

SOUTH DAKOTA STATEWIDE STUDY

Executive Summary



2021 SOUTH DAKOTA AIRPORT PAVEMENT CONDITION INDEX (PCI) STUDY

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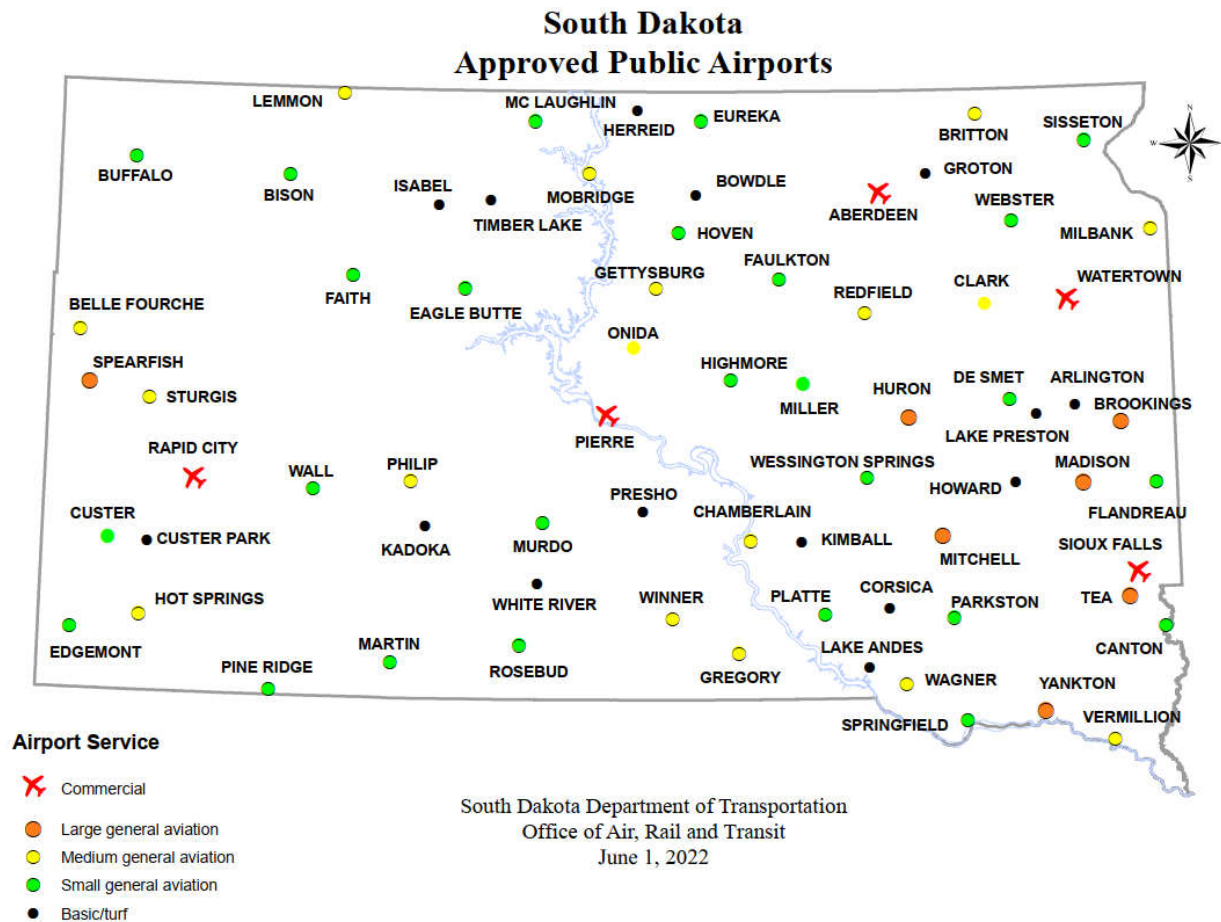
OVERVIEW

To comply with the Federal Aviation Administration (FAA) Airport Improvement Program (AIP) Grant Assurances, the South Dakota Department of Transportation (SDDOT) has implemented an Airport Pavement Management System to provide the tools for the decision makers for efficiently prioritizing pavement improvements, maximize return on the infrastructure investment, improve airport pavement system performance and extend the pavement useful life to provide a world-class safe and efficient aviation system in South Dakota.

The purpose of the SDDOT Airport Pavement Condition Index (PCI) study is to collectively assess the conditions and maintenance needs of the pavement infrastructure at the 55 public-use airports included in the South Dakota State Aviation System to maximize pavement life, and to identify projects and planning to support the SDDOT's mission. The state conducts a Statewide Airport PCI inspection every 3 years of all publicly-owned, paved airports in South Dakota and updates the pavement maintenance plan using the PAVER™ software. The survey was last completed in 2018.

