February 17, 2021

Mr. Ricky Denton
Navajo County Engineering Department
P.O. Box 668
Holbrook, AZ 86025

RE: Geotechnical Report
Starlight Ridge Pavement Distress
Webb Dr. & Starlight Ridge Rd.
Wagon Wheel, Arizona
S&A project Number 201542SS

Dear Mr. Denton:

This letter presents the results of a limited investigation and recommendations for evaluation of the existing pavement section for the Starlight Ridge Units I & II, west of the intersection of Webb Drive and Starlight Ridge Road in Wagon Wheel, Arizona.

S&A understands that the client intends to, at a minimum, mill/pulverize the in place existing residential roadway pavement section, reuse/reshape the AC millings and then repave the roadways. However, there is a concern that areas of the pavement that have failed, or are near failure, from loss of subgrade support due to moisture infiltration. Remediation of the existing pavement may require recommendations beyond typical milling and repaving the existing section(s) as discussed below.

The residential pavement encompasses several thousand linear feet of road, which includes the two initial phases of Starlight Ridge residential development. The residential roadways are expected to support primarily low volume passenger vehicular traffic. However, the development has sat mostly inactive, with respect to home construction over the past several years. It is evident that new construction has increased with respects to home development over the past year. It is expected that as the area develops, more construction traffic is anticipated (i.e.: construction delivery trucks, heavy duty excavation equipment, moving trucks, etc).

This site, which the investigation includes Phases I and II, is noted as 'hilly' topography. The roads are cut into some hillsides and portions are also placed upon mass fills. We understand that the two phases of this development were paved a few years apart, and the pavement is approximately 10-15 years old. The borings investigated were predetermined by Speedie & Associates with aid of the client representative via driving the site to discuss the problematic areas of pavement failure. The borings were then located at areas of interest due to possible moisture infiltration of subgrade soils (see attached Log of Borings). We are aware that as the roadways were developed, the subgrade soils was reportedly stabilized with chemical lime slurry (LSS) in order to alleviate subgrade to pavement stabilization issues. It is unknown to what thicknesses the lime slurry was placed, but during conversations with the client it was determined that 6-12 inches of LSS was mixed with subgrade soils and then compacted prior to placement of the roadway aggregate base course and pavement.

Existing Pavement Conditions: The original pavement appears to be, on average, in an aged and generally deteriorated condition. The pavement in most locations seems to be un-level and generally rough during driving. The pavement exhibits block-shrinkage cracking, typical of aged asphalt concrete pavements. Moderate to severe "Alligator" and fatigue cracking is also evident in some areas indicating overstressing and possible subgrade failure. In some locations, the "Alligator" cracked pavement has moderate rutting of the pavement. These pavement features can be caused by a combination of poor asphalt concrete materials, weak subgrade soils and water infiltration into these weak subgrade soils. The pavement appeared to have been fog or slurry seal coated at some point, along with crack sealing. There is also evidence, and verified by discussions with the client, that multiple areas where complete pavement failure occurred were replaced, which is evident with multiple pavement patches observed throughout the both phases of the development. The pavement also shows some signs of moderate to significant drying and stripping (loss of surface fines), also part of the aging process. The fog seal coating suggests that periodic maintenance was implemented. In addition there are some drainage and grading concerns with depressed areas allowing water to pond. The shoulders just off pavement edges in multiple locations appear inadequate for drainage. These areas appear to allow surface water to enter the pavement in a negative flow direction. It also appears that the pavement does not have a 'Maricopa' or thickened edge and does not have a curbing to provide lateral support for pavement edges and alleviate sub-surface water flow from the shoulders to enter the aggregate base course under the surface.

Geotechnical Evaluation: S&A obtained information about the subsurface conditions at the site using eight (8) solid-stem auger soil borings advanced using a Deere 317 skid-steer with auger attachment, to record the subsurface soil conditions and collect samples for laboratory testing. All of the soil borings were drilled in the existing residential paved roadway areas within the development. Six (6) of the borings were drilled to their intended advancement depth of approximately 3 feet below the existing finished pavement surface, and the remaining two (2) were terminated at a depth of 1 foot below existing pavement elevation due to auger refusal on sandstone/mudstone bedrock. The asphalt was cored at each location utilizing a 10 inch diameter core barrel with coring machine. The cores were collected for thickness measurements and photo logs. Soil samples were collected from beneath aggregate base bottom elevation to 1 foot below pavement. Soil samples were then collected from 1 to 3 feet below finished pavement elevation. The existing pavement section consists of 2.5 to 3.0 inches of Asphaltic Concrete (AC) over 2.5 to 4.5 inches of Aggregate Base Course (ABC). No subsurface groundwater was visible in any of the borings during the investigation. Selected soil samples were laboratory tested to determine grain-size distribution and plasticity (Atterberg Limits) for classification and pavement design parameters. The approximate boring locations are shown on the attached Soil Boring Location Plan. The laboratory data is presented in the attached Tabulation of Test Data.

