Alabama Statewide Airport Pavement Management Program Update

Mac Crenshaw Memorial Airport (PRN)

Final Report

February 2022

Submitted to

Alabama Aeronautics Bureau

Submitted by

JVIATION

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Pavement Management – Evaluation – Testing - Design

ALABAMA STATEWIDE AIRPORT PAVEMENT MANAGEMENT PROGRAM UPDATE

Mac Crenshaw Memorial Airport, Greenville (PRN)

FINAL REPORT

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Executive Summary

The Jviation Inc. team, which included All About Pavements, Inc., (API) was awarded a contract by the Alabama Department of Transportation's Aeronautics Bureau (ALDOT) in 2018 to update the existing Alabama Statewide Airport Pavement Management Program (APMP). The scope of this project includes the airside pavement network at Mac Crenshaw Memorial Airport (PRN).

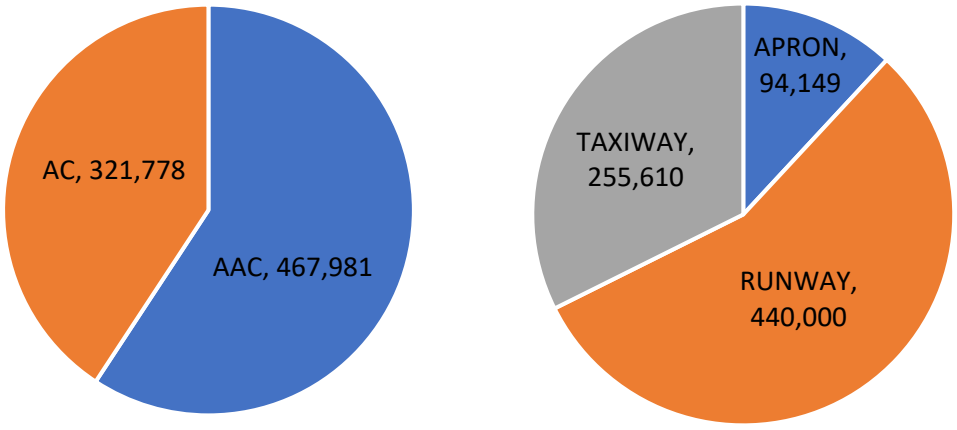
The following APMP tasks were completed to achieve the project objectives at PRN:

- Update the PAVER work history with records review information provided by ALDOT
- Conduct a visual pavement condition survey of the airfield pavements
- Update the PAVER database with inventory and condition data
- Update Maintenance and Rehabilitation (M&R) policies and unit costs
- Develop a 7-Year Pavement Capital Improvement Program (PCIP) with associated cost estimates

ES.1 Pavement Inventory

There are 6 branches and 12 sections within PRN's pavement network with a total surface area of approximately 0.8 million square feet (sf). Figure ES-1 shows the distribution of the pavement network by surface type and branch use.

Figure ES-1: Pavement Area (sf) by Surface Type and Branch Use.



ES.2 Pavement Condition

Visual pavement inspections were conducted in November 2019 using the Pavement Condition Index (PCI) method as specified in ASTM D5340-12 and FAA AC 150/5380-6C. The PCI is a numerical rating scale from 0 to 100 that provides a measure of the pavement's functional surface condition. The overall

area-weighted network PCI (AW PCI) for the PRN pavement network is 87, representing a "Good" condition. The network area-weighted pavement age (AW Age) is 7 years.

Table ES-1 is a listing of the section PCI values and ratings.

Table ES-1: PRN Section PCI Values and Ratings.

Branch ID	Name	Section ID	Surface	Area, sf	PCI	PCI Category
A01	Apron 01	01	AC	94,149	66	Fair
R1432	Runway 14-32	01	AAC	416,000	100	Good
R1432	Runway 14-32	02	AAC	24,000	98	Good
TA	Taxiway A	01	AAC	13,098	98	Good
TA	Taxiway A	02	AC	46,105	80	Satisfactory
TA	Taxiway A	03	AC	147,597	66	Fair
TA	Taxiway A	04	AC	4,485	100	Good
TA1	Taxiway A1	01	AC	7,734	56	Fair
TA1	Taxiway A1	02	AAC	7,480	99	Good
TB	Taxiway B	01	AC	3,752	37	Very Poor
TB	Taxiway B	02	AAC	7,403	99	Good
THANG01	Taxiway Hangar 01	01	AC	17,956	70	Fair

ES.3 Pavement Maintenance and Repair Funding Levels

The PAVER database was updated with 2019 condition data, maintenance and repair (M&R) policies, and unit costs; which were then used to evaluate the effect of multiple funding levels on the overall future pavement condition. Figure ES-2 presents the forecasted PRN network PCI values for each funding level.

ES.4 Pavement Capital Improvement Program (PCIP)

The analysis output from the unlimited funding budget scenario was used as a starting point in developing the PCIP. For this scenario, sections were grouped into projects to allow for a logical construction sequence. Table ES-2 summarizes the 7-year PCIP, which has an estimated total cost of approximately $1.7 million. These recommendations are based on a network-level evaluation. Project-level evaluations should be conducted prior to developing design and bid package documents.

In addition to the major rehabilitation needs that are identified in the PCIP, PAVER was used to develop maintenance activities to repair specific PCI distresses in Year 1. The estimated costs for these maintenance activities are $66,027 as summarized in Table ES-3.

Figure ES-2: M&R Funding Levels.

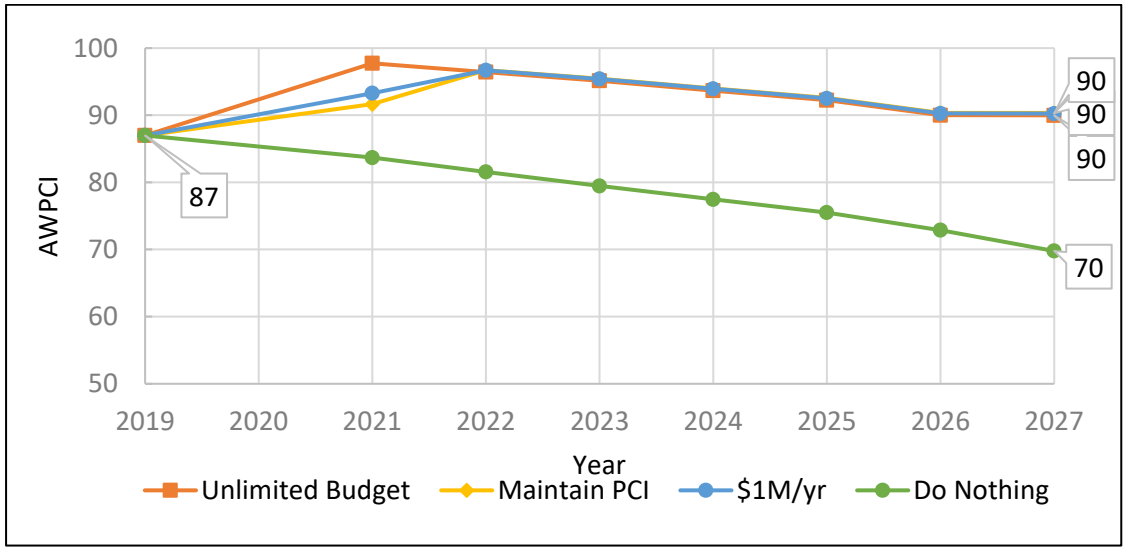


Table ES-2: Summary of Pavement Capital Improvement Program.

Project Year	CIP Project	Total Project Cost	Total Project Area, sf	AWPCI Before	AWPCI After
2021	PRN_21-01_Taxiway A Preservation	$40,415	46,105	77	83
	PRN_21-02_Taxiway A Rehabilitation	$663,859	159,083	58	100
2022	PRN_22-01_Apron and T-Hangar Rehabilitation	$464,358	112,105	60	100
2024	PRN_24-01_Taxiway A Surface Treatment	$101,245	159,083	96	99
2025	PRN_25-01_Apron Surface Treatment	$61,717	94,149	93	98
2027	PRN_27-01_Runway 14-32 Preservation	$339,978	472,466	87	93
	Total	**$1,671,572**			

Table ES-3: Summary of Localized Maintenance Plan.

Policy	Work Description	Work Quantity	Work Unit	Work Cost
Preventive	Crack Sealing - AC	3,053	Ft	$12,060
	Patching - AC Full-Depth	2,129	SqFt	$53,340
	Patching - AC Partial-Depth	39	SqFt	$627
			Total	**$66,027**

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1 Introduction

1.1. Overview

The Alabama Department of Transportation's Aeronautics Bureau (ALDOT) is responsible for preserving and enhancing Alabama's air transportation system, which consists of 72 airports throughout the State. ALDOT implemented an Airport Pavement Management Program (APMP) in 2008 using the PAVER system. ALDOT awarded a project in 2018 to Jviation Inc. (Jviation) to update the System Plan and conduct an Economic Analysis for the Alabama airports. The scope of work also included an update of the APMP for 59 airports, which was conducted by All About Pavements, Inc., (API), a Jviation team member.

With this update of the APMP, the Alabama airports continue to be eligible for FAA funding for major pavement rehabilitation work under the Airport Improvement Program (AIP) since an APMP meets the pavement maintenance management requirements described in Appendix A of AC 150/5380-6C.

This report discusses the evaluation of the airside pavements at Mac Crenshaw Memorial Airport (PRN), the current and forecasted pavement condition, and the development of the Pavement Capital Improvement Program (PCIP).

1.2. Work Scope

The goals of the Alabama Statewide Airport Pavement Management Update program are as follows:

- Conduct a visual pavement inspection of the asphalt surfaced pavements for 59 of the 72 public use airports in Alabama.
- Based on the visual inspection analysis results, develop a 7-year PCIP for each airport.

The scope of work is as shown below:

- Conduct a Records Review
- Update Pavement Network Definition
- Conduct Pavement Condition Surveys
- Update and customize existing APMP PAVER database
- Develop PCIP and associated project cost estimates
- Prepare Draft and Final Reports
- Develop a web-based viewer for reporting APMP data

As required in the Scope of Work, a detailed pavement condition survey was not conducted for any Portland Cement Concrete (PCC) aprons and PCC taxiways longer than 2,000 ft. Instead, a condition rating of "Good", "Fair", or "Poor" was assigned based on the overall pavement condition.

The deliverable products include a PAVER 7.0 database, individual airport evaluation reports, a statewide summary report, and the web viewer. The PRN report will be one of the 59 individual airport reports that will be available on ALDOT's website.

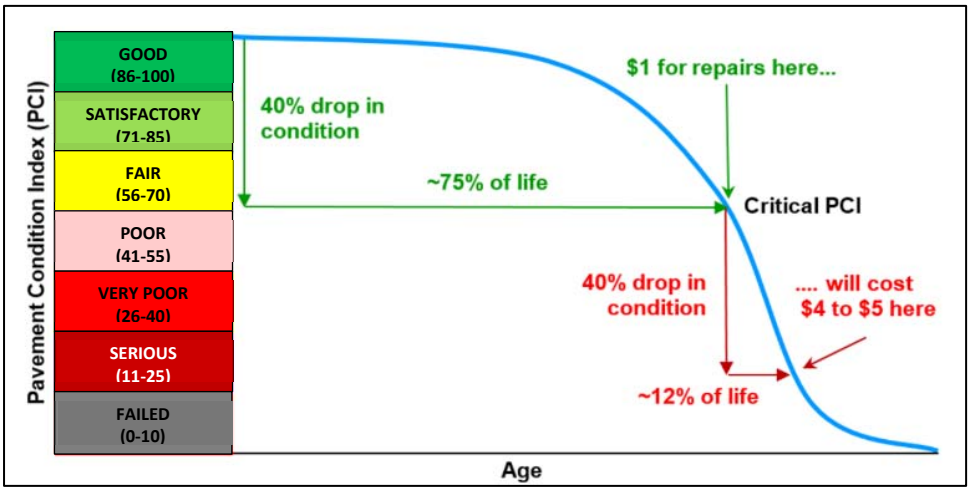
1.3. Pavement Management Concept

An APMP provides an integrated framework for comprehensive evaluation and decision making for managing airfield pavements. The essential components of an effective APMP provide for an objective evaluation of the condition of existing pavements, identification of short-term and long-range major rehabilitation work, necessary improvements in the pavement structural capacity, and the recurring maintenance work that should be completed each year. The APMP will also provide a budget for each of these types of pavement construction.

Historically, most organizations have made maintenance decisions based on past experience, without the benefit of documented data or analysis. This practice does not encourage life cycle cost analysis, nor the evaluation of cost effectiveness of alternate scenarios, and can lead to the inefficient use of funds. With limited allocated funding for Maintenance and Repair (M&R) Program projects, a defined procedure for setting priorities and schedules that will maximize the funds available is more important than ever.

In examining the lifespan of a 20-year pavement, a "Good" to "Fair" condition rating may last only 5 to 15 years. After that point, the rate of deterioration of pavements accelerates sharply as the age of the pavement increases, and within five years, the pavement may deteriorate to the point of failure. In order to extend pavement life, maintenance and repairs need to be scheduled and performed before the pavement surface declines to a "fair" condition. The point at which rehabilitation can be done before the steep decline occurs is called the "critical PCI", and is generally considered to occur when the Pavement Condition Index (PCI) is between 60 and 70 for general aviation airports. If the work is done before deterioration accelerates, the cost of rehabilitation can be reduced as shown in Figure 1.1.

Figure 1.1: Pavement Management Concept.



2 Airfield Pavement Inventory

2.1. Introduction

PRN is a General Aviation (GA) airport located approximately 2 miles north east of Greenville. The airport was activated in May 1962 and is owned and operated by the City of Greenville. Figure 2.1 shows an aerial image of the airport.

Figure 2.1: Mac Crenshaw Memorial Airport.

(Source: Google Earth)

2.2. Pavement Inventory

PRN consists of one runway, a parallel taxiway, two connector taxiways, and an apron. The total pavement area is approximately 0.8 million square feet. Pavement surfaces at PRN include Asphalt Concrete (AC) and Asphalt Overlay over AC (AAC). A complete listing of the pavement sections is included in Appendix A. Runway 14-32 is 5,501 ft. long and 80 ft. wide.

A records search was undertaken to identify any preservation or rehabilitation work that has occurred at Mac Crenshaw Memorial Airport since the last APMP update in 2009. The following records that were provided by ALDOT were reviewed, and the PAVER database was updated with work history information:

- Taxiway Extension, 2011
- Runway 14-32 Full Depth Reclamation, 2018

2.3. Climatic Conditions

Table 3.1 provides a summary of the climatic data for the geographic region that includes PRN. As the table shows, the pavements at PRN are not exposed to any freeze-thaw cycles. The mean air temperature for January ranges from an average low of 37 degrees ^{o}F to an average high of 59 degrees ^{o}F. The average annual rainfall at PRN is near 58 inches.

Table 2.1: Average Annual Temperatures and Rainfall for PRN.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High Temp (°F)	59	64	72	78	85	90	92	92	87	79	69	61
Low Temp (°F)	37	40	46	52	60	67	70	69	65	54	46	39
Precip. (in)	6.0	5.1	6.7	4.2	4.1	4.9	5.5	4.3	4.6	2.7	4.7	4.9

Source: www.intellicast.com

2.4. Pavement Network Definition

A key element in developing an APMP system is defining the pavement network, which is the process of dividing an agency's pavements into a hierarchical order that facilitates inspection and M&R planning. The PRN network (e.g. all airside pavements) is then divided into branches, which are a readily identifiable part of the pavement system and have distinct functions. For airports, branches typically consist of individual runways, taxiways and aprons. Figure B1A in Appendix B shows the branches at PRN.

Once branches have been defined, pavement evaluation and analysis techniques require the airfield pavement system to be broken up into discrete sections. A pavement "section" is the smallest management unit that is used when considering the application and selection of maintenance and rehabilitation (M&R) treatments, and is defined in Section 2.1.8 of ASTM D 5340-12 as *"a contiguous pavement area having uniform construction, maintenance, usage history, and condition. A section should also have the same traffic volume and load intensity."* A complete list of the pavement inventory and the corresponding section designations are included in Appendix A. Figure B1B presents the section layout.

To facilitate the visual survey of the airside pavement, each section is further subdivided into conveniently defined sub-section areas, or sample units. Similar sizing is critical as studies have found that maintaining the size of the sample units to within 40 percent of the established norm may reduce the standard error of the average PCI values. To meet that criteria, ASTM recommends that sample units for asphalt pavements be 5,000 square feet (± 2,000).

Table 2.2 was used as a guideline in developing sampling rates that reflect typical rates that are used for other large pavement networks. In general, this sampling rate will not provide a 95% confidence level with a standard error of 5 PCI points. A higher level of sampling is recommended before a project-level rehabilitation design is developed for a pavement section or facility.

Sample units that include a one-time occurrence of a distress (i.e. a large patch) or an unusual severity or quantity of a distress seen elsewhere, were designated as "additional" sample units as described in the ASTM D5340 PCI procedure. This allows the PCI to be calculated without extrapolating the aberrant

distress throughout the section as a whole. In Appendix B, Figure B1C shows the sample unit layout for PRN.

Table 2.2: PCI Sampling Rate for AC Surfaces.

Total Samples	Samples to Inspect
1	1
2	2
3 – 6	3
7 – 13	4
14 – 39	5
> 39	15 percent, but less than 12

2.5. Inventory Summary

There are 6 branches (facilities) at PRN that include 12 pavement sections and a total area of approximately 0.8 million square feet of paved surfaces, as shown in Table 2.3.

Table 2.3: PRN Pavement Branches.

Branch ID	Branch Name	Branch Use	Area, sf	Number of Sections
A01	Apron 01	APRON	94,149	1
R1432	Runway 14-32	RUNWAY	440,000	2
TA	Taxiway A	TAXIWAY	211,285	4
TA1	Taxiway A1	TAXIWAY	15,214	2
TB	Taxiway B	TAXIWAY	11,155	2
THANG01	Taxiway Hangar 01	TAXIWAY	17,956	1
		Total	**789,759**	**12**

Table 2.4 shows the distribution of airfield pavement by age with the area-weighted age being 7 years for all airside pavements at PRN.

Table 2.4: PRN Pavement Age.

