Prepared for:
NASA Ames Research Center
Moffett Federal Airfield, CA

Prepared by:
AECOM
Orange, CA
October 1, 2012

Pavement Evaluation Report
For
NASA Ames Research Center

Final Report

October 2012

Prepared for:
NASA Ames Research Center
Moffett Federal Airfield, CA

Prepared by:
AECOM
Orange, CA
October 1, 2012

Pavement Evaluation Report
For
NASA Ames Research Center

Prepared By Katherine Keegan, P.E

Reviewed By John Behzadi, P.E

Contents

List of Appendices

List of Tables

List of Figures

Executive Summary

An airfield pavement evaluation was completed by AECOM for NASA Ames Research Center (NARC) at Moffett Federal Airfield (Moffett) in California in support of determining the current pavement condition; providing detailed maintenance recommendations for localized pavement areas; and prioritizing future major pavement rehabilitation needs on the airfield. Analysis of Pavement Classification Number for Runways 14L and 14R are provided using reported 2002 materials data and 2012 traffic information.

AECOM completed a field investigation of select pavements. This included approximately 61% of the total airfield pavement. Pavement areas not included in the field investigation are: Southeast Ramp, 211 Ramp, Compass Rose, and the Runway 32R overrun. The investigation included a visual review of the pavement surface in accordance with UFC 3-260-16FA 'Airfield Pavement Condition Survey Procedures Pavements'. The visual review was used to determine the Pavement Condition Index (PCI) of all evaluated pavements. Additional data collection in the form of distress mapping was completed on ten pavement sections, deemed by NARC to be in the worst condition, to be used to determine specific and immediate repair needs. There was neither a geotechnical investigation nor Non-Destructive Testing of the pavement completed as part of this investigation.

Update to Work History and Pavement Maps

An extensive evaluation of the airfield pavements was completed in 2002 by the Naval Facilities Engineering Command (NFEC) with a PCI update completed in 2008. The main construction activity since these evaluations includes a Polymer Concrete Micro-Overlay (PCMO) placed on most of Runway 14R-32L in 2008. AECOM prepared a pavement section map based on historical reports and the Airport Layout Plan and can provide this electronically to NARC.

Pavement Condition Index Updates

The PCI is a numerical rating (on a scale of 0 to 100, with 0 representing failed pavement and 100 representing new pavement) based on the type, severity and quantity of pavement distress found in an inspected sample unit. The results are displayed using seven categories and ratings, 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 ES-1. The typical pavement life cycle is shown in Figure ES-1 which shows correlation between PCI rating, pavement age, and approximate costs of maintenance or rehabilitation. Pavement deterioration is generally flat at the beginning of the service life and over time begins to deteriorate more quickly on a steeper curve. When maintenance is performed on pavement before it deteriorates substantially, the pavement's useful life can be extended, both increasing PCI and flattening the curve, with methods that are less expensive. The condition at which rehabilitation can be done most cost-effectively is referred to as the "critical PCI". Within this report, critical PCI is defined as 70 for runway, and 60 for taxiway and apron pavements.

Table ES-1 Pavement Condition Index (PCI) 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.
			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.

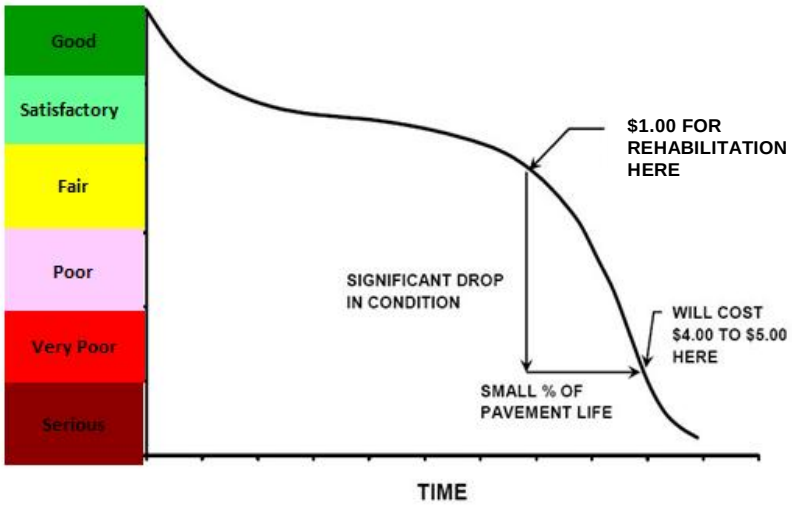

Figure ES-1 Pavement Life Cycle

(Source: FAA Advisory Circular 150/5380-7A 'Airport Pavement Management Program').

Generally pavements should be rehabilitated in the PCI range of 60 to 70. This means pavement is repaired before it requires reconstruction and when it is most cost-effective, as shown in Figure ES-1.

The overall current 2012 area-weighted PCI values of the inspected area, or approximately 61% of the total area, are shown in Figure ES-2 and Figure ES-3. The 2012 average values correspond to UFC ratings of "Fair" for runways and aprons, and "Satisfactory" for taxiways. As can be seen in Figure ES-2, the majority of the inspected pavement at Moffett is in the "Fair" category which corresponds to the appropriate timing for cost-effective repairs as shown in Figure ES-1.

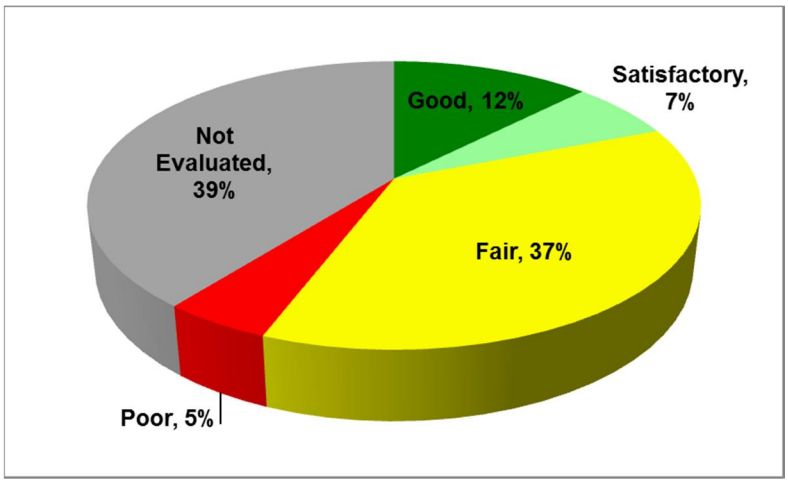

Figure ES-2 Overall Condition Summary

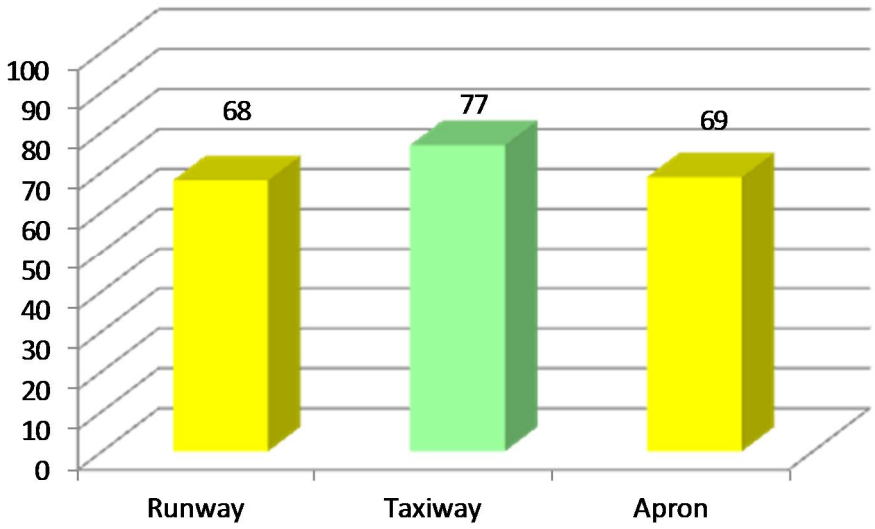

Figure ES-3 Condition Summary by Branch Type for Inspected Areas

Rehabilitation Recommendations

Short term rehabilitation recommendations are proposed for the ten sections where detailed distress mapping was completed. The estimated repair cost for these sections is over $12 million dollars as shown in Table 5-3. However, four of the seven sections recommended for major rehabilitation may benefit from preventive maintenance reducing the immediate major rehabilitation need to $4 million. The remaining three sections are R11A, T15A, and T27C which are recommended for reconstruction and will not benefit from preventive maintenance. Additionally, preventive maintenance of approximately $0.6 million is recommended for the remaining Priority 1 pavement sections.

