Le Mars Municipal Airport

Pavement Classification Number Report

USING AIRCRAFT METHOD

PREPARED BY

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applied pavement
TECHNOLOGY

LE MARS MUNICIPAL AIRPORT
PAVEMENT CLASSIFICATION NUMBER REPORT USING AIRCRAFT METHOD

PREPARED FOR:

IOWA DEPARTMENT OF TRANSPORTATION
AVIATION BUREAU

PREPARED BY:

APPLIED PAVEMENT TECHNOLOGY, INC.

October 2020

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TABLE OF CONTENTS

LIST OF TABLES

APPENDIXES

INTRODUCTION

As part of the Airport Pavement Management System (APMS) update for the Iowa Department of Transportation, Aviation Bureau (Iowa DOT), Applied Pavement Technology, Inc. (APTech) determined the Pavement Classification Number (PCN) for Runway 18/36 at Le Mars Municipal Airport.

PCNs can be calculated using the Technical Evaluation Method or the Using Aircraft Method. The Technical Evaluation Method requires information on pavement cross-section and subgrade strength as well as aircraft data, whereas the Using Aircraft Method is based only on aircraft traffic data. The Iowa DOT and the Federal Aviation Administration (FAA) chose to use the Using Aircraft Method for this phase of the project.

Through a review of publicly available data (specifically from FAA's Traffic Flow Management System Counts [TFMSC] obtained from aspm.faa.gov and overall operational volumes from airnav.com) and input from Airport Managers, APTech compiled representative traffic data for use in determining the associated PCN. Each aircraft type using a pavement has an associated Aircraft Classification Number (ACN), with the ACNs determined using the FAA's COMFAA 3.0 software. The largest ACN associated with an aircraft regularly using the facility was reported as the PCN. Additional considerations are presented under the PCN Determination heading in this report.

This report includes a general overview of the Aircraft Classification Number–Pavement Classification Number (ACN–PCN) system; relevant information regarding the Pavement Condition Index (PCI) results, especially regarding load-related distress; inputs for determining PCNs; and the resulting PCNs.

PAVEMENT CONDITION SUMMARY

As part of the Iowa DOT's statewide APMS project, APTech visually assessed the pavement using the PCI procedure. This procedure is described in FAA Advisory Circular 150/5380-6C, *Guidelines and Procedures for Maintenance of Airport Pavements*, FAA Advisory Circular 150/5380-7B, *Airport Pavement Management Program (PMP)*, and ASTM D5340-12(2018), *Standard Test Method for Airport Pavement Condition Index Surveys*, and is supported by the PAVER pavement management software. Detailed information regarding the PCI procedure and results can be found in the 2019 Individual Airport Pavement Management Report for this airport.

Pavement condition data are not directly used in the structural analysis; however, the results should be considered when determining the PCN to publish. For example, a pavement exhibiting a significant amount of load-related distress provides a strong indication that the past traffic has exceeded the limits the structure can support. The following distresses are considered load-related:

- Hot-mix asphalt (HMA)-surfaced pavement:
  - Alligator (fatigue) cracking.
  - Rutting.
- Portland cement concrete (PCC) pavement:
  - Corner break.
  - Longitudinal, transverse, and diagonal (LTD) cracking.
  - Shattered slab.

For reference, the percent of the PCI deduct caused by load-related distress and the specific load-related distress(es) recorded during the most recent pavement inspection at Le Mars Municipal Airport are summarized in Table 1.

Table 1. PCI results.

Branch	Section	Surface Type	Last Construction Date	2019 PCI	Deduct due to Load-Related Distress, %	Load-Related Distress Observed
R18LE	01	PCC	5/1/1980	47	38	Corner Creak, LTD Cracking, Shattered Slab
R18LE	02	PCC	6/3/1964	41	63	LTD Cracking, Shattered Slab
R18LE	03	PCC	5/1/1980	54	57	Corner Break, LTD Cracking, Shattered Slab
R18LE	04	PCC	5/1/1996	65	81	LTD Cracking, Shattered Slab
R18LE	05	PCC	7/1/2007	90	37	LTD Cracking
R18LE	06	PCC	7/1/2007	89	70	Corner Break, LTD Cracking
R18LE	07	PCC	5/3/2018	100	0	None
R18LE	08	PCC	8/3/2018	100	0	None

Table 1. PCI results (continued).

