Street Condition Inventory

City Council Briefing

Public Works & Transportation
And Street Services
Departments

September 7, 2005

Purpose

- Provide the history of the Pavement Surface Inventory Program and its utilization
- Review and discuss accomplishments of the “Streets 2010” Program
- Discuss Enhancing / Modernizing the Pavement Surface Inventory Program

Current Pavement Surface Inventory Program

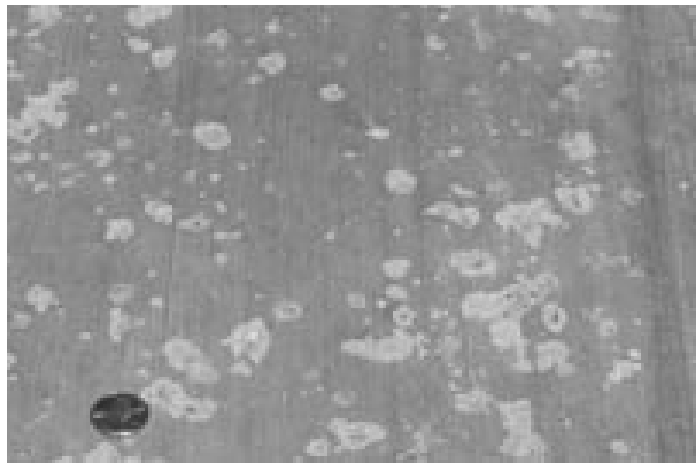
- Established 1975 as a means of annually collecting comprehensive information on the conditions of the street inventory and **forecasting** conditions to assist in the development of **needs lists** for various treatments to repair and maintain the network - provides input for the **Streets 2010 Program** and **Capital Bond Programs**
- **Considered a benchmark system** at its inception as there were few cities performing street condition assessments at this level of detail and for such large networks
- Evolved from originally 28 to now over 60 data items collected describing the physical composition and condition of riding surfaces, curbs and gutters, sidewalks, and distress types collected by street block – alleys were included in **1993**
- Provides thorough and consistent manual data collection – experienced staff (average 18 years of experience) are trained in technical assessment of the inventory

Condition Assessment Process

- Inspection teams assess the condition of the entire city-maintained inventory of nearly 11,600 lane miles of streets and 3,300 miles of alleys annually (generally January through August) through field inspection based on technical scoring criteria
- Each block is evaluated on the extent and severity of at least 11 surface distress types based on technical observation
- Worst conditions encountered along the block are used for the entire block (see *Appendix* for types of distress data collected)

Examples of Condition Data Collected

- Density of popouts



- Spalling

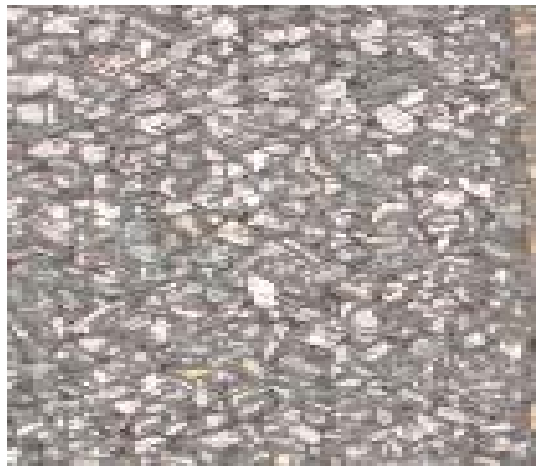
Examples of Condition Data Collected

- Depth and extent of base failure

- Rutting

Examples of Condition Data Collected

- Polishing
  - Relatively new flexible asphalt paving



  - Older, “polished” surface that has lost some skid resistance due to the polishing effect of traffic over time

Example Condition Data Collected

- Raveling

- Cracking

Condition Assessment Process

- Full inventory of streets and alleys are inspected January through August
- Inspection teams complete re-evaluations generally between September and December of streets improved during that year's construction season (capital projects, O&M maintenance, etc.) and update the database
- Annual reports are normally generated in January including new "percent satisfactory" and forecast of future network conditions

Percent Satisfactory Ratings by Others

- Each entity determines what is satisfactory for its network of streets
- The definition of “satisfactory” changes periodically within a city based on availability of resources, public input, etc. – currently streets rated “A” - “C” are considered “satisfactory” in Dallas
- Standards exist for performing quantitative assessments but not for differentiating satisfactory / unsatisfactory conditions

Current Street Conditions and Maintenance Responses

Satisfactory

Unsatisfactory

Ratings	Description	Anticipated Maintenance
A	**Excellent** Pavements that have no distress (mostly new or newly rehabilitated surfaces)	None
B	**Very Good** Very good ride quality - require preventive maintenance (slurry seal or similar) if any	Slurry Microseal Resurface
C	**Good** Acceptable ride quality, though road surfaces are becoming worn – slurry, microsurfacing, or similar is needed to prevent rapid deterioration	Mill and Overlay / Resurface
D	**Fair** Marginally acceptable ride quality – microsurfacing , chip sealing, or partial reconstruction is needed to prevent rapid deterioration	Resurface, Partially Reconstruct
E	**Poor** Pavements that have extensive amounts of distress and require partial or full reconstruction	Reconstruct

What is a Satisfactory Street?