Stop gap repair options are also provided for all Priority 1 sections with a total cost of $85,470, but these repairs should be considered the minimum required and will address FOD and operational safety only. Stop gap repairs provide no benefit to the pavement service life.

Note that the PCMO sections of Runway 14R-32L are exhibiting some staining at cracks due to water pumping. It is critical that prior to any repairs, the source of the water be determined to ensure an appropriate repair is applied.

Long term recommendations are also provided for the remainder of the airfield that was surveyed based on PCI limits for airfield pavement rehabilitation of 70 for runways and 60 for taxiways and aprons. The recommendations are provided as priorities indicating which pavement should be rehabilitated first. Based on expected deterioration and the critical PCI for rehabilitation (70 for runways and 60 for other pavement), approximately 70% of the inspected area will meet these threshold limits in the next six years as shown in Figure ES-4. The recommended rehabilitation includes joint seal, crack seal, spall repair, patching and slab replacements for PCC pavements and milling and resurfacing repairs for asphalt pavements.

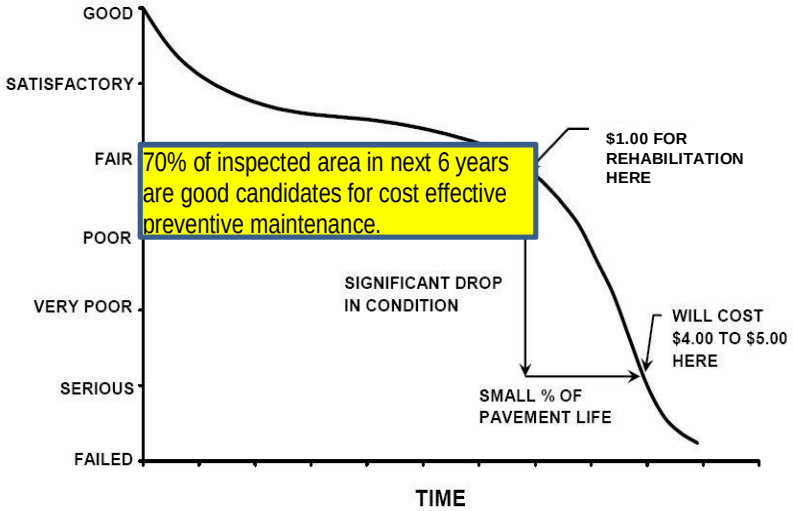

Figure ES-4 Projected Condition of Airfield Relative to Pavement Life-Cycle

Pavement Classification Number

UFC 3-260-03 'Airfield Pavement Evaluation' defines Aircraft Classification (ACN) and Pavement Classification Numbers (PCN) as follows;

> ACN – A number that expresses the relative structural effect of an aircraft on different pavement types for specified standard subgrades in terms of a standard single-wheel load.
>
> PCN – A number that expresses the relative load-carrying capacity of a pavement in terms of a standard single-wheel load.

The PCN results suggest that part of Runway 14R-32L is not capable of sustaining the 10 years mission at the full design load. In general, this requires a reduction in traffic by reducing the aircraft weights (and keeping the passes and expected life constant), by reducing the aircraft passes (and keeping the aircraft weight and expected life constant), or by realizing that at the current weight and passes, the expected life will be shorter. From a functional perspective however, based on PCI data, both runways require rehabilitation as soon as budgets allow.

1.0 Introduction

An airfield pavement evaluation was completed by AECOM for NASA Ames Research Center (NARC) at Moffett Federal Airfield in California in support of determining the current pavement condition; providing detailed maintenance recommendations for localized pavement areas; and prioritizing future major pavement rehabilitation needs on the airfield. The specific scope of services included:

- Review of existing pavement evaluation reports from 2002 and 2008; additional available as-built drawings; and the most recent airport layout plan and aerial photography. Appendix A1 provides the current layout of Moffett Federal Airfield.
- Develop a current airfield Network Identification Map locating distinct pavement sections as developed in previous pavement evaluation reports and integrating updates to the airfield network since 2008.
- Conduct a visual pavement condition survey in general accordance with UFC 3-260-16FA Airfield Pavement Condition Survey Procedures Pavements to include both detailed surveys with 100% coverage on specified areas and statistical based surveys on other areas. In general, runway and taxiway areas identified in 2008 as having “Fair” and “Poor” condition were surveyed with 100% coverage using spatial distress mapping while the remaining areas were surveyed using statistical based sampling methods and rates (approximately 10-20%) as specified in UFC 3-260-16FA. Appendix A2 identifies how each pavement section was surveyed.
- Develop detailed maintenance and rehabilitation recommendations including typical repair details for the runway and taxiway pavements identified in “Fair” and “Poor” condition in 2008.
- Develop a prioritized project listing for the remaining areas based on their functional condition as measured using statistical based sampling methods.

2.0 Records Review

The following reports were provided by NARC to AECOM for review.

1. Naval Facilities Engineering Service Center, Site Specific Report SSR-2765-SHR, Airfield Pavement Evaluation Moffett Federal Airfield, September 2002.
2. Southwest Division, Naval Facilities Engineering Command, Airfield Pavement Load Evaluation Moffett Federal Airfield, July 2002.
3. Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Airfield Pavement Condition Survey Moffett Federal Airfield, July 2002.
4. Southwest Division, Naval Facilities Engineering Command, Void Detection under Airfield Pavements Moffett Federal Airfield, July 2002.
5. Final Report Resurfacing of Runway 14R-32L by Wilson Construction, August 2008.
6. Newman, K and Schoenberger, J, Polymer Concrete Micro-Overlay for Fuel and Abrasion Resistance Surfacing, Laboratory Results and Field Demonstrations, May 2002.
7. Engineering Brief No. 62, Polymer Concrete Micro-Overlay for Fuel Resistance Wearing Surfaces, Federal Administration Aviation, December 2002.
8. 2008 PCI Diagram Moffett Federal Airfield, prepared by Air National Guard Civil Engineering Technical Services Center.

Within these reports, the construction history of the pavement up to 2002 was summarized in Appendix A of Site Specific Report SST-2765-SHR. This table has been updated and included in this report with observations of maintenance and repair work from the field survey and aerial photography review and is included in Appendix A4. AECOM also provides a map summary of the original construction date for each pavement section in map format in Appendix B2.

In general, the maintenance and rehabilitation work completed since 2008 includes the following, as provided by NARC:

a. Polymer Concrete Micro-Overlay (PCMO) on the majority of Runway 14R-32L (section R07A), 2008
b. Asphalt crack repairs on part of the West Parallel Taxiway (sections T16A and T17A), 2009
c. Concrete spall repairs on part of Runway 14L-32R (Section R03C), part of Taxiway A (Section T25C), and part of the East Parallel Taxiway (Section T09A) in 2011
d. Concrete spall repairs along full length of Runway 14L-32R in 2012

Based on the construction history and the field survey, Appendix B3 provides a graphical representation of the observed surface types at Moffett field.