Age (Years)	Number of Sections	Percent of Area	Area, sf
0 – 5	6	60	472,466
6 – 10	2	8	64,061
11 – 15	0	0	0
16 – 20	3	31	249,480
> 20	1	1	3,752

Figure 2.2 shows the distribution by surface type. Figure 2.3 presents the distribution by pavement use (e.g. runway, taxiway, and apron).

Figure 2.2: PRN Pavement Area by Surface Type.

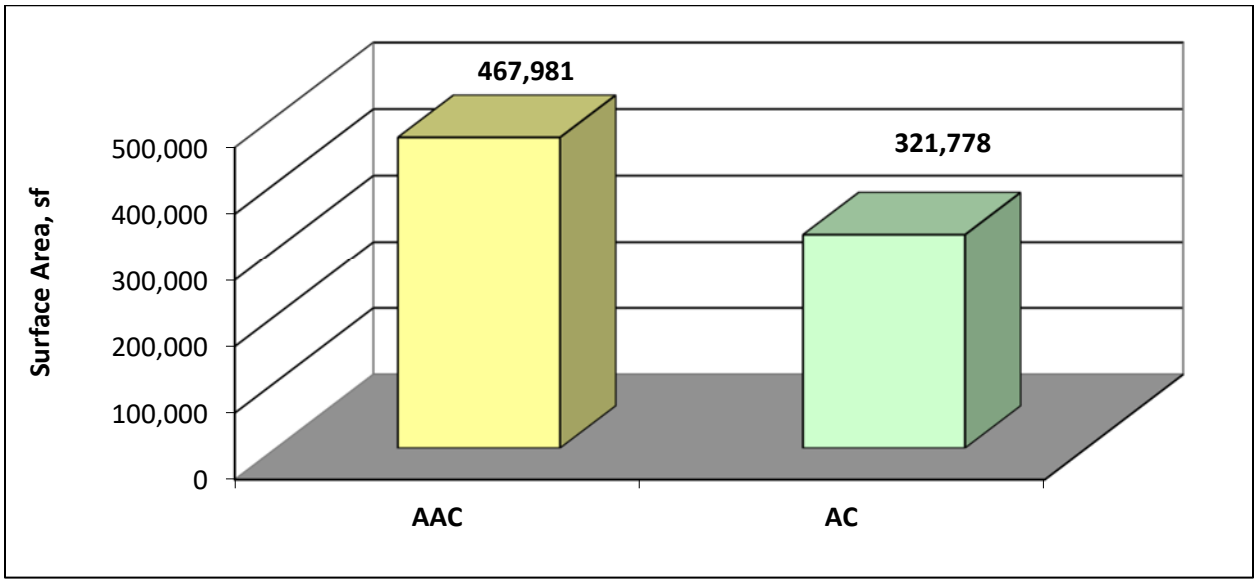
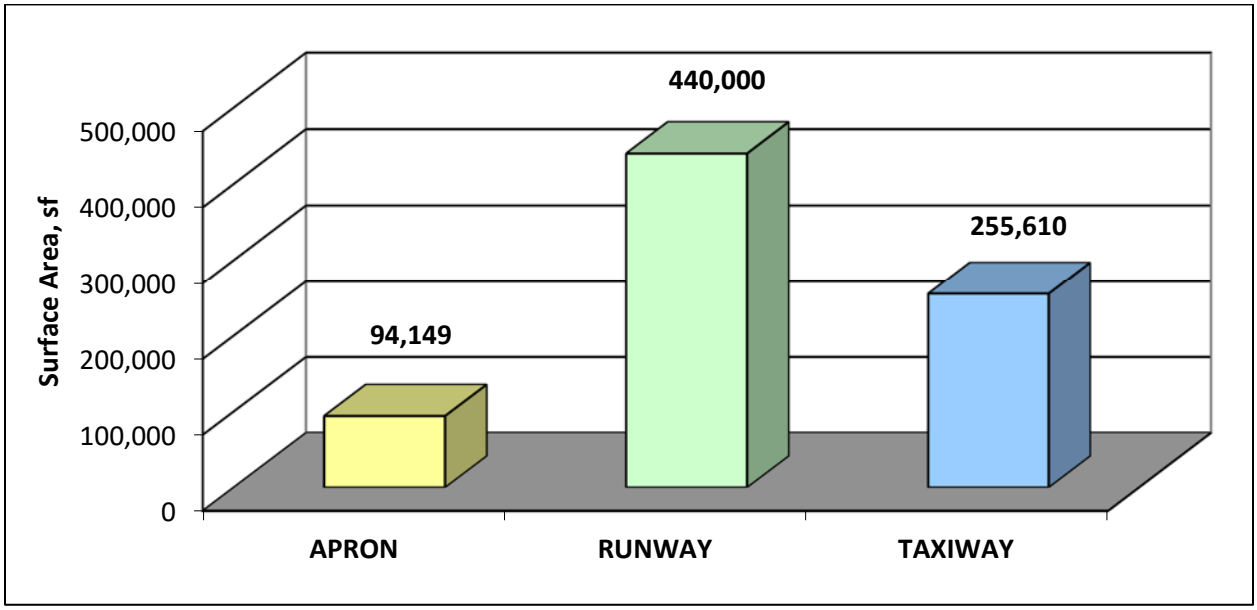


Figure 2.3: PRN Pavement Area by Branch Use.



Maps B1D, B1E, and B1F show the pavement type, branch use, and pavement age, respectively.

3 Pavement Condition

3.1. Introduction

A visual PCI survey of the airside pavements at PRN was conducted in order to assist in the development of a realistic PCIP. The PCI survey measures and records pavement distresses that exist within each of the inspected sample units. This survey was conducted in November 2019 by a 2-person team. The survey was performed in accordance with the methods described in ASTM D 5340-12 and FAA AC 150/5380-7B, using the sampling rates from Chapter 2 of this API report.

During the pavement survey, Quality Control (QC) and data verification were performed on both the individual distresses and the calculated section PCI values. QC included the following activities;

- Review of distress quantities to identify data entry errors (100% review at the sample unit level). General guidance was used from ASTM D5340-12, section 13, which addresses the precision of distress quantities that are recorded during PCI surveys.
- Duplicate surveys were performed to ensure consistency between each of the inspectors in a 2-person PCI survey team.

3.2. Pavement Condition Rating Methodology

The PCI is a measure of the pavement's functional surface condition. It provides insight into the causes of each distress, and whether the distress is primarily caused by load, climatic conditions, and other material related deficiencies. The PCI is a numerical rating (on a scale of 0 to 100) that is based on the type, severity and quantity of each distress that is found in an inspected sample unit.

The PCI survey results are displayed using seven categories and ratings in accordance with the ASTM, but can also be presented using a simplified 3-category rating system for use in comparing with other distress related indices, as shown in Table 3.1.

Table 3.1: Pavement Condition Index Rating Scale.

	Simplified PCI Color Legend	ASTM PCI Color Legend	PCI Range	PCI Ratings and Definition
GOOD			86-100	GOOD: Pavement has minor or no distresses and should require only routine maintenance.
			71-85	SATISFACTORY: Pavement has scattered low-severity distresses that should require only routine maintenance.
FAIR			56-70	FAIR: Pavement has a combination of generally low- and medium-severity distresses. Near-term maintenance and repair needs may range from routine to major.
POOR			41-55	POOR: Pavement has low-, medium-, and high-severity distresses that probably cause some operational problems. Near-term M&R needs range from routine to major. requirement for
			26-40	VERY POOR: Pavement has predominantly medium- and high-severity distresses that cause considerable maintenance & operational problems. Near-term M&R needs will be major.
			11-25	SERIOUS: Pavement has mainly high-severity distresses that cause operational restrictions; immediate repairs are needed.
			0-10	FAILED: Pavement deterioration has progressed to the point that safe aircraft operations are no longer possible; complete reconstruction is required.

3.3. Distress Types

The ASTM D5340 standard considers 17 distresses, which tend to fall into one of the following four cause categories:

- Load related: AC distresses include alligator cracking, corrugation, depression, polished aggregate, rutting and slippage cracking; PCC distresses include corner breaks, longitudinal cracking, divided slabs, polished aggregate, pumping and joint spalling.
- Climate and durability related: AC distresses include bleeding, block cracking, joint reflection cracking, longitudinal and transverse (L&T) cracking, swelling, raveling, and weathering; PCC distresses include blow-ups, “D” cracking, longitudinal cracking, pop-outs, pumping, scaling, shrinkage cracks, and joint and corner spalling.
- Moisture & Drainage related: AC distresses include alligator cracking, depressions, potholes and swelling; PCC distresses include corner breaks, divided slabs and pumping.
- Other factors: Oil spillage, jet blast erosion, bleeding, patching and concrete slab joint faulting.

As described above, distress may have more than one cause. For example, depressions may be caused by incorrect compaction during construction, or by subgrade softening due to environmental factors. In addition, a distress may be initiated by one cause but may progress to a distress of higher severity by another cause. Therefore, engineering judgment is critical in analyzing the actual causes of the distress.

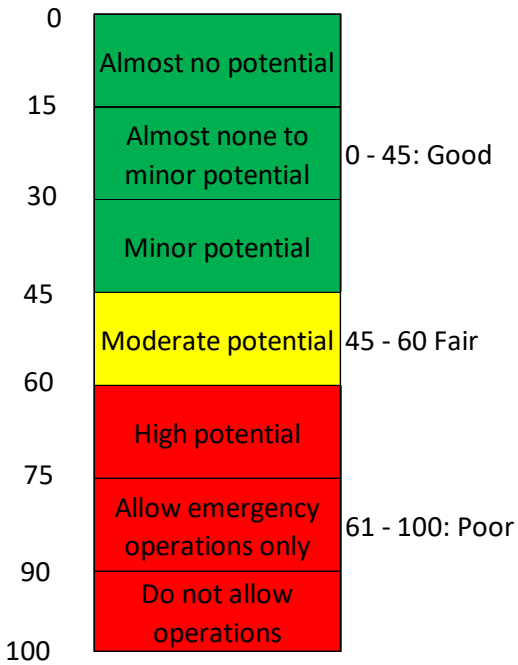
Distress descriptions provided in Appendix C were taken from the "PCI Field Manual," developed by the U.S. Army Construction Engineering Research Lab (CERL), latest edition. Appendix C provides a detailed explanation of each type of AC and PCC surface distress.

3.4. Additional PCI-based Indices

The distress data used to compute PCI can also be used to calculate additional indices that are helpful in understanding the condition of the pavement and developing PCIP recommendations. One additional index that was computed is the Foreign Object Damage (FOD) potential index.

The FOD index was developed by the US Air Force and is described in detail in the US Army Corp of Engineers Engineering Technical Letter (ETL) 04-09, Pavement Engineering Assessment (EA) Standards. Loose objects on an airfield pavement surface resulting from pavement distresses can be detrimental to aircraft engines, specifically engines that are low to the ground. The objects are ingested into the engines causing costly damage and presenting a safety hazard. Not all pavement distresses create a FOD potential. Therefore, an additional index was identified that uses the results of the PCI distress survey. As shown in Figure 3.1, the scale ranges from 0 to 100 with 0 being no FOD potential. Note that the FOD index uses a simplified three color scale.

Figure 3.1: FOD Potential Rating Scale.



3.5. PCI Survey Results

The airside pavements at PRN include 12 sections with 146 sample units. The sample number of sample units that were surveyed in the field is 45, which is 31 percent of the total samples. Data from the inspected sample units were input into the PAVER database and a resultant PCI for each section was computed.

Figure 3.2 presents the area-weighted PCI by use and the overall airside network.

Figure 3.2: Pavement Condition by Branch Use.

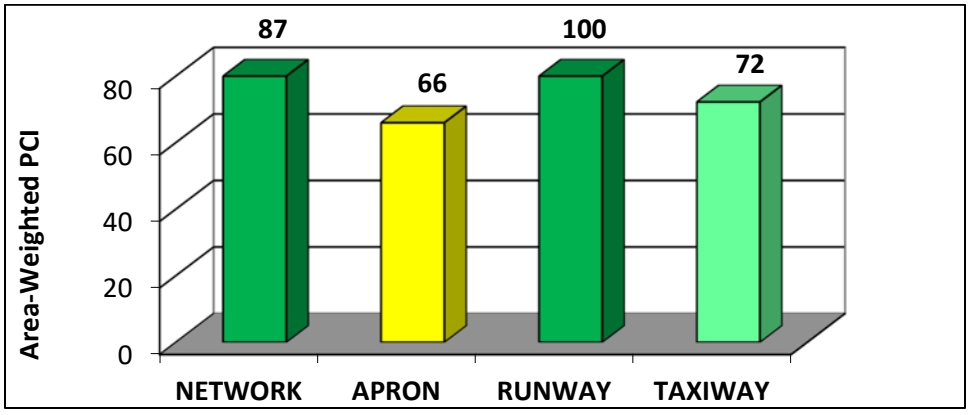


Figure 3.3 shows the distribution of the PRN pavement network by condition. None of the network is in "Poor" or worse condition.

Figure 3.3: Pavement Condition by Percent of Area.

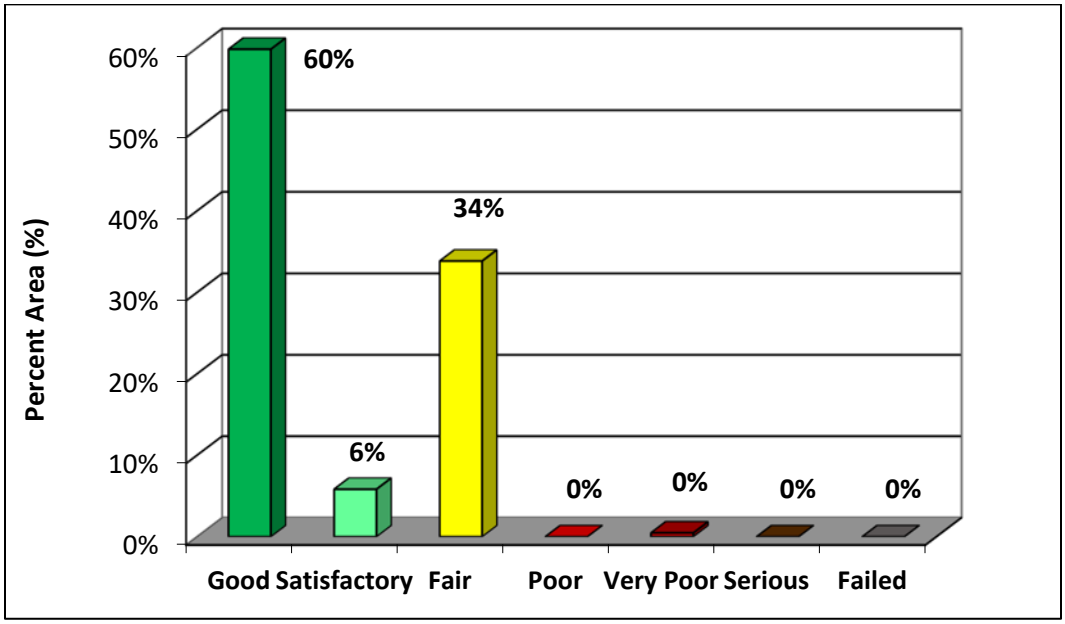


Table 3.2 is a listing of the section PCI.

Table 3.2: Section PCI.

Branch ID	Name	Section ID	Surface	Area, sf	PCI	PCI Category	FOD
A01	Apron 01	01	AC	94,149	66	Fair	44
R1432	Runway 14-32	01	AAC	416,000	100	Good	0
R1432	Runway 14-32	02	AAC	24,000	98	Good	11
TA	Taxiway A	01	AAC	13,098	98	Good	11
TA	Taxiway A	02	AC	46,105	80	Satisfactory	32
TA	Taxiway A	03	AC	147,597	66	Fair	46
TA	Taxiway A	04	AC	4,485	100	Good	0
TA1	Taxiway A1	01	AC	7,734	56	Fair	59
TA1	Taxiway A1	02	AAC	7,480	99	Good	10
TB	Taxiway B	01	AC	3,752	37	Very Poor	63
TB	Taxiway B	02	AAC	7,403	99	Good	10
THANG01	Taxiway Hangar 01	01	AC	17,956	70	Fair	43

Figure B2A and B2B in Appendix B are maps of the section PCI in 7- and 3-scale categories, respectively. Figures B2C is a map of the FOD rating. Appendix D contains a detailed report of the PCI values and distress type, quantity, and severity data for each sample unit that was surveyed in a section. Appendix E is a summary report of the extrapolated distress data at the section level.

Appendix F contains current section and branch PCI data and forecasted section PCI values. FOD values by section and branch are also presented. Figure B2D in Appendix B shows the locations of the photos that were taken during the survey. Photos are included in Appendix J.

3.6. PCC Pavements

As stated earlier, the project scope did not include a detailed pavement condition survey for any Portland Cement Concrete (PCC) aprons. For these pavements, a rating of “Good”, “Fair”, or “Poor” was assigned based on the overall pavement condition. There are no PCC aprons at PRN.

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4 Pavement Capital Improvement Program

4.1. Introduction

PCI data were collected and entered into the PAVER database. In addition, the database customization included the following components, which are described in detail in this chapter.

1. Performance Modeling
2. Maintenance & Repair (M&R) Triggers (Critical PCI)
3. M&R Policies
4. Unit Costs

Once the database was customized, it was used to run budget analysis scenarios and develop a 7-year PCIP.

4.2. Performance Modeling

To determine long-term M&R needs, a APMP must be able to predict future pavement condition. Future pavement condition is predicted using equation models that are generated from current and historical PCI data. Equation models are developed by grouping pavements based on similar performance characteristics such as region, construction history, surface type, traffic, priority and use. Mathematical techniques such as straight-line extrapolation and regression that include boundary and outlier filters are used to develop models that provide the best fit equation for the pavement condition data. PAVER's Prediction Modeling module was used to develop pavement performance models that are commonly referred to as 'Family Curves'.

Prediction models are used at the section level to compute future conditions based on the typical performance of the pavement sections that are included in each model. Future condition is computed by defining its position relative to the prediction model. The section prediction curve, or equation, is drawn through the current PCI-age point for each specific section. Since the shifted curve will run parallel to the computed prediction model, the predicted condition can be computed for any future age. Figure 4.1 is an illustration of this process.