Based on the results of the field and laboratory evaluation, the subsoils at the site underlying the ABC consists of generally stiff to medium dense, silty sand, clayey sand, sandy clays, with subordinate amounts of gravel. Underlying these soils is weathered sandstone/mudstone, which was only evident borings B-6 and B-7. Lime treated soils were evident in some of the borings. Laboratory testing consisted of grain-size distribution and plasticity (Atterberg Limits) tests for classification and pavement design parameters. Laboratory testing indicates liquid limits in the range of Non-Plastic (NP) to 39 percent with plasticity indices ranging from NP to 19 percent in the upper 1 foot soils. In the soils from 1-3 feet, the Laboratory testing indicates liquid limits in the range of Non-Plastic (NP) to 63 percent with plasticity indices ranging from NP to 37 percent. These results correlate to an average R-value of 56.6 in the upper 1 foot of the subgrade soils. The results from 1-3 feet in the subgrade soils correlate to an average R-value of 37.4.

Analysis: As indicated, the pavement appears to be showing varying signs of aging and is likely nearing the end of its useful design life. Block cracking is usually the result of volume change that can be related to fine aggregate AC mixes that have a high content of low penetration asphalt and adsorptive aggregates. As the asphalt oil ages, the mix becomes stiffer (less flexible) to the point where the pavement cannot tolerate the shrinkage forces that result from daily temperature changes. These types of cracks typically do not represent structural failure. However, as the pavement deteriorates, pathways for water infiltration into the subgrade soil develop, which can cause the subgrade to weaken and resulting in loss of support and progressive failure. Several areas show early signs of potential weakening and if left untreated they could gradually continue fail.

The subgrade will provide only marginal support for pavements due to the presence of highly plastic clay soils and resulting low R values in the underlying soils (beneath ~1 foot where LSS was noted). If paved shoulders or curbs are not used, it is recommended to at least provide a thickened asphalt ("Maricopa") edge to provide some lateral edge constraint and an edge moisture barrier. Longitudinal cracking is common where high shrink-swell potential clay subgrade are subject to wetting and drying and resulting movement.

Based on the current conditions of the pavement as outlined above, S&A primarily recommends that the existing pavement should be removed and replaced. Complete removal and replacement will provide the longest life and allow the opportunity to improve any poor drainage or subgrade issues. Full depth replacement-reconstruction will allow for a 20 plus year design life, provided that the pavement is properly maintained with a regular pavement maintenance program and cleaning of bar ditches/addressing drainage maintenance issues as they arise.

Due to the generally weakened pavement condition and relatively thin pavement thicknesses in most areas, a traditional mill and/or overlay option would be difficult as the milling process will likely result in significant 'pop-outs', and an overlay would most likely exhibit reflective cracking of the original asphalt, and therefore are not recommended.

The subgrade soils appear to be in fair to satisfactory condition, however it should be noted that zones of moderately moist soils were encountered in a few locations (mostly in areas of poor drainage or highly cracked pavement). There is a possibility that soft, moist, unstable zones exist in other areas that were not sampled/investigated. These areas may need some form of remediation or stabilization, or additional time to dry prior to placing new aggregate base or asphaltic concrete pavement.

As an option to possibly reduce costs by reducing the amount of export or import, the asphaltic concrete millings and existing aggregate base could be recycled and re-used for the new aggregate base course. This is likely the most economical option. These options are discussed in further detail in the following sections. Another option that could be considered is Cold In-Place Recycling. Contact this office for more information if interested. The owner should determine which option best meets their desires for extending the life of the pavement and the available project budget.

First, however, it must be noted that all new asphaltic concrete pavements will eventually crack. Cracking is typical and should be expected over the life of the pavement. In fact, it has been our experience on recent projects that the new asphalt binders that are available typically result in the earlier onset of age-related cracking. Routine maintenance is required to mitigate accelerated deterioration. Accordingly, it is highly recommended to establish a maintenance program where the cracks are routinely filled as they appear beginning at about the second year of life. It is also recommended that surface fog seal coats be considered beginning at about year 5 and every 5 years thereafter. This will help preserve the pavement and extend its service life.

If available, a review of the maintenance history of the existing pavement would be valuable information. Knowledge of previous mill and overlays or other forms of maintenance may result in adjustments to the recommendations made herein.

Remove and Replace: Based on the observed conditions of the existing pavement, the best approach from a geotechnical standpoint for this project would be removal and replacement to provide a new pavement structural section that can support the anticipated traffic loading. The new section will provide for a 20-year design life with proper maintenance. Removal and replacement will require complete removal of the existing asphaltic concrete surfacing layer and replacing it with a structural section consisting of new asphaltic concrete installed on top of the re-compacted existing aggregate base (AB). However, we recommend that additional ABC should be added to increase the structural support of the pavement section(s). The surface pavement may be removed down to the existing AB by milling & pulverizing. This method often does less damage to the underlying AB. However the surface can also be pulled off in sheets/chunks and removed from the site. If milled, some or all of the millings can be left behind to added to the existing AB section taking an opportunity to re-shape the surface and perhaps increase the cross drainage by elevating the crown and low spots that do not drain well. Millings can also be used to fix soft spots as discussed below.