SDDOT AVIATION SYSTEM

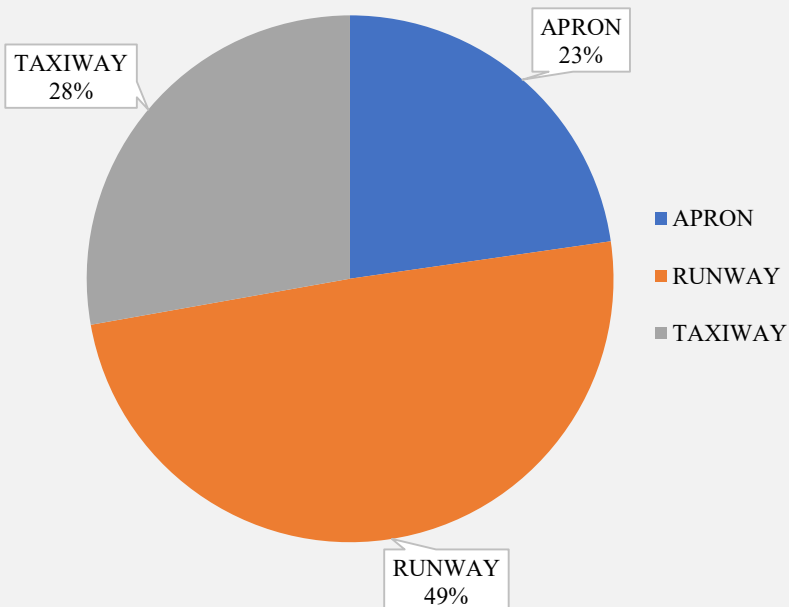
South Dakota's Airport System includes 55 airports that are publicly owned, and are included in the FAA's National Plan of Integrated Airport Systems (NPIAS). Five of the system airports support Commercial Service and the remaining 50 airports support General Aviation only.



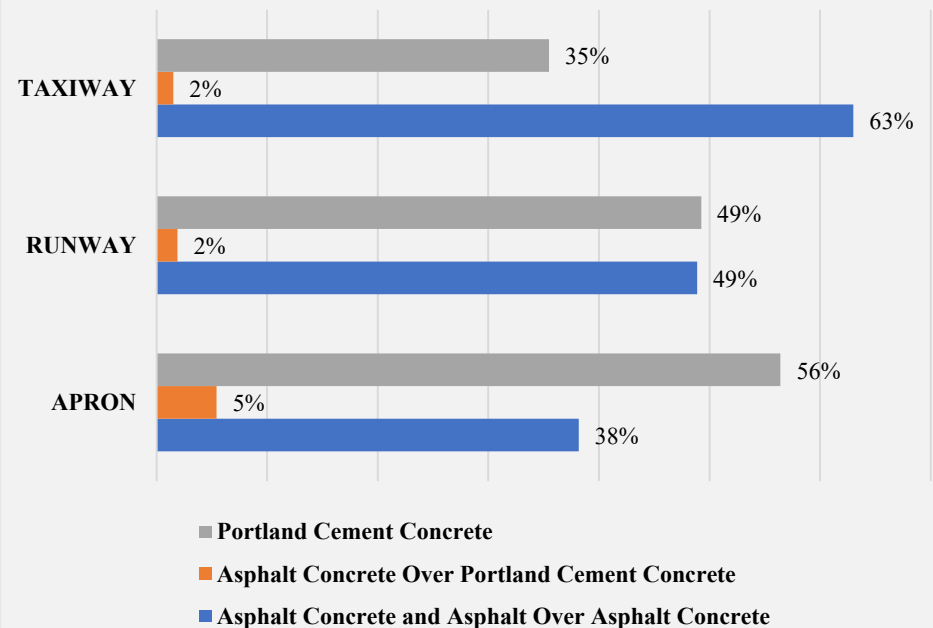
SDDOT AVIATION SYSTEM INVENTORY

For an efficient Pavement Management System, it is crucial to have an accurate airport facility inventory data to evaluate the System's pavement performance and for the development of a maintenance program. **The total systemwide airport pavement area which are subjected to aircraft loading is approximately 57,830,727 square feet out of which 30,621,036 square feet is asphalt surfaced pavements and 27,209,691 square feet is concrete pavements.** Charts below show the Percent Area of the System pavement network by Use and Surface Type.

Percent Area By Use



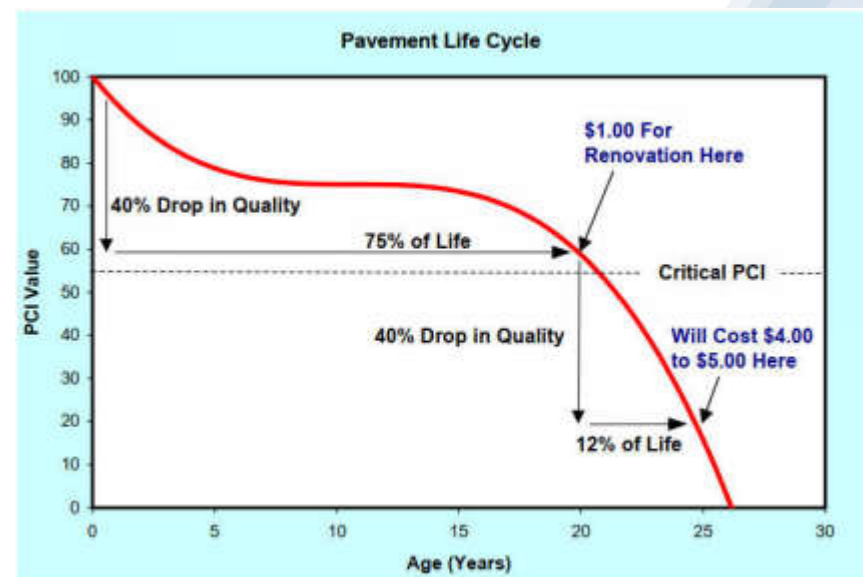
Percent Area By Use and By Surface Type



AIRPORT PAVEMENT EVALUATION

The PCI is a numerical indicator that rates the surface condition of the pavement on a 0-100 scale, with 100 being good condition and 0 being failed condition. The Pavement Life Cycle figure below illustrates how pavement typically deteriorates and the relative cost of rehabilitation at various times throughout its life. Maintaining and preserving a pavement in good condition versus rehabilitating a pavement in fair to poor condition is four to five times less expensive and increases pavement useful life. In order to extend the life of the pavement, the SDDOT will incorporate preventive maintenance strategies including crack sealing, rejuvenator, slurry seal coats, or joint seal replacement as part of their annual statewide airport pavement maintenance project. Major rehabilitation projects will likely include a mill and overlay or large scale panel replacement projects, which will likely be a standalone AIP project.

Standard PCI		Typical Repair Strategy
100	Good	PREVENTIVE MAINTENANCE
85	Satisfactory	
70	Fair	MAJOR REHABILITATION
55	Poor	
40	Very Poor	RECONSTRUCTION
25	Serious	
10	Failed	



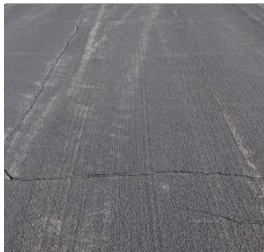
TYPICAL ASPHALT PAVEMENT DISTRESS TYPES



Alligator Cracking. Alligator cracking is a distress caused by repeated aircraft loading that causes cracking initially at the bottom of the asphalt, before propagating upward first as parallel cracks, then interconnecting into sharp-angled pieces resembling alligator skin.



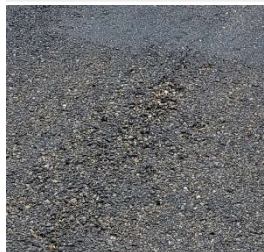
Depressions. Depressions are pavement areas with slightly lower elevation than surrounding pavement. Many times, this is only noticeable after rain, when water pools at the bottom of the depression. This water can cause hydroplaning.



Longitudinal/Transverse Cracking. Longitudinal/Transverse cracks (L & T cracks) can be caused by poorly constructed lane joints, shrinkage of the AC surface in low temperatures, or cracks reflecting from cracks below the surface layer.



Patch. Patches are considered distresses no matter their severity.



Raveling/Weathering. Raveling and weathering are distresses characterized by the wearing away of coarse aggregate, and asphalt binder and fine aggregate respectively.

TYPICAL CONCRETE PAVEMENT DISTRESS TYPES



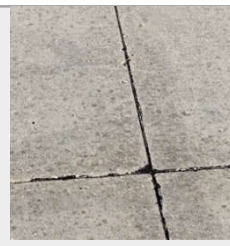
Corner Break. A corner break is a break that intersects the joints at less than half of the slab length on each side. This is usually caused by load repetition, loss of support below the corner, and curling stress.



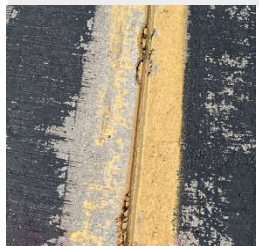
Corner Spall. Corner spalling is the raveling/breakdown of a slab at the corner of the slab. Unlike a corner break, which occurs vertically through the slab, spalling usually angles downward to intersect the joint.



Durability Cracking. Durability cracking is caused by environmental factors such as the freeze-thaw cycle. Typically appears as cracks parallel to a joint or linear crack, often accompanied by dark discoloring in the affected area.



Joint Seal Damage. Joint seal damage is anything allowing soil or rocks to accumulate in the joints, or allowing significant water infiltration. Incompressible materials in the joints can prevent the slab from expanding, and can cause buckling or spalling.



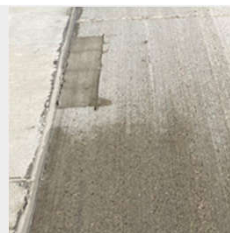
Joint Spalling. Joint spalling is breakdown of slab edges near the side of the joint. The spall usually intersects the joint at the angle. This distress is usually caused by cracking due to incompressible materials, or due to excessive stresses at the joint, or repeated loading.



Linear Cracking. Linear cracks divide the slab into two or three pieces, and are caused by load repetition, curling stress, and shrinkage stress. Medium- and high-severity distresses are usually considered major structural distresses.