Table Notes:

1. See Figure A-1 located in Appendix A for the location of the branch and section.
2. Surface Type: AC = asphalt cement concrete; AAC = asphalt overlay on AC; PCC = portland cement concrete; APC = asphalt overlay on PCC.
3. Distress types are defined by ASTM D5340-12(2018).

Runway 18/36 consists of eight sections constructed with PCC pavement. Section 02 represents the original, central portion of the runway and was constructed in 1964. Runway 18/36 has had multiple extensions since its original construction. Sections 01 and 03 were constructed in 1980 and are located to the immediate north and south of Section 02, respectively. Sections 04 and 06 were constructed in 1996 and 2007, respectively, and are located at Runway 36 Approach. Sections 05, 07, and 08 which were constructed in 2007, 2018, and 2018, respectively, and are located at Runway 18 Approach. All sections (except the recently constructed Sections 07 and 08) contain load related distress. Available work history information for Runway 18/36 is entered in the APMS PAVER database. A summary of available construction information is presented in Table 2.

Table 2. Pavement cross section information.

Branch	Section	Construction Date	Layer Thickness, in	Material Type
R18LE	01	5/1/1980	Unknown	PCC*
R18LE	02	6/3/1964	6	PCC (P-501)
R18LE	02	6/2/1964	6	Aggregate (P-154)
R18LE	03	5/1/1980	Unknown	PCC*
R18LE	04	5/1/1996	Unknown	PCC*
R18LE	05	7/1/2007	Unknown	PCC*
R18LE	06	7/1/2007	Unknown	PCC*
R18LE	07	5/3/2018	6	PCC (P-501)
R18LE	07	5/2/2018	6	Aggregate (P-209)
R18LE	08	8/3/2018	6	PCC (P-501)
R18LE	08	8/2/2018	6	Aggregate (P-209)

Table Notes:

1. See Figure A-1 located in Appendix A for the location of the branch and section.

* In addition to the PCC layer, information regarding any underlying base layers is unknown.

ACN–PCN OVERVIEW

The ACN–PCN system of reporting pavement strength was developed by the International Civil Aviation Organization (ICAO). Because the United States is a member of this organization, the FAA is obligated to adhere to this system and provides guidance to comply with the ICAO standards.

The ACN–PCN procedure is structured so that a pavement with a given PCN can support an aircraft that has an ACN equal to or less than the PCN. Likewise, the pavement cannot, according to the procedure, handle frequent loadings from an aircraft with an ACN exceeding the PCN. Some infrequent overloads are allowed in accordance with the general overload guidance, which is presented within this report. Aircraft operators are required to obtain permission to use a facility when their aircraft's ACN exceeds the published PCN.

ACNs

According to FAA Advisory Circular 150/5335-5C, the ACN is defined as a number that expresses the relative effect of an aircraft at a given weight on a pavement structure for a specified standard subgrade strength. The ACN can be calculated for any operating weight. Higher ACNs indicate an aircraft has a more severe effect on the pavement, while lower values indicate a less severe effect. ACNs are reported by pavement type for each subgrade strength category. Stronger subgrade support conditions (e.g., granular subgrade soils with higher k-values or California Bearing Ratios [CBRs]) correspond to lower ACNs as compared to weaker subgrade support conditions. The ACN has a minimum value of 0 and no upper limit.

A list of ACNs for common aircraft is shown in Table 3 to assist decision-makers with determining whether the analyzed pavements can realistically support aircraft that might not be in the traffic mix. The listed ACNs were determined using the FAA's COMFAA software and are presented for each subgrade strength category for both flexible and rigid pavement types; the presented ACNs are for the specified aircraft weight and tire pressure. For a given aircraft, the ACNs will decrease as aircraft weight decreases. It is also worth noting that tire pressure influences ACNs for specific aircraft. For example, given two aircraft with similar weights and gear configurations (for a specific pavement type and subgrade strength category), the aircraft with the lower tire pressure will have a lower ACN, indicating that its demand on a pavement is less than a similar aircraft with a higher tire pressure.

Table 3. ACNs for common aircraft by pavement type and subgrade category (not specific to this airport).