3.0 Network Definition

NARC provided the Airport Layout Plan (ALP) to AECOM in AutoCAD format. A review of the prior pavement evaluation study (2002) and the 2008 PCI diagram, identified the historical pavement segmentation at Moffett Federal Airfield. From these exhibits, AECOM utilized the ALP to prepare a current Network Definition Map for the airfield, based on the MicroPAVER pavement management approach applied in previous condition evaluations.

The MicroPAVER system defines the **network** to be all airfield pavements at Moffett Federal Airfield. Each runway, taxiway or apron is a distinct **branch** and each branch is divided into **sections**. Sections are generally broken down based on homogeneous pavement thickness, traffic, age and condition. The sections were built to match the segmentation as provided in the most recent 2008 report with updates completed to reflect changes as summarized in the record review. For additional benefit to NARC, AECOM has further subdivided the sections into **sample units,** as shown in Appendix A3, and specifically identifies the samples surveyed within this scope of work. AECOM provides this file to NARC electronically in AutoCAD format for their future use.

4.0 Pavement Condition Survey and Results

A visual pavement condition survey was completed in general accordance with UFC 3-260-16FA 'Airfield Pavement Condition Survey Procedures Pavements'. The survey was completed between April 9th and 17th, 2012 by a two person survey team using electronic and geospatial data collection methods.

A detailed survey with 100% coverage (distress mapping) was completed on specific areas as directed by NARC while other areas were surveyed using statistical based sampling methods (PCI sampling) and rates amounting to approximately 10-20% area coverage in

accordance with the methods in UFC 3-260-16FA. Appendix A3 provides a map locating which areas were surveyed by each particular method.

The distress mapping was completed using geospatial data collection, resulting in crack maps for the areas, as shown in Appendix C1. These maps show each distress that was observed throughout the pavement area, located geospatially to where it was observed on the airfield. A summary of total distress for each of these sections is provided in Table 4-1. The quantities are a 'count' of the total occurrences, with the exception of joint seal damage where the quantity represents the number of slabs with damage. These survey data were used to develop detailed repair recommendations for these pavement sections. A Pavement Condition Index (PCI) value, as defined in Table 4-2, was also calculated for each pavement section. The PCI values are shown in Appendix B1.

As seen in Table 4-1, the predominant distresses observed in the PCC pavement include cracks (linear and corner breaks), spalls, joint seal damage, patches, and scaling. The scaling, in many cases was medium severity and extensive within a pavement section. Generally, slabs with scaling at this severity level are removed to address Foreign Object Debris (FOD) risks. Scaling, however, can also exist at a steady state condition for a long period of time depending on weather, traffic, de-icing chemicals, pavement age, and others variables. Since this is AECOM's first evaluation of the pavement, it is not known whether the scaling has been deteriorating over time or is remaining in relatively the same condition. Recommendations herein will assume that the scaling is in a deteriorating state.

Table 4-1 Distress Mapping Summary

Branch Section ID (PCI)	Distress Code and Description	Low	Medium	High	N/A
RW 14R R05A (50)	(65) Joint Seal Damage*	104			
	(66) Small Patching	12			
	(67) Large Patching	3			
	(70) Scaling/Crazing		104		
	(74) Joint Spall	1	3	2	
	(75) Corner Spall		1		
	Total	120	108	2	
RW 32L R11A (47)	(63) Linear Transverse diagonal Cracking	18	10	5	
	(65) Joint Seal Damage*	256			
	(66) Small Patching	21			
	(67) Large Patching	1			
	(70) Scaling/Crazing		256		
	(74) Joint Spall	2		1	
	(73) Shrinkage Cracking				16
	Total	298	266	1	16

Branch Section ID (PCI)	Distress Code and Description	Low	Medium	High	N/A
EPTW T03A (52)	(63) Linear Transverse diagonal Cracking	11			
	(65) Joint Seal Damage*	79			
	(66) Small Patching	17	2		
	(67) Large Patching	1			
	(70) Scaling/Crazing	5	79		
	(73) Shrinkage Cracking				2
	(74) Joint Spall	1	3	2	
	(75) Corner Spall		1		
	Total	114	85	2	2
TWD T28A (53)	(63) Linear Transverse diagonal Cracking	3			
	(65) Joint Seal Damage*	81			
	(66) Small Patching	20	1		
	(70) Scaling/Crazing	5	76		
	(73) Shrinkage Cracking				2
	(74) Joint Spall		1		
	Total	109	78	0	2
TWD T26A (87)	(63) Linear Transverse diagonal Cracking	2			
	(65) Joint Seal Damage*	57			
	(67) Large Patching			1	
	(70) Scaling/Crazing	1			
	(73) Shrinkage Cracking				1
	Total	60	0	1	1
TWAA T12A (80)	(65) Joint Seal Damage*			111	
	(67) Large Patching	6	1		
	(70) Scaling/Crazing	1			
	(74) Joint Spall	1	3	1	
	(75) Corner Spall		4		
	Total	8	8	112	
TWAA T15A (47)	(63) Linear Transverse diagonal Cracking	32	7		
	(65) Joint Seal Damage*			59	
	(66) Small Patching	5		1	
	(67) Large Patching	1		1	
	(70) Scaling/Crazing	51	7		
	(73) Shrinkage Cracking				8
	(74) Joint Spall	3	4		
	Total	92	18	61	8

Branch Section ID (PCI)	Distress Code and Description	Low	Medium	High	N/A
WPTW T18A (48)	(63) Linear Transverse diagonal Cracking	9			
	(65) Joint Seal Damage*	63	42	201	
	(66) Small Patching	80	18	15	
	(67) Large Patching	9	2		
	(68) Popouts	3			
	(70) Scaling/Crazing	116	100		
	(73) Shrinkage Cracking				20
	(74) Joint Spall	15	22	14	
	(75) Corner Spall	2			
	Total	297	184	230	20
TWA T20C (88)	(62) Corner Break	32	2		
	(63) Linear Transverse diagonal Cracking	5	1		
	(65) Joint Seal Damage*	264	236		
	(73) Shrinkage Cracking				4
	(74) Joint Spall				
	(75) Corner Spall	1			
	Total	302	239	0	4
TWA T27C (56)	(62) Corner Break	41	44		
	(63) Linear Transverse diagonal Cracking	2	26		
	(65) Joint Seal Damage*		90		
	(73) Shrinkage Cracking				4
	(74) Joint Spall	1	1		
	(75) Corner Spall	3			
	Total	47	161	0	4

* Joint Seal Damage rated based on the overall condition of sample unit

Table 4-2 Pavement Condition Index (PCI) 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.
			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.

The remaining sections were surveyed using statistically based sample methods (PCI Sampling) resulting in a PCI value to be used in determining longer term rehabilitation needs. Appendix C1 provides the PCI values for each of these sections, with Appendix C2 providing the detailed distress data for each section in reports exported from MicroPAVER.

Overall, the 2012 average values correspond to ASTM ratings of “Fair” for runways and aprons, and “Satisfactory” for taxiways. Figure 4-1 provides a summary of the distribution of condition at Moffett Federal Airfield.

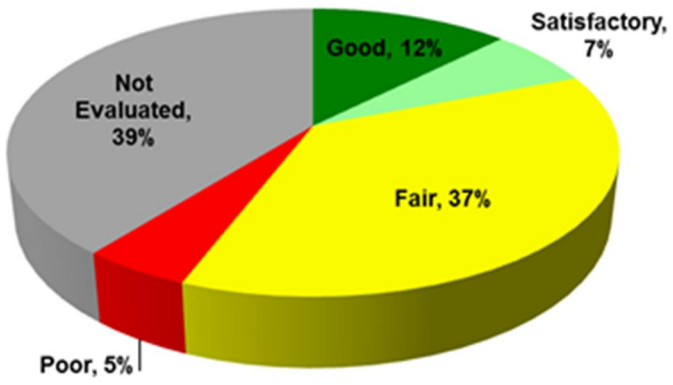

Figure 4-1 Condition Summary

Figure 4-2 provides the area-weighted average pavement condition by branch use for the pavement sections surveyed.

