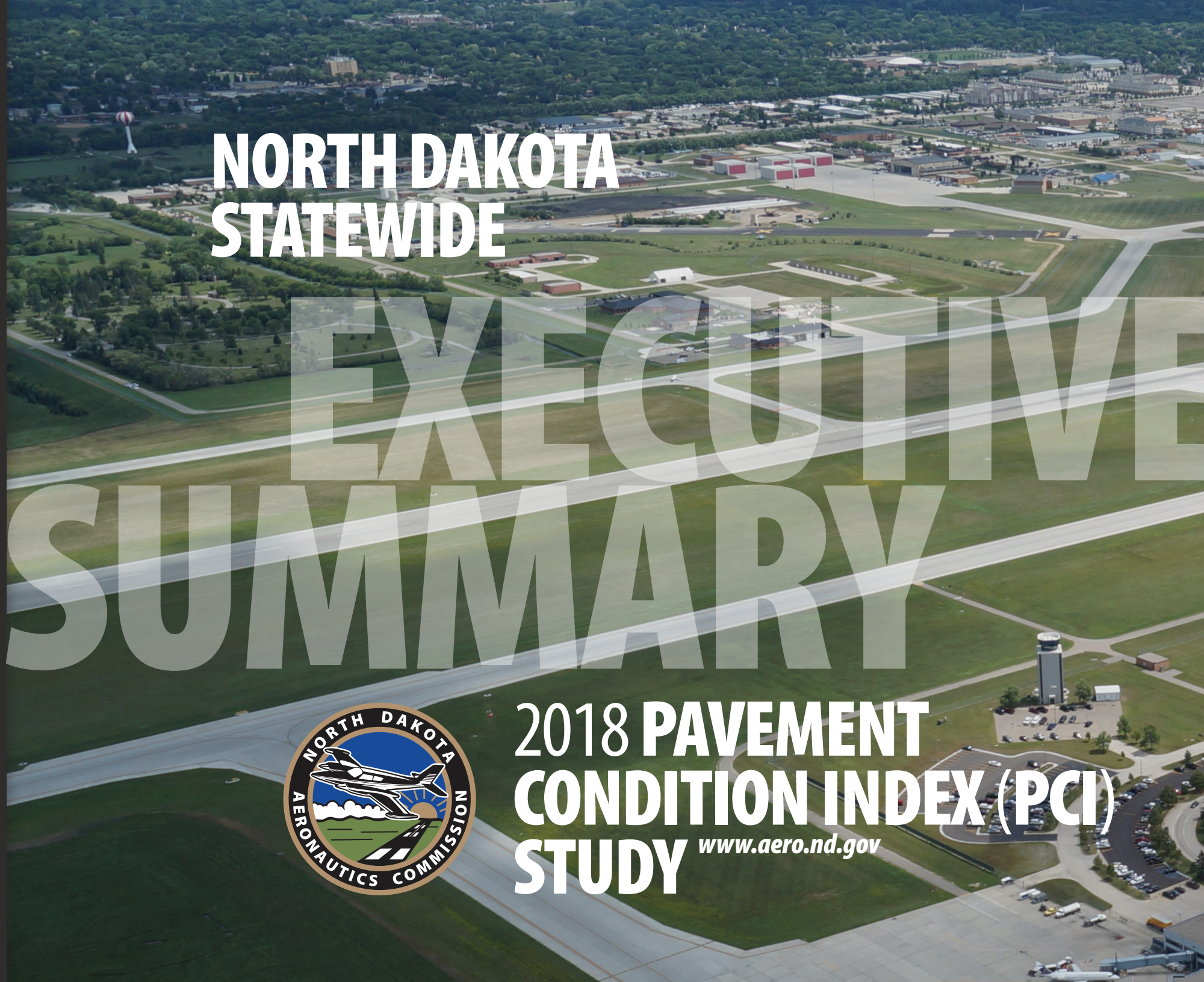

NORTH DAKOTA STATEWIDE

EXECUTIVE SUMMARY

2018 PAVEMENT CONDITION INDEX (PCI) STUDY

www.aero.nd.gov

FEDERAL AVIATION ADMINISTRATION
A.I.P. No. 3-38-0000-014-2018

THIS DOCUMENT WAS PREPARED UNDER THE GUIDANCE OF

NORTH DAKOTA
AERONAUTICS COMMISSION
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2018 PAVEMENT CONDITION INDEX (PCI) STUDY

www.aero.nd.gov

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Overview

The Federal Aviation Administration (FAA) developed the Airport Pavement Management System (APMS) with the intent to provide a consistent and systematic approach to identifying pavement that needs maintenance or rehabilitation. The North Dakota Aeronautics Commission (NDAC) developed a customized APMS according to FAA requirements.

An APMS evaluates the current condition of the pavement and predicts a future condition based on the Pavement Condition Index (PCI). This allows the individual airports, the NDAC, and the FAA to monitor the condition of the airport pavements and budget for required maintenance to avoid excessive deterioration. The timing of this maintenance or rehabilitation is vital to support the crucial role airport pavement conditions play in safeguarding airport users.

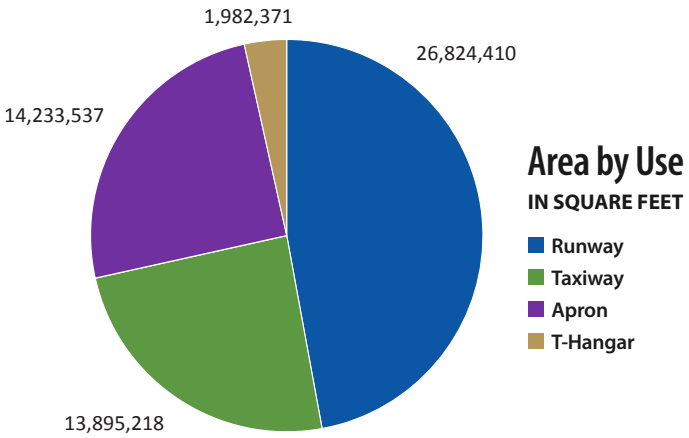
The North Dakota APMS is provided in an electronic format to allow the data to be readily available to the airports, the FAA, and the NDAC. The APMS is updated every three years to accurately reflect pavement conditions across the state's airports. PCI results are used to build 5- and 10-year capital improvement plans (CIPs) with each airport's respective city, county, or airport authority.