Aircraft	**Weight, lbs**	**Tire Pressure, psi**	**Gear Type**	**ACN: Flexible Pavement, Subgrade Category A**	**ACN: Flexible Pavement, Subgrade Category B**	**ACN: Flexible Pavement, Subgrade Category C**	**ACN: Flexible Pavement, Subgrade Category D**	**ACN: Rigid Pavement, Subgrade Category A**	**ACN: Rigid Pavement, Subgrade Category B**	**ACN: Rigid Pavement, Subgrade Category C**	**ACN: Rigid Pavement, Subgrade Category D**
Chk.Six-PA-32	3,400	50	S	1	1	1	1	1	1	1	1
Aztec-D	5,200	46	S	1	1	2	2	1	2	2	1
Baron-E-55	5,424	56	S	1	1	2	2	2	2	2	2
Navajo-C	6,536	66	S	2	2	2	3	2	2	2	2
GrnCaravanCE208B	8,750	75	S	2	3	3	3	3	3	3	3
Air Tractor 502	9,000	62	S	2	3	3	4	3	3	3	3
Citation 525	10,500	98	S	4	4	4	4	4	4	4	4
Air Tractor 802	14,200	62	S	3	5	5	6	4	4	5	5
Citation-550B	15,000	130	S	6	6	6	6	6	6	6	6
Citation-V	16,500	130	S	6	7	7	7	6	7	7	7
Sabreliner-60	20,372	214	S	9	9	9	9	9	9	9	9
Shorts 360	27,200	78	S	7	9	10	11	9	9	9	9
King Air B-100	11,500	52	D	1	2	2	3	2	2	2	3
Super King Air-B200	12,590	98	D	2	3	3	4	3	3	3	4
Super King Air-300	14,100	92	D	3	3	4	4	3	4	4	4
Super King Air-350	15,100	92	D	3	3	4	5	4	4	4	4
Learjet-55	21,500	201	D	6	6	7	7	7	7	8	8
Hawker-800	27,520	135	D	7	7	8	9	8	8	9	9
Falcon-2000	35,000	197	D	9	10	11	11	11	11	12	12
Falcon-50	38,800	208	D	10	11	12	13	13	13	13	14
Falcon-900	45,500	145	D	12	13	14	15	14	15	15	16
Challenger-CL-604	48,200	145	D	12	12	14	16	14	14	15	15
Gulfstream-G-II	66,000	160	D	18	20	21	22	21	22	23	23
Gulfstream-G-IV	75,000	185	D	22	24	25	25	26	26	27	28

Table Notes:

1. Configuration of the main gear: S = single wheel and D = dual wheel (as defined in FAA Order 5300.7, *Standard Naming Convention for Aircraft Landing Gear Configurations*).

PCNs

The PCN is assigned to a pavement and expresses the relative load-carrying capacity of that pavement. Ideally, the PCN will be determined based on aircraft departures (frequency and weight) along with any pavement and subgrade layer properties. If these data become available, APTech recommends a technical evaluation be completed to determine the PCN.

FAA Advisory Circular 150/5335-5C states the following regarding the Using Aircraft Method of reporting PCNs:

> *The accuracy of this method is greatly improved when aircraft traffic information is available. Significant over-estimation of the pavement capacity can result if an excessively damaging aircraft, which uses the pavement on a very infrequent basis, is used to determine the PCN. Likewise, significant under-estimation of the pavement capacity can lead to uneconomic use of the pavement by preventing acceptable traffic from operating. Use of the Using Aircraft Method is discouraged on a long-term basis due to the concerns listed above.*

As with the ACN, the PCN has a minimum value of 0 and has no upper limit. In addition to the numerical value, the PCN is reported with four codes, which represent the following categories:

- Pavement Type
  - R = Rigid
  - F = Flexible
- Subgrade Strength Category
  - 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 = Unlimited (no pressure limit)
  - X = High (pressure limited to 254 psi)
  - Y = Medium (pressure limited to 181 psi)
  - Z = Low (pressure limited to 73 psi)
- Pavement Evaluation Method
  - T = Technical Evaluation
  - U = Using Aircraft Evaluation

General Overload Guidance

For aircraft with an ACN that exceeds the PCN, ICAO overload guidance can be referenced. Alternatively, aircraft with ACNs greater than the PCNs for analyzed facilities may be able to safely use these pavements (following the ACN–PCN procedure) by operating at a reduced weight. Appendix D of FAA Advisory Circular 150/5335-5C presents the following guidance for pavement overloads (ICAO 1983):

- For flexible pavements, occasional traffic cycles by aircraft with an ACN not exceeding 10 percent above the reported PCN should not adversely affect the pavement.