After removal of the AC surface layer, the exposed aggregate base will require fine grading and re-compaction. It is recommended to add additional aggregate base or milled asphaltic concrete as necessary to result in the total section(s) recommended below, or remove some of the aggregate base to provide for a thicker section of asphaltic concrete surface. This may be reduced where it is necessary to tie into fixed grades. The exposed aggregate base should be compacted to at least 100 percent dry density as determined by ASTM D698. The entire area should be proof-rolled with a heavy pneumatic-tired roller to identify unstable areas for repair prior to paving.

As noted above, some potential exists that wet, unstable subgrade soils will be uncovered/revealed. Therefore the repairs should include a contingency to remove and replace additional subgrade soils if soft, wet areas are encountered. If it is not possible to remove the wet soils and replace with dry soils or millings, or allow the soils to dry, other means (such as cement treating the soils, incorporating a geogrid, etc.) may be used to stabilize. Alternatively, it may be possible to use the millings and existing aggregate base to stabilize any areas that require stabilization, provided the millings are prepared and meet the requirements of Maricopa County (M.A.G.) Specifications for ABC. If cement treating is used, it should be done following the guidelines of M.A.G. Standard Specification Section 311. If a geogrid is used, it is recommended to use 12 inches of AB or millings installed on a layer of Tensar TX140 or better, along with a woven geotextile fabric, installed per manufacture recommendations. The geotextile fabric will aid in alleviate loss of subgrade support should the soils become saturated. Contact this office or an Arizona Tensar representative for more information.

<u>Recommended Minimum Pavement Sections</u>: The County should choose the appropriate sections to meet the anticipated traffic volume and life expectancy. The section capacity is reported as daily ESAL's, Equivalent 18 kip Single Axle Loads. Typical heavy trucks impart 1.0 to 2.5 ESAL's per truck depending on load. It takes approximately 1200 passenger cars to impart 1 ESAL, RV's can range between 1 to 2 ESALs.

The following design parameters and sections are recommended for asphaltic concrete (AC) on aggregate base course (ABC), and it is noted that this design is based on an average of the most severe correlated R-values of the sub soils to better encompass the variability in soil types to obtain an average more stable pavement section(s).

<u>Pavement Design Parameters</u>

Assume:	One 18 kip Equivalent Single Axle Load (ESAL)/Truck
Life:	20 years
Subgrade Soil Profile:	
Material Passing #200 sieve:	69 Percent (Avg)
Plasticity Index:	26 (Avg)
R value:	14.4 (per ADOT tables)
M_R:	4,400 (per AASHTO design)

Area of Placement	18-kip ESALs	Flexible Pavement		
	Daily/Total	AC (0.39/0.42)	New ABC (0.12)	AC Millings (0.08)
Residential Roadways	2/11,600	3.0″	4.0″	4.0”
	3/23,300	3.0″	6.0″	4.0”
	6/44,100	3.0″	8.0″	4.0”
	11/79,200	3.0″	10.0″	4.0”
	12/84,900	4.0”	6.0”	4.0”
	20/145,100	4.0”	8.0”	4.0”
	33/238,900	4.0″	10.0″	4.0”

Notes:

1. Designs are based on AASHTO design equations and ADOT correlated R-Values.
2. Full Depth asphalt or increased asphalt thickness can be increased by adding 1.0-inch asphalt for each 3.0-inches of base course replaced.

These designs assume that all subgrades are prepared in accordance with this report and in accordance with state and local specifications, and paving operations are conducted in a proper manner. If pavement subgrade preparation is not completed immediately prior to paving, the entire area should be proof-rolled at that time with a heavy pneumatic-tired roller to identify locally unstable areas for repair.

The soils are moisture sensitive and the exposed subgrade may become unstable depending on the moisture content at the time of construction and/or precipitation events if left exposed for an extended period of time. If areas of elevated moisture exists, there is a potential for the soils to become soft and unstable. Several options are available to remedy this condition including deep ripping to open the wet subgrade and allow the soils time to dry, or removal and replacement of the wet, soft soils with suitable materials. If instability extends too deep, replacement can be combined with at least 12 inches of granular fill (ABC and/or millings) with geogrid such as Tensar Triax installed per the manufacturer's recommendations. Or cement could be used to create a cement-treated subgrade. Prior to placement of the aggregate base course, the pavement subgrade could be proof rolled with a 5,000 gallon water truck (or similar vehicle) to determine if there are soft unstable areas.

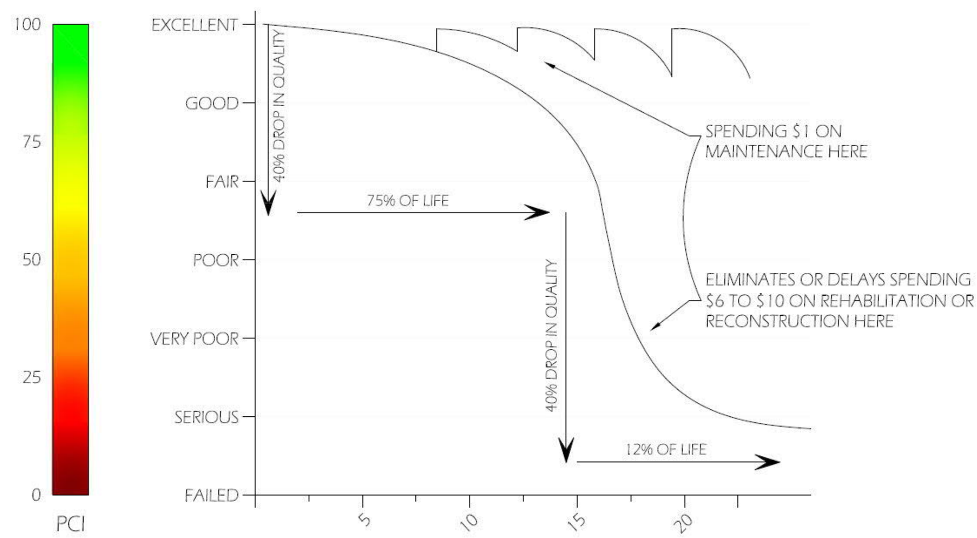
After grading to provide proper drainage, the exposed grades should be scarified a minimum of 8 inches deep, or assuming 4-6 inches deep if existing ABC is to be left in place and reused as asphalt concrete support. This includes improving the drainage off-pavement to allow pavement surface flow, during precipitation events, to drain away from the pavement into bar ditches and or other conveyance systems. The scarified soils should be thoroughly and uniformly moisture conditioned to ±2 percent of the material's optimum moisture content and compacted to at least 95 percent of its maximum dry density as determined by ASTM D-698 laboratory test procedures. If fill is required, the fill should be placed in horizontal lifts of a maximum of 8-inch loose thickness (or less depending on the compaction equipment) properly moisture conditioned as described above and compacted to at least 95 percent of the material's maximum dry density per ASTM D-698. New and existing aggregate base course or GSA should be properly moisture conditioned and compacted to a minimum of 100 percent of the material's maximum dry density per ASTM D-698.

Asphaltic concrete and pavement base course material should be per M.A.G. Specifications modified for the higher elevation. It is recommended that ½ inch or ¾ inch mix design be used for the pavements. While the ¾ inch mix has a somewhat rougher texture, it tends to offer more stability and resistance against surface scuffing, particularly in truck turning areas. Pavement installation should be carried out under applicable portions of M.A.G. specifications and local municipality standards. The asphalt supplier should be informed of the pavement use and required to provide a mix that will provide stability and be aesthetically acceptable. Some of the newer mixes are very coarse and could cause placing and finishing problems. A mix design should be submitted for review to determine if it will be acceptable for the intended use.

<u>Pavement Maintenance Plan</u>: Regardless of the pavement repair option selected, to achieve an extended life in the pavement, it is highly recommended that a maintenance plan be used to address the aging process of the pavement. This will allow for a lower operational cost, while extending the life of the pavement.

Proper pavement maintenance has been well documented to prolong the life of the pavement at a lower cost than having the pavement age with no maintenance. The figure below shows how implementing pavement preservation at the correct time will be a significantly more cost effective means for extending the life of the pavement. As long as the pavement remains in a fair to excellent condition, the cost of pavement preservation is relatively small, however, as the pavement deteriorates into the fair to serious range, the pavement life becomes significantly shorter and there is a change from preservation to pavement rehabilitation and reconstruction (at a significantly higher cost). Once the pavement enters into this middle zone, light pavement preservation techniques, such as seal coats, crack sealing, etc. become a poor use of funds and the process results in chasing the distress. This will result in the owner spending high amounts of money just to maintain the current pavement condition. The following figure provides a Pavement Condition Index (PCI) rating, which is a visual condition scale rating from 0 to 100, with 100 being a brand new pavement and 0 being a completely failed pavement. The PCI is a standardized method for rating a pavement based on a visual condition survey of the pavement. The rating procedure uses the pavement distress type and severity to calculate a PCI value for the pavement.

Life Cycle Cost Analysis



As discussed, all new asphaltic concrete pavements will eventually crack. Cracking in asphaltic concrete pavement is typical and should be expected over the life of the pavement. All pavements will age at different rates due to numerous variables, including factors such as loading condition and moisture infiltration or drainage issues. Accordingly, it is highly recommended to establish a maintenance program that addresses this aging process. In general terms it is recommended that the cracks are routinely filled as they appear. Cracking will typical begin to appear around the 2nd to 3rd year of life. So the maintenance program should include a budget item to conduct crack sealing of the pavement every year. The amount of crack sealing that is required will depend on how the pavement is aging. Once cracks are sealed, they typically will not need to be sealed for another 4 to 5 years. Therefore, the budget estimates should assume that approximately 25 percent of the pavement areas will need isolated crack sealing every year. It is also recommended that surface fog seal coats be considered beginning at about year 5 and every 5 years thereafter. This will help preserve the pavement surface as well as minimize the effects from moisture infiltration. Depending on the progression of the aging, more costly surface treatments such as thin overlays or slurry seals should be anticipated at the 15 to 20 year point of the pavements life.

General: Our analysis of data and the recommendations presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific sample locations. Our work has been performed in accordance with generally accepted engineering principles and practices; this warranty is in lieu of all other warranties express or implied.

We recommend that a representative of the Geotechnical Engineer observe and test the earthwork and pavement portions of this project to ensure compliance to project specifications and the field applicability of subsurface conditions which are the basis of the recommendations presented in this report. If any significant changes are made in the scope of work or type of construction that was assumed in this report, we must review such revised conditions to confirm our findings if the conclusions and recommendations presented herein are to apply.

We trust this meets your needs. If there are any questions, please do not hesitate to contact us.

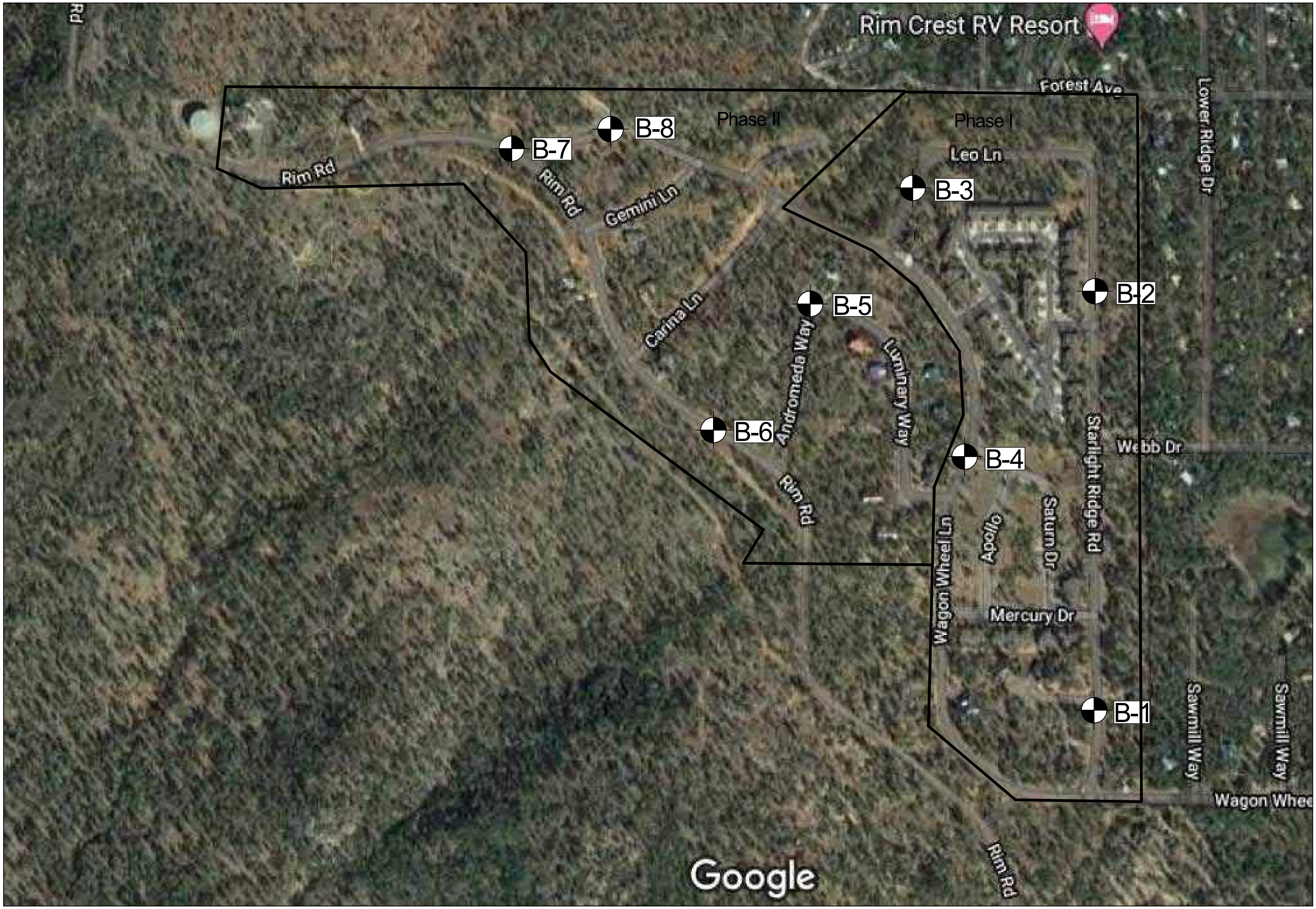
Respectfully Submitted,
SPEEDIE & ASSOCIATES, INC.

Shaun M. Kulish, G.I.T.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
14388
GREGG ALAN
CREASER
Date Signed 2/17/2021
ARIZONA, U.S.A.

Gregg A. Creaser, P.E.

Attachments: Appendix (Boring Location Plan, Log of Test Borings, Tabulation of Test Data, & Asphalt Core Photographs)



– APPROXIMATE SOIL BORING LOCATIONS

Drawing Courtesy of Google, Inc.