- A-Good: Good riding surface, no obvious defects

What is a Satisfactory Street?

- B-Acceptable: Good riding surface, minor defects

What is a Satisfactory Street?

- C-Fair: Slightly rough, beginning to breakdown

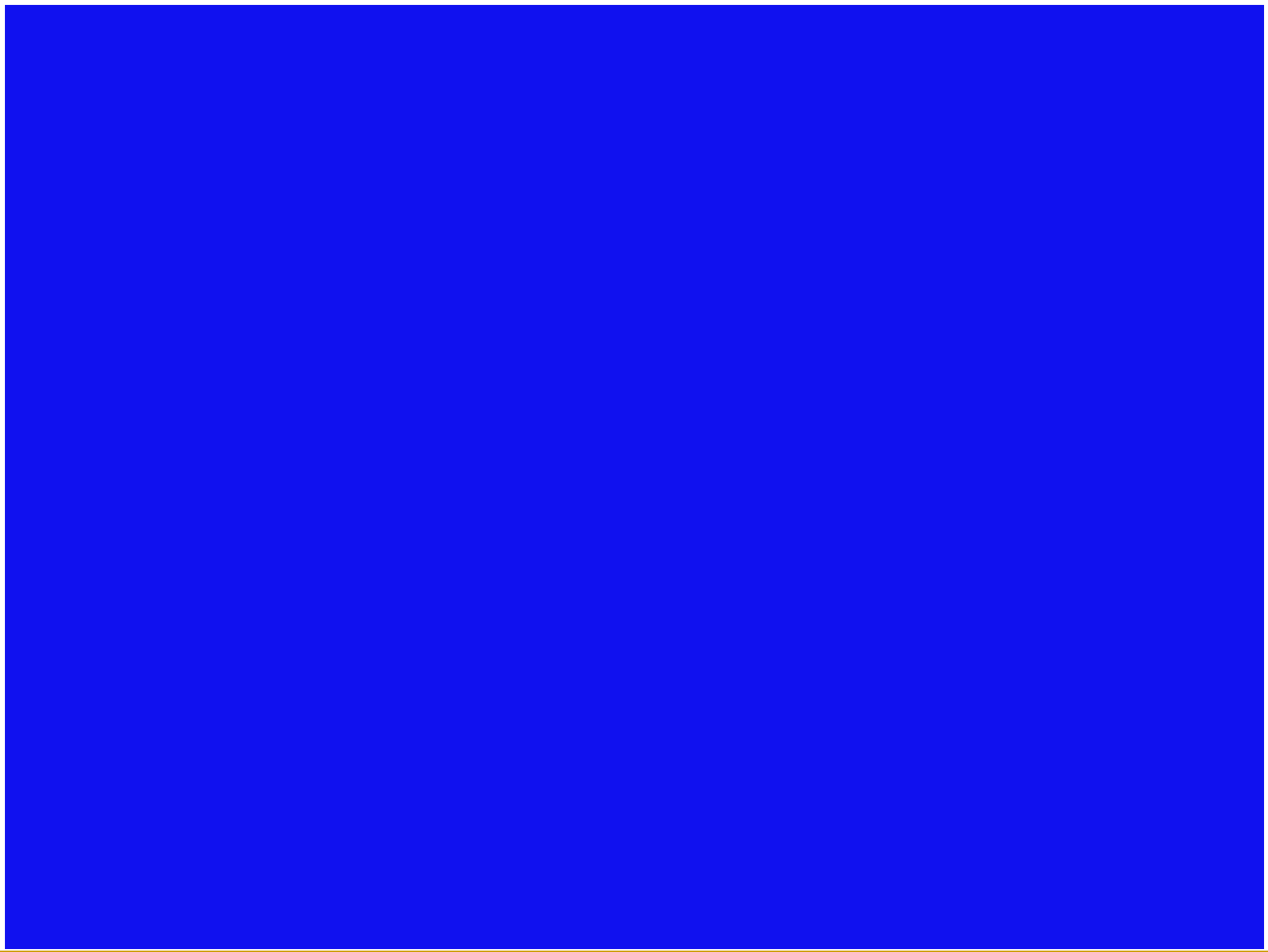
Unsatisfactory Conditions

- D- Poor: Moderately rough, pavement failures

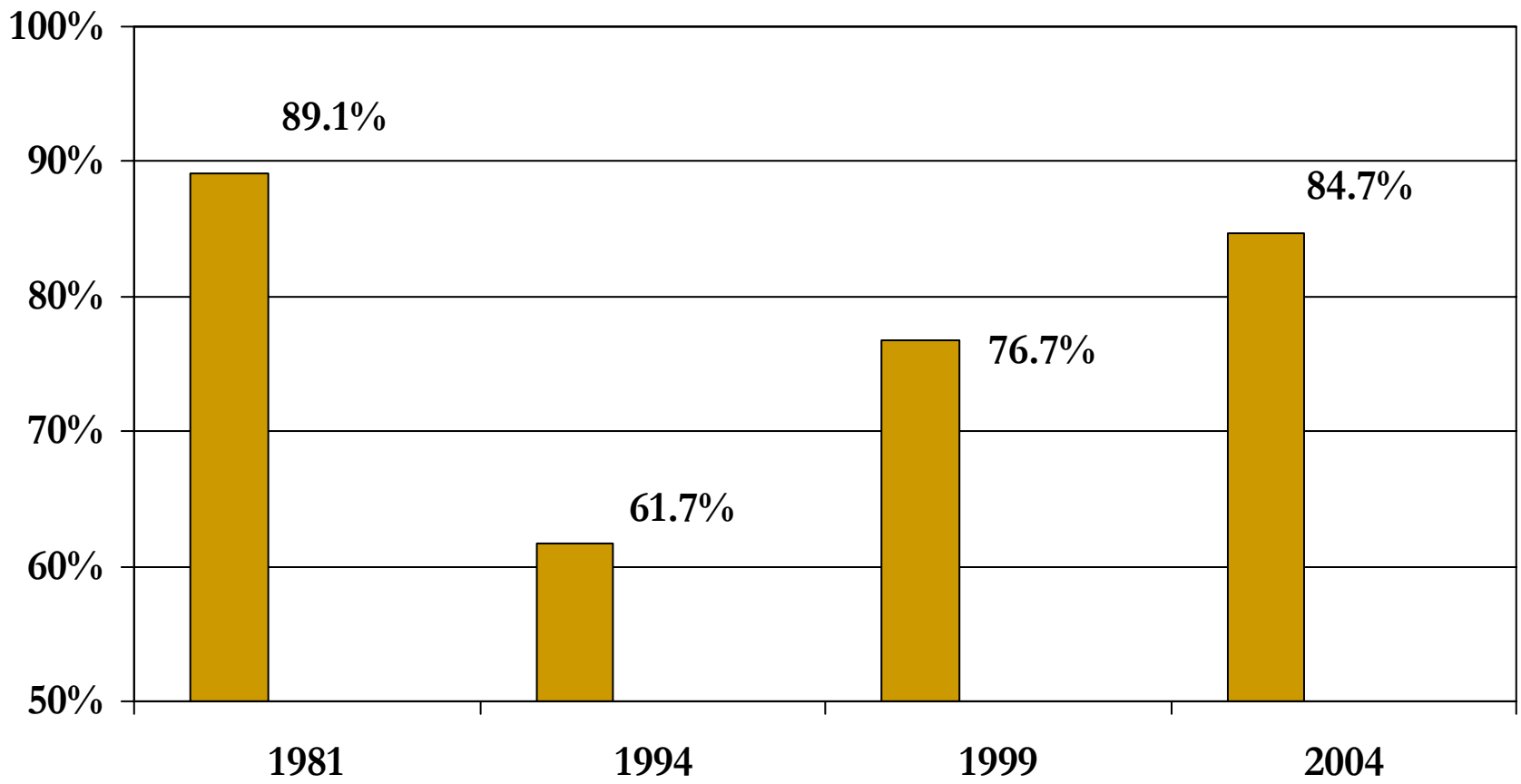
Unsatisfactory Conditions

- E-Unacceptable: Very rough riding surface, large areas in bad condition

Video Tour



Percent Satisfactory Trends



Percent Satisfactory History

- In 1981, **89.1%** of streets were in satisfactory condition
- The economy of the late 1980's resulted in budgets that reduced or eliminated many street repair and preventative maintenance services resulting in a significant decline in the overall condition rating
- In 1994, the network was rated as **61.7%** (lowest level) in satisfactory condition and projections indicated only **15%** of the network would be rated satisfactory by 2015 at the current level of investment

Percent Satisfactory History

- “Street Maintenance Improvement” issue paper presented to Council in June 1995 and Council adopted goal of 75% satisfactory street condition by the year 2015
- In 1996, the Council accelerated the program to reach the 75% satisfactory goal by year 2010 instead of 2015
- In 1999, a 76.7% satisfactory rating was obtained; exceeding the revised goal by 11 years

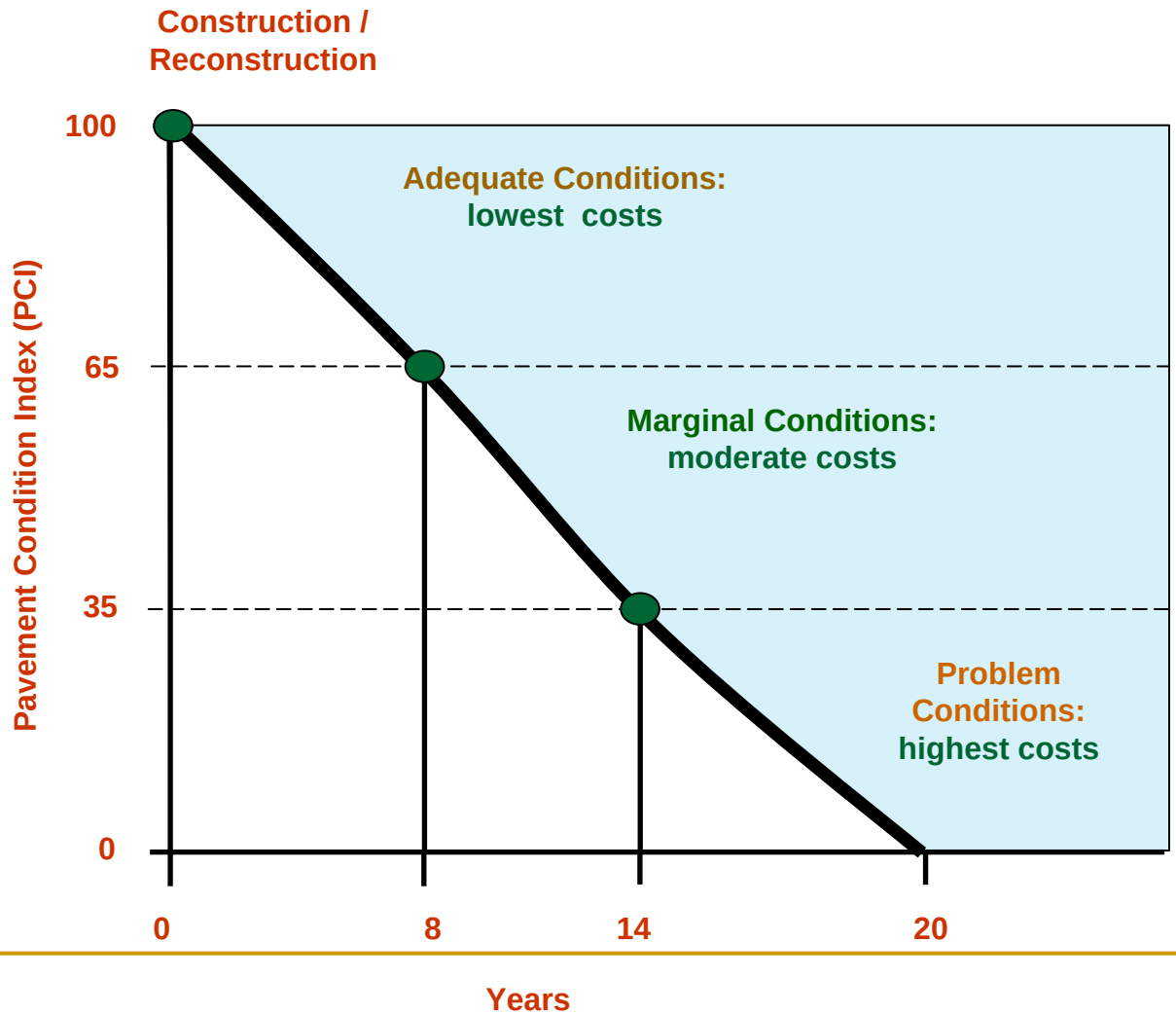
Percent Satisfactory History

- The percent satisfactory rating has continued rise and is currently 85%
- Council and the citizens of Dallas have demonstrated a commitment to maintain and enhance the roadway network by investing over $375M in bond funding and $70M in O&M funding for roadway infrastructure maintenance and improvements since 1994