- For rigid or composite pavements, occasional traffic cycles by aircraft with an ACN not exceeding 5 percent above the reported PCN should not adversely affect the pavement.
- The annual number of overload traffic cycles should not exceed approximately 5 percent of the total annual aircraft traffic cycles. [As additional guidance, the FAA recommends limiting the overload cycles to 500 coverages; the corresponding number of annual departures depends on the aircraft and its typical pass-to-coverage ratio.]
- Overloads should not normally be permitted on pavements exhibiting signs of load-related distress, during periods of thaw following frost penetration, or when the strength of the pavement or its subgrade could be weakened by water.
- When overload operations are conducted, the airport owner should regularly inspect the pavement condition. The airport owner should periodically review the criteria for overload operations. Excessive repetition of overloads can cause a significant reduction in pavement life or accelerate when a pavement will require a major rehabilitation.

In general, pavement overloads are expected to decrease pavement life but do not often cause immediate or catastrophic failures unless they are excessive.

PCN DETERMINATION—USING AIRCRAFT METHOD

Aircraft traffic is the primary consideration when reporting a PCN following the Using Aircraft Method. The PCN is reported based on the pavement type (rigid or flexible) corresponding to a given subgrade category. For the Using Aircraft Method, the specific strength is not required, but a subgrade category should be specified so the corresponding ACN can be referenced. The subgrade support conditions are unknown for this airport, and a subgrade strength category C was assumed based on typical conditions throughout Iowa.

APTech compiled traffic data to provide a representation of the aircraft using Runway 18/36 based on publicly available information. This information was provided to the Airport Manager for review, who noted that the traffic was representative of the aircraft using Runway 18/36 and provided additional input. Representative traffic information is presented in Table 4 along with the corresponding ACNs (as determined using COMFAA) for the pavement types and subgrade strength categories associated with Le Mars Municipal Airport.

Table 4. Traffic data.

Representative Aircraft	Weight, lbs	Gear Type	Tire Pressure, psi	ACN: Rigid Pavement, Subgrade Category C
Skylane 182	3,110	S	50	1
Piper PA-34	4,773	S	46	1
Air Tractor 502	9,000	S	62	3
Beech King Air 90	9,650	S	58	3
Citation CJ3	13,870	S	130	6
Air Tractor 802	14,200	S	62	5
Phenom 300	17,986	S	185	8
Cessna Excel/XLS	20,200	S	214	9
Beech Super King Air 350	15,100	D	92	4
Learjet 75	21,500	D	201	7
Dassault Falcon 2000	35,000	D	197	12

Table Notes:

1. Defined by the configuration of the main gear: S = single wheel and D = dual wheel (as defined in FAA Order 5300.7, *Standard Naming Convention for Aircraft Landing Gear Configurations*).

Based on the representative aircraft using Runway 18/36, of which the most demanding representative aircraft is the Dassault Falcon 2000 with an ACN of 12 for the given pavement type and subgrade category, the PCN and corresponding allowable aircraft weights are presented in Table 5. The corresponding allowable aircraft weights were determined using the FAA's COMFAA Support Spreadsheet, which are approximations and are not specific for any particular aircraft model. The PCN can be reported to the FAA's regional office using the results from this report.

Table 5. PCN results and corresponding allowable aircraft weights.

Branch	PCN	Single Wheel Allowable Aircraft Weight, lbs	Dual Wheel Allowable Aircraft Weight, lbs
Runway 18/36	12/R/C/W/U	37,000	49,500

Table Notes:

1. Single or dual wheel allowable aircraft weight refers to the aircraft's main gear type.

Load-related distresses were observed during the 2019 PCI inspection on Runway 18/36, which indicates that some aircraft may be overloading the pavement. Therefore, additional investigation is recommended to determine a more accurate assessment of the capacity of the runway. Furthermore, the overall pavement condition and progression of distress should continue to be monitored.

The ICAO overload guidance, included in the ACN–PCN Overview chapter of this report, can be referenced for aircraft with an ACN that exceeds the PCN for a specified pavement, although this information is more applicable for PCNs determined from a Technical Evaluation Method. Alternatively, aircraft with ACNs greater than the documented PCN may be able to use the facility, following the ACN–PCN procedure, by operating at a reduced weight. In general, pavement overloads are expected to decrease pavement life but do not often cause immediate or catastrophic failures unless they are excessive.

SUMMARY

This report presents an overview of the ACN–PCN procedure and documents the representative traffic considered when determining the PCN following the FAA's Using Aircraft Method, as described in FAA Advisory Circular 150/5335-5C. The PCN recommended for publication for Runway 18/36 is 12/R/C/W/U. Load-related distresses were observed during the 2019 PCI inspection on the runway, which indicates that some aircraft may be overloading the pavement.