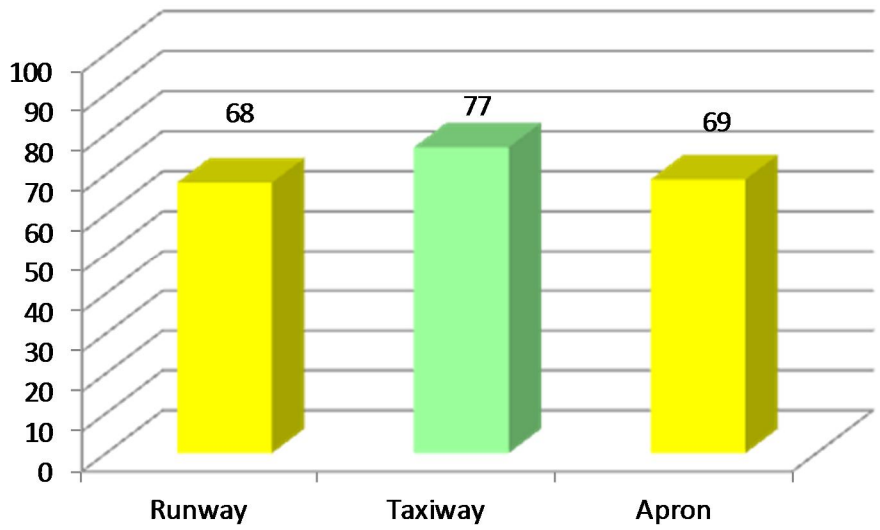

Figure 4-2 Area-Weighted Average Condition by Branch Use

4.1 Polymer Concrete Micro Overlay (PCMO)

The majority of Runway 14R-32L received a Polymer Concrete Micro-Overlay (PCMO) surface treatment in 2008. The application of PCMO is referenced in Engineering Brief No.62 and is generally recommended for taxiways, aprons, and landside facilities. The application of PCMO on runways is unique. A visual survey of the PCMO condition indicates extensive low severity block cracking and some discoloration along these cracks after rain (Appendix F Photos 1 through 3).

Construction records indicate this area has 13 to 15 inches of bituminous material over 6 to 12 inches of mechanically stabilized base and 15 inches of original flexible pavement structure built in 1938. Core samples confirm that the underlying bituminous layers are approximately 12.75 to 13.75 inches.

It appears that the condition of the PCMO deteriorated quickly in the first four years. It was placed in 2008 and should be assumed that the PCI was 100 at that time. It now has a PCI of 67, indicating a deterioration rate of approximately 8 points per year. This is expected due to cracks on the underlying asphalt reflecting up to the PCMO surface. Additionally, the discoloration observed at the cracks indicates the presence of water in the pavement. The water may simply sit in the crack after rainfall however, based on the staining, it may be due to other reasons such as; (1) surface water inflow that is retained between the PCMO layer and underlying asphalt if delaminations exist, or (2) pumping from the underlying subgrade coming up through cracks. Previous reports have shown the presence of a variable groundwater table due to artesian wells. The location of wells is not known.

Generally pavements within this PCI range should be considered for rehabilitation and due to the extent of cracking, the PCMO is no exception. A 10-year warranty has been provided from the manufacturer that includes delamination and peeling. The pavement is now at the half-life of the warranty and it is recommended that frequent monitoring of the pavement be done to assess the rate of deterioration and to check for delaminations or debonding that may lead to Foreign Object Debris (FOD). Delaminating is the main concern for this type of overlay and is the mode of failure experienced at other facilities. There is no standard method of testing for delaminations with this type of surface.

The recommended approach for monitoring is as follows:

1. Complete a crack map of the surface to establish a baseline condition of both PCI and type/severity/extent of distresses.
2. Identify and document any delaminations (peeling) during regular operational inspections as they occur.
3. Update this baseline map annually to determine any changes to condition and assess the remaining service life based on the changes and presence of delaminations.

At this time, it can be assumed that the pavement will last until the end of the 10-year warranty period, in 2008 based on current observations. However, there is no precedent for a 10-year life of this product on a runway and monitoring of the condition will help to identify potential problems before they arise.

At the end of the PCMO service life, whether in 2018 or sooner, any repair strategy will require removal of the PCMO surface. The surface is not a structural layer and cannot be left in place under a new surface layer even if not delaminated. If it were to delaminate in the future underneath a new layer, it could cause premature failure of the new surface. At the time of replacement of the PCMO, a new design should be completed in accordance with the most current UFC procedures to determine the feasible repair alternatives. This should include an assessment of the structural remaining life of the runway relative to the expected future traffic loads in addition to life cycle cost analysis of the alternative repair strategies.

AECOM reviewed the prior PCI data (2002 and 2008) and provides a review of the PCI change over time in Table 4-3.

Table 4-3 Deterioration of Pavement Condition Index (PCI)

Branch ID	Section ID (2012)	Section ID (2002)	PCI (2012)	PCI (2008)	PCI (2002)
14L	R01A	R14L-03; R14L-04	82	90	83; (between 87 to 100)
	R02C	R14L-02	68	72	67
	R03C	R14L-01	68	82	80
	R04A	R14L-01	75	79	80
14R	R05A	R14R-02	50	60	71
	R06A	R14R-01	67	81	77
	R07A	R14R-01	66	83	77
	R10A	R14R-03	93	93	91
	R11A	R14R-04	47	54	62
AP_West	A20B	WRP-3	63	63	NA
	A21B	WRP-2	94	97	93
	A22B	WRP-4	76	91	90
TW A	T20C	TWA-01; TWA-02; TWA-03	88	68	66; 82; 70
	T25C	TWA-3B	68		
	T27C[(1)]	(subsection T20C)	56	68	66; 82; 70
TW AA	T12A	TWAA-01	80	67	86
	T14A	TWAA-1A	70	85	NA
	T15A	R14R-04; TWAA-02	47	56	62
TW B	T21C	TWB-01; TWB-02; TWB-03	75	71	61; 76
	T24C	TWB-2A; TWB-3A	70		
TW C	T22C	TWC-01; TWC-02	76	78	88; 83
	T23C	TWC-1A	64		
TW D	T03A[(1)] T28A[(1)]	TWD-01; TWD-02;EPTW-03	52	65	89; 88
	T26A[(1)]	(subsection T03A)	87	65	89; 88
TW East	T01A	EPTW-04;EPTW-4C	91	90	99; NA
	T02A	EPTW-4A	63	85	NA
	T04A	EPTW-01	92	92	95
	T09A	EPTW-02	86	83	96
	T13A	EPTW-4B	93	92	NA
TW West	T16A	WPTW-01; WPTW-01A	94	97	NA
	T17A	WPTW-02	65	78	95
	T18A	WPTW-03	48	62	82
	T19A	Not available	97	(between 87 to 100)	(between 87 to 100)

[(1)] Section further broken down into sub-sections in 2012 due to varying pavement condition but aggregated here for comparison to prior year data.

5.0 Rehabilitation Recommendations

A Pavement Condition Index (PCI) survey was completed in FY'08 and the results showed several areas on the airfield that were in 'Fair' or 'Poor' condition, which translates to PCI values less than 70. Generally pavements are rehabilitated once their PCI value is below 60 or 70, depending on the type and use of the pavement. PCI life cycle trends are shown in Figure 5-1 below. As can be seen, the worse the condition of the pavement, the more expensive the rehabilitation treatment will be. For example, preventive maintenance is generally applied to pavement in the 'Satisfactory' or 'Good' condition category; major rehabilitation such as resurfacing and slab replacements are done when pavement is in 'Fair' condition; and once pavements are 'Poor' or worse, they generally require reconstruction. In the absence of reconstruction or preventive maintenance being completed which is often the case due to limited budgets, stop-gap repairs can be completed to help provide for safe operations of aircraft along the pavement until such time as reconstruction can be completed. It is important to appreciate the difference between preventive maintenance and stop-gap repairs. Preventive maintenance is applied to pavements in fair to good condition to help improve their condition and increase the life cycle of the pavement. Stop-gap treatments, conversely, are intended to hold the pavement in a safe condition until such time as reconstruction can be completed. Stop-gap treatments intend to address the bare minimum in repairs because any funding spent on these repairs provides no long term benefits aside from safety.

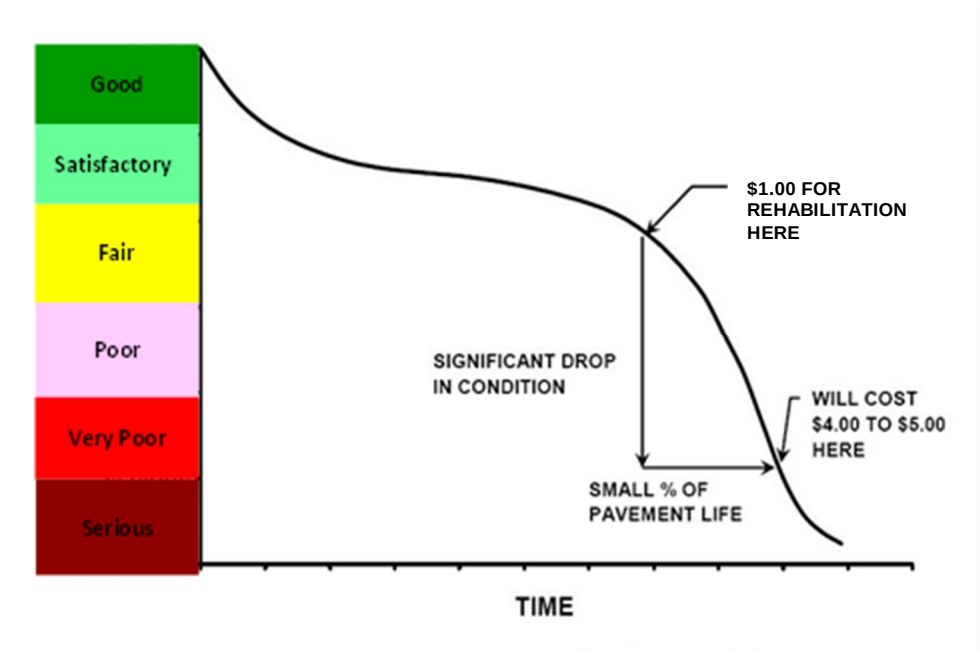

Figure 5-1 Pavement Life Cycle and PCI

5.1 Priority 1 Repairs

The areas identified as 'Fair' or worse in 2008 are considered the 'Priority 1' pavements for repair at Moffett Federal Airfield. They were inspected in 2012 in detail to determine current condition and rehabilitation needs, with distresses being mapped using GPS enabled tablet computers. Based on the pavement condition survey, airfield pavement rehabilitation

recommendations have been developed for these pavements. Priority 1 repairs include only ten sections that were inspected in detail and it is noted herein whether the recommended repairs are major rehabilitation, preventive maintenance or stop-gap. In general, preventive maintenance and stop-gap repairs are recommended as an alternative to major rehabilitation and this carries a risk with it due to allowing the pavement to continue to deteriorate to a point of requiring more costly maintenance at a later date – essentially the cost of deferral. Note that stop-gap repairs should be viewed as the very minimum that should be invested in the pavement to address FOD and maintain a safe operating environment. Specific repair locations and typical repair details are provided for the features noted below in Appendices D1 and D2 respectively. These are the locations where distress mapping has been completed as shown in Appendix A2.

A. Taxiway "D" PCC pavement identified as T03A (yellow color) on FY 2008 Condition Report (now sections T03A, T26A, and T28A).
B. Runway 14R Approach end, PCC pavement identified as R05A (Yellow color) on FY 2008 Condition Report.
C. West Parallel Taxiway PCC pavement identified as T18A (yellow color) on FY 2008 Condition Report.
D. Taxiway "A" PCC pavement identified as T20C (yellow color) on FY 2008 Condition Report (now sections T20C and T27C)
E. Taxiway "AA" PCC pavement identified as T12A and T15A (yellow color) on FY 2008 Condition Report.
F. Runway 32L Approach end, PCC pavement identified as R11A (purple color) on FY 2008 Condition Report.
G. Runway 14R-32L at Taxiway "B" crossing – Visual assessment of subsurface drainage issues and possible mitigation

During the inspection, AECOM noted that in some cases, for example Taxiway D, the condition of the pavement was not homogeneous along its length and therefore the pavement management sectioning was updated to better reflect the condition. This resulted in the condition of some sections appearing to 'improve' from 2008. Sections that are still within the PCI category of less than 70 are recommended for Priority 1 rehabilitation activities. Some of these activities include major rehabilitation such as reconstruction, depending on the specific conditions. Given that budgets are limited, both preventive maintenance and stop-gap maintenance are recommended as alternatives if appropriate.

Taxiway D (west of RW 14L – section T26A)

This section was previously combined with the section of Taxiway D east of Runway 14L and also part of the East Taxiway. Based on its condition and traffic flow patterns, this section was evaluated on its own in 2012. The condition of this section is 'Good', with a PCI of 87.

The distresses observed within this section are infrequent and generally low in severity. Minor preventive maintenance in the form of resealing joints, spall repair and crack seal are recommended. There is one high severity distress at the fillet near Runway 14L that should be reviewed and repaired if there is evidence of FOD potential.

Based on the minor preventive maintenance needs on this section, it has not been included as a Priority 1 area.

Taxiway D (east of RW 14L – part of section T28A)

This section was previously combined with the section of Taxiway D west of Runway 14L and also part of the East Taxiway. Based on its condition and traffic flow patterns, this section was evaluated on its own in 2012. The condition of this section is 'Poor', with a PCI of 53.

The distresses observed within this section range from low to medium severity and include joint seal damage, patches and surface scaling. The surface scaling is medium severity throughout, and by definition this type of distress exhibits Foreign Object Damage (FOD) potential. From this survey, it is not clear as to the reason for the patching, nor is it clear how quickly the surface scaling will deteriorate. Generally with medium severity scaling, full slab replacement is recommended to remove the FOD risk and therefore this taxiway is included as a Priority 1 pavement for major rehabilitation. If, however, the rate of deterioration is slow, a short term repair option may be to complete preventive maintenance repairs now, and monitor the area to address any FOD concerns as they arise. At such time as the extent of patching and FOD risk becomes unmanageable, stop-gap repairs can then be performed until the major rehabilitation is completed.

East Taxiway (between Taxiways C and D, part of section T03A)

This section was previously combined with Taxiway D on both sides of Runway 14L. Based on its condition and traffic flow patterns, this section was evaluated on its own in 2012. The condition of this section is 'Poor', with a PCI of 51, showing deterioration since 2008.

The distresses observed within this section range from low to high severity and include joint seal damage, patches, spalls and surface scaling. Similar to the adjacent section on Taxiway D, the surface scaling is medium severity throughout which has the potential for FOD. This section also exhibits some medium and high severity joint and corner spalls which require patching and several continuous slabs (outer slab row south of centerline) with a longitudinal crack. Some of the existing patches are also deteriorating and should be considered for replacement. From this survey, it is not clear as to the reason for the patching, nor is it clear how quickly the surface scaling will deteriorate. Generally with medium severity scaling, full slab replacement is recommended to remove the FOD risk and therefore this taxiway is included as a Priority 1 pavement for major rehabilitation. If, however, the rate of deterioration is slow, a short term repair option may be to complete preventive maintenance repairs now, and monitor the area to address any FOD concerns as they arise. At such time as the extent of patching and FOD risk becomes unmanageable, stop-gap repairs can then be performed until the major rehabilitation is completed.