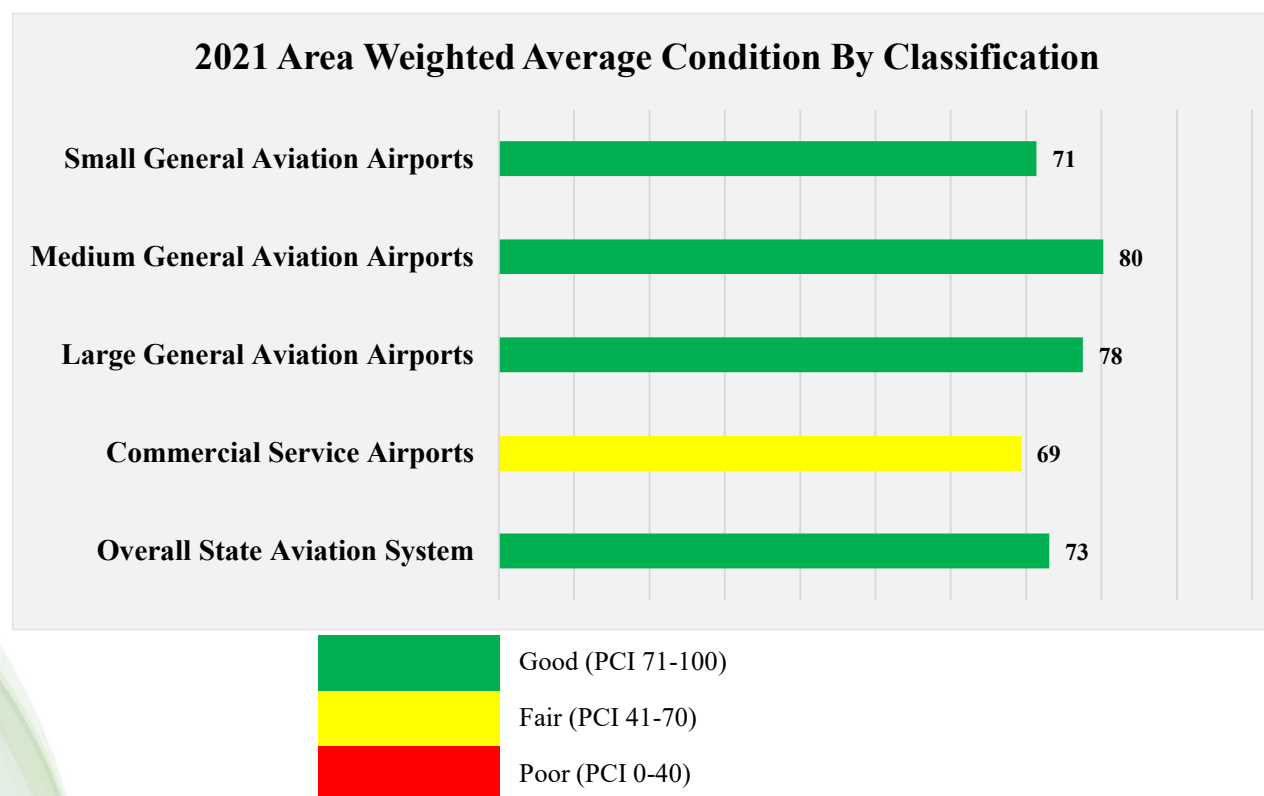
Shattered Slab. A shattered slab is a slab broken into 4 or 5 pieces with high-severity cracks, or 6 or more pieces with at least 15% medium- or higher severity cracks.



Small Patch. A small patch is defined as any patch smaller than 5 ft².

SYSTEMWIDE CURRENT PAVEMENT CONDITION

The Area Weighted Average PCI value by Airport Classification is shown in the chart below. The 2021 SDDOT Statewide Overall Pavement Area Weighted Average PCI is 73 which is at the same condition level compared to the nationwide average* PCI of 73. The General Aviation Airports pavements are generally in Good condition (PCI > 70) and the Commercial Service Airports are generally in Fair condition (40 > PCI < 70).



* The nationwide data was compiled from 18 Statewide APMS reports.

SYSTEMWIDE CURRENT PAVEMENT CONDITION BY USE

The 2021 SDDOT Systemwide Runway Pavement Area Weighted Average PCI is 76 which is at the same condition level compared to the nationwide average* PCI of 76. The Runway pavements are generally in Good condition (PCI >70).

The 2021 SDDOT Systemwide Taxiway Pavement Area Weighted Average PCI is 77 which is above the nationwide average* PCI of 74. The Taxiway pavements are generally in Good condition (PCI >70).

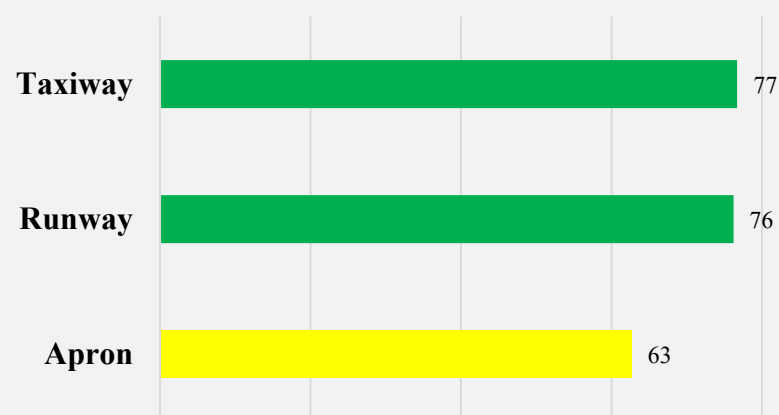
The 2021 SDDOT Systemwide Apron Pavement Area Weighted Average PCI is 63 which is below the nationwide average* PCI of 70. The Apron pavements are generally in Fair condition (40 > PCI < 70).

The Systemwide Runway Pavement Area distribution by PCI Category groups is shown in the chart. 60% of the systemwide total pavement area (all use) is in Good condition (PCI >70). 30% of the systemwide total pavement area (all use) is in Fair condition (40 > PCI < 70). 9% of the systemwide total pavement area (all use) is in poor condition (PCI < 40).

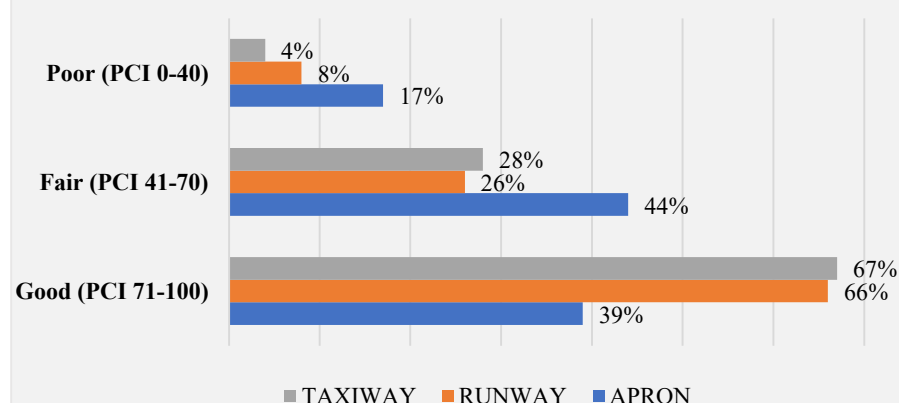
The 2021 SDDOT Area Weighted Average PCI Value by each Airport is shown in the chart on the next page.

