Materials Laboratory • PO Box 950 • 2500 Waterfield Dr. • Garner, NC 27529 • Telephone (919) 760-4780

Date: February 13th, 2020

To: Mike Carney

CC: Sam Johnson

From: Kyle Brashear

Re: Snyder Quarry Ballast Test Results

On February 2nd, 2020, the Technical Services Lab in Garner, NC received a sample of 4A Railroad Ballast (Lab Sample #20-136; Stonemont Sample #NA) sampled from Snyder Quarry in Snyder, OK. The samples were tested using the following procedures:

ASTM C-88 Soundness of Aggregates by Use of Sodium Sulfate
ASTM C-117 Particles Finer than 75um in Aggregates by Washing
ASTM C-127 Specific Gravity and Absorption of Coarse Aggregates
ASTM C-136 Sieve Analysis of Fine and Coarse Aggregates
ASTM C-142 Clay Lumps and Friable Particles in Aggregates
ASTM C-535 Degradation of Large-Size Coarse Aggregate By Abrasion and Impact in the LA Abrasion Machine
ASTM D-4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D-4791 Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
UPRR Mill Abrasion

Table 1. Sieve analysis (Lab #M1106)

Material	Sieve Analysis		Specification
	Sieve	**% Passing**	**% Passing**
4A Ballast	2 ½"	100.0	100
	2"	93.8	90-100
	1 ½"	70.5	50-80
	1"	20.1	10-35
	¾"	3.8	0-10
	½"	0.7	0-5

Table 2. Particles Finer than 75um (Lab #M1107)

Material	Percent Passing #200	Specification
4A Ballast	0.28	**0.5% max**

Table 3A. Loss by Sodium Sulfate Qualitative Examination (Lab #M1113)

Material	Loss by 5-cycle Sodium Sulfate					
	Sieve Size	**% of Sample**	**Mass before Test (g)**	**Loss after Test (%)**	**Weighted Loss**	**Spec. (% max)**
4A Ballast	2 ½" to 1 ½"	29.5	5068.3	5067.4	0.01	
	1 ½" to ¾"	66.7	1502.5	1501.9	0.03	
	Totals	**96.2**	------	----	0.03	**2.0**

Table 3B. Qualitative Examination

Material	Sieve Size	# Particles before Test	# Particles Exhibiting Stress
4A Ballast	2 ½ to 2"	16	0
	1 ½" to 1"	45	0
	1" to ¾"	49	0

Table 4. Specific Gravity of Coarse Aggregate (Lab #M1108)

Material	Specific Gravity			
	Bulk Dry	**Bulk SSD**	**Apparent**	**Absorption (%)**
4A Ballast	2.617	2.627	2.644	0.39
Specification	**2.600 (min)**			**0.5 (max)**

Table 5. Percent Clay Lumps and Friable Particles (Lab #1114)

Material	Clay Lumps and Friable Particles				
4A Ballast	**Sieve Size**	**Beginning Mass (g)**	**Ending Mass (g)**	**Friable (%)**	**Specification (% max)**
	>1 ½"	4990.2	4983.6	0.13	
	1 ½" to ¾"	3005.2	3002.2	0.10	
	Weighted Total Friable			0.11	**0.5**

Table 6. Loss by LA Abrasion (Lab #M1110)

Material	Loss by LA Abrasion		Specification
	ASTM Grading	**Loss (%)**	**(% max)**
4A Ballast	2	10.9	**25**

Table 7. Loss by Mill Abrasion as specified by UPRR (Lab #M1112)

Material	Loss by Mill Abrasion (% Loss)	Specification (% max)
4A Ballast	1.5	**25**

The **Abrasion Number is 18.4** (40.0% Max). [(5 x Mill Abrasion) + LA]

Table 8. Liquid Limit and Plasticity Index of LA Abrasion Fines (Lab #M1111)

Material	Liquid Limit	Plasticity Index	Specification
4A Ballast LA Fines	NA	Non-Plastic	**Non-Plastic**

Table 9. Percentage of Flat or Elongated Particles (Lab #M1109)

Material	Flat or Elongated by Sieve			Flat or Elongated Weighted Average (%)	
4A Ballast	Sieve	3:1 ratio	5:1 ratio	3:1 ratio	5:1 ratio
	1 ½"	3.59	0.00	3.68	0.0
	1"	3.88	0.00		
	¾"	4.04	0.00		
	Specification			**5.0**	

Feel free to contact me should you have any questions.