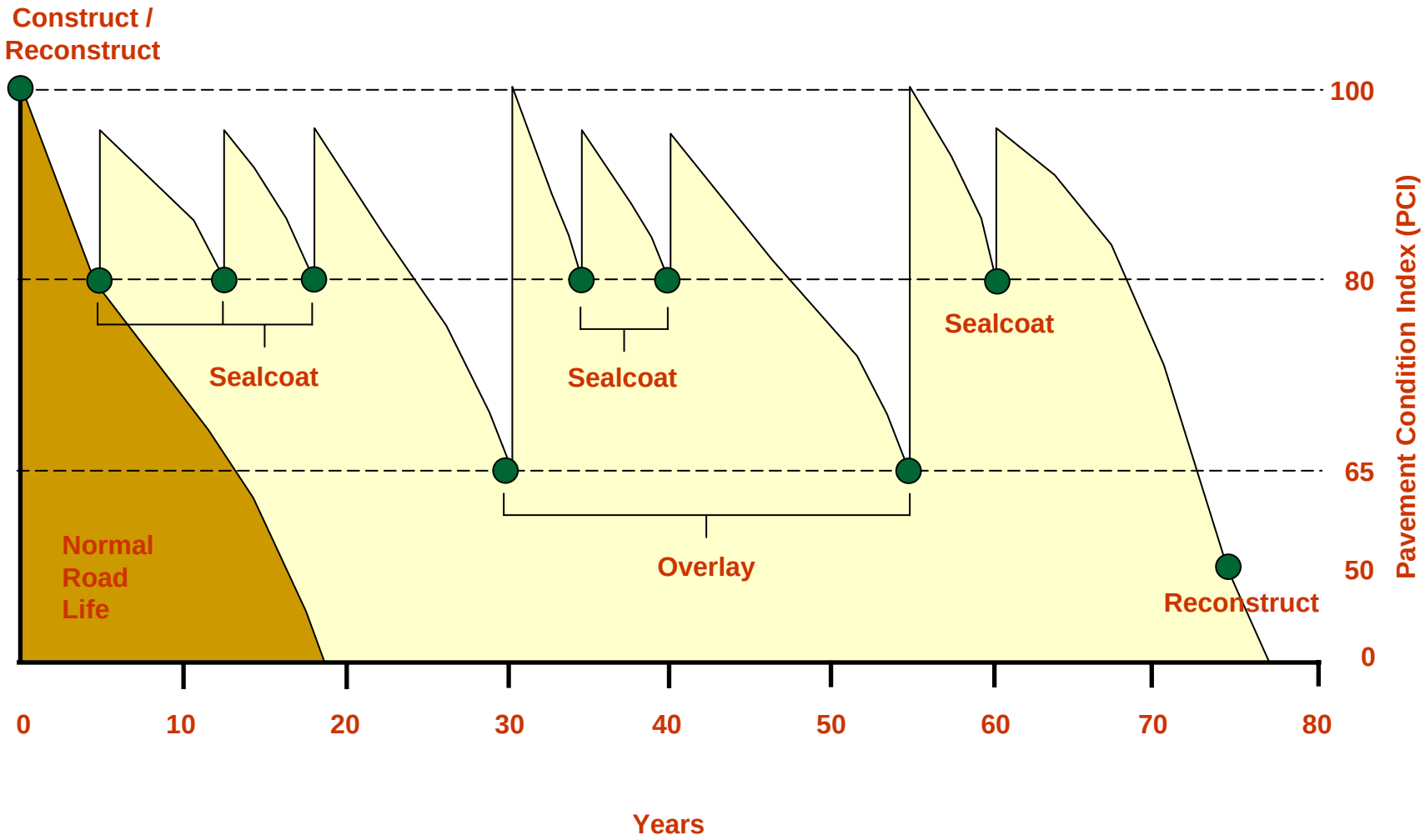
Continued Capital and Operating Investment

- The 2003 Capital Bond Program is the largest investment to date and has two years remaining
- The current annual average of $70M in bond funding is a historically high rate of investment and is needed to address streets where preventive maintenance is no longer an option
- Operating investment is also needed to continue to address those streets where lower unit-cost treatments can extend the useful life complimenting the capital program

Variation of Maintenance Costs for Streets Over Time



General Extension of Useful Life of a Street Through a Maintenance Program



Example Streets

500 Block of Twelfth St.

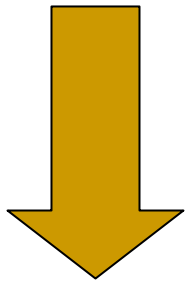
- Resurfaced 1999
  - $33,416
  - From “D” to “A”
- Micro-surfaced 2005
  - $8,789
  - From “C” to “A”

1100 Block of Woodin Blvd

- Resurfaced 2000
  - $17,531
  - From “E” to “A”
- Slurry seal in 2005
  - $2,395
  - From “B” to “A” (in progress)

Pavement Surface Inventory Program

Further study/research



Enhancements to means and methods

Pavement Management Program (PMP)

Partial List of Automated Data Collection Technologies for Consideration

- Ground-penetrating radar that aides in detection of problems beneath the surface before they become visible
- Lasers that detect lateral and longitudinal ruts
- Video logging that evaluates curb and gutter, sidewalk, signs, streetlights, etc. in addition to the road surface
- Special lighting to enable use during periods of low ambient lighting and provide consistent video imagery
- Profilometers to provide quantifiable pavement roughness data based on international standards
- GPS location for ease of linking condition data to GIS database

Automated Data Collection Options

- Contracted Service – Arlington recently contracted with Applied Research Associates of Champaign, IL for data collection ($500K per cycle – 3,400 lane- miles of streets – no alleys, five (5) months for vendor to collect data – considering collecting data once every four years)

- In-house with equipment purchase – Fort Worth recently took delivery of a GPS and computer equipped vehicle as a first phase of a multi-phased transition to automated data collection (roughly $60K, network of 6,200 lane-miles, previously inventoried ½ every three years at a cost of approx. $213K every three years – future frequency and additional equipment to be determined)