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-- APPROXIMATE PHASE I & II BOUNDARIES

TMPLT 2000.CAD 10/23/00

SOIL BORING LOCATION PLAN					Starlight Ridge Pavement Distress Webb Dr. & Starlight Ridge Rd. Wagon Wheel, AZ	SPEEDIE AND ASSOCIATES GEOTECHNICAL/ENVIRONMENTAL/MATERIALS ENGINEERS 2026 N. THIRD ST. FLAGSTAFF, ARIZONA 86004
DR:SMK	CHK:GAC	REV:	DATE: 8-28-20	PROJECT NO. 201542SS		

SOIL LEGEND

SAMPLE DESIGNATION	DESCRIPTION	
AS	**Auger Sample**	A grab sample taken directly from auger flights.
BS	**Large Bulk Sample**	A grab sample taken from auger spoils or from bucket of backhoe.
S	**Spoon Sample**	Standard Penetration Test (ASTM D-1586) Driving a 2.0 inch outside diameter split spoon sampler into undisturbed soil for three successive 6-inch increments by means of a 140 lb. weight free falling through a distance of 30 inches. The cumulative number of blows for the final 12 inches of penetration is the Standard Penetration Resistance.
RS	**Ring Sample**	Driving a 3.0 inch outside diameter spoon equipped with a series of 2.42-inch inside diameter, 1-inch long brass rings, into undisturbed soil for one 12-inch increment by the same means of the Spoon Sample. The blows required for the 12 inches of penetration are recorded.
LS	**Liner Sample**	Standard Penetration Test driving a 2.0-inch outside diameter split spoon equipped with two 3-inch long, 3/8-inch inside diameter brass liners, separated by a 1-inch long spacer, into undisturbed soil by the same means of the Spoon Sample.
ST	**Shelby Tube**	A 3.0-inch outside diameter thin-walled tube continuously pushed into the undisturbed soil by a rapid motion, without impact or twisting (ASTM D-1587).
--	**Continuous Penetration Resistance**	Driving a 2.0-inch outside diameter "Bullnose Penetrometer" continuously into undisturbed soil by the same means of the spoon sample. The blows for each successive 12-inch increment are recorded.

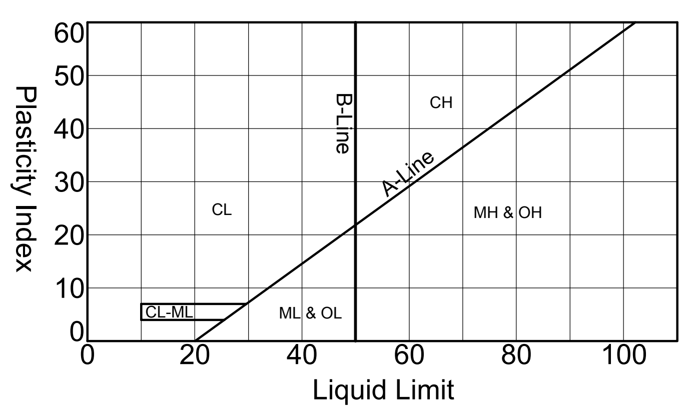
CONSISTENCY			RELATIVE DENSITY	
Clays & Silts	Blows/Foot	Strength (tons/sq ft)	Sands & Gravels	Blows/Foot
Very Soft	0 - 2	0 - 0.25	Very Loose	0 - 4
Soft	2 - 4	0.25 - 0.5	Loose	5 - 10
Firm	5 - 8	0.5 - 1.0	Medium Dense	11 - 30
Stiff	9 - 15	1 - 2	Dense	31 - 50
Very Stiff	16 - 30	2 - 4	Very Dense	> 50
Hard	> 30	> 4		

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL OR MODIFIED SYMBOLS MAY BE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS OR TO PROVIDE A BETTER GRAPHICAL PRESENTATION OF THE SOIL

MATERIAL SIZE	PARTICLE SIZE			
	Lower Limit		Upper Limit	
	mm	Sieve Size ◆	mm	Sieve Size ◆
SANDS				
Fine	0.075	#200	0.42	#40
Medium	0.420	#40	2.00	#10
Coarse	2.000	#10	4.75	#4
GRAVELS				
Fine	4.75	#4	19	0.75" ×
Coarse	19	0.75" ×	75	3" ×
COBBLES	75	3" ×	300	12" ×
BOULDERS	300	12" ×	900	36" ×

◆U.S. Standard ×Clear Square Openings



Rig Type: **Deere 317 Skidsteer**
Boring Type:
Surface Elevation: **N/A**

Depth (feet)	Visual Classification	Depth	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0 – 25 – 50)
0	2.5" ASPHALT CONCRETE	0.2					
	4.5" AGGREGATE BASE	0.6					
	Medium Dense Brown SILTY SAND (SM-Moist) with Little Gravel (Possible Lime Treated Subgrade)	1.0	AS-1	1.0	NT	NT	
	Stiff Brown SANDY LEAN CLAY (CL-Moist) with Little Gravel	2.0					
	Medium Dense Orangish Brown SILTY/CLAYEY SAND (SC-Moist) with Little Gravel	3.0	AS-2	3.0	NT	NT	
	End of Boring						
5							

Boring Date: **8-27-20**
Field Engineer/Technician: **G. Chott**
Driller: **R. Denton**
Contractor: **Navajo County**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-1**

Starlight Ridge Road Pavement Distress

Starlight Ridge Road and Webb Dr.