Runway 14R Approach End (section R05A)

The condition of this section is 'Poor', with a PCI of 50, showing deterioration since 2008.

The distresses observed within this section range from low to high severity and include joint seal damage, patches, spalls and surface scaling. The spalls are generally medium and high severity and should be patched. No structural cracking were observed on this section. There are many existing patches that appear to have been placed to repair spalls at corners and joints. Generally with medium severity scaling, which exists throughout the section, full slab replacement is recommended to remove the FOD risk and therefore this runway approach end is included as a Priority 1 pavement for major rehabilitation pavement. If, however, the rate of deterioration of scaling is slow, a short term repair option may be to complete preventive maintenance repairs now, and monitor the area to address any FOD concerns as they arise. Subsequently, monitoring of the area should continue frequently to complete patching for FOD concerns as they occur.

West Parallel Taxiway (Runway 14R Approach End to Taxiway C, Sections T18A)

The condition of this section is 'Poor', with a PCI of 48, showing deterioration since 2008.

Starting at the Runway 14R approach end and for approximately 525 feet, medium severity scaling is observed over the full extent of the taxiway. The other distresses noted include mostly low severity spalls, patches and joint seal damage. The next 500 feet show a decrease in scaling severity to low, but an increase in both the quantity and severity of spalls and patches. The remainder of the taxiway is similar to this latter section (525' to 1000') however in the west row of slabs, the scaling is again medium severity. Based on the extent of maintenance required on this taxiway and the scaling throughout, reconstruction is recommended. An alternative and less costly approach is to complete preventive maintenance that addresses the FOD issues by patching of the medium and high severity spalls, replacement of deteriorated patches and resealing joints. Subsequently, monitoring of the area should continue frequently to complete patching for FOD concerns as they occur.

Taxiway A (West Taxiway to Runway 32L, Section T27C)

The condition of this section is 'Fair', with a PCI of 56, showing deterioration since 2008.

The taxiway is six slabs wide and exhibits extensive structural failure evidenced by corner breaks and linear cracks on the interior four slabs. Over half of the corner breaks are medium severity indicating FOD potential related to the crack. There is very little that can be done for these slabs from a preventive maintenance standpoint. Crack sealant will not hold for long term because the slabs are continuously moving under traffic which will dislodge the sealant. Full taxiway reconstruction is recommended, however removal and replacement of the four center slabs would address the heavily trafficked area of the taxiway and this latter scenario is included as the Priority 1 major rehabilitation recommendation. FOD management, which is purely a stop-gap measure, should be performed until the slabs can be replaced. As such, a preventive maintenance alternative is not recommended for this section.

Taxiway A (Runway 32L to Runway 32R and Runway 32R to East Taxiway, Section T20C)

The condition of this section is 'Good', with a PCI of 88. This section was in 'Fair' condition in 2008, but included Section T27C. For this current inspection, based on the more deteriorated condition of this taxiway between the West Taxiway and Runway 32L, the taxiway was broken into more sections to better assess the condition. Consequently, it is noted that the portion of the taxiway from Runway 32L to the East Taxiway (Section T20C) is in better shape than the section (T27C) discussed above.

The taxiway is six slabs wide and exhibits the beginning of structural failure evidenced by mostly low severity corner breaks. At this time, the best approach is to seal the cracks to try and reduce the deterioration rate of the corner breaks. Also, replacing deteriorated joint sealant would keep water out from beneath the slab providing long term benefits to the pavement. Preventive maintenance is the recommendation at this time. If this is not performed, then stop-gap repairs can be completed at the risk of more rapid deterioration of the pavement and a need for major rehabilitation sooner.

Taxiway AA (PCC pavement between Runway 32L to Runway 32R, Section T12A)

The condition of this section is 'Satisfactory', with a PCI of 80.

The main distresses observed within this section include medium to high severity patches and high severity joint seal damage. The patches are generally located within the taxiway

keel section and therefore should be addressed. The spalls are generally medium and high severity and should be patched. Neither structural cracking nor scaling was observed on this section. At this time, the best approach is to repair the patches and spalls and re-seal the joints. This preventive maintenance approach is included as a Priority 1 item. If this is not performed, then stop-gap repairs can be completed at the risk of more rapid deterioration of the pavement and a need for major rehabilitation sooner.

Additionally, localized joint repair is recommended at the intersection of Runway 32L and TW AA, where wide joint opening between the asphalt and Portland Cement Concrete is observed and documented in Appendix F.

Runway 32L End (PCC pavement, Sections R11A and T15A)

The condition of this section is 'Poor', with a PCI of 47.

The main distresses observed within these sections include low to high severity cracks and joint seal damage, low to medium severity scaling, low severity joint spalls and some patching. The combination of structural cracks and scaling make this runway section a candidate for full reconstruction and that is the recommendation for this section provided as Priority 1 in the rehabilitation plan. The alternative is to apply stop-gap repairs such as slab replacements on slabs with high severity cracks.

5.2 Cost Estimates

Based on the detailed review provided above cost estimates were developed for these 'Priority 1' sections to include major rehabilitation, preventive maintenance or stop-gap repairs.

The repair recommendations for preventive maintenance and stop-gap repairs are based on the repair policies developed by AECOM as outlined in Table 5-1 below.

Table 5-1 Repair Policies

Distress Code (UFC) and Description		Severity	Preventive Maintenance Repairs	Stop-Gap Repairs
62	Corner Break	L	Do Nothing	Do Nothing
62	Corner Break	M	Partial Slab Replacement	Do Nothing
62	Corner Break	H	Partial Slab Replacement	Partial Slab Replacement
63	Linear Cracking	L	Do Nothing	Do Nothing
63	Linear Cracking	M	Crack Seal	Do Nothing
63	Linear Cracking	H	Full Slab Replacement	Full Slab Replacement
65	Joint Seal Damage	L	Do Nothing	Do Nothing
65	Joint Seal Damage	M	Reseal Joints	Do Nothing
65	Joint Seal Damage	H	Reseal Joints	Do Nothing
66	Small Patch	L	Do Nothing	Do Nothing
66	Small Patch	M	Partial Slab Replacement	Do Nothing
66	Small Patch	H	Partial Slab Replacement	Partial Slab Replacement
67	Large Patch	L	Do Nothing	Do Nothing
67	Large Patch	M	Full Slab Replacement	Do Nothing

Distress Code (UFC) and Description		Severity	Preventive Maintenance Repairs	Stop-Gap Repairs
67	Large Patch	H	Full Slab Replacement	Full Slab Replacement
68	Popouts		Do nothing	Do nothing
70	Scaling	L	Do Nothing	Do Nothing
70	Scaling	M	Do nothing	Do Nothing
70	Scaling	H	Full Slab Replacement	Full Slab Replacement
73	Shrinkage Cracking		Do Nothing	Do Nothing
74	Joint Spall	L	Spall Repair	Do Nothing
74	Joint Spall	M	Spall Repair	Do Nothing
74	Joint Spall	H	Spall Repair	Spall Repair
75	Corner Spall	L	Spall Repair	Do Nothing
75	Corner Spall	M	Spall Repair	Do Nothing
75	Corner Spall	H	Spall Repair	Spall Repair
76	Alkali Silika Reaction	L	Full Slab Replacement	Do Nothing
76	Alkali Silika Reaction	M	Full Slab Replacement	Do Nothing
76	Alkali Silika Reaction	H	Full Slab Replacement	Full Slab Replacement

Table 5-2 provides the unit costs for each repair type noted above, as well as AC Crack Seal should this be needed. The estimated costs for repair of the airfield pavements are provided for planning purposes and should be reevaluated at the time of bidding. The unit prices are developed based on a review of the bid tabulations from the most recent projects in the Bay Area (Oakland and San Francisco International Airports, NASA Moffett Field) and Los Angeles International Airport. In developing the unit costs and estimates, AECOM assumed that the repair work will be performed during normal day-time working hours (Monday through Friday). The unit costs include a 10% contingency for security badge requirements and mobilization / demobilization.