What Index Cities are Doing

- Staff polled several index cities in June and July comparing existing pavement management programs
- In general, responses from those cities responding that have programs indicate:
  - Until the past few years, ***none*** had programs nearly as extensive and technically advanced as Dallas
  - None include road and alley networks of comparable size to Dallas
  - None assess the entire network annually
  - Only Arlington and Fort Worth have somewhat comprehensive programs linked to GIS
  - Most are currently researching new technology and options available to change to automated data collection in the next 2 – 3 years

Survey Results

City	Program Established	Alleys Included	Network size (Lane-Mi.)	Automated Data Collection	GIS – based	Frequency
Dallas	**1975**	**Y**	11,577 (streets) and 3,300 (alleys)	N	N	Annually
Phoenix	1986	**Y**	4,600	**Y**	N	Every 2 yrs
San Jose	1988	**Y**	2,300	N	N	4yrs – alleys/ residential, 2yrs - arterials
Fort Worth	1999	N	6,200	**semi**	**Y**	Every 3 yrs
Arlington	2005	N	3,400	**Y**	**Y**	TBD
San Antonio	1995	N	11,666	N	N	Every 3 yrs

Preliminary Scope of Professional Services Contract for Enhanced PMP

- Recommend pavement management software (PMS)
- Study linking historical data to the new software
- Calculate Pavement Condition Index (PCI) models for flexible and rigid asphalt surfaces which will be the basis for decisions made in the PMP (finalize PCI ranges for A-F ratings and develop/confirm deterioration curves)
- Quality Assurance/Quality Control and system testing

Preliminary Scope of Professional Services Contract for Enhanced PMP

- Specify and possibly procure automated data collection equipment
- Formulate procedures for data collection
- Trained City staff on all aspects of the PMS, including software (data entry, reporting, editing, etc.), field data collection, and automated data collection equipment operation
- Specify and procure data storage
- Provide technical assistance as needed after completion of this project

Approximate Implementation Schedule for Enhanced PMP

RFP for Professional Services	November 2005
Award contract	January 2006
Research, demo, select, and procure software	Feb. - Mar. 2006
Research available technologies	Feb. - Apr. 2006
Determine efficient and cost-effective frequencies for data collection	May – June 2006
Develop and verify automated GIS link of condition data to GIS	Apr. – Oct. 2006
Specify and procure equipment	Apr. – Aug. 2006
System Integration and staff training	Aug. – Dec. 2006
Begin Enhanced Data Collection	1st Quarter 2007

Estimated FY2005-06 Costs of Enhanced PMP Development

- Hardware / Software, Data Collection Equipment, and Professional Services

$300,000

- Included in the Recommended *FY2005-06 budget for this service*
- *Recommended Budget for this service is $20,000 less than FY2004-05.*

Enhanced Pavement Management Program

- Future Annual Operating costs of approximately $497,000 vs $760,000 ($263,000 reduction)
- Automated data collection at or near highway speeds to replace current manual, stop-and-go method that is very time and labor–intensive
- Quantifiable, objective and repeatable condition ratings based on ASTM international standard procedures using new technology

Enhanced Pavement Management Program

- More extensive evaluations of pavement condition to confirm maintenance decisions and extend infrastructure dollars
- Optional ability to verify/enhance inventories of other assets within the right of way (street lights, signs, sidewalks, curbs and gutters, etc.) for additional costs
- Assessment cycles to be evaluated and refined as part of the professional services during FY2005-06

Questions and Discussion

APPENDIX

Condition Ratings and Distress Types

TABLE A
Street Surface Condition

CONDITION	DESCRIPTION
A - GOOD	Good riding surface, no noticeable wear or obvious defects.
B - ACCEPTABLE	Good riding surface, but has some minor surface defects and wear indications. Some good cut or patch repairs may exist.
C - FAIR	Slightly rough riding surface, edges beginning to break down, some gutter / street misalignments, small areas of spalling, cracks and cut repairs beginning to require attention.
D - POOR	Uncomfortable and / or badly worn riding surface, extensive spalling, cracks, paving failures, poor patches and / or cut repairs, edge breakdown, and gutters / street misalignment.
E - UNACCEPTABLE	Very rough and / or uneven riding surface, drainage problems, large surface areas in bad condition, many unsatisfactory patches and cut repairs.

TABLE B
Curb and Gutter Condition

CONDITION	**DESCRIPTION**
A - GOOD	No apparent defect or misalignments, requires no maintenance.
B - ACCEPTABLE	Minor chips, cracks, and / or misalignments. Can be remedied with minor repairs.
C - FAIR	Broken, extensive misalignment, poor drainage requiring major repairs or replacement.

TABLE C
Sidewalk Condition

CONDITION	DESCRIPTION
A - GOOD	No apparent defect or misalignments, requires no maintenance.
B - ACCEPTABLE	Minor chips, cracks, and / or misalignments. Can be remedied with minor repairs.
C - FAIR	Broken, extensive misalignment, poor drainage requiring major repairs or replacement.