ACNs of common aircraft are provided, and overload guidance is presented. In general, pavement overloads are expected to decrease pavement life but do not often cause immediate or catastrophic failures unless they are excessive.

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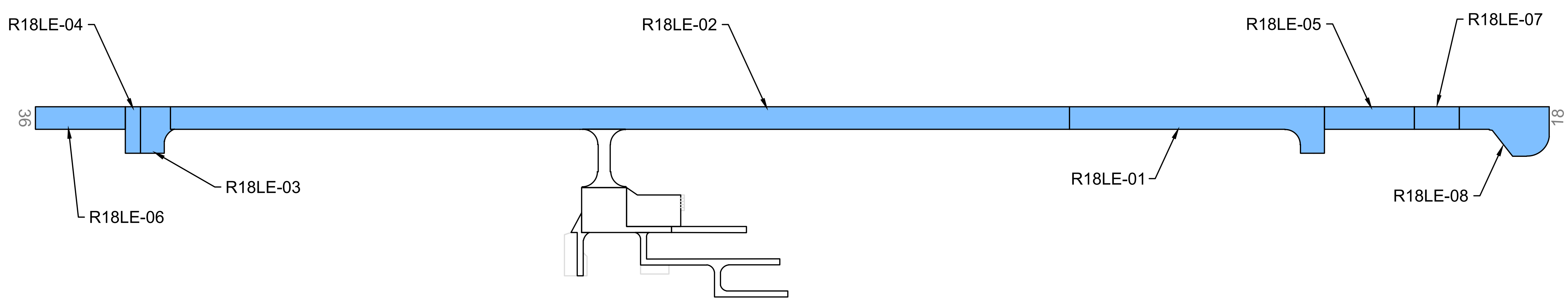
APPENDIX A

PCN SECTION IDENTIFICATION MAP

FIGURE A-1. PCN SECTION IDENTIFICATION MAP.



Runway 18/36 PCN: 12/R/C/W/U
Corresponding Single Wheel Aircraft Weight: 37,000 pounds
Corresponding Dual Wheel Aircraft Weight: 49,500 pounds

LEGEND

BRANCH IDENTIFIER
SECTION IDENTIFIER
R02AT-10
32/R/C/W/U — PCN VALUE
SECTION BREAK LINE
PCN SECTION

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AGENCY: Iowa Department of Transportation Office of Aviation