* The nationwide data was compiled from 18 Statewide APMS reports.

2021 Area Weighted Average Condition (PCI) By Use

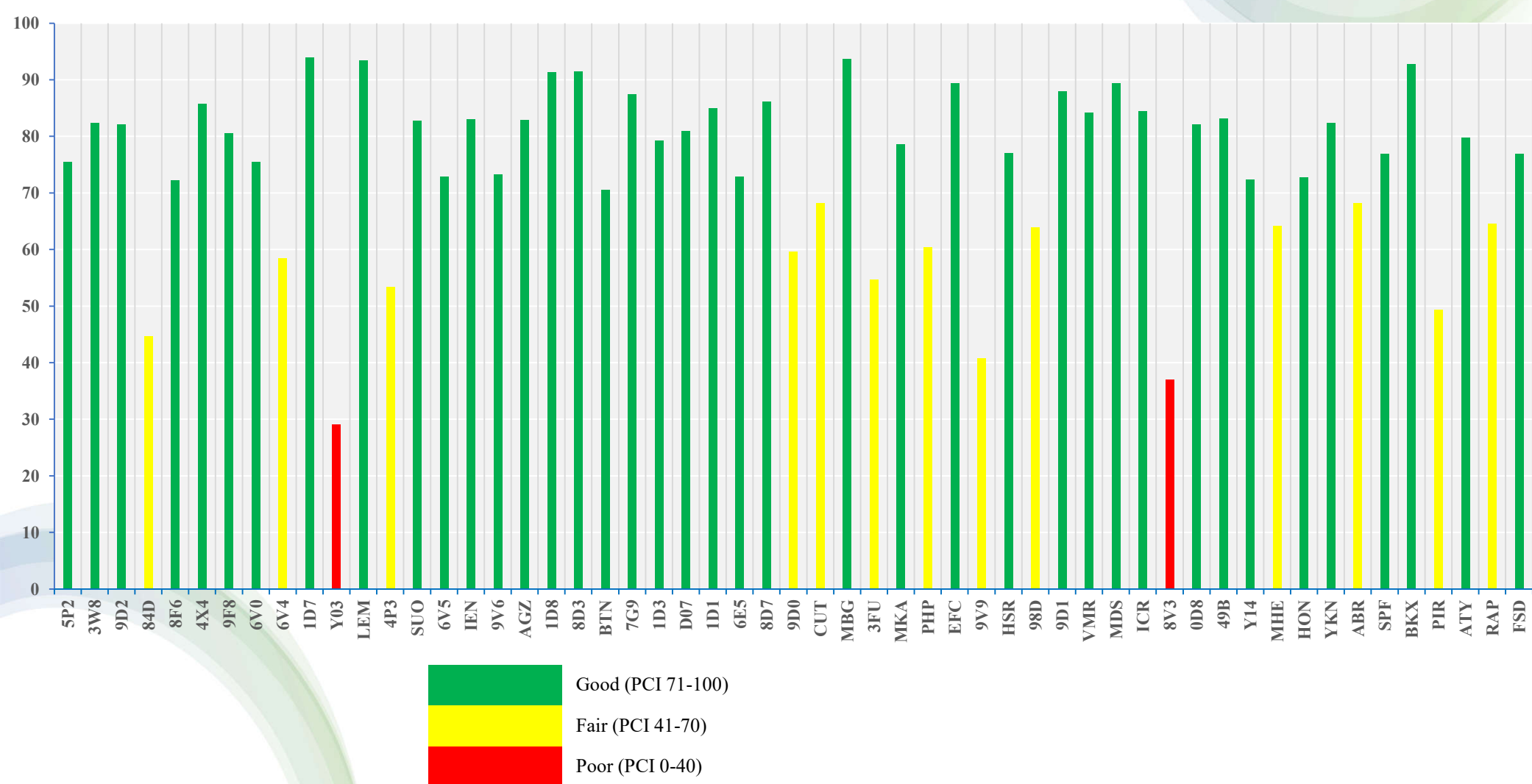


Total Systemwide Percent Area Distribution by PCI Category and Use



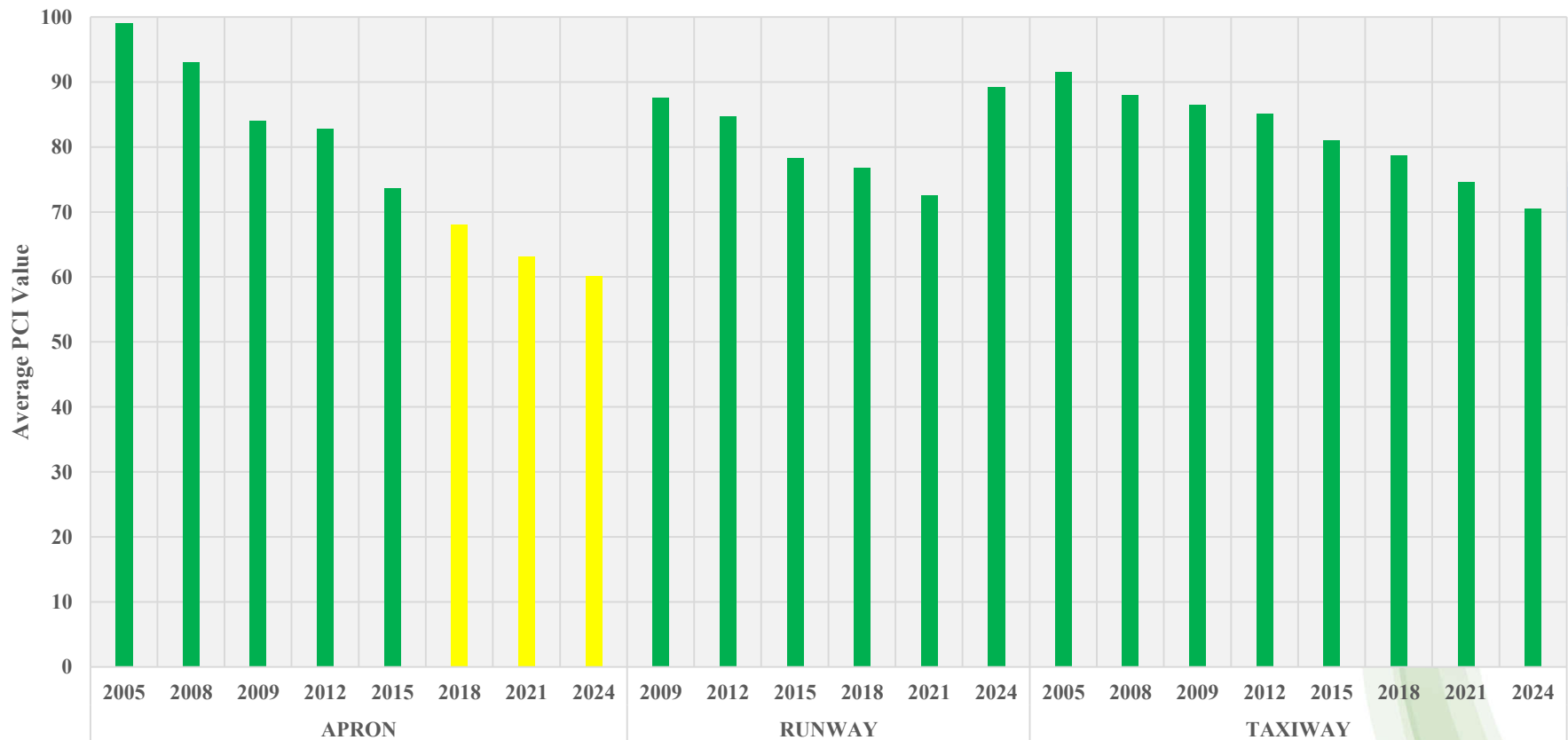
CURRENT PAVEMENT CONDITION BY AIRPORT

2021 Area Weighted Average Pavement Condition By Airport



SYSTEMWIDE PAVEMENT CONDITION PERFORMANCE

It is important that the data collected during each inspection can be compared with previous pavement inspections. The APMS is updated every three years and knowledge of how the pavements have performed over the years will be useful in improving the Pavement Management process. The Systemwide Historic (2005 thru 2018) Average PCI values, Current (2021) PCI values and Projected (2024) PCI Values by Use are shown in the chart below.



PAVEMENT FUNDING ASSESSMENT

A Maintenance and Repair (M&R) planning analysis was performed in order to determine the most cost-effective treatment and suggest the optimum utilization of available M&R funds over a 20-year period. Using the existing conditions and pavement deterioration models, an initial funding needs was determined with a goal to maintain the average network PCI at or above the established Critical PCI values for each airport type and Facility use while optimizing the funds globally across the SDDOT Aviation System. **The analysis showed that to reach the Critical PCI goal for each section at the end of 20 years, a total of \$850,206,000 M&R funds are needed for SDDOT NPIAS Airports.** Tables on the next two pages show the unlimited budget funding needs for Pavement Maintenance, Resurfacing and Reconstruction through 2041 by Use. The future cost of work includes 3 percent inflation factor and are calculated based on the unit costs extracted from recent projects completed throughout the state. The Critical PCI Values established for SDDOT Airport pavement Management System are shown in the table below by Facility Use.

Critical PCI Values		
Branch (Facility) Use	Commercial Service	General Aviation
Runways	70	70
Taxiways	70	65
Apron	65	60