The following additional costs should be evaluated and be added to each bid package as needed depending on the type of repair and size of the project:

1. Traffic Control and Phasing (2% to 4% of estimated construction cost)
2. Temporary Erosion and Pollution Control (2% to 4% of estimated construction)
3. Night and Weekend work (10% to 20% of estimated construction cost)
4. Contingency (10% of estimated construction cost)
5. Design and Construction Management (15% of estimated construction cost)

Note that the actual costs may be up to 50% more than the estimates provided herein based on these potential additional contingency items.

Table 5-2 Repair Unit Costs

Repair Type	Unit Cost ($)	Unit of Measure
PCC Crack Seal	7.90	Linear Feet (LF)
AC Joint and Crack Seal	5.50	Linear Feet (LF)
PCC Joint Seal	7.50	Linear Feet (LF)
Spall Repair	180.00	Square Feet (SF)
Partial Slab Replacement	32.00	Square Feet (SF)
Full Slab Replacement	22.50	Square Feet (SF)

Table 5-3 provides the estimate of repair types and associated costs for each specific location as detailed in Section 5.2. AECOM recommends major rehabilitation, which is generally reconstruction of PCC slabs, in all Priority 1 sections except T26A and T20C. T26A is in good condition and does not need rehabilitation or maintenance. T20C does not require major rehabilitation but will benefit from preventive maintenance. AECOM recognizes that budget constraints exist, however, and a preventive maintenance alternative to major rehabilitation is included within Table 5-3 if appropriate. So, while the recommended rehabilitation cost is $12.8 million, four of the seven sections may receive benefit from preventive maintenance treatments rather than more extensive major rehabilitation, at least in the short term, as shown in the table, reducing the immediate major rehabilitation need to approximately $4 million. Note that the alternative approach is meant to maintain pavements in safe operational conditions and slow the deterioration of the pavement. These pavement sections will likely still remain below the PCI threshold of 70 for major rehabilitation after completion of the preventive maintenance repairs. Table 5-3 also provides an estimate of the total Priority 1 stop gap repair quantities for these sections, should either major rehabilitation or preventive maintenance not be performed.

Table 5-3 Estimate Major Rehabilitation and Preventive Costs of Priority 1 areas

Section ID (Branch, PCI)	Major Rehabilitation Cost	Alternative Cost (Preventive Maintenance)	Stop Gap Cost (Minimum Recommended)
R05A (R14L, 50)(1)	$1,436,940	$2,520	N/A
R11A (R32L, 47)	$3,610,260	N/A	$70,673
T03A (EPTW, 52) (1)	$1,144,515	$22,520	N/A
T28A (TWD, 53) (1)	$1,168,439	$10,360	N/A
T26A (TWD, 87) (3)	N/A	N/A	N/A
T12A (TWAA, 80)	N/A	$30,353	$360
T15A (TWAA, 47)	$500,558	N/A	$14,438
T18A (WPTW, 48) (1)	$4,487,310	$468,330	N/A
T20C (TWA, 88) (3)	N/A	$55,154	N/A
T27C (TWA, 56) (3)	$438,750	N/A	N/A
Total	**$12,786,771**	**$589,236**	**$85,470**
Reduced Total (2)	**$4,549,568**		

(1)Sections that may benefit from preventive maintenance total $ 8.2 million, reducing major rehabilitation cost to approximately $4 million.

(2) Highest priority major rehabilitation sections. Sections that will not benefit from preventive maintenance.

(3)Distress data does not indicate the need for Stop Gap repair.

Table 5-4 provides quantities for both preventive and stop gap repairs, as indicated in Table 5-3, by section. In each case, stop gap repairs are an alternative to major rehabilitation also but should be viewed as the minimum amount of work that should be completed with the sole focus of maintaining the pavement in a safe operating condition. These pavement sections will continue to deteriorate as though no maintenance were performed.

Table 5-4 Estimate Total Repair Quantity

Repair Type	Repair Quantity	
Joint Seal	21,693	LF
Crack Seal	15	LF
Spall Repair	158	SF
Partial Slab Replacement	11,625	SF
Full Slab Replacement	4,938	SF

Typical repair details for these repair recommendations are provided in Appendix D2.

Table 5-5 and Table 5-6 provide cost estimates of repair type by section for preventive and stop gap, respectively.

Table 5-5 Cost Estimate for Preventive Repairs by Section

Section ID (PCI)	Summary Repair Type	Count	Estimate Repair Area	Unit of Measure	Unit Cost ($/UOM)	Estimate Cost
R05A R14R (50)	Spall Repair	7	14	SF	180	$2,520
					Total	**$2,520**
T03A EPTW (52)	Spall Repair	7	14	SF	180	$2,520
	Partial Slab Replacement	2	625	SF	32	$20,000
					Total	**$22,520**
T28A TWD (53)	Spall Repair	1	2	SF	180	$360
	Partial Slab Replacement	1	313	SF	32	$10,000
					Total	**$10,360**
T12A TWAA (80)	PCC Joint Seal	111	3,053	LF	7.5	$22,894
	Spall Repair	9	18	SF	180	$3,240
	Full Slab Replacement	1	188	SF	22.5	$4,219
					Total	**$30,353**
T18A WPTW (48)	PCC Joint Seal	243	12,150	LF	7.5	$91,125
	Spall Repair	53	106	SF	180	$19,080
	Partial Slab Replacement	33	10,313	SF	32	$330,000
	Full Slab Replacement	2	1,250	SF	22.5	$28,125
					Total	**$468,330**
T20C TWA (88)	PCC Joint Seal	236	6,490	LF	7.5	$48,675
	PCC Crack Seal	1	15	LF	7.9	$119
	Spall Repair	1	2	SF	180	$360
	Partial Slab Replacement	2	188	SF	32	$6,000
					Total	**$55,154**

Table 5-6 Cost Estimate for Stop Gap Repairs by Section

Section ID (PCI)	Summary Repair Type	Count	Estimate Repair Area	Unit of Measure	Unit Cost ($/UOM)	Estimate Cost
R11A	Spall Repair	1	2	SF	180	$360
R32L	Full Slab Replacement	5	3,125	SF	22.5	$70,313
(47)					**Total**	**$70,673**
T12A TWAA	Spall Repair	1	2	SF	180	$360
(80)					**Total**	**$360**
T15A	Partial Slab Replacement	1	188	SF	32	$6,000
TWAA	Full Slab Replacement	1	375	SF	22.5	$8,438
(47)					**Total**	**$14,438**

5.3 Long Term Repairs

AECOM has reviewed the PCI deterioration as shown in Table 4-3 to help project the expected future condition of the airfield pavement. Based on these data points and current pavement age, it is expected that a deterioration of approximately 1 point per year for PCC pavements and 3 points per year for asphalt surface over concrete pavements can be expected.

As stated in the 2002 Site Specific Report, the PCI limits for airfield pavement rehabilitation are 70 for runways and 60 for taxiways and aprons.

The remainder of the airfield was evaluated to assess the current condition and prioritize pavement rehabilitation projects for the future. Projects were developed and prioritized based on the following:

- Priority of use (ie. Runway more important than taxiway, etc)
- Current condition and expected deterioration based on typical deterioration for pavement type

For example, Runway 14L-32R is the main runway and in fair condition and therefore is Priority 2. Runway 14R-32L is in similar condition but slightly lesser priority and therefore Priority 3. Main taxiways follow based on condition, then secondary taxiways and aprons.