TABLE D
Valley Gutter Condition

CONDITION	DESCRIPTION
A - GOOD	No noticeable wear or obvious defects.
B - ACCEPTABLE	Some minor surface defects.
C - FAIR	Small areas of spalling, cracking and edges breaking down.
D - POOR	Extensive spalling, cracking, and paving failures.
E - UNACCEPTABLE	Very rough, large surface area in bad condition.

TABLE E

Distress Data

CONCRETE (Rigid Pavements)	ASPHALT / PENETRATION (Flexible Pavements)
CRACKING	
1 <= ½" wide 2 ½" <= 1" wide 3 1" <= 3" wide 4 > 3" wide Do not count hairline cracks on concrete streets. Width includes any spalled or popout area adjoining crack.	1 2 ***SAME*** 3 4 Do not count hairline cracks on concrete overlaid streets. With includes any raveled or pothole area adjoining crack.
BASE FAILURE	
1 <= 5 ft. area AND < 1" deep 2 5 ft. <= 11 ft. Area OR 1" <= 2" deep 3 > 11 ft. area OR > 2" deep	*SAME*
POPOUTS	**POTHOLES**
1 Low Density (3 or less per 20' x 20' slab 2 Medium Density (4 - 10 per slab) 3 High Density (11 or greater per slab)	1 <= 8" diameter AND <= 1 ½" deep 2 8" <= 18" diameter OR 1 ½" <+ 3" deep 3 > 18" diameter OR > 3" deep If pothole is within 1-2 feet of travel lane but in the shoulder, count only 50% of the number of potholes.
JOINT FAILURE	
1 Noticeable; minor, negligible spalling; significant cracking within 2 ft. of joint 2 Uncomfortable; minor speed reduction; significant spalling with minor popouts, buckling 3 Excessive Roughness; considerable speed reduction; significant popouts, pavement	**Resurfaced Concrete Only:** 1 Noticeable; minor, negligible raveling or spalling; significant cracking within 2 ft. of joint 2 Uncomfortable; minor speed reduction; significant raveling or spalling with minor popouts or buckling 3 *SAME*

TABLE E
Distress Data

CONCRETE (Rigid Pavements)	ASPHALT / PENETRATION (Flexible Pavements)
breakup, or buckling	
SPALLING	**RUTTING**
	Includes Rutting, Shoving, and Corrugation
1 >= 10 sq. ft. BUT <= 1% of pavement surface	1 ¼" <= ½" depth
2 1% <= 15% of pavement surface	2 ½" <= 1" depth
3 > 15% of pavement surface	3 > 1" depth
CONCRETE	ASPHALT / PENETRATION
	ALLIGATOR CRACKING
	1 Fine, hairline cracks, few interconnecting cracks
	2 Light alligator pattern of interconnecting cracks
	3 Well defined alligator cracks, spalling apparent along cracks
	RAVELING
	1 Asphalt wearing away; starting to pit
	2 Aggregate moderately dislodged, rough and pitted; Asphalt severely worn away
	3 Considerable dislodged aggregate, very rough, severely pitted
POLISHING	
EXTENT ONLY	*EXTENT ONLY*
ROUGHNESS	

	LEVEL OF ROUGHNESS		
SEVERITY DEFINED	LOW <=20%	MEDIUM 20% <= 50%	HIGH >50%
Noticeable roughness, no speed	**1**	**1**	**2**

TABLE E
Distress Data

CONCRETE (Rigid Pavements)	ASPHALT / PENETRATION (Flexible Pavements)		
reduction			
Uncomfortable roughness, some speed reduction	**1**	**2**	**3**
Excessive roughness, considerable speed reduction	**2**	**3**	**3**

Flexible Pavement Distress Maintenance (from TXDOT Maintenance Operations Manual)

Types of flexible pavement distress are listed below with guidelines for maintenance.