Show Low, Arizona

Project No.: **201542SS**

Rig Type: **Deere 317 Skidsteer**
Boring Type:
Surface Elevation: **N/A**

Depth (feet)	Visual Classification	Depth	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0 / 25 / 50)
0	2.4" ASPHALT CONCRETE	0.2					
	3.0" AGGREGATE BASE	0.5					
	Stiff Brown SANDY LEAN CLAY (CL-Moist)	1.0	AS-1	1.0	NT	NT	
	Stiff to Very Stiff Brown FAT CLAY (CH-Moist)	2.5	AS-2	2.5	NT	NT	
	Very Dense Light Reddish Brown SANDSTONE (-Moist) (Predominantly Decomposed)	3.0					
	End of Boring						
5							

Boring Date: **8-27-20**
Field Engineer/Technician: **G. Chott**
Driller: **R. Denton**
Contractor: **Navajo County**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-2**

Starlight Ridge Road Pavement Distress

Starlight Ridge Road and Webb Dr.

Show Low, Arizona

Project No.: **201542SS**

Depth (feet)	Graphic Log	Rig Type: Deere 317 Skidsteer Boring Type: Surface Elevation: N/A Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0 – 25 – 50)
0		3.0" ASPHALT CONCRETE					
		0.3 — 3.0" AGGREGATE BASE					
		0.5 — Medium Dense Brown SILTY SAND (SM-Moist) with Little Gravel (Possible Lime Treated Subgrade)					
		1.5 — Medium Dense Light Reddish Brown SILTY SAND (SM-Moist) with Trace Gravel, (Predominantly Decomposed Sandstone)	AS-1	2.1	NT	NT	
		3.0	AS-2	3.0	NT	NT	
		End of Boring					
5							

Boring Date: **8-27-20**
Field Engineer/Technician: **G. Chott**
Driller: **R. Denton**
Contractor: **Navajo County**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-3**

Starlight Ridge Road Pavement Distress

Starlight Ridge Road and Webb Dr.

Show Low, Arizona

Project No.: **201542SS**

Depth (feet)	Graphic Log	Rig Type: **Deere 317 Skidsteer** Boring Type: Surface Elevation: **N/A** Visual Classification		Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0 – 25 – 50)
0		3.0" ASPHALT CONCRETE	0.3					
		2.5" AGGREGATE BASE	0.5					
		Very Stiff Brown SANDY LEAN CLAY (CL-Moist) with Trace Gravel		AS-1	1.0	NT	NT	
		Dark Brown from 1.5'-3.0'	3.0	AS-2	3.0	NT	NT	
		End of Boring						
5								

Boring Date: **8-27-20**
Field Engineer/Technician: **G. Chott**
Driller: **R. Denton**
Contractor: **Navajo County**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-4**

Starlight Ridge Road Pavement Distress

Starlight Ridge Road and Webb Dr.

Show Low, Arizona

Project No.: **201542SS**

_SPEEDIE 201542SS.GPJ GENGEO.GDT 1/28/21

Rig Type:	Deere 317 Skidsteer
Boring Type:	
Surface Elevation:	N/A

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0–25–50)
0 – 0.3	3.0" ASPHALT CONCRETE					
0.3 – 0.5	3.0" AGGREGATE BASE					
0.5 – 1.5	Medium Dense Reddish Brown SILTY SAND (SM-Moist) with Some Gravel (Possible Lime Treated Subgrade)	AS-1	1.0	NT	NT	
1.5 – 3.0	Very Stiff Brown SANDY LEAN CLAY (CL-Moist) with Trace Gravel	AS-2	3.0	NT	NT	
3.0	End of Boring					

Boring Date:	8-27-20
Field Engineer/Technician:	G. Chott
Driller:	R. Denton
Contractor:	Navajo County

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-5**

Starlight Ridge Road Pavement Distress

Starlight Ridge Road and Webb Dr.

Show Low, Arizona

Project No.: **201542SS**

_SPEEDIE 201542SS.GPJ GENGEO.GDT 1/28/21

Depth (feet)	Graphic Log	Rig Type: Deere 317 Skidsteer Boring Type: Surface Elevation: N/A Visual Classification		Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0 – 25 – 50)
0		2.5" ASPHALT CONCRETE	0.2					
		3.0" AGGREGATE BASE	0.5					
		Medium Dense Brown SILTY SAND (SM-Dry to Moist) with Gravel (Possible Lime Treated Subgrade)	1.0	AS-1	1.0	NT	NT	
		Auger Refusal on Sandstone/Mudstone Bedrock						
5								

Boring Date: **8-27-20**
Field Engineer/Technician: **G. Chott**
Driller: **R. Denton**
Contractor: **Navajo County**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-6**

Starlight Ridge Road Pavement Distress

Starlight Ridge Road and Webb Dr.