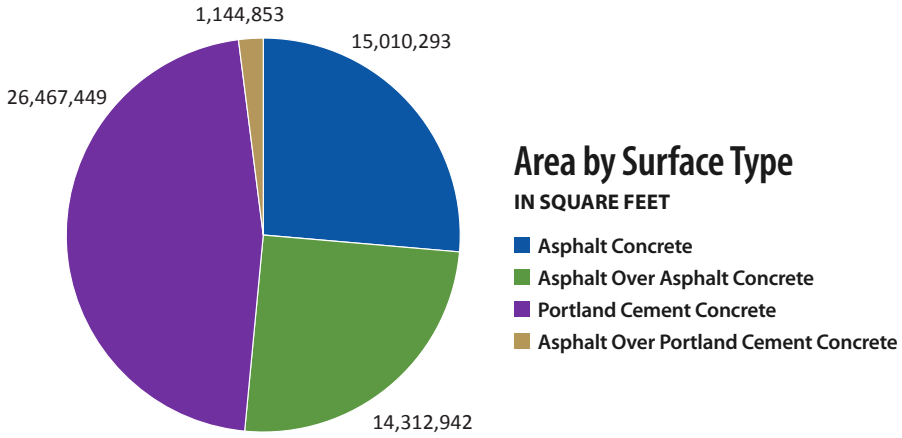
In 2018, Mead & Hunt along with Applied Pavement Technology and EVS conducted the update to the North Dakota APMS. As part of this update, pavement history information collected over the past three years was added to the online database, pavement inspections were completed, and functionality improvements were made to the website. The findings and recommendations of the APMS update are included in this report. Full results can be found on the NDAC website, **WWW.AERO.ND.GOV**.

Pavement Inventory

In 2018, 72 airports were assessed. Of these, 54 were part of the National Plan of Integrated Airport Systems (NPIAS) and 18 were non-NPIAS. Only NPIAS airports qualify for federal funding, so the FAA provided funding for the pavement inspections and reports for the NPIAS airports, while the same work for the non-NPIAS airports was funded solely by the North Dakota Aeronautics Commission. Of the 54 NPIAS airports assessed for the project, 53 were inspected (seven commercial service and 46 general aviation). All 18 non-NPIAS general aviation airports assessed for the project were inspected. Williston, a NPIAS airport, was not inspected as part of the 2018 study due to the relocation of the existing airport. However, Williston's planned geometry of airfield pavements was included in the overall data analysis and system assessment. A PCI of 100 was used to reflect the assumed condition of all of Williston's newly constructed pavement. Projected costs for Williston were excluded from the funding assessment needs. A PCI of 100 was also assumed for all newly constructed pavement or pavement programmed to be reconstructed in the next year for airports statewide. Pavement inventory data includes area, age, surface type, and observed distresses. The map on page 5 identifies all the airports in North Dakota that were included as part of the 2018 APMS update.

These airports represent 56.9 million square feet of pavement – approximately 26.8 million square feet of runway pavement, 13.9 million square feet of taxiway pavement, 14.2 million square feet of apron pavement, and 2 million square feet of T-hangar pavement. **Comprised of both concrete and asphalt**, the pavements are shown in the *Area by Use* and *Area by Surface Type* pie charts below. Pavement at the airports in the state **have an average age of 15 years for commercial service airports and 10 years for general aviation airports.** Throughout the years, the airports have performed preventive maintenance and carried out a series of rehabilitation/reconstruction projects to eliminate foreign object debris (FOD) as well as sustain and extend the pavement life. The charts shown on the next page, *Pavement Area by Use* and *Area-Weighted Average Age by Use*, summarize the total square footage of pavements found in the state and the average age of those pavements based on use, broken out for the overall state system, commercial service and general aviation airports.

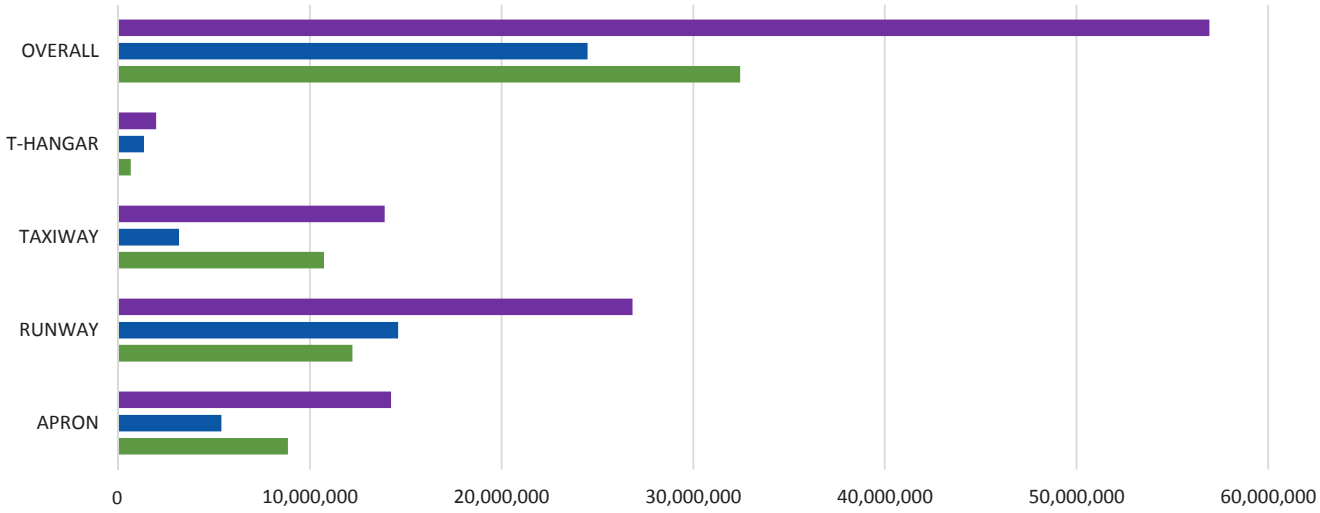




Pavement Area by Use

IN SQUARE FEET

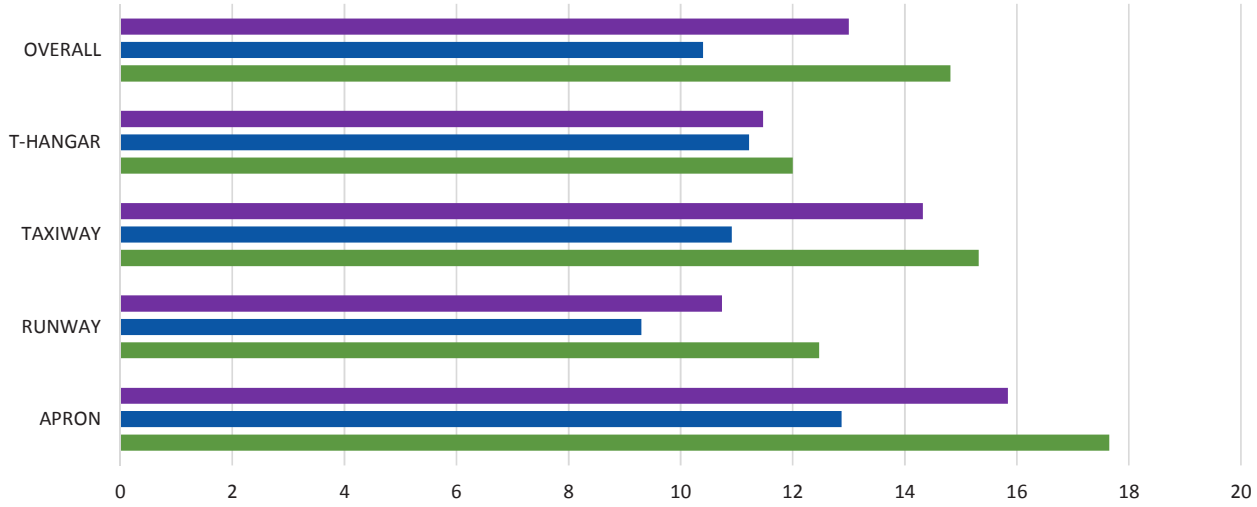
- Overall State System
- General Aviation
- Commercial Service



Area-Weighted Average Age by Use

IN YEARS

- Overall State System
- General Aviation
- Commercial Service

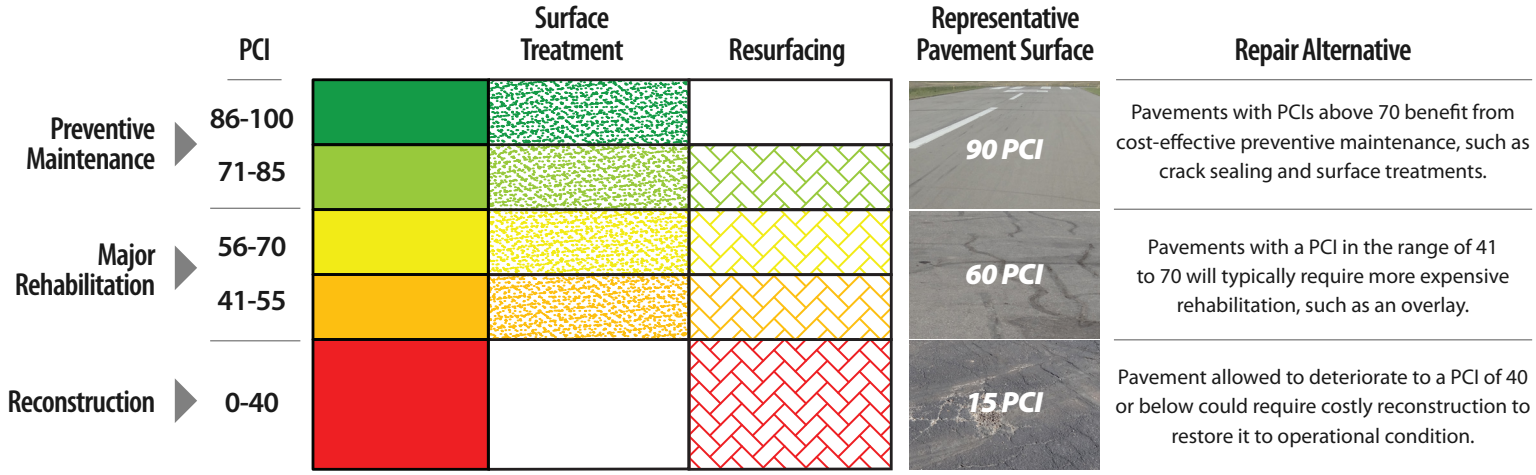


Pavement Evaluation

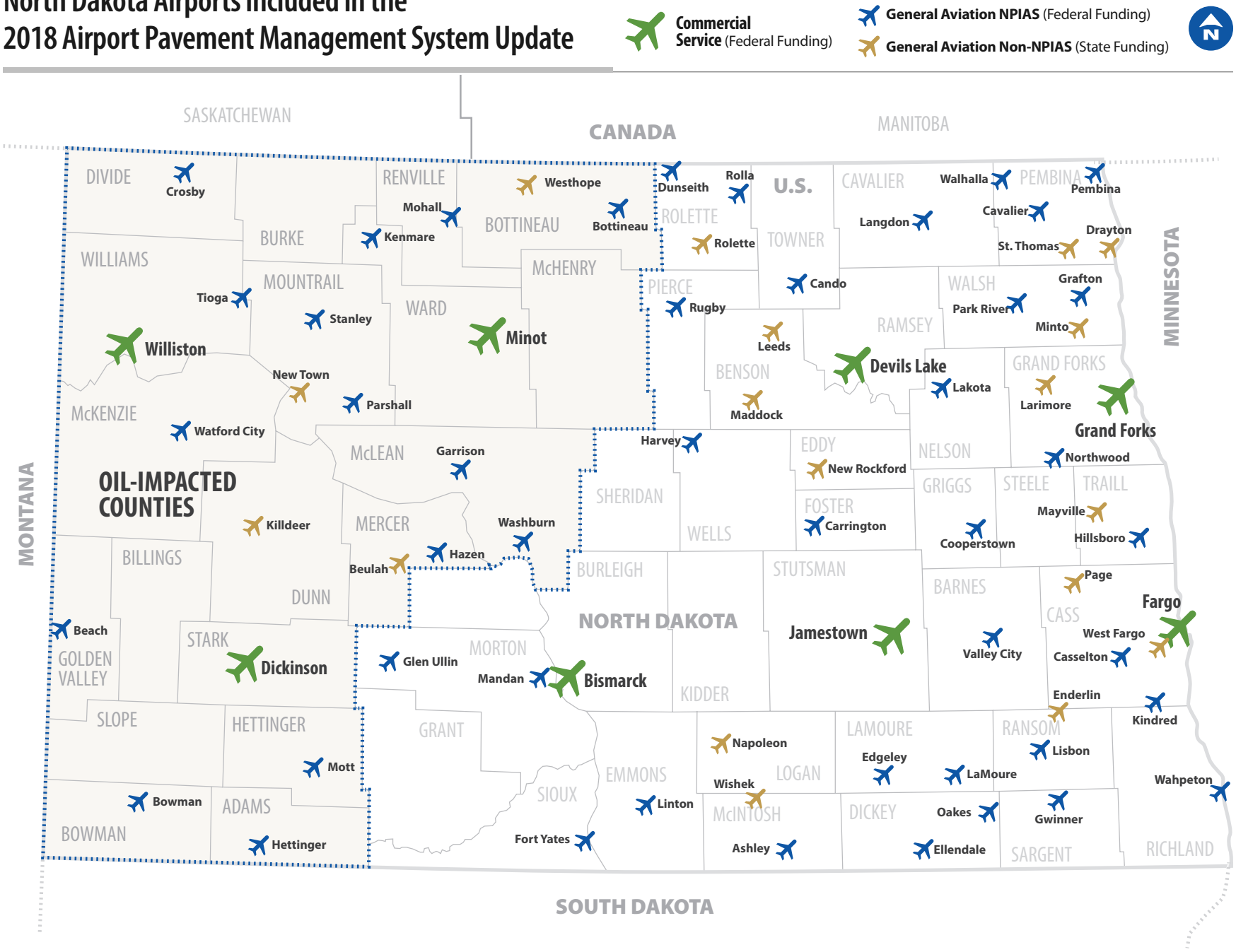
Pavement Evaluation Procedure

A PCI survey was conducted at each of the 71 airports inspected as part of the project according to the procedures outlined in American Society for Testing and Materials (ASTM) Standard D5340, *Standard Test Method for Airport Pavement Condition Index Surveys* and the FAA's Advisory Circular 150/5380-6C, *Guidelines and Procedures for Maintenance of Airport Pavements*. A PCI survey consists of dividing pavement into a series of sections, selecting random sections for sampling, and inspecting a given portion of each sample section to determine overall pavement deterioration. Pavement deterioration is based on the quantification of the different types, the severity and the number of distresses present in the sample section. This information is then used to formulate a composite index numerical value that represents the overall pavement condition. This value will range from 0 (failed) to 100 (excellent).

As part of the APMS, the PCI will be used to determine current pavement conditions, predict future conditions, develop a maintenance program and identify the most cost-effective time frame to perform major rehabilitation. The PCI will also aid in tracking and determining causes of deterioration on a pavement. The correlation between a PCI number and a recommended repair is shown in the illustration below. Preventive maintenance consists of patching, crack sealing and joint sealing. Pavement rehabilitation includes surface treatments and thin overlays. Pavement reconstruction refers to full-depth reconstruction and thick overlays. Surface treatments are used to address weathering and low-severity raveling. Nominal resurfacing is used to address medium- and high-severity raveling.



North Dakota Airports included in the 2018 Airport Pavement Management System Update



Typical Distress Types

The FAA Advisory Circular provides a list of specific distresses to be analyzed and recorded when inspecting pavement. Airports in North Dakota are a combination of asphalt concrete (AC) pavement and Portland cement concrete (PCC) pavement with there being slightly more AC pavement than PCC pavement. These two pavement types have unique pavement distresses and repairs. The following is a brief description of commonly observed pavement distresses at North Dakota airports.

ALLIGATOR CRACKING. Alligator (fatigue) cracking is a load-related distress caused by excessive tensile strains at the bottom of the AC layer or stabilized asphalt base layer from repeated aircraft loadings. Alligator cracking typically shows up on the surface as a series of parallel cracks, which eventually interconnect to form a pattern resembling the skin of an alligator.

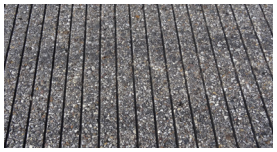
JOINT SEAL DAMAGE. Joint sealant damage is any condition that enables soil or rocks to accumulate in the joints or allows significant infiltration of water. Accumulation of incompressible materials prevents the slabs from expanding and may result in buckling, shattering, or spalling. A pliable joint filler bonded to the edges of the slabs protects the joints from accumulation of materials and prevents water from seeping down and softening the foundation supporting the slab. Typical types of joint seal damage are: (1) stripping of joint sealant, (2) extrusion of joint sealant, (3) weed growth, (4) hardening of the filler (oxidation), (5) loss of bond to the slab edges, and (6) absence of sealant in the joint.

LONGITUDINAL AND TRANSVERSE CRACKING. The predominant distress type found on asphalt pavements at North Dakota airports is longitudinal and transverse (L&T) cracking. This distress can be caused by any of the following: (1) separation of pavement at paving lane joints, (2) shrinkage of AC pavement due to temperature differentials in older or brittle pavements, or (3) reflection cracking from underlying faults in supportive layers of pavement or subgrade. Cracking is also a common distress type for PCC pavement. This distress is caused by a combination of load repetition, curling stresses, and shrinkage stresses.

ALYZING PAVEMENT DISTRESS

RAVELING. As pavements age and are exposed to oxidation and other environmental stresses, they may experience a loss in the material making up the pavement matrix. Raveling is the dislodging and loss of coarse aggregate in the surface of a pavement. The pavement may be showing signs of aging and hardening and may result in the production of FOD.

SPALLING. Spalling, in PCC pavement, is the breakdown of the slab edges near the slab joint. Spalling is identified as occurring in the corner or along the joint of a PCC slab. Spalling is typically caused by the introduction of incompressible material in the joint, weaker pavement at the joint caused by overworking of the pavement during construction, traffic loading or a combination of these.



WEATHERING. As pavements age and are exposed to oxidation and other environmental stresses, they may experience a loss in the material making up the pavement matrix. Weathering is the loss of asphalt binder and fine aggregate in the surface of the pavement. The loss of fine matrix material in the surface may eventually lead to the exposure and dislodging of coarse aggregate, leading to raveling and FOD.

Pavement Classification Number (PCN)

A PCN is a value that indicates the strength of a pavement as it relates to aircraft classification numbers, which are assigned to each type of aircraft. Aircraft traffic information as well as subgrade and pavement strengths are critical inputs in determining this value. Runway pavements at the commercial service airports were analyzed in 2012 to provide a PCN value as detailed in FAA Advisory Circular 150/5335-5B (or 150/5335-5C for any PCNs calculated in 2018), *Standardized Methods of Reporting Airport Pavement Strength – PCN*. PCN values denoted as (2018) in the table reflect updated PCN values, provided by the airport, due to completion of major runway construction projects since 2012. The PCN is expressed as a five-part code. The first part of the PCN is a numerical value indicating the load-carrying capacity of the pavement. This numerical value is followed by four codes representing the following categories:

- **PAVEMENT TYPE**
  - **R = Rigid**
  - **F = Flexible**
- **SUBGRADE STRENGTH**
  - **A = High** (k-value ≥ 442 psi/in or CBR ≥ 13)
  - **B = Medium** (221 psi/in < k-value < 442 psi/in or 8 < CBR < 13)
  - **C = Low** (92 psi/in < k-value ≤ 221 psi/in or 4 < CBR ≤ 8)
  - **D = Ultra Low** (k-value ≤ 92 psi/in or CBR ≤ 4)
- **MAXIMUM ALLOWABLE TIRE PRESSURE**
  - **W = High** (no pressure limit)
  - **X = Medium** (146 to 218 psi)
  - **Y = Low** (74 to 145 psi)
  - **Z = Ultra Low** (pressure limited to 73 psi)
- **PAVEMENT EVALUATION METHOD**
  - **T = Technical Evaluation**
  - **U = Using Aircraft Evaluation**

The latest PCN results for each commercial service airport are listed in the table below. A detailed PCN report for each airport can be found on the NDAC website, **WWW.AERO.ND.GOV**.

PCN Results

AIRPORT	BRANCH ID	PCN
Bismarck Municipal	Runway 13-31 (2018)	100 R/B/X/T
	Runway 3-21	26 F/A/W/T
Devils Lake Regional	Runway 13-31	27 F/D/W/T
	Runway 3-21	26 F/D/W/T
Dickinson Theodore Roosevelt Regional	Runway 14-32	20 F/D/W/T
	Runway 7-25	6 F/D/W/T
Fargo - Hector International	Runway 18-36	95 R/C/W/T
	Runway 9-27	25 R/C/W/T
	Runway 13-31	17 R/D/W/T
Grand Forks International	Runway 17L-35R	9 R/C/W/T
	Runway 17R-35L	35 R/C/W/T
	Runway 9L-27R	24 R/B/W/T
	Runway 9R-27L	10 R/C/W/T
Jamestown Regional	Runway 13-31	79 F/C/W/T
	Runway 4-22	25 F/D/W/T
Minot International	Runway 13-31	43 R/C/W/T
	Runway 8-26	34 F/D/W/T
Williston Basin International	Runway 14-32 (2018)	72*
	Runway 4-22	TBD

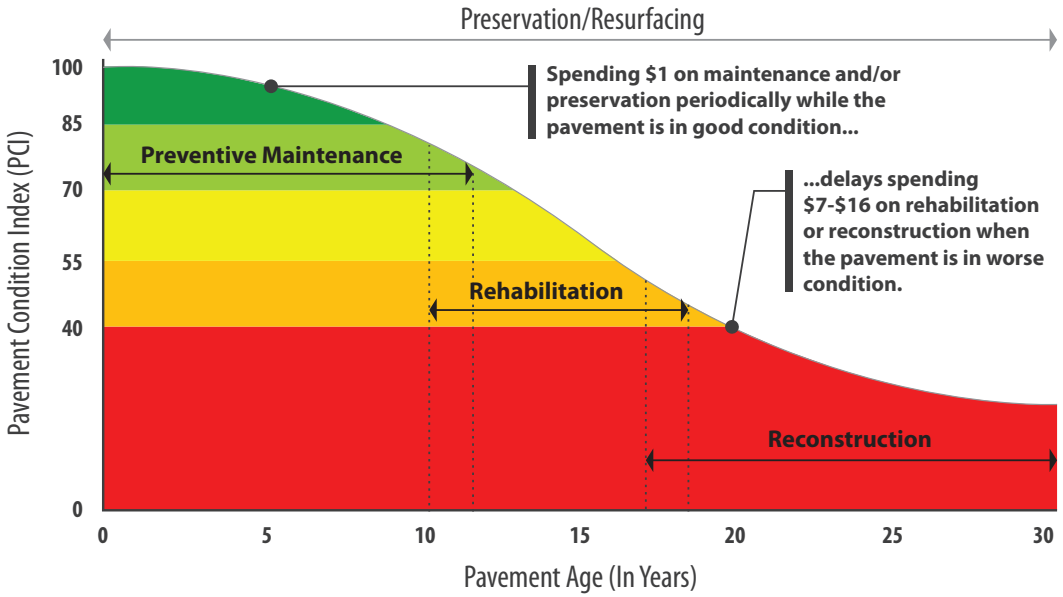
* *Williston's PCN is a projected value and will be finalized upon construction completion.*

Analysis of Results

Critical PCI Values

For each year of the analysis, the future condition of each of the pavements was estimated. The next step was to determine whether preventive maintenance or major rehabilitation/reconstruction was the appropriate and most cost-effective method of maintaining pavement life. If a pavement was projected to be above the critical PCI values listed below, the pavement was recommended for preventive maintenance. Major rehabilitation/reconstruction was recommended for any PCI value below the PCI critical thresholds. Surface treatments were identified for viable candidates that exhibited weathering and/or raveling. These were identified separate from the critical value analysis.

- **60 for general aviation taxiways and aprons**
- **65 for commercial service taxiways and aprons**
- **70 for general aviation runways**
- **75 for commercial service runways**



Interested in a Particular Airport's Pavement Condition & History?

*For information on pavement distresses for a specific airport, visit the Interactive Data Exchange Application (IDEA) website by going to **www.aero.nd.gov** and navigating to "**Studies**" then "**Pavement Condition Index**" then "**Click Here.**" Once there, you can view a list of the distresses that were identified as well as a maintenance and rehabilitation plan for each airport. The IDEA site also contains photos of each airport along with an interactive version of the airport's PCI map.*

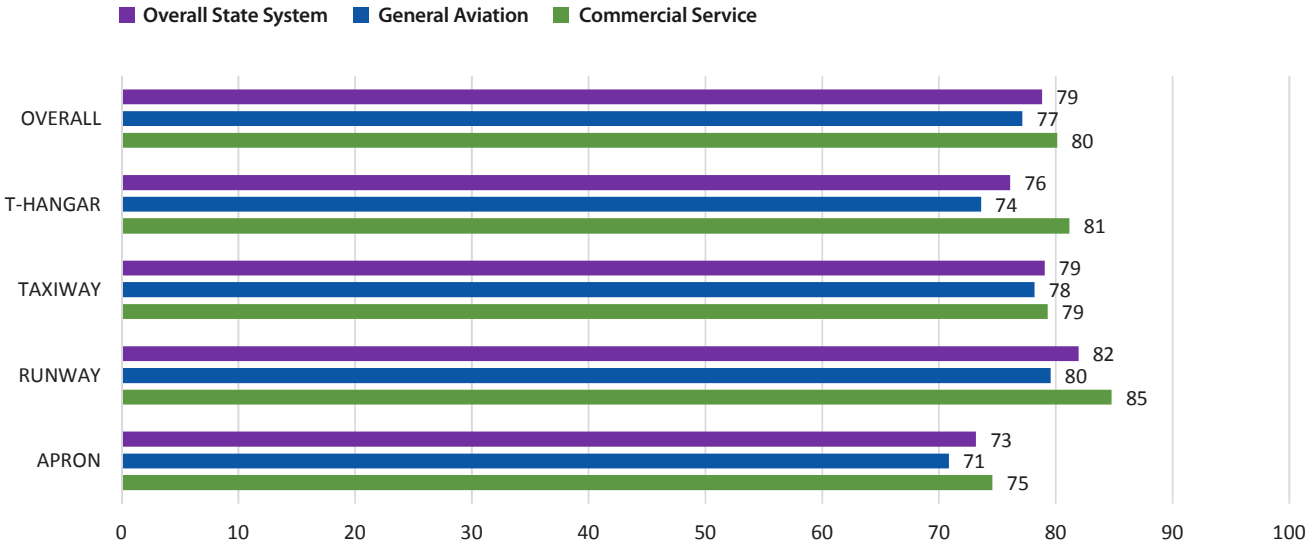
Overall Pavement Condition

Each airport was inspected and an overall area-weighted pavement condition is assigned to each. The information collected at each airport is used to provide greater detail on the uses of pavements and the correlating PCI value associated with each use. The overall area-weighted PCI of all the airports included in this study is 79. The *Area-Weighted Average PCI Value by Use* chart shows the 2018 condition of the pavement broken out by use and airport classification.

