized annual expenditures and declining unfunded need, indicates that the overall pavement condition could reach the optimal level of 80 by the end of Year 10. This PCI would be sustainable as long as sufficient funds are allocated to preventive maintenance and minor rehabilitation in Year 11 and beyond. With this level of funding, the linear miles of pavement in the “at risk,” “poor,” and “failed” categories would all decline, while almost 52 more linear miles would be in “fair” to “very good-excellent” condition than are currently in those conditions.

SAMPLE SCENARIO 6: $15 million base budget

AVERAGE PCI AFTER FIVE YEARS OF TREATMENT: 79

ARTERIALS
Total 5-Year Costs: $12,656,573
Average PCI at Year 5: 86

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	19.46	89.48%
Good (79-70)	2.09	9.62%
Fair (69-60)	0.20	0.91%
At Risk (59-50)	0.00	0.00%
Poor (49-25)	0.00	0.00%
Failed (24-0)	0.00	0.00%
TOTAL	**21.75**	**100.00%**

COLLECTORS
Total 5-Year Costs: $27,329,638
Average PCI at Year 5: 87

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	31.91	86.40%
Good (79-70)	3.00	8.14%
Fair (69-60)	1.44	3.90%
At Risk (59-50)	0.48	1.31%
Poor (49-25)	0.09	0.26%
Failed (24-0)	0.00	0.00%
TOTAL	**36.93**	**100.00%**

RESIDENTIAL
Total 5-Year Costs: $36,813,792
Average PCI at Year 5: 75

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	100.24	63.64%
Good (79-70)	15.43	9.79%
Fair (69-60)	2.85	1.81%
At Risk (59-50)	10.76	6.83%
Poor (49-25)	23.81	15.12%
Failed (24-0)	4.41	2.80%
TOTAL	**157.51**	**100.00%**

TOTAL EXPENDITURES AND AVERAGE PCI BY YEAR

Year	Rehabilitation	Preventive Maintenance	Total Expenditures	Unfunded Need	Average PCI
Year 1	$14,249,919	$750,133	$15,000,052	$30,358,730	65
Year 2	$14,676,552	$773,537	$15,450,089	$25,464,638	67
Year 3	$14,675,957	$774,171	$15,450,128	$21,341,300	71
Year 4	$14,675,574	$774,490	$15,450,064	$14,084,826	75
Year 5	$14,668,744	$780,926	$15,449,670	$7,072,403	79
TOTAL	**$72,946,746**	**$3,853,257**	**$76,800,003**	**N/A**	**N/A**

What do these results mean? At the end of year five, the average PCI would increase 21 percentage points over the current average PCI of 58 and the unfunded need would decline to $7.1 million (77 percent reduction). This rate of change indicates the average PCI would be at least 80 and the unfunded need would be eliminated within Year 6. Both conditions would be sustainable as long as sufficient funds are allocated to preventive maintenance and minor rehabilitation in Year 7 and beyond. With this level of funding, the linear miles of pavement in the “at risk,” “poor,” and “failed” categories would all decline, while almost 70 more linear miles would be in “fair” to “very good-excellent” condition than are currently in those conditions.

SAMPLE SCENARIO 7: $17.5 million base budget

AVERAGE PCI AFTER FIVE YEARS OF TREATMENT: 82

ARTERIALS
Total 5-Year Costs: $12,656,573
Average PCI at Year 5: 86

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	19.46	89.48%
Good (79-70)	2.09	9.62%
Fair (69-60)	0.20	0.91%
At Risk (59-50)	0.00	0.00%
Poor (49-25)	0.00	0.00%
Failed (24-0)	0.00	0.00%
TOTAL	**21.75**	**100.00%**

COLLECTORS
Total 5-Year Costs: $27,259,146
Average PCI at Year 5: 87

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	31.91	86.40%
Good (79-70)	3.00	8.14%
Fair (69-60)	1.44	3.90%
At Risk (59-50)	0.48	1.31%
Poor (49-25)	0.09	0.26%
Failed (24-0)	0.00	0.00%
TOTAL	**36.93**	**100.00%**

RESIDENTIAL
Total 5-Year Costs: $44,248,851
Average PCI at Year 5: 80

PCI Category	Linear Miles	% of Total
Very Good-Excellent (100-80)	114.77	72.87%
Good (79-70)	15.65	9.93%
Fair (69-60)	1.00	0.63%
At Risk (59-50)	9.08	5.77%
Poor (49-25)	17.01	10.80%
Failed (24-0)	0.00	0.00%
TOTAL	**157.51**	**100.00%**

TOTAL EXPENDITURES AND AVERAGE PCI BY YEAR

Year	Rehabilitation	Preventive Maintenance	Total Expenditures	Unfunded Need	Average PCI
Year 1	$16,624,765	$875,304	$17,500,069	$27,858,726	66
Year 2	$17,123,078	$902,046	$18,025,124	$20,316,190	70
Year 3	$17,122,815	$902,296	$18,025,111	$13,650,740	74
Year 4	$17,114,324	$698,877	$17,813,201	$4,218,766	79
Year 5	$12,161,513	$639,552	$12,801,065	$0	82
TOTAL	**$80,146,495**	**$4,018,075**	**$84,164,570**	**N/A**	**N/A**

What do these results mean? At the end of Year 5, the average PCI would increase 24 percentage points over the current average PCI of 58 and the unfunded need would be eliminated. Both conditions would be sustainable as long as sufficient funds are allocated to preventive maintenance and minor rehabilitation in Years 6 and beyond. With this level of funding, the linear miles of pavement in the “at risk” and “poor” categories would decline, while almost 83 more linear miles would be in “fair” to “very good-excellent” condition than are currently in those conditions. There would be no linear miles in “failed” condition.