PAVEMENT FUNDING ASSESSMENT

YEAR/ USE	PAVEMENT MAINTENANCE COST	RECONSTRUCTION/ RESURFACING COST	TOTAL ESTIMATED COST	AVERAGE CONDITION BEFORE	AVERAGE CONDITION AFTER
2022					
APRON	\$ 780,000	\$ 1,488,000	\$ 2,268,000	61	63
RUNWAY	\$ 1,841,000	\$ 37,364,000	\$ 39,205,000	73	80
TAXIWAY	\$ 1,406,000	\$ 1,463,000	\$ 2,869,000	73	75
		TOTAL COST	\$ 44,342,000		
2023					
APRON	\$ 87,000	\$ 17,000	\$ 104,000	61	61
RUNWAY	\$ 325,000	\$ 43,711,000	\$ 44,036,000	77	87
TAXIWAY	\$ 205,000	\$ -	\$ 205,000	73	73
		TOTAL COST	\$ 44,345,000		
2024					
APRON	\$ 58,000	\$ 13,000	\$ 71,000	59	59
RUNWAY	\$ 168,000	\$ 41,868,000	\$ 42,036,000	85	90
TAXIWAY	\$ 86,000	\$ 2,140,000	\$ 2,226,000	71	72
		TOTAL COST	\$ 44,333,000		
2025					
APRON	\$ 148,000	\$ -	\$ 148,000	57	57
RUNWAY	\$ 1,077,000	\$ 22,826,000	\$ 23,903,000	88	90
TAXIWAY	\$ 300,000	\$ 19,994,000	\$ 20,294,000	69	74
		TOTAL COST	\$ 44,345,000		
2026					
APRON	\$ 50,000	\$ -	\$ 50,000	55	55
RUNWAY	\$ 769,000	\$ 32,018,000	\$ 32,787,000	88	91
TAXIWAY	\$ 144,000	\$ 11,348,000	\$ 11,492,000	71	72
		TOTAL COST	\$ 44,329,000		
2027					
APRON	\$ 633,000	\$ -	\$ 633,000	53	54
RUNWAY	\$ 2,373,000	\$ 2,492,000	\$ 4,865,000	89	91
TAXIWAY	\$ 1,121,000	\$ 37,704,000	\$ 38,825,000	70	79
		TOTAL COST	\$ 44,323,000		
2028					
APRON	\$ 101,000	\$ 73,000	\$ 174,000	51	52
RUNWAY	\$ 686,000	\$ 3,407,000	\$ 4,093,000	89	90
TAXIWAY	\$ 408,000	\$ 39,666,000	\$ 40,074,000	77	84
		TOTAL COST	\$ 44,341,000		
2029					
APRON	\$ 67,000	\$ 26,302,000	\$ 26,369,000	50	56
RUNWAY	\$ 274,000	\$ 5,355,000	\$ 5,629,000	88	89
TAXIWAY	\$ 203,000	\$ 12,088,000	\$ 12,291,000	82	88
		TOTAL COST	\$ 44,289,000		

PAVEMENT FUNDING ASSESSMENT

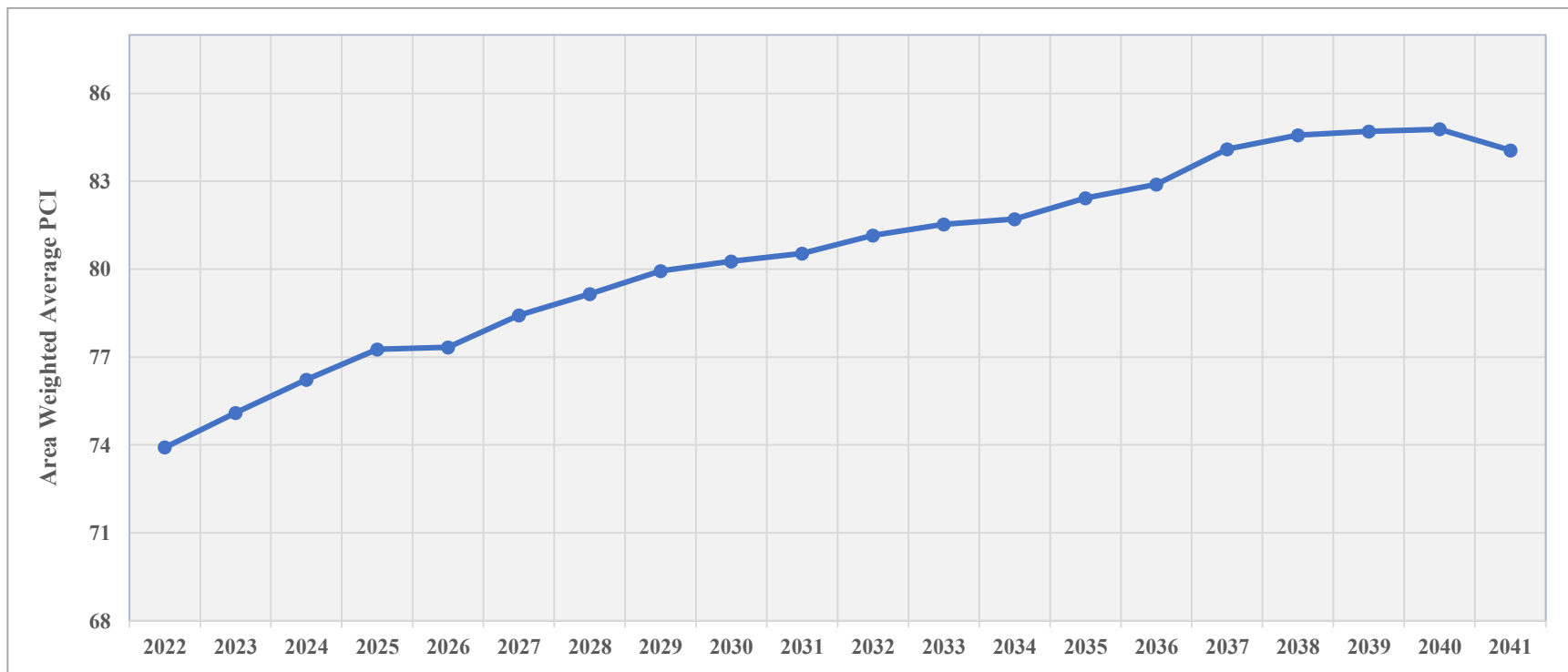
YEAR/ USE	PAVEMENT MAINTENANCE COST	RECONSTRUCTION/ RESURFACING COST	TOTAL ESTIMATED COST	AVERAGE CONDITION BEFORE	AVERAGE CONDITION AFTER
2030					
APRON	\$ 158,000	\$ 28,416,000	\$ 28,574,000	54	57
RUNWAY	\$ 1,096,000	\$ 12,756,000	\$ 13,852,000	87	89
TAXIWAY	\$ 843,000	\$ 1,033,000	\$ 1,876,000	86	87
		TOTAL COST	\$ 44,302,000		
2031					
APRON	\$ 59,000	\$ 32,662,000	\$ 32,721,000	55	61
RUNWAY	\$ 892,000	\$ 5,844,000	\$ 6,736,000	87	88
TAXIWAY	\$ 440,000	\$ 4,418,000	\$ 4,858,000	85	87
		TOTAL COST	\$ 44,315,000		
2032					
APRON	\$ 688,000	\$ 772,000	\$ 1,460,000	59	61
RUNWAY	\$ 1,884,000	\$ 35,343,000	\$ 37,227,000	86	89
TAXIWAY	\$ 1,214,000	\$ 4,437,000	\$ 5,651,000	85	87
		TOTAL COST	\$ 44,338,000		
2033					
APRON	\$ 170,000	\$ 16,241,000	\$ 16,411,000	59	64
RUNWAY	\$ 795,000	\$ 25,602,000	\$ 26,397,000	87	88
TAXIWAY	\$ 568,000	\$ 950,000	\$ 1,518,000	85	86
		TOTAL COST	\$ 44,326,000		
2034					
APRON	\$ 150,000	\$ 30,025,000	\$ 30,175,000	62	64
RUNWAY	\$ 318,000	\$ 2,067,000	\$ 2,385,000	87	88
TAXIWAY	\$ 276,000	\$ 11,496,000	\$ 11,772,000	84	85
		TOTAL COST	\$ 44,332,000		
2035					
APRON	\$ 185,000	\$ 26,497,000	\$ 26,682,000	62	67
RUNWAY	\$ 1,641,000	\$ 11,936,000	\$ 13,577,000	86	87
TAXIWAY	\$ 1,067,000	\$ 2,977,000	\$ 4,044,000	84	85
		TOTAL COST	\$ 44,303,000		
2036					
APRON	\$ 218,000	\$ 9,760,000	\$ 9,978,000	66	68
RUNWAY	\$ 1,345,000	\$ 20,222,000	\$ 21,567,000	86	87
TAXIWAY	\$ 533,000	\$ 12,255,000	\$ 12,788,000	83	85
		TOTAL COST	\$ 44,333,000		