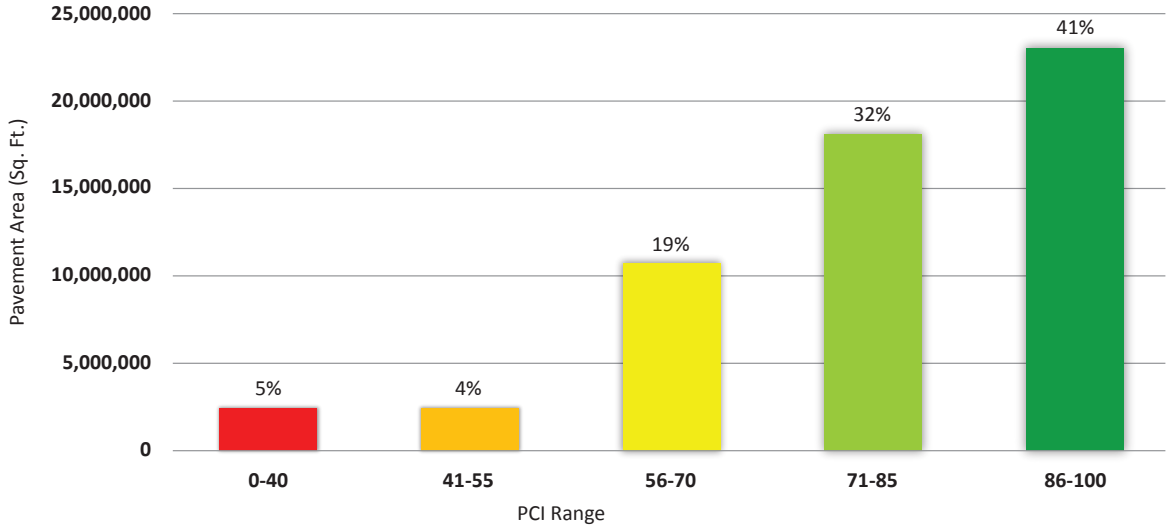
The *Total Statewide Pavement Area by PCI Range (All Airports)* chart provides a summary of how many square feet of pavement in the state fall into each individual PCI range. The *Overall Area-Weighted PCI* table on the next page provides the area-weighted PCI for each individual airport, which is comprised of all pavements on the airport.

Area-Weighted Average PCI Value by Use

BY PCI INDEX



Total Statewide Pavement Area by PCI Range (All Airports)