Show Low, Arizona

Project No.: **201542SS**

_SPEEDIE 201542SS.GPJ GENGEO.GDT 1/28/21

Rig Type: **Deere 317 Skidsteer**
Boring Type:
Surface Elevation: **N/A**

Depth (feet)	Visual Classification	Depth	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0 – 25 – 50)
0	2.75" ASPHALT CONCRETE	0.2					
	3.0" AGGREGATE BASE	0.5					
	Medium Dense Brown SILTY SAND (SM-Dry to Moist) with Some Gravel (Possible Lime Treated Subgrade)	1.0	AS-1	1.0	NT	NT	
	Auger Refusal on Sandstone/Mudstone Bedrock						
5							

Boring Date: **8-27-20**
Field Engineer/Technician: **G. Chott**
Driller: **R. Denton**
Contractor: **Navajo County**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-7**

Starlight Ridge Road Pavement Distress

Starlight Ridge Road and Webb Dr.

Show Low, Arizona

Project No.: **201542SS**

Rig Type:	**Deere 317 Skidsteer**
Boring Type:	
Surface Elevation:	**N/A**

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0 – 25 – 50)
0 – 0.2	2.5" ASPHALT CONCRETE					
0.2 – 0.5	3.0" AGGREGATE BASE					
0.5 – 1.0	Medium Dense Reddish Brown SILTY SAND (SM-Moist) (Possible Lime Treated Subgrade)	AS-1	1.0	NT	NT	
1.0 – 2.5	Medium Dense Brown SILTY SAND (SM-Moist) with Trace Gravel	AS-2	2.5	NT	NT	
2.5 – 3.0	Very Stiff Reddish Brown SANDY LEAN CLAY (CL-Moist)					
3.0	End of Boring					
5						

Boring Date:	**8-27-20**
Field Engineer/Technician:	**G. Chott**
Driller:	**R. Denton**
Contractor:	**Navajo County**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-8**

Starlight Ridge Road Pavement Distress

Starlight Ridge Road and Webb Dr.

Show Low, Arizona

Project No.: **201542SS**

TABULATION OF TEST DATA

SOIL BORING or TEST PIT NUMBER	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE INTERVAL (ft)	NATURAL WATER CONTENT (Percent of Dry Weight)	IN-PLACE DRY DENSITY (Pounds Per Cubic Foot)	PARTICLE SIZE DISTRIBUTION (Percent Finer)					ATTERBERG LIMITS			UNIFIED SOIL CLASSIFICATION	SPECIMEN DESCRIPTION
						#200 SIEVE	#40 SIEVE	#10 SIEVE	#4 SIEVE	3" SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
B-1	AS-1	AS	0.5 - 1.0	NT	NT	39.4	84	95	97	100	NP	NP	NP	SM	SILTY SAND
B-1	AS-2	AS	2.0 - 3.0	NT	NT	32.6	81	97	98	100	24	19	5	SC-SM	SILTY, CLAYEY SAND
B-2	AS-1	AS	0.5 - 1.0	NT	NT	46.1	61	72	74	100	NP	NP	NP	SM	SILTY SAND with GRAVEL
B-2	AS-2	AS	1.0 - 2.5	NT	NT	71.4	88	95	97	100	63	26	37	CH	FAT CLAY with SAND
B-3	AS-1	AS	0.8 - 2.1	NT	NT	38.3	66	78	84	100	NP	NP	NP	SM	SILTY SAND with GRAVEL
B-3	AS-2	AS	1.5 - 3.0	NT	NT	21.5	70	90	94	100	NP	NP	NP	SM	SILTY SAND
B-4	AS-1	AS	0.5 - 1.0	NT	NT	69.3	91	97	97	100	39	20	19	CL	SANDY LEAN CLAY
B-4	AS-2	AS	1.8 - 3.0	NT	NT	76.4	95	100	100	100	41	20	21	CL	LEAN CLAY with SAND
B-5	AS-1	AS	0.5 - 1.0	NT	NT	23.2	50	66	74	100	NP	NP	NP	SM	SILTY SAND with GRAVEL
B-5	AS-2	AS	1.5 - 3.0	NT	NT	61.5	91	98	98	100	45	18	27	CL	SANDY LEAN CLAY
B-6	AS-1	AS	0.5 - 1.0	NT	NT	15.3	36	52	62	100	NP	NP	NP	SM	SILTY SAND with GRAVEL
B-7	AS-1	AS	0.5 - 1.0	NT	NT	21.1	44	62	70	100	37	28	9	SM	SILTY SAND with GRAVEL
B-8	AS-1	AS	0.5 - 1.0	NT	NT	40.1	86	100	100	100	NP	NP	NP	SM	SILTY SAND
B-8	AS-2	AS	1.5 - 2.5	NT	NT	40.6	80	91	93	100	NP	NP	NP	SM	SILTY SAND

Sieve analysis results do not include material greater than 3". Refer to the actual boring logs for the possibility of cobble and boulder sized materials.

NT=Not Tested

Starlight Ridge Road Pavement Distress
Starlight Ridge Road and Webb Dr.
Show Low, Arizona
Project No. 201542SS

SPEEDIE AND ASSOCIATES

Asphalt Core Photographs

Photo No. 1: View of Core 1; B-1

Photo No. 2: View of Core 2; B-2

Photo No. 3: View of Core 3; B-3

Photo No. 4: View of Core 4; B-4

Photo No. 5: View of Core 5; B-5

Photo No. 6: View of Core 6; B-6

Photo No. 7: View of Core 7; B-7

Photo No. 8: View of Core 8; B-8