PAVEMENT FUNDING ASSESSMENT

YEAR/ USE	PAVEMENT MAINTENANCE COST	RECONSTRUCTION/ RESURFACING COST	TOTAL ESTIMATED COST	AVERAGE CONDITION BEFORE	AVERAGE CONDITION AFTER
2037					
APRON	\$ 739,000	\$ 32,750,000	\$ 33,489,000	67	78
RUNWAY	\$ 1,921,000	\$ -	\$ 1,921,000	86	86
TAXIWAY	\$ 1,141,000	\$ 7,693,000	\$ 8,834,000	83	85
		TOTAL COST	\$ 44,244,000		
2038					
APRON	\$ 234,000	\$ 28,791,000	\$ 29,025,000	76	80
RUNWAY	\$ 766,000	\$ 3,259,000	\$ 4,025,000	85	85
TAXIWAY	\$ 645,000	\$ 10,644,000	\$ 11,289,000	83	84
		TOTAL COST	\$ 44,339,000		
2039					
APRON	\$ 280,000	\$ 17,581,000	\$ 17,861,000	78	81
RUNWAY	\$ 523,000	\$ 21,919,000	\$ 22,442,000	83	85
TAXIWAY	\$ 368,000	\$ 3,484,000	\$ 3,852,000	82	83
		TOTAL COST	\$ 44,155,000		
2040					
APRON	\$ 412,000	\$ 20,627,000	\$ 21,039,000	79	85
RUNWAY	\$ 1,607,000	\$ 3,950,000	\$ 5,557,000	83	84
TAXIWAY	\$ 1,177,000	\$ 2,994,000	\$ 4,171,000	81	83
		TOTAL COST	\$ 30,767,000		
2041					
APRON	\$ 415,000	\$ 2,776,000	\$ 3,191,000	83	84
RUNWAY	\$ 1,487,000	\$ 12,073,000	\$ 13,560,000	82	84
TAXIWAY	\$ 766,000	\$ 4,288,000	\$ 5,054,000	81	82
		TOTAL COST	\$ 21,805,000		

STATEWIDE BUDGET OF \$44.4 MILLION PER YEAR NEEDED TO REACH CRITICAL PCI GOALS FOR EVERY SECTION BY THE END OF 20 YEARS

If unlimited funds are available and if all the sections that are below Critical PCI value should be repaired, an **approximate total of \$850 million would be needed during the next twenty years**. The progression of the Systemwide Area Weighted Average PCI value after the repairs are completed is shown in the chart below.



STATEWIDE BUDGET OF \$55.1 MILLION PER YEAR NEEDED TO REACH CRITICAL PCI GOALS FOR EVERY SECTION BY THE END OF 10 YEARS

If unlimited funds are available and if all the sections that are below Critical PCI values should be repaired, an **approximate total of \$541 million would be needed during the next ten years.** The progression of the Systemwide Area Weighted Average PCI value after the repairs are completed is shown in the chart below.