Prediction models provide an effective way to compute future pavement performance based on past and current conditions, and pavement maintenance and rehabilitation practices. As new PCI inspection surveys are conducted, these models should be updated accordingly. In the case of the Alabama statewide airport pavement network, the best fit family curves were developed for each region by grouping pavements according to branch use (e.g. runway, taxiway) and surface type (e.g. AC, AAC, and APC). The family curves for ALDOT were developed based on branch use and are presented in Figure 4.2.

Figure 4.1: PCI Forecasting.

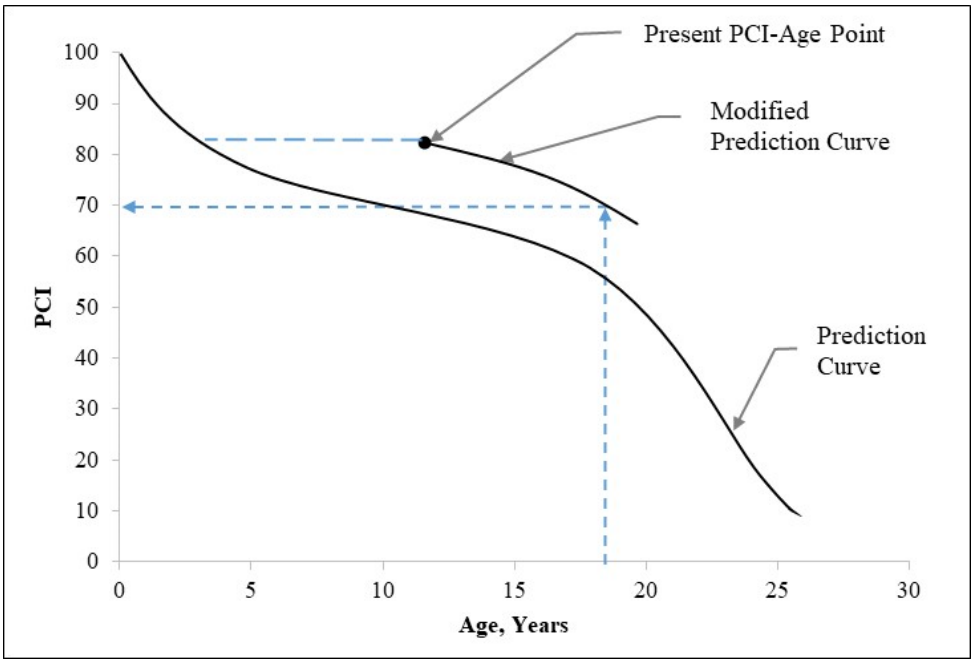
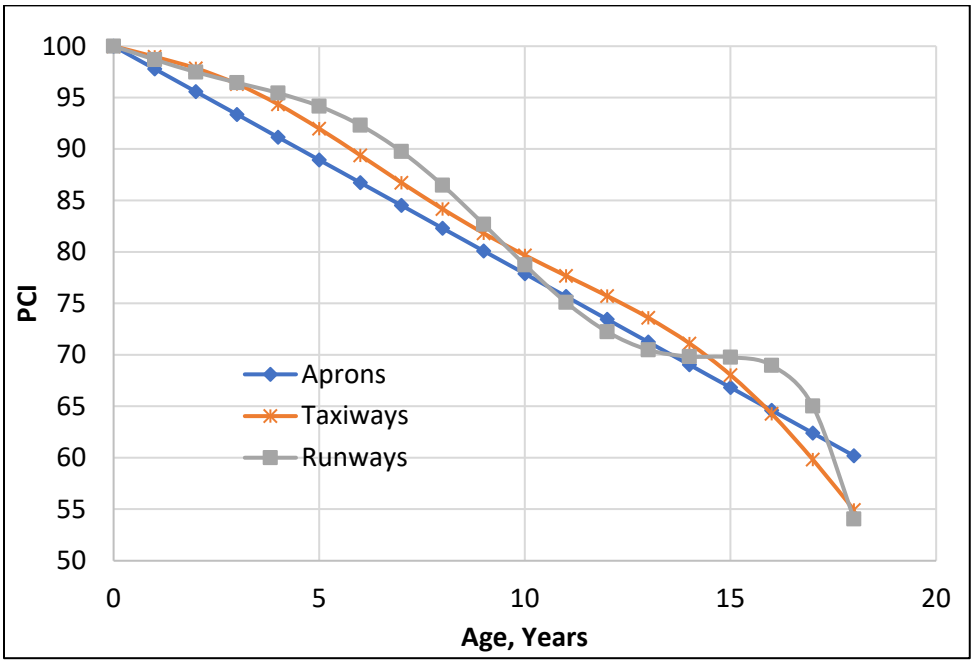


Figure 4.2: Family Curves.



4.3. Critical PCI Values

The Critical PCI value is defined as "*the PCI value at which the rate of PCI loss increases with time, or the cost of applying localized preventive maintenance increases significantly*." This definition is incorporated into PAVER in defining and measuring the critical PCI values. These values, or M&R triggers, are assigned for each prediction model. As such, the critical PCI values are directly related to the branch use.

These critical PCI levels are selected based on several factors including a review of performance models; experience; other airport triggers; and acknowledge that time is required for funding approval and design. Note that preventive maintenance is recommended, and it should generally be performed above the critical PCI (trigger) values and Major M&R is generally performed below them. The critical PCI (CP) values were set at 70 for runways and taxiways, and 65 for other pavements.

4.4. M&R Policies and Unit Costs

M&R policies refer to the activities that are applied at different condition levels to maintain and repair a pavement section.

Maintenance activities are localized activities which are typically assigned in the first year of the M&R plan based on the observed distresses. Safety (stopgap) maintenance addresses distresses that would affect operational safety if left unrepaired and is applied to pavements below the critical PCI. Preventive maintenance activities are aimed at slowing the rate of deterioration through consistent maintenance of existing pavements and are generally applied to pavements above the critical PCI. Appendix G presents the policies for preventive and safety maintenance.

Repair activities are conducted for larger areas, typically at the section level and are assigned based on the critical PCI. Repair activities broadly consist of three categories: preservation, rehabilitation, and reconstruction. Pavement preservation involves activities like surface treatments that are used to extend pavement service life and to delay more expensive rehabilitation work. These are applied when the pavement is in relatively good condition and does not exhibit any structural distress. Rehabilitation activities are used to repair pavements below or around the critical PCI and typically include mill and overlay. Reconstruction is recommended when the pavement has deteriorated to a level where rehabilitation is no longer cost effective.

Table 4.1 lists the pavement activity types, the individual activities within each type, and their associated 2020 unit costs. A more detailed description of the M&R activities and the development of the M&R unit costs is presented in Appendix H.

In accordance with ALDOT's focus on preservation, surface treatment is applied to all resurfaced and reconstructed runways, taxiways, and aprons three years after construction work is complete. Taxilanes and T-Hangar pavements are excluded from this requirement. This policy is applicable for projects in the PCIP between 2021 and 2024. For cost estimating, this surface treatment is assumed to have the same cost as the runway surface treatment.

Table 4.1: M&R Activities and Unit Costs.

Activity Type	PCI	Activity	Cost/sf
Maintenance	Note 1	Seal Cracks – AC ($/lf)	$3.95
		AC Full-Depth Patching	$25.05
		AC Partial-Depth Patching	$16.28
Preservation	75-90	Runway Surface Treatment	$0.57
		Taxiway and Apron Surface Treatment	$0.85
Rehabilitation	> CP	2" AC OL[2]	$3.54
	55 - CP	Mill 2" & 2" AC OL	$3.90
	45 - 55	Mill 2" & 2" AC OLP (With Pre-Overlay Repairs)	$4.82
Reconstruction	0 - 45	AC Reconstruction	$8.25

[1] Preventive > CP; Safety (Stopgap) < CP

[2] For sections with structural distress and PCI > CP

4.5. Pavement CIP Development

The PAVER database, updated with condition data and customized with condition performance priorities, policies, and costs; was used to evaluate the effect of multiple funding levels on the overall future pavement condition. This output was further used to develop the PCIP. Figure 4.3 illustrates the process that PAVER uses in the funding analysis.

The following M&R funding levels were used for the PRN pavement network to help establish the 7-Year PCIP. Figure 4.4 presents the network area-weighted average PCI for each of the following funding scenarios at the end of the analysis period:

- Unlimited Funding: Unlimited funding is available for all pavement needs. The PCI increases to 90 by 2027.
- Maintain PCI: Maintain existing PCI of 87.
- Constrained Funding: This scenario constrains the funding to $1 million each year (total of $7 million). The PCI increases to 90 in 2027.
- Do Nothing: Performing no M&R would reduce the network PCI from 87 to 70 by 2027.

Figure 4.3: Budget Analysis Process.

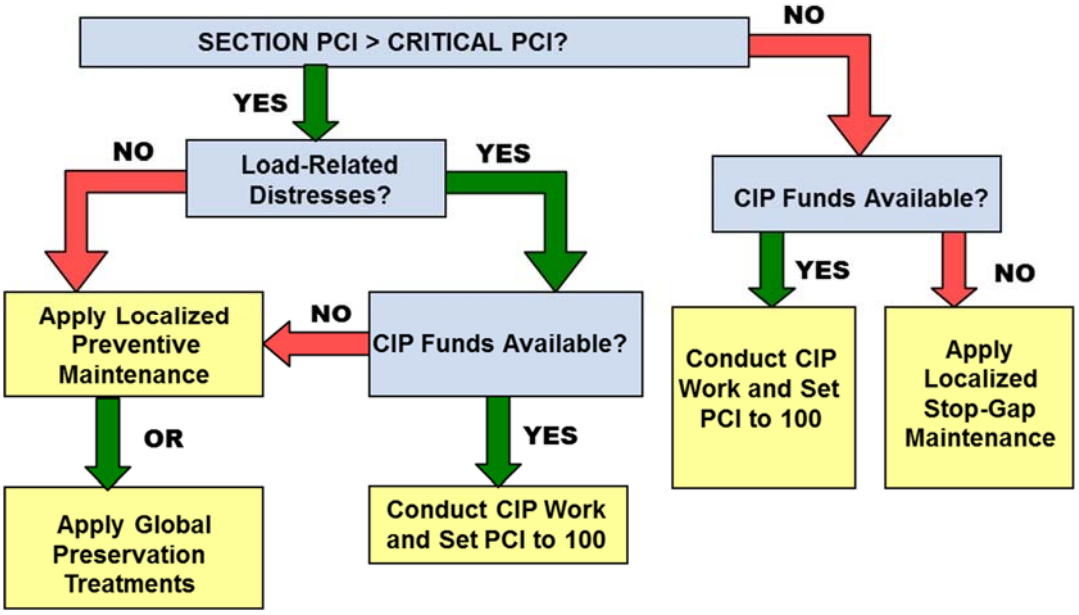


Figure 4.4: M&R Funding Levels.

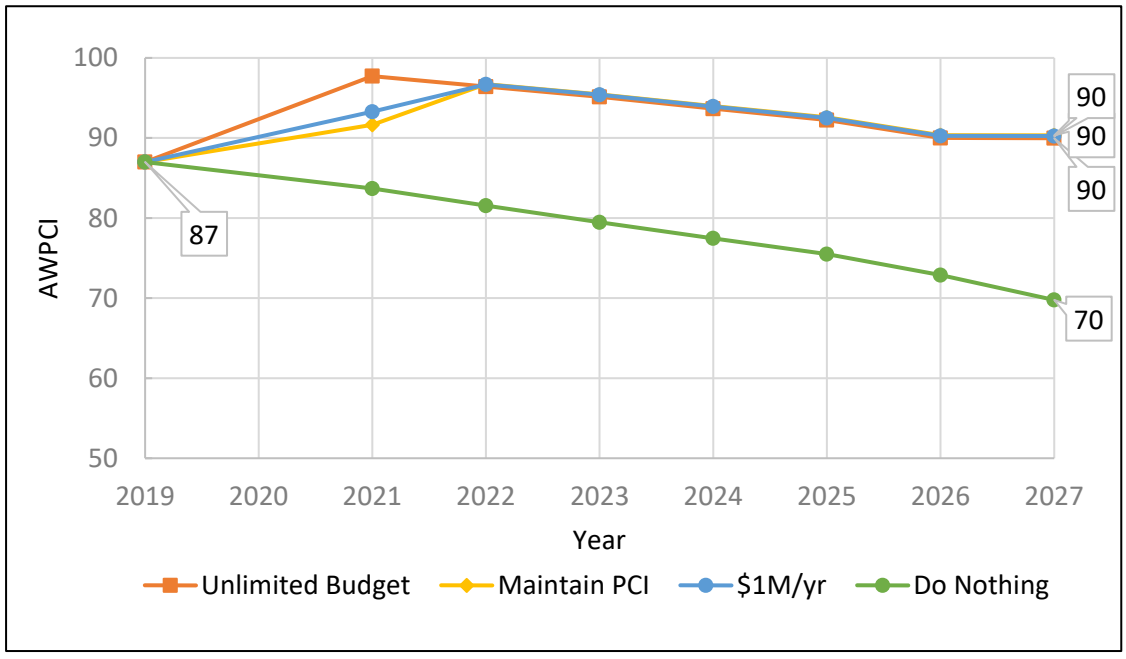


Table 4.2 summarizes the annual funding required for the above analyses. For the unlimited analysis, all pavement needs are funded in the year they are required. Therefore, the unfunded costs are zero. The total funded amount over the 7-year period is approximately $1.5 million. For the annual funding level of $1 million per year, funding is prioritized based on the prioritization matrix. When the needs exceed the funding for any year, the remaining sections are transferred to the succeeding year and the amount

for these activities are represented as “unfunded”. There are no “unfunded” repairs in 2027 for this funding level.

Table 4.2: Summary of M&R Funding Level Analyses.

Year	Unlimited	Maintain PCI	Constrained $1M/year	Do Nothing
2021	$1,134,000	$628,000	$769,000	$0
2022	$3,000	$535,000	$381,000	$0
2023	$4,000	$4,000	$4,000	$0
2024	$6,000	$5,000	$5,000	$0
2025	$50,000	$49,000	$49,000	$0
2026	$9,000	$9,000	$9,000	$0
2027	$295,000	$295,000	$295,000	$0
Total	**$1,501,000**	**$1,526,000**	**$1,512,000**	**$0**
2027 Backlog	**-**	**-**	**-**	**$2,886,000**

Map B3A in Appendix B presents the 2027 forecasted PCI by section when the M&R activities recommended in the CIP are not conducted.

4.6. Pavement Capital Improvement Program

The unlimited funding analysis contains rehabilitation activities for sections from the same branch spread out over the seven-year period, which is not always operationally feasible to construct. The analysis output was treated as a starting point in developing the CIP. Sections were often integrated together to account for construction feasibility and other factors, resulting in larger projects which were more realistic. In addition, each project could contain sections whose condition did not trigger rehabilitation but were included to provide a logical plan which would avoid creating “islands” of newer pavement within a particular feature. For example, if the PAVER analysis showed rehabilitation was required for eight out of 10 sections on a runway, the entire runway would be recommended for rehabilitation to provide a continuous new pavement surface.

Table 4.3 shows the projects and the associated costs for the recommended 7-year PCIP. Table 4.4 is a more detailed view of the PCIP. This table lists the individual pavement section, section level M&R work, section repair cost, surface area and the PCI before the M&R is applied. The costs that are presented represent an annual escalation rate of 3% for the unit costs. The total 7-year PCIP cost is approximately $1.7 million. Map B3B shows the recommended repair types, while Map B3C presents the recommended projects and activities in the PCIP. Appendix I1 presents a summary of the recommended activities and cost by year for each section at PRN.

Table 4.3: Summary of 7-Year PCIP by Project.

Project Year	CIP Project	Total Project Cost	Total Project Area, sf	AWPCI Before	AWPCI After
2021	PRN_21-01_Taxiway A Preservation	$40,415	46,105	77	83
	PRN_21-02_Taxiway A Rehabilitation	$663,859	159,083	58	100
2022	PRN_22-01_Apron and T-Hangar Rehabilitation	$464,358	112,105	60	100
2024	PRN_24-01_Taxiway A Surface Treatment	$101,245	159,083	96	99
2025	PRN_25-01_Apron Surface Treatment	$61,717	94,149	93	98
2027	PRN_27-01_Runway 14-32 Preservation	$339,978	472,466	87	93
	Total	**$1,671,572**			

Table 4.4: Summary of 7-Year PCIP by Project and Section.

Branch	Section	Area, sf	PCI Before Rehab	Activity	Activity Type	Cost
PRN_21-01_Taxiway A Preservation						**$40,415**
TA	02	46,105	78	Taxiway & Apron Surface Treatment	Preservation	$40,415
PRN_21-02_Taxiway A Rehabilitation						**$663,859**
TA	03	147,597	61	Mill 2" & 2" AC OL	Rehabilitation	$593,565
TA1	01	7,734	50	Mill 2" & 2" AC OLP	Rehabilitation	$38,397
TB	01	3,752	33	AC Reconstruction	Reconstruction	$31,897
PRN_22-01_Apron and T-Hanger Rehabilitation						**$464,358**
A01	01	94,149	61	Mill 2" & 2" AC OL	Rehabilitation	$389,981
THANG01	01	17,956	62	Mill 2" & 2" AC OL	Rehabilitation	$74,377
PRN_24-01_Taxiway A Surface Treatment						**$101,245**
TA	03	147,597	-	Surface Treatment	Preservation	$93,935
TA1	01	7,734	-	Surface Treatment	Preservation	$4,922
TB	01	3,752	-	Surface Treatment	Preservation	$2,388
PRN_25-01_Apron Surface Treatment						**$61,717**
A01	01	94,149	-	Surface Treatment	Preservation	$61,717
PRN_27-01_Runway 14-32 Preservation						**$339,978**
R1432	01	416,000	89	Runway Surface Treatment	Preservation	$289,305
R1432	02	24,000	84	Runway Surface Treatment	Preservation	$16,691
TA	01	13,098	82	Taxiway & Apron Surface Treatment	Preservation	$13,709
TA	04	4,485	86	Taxiway & Apron Surface Treatment	Preservation	$4,694
TA1	02	7,480	84	Taxiway & Apron Surface Treatment	Preservation	$7,829
TB	02	7,403	84	Taxiway & Apron Surface Treatment	Preservation	$7,749
					Total	**$1,671,572**

The FAA, under the Airport Improvement Program (AIP) provides approximately 90 percent of eligible costs for planning and development of public-use airports included in the NPIAS as grants. The remaining 10 percent of costs are shared between ALDOT and the airport sponsor. The following is the distribution of the 7-yr PCIP cost of $1.7 million for PRN:

- FAA (90%): $1.5 million
- ALDOT (5%): $0.1 million
- Airport Sponsor (5%): $0.1 million

The recommendations within the PCIP are based on a network-level study and should be used for planning purposes only. A detailed project-level assessment should be conducted for each project to determine the appropriate repair activities and develop more accurate cost estimates.