LOCATION: Le Mars Municipal Airport, Le Mars, Iowa

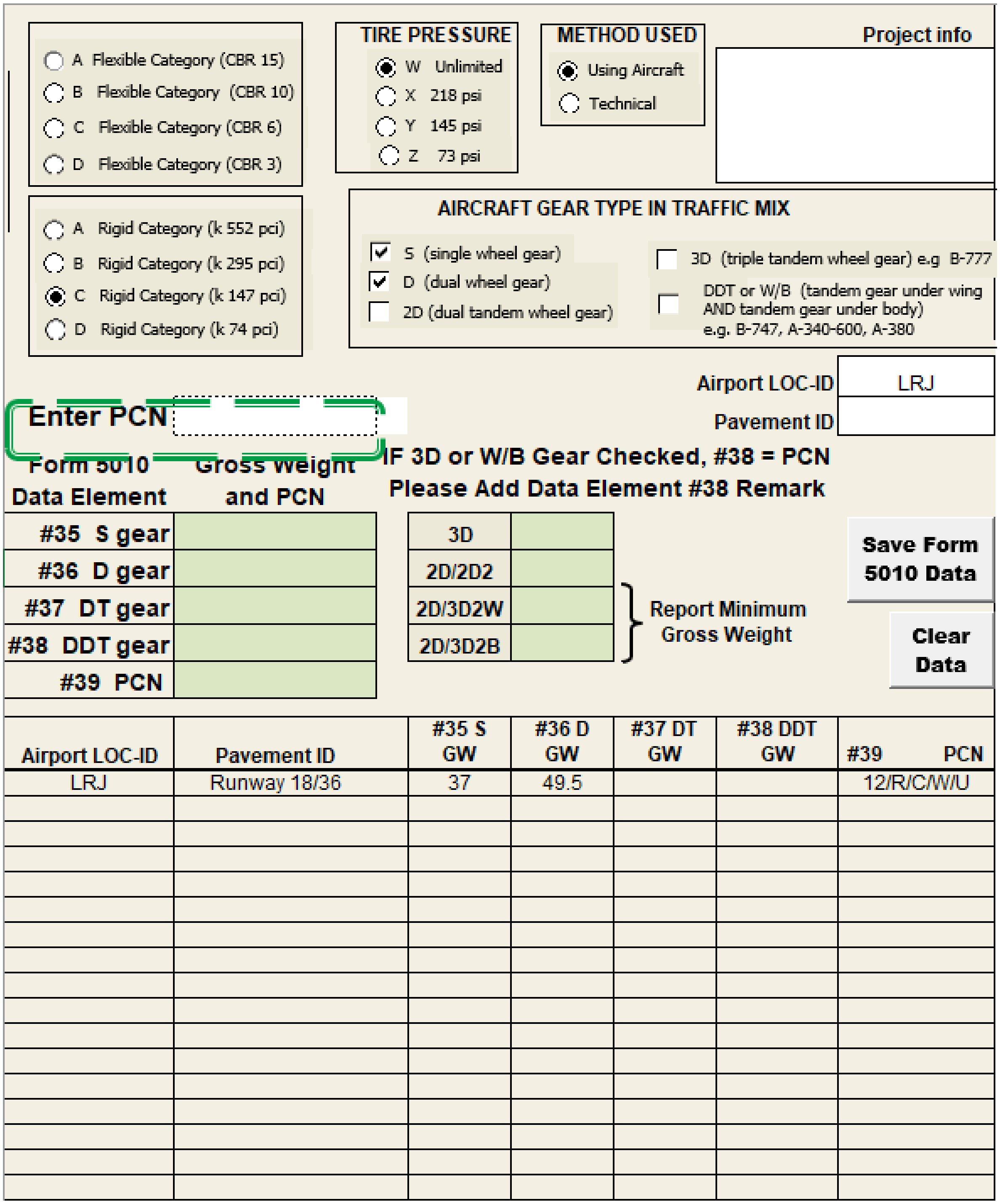
PAGE TITLE: PCN Section Identification Map

PROJECT DATE:	CREATION DATE:	PROJECT MANAGER:	JOB NUMBER:
OCT. 2019	OCT. 2019	LJR	2017-020-AM03
DRAWING SCALE: 1"=400'	LAST MODIFIED DATE: OCT. 2020	REVISED BY: KEW	DRAWN BY: KEW
FILENAME: Le Mars.dwg		LAYOUT NAME/NUMBER: PCN	PAGE NUMBER: A-1

APPENDIX B

FAA FORM 5010 DATA ELEMENTS

Figure B-1. Form 5010 Data Elements
(Standard Form from the FAA's Support Spreadsheet for COMFAA 3.0).



- ( ) A Flexible Category (CBR 15)
- ( ) B Flexible Category (CBR 10)
- ( ) C Flexible Category (CBR 6)
- ( ) D Flexible Category (CBR 3)

TIRE PRESSURE

- (•) W Unlimited
- ( ) X 218 psi
- ( ) Y 145 psi
- ( ) Z 73 psi

METHOD USED

- (•) Using Aircraft
- ( ) Technical

Project info

- ( ) A Rigid Category (k 552 pci)
- ( ) B Rigid Category (k 295 pci)
- (•) C Rigid Category (k 147 pci)
- ( ) D Rigid Category (k 74 pci)

AIRCRAFT GEAR TYPE IN TRAFFIC MIX

- [x] S (single wheel gear)
- [x] D (dual wheel gear)
- [ ] 2D (dual tandem wheel gear)
- [ ] 3D (triple tandem wheel gear) e.g B-777
- [ ] DDT or W/B (tandem gear under wing AND tandem gear under body) e.g. B-747, A-340-600, A-380

Airport LOC-ID: LRJ

Pavement ID:

Enter PCN

Form 5010 Data Element	Gross Weight and PCN
#35 S gear	
#36 D gear	
#37 DT gear	
#38 DDT gear	
#39 PCN	

IF 3D or W/B Gear Checked, #38 = PCN
Please Add Data Element #38 Remark

3D	
2D/2D2	
2D/3D2W	
2D/3D2B	

Report Minimum Gross Weight

Save Form 5010 Data

Clear Data

Airport LOC-ID	Pavement ID	#35 S GW	#36 D GW	#37 DT GW	#38 DDT GW	#39 PCN
LRJ	Runway 18/36	37	49.5			12/R/C/W/U

PREPARED FOR

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