Based on expected deterioration and the PCI limits for rehabilitation, approximately 70% of the inspected area is expected to reach these limits (70 for runways and 60 for other pavements) in the next six years. Rehabilitation includes joint seal, crack seal, spall repair, patching and slab replacements for PCC pavements and milling and resurfacing with concrete surface repairs for asphalt surfaces. In order to better determine the needs of these pavements and alternative repair approaches, detailed crack mapping is recommended during the next pavement condition update.

Appendix E provides a graphical representation of the long term pavement rehabilitation recommendations.

5.4 Mitigation of Subsurface Water under Runway Pavements

It has been observed by NARC that underground water seeps to the surface through the existing pavement cracks of the PCMO within the Runway 14R-32L and Taxiway B intersection. AECOM observed localized standing water at this location during inspections

after a rain event. This water issue may be more widespread along the runway based on discoloration observed at cracks by AECOM during inspections. Based on existing reports reviewed, Runway 14R-32L has neither a drainage layer nor a subsurface drainage system in place.

Water sources in pavement, can be from infiltration or subterranean water. Infiltration is surface water which enters the pavement through cracks or joints in the pavement. Subterranean water comes up from below the pavement and can occur in areas of high water tables or localized artesian wells.

The 2002 Site Specific Report indicated the presence of artesian wells at the South East Ramp and also indicated the potential for these wells to exist at other locations. This would support the theory that this particular water issue is subterranean rather than from infiltration.

It is certainly possible, however, that there are delaminations between the PCMO and underlying asphalt where surface water that seeps into the many surface cracks may be held. Further investigation is needed to determine the cause so that an appropriate solution can be designed. Further investigation can be completed to determine if the issue is subterranean as follows:

1. Visual inspection of the drainage system inlets and cleaning as needed if they are clogged. Review of drainage as-built records to ensure all inlets exist as designed.
2. Install ground water monitoring wells at the intersection and monitor frequently, including at significant rain events.
3. Video inspection of the 12 inch storm drain that is underneath the Runway 14R-32L and Taxiway B intersection to look for any cracks in the pipe.
4. Survey of the pavement to check grades and identify any localized low spots.

This investigation can be phased in the order presented above to minimize costs. If this investigation does not yield information supporting subterranean water, then infiltration is the likely cause.

Should infiltration be the cause, the installation of an underdrain system along the edges of the effected runway may help mitigate this condition to remove the accumulation of water underneath the pavement. The underdrain system may consist of perforated 6-inch PVC pipes in a gravel trench (porous material wrapped with geotextile fabric), and constructed 36 inches from the runway pavement edge in the AC pavement, with a minimum of 12 inches below the base course layer. Water underneath the pavement can enter the perforated pipes and be conveyed into the existing storm drainage system. This removal of water can potentially prevent pavement failures due to subgrade saturation. Appendix D3 provides a detail for this repair. Placement of a drainage layer is crucial for the underdrain system to function as intended.

In general, subterranean water can be addressed by sub surface drainage systems that control the ground water level. This can be done during initial or reconstruction, but not as a retrofit to existing pavement.

6.0 Pavement Classification Number

UFC 3-260-03 ‘Airfield Pavement Evaluation’ defines Aircraft Classification (ACN) and Pavement Classification Numbers (PCN) as follows;

ACN – A number that expresses the relative structural effect of an aircraft on different pavement types for specified standard subgrades in terms of a standard single-wheel load.

PCN – A number that expresses the relative load-carrying capacity of a pavement in terms of a standard single-wheel load.

In theory, a pavement with a particular PCN value can support, without weight restrictions, an aircraft that has an ACN value equal to or less than the pavement's PCN value.

For Navy airfields, the pavement is evaluated for a 10-year life expectancy to assess its capability to carry out its mission over that time period. This was done in 2002 for Moffett Federal Airfield by the Southwest Division Naval Facilities Engineering Command and the data were presented in a July 2002 report titled 'Airfield Pavement Load Evaluation'. The PCN values have been re-evaluated for Moffett based on updates to traffic data and a review of pavement section thickness and layer strength data. The results of this evaluation are summarized in Table 6-1 and represented graphically in Appendix G. Appendix G also provides more details of the data used in the analysis. Note that the 2002 input data were evaluated to reproduce the results and after several reviews the results could not be duplicated given the inputs provided in the 2002 report. Appendix G provides the comparison of 2002 data to the results calculated today using the military's PCASE software.

Table 6-1 Evaluation of Pavement Classification Number

SECTION (2002)	SECTION (2012)	2012 PCN	ACN	ACN/PCN
R14L - 01	R03C and R04A	67/R/B/W/T	49.3	0.74
R14L - 1B	part R02C (TW C)	81/R/B/W/T	49.3	0.61
R14L - 02	R02C	71/R/B/W/T	49.3	0.69
R14L - 03	R01A	63/R/B/W/T	49.3	0.78
R14L - 04	R01A	67/R/B/W/T	49.3	0.74
R14R - 01	R06A and R07A	92/F/A/W/T	50.9	0.55
R14R - 02	R05A	45/R/B/W/T	49.3	1.11
R14R - 03	R10A	39/R/B/W/T	49.3	1.28
R14R - 04	R11A	33/R/B/W/T	49.3	1.52

As shown in Table 6-1, there are 3 sections that have an expected pavement life of less than 10 years, evidenced by an ACN/PCN ratio that is greater than 1. This is evaluating the PCN against the highest ACN value for the aircrafts evaluated, in peacetime, which is 49 to 51 for the C-17, depending on pavement type. A sensitivity analysis was completed to account for some uncertainty in traffic inputs. Volumes for aircraft that are heavier than 100,000 pounds were increased by 10% and the results are shown in Table 6-2. As can be seen, this increase in traffic does not change the PCN due to the relatively low volume of aircraft at the airport. What the PCN results suggest is that the majority of Runway 14R-32L is not capable of sustaining the 10 years mission at the full design load. In general, this requires reduction in mission by reducing the aircraft weights (and keeping the passes and expected life constant), as shown in Table 6-3, by reducing the aircraft passes (and keeping the aircraft weight and expected life constant), or by realizing that at the current weight and passes, the expected life will be shorter. From a functional perspective however, based on PCI data, both runways require rehabilitation as soon as budgets allow.

Table 6-2 Sensitivity Analysis Pavement Classification Number

SECTION (2002)	SECTION (2012)	2012 PCN	2012 PCN (sensitivity check using 10% increased traffic
R14L - 01	R03C and R04A	**67/R/B/W/T**	67/R/B/W/T
R14L - 1B	part R02C (TW C)	**81/R/B/W/T**	81/R/B/W/T
R14L - 02	R02C	**71/R/B/W/T**	71/R/B/W/T
R14L - 03	R01A	**63/R/B/W/T**	63/R/B/W/T
R14L - 04	R01A	**67/R/B/W/T**	67/R/B/W/T
R14R - 01	R06A and R07A	**92/F/A/W/T**	92/F/A/W/T
R14R - 02	R05A	**45/R/B/W/T**	45/R/B/W/T
R14R - 03	R10A	**39/R/B/W/T**	39/R/B/W/T
R14R - 04	R11A	**33/R/B/W/T**	33/R/B/W/T

Table 6-3 Allowable Aircraft Gross Load (kips)

Runway – (2012 Evaluation)	Gear Type and Typical Aircraft								
	S Single	T Twin	ST Single Tandem	SBTT Single Belly Twin Tandem	TDT Twin Delta Tandem	TRT Triple Tandem	TT Twin Tandem	DDT Double Dual Tandem	5D[1] 5Dual
32R/14L	40	55	90	NA	485	340	207	460	606
32L/14R	72	120	138	NA	675	503	226	686	743

[1] Represents the Antonov 124