Table 4.5 summarizes the maintenance activities that are recommended for Year 1 (2021). The estimated cost is approximately $66,027. A complete listing of the maintenance activities by section is presented in Appendix I2. This may be used as a basis for establishing an annual maintenance budget for the PRN pavements.

Table 4.5: Summary of Year-1 Maintenance Plan.

Policy	Work Description	Work Quantity	Work Unit	Work Cost
Preventive	Crack Sealing - AC	3,053	Ft	$12,060
	Patching - AC Full-Depth	2,129	SqFt	$53,340
	Patching - AC Partial-Depth	39	SqFt	$627
			Total	**$66,027**

APPENDIX A

INVENTORY

Appendix A

Pavement Inventory Report

Mac Crenshaw Memorial Airport (PRN)

Branch ID	Name	Branch Use	Section ID	Rank[1]	Length (ft)	Width (ft)	Area (sf)	LCD[2]	Surface[3]
A01	Apron 01 Greenville	APRON	01	S	500	136	94,149	6/20/04	AC
R1432	Runway 14-32 Greenville	RUNWAY	01	P	5,200	80	416,000	6/1/18	AAC
R1432	Runway 14-32 Greenville	RUNWAY	02	P	300	80	24,000	6/1/18	AAC
TA	Taxiway A Greenville	TAXIWAY	01	P	169	75	13,098	6/1/18	AAC
TA	Taxiway A Greenville	TAXIWAY	02	P	1,257	35	46,105	1/1/12	AC
TA	Taxiway A Greenville	TAXIWAY	03	P	4,205	35	147,597	4/10/04	AC
TA	Taxiway A Greenville	TAXIWAY	04	P	76	56	4,485	11/3/19	AC
TA1	Taxiway A1 Greenville	TAXIWAY	01	S	148	35	7,734	1/21/02	AC
TA1	Taxiway A1 Greenville	TAXIWAY	02	S	111	35	7,480	6/1/18	AAC
TB	Taxiway B Greenville	TAXIWAY	01	S	69	47	3,752	9/20/96	AC
TB	Taxiway B Greenville	TAXIWAY	02	S	111	35	7,403	6/1/18	AAC
THANG01	Taxiway Hangar 01 Greenville	TAXIWAY	01	T	189	95	17,956	1/1/12	AC

[1] P = Primary pavement, S = Secondary pavement, T = Tertiary pavement

[2] LCD = Last construction date. The date of the last major pavement rehabilitation (e.g. AC overlay)

[3] AC = Asphalt Cement Concrete, AAC = Aphalt Overlay AC, PCC = Portland cement Concrete, APC = Asphalt Overlay PCC

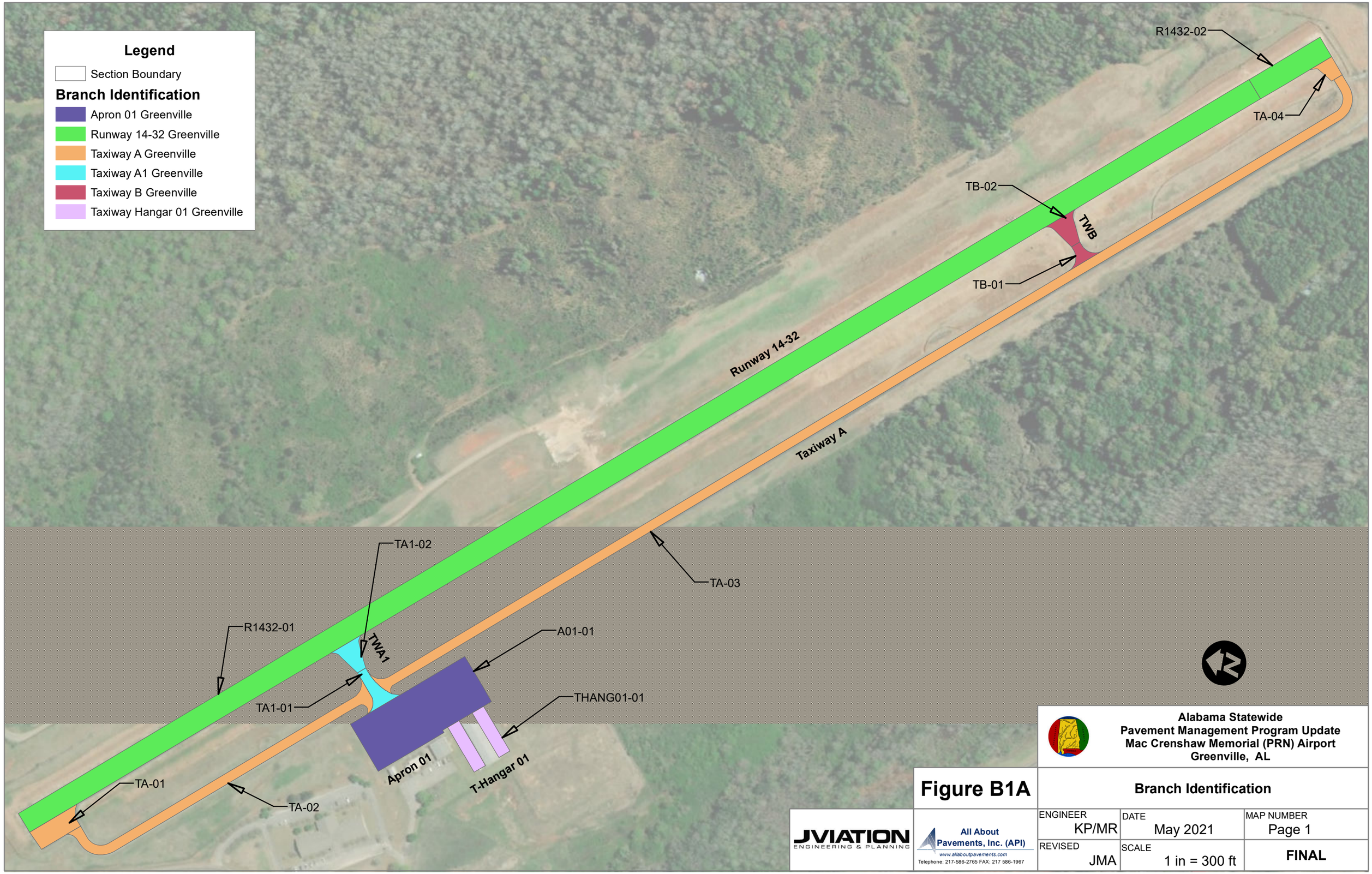
APPENDIX B

PMP Maps

B1: Inventory Maps
- B1A: Branch Identification
- B1B: Section Identification
- B1C: Sample Unit Layout
- B1D: Pavement Type
- B1E: Branch Use
- B1F: Pavement Age

B2: Surface Condition Maps
- B2A: 7-Color PCI
- B2B: 3-Color PCI
- B2C: FOD Rating
- B2D: Survey Photo Locations

B3: Pavement Capital Improvement Plan (PCIP) Maps
- B3A: 2027 Forecasted PCI without PCIP
- B3B: M&R Needs
- B3C: PCIP Recommendations



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Pavement Management Program Update
Mac Crenshaw Memorial (PRN) Airport
Greenville, AL

Figure B1A

Branch Identification

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ENGINEER	DATE	MAP NUMBER
KP/MR	May 2021	Page 1
REVISED	SCALE	
JMA	1 in = 300 ft	FINAL

Legend

Section Boundary

R1432-02

TA-04

TB-02

TWB

TB-01

Runway 14-32

Taxiway A

TA1-02

TA-03

R1432-01

TWA1

A01-01

TA1-01

THANG01-01

Apron 01

T-Hangar 01

TA-01

TA-02

N

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Figure B1B

Section Identification

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KP/MR	May 2021	Page 2
REVISED	SCALE	
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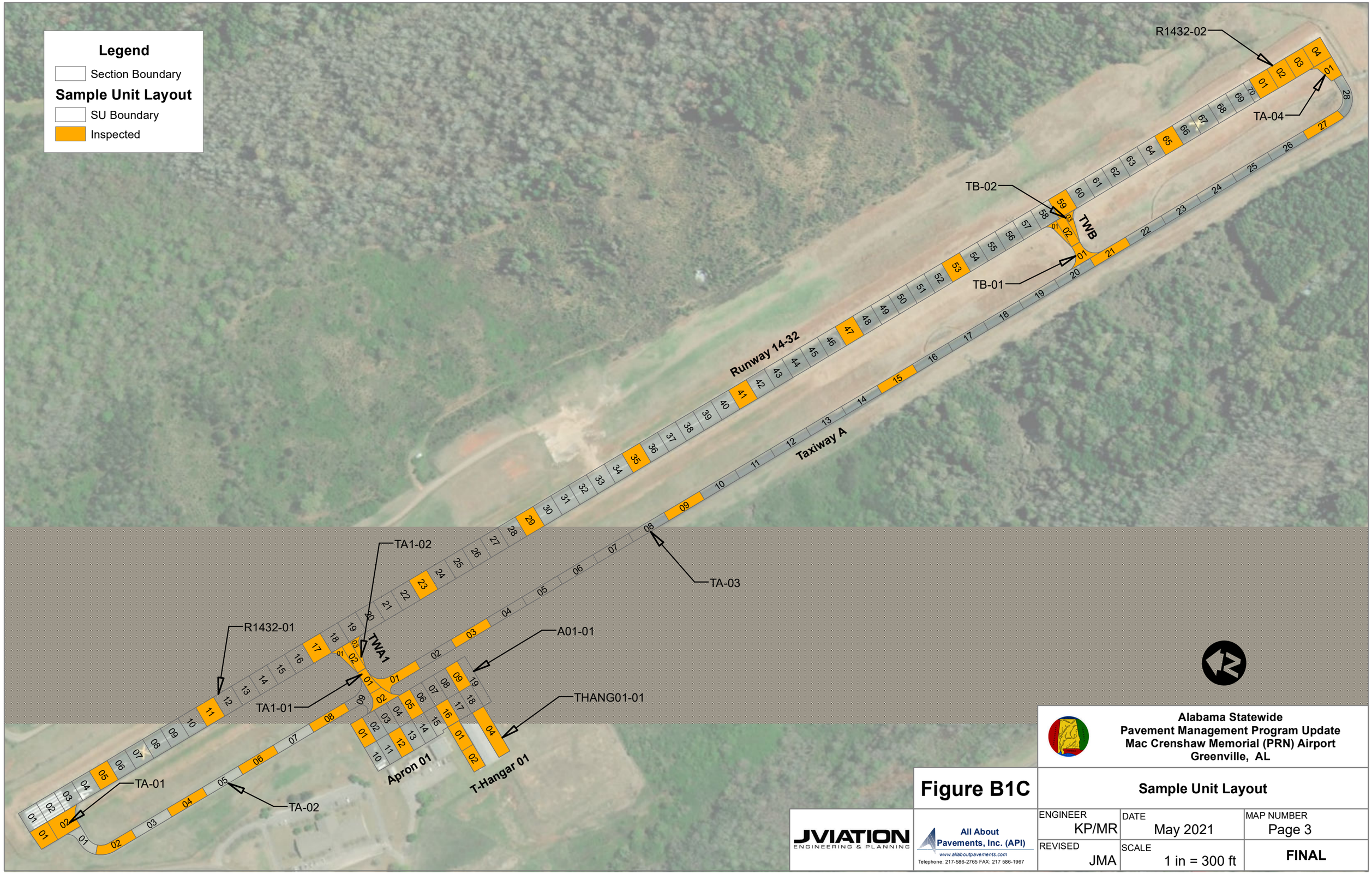

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Figure B1C

Sample Unit Layout

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KP/MR	May 2021	Page 3
REVISED	SCALE	
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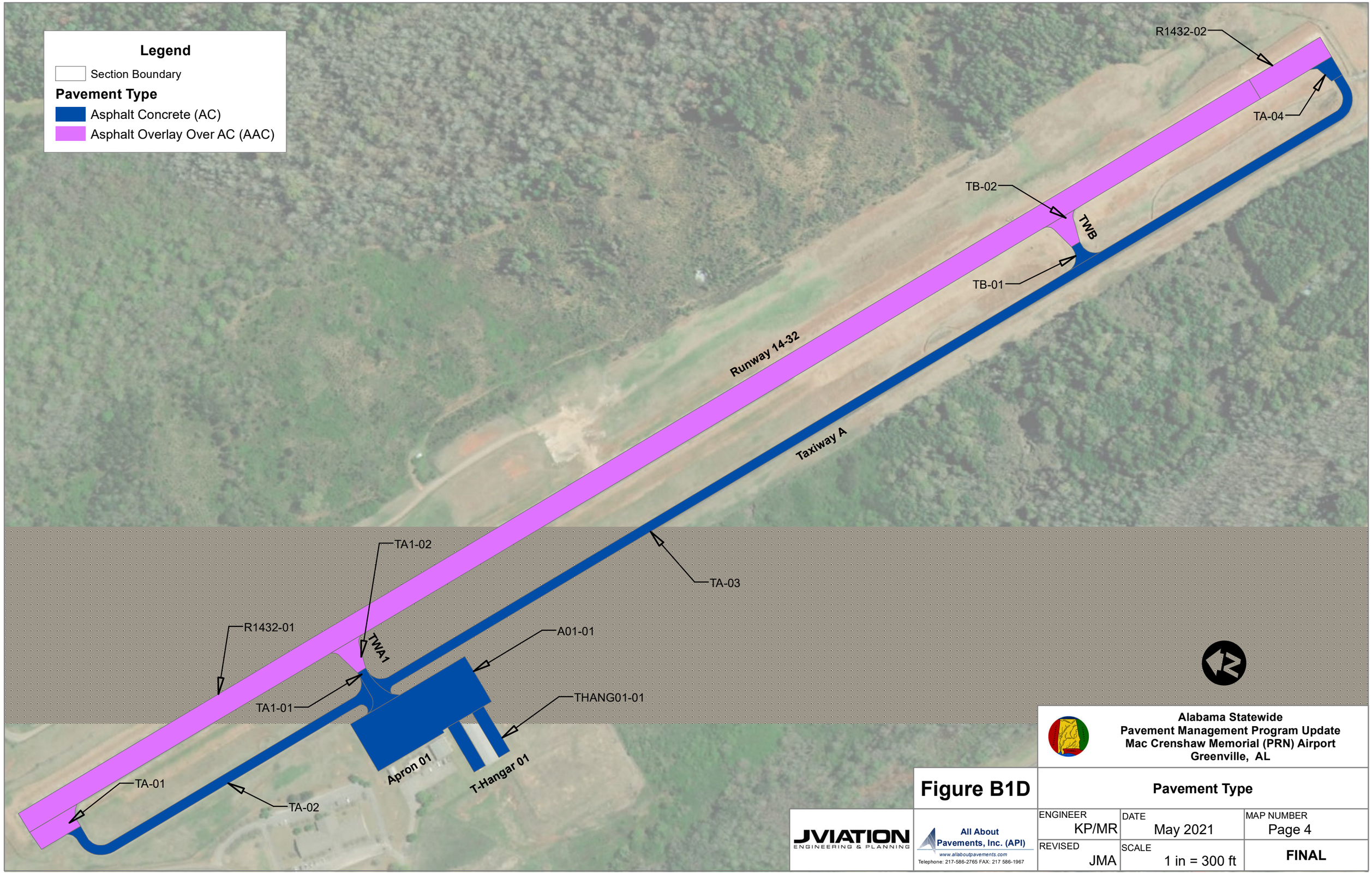

