Final Report: Recycled Asphalt Shingles on Gravel Roads Grant

Grant Project: 18-G550-07

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RE: Recycled Asphalt Shingles on Gravel Roads Grant – 18-G550-07 Annual Report

Angela Kersten, County Engineer for Scott County Secondary Roads Department, graciously put together the following information for our report:

In May of 2018, the Waste Commission of Scott County (WCSC) in partnership with the Scott County Secondary Roads Department (SCSