SUNRISE PARK-BIG LAKE
AZ PFH 43-1(1)
3R Segment

PAVEMENT REPORT
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I. INTRODUCTION

On August 5, 2003, a pavement and subgrade soil investigation was completed along the 3R project segment of the Big Lake-Sunrise Park project. This segment is located within the Fort Apache Indian Reservation and provides access to the Apache-Sitgreaves National Forest. The investigation started at about MP 377.4, the intersection of State Route 260 and Forest Highway 43 (also known as State Route 273). The investigation proceeded south along Forest Highway 43 for about 5.5 miles (MP 383). There were two primary goals of this investigation. The first goal was to complete dynamic cone penetrometer (DCP) testing of the base/subgrade and to obtain soil subgrade samples. The DCP results and testing results on the soil subgrade were used for characterizing the subgrade/base strength for pavement structural design. The second goal was to evaluate the pavement and pavement thickness in order to develop pavement rehabilitation recommendations. There were 8, 5-foot borings completed and 12 core-holes completed to determine pavement depth. Four subgrade samples were submitted for soil classification and R-value testing. The boring logs, lab test results, and the pavement rehabilitation and design recommendations are included in this report.

II. CLIMATE AND THE EXISTING PAVEMENT, SOILS, & GEOLOGY

Climate

This segment of Forest Highway (FH) 43 is close to 9000 feet above sea level. The winters are cold and snowy with average high temperatures in the 40's°F and lows in the upper teens. The summers are pleasant with high temperatures rarely exceeding 85°F, and lows between 40°F and 50°F. The summer months will typically have frequent, monsoon-type afternoon thunderstorms. The average annual precipitation is about 23 inches. Over 50% of this precipitation falls within a four-month span from July through October.

Existing Pavement

The pavement had the following existing conditions:

The width of the pavement varied from 32' to 35' with a predominant width of 34'. The northbound lane has a wide shoulder varying in width from 8' to 10'. The shoulder has a gravel surface that had been primed and/or fog sealed. The mainline roadway surface consists of a recently placed good quality chip seal. The depth of bituminous material (HACP and chip seals) varied from 3.25" to 5" with an average depth of 4". It was not determined when the pavement section was constructed, but it is presumed to be 20+ years old. The typical material beneath the asphalt pavement was crushed red cinder. Most of the roadway was built on an embankment fill consisting of this crushed red

cinder. The R-values of this material are very high and will be able to support a recycling operation. The relatively new chip seal is masking much of the pavement distress. In numerous areas it is apparent that sealed transverse, longitudinal, and block cracks exist beneath the chip seal. No rutting greater than 0.25 inch was observed and for the most part was non-existant.

For the table below and throughout the report milepost 377.4 is approximately the location of the SR 260 and FH 43 intersection.

Table 1: PAVEMENT CONDITION SUMMARY

Milpost/ Location*	Pav't Width	Shldr Width (NB lane)	Asphalt Depth	Pavement Conditions
377.4 (~150' from intersection with SR 260).	34'	-	3.5"	Chip seal lightly flushing. No cracking.
377.5	34'	8'	4"	Chip seal lightly flushing. No cracking.
377.75	-	-	4"	Chip seal lightly flushing. No cracking.
378	35'	9'	5"	Chip seal lightly flushing. No cracking.
378.25	-	-	4"	Chip seal lightly flushing. No cracking.
378.5	33'	9'	4.75"	Chip seal lightly flushing. No cracking.
379	-	-	4.25"	Indications of sealed transverse cracks beneath chip seal, every 30' to 40'.
379.25	-	-	4"	Block, longitudinal, and transverse cracking is apparent beneath chip seal.
379.50	35'	10'	4"	Block, longitudinal, and transverse cracking is apparent beneath chip seal.
379.75	35'	10'	4.5"	Regularly spaced transverse cracks (about every 50') are apparent beneath chip seal. Necking down (concave) at transverse cracks.
380	34'	10'	4"	Regularly spaced transverse cracks (about every 50') are apparent beneath chip seal. Necking down (concave) at transverse cracks
380.25	33'	9'	4"	Regularly spaced transverse cracking is apparent beneath chip seal.
380.5	-	-	4"	Regularly spaced transverse cracking is apparent beneath chip seal.

Milpost/ Location*	Pav't Width	Shldr Width (NB lane)	Asphalt Depth	Pavement Conditions
381	35'	9'	4"	Regularly spaced transverse cracking is apparent beneath chip seal.
381.25	-	-	3.5"	Regularly spaced transverse cracks (about every 50') are apparent beneath chip seal. Necking down (concave) at transverse cracks.
381.50	33'	8'	4"	Regularly spaced transverse cracks (about every 50') are apparent beneath chip seal. Necking down (concave) at transverse cracks.
381.9	-	-	3.75"	Regularly spaced transverse cracking (about every 40') is apparent beneath chip seal.
382.15	32'	10'	3.5"	Moderate severity edge cracking. Regularly spaced transverse cracks (about every 50') are apparent beneath chip seal. Necking down (concave) at transverse cracks.
382.6	-	-	3.25"	Moderate severity edge cracking. Regularly spaced transverse cracks (about every 50') are apparent beneath chip seal. Necking down (concave) at transverse cracks.
383	-	-	3.25"	Moderate severity edge cracking. Regularly spaced transverse cracks (about every 50') are apparent beneath chip seal. Necking down (concave) at transverse cracks.

*Locations are approximate/estimated.

Soils

The predominant subgrade soil was red cinder fill material. There were only two borings (B-4 & B-8) where it appeared that native soil was encountered. The red cinders have an AASHTO soil classification of A-1 and an average R-value of 78. In some of the borings the cinders were moist below 2 feet. All of the borings except B-8 contained red cinder material in the top 4 feet. At boring B-8, an AASHTO soil classification A-7-6(15) material was encountered 16 inches from the surface. This material has an R-value of 8.

Beneath the asphalt cores at C-6, C-7, C-8, C-9, and C-10 it was observed that the top 1 to 1.5 inches of the red cinder fill was bound together. A dust palliative, deep-penetrating prime, or some other stabilizing agent could have been applied during original construction to cause this effect.

See the boring logs and test results for specific depths and more detailed information.

Geology

See the Geotechnical Report for the 4R (reconstruction) segment of this project for geologic information and background.

III. EXPLORATION

On August 8, 2003, a two-person crew from GeoMechanics Drilling completed 8 auger borings and 12 pavement cores within the 5.5-mile 3R project segment. A CME – 75 truck-mounted drill rig was used. Traffic control was provided by CFLHD staff with the use of signage from the drilling contractor. The borings were drilled to a depth of 5 feet at about 2600 feet intervals. The cores were taken in between the boring locations so pavement depth measurements were completed about every quarter-mile. All of the borings and cores were drilled within the roadway. Soil samples were taken at appropriate sites. CFLHD staff completed visual identification of the soils and logged the borings. Four samples were tested for strength (R-values) and soil classification. See the boring log in Appendix B for additional details.

Dynamic cone penetrometer (DCP) testing was performed at most of the core sites. The DCP measures the penetration rate through undisturbed soil or compacted aggregate. The penetration rate can be related to the *in situ* CBR. However, it is important to note that the *in situ* CBR will generally not correlate with a laboratory CBR test of the same material. The DCP test is intended to evaluate the field conditions of the material. Laboratory testing is not always representative of field conditions.

Typical pavement distresses were recorded and photos were taken to further document the condition of the pavement. Measurements of the pavement and shoulder width were taken periodically.

IV. TEST RESULTS

Table 2 provides a summary of the soil properties and test results on the soil samples submitted for laboratory testing. Appendix B contains the full laboratory report.

Table 2: SOIL PROPERTIES

Milpost/ Boring	Sample Depth	AASHTO Classification	R-Value	Fines (< #200) %	PI
MP 377.5 / B-1	3’-5’	A-1-a (0)	79	9.7	NP
MP 379 / B-3	2’–5’	A-1-b (0)	77	18	NP

Milpost/ Boring	Sample Depth	AASHTO Classification	R-Value	Fines (< #200) %	PI
MP 381 / B-6	1'-5'	A-1-b (0)	78	16	NP
MP 382.6 / B-8	1.25'-5'	A-7-6 (15)	8	58	30

The poor subgrade material in boring B-8 was isolated to the vicinity of this borehole. The core and boring locations before and after B-8 showed no evidence of fat clays within 2 feet of the surface. In this isolated area it is suggested to subexcavate a portion of this clay and replace with a granular material. See Section V, Pavement Recommendations.

Table 3: Dynamic Cone Penetrometer (DCP) Results

Milpost/ Core	Cumulative Depth (total) mm	DCP Index (averaged)	CBR*
MP 377.4 / C-1	203	3	73
MP 378.25 / C-3	118	4	55
MP 379.25 / C-5	82	2	100
MP 380.25 / C-7	202	4.5	49
MP 381.25 / C-9	129	4	55
MP 382.15 / C-11	198	4.5	49
MP 383 / C-12	144	4	55

*The CBR is derived from the USACOE correlation equation

As Table 3 indicates, the base/fill material beneath the asphalt pavement will provide good strength and support. The R-value results strongly support this conclusion.

Chart 1 and 2 on the following pages illustrates the pavement depths and subgrade material at the core and boring locations.

V. PAVEMENT RECOMMENDATIONS AND DISCUSSION

Pavement Design

The Arizona DOT supplied detailed traffic data. Based upon this data the following traffic inputs were used:

- AADT: 146
- 81% passenger vehicles, 10% RVs, 7% delivery/service trucks, 2% large trucks
- Growth rate of 2%
- Calculated 20-year cumulative ESALs: 132,000

The subgrade investigation produced 4 R-values to represent the strength of the typical soils. Three of the R-values tests were completed on the typical red cinder subgrade and one R-value test was completed on a red clay soil, which was found near the surface in only one location. The average of the three R-values representing the red cinder subgrade is 78. A design R-value of 70 was used. This R-value correlates to a resilient modulus of about 20,000 psi according to figure FF.6 in Vol. 2 of the AASHTO Guide for Design of Pavement Structures. The R-value of the red clay is 7. As discussed below, it is recommended that this small area be subexcavated. See Appendix B for additional design parameters and calculations.

Mainline Roadway

Moderate to high severity transverse, block, and edge cracking was apparent below the chip seal, especially from MP 379 to 383. The recently placed chip seal may be masking additional distress. Placing just an overlay is not recommended for long-term performance given the age of the existing asphalt, the working cracks, and the freeze-thaw environment of the roadway. The recommended rehabilitation is to cold in-place recycle (CIPR) the existing 100 mm of asphalt pavement and place a 50 mm HACP overlay. This rehabilitation is cost effective and should provide a 20 year service life.

The roadway geometrics are well suited for CIPR. The DCP and R-value results indicate that the base/subgrade is strong enough to support the heavy CIPR train.

Given the above traffic and subgrade inputs, the calculated design structural number (SN) is 1.52. The following recommended pavement structural section satisfies this SN:

Recommended Pavement Structural Section

Material Type	Thickness	Structural Coefficient	SN
HACP – Superpave	50 mm (2 inches)	0.44	0.88
CIPR	100 mm (4 inches)	0.28	1.12
Totals	150 mm (6 inches)		2.00

Shoulder adjacent to Northbound (NB) lane

The existing gravel shoulder that has been treated with a penetrating prime/fog seal is in satisfactory condition. Essentially no erosion or other major degradation exists on the shoulder, and it appears to be structurally adequate for the minor amount of traffic/loads it receives. Two options exist for rehabilitating the shoulder:

(1) Recondition and re-prime.
(2) Recondition, re-prime, and place 50 mm HACP overlay to match mainline.

If the roadway stakeholders do not have any particular need to improve the functionality of the shoulder, option 1 is strongly recommended because of its significantly lower cost.

Parking Lot (MP 383)

The parking lot is in fair condition with some cracking and low spots. The parking lot appears oversized for the amount of use. There was not a single car parked in the lot during the field investigation.

The recommended rehabilitation is to crack seal, level and/or patch low spots with a fine minor asphalt mix (blade laid), and overlay with 50 mm of HACP to match the mainline.

Pavement Materials

- The HACP should be Superpave, bid item 401, 12.5 mm grading, and Type II smoothness. The unit weight can be estimated at 2325 kg/m^3.
- Hydrated lime (Type III), at 1%, will be the antistrip additive.
- The asphalt cement should be a PG 58-28 based upon LTPPbind software. Quantity can be estimated at 6% by weight of mix.
- A Tack coat (at 0.45 L/m^2 for estimating) between the CIPR and the HACP overlay should either be a CSS-1, CSS-1h, SS-1, or SS-1h emulsion.
- The CIPR, bid item 416, can be paid by the kilometer. The emulsified binder agent grade will be an HFMS-2p. A fog seal (at 0.45 L/m^2 for estimating) will be placed on the CIPR after final compaction to seal and provide protection against raveling and can be a CSS-1, CSS-1h, SS-1, or SS-1h emulsion.

Drainage, Subexcavation, and other Issues

For nearly the entire length, the roadway is on a built-up embankment of red cinders. Good drainage conditions exist. In regards to pavement performance, no special drainage corrections are necessary.

At MP 382.6, a fat, red clay was found within 400 mm from the surface. It is recommended to subexcavate this area 0.9 m from the top of pavement. It is also recommended that the select borrow (backfill) be daylighted to the foreslopes if possible. The exact limits of subexcavation should be determined by the CO, but for estimating purposes assume subexcavation from MP 382.5 to 382.9 (~entrance to parking lot).

The select borrow used for backfill should be relatively inexpensive because of acceptable local sources of red cinders.

The pavement structural section within the limits of the subexcavation should be 150 mm of aggregate base and 75 mm of HACP.

The width of the CIPR should be the width of the entire paved surface (34 to 35 feet). In order to maintain the existing crown, the recycling train will not be allowed to cross the centerline. The recycling train will most likely have to make two passes per lane because the widest milling header (with extensions) is 16 feet.

APPENDICES

A – Location Map

B – Laboratory Test Results, Pavement Design Worksheets, & Field Log

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