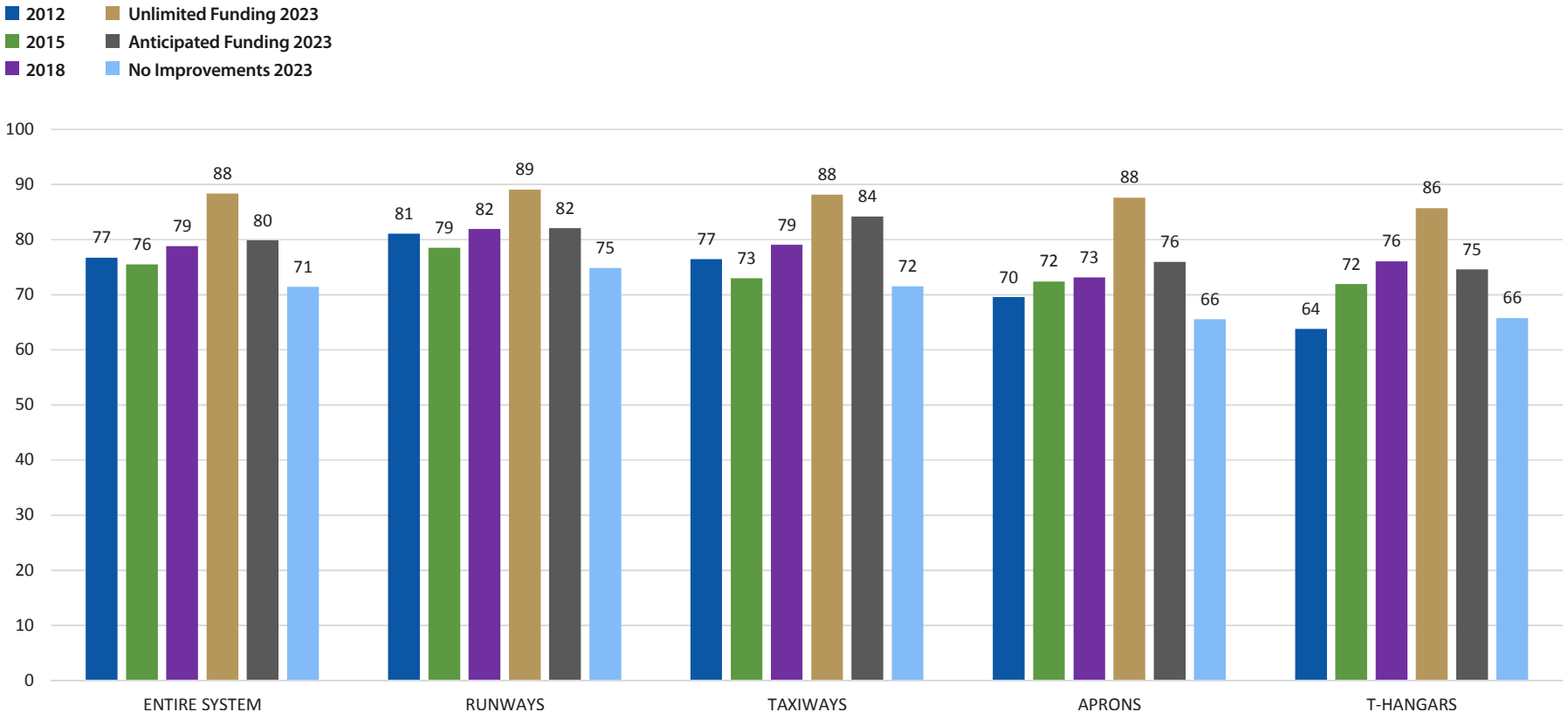
Overall Area-Weighted PCI

AIRPORT NAME	AREA-WEIGHTED PCI
Ashley Municipal	93
Beach	81
Beulah Municipal	71
Bismarck Municipal	82
Bottineau Municipal	74
Bowman Regional	100
Cando Municipal	68
Carrington Municipal	62
Casselton Robert Miller Regional	64
Cavalier Municipal	79
Cooperstown Municipal	82
Crosby Municipal	72
Devils Lake Regional	75
Dickinson Theodore Roosevelt Regional	69
Drayton Municipal	82
Dunseith - International Peace Garden	81
Edgeley Municipal	70
Ellendale Municipal	62
Enderlin - Sky Haven	75
Fargo - Hector International	83
Fort Yates - Standing Rock	66
Garrison Municipal	89
Glen Ullin Regional	64
Grafton Hutson Field	68
Grand Forks International	80
Gwinner-Roger Melroe Field	94
Harvey Municipal	72
Hazen - Mercer County Regional	61
Hettinger Municipal	82
Hillsboro Regional	84
Jamestown Regional	64
Kenmare Municipal	89
Killdeer - Dunn County	90
Kindred - Robert Odegaard Field	70
Lakota Municipal	65
LaMoure Rott Municipal	74
Langdon - Robertson Field	88
Larimore Municipal	65
Leeds Municipal	41
Linton Municipal	78
Lisbon Municipal	79
Maddock Municipal	96
Mandan Municipal	82
Mayville Municipal	78
Minot International	76
Minto Municipal	79
Mohall Municipal	83
Mott Municipal	65
Napoleon Municipal	93
New Rockford - Tomlinson Field	64
New Town Municipal	84
Northwood Municipal - Vince Field	92
Oakes Municipal	83
Page Regional	33
Park River - W C Skjerven Field	77
Parshall-Hankins	76
Pembina Municipal - Thomas Nord Field	75
Rolette	81
Rolla Municipal	83
Rugby Municipal	72
St. Thomas Municipal	60
Stanley Municipal	81
Tioga Municipal	78
Valley City - Barnes County Municipal	83
Wahpeton - Harry Stern	83
Walhalla Municipal	80
Washburn Municipal	95
Watford City Municipal	63
West Fargo Municipal	73
Westhope Municipal	71
Williston Basin International	100
Wishek Municipal	73

Historic Pavement Condition

The APMS is updated every three years and it is important to show how the system as a whole is performing from update to update. The *Historical PCI and Projected Area-Weighted Average PCI by Funding Scenario* chart below provides a summary of the 2012 and 2015 historic PCI values; current 2018 PCI values; projected PCI values in 2023 if unlimited funding were available; projected PCI values in 2023 if only the anticipated state budget funding were available; and the projected PCI values in 2023 if no improvements were completed on the existing system.

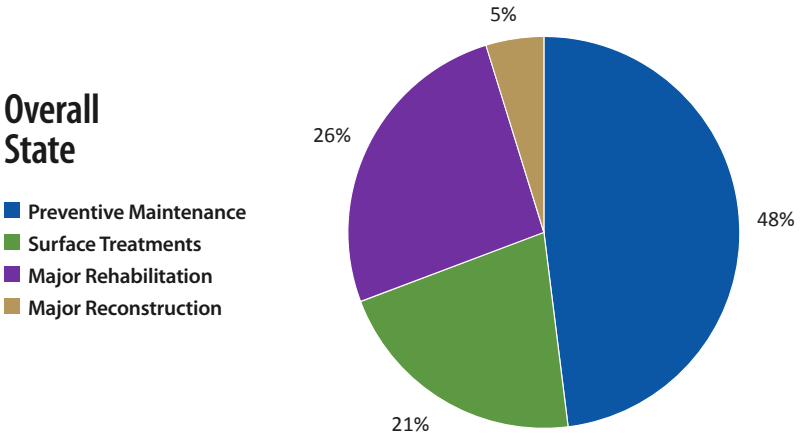
Historical PCI and Projected Area-Weighted Average PCI by Funding Scenario



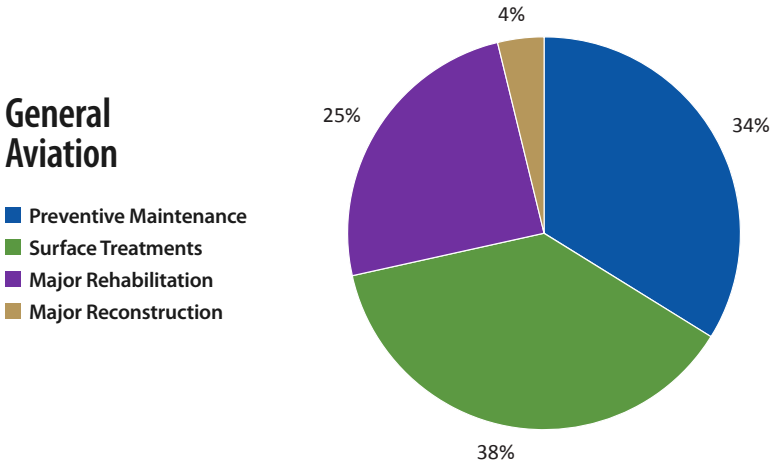
Pavement Condition Distribution

The pie chart to the right summarizes the overall state data for the airports included in the 2018 APMS. Approximately 48 percent have PCIs indicating they will benefit from preventive maintenance actions, such as crack sealing, joint sealing, and patching. Roughly 21 percent would benefit from applying a surface treatment. Approximately 26 percent of the pavement infrastructure needs more extensive rehabilitation, while 5 percent needs reconstruction to restore the pavement. The pie charts below break out this same information by general aviation and commercial service airports.

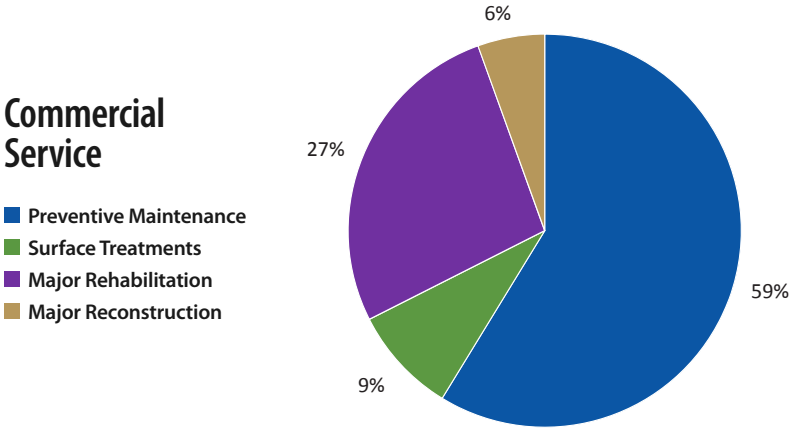
Overall State



General Aviation



Commercial Service



Pavement Funding Assessment

Funding for aviation projects within the state is crucial to maintain a steady pavement condition and safeguard aviation users. If no funding is provided for pavement maintenance and repair, North Dakota's pavement system will experience a slow and steady decline in condition. This decline would create a need for more major rehabilitation or reconstruction projects, which in turn significantly increases future cost.

Using the information collected during the pavement inspection, a rehabilitation program for 2019 through 2023 was developed for every airport in the study. A five-year program was prepared with the goal of maintaining the pavement above the established critical PCI values listed earlier in this report. The program generates a major rehabilitation recommendation for pavement in the year they drop below their critical PCI.

If all projects identified in the PCI study were funded, an approximate total of $165 million would be needed during the next five years – $101.2 million for commercial service airports and $63.4 million for general aviation airports. The unlimited budget funding for individual airport needs through 2023 are summarized in the table shown to the right, *Five-Year Funding Plan*. This analysis is for 2019 through 2023 with an inflation factor of 4 percent when calculating future cost of work. The unit costs used to estimate overall project costs are based on averages of recent projects completed throughout the state. These costs are averages and are not intended to be used for specific project planning purposes. Funding needs identified in an unlimited budget scenario are to maintain or rehabilitate existing infrastructure and do not include any additional needs or improvements made.

Five-Year Funding Plan

CLASSIFICATION	AIRPORT NAME	5-YEAR TOTAL FUNDING NEEDS
Commercial Service	Bismarck Municipal	$14,364,759
	Devils Lake Regional	$6,042,279
	Dickinson Theodore Roosevelt Regional	$10,560,594
	Fargo - Hector International	$14,464,791
	Grand Forks International	$21,115,052
	Jamestown Regional	$14,638,223
	Minot International	$19,989,786
Five-Year Commercial Service Funding Total		**$101,175,484**
General Aviation *(NPIAS)*	Ashley Municipal	$130,144
	Beach	$666,103
	Bottineau Municipal	$304,660
	Bowman Regional*	$0
	Cando Municipal	$1,352,832
	Carrington Municipal	$3,056,230
	Casselton Robert Miller Regional	$6,016,688
	Cavalier Municipal	$932,741
	Cooperstown Municipal	$3,586
	Crosby Municipal	$2,085,373
	Dunseith - International Peace Garden	$159,808
	Edgeley Municipal	$252,403
	Ellendale Municipal	$288,032
	Fort Yates - Standing Rock	$1,775,783
	Garrison Municipal	$334,318
	Glen Ullin Regional	$1,777,133
	Grafton - Hutson Field	$2,397,739
	Gwinner - Roger Melroe Field	$201,916
	Harvey Municipal	$190,742

** No or minimal five-year funding needed because airport was recently constructed or reconstructed.*

CLASSIFICATION	AIRPORT NAME	5-YEAR TOTAL FUNDING NEEDS
General Aviation *(NPIAS)*	Hazen - Mercer County Regional	$3,858,366
	Hettinger Municipal	$799,074
	Hillsboro Regional	$1,142,475
	Kenmare Municipal	$309,903
	Kindred - Robert Odegaard Field	$2,526,462
	Lakota Municipal	$2,002,555
	LaMoure Rott Municipal	$538,778
	Langdon - Robertson Field	$145,478
	Linton Municipal	$499,750
	Lisbon Municipal	$143,604
	Mandan Municipal	$2,459,825
	Mohall Municipal	$358,226
	Mott Municipal	$197,646
	Northwood Municipal - Vince Field	$275,994
	Oakes Municipal	$199,709
	Park River - W C Skjerven Field	$124,740
	Parshall-Hankins	$1,490,577
	Pembina Municipal - Thomas Nord Field	$1,501,206
	Rolla Municipal	$270,396
	Rugby Municipal	$419,224
	Stanley Municipal	$1,054,916
	Tioga Municipal	$2,108,366
	Valley City - Barnes County Municipal	$344,548
	Wahpeton - Harry Stern	$1,415,622
	Walhalla Municipal	$166,409
	Washburn Municipal	$20,316
	Watford City Municipal	$4,188,098
Five-Year General Aviation NPIAS Funding Total		**$50,488,494**

CLASSIFICATION	AIRPORT NAME	5-YEAR TOTAL FUNDING NEEDS
General Aviation *(Non-NPIAS)*	Beulah Municipal	$761,451
	Drayton Municipal	$69,615
	Enderlin - Sky Haven	$430,360
	Killdeer - Dunn County	$137,068
	Larimore Municipal	$557,196
	Leeds Municipal	$2,132,491
	Maddock Municipal*	$0
	Mayville Municipal	$544,806
	Minto Municipal	$355,515
	Napoleon Municipal*	$0
	New Rockford - Tomlinson Field	$1,718,973
	New Town Municipal	$33,443
	Page Regional	$1,193,391
	Rolette	$487,609
	St. Thomas Municipal	$1,193,392
	West Fargo Municipal	$1,095,791
	Westhope Municipal	$1,001,548
	Wishek Municipal	$1,160,558
Five-Year General Aviation Non-NPIAS Funding Total		**$12,873,207**
FIVE-YEAR STATEWIDE FUNDING TOTAL**		**$164,537,185**

* *No or minimal five-year funding needed because airport was recently constructed or reconstructed.*
** *Williston was excluded from the funding needs assessment.*

Summary

This report summarizes the results of the pavement evaluation conducted in North Dakota as part of the state APMS database update for airports. This includes 7* NPIAS commercial service airports, 46 NPIAS general aviation airports and 18 non-NPIAS general aviation airports. The system currently has 56.9 million square feet of pavement – 32.4 million square feet at commercial service airports and 24.5 million square feet at general aviation airports. In 2015, the PCI value for the state was 76. During a visual inspection of the pavements in 2018, it was found that the current weighted PCI of the pavement network is 79. If no funding is provided, this PCI value will steadily fall to 71 by the end of 2023. If the funding anticipated in the state budget is provided, the 2023 overall PCI value of the system is anticipated to be 80. If all work identified were to be completed, the 2023 overall PCI of the system is anticipated to increase to a value of 88.

Approximately $165 million in funding would be needed over the next five years to complete all work that has been identified in the unlimited budget scenario. This includes approximately $101.2 million for commercial service airports and $63.4 million for general aviation airports. Additional information can be found by visiting the NDAC website, **WWW.AERO.ND.GOV**.

** Williston was not inspected as part of the 2018 study due to the relocation of the existing airport. Williston's planned pavement inventory data used as part of the analysis includes area, age and condition (assumed PCI of 100) but does not include the cost.*

2018 **PAVEMENT CONDITION INDEX (PCI) STUDY**

2018

EXECUTIVE SUMMARY

FOR ADDITIONAL INFORMATION, PLEASE VISIT **WWW.AERO.ND.GOV**

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2018 PAVEMENT CONDITION INDEX (PCI) STUDY

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