- **Alligator cracking** is a type of distress that is generally caused by inadequate base support or brittle asphalt surface. Since cracks allow surface water to enter the subgrade and further destroy the stability of the subgrade, sealing should be accomplished as soon as practical. When cracking has progressed to the extent that failure of the roadway surface is imminent, repairs should be made as soon as possible. The alligator cracked surface material approaching failure will normally have to be removed and replaced with asphalt patching material. Where the base is unstable or wet, the base material will need to be removed replaced or stabilized.
- **Corrugations** are deviations of the pavement surface from its original cross section and are generally caused by excessive bitumen, improper aggregate gradation in the pavement, insufficient compaction of the mix or low interparticle friction to a degree that causes an unstable pavement with low resistance to traffic loads. Grooving, rutting, and shoving will also occur where the pavement is unstable. These distresses cause considerable annoyance to motorists. Repairs should be made as soon as practical when severe corrugations are evident. Repairs will normally involve removing the corrugated material and replacing it with new asphalt concrete.
- **Cracks** are considered significant when the pavement is cracked to the extent that water or foreign material can cause structural damage. At this point, cracks should be sealed as soon as practical. Efforts should be made to avoid a buildup of crack sealing material.
- **Edge cracking** frequently happens on narrow pavements at the same time drop-offs occur. This distress can be started by shrinkage of the asphalt at the edge of the pavement or shrinkage cracks in the base or subgrade. Edge loads tend to cause failure of this type by breaking off the pavement edge.
- **Failures and potholes** are subject to rapid enlargement and may result in considerable pavement loss and objectionable ride and may affect vehicle control. Failures and potholes should be repaired as soon as possible after they are observed or reported. In inclement weather, temporary repairs should be made and permanent repairs scheduled.
- **Pavement edge drop-offs** frequently occur on narrow pavement or pavement without paved shoulders where the wheels of vehicle frequently traverse off the pavement. New overlay may also leave a drop-off. When drop-offs get deep enough to cause hazards, repairs should be made as soon as practical. Pavement edge repairs are made by two accepted methods:
  - One method is to bring the natural material from the shoulder or the embankment material up to the level of the pavement surface edge.
  - The second method is to bring in asphalt or other material and add it to the edge of the pavement to remove the drop-off.
- **Raveling** is the progressive failure of the binder and loss of aggregate from the surface by weathering and/or traffic abrasion. When surface raveling begins to impair safety and/or extensive pavement loss is imminent, corrective action should be taken as soon as practical. Less critical raveling should be scheduled for

correction on a priority basis.

- **Rutting** occurs when wheel track depressions have the undesirable effect of trapping water and may make vehicle control difficult. Corrections to the depressions should be made as soon as possible wherever ruts are determined to be a safety problem.
- **Slippery pavement** is the surface texture of bituminous pavement that is subject to adverse change as a result of aging, excessive asphalt, wearing, etc. Continuous surveillance of pavement texture should be made with particular attention being given to pavements that become slippery. Obvious slippery areas should be corrected as soon as practical to the extent feasible under the prevailing conditions. When additional corrective action is necessary, it should be scheduled and initiated promptly.
- **Waves, sags, and humps** are surface defects that often result in poor ride quality, and excessive impact loading of bridges and slabs, and may also make vehicle control difficult. Typical causes are fill settlement, unstable cuts, expansive soils and embankment shear failures. This type of defect may not cause any problem at low speeds but would be objectionable or intolerable at high speeds. Corrections to the surface should be made as soon as practical when ride quality is objectionable.

Rigid Pavement Distress Maintenance (from TXDOT Maintenance Operations Manual)

Types of rigid pavement distress are listed below with guidelines for maintenance.

- **Blowups** are caused by expansion of concrete to the point where the stress causes the concrete to be raised. This can result in a problem ranging from a small bump to a shattering of concrete as if an explosion occurred. When blowups occur, the loose material should be removed and temporary repairs should be made until permanent repairs are practical.
- **Cracks**, both longitudinal and transverse, may occur in concrete pavement. Transverse cracks are meant to occur in continuously reinforced concrete pavement (CRCP) and should not be sealed. These cracks have little effect on ride quality and should not allow moisture to enter underlying layers and lead to other distress. However, transverse cracks on jointed concrete pavement tend to be wider and will allow moisture into the pavement and should be sealed.
- **Failures** are punchouts, corner breaks and other major distresses that can cause very uncomfortable ride and in severe conditions could result in vehicle damage. Make repairs whenever areas of the pavement become cracked or broken to the extent that ride quality and structural integrity of the pavement is lost.
- **Joint failures** (jointed pavements) occur at various spacing on jointed concrete pavement and can cause an unpleasant ride if not properly maintained. Joint failures appear in many forms from minor to major spalling to blowups. Deep spalls and failures may affect vehicle contact with the pavement and should be repaired as soon as possible. Joints should be inspected routinely and should be maintained to exclude foreign material and to preserve the integrity of the joint. When excessive foreign material or infiltration of water is evident, cleaning which includes the repairing and sealing of the joints should be scheduled. This should be done in accordance with "Standard Specification Item 438 Cleaning and/or Sealing Joints and Cracks" (Portland Cement Concrete).
- **Settlement, heave, and/or faulting** can occur in jointed pavement. Settlement and heave are normally gradual changes and can lead to an uncomfortable ride. Faulting can occur rather suddenly when a slab rises or lowers. Repairs should be made as soon as practical when the ride quality becomes objectionable. Severe faulting that may affect vehicle control should be repaired as soon as possible.
- **Surface deterioration** such as raveling, popouts, joint spalling and other surface type deterioration allows moisture to penetrate to steel reinforcing, causing further distress. Ride quality also becomes uncomfortable. Repairs are to be made as soon as possible when a section of a roadway is considered to have a severe condition of this type.