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Figure B1D

Pavement Type

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REVISED	SCALE	
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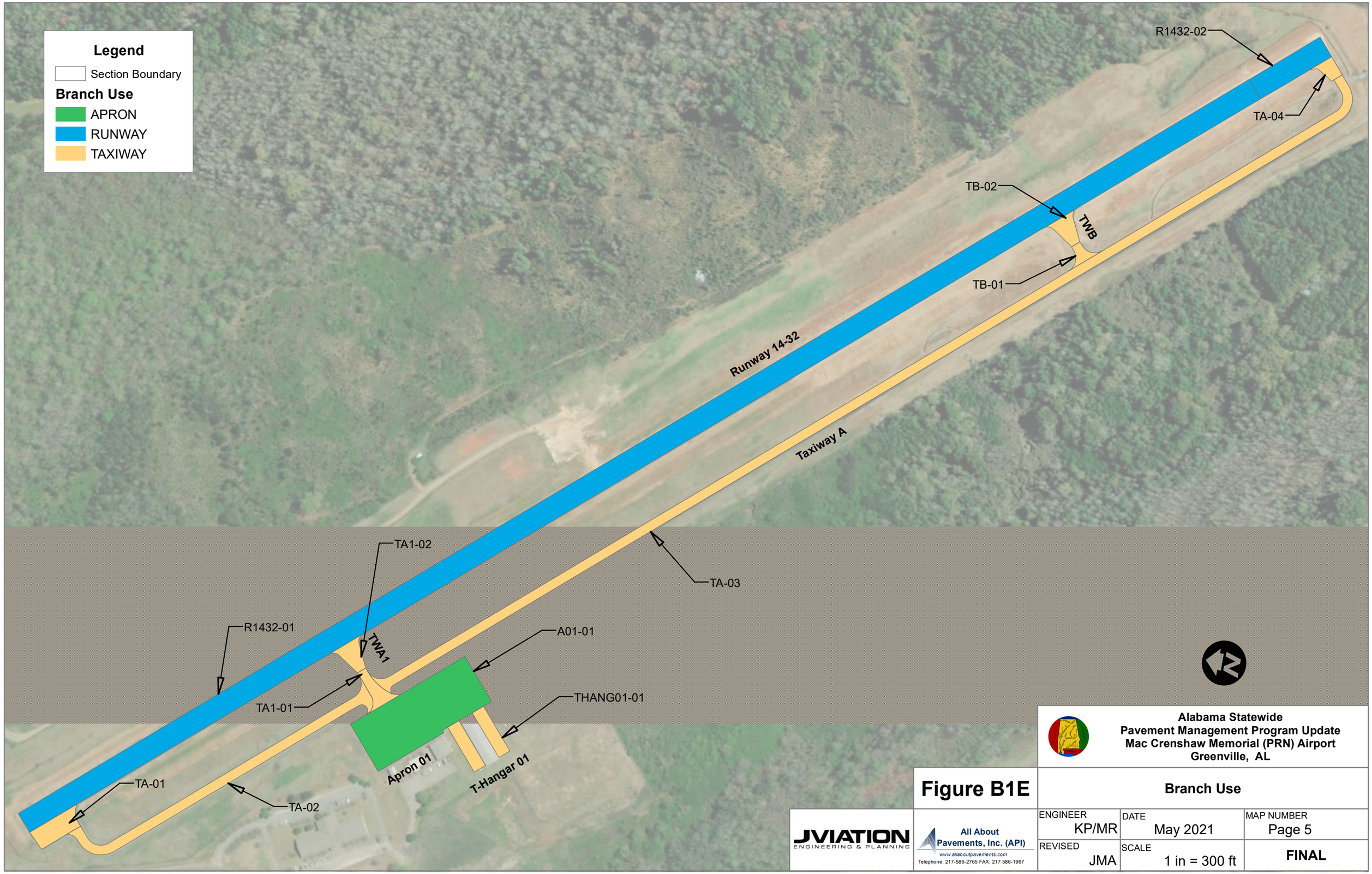

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Figure B1E

Branch Use

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REVISED	SCALE	
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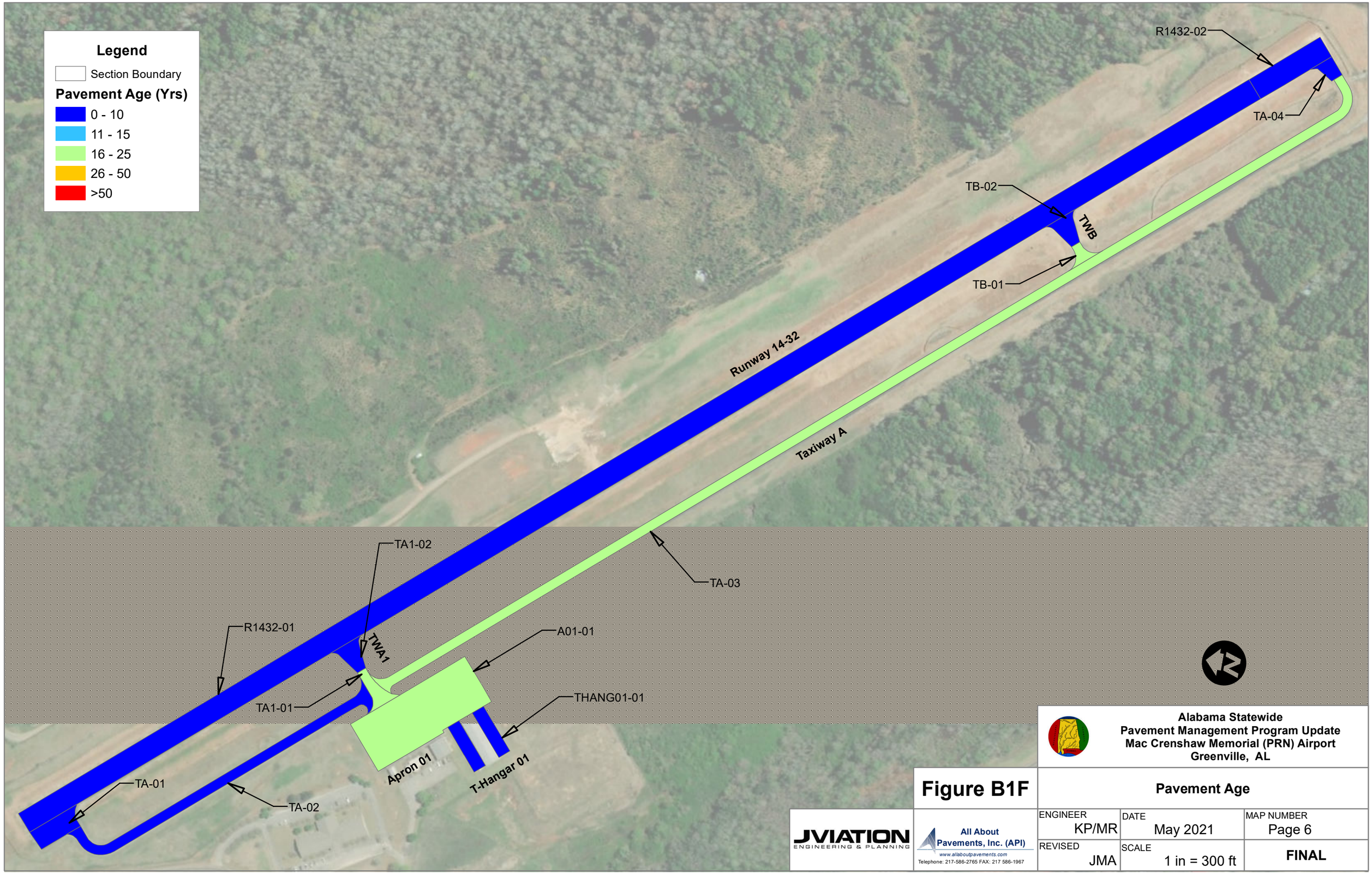

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Figure B1F

Pavement Age

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ENGINEER	DATE	MAP NUMBER
KP/MR	May 2021	Page 6
REVISED	SCALE	
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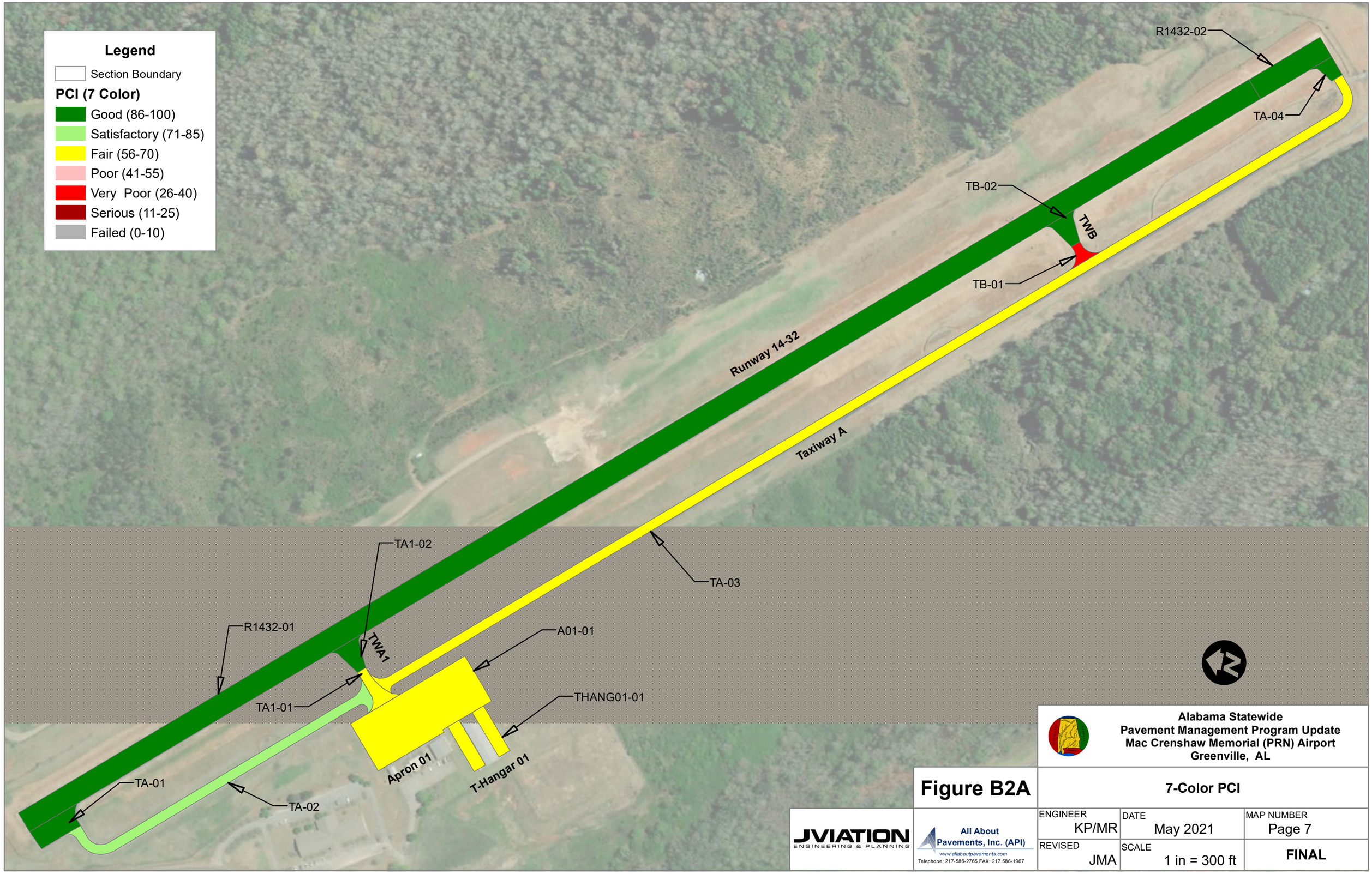

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Figure B2A

7-Color PCI

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KP/MR	May 2021	Page 7
REVISED	SCALE	
JMA	1 in = 300 ft	FINAL

Legend

Section Boundary

PCI (3 Color)

Good (71-100)

Fair (56-70)

Poor (0-55)

R1432-02

TA-04

TB-02

TWB

TB-01

Runway 14-32

Taxiway A

TA1-02

TA-03

R1432-01

TWA1

A01-01

TA1-01

THANG01-01

Apron 01

T-Hangar 01

TA-01

TA-02

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Figure B2B

3-Color PCI

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REVISED	SCALE	
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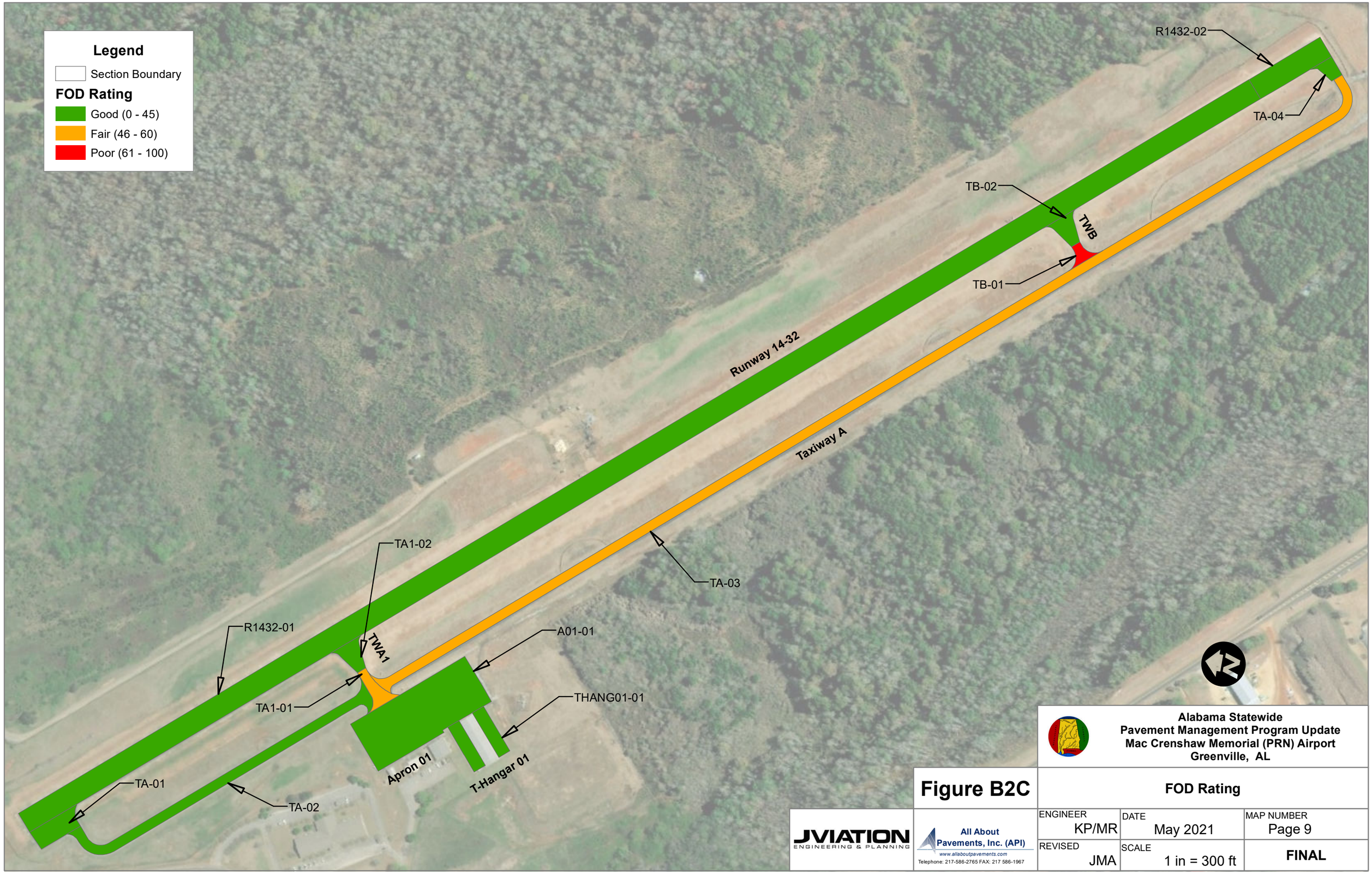

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Figure B2C

FOD Rating

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KP/MR	May 2021	Page 9
REVISED	SCALE	
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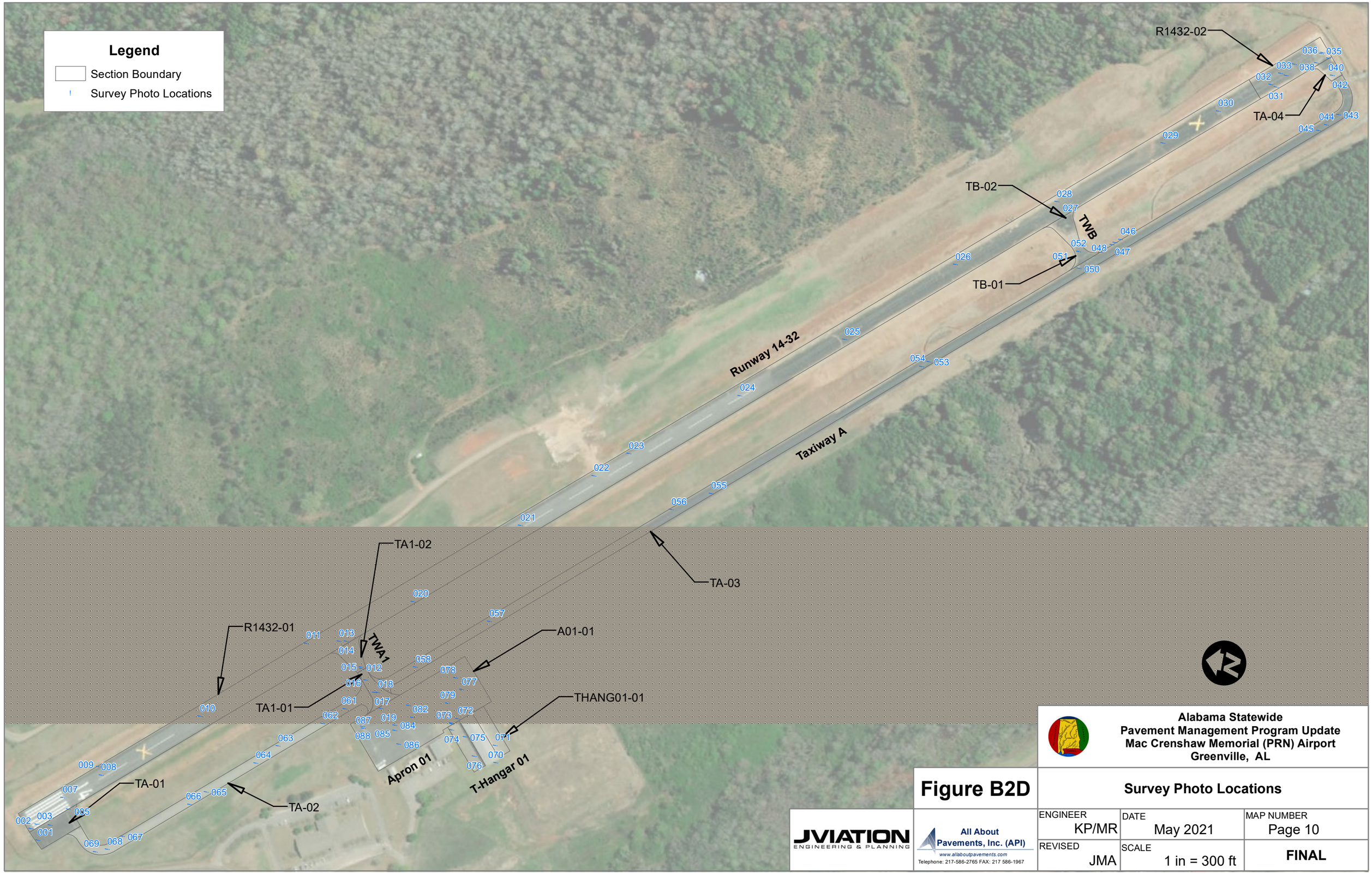

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Figure B2D

Survey Photo Locations

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KP/MR	May 2021	Page 10
REVISED	SCALE	
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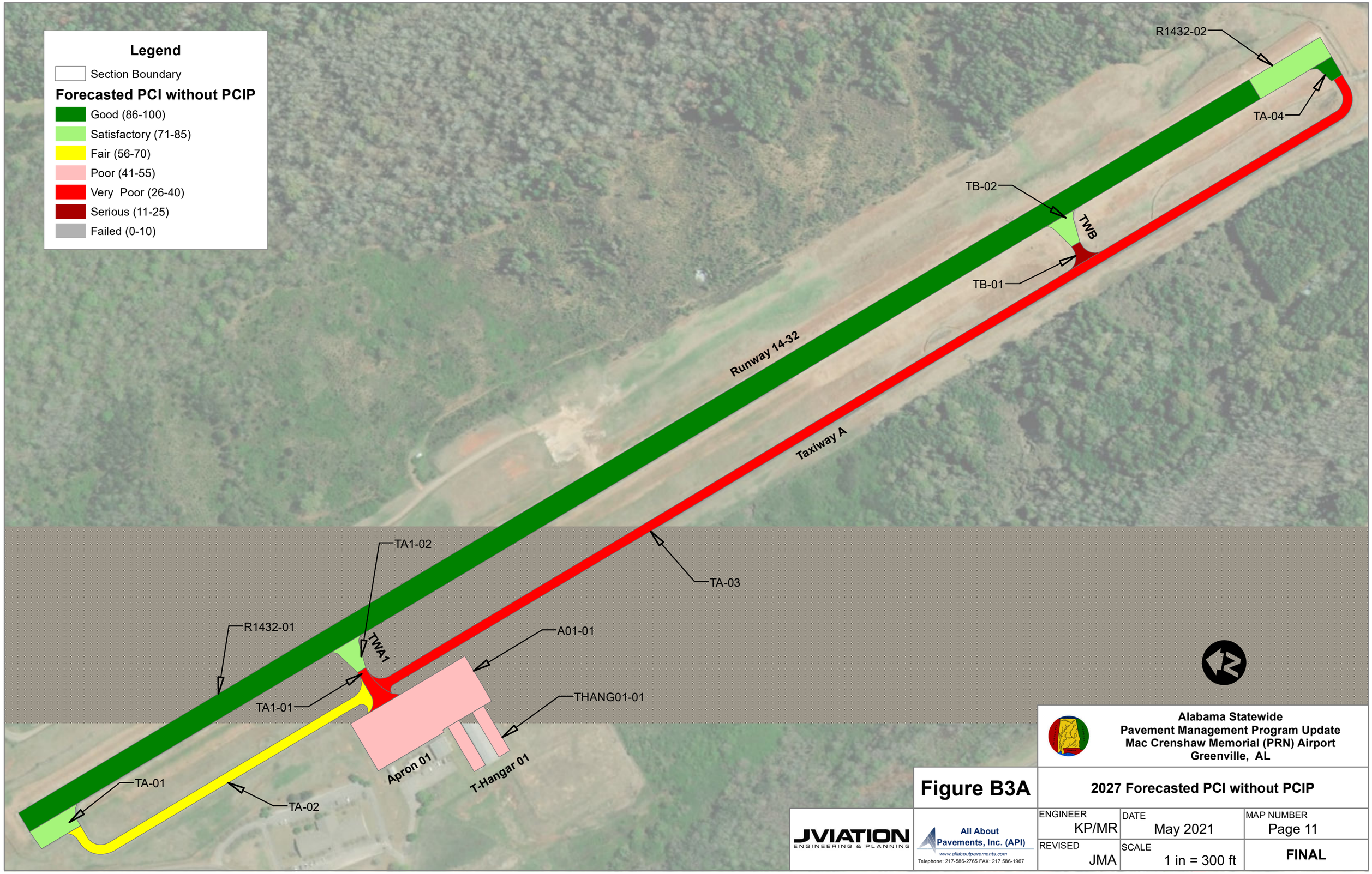

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Figure B3A

2027 Forecasted PCI without PCIP

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KP/MR	May 2021	Page 11
REVISED	SCALE	
JMA	1 in = 300 ft	FINAL

All sections recommended for Rehabilitation or Reconstruction between 2021 and 2024 also receive Surface Treatment in the 3rd year of paving.

Legend

Section Boundary

Repair Type

- Preservation
- Reconstruction
- Rehabilitation

R1432-02
TA-04
TB-02
TWB
TB-01
Runway 14-32
Taxiway A
TA1-02
TA-03
R1432-01
TWA1
A01-01
TA1-01
THANG01-01
Apron 01
T-Hangar 01
TA-01
TA-02

12

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Greenville, AL

Figure B3B

Repair Type

JVIATION
ENGINEERING & PLANNING

All About Pavements, Inc. (API)
www.allaboutpavements.com
Telephone: 217-586-2765 FAX: 217 586-1967

ENGINEER	DATE	MAP NUMBER
KP/MR	May 2021	Page 12
REVISED	SCALE	
JMA	1 in = 300 ft	FINAL

All sections recommended for Mill & AC Overlay or AC Reconstruction between 2021 and 2024 also receive Surface Treatment in the 3rd year of paving

Legend

Project Name

- PRN_21-01_Taxiway A Preservation
- PRN_21-02_Taxiway A Rehabilitation
- PRN_22-01_Apron and T-Hanger Rehabilitation
- PRN_27-01_Runway 14-32 Preservation

M&R Activity

- AC Reconstruction
- Mill 2" & 2" AC OL
- Mill 2" & 2" AC OLP
- Runway Surface Treatment
- Taxiway & Apron Surface Treatment

R1432-02
TA-04
TB-02
TWB
TB-01
Runway 14-32
Taxiway A
TA-03
TA1-02
R1432-01
TWA1
A01-01
TA1-01
THANG01-01
Apron 01
T-Hangar 01
TA-01
TA-02

Alabama Statewide
Pavement Management Program Update
Mac Crenshaw Memorial (PRN) Airport
Greenville, AL

Figure B3C

PCIP Recommendations

JVIATION ENGINEERING & PLANNING

All About Pavements, Inc. (API)
www.allaboutpavements.com
Telephone: 217-586-2765 FAX: 217 586-1967

ENGINEER	DATE	MAP NUMBER
KP/MR	May 2021	Page 13
REVISED	SCALE	
JMA	1 in = 300 ft	FINAL

APPENDIX C

OVERVIEW OF PAVEMENT DISTRESSES

1. Alligator Cracking (AC)

2. Bleeding (AC)

3. Block Cracking (AC)

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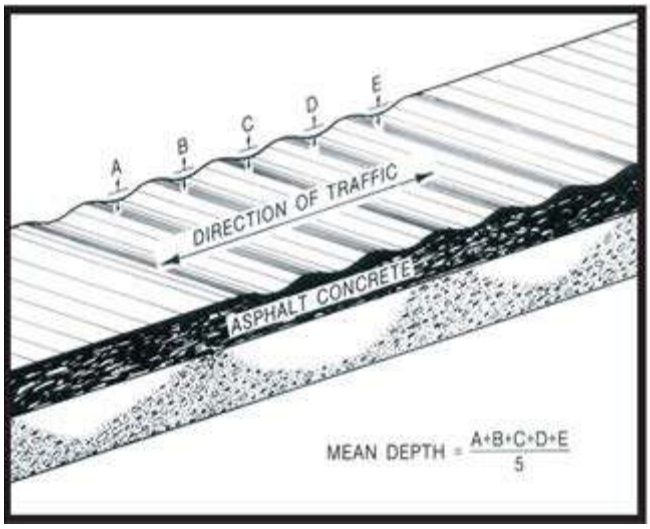
4. Corrugation (AC)

Description

Corrugation is a series of closely spaced ridges and valleys (ripples) occurring at fairly regular intervals, usually less than 5 feet (1.5 meters) along the pavement. The ridges are perpendicular to the traffic direction. Traffic action combined with an unstable pavement surface or base usually causes this type of distress.

Severity Levels



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CAP

7. Joint Reflection Cracking (AC)

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48 M

9. Oil Spillage (AC)

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10. Patching

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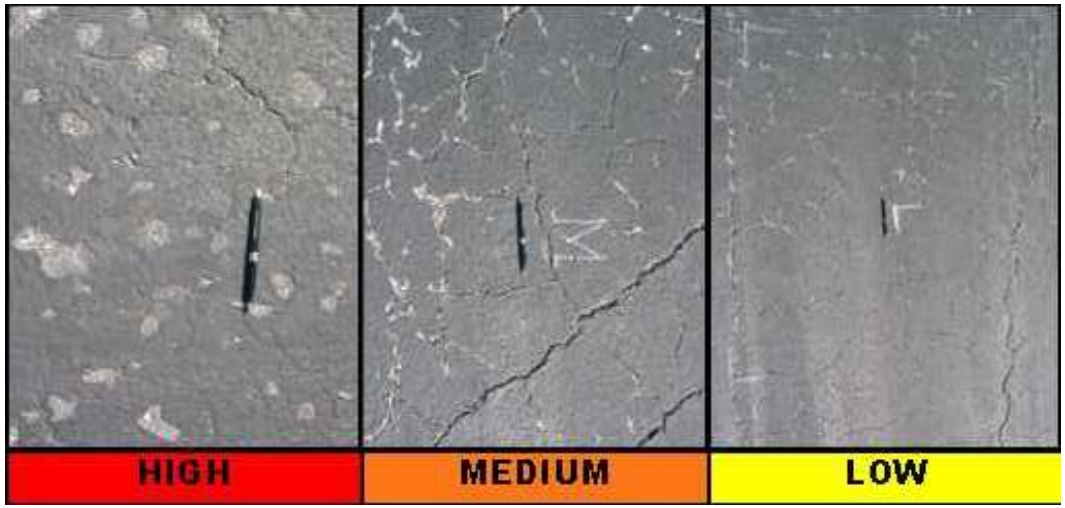
11. Polished Aggregate (AC)

12. Raveling (AC)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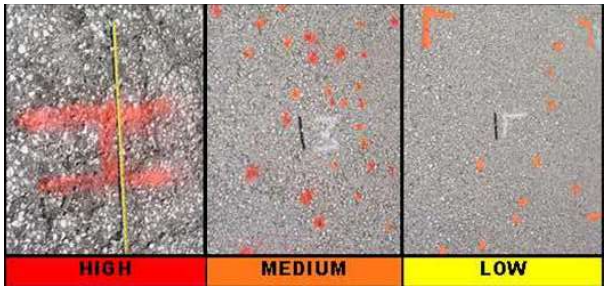
HIGH
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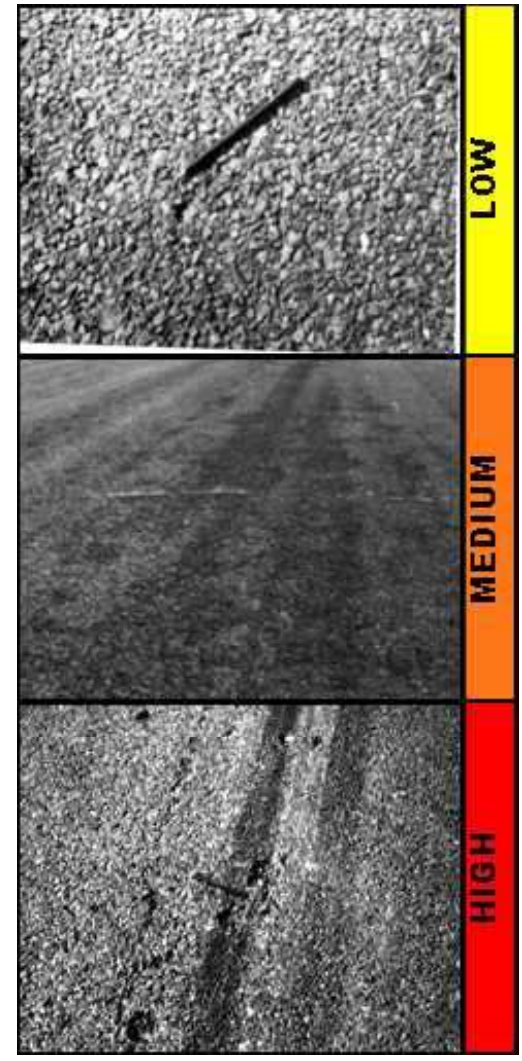
LOW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MEDIUM
HIGH

13. Rutting (AC)

from the direction of traffic. They are produced when braking or turning wheels cause the

_____ No degrees of severity are defined. It is sufficient to indicate that a slippage

_____

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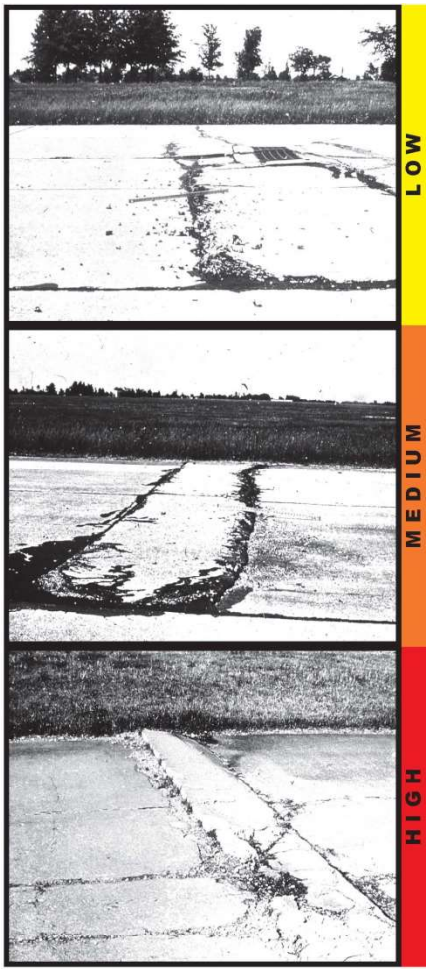
- ♦

15. Swelling (AC)

16. Weathering (AC)

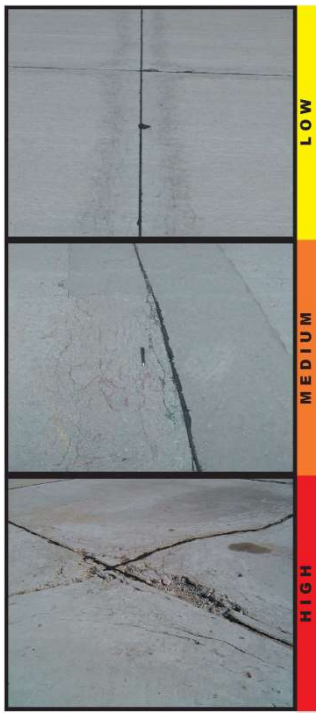

LOW
MEDIUM
HIGH

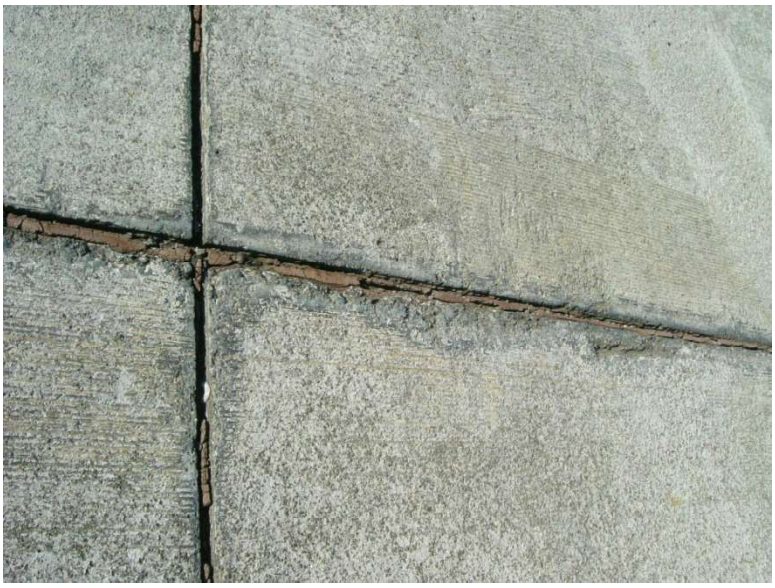
- filled, it has a mean width less than approximately 1 inch (3 millimeters); a filled crack can be of any width, but the filler material

- One of the following conditions exists: (1) filled or non filled c filled crack has a mean width between 1/8 inch (3 millimeters) and 1 inch (25 millimeters); (3) a filled crack is not spalled or only lightly spalled, but the filler is in unsatisfactory

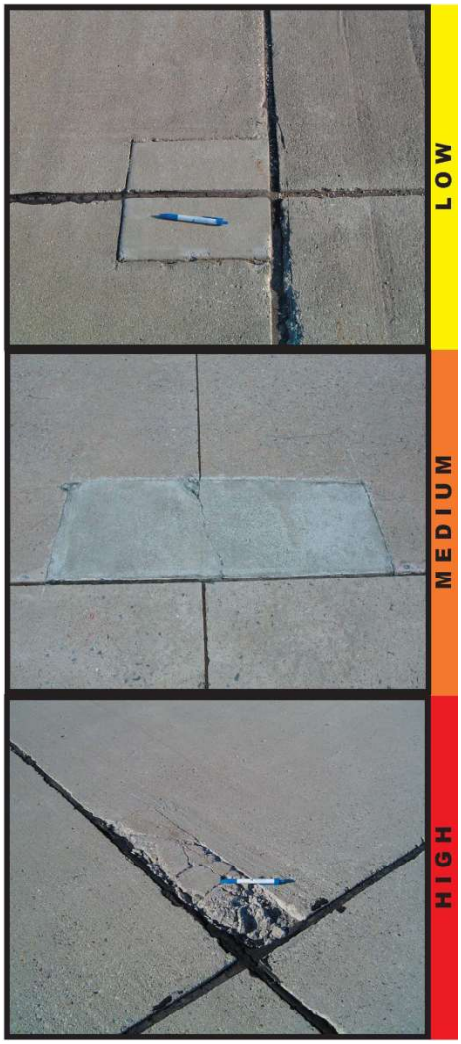
- One of the following conditions exists: (1) filled or non filled crack is severely spalled, causing definite FOD potential; (2) a non filled crack ha

parallel to a joint or linear crack. A dark coloring can usually be seen around the fine





has been removed and replaced by a filler



Patching is the same as defined

No degrees of severity are defined for popouts.

of approximately 1⁄4 to 1⁄2 in

Severity levels are defined by the difference in elevation across the fault and the

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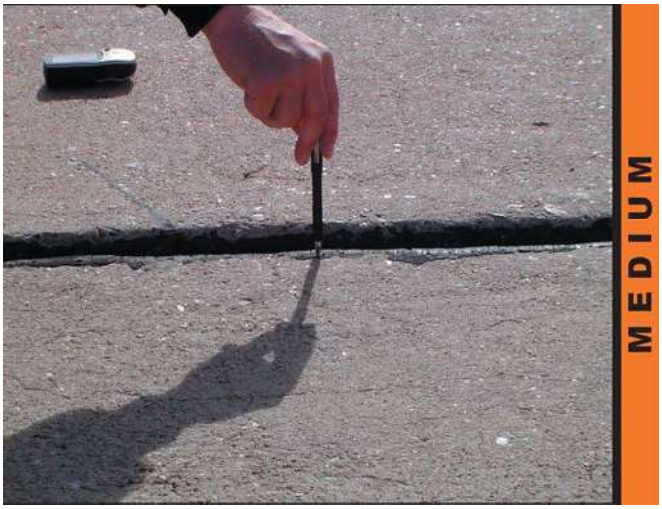

severity level of this distress type, as defined below,

- Slab is broken into four or five pieces with the vast majority of the cracks
- (1) Slab is broken into four or five pieces with over 15 percent of the
- four or five pieces with some or all of the cracks of high severity; (2) slab is

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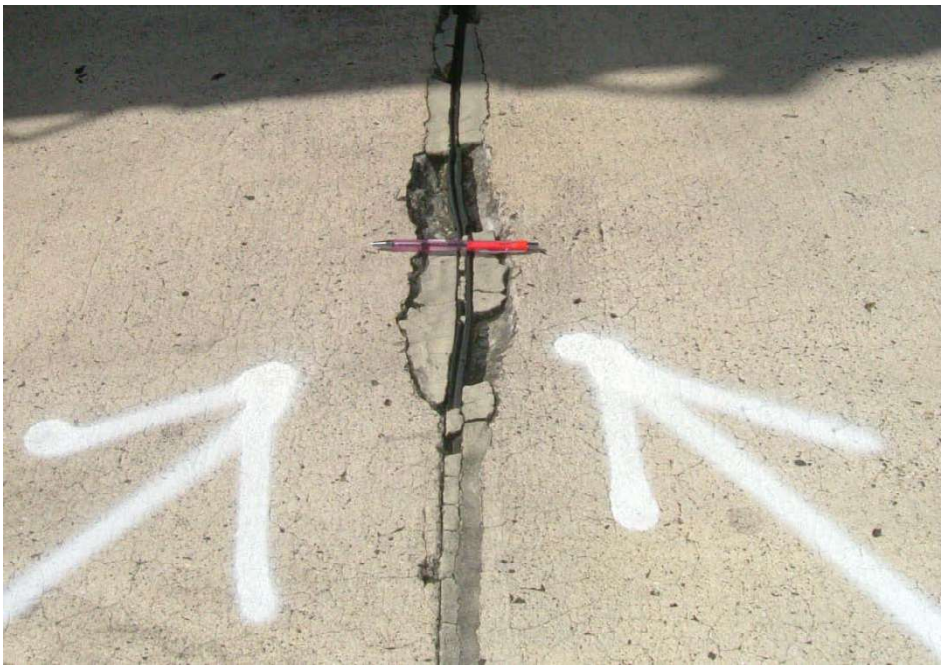
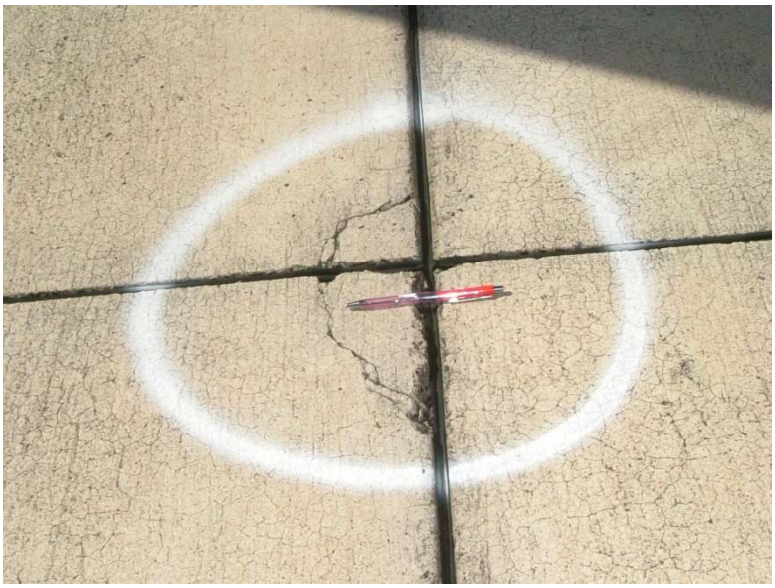
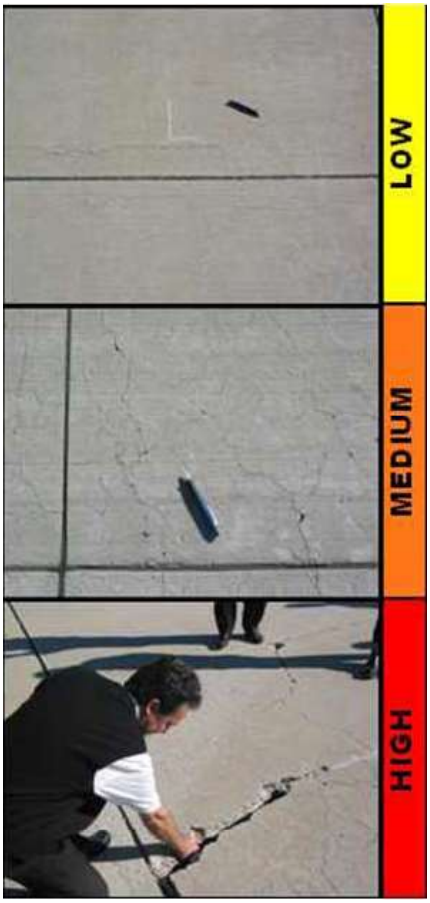
No degrees of severity are defined. It is sufficient to indicate that shrinkage cracks exist.






LOW
MEDIUM
HIGH

APPENDIX D

DETAILED PAVEMENT CONDITION DATA

APPENDIX E

DISTRESS SUMMARY REPORT

Appendix E

Distress Summary Report

Mac Crenshaw Memorial Airport (PRN)

Branch ID	Section ID	Surface[1]	Area (sf)	Distress Number	Description	Distress Mechanism	Severity	Quantity	Quantity Units	Distress Density
A01	01	AC	94,149	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Low	8,183	Ft	8.7%
A01	01	AC	94,149	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Medium	2,680	Ft	2.8%
A01	01	AC	94,149	52	RAVELING	Climate/Durability	High	39	SqFt	0.0%
A01	01	AC	94,149	52	RAVELING	Climate/Durability	Low	2,118	SqFt	2.2%
A01	01	AC	94,149	52	RAVELING	Climate/Durability	Medium	77	SqFt	0.1%
A01	01	AC	94,149	56	SWELLING	Other	Low	1,925	SqFt	2.0%
R1432	01	AAC	416,000	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Low	76	Ft	0.0%
R1432	02	AAC	24,000	45	DEPRESSION	Other	Low	8	SqFt	0.0%
R1432	02	AAC	24,000	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Low	15	Ft	0.1%
R1432	02	AAC	24,000	52	RAVELING	Climate/Durability	Low	60	SqFt	0.3%
TA	01	AAC	13,098	52	RAVELING	Climate/Durability	Low	53	SqFt	0.4%
TA	02	AC	46,105	52	RAVELING	Climate/Durability	Low	11,522	SqFt	25.0%
TA	02	AC	46,105	57	WEATHERING	Climate/Durability	Low	34,583	SqFt	75.0%
TA	03	AC	147,597	43	BLOCK CRACKING	Climate/Durability	Medium	4,083	SqFt	2.8%
TA	03	AC	147,597	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Low	1,964	Ft	1.3%
TA	03	AC	147,597	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Medium	8,842	Ft	6.0%
TA	03	AC	147,597	56	SWELLING	Other	Low	1,193	SqFt	0.8%
TA	04	AC	4,485					0		0.0%
TA1	01	AC	7,734	43	BLOCK CRACKING	Climate/Durability	Medium	3,200	SqFt	41.4%
TA1	01	AC	7,734	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Medium	437	Ft	5.7%
TA1	02	AAC	7,480	52	RAVELING	Climate/Durability	Low	40	SqFt	0.5%
TB	01	AC	3,752	43	BLOCK CRACKING	Climate/Durability	Low	200	SqFt	5.3%
TB	01	AC	3,752	45	DEPRESSION	Other	Low	200	SqFt	5.3%
TB	01	AC	3,752	45	DEPRESSION	Other	Medium	140	SqFt	3.7%

Appendix E

Distress Summary Report

Mac Crenshaw Memorial Airport (PRN)

Branch ID	Section ID	Surface[1]	Area (sf)	Distress Number	Description	Distress Mechanism	Severity	Quantity	Quantity Units	Distress Density
TB	01	AC	3,752	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Low	84	Ft	2.2%
TB	01	AC	3,752	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Medium	467	Ft	12.4%
TB	01	AC	3,752	56	SWELLING	Other	Low	61	SqFt	1.6%
TB	02	AAC	7,403	52	RAVELING	Climate/Durability	Low	15	SqFt	0.2%
THANG01	01	AC	17,956	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Low	373	Ft	2.1%
THANG01	01	AC	17,956	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Medium	373	Ft	2.1%
THANG01	01	AC	17,956	57	WEATHERING	Climate/Durability	Medium	17,956	SqFt	100.0%

[1] AC = Asphalt Cement Concrete, AAC = Aphalt Overlay AC, PCC = Portland Cement Concrete, APC = Asphalt Overlay PCC

[2] LCD = Last construction date. The date of the last major pavement rehabilitation (e.g. AC overlay)

APPENDIX F

INVENTORY

F1: Section Forecasted Pavement Condition Rating
F2: Branch PCI Rating
F3: Branch FOD Rating

Appendix F1

Forecasted Section PCI

Mac Crenshaw Memorial Airport (PRN)

Branch ID	Section ID	Forecasted PCI						
		2021	2022	2023	2024	2025	2026	2027
A01	01	63	61	59	57	55	52	50
R1432	01	98	97	96	95	94	92	89
R1432	02	97	96	95	93	91	88	84
TA	01	96	94	92	89	87	84	82
TA	02	78	76	74	71	68	64	60
TA	03	61	56	51	47	45	42	38
TA	04	99	98	96	94	92	89	86
TA1	01	50	47	45	41	38	34	31
TA1	02	98	96	94	92	89	86	84
TB	01	33	29	26	22	19	15	12
TB	02	98	96	94	92	89	86	84
THANG01	01	66	62	57	52	48	45	43

Branch Condition Report

Pavement Database: ALDOT_Combined_201201

Branch ID	Number of Sections	Sum Section Length (Ft)	Avg Section Width (Ft)	True Area (SqFt)	Use	Average PCI	Standard Deviation PCI	Weighted Average PCI
A01	1	500.00	136.00	94,149.00	APRON	66.00	0.00	66.00
R1432	2	5,500.00	80.00	440,000.00	RUNWAY	99.00	1.00	99.89
TA	4	5,707.00	50.25	211,285.00	TAXIWAY	86.00	13.93	71.76
TA1	2	259.00	35.00	15,214.00	TAXIWAY	77.50	21.50	77.14
TB	2	180.00	41.00	11,155.00	TAXIWAY	68.00	31.00	78.15
THANG01	1	189.00	95.00	17,956.00	TAXIWAY	70.00	0.00	70.00

Pavement Database: ALDOT_Combined_201201

Use Category	Number of Sections	Total Area (SqFt)	Arithmetic Average PCI	Average STD PCI	Weighted Average PCI
APRON	1	94,149.00	66.00	0.00	66.00
RUNWAY	2	440,000.00	99.00	1.00	99.89
TAXIWAY	9	255,610.00	78.33	21.45	72.24
ALL	12	789,759.00	80.75	20.58	86.90

APPENDIX G

SAFETY AND PREVENTIVE MAINTENANCE POLICIES

Appendix G1
Localized Safety (Stopgap) Repair Policy

Distress	Distress Severity	Description	Code	Work Type	Work Unit
41	High	ALLIGATOR CR	PA-FD	Patching - AC Full-Depth	SqFt
43	High	BLOCK CR	CS-AC	Crack Sealing - AC	Ft
45	High	DEPRESSION	PA-FD	Patching - AC Full-Depth	SqFt
47	High	JT REF. CR	CS-AC	Crack Sealing - AC	Ft
48	High	L & T CR	CS-AC	Crack Sealing - AC	Ft
50	High	PATCHING	PA-FD	Patching - AC Full-Depth	SqFt
53	High	RUTTING	PA-FD	Patching - AC Full-Depth	SqFt
54	High	SHOVING	PA-PD	Patching - AC Partial-Depth	SqFt
55	NA	SLIPPAGE CR	PA-PD	Patching - AC Partial-Depth	SqFt
56	High	SWELLING	PA-FD	Patching - AC Full-Depth	SqFt
61	High	BLOW-UP	SL-PC	Slab Replacement - PCC	SqFt
61	Medium	BLOW-UP	PA-PF	Patching - PCC Full Depth	SqFt
62	High	CORNER BREAK	PA-PF	Patching - PCC Full Depth	SqFt
63	High	LINEAR CR	PA-PF	Patching - PCC Full Depth	SqFt
63	Medium	LINEAR CR	CS-PC	Crack Sealing - PCC	Ft
64	High	DURABIL. CR	SL-PC	Slab Replacement - PCC	SqFt
64	Medium	DURABIL. CR	PA-PF	Patching - PCC Full Depth	SqFt
66	High	SMALL PATCH	PA-PP	Patching - PCC Partial Depth	SqFt
67	High	LARGE PATCH	PA-PF	Patching - PCC Full Depth	SqFt
70	High	SCALING	SL-PC	Slab Replacement - PCC	SqFt
71	High	FAULTING	GR-PP	Grinding (Localized)	Ft
72	High	SHAT. SLAB	SL-PC	Slab Replacement - PCC	SqFt
74	High	JOINT SPALL	PA-PP	Patching - PCC Partial Depth	SqFt
75	High	CORNER SPALL	PA-PP	Patching - PCC Partial Depth	SqFt
76	High	ASR	SL-PC	Slab Replacement - PCC	SqFt

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APPENDIX H

M&R UNIT COSTS

H1: M&R Unit Costs
H2: Component Costs for Repair
H3: Airport Category

Maintenance and Repair (M&R) Unit Costs

The M&R costs developed for the ALDOT PMP include costs for maintenance, preservation, and repair activities and are described below.

Unit Costs Source Data

The source for the M&R costs data is RSMeans, which has data for 14 locations throughout Alabama, as identified by the yellow highlighted boxes in Figure 1. The cost data is presented in terms of individual line items like asphalt wearing course, aggregate base etc., which were consolidated to develop the activity costs described below.

The cost data show a distinct difference in costs between locations north and south of Birmingham, especially for the higher value items like the asphalt layers. Therefore, the unit costs were developed accordingly for the airports north and south of Birmingham, as identified in Figure 1. Appendix H2 presents the component costs used in developing the M&R costs.

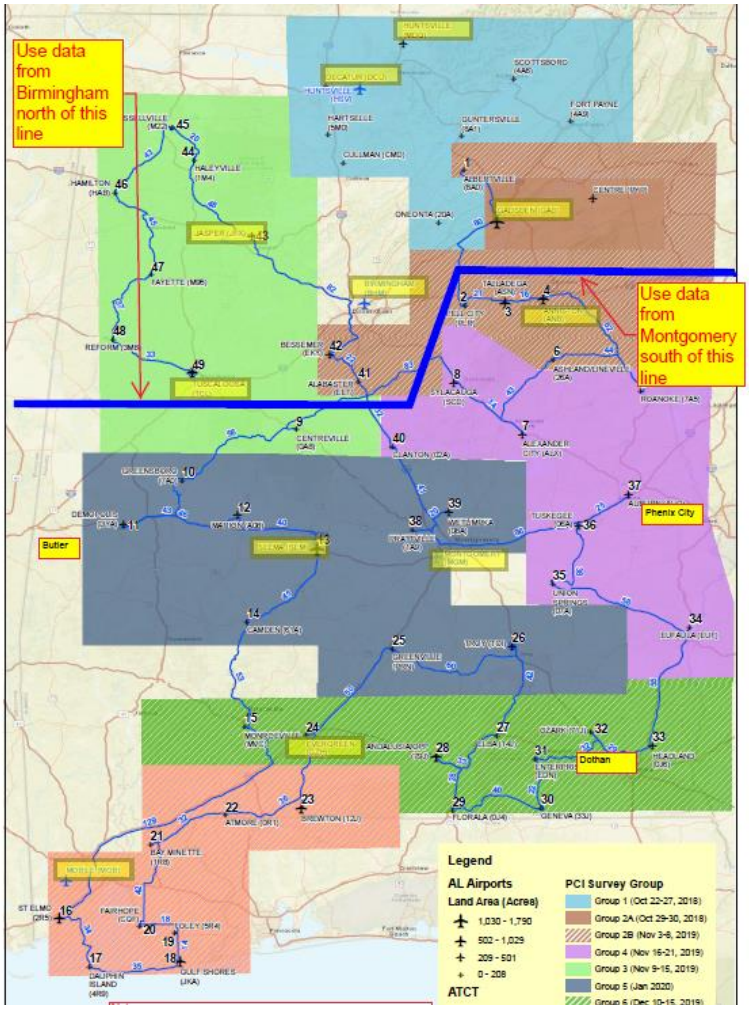

Figure 1: RSMeans Unit Costs Locations.

Maintenance & Repair (M&R) Activities

Maintenance activities are localized activities which are typically assigned in the first year of the M&R plan based on the observed distresses.

Repair activities are further subdivided into preservation, rehabilitation, and reconstruction. Repair activities are conducted for larger areas, typically at the section level and are assigned based on the /NŽůÓl·f tl·ØÔY˘Ôyű /2yŘŽůž2y˘LyŘÔÈŁ ŘÔy2ůÔŘ l·ă /t ŽY˘¢l·ōfÔ м¢ KÔ /t Žă ōl·ăÔŘ 2y˘ůKÔ ăÔÓůŽ2yŒă Nl·y˘ļ 2N importance within the overall network and typically ranges from 55 to 70. The CP was set at 70 for the ALDOT runway pavements and 65 for the other pavements.

Table 1: Repair Activities.

Activity Type	PCI	Activity
Preservation	> CP	Runway Surface Treatment
		Taxiway and Apron Surface Treatment
Rehabilitation	> CP	2" AC OL[1]
	55 - CP	Mill 2" & 2" AC OL
	45 - 55	Mill 2" & 2" AC OLP (With Pre-Overlay Repairs)
Reconstruction	0 - 45	Reconstruct with AC

[1]For Sections with Structural Distress and PCI greater than Critical PCI

The depths for the milling and overlay (AC OL) in Table 1 were established by creating a balance between removal of surficial distress and providing additional pavement structural capacity. All overlay options include full-depth patching to repair localized distresses.

From the FAA 5010 records, the Alabama airport network includes a wide range of allowable aircraft loads. The airports were divided into three categories of allowable aircraft loads based on requirements for minimum pavement thickness and the use of a P-401 surface layer. The categories are based on the aircraft maximum gross takeoff weight (MGTOW) and include: less than 12,500 lbs, 12,500 to 30,000 lbs, and 30,000 to 100,000 lbs. Appendix H3 presents the category for each airport.

For any sections requiring reconstruction, the pavement sections were established primarily in accordance with the requirements iy˘¢l·ōfÔ o 2ŦůKÔ C!!Ža !ŘØŽă2NŠè /ŽNŽÓdzfl·N 150/5320-6F. The pavement sections used for developing the cost estimates are:

- Ж м2,500 lbs 4ɛ t-403 (State HMA Mix) + 6ɛ P-209 Base
- 12,500 ς 30,000 lbs nɛ t-403 (State HMA Mix) + 8ɛ t-209 Base
- 30,000 ς 100,000 lbs pɛ t-401 + 10ɛ t-209 Base

It is important to note that while the FAA requires a stabilized base for those pavements that support aircraft operations with MGTOWs that are greater than 100,000 lbs, the number of such operations is minimal for those airports shown in Appendix H3. As a result, the cost of a stabilized base is excluded in ůKÔ ŘÔØÔf2LJY˘Ôyű 2Ŧ ůKÔ dzyNű Ó2ăůă Ŧ2N ![5h¢Ža t a t dzLJŘl·úÔ¢ l2øŠØÔŠNŒ ōl·ăÔŘ 2y˘ůKÔ 9yƎŽyŠÔŠNŒă ŦdzűdzNŠ design and aircraft fleet mix development, project-level construction work could include the use of a stabilized base at that time.

M&R Unit Costs

Paving projects typically include additional project costs like mobilization, design, construction administration and inspections, and drainage improvements. A summary of non-direct pavement construction line items has been included in the unit costs in Tables 5 and 6 as described below. These non-direct items are expressed as a percentage of the total component costs for each activity.

These non-Ř⅄ⅈⅇŜŏű ⅃Ⅎ·ØŜϒŝyű ŏ2yãúⅈⅇdzÔú⅄2yˇ⅄úŜϒă ø ŜⅈⅇŜ ŘŜØŜf2⅃ŜŘ ₸ⅈⅇ2ϒ ˇ ! t⅃ⅇăŜÈúŜyã⅄ØŜ ŜÈ⅃Ŝⅈⅇ⅄ŜyŎŜ ø⅄úK APMP project cost estimation. These percentages may vary for Alabama airport construction projects; however, since the direct pavement scope of work is estimated in a network-level evaluation, these conservative estimates serve as a good starting point for the development of realistic total project costs and annual APMP budgets for ALDOT. For repair activities such as Mill & Overlay, which typically do not include significant drainage work, the corresponding multiplier was reduced by 50 percent. The non-direct cost factors are presented in Table 2.

Table 2: Cost Factors.

Factor	Function of	Estimate		
		Preservation	Rehabilitation	Reconstruction
Mobilization	All costs, less design	10%	10%	10%
Drainage Improvements	Paving costs	-	4%	8%
Contingency	All costs, less mobilization and design	10%	20%	20%
Design & CM	All costs, less mobilization and design	15%	20%	20%

The M&R unit costs for maintenance, preservation, and repair activities were developed from the RSMeans cost data and are presented in the following section.

Maintenance

The maintenance activities include crack seal, and full and partial-depth patching. The unit costs are presented in Table 3.

Table 3: Unit Costs for Maintenance.

Activity	Unit Cost	Unit
Seal Cracks - AC	$3.95	lf
AC Full-Depth Patching	$25.05	sf
AC Partial-Dept Patching	$16.28	sf
Seal Cracks ς PCC	$8.35	lf
PCC Full-Depth Patching	$48.70	sf
PCC Partial-Depth Patching	$243.51	sf
Jt. Seal	$11.13	lf
Slab Replacement	$27.83	sf
Grinding	$6.96	lf

Preservation

The unit costs for the surface treatments are presented in Table 4. They include sealing of cracks and application of pavement markings.

Table 4: Unit Costs for Preservation Activities.

Activity	Unit Cost	Unit
Runway Surface Treatment	$0.57	sf
Taxiway and Apron Surface Treatment	$0.88	sf

Rehabilitation and Reconstruction

As discussed previously, repair activities are also divided into rehabilitation and reconstruction. The unit costs for airport repair for the Northern Region (Birmingham Area) and Southern Region (Montgomery Area) are shown in Tables 5 and 6, respectively.

Table 5: Unit Costs for Repair Activities, Northern Region.

Activity Type	Activity	MGTOW, thousand lbs		
		≤ 2.5	12.5-30	30-100
Rehabilitation	2" AC OL	$3.78		$4.19
	Mill 2" & 2" AC OL	$4.15		$4.56
	Mill 2" & 2" AC OLP	$5.18		$5.79
Reconstruction	AC Reconstruction	$8.40	$9.10	$10.91

Table 6: Unit Costs for Repair Activities, Southern Region.

Activity Type	Activity	MGTOW, thousand lbs		
		≤ 2.5	12.5-30	30-100
Rehabilitation	2" AC OL	$3.54		$3.91
	Mill 2" & 2" AC OL	$3.90		$4.27
	Mill 2" & 2" AC OLP	$4.82		$5.37
Reconstruction	AC Reconstruction	$7.63	$8.25	$9.87

Appendix H2
Component Costs for Repair

Activity Type	Unit	Birmingham (Northern)	Montgomery (Southern)	Comments
Milling 1" to 3"	SY	$2.08	$2.01	
Pavement Demolition	SY	$6.34	$6.12	
Haulage - For Demolition & AC	CY	$6.08	$5.87	
Haulage for 12" Thick Demolition	SY	$2.03	$1.96	
Haulage for 2" Thick AC Paving	SY	$0.34	$0.33	
Haulage for 3" Thick AC Paving	SY	$0.51	$0.49	
Haulage for 4" Thick AC Paving	SY	$0.68	$0.65	
AC Wearing Course	Ton	$97.42	$86.90	
AC Binder Course	Ton	$87.80	$78.17	
P401 - For airports with >60 kip aircraft	Ton	$116.90	$104.28	Assumed P401 cost to be 20% greater than AC Wearing Course
6" Aggregate Base (P208)	SY	$10.17	$9.12	
8" Aggregate Base (P208)	SY	$13.29	$11.89	
6" P209 Aggregate Base	SY	$12.20	$10.94	Assumed P209 cost to be 20% greater than P208
8" P209 Aggregate Base	SY	$15.95	$14.27	Assumed P209 cost to be 20% greater than P208
10" P209 Aggregate Base	SY	$19.94	$17.84	Direct multiplier for 10" from 8"
4" P154 Aggregate Base	SY	$5.42	$4.86	Assumed P154 cost to be 20% lower than P208
6" P154 Aggregate Base	SY	$8.14	$7.30	Assumed P154 cost to be 20% lower than P208
Pavement Markings	sf	$1.48	$1.39	

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APPENDIX I

PAVEMENT CAPITAL IMPROVEMENT PROGRAM

I1: PCIP Summary
I2: Year 1 Maintenance Plan

Mac Crenshaw Memorial Airport (PRN)

Branch & Section	2021	2022	2023	2024	2025	2026	2027
A01-01	StopGap $1672.37 Before:62.62 After:62.62	Required Project Major Below Critical $389776.86 Before:60.41 After:100	Preventive $225.49 Before:97.79 After:97.79	Preventive $465.46 Before:95.57 After:95.57	Preventive + Required Project Global MR $62856.99 Before:93.36 After:97.79	Preventive $492.8 Before:95.58 After:95.58	Preventive $761.37 Before:93.37 After:93.37
R1432-01	Preventive $842.52 Before:98.02 After:98.02	Preventive $1349.46 Before:96.92 After:96.92	Preventive $1836.86 Before:95.93 After:95.93	Preventive $2407.19 Before:94.82 After:94.82	Preventive $3218.87 Before:93.27 After:93.27	Preventive $4404.16 Before:91.06 After:91.06	Preventive + Required Project Global MR $297236.07 Before:88.11 After:93.26
R1432-02	Preventive $88.96 Before:96.37 After:96.37	Preventive $117.12 Before:95.36 After:95.36	Preventive $155.17 Before:94.04 After:94.04	Preventive $210.75 Before:92.14 After:92.14	Preventive $289.35 Before:89.52 After:89.52	Preventive $392.37 Before:86.2 After:86.2	Preventive + Required Project Global MR $17315.7 Before:82.39 After:89.52
TA-01	Preventive $59.26 Before:95.57 After:95.57	Preventive $90.74 Before:93.42 After:93.42	Preventive $128.71 Before:90.94 After:90.94	Preventive $171.26 Before:88.29 After:88.29	Preventive $215.84 Before:85.67 After:85.67	Preventive $260.83 Before:83.19 After:83.19	Preventive + Required Project Global MR $14057.88 Before:80.92 After:88.29

Mac Crenshaw Memorial Airport (PRN)

Branch & Section	2021	2022	2023	2024	2025	2026	2027
TA-02	Preventive + Required Project Global MR $41644.94 Before:76.96 After:83.28	Preventive $922.06 Before:81 After:81	Preventive $1048.33 Before:78.93 After:78.93	Preventive $1171.52 Before:76.97 After:76.97	Preventive $1303.09 Before:74.97 After:74.97	Preventive $1452.91 Before:72.74 After:72.74	Preventive $1633.56 Before:70.06 After:70.06
TA-03	Required Project Major Below Critical $593339.94 Before:59.37 After:100	Preventive $158.18 Before:98.98 After:98.98	Preventive $344.77 Before:97.85 After:97.85	Preventive + Required Project Global MR $95067.42 Before:96.33 After:98.98	Preventive $365.77 Before:97.85 After:97.85	Preventive $642.21 Before:96.33 After:96.33	Preventive $1015.13 Before:94.36 After:94.36
TA-04	Preventive $7.25 Before:98.42 After:98.42	Preventive $13.69 Before:97.1 After:97.1	Preventive $22.68 Before:95.34 After:95.34	Preventive $34.42 Before:93.13 After:93.13	Preventive $48.35 Before:90.63 After:90.63	Preventive $63.86 Before:87.98 After:87.98	Preventive + Required Project Global MR $4789.3 Before:85.37 After:93.13
TA1-01	Required Project Major Below Critical $38360.64 Before:48.76 After:100	Preventive $8.29 Before:98.98 After:98.98	Preventive $18.07 Before:97.85 After:97.85	Preventive + Required Project Global MR $4981.48 Before:96.33 After:98.98	Preventive $19.17 Before:97.85 After:97.85	Preventive $33.65 Before:96.33 After:96.33	Preventive $53.19 Before:94.36 After:94.36

Mac Crenshaw Memorial Airport (PRN)

Branch & Section	2021	2022	2023	2024	2025	2026	2027
TA1-02	Preventive $21.89 Before:97.14 After:97.14	Preventive $36.29 Before:95.39 After:95.39	Preventive $55.15 Before:93.2 After:93.2	Preventive $77.76 Before:90.69 After:90.69	Preventive $102.85 Before:88.05 After:88.05	Preventive $129.14 Before:85.43 After:85.43	Preventive + Required Project Global MR $8009.41 Before:82.97 After:90.69
TB-01	Required Project Major Below Critical $31892 Before:31.57 After:100	Preventive $4.02 Before:98.98 After:98.98	Preventive $8.76 Before:97.85 After:97.85	Preventive + Required Project Global MR $2416.67 Before:96.33 After:98.98	Preventive $9.3 Before:97.85 After:97.85	Preventive $16.33 Before:96.33 After:96.33	Preventive $25.81 Before:94.36 After:94.36
TB-02	Preventive $21.66 Before:97.14 After:97.14	Preventive $35.92 Before:95.39 After:95.39	Preventive $54.58 Before:93.2 After:93.2	Preventive $76.96 Before:90.69 After:90.69	Preventive $101.79 Before:88.05 After:88.05	Preventive $127.81 Before:85.43 After:85.43	Preventive + Required Project Global MR $7926.97 Before:82.97 After:90.69
THANG01-01	StopGap $282.25 Before:64.62 After:64.62	Required Project Major Below Critical $74337.84 Before:60.22 After:100	Preventive $19.82 Before:98.98 After:98.98	Preventive $43.2 Before:97.85 After:97.85	Preventive $75.85 Before:96.33 After:96.33	Preventive $120.29 Before:94.35 After:94.35	Preventive $175.48 Before:91.99 After:91.99

Appendix I2

Localized Maintenance Plan

Mac Crenshaw Memorial Airport (PRN)

Branch ID	Section ID	Policy	Distress Code	Description	Severity	Distress Qty	Distress Unit	Percent Distress	Work Description	Work Qty	Work Unit	Unit Cost	Work Cost
A01	01	Preventive	48	L & T CR	Medium	2,680	Ft	2.85	Crack Sealing - AC	2,680	Ft	$3.95	$10,586
A01	01	Preventive	48	L & T CR	Low	8,183	Ft	8.69	No Localized M & R	0		$0.00	$0
A01	01	Preventive	52	RAVELING	High	39	SqFt	0.04	Patching - AC Partial-Depth	39	SqFt	$16.28	$627
A01	01	Preventive	52	RAVELING	Medium	77	SqFt	0.08	No Localized M & R	0		$0.00	$0
A01	01	Preventive	56	SWELLING	Low	1,925	SqFt	2.04	Patching - AC Full-Depth	2,105	SqFt	$25.05	$52,754
A01	01	Preventive	52	RAVELING	Low	2,118	SqFt	2.25	No Localized M & R	0		$0.00	$0
R1432	01	Preventive	48	L & T CR	Low	76	Ft	0.02	No Localized M & R	0		$0.00	$0
R1432	02	Preventive	45	DEPRESSION	Low	8	SqFt	0.03	Patching - AC Full-Depth	24	SqFt	$25.05	$586
R1432	02	Preventive	52	RAVELING	Low	60	SqFt	0.25	No Localized M & R	0		$0.00	$0
R1432	02	Preventive	48	L & T CR	Low	15	Ft	0.06	No Localized M & R	0		$0.00	$0
TA	01	Preventive	52	RAVELING	Low	54	SqFt	0.41	No Localized M & R	0		$0.00	$0
TA	02	Preventive	52	RAVELING	Low	11,522	SqFt	24.99	No Localized M & R	0		$0.00	$0
TA	02	Preventive	57	WEATHERING	Low	34,583	SqFt	75.01	No Localized M & R	0		$0.00	$0
TA	03	Safety	48	L & T CR	Low	1,964	Ft	1.33	No Localized M & R	0		$0.00	$0
TA	03	Safety	43	BLOCK CR	Medium	4,083	SqFt	2.77	No Localized M & R	0		$0.00	$0
TA	03	Safety	48	L & T CR	Medium	8,842	Ft	5.99	No Localized M & R	0		$0.00	$0
TA	03	Safety	56	SWELLING	Low	1,193	SqFt	0.81	No Localized M & R	0		$0.00	$0
TA1	01	Safety	43	BLOCK CR	Medium	3,200	SqFt	41.38	No Localized M & R	0		$0.00	$0
TA1	01	Safety	48	L & T CR	Medium	437	Ft	5.65	No Localized M & R	0		$0.00	$0
TA1	02	Preventive	52	RAVELING	Low	40	SqFt	0.53	No Localized M & R	0		$0.00	$0
TB	01	Safety	45	DEPRESSION	Medium	140	SqFt	3.73	No Localized M & R	0		$0.00	$0
TB	01	Safety	43	BLOCK CR	Low	200	SqFt	5.33	No Localized M & R	0		$0.00	$0
TB	01	Safety	48	L & T CR	Low	84	Ft	2.24	No Localized M & R	0		$0.00	$0
TB	01	Safety	56	SWELLING	Low	61	SqFt	1.63	No Localized M & R	0		$0.00	$0
TB	01	Safety	48	L & T CR	Medium	467	Ft	12.45	No Localized M & R	0		$0.00	$0
TB	01	Safety	45	DEPRESSION	Low	200	SqFt	5.33	No Localized M & R	0		$0.00	$0
TB	02	Preventive	52	RAVELING	Low	15	SqFt	0.2	No Localized M & R	0		$0.00	$0
THANG01	01	Preventive	57	WEATHERING	Medium	17,956	SqFt	100	No Localized M & R	0		$0.00	$0
THANG01	01	Preventive	48	L & T CR	Low	373	Ft	2.08	No Localized M & R	0		$0.00	$0
THANG01	01	Preventive	48	L & T CR	Medium	373	Ft	2.08	Crack Sealing - AC	373	Ft	$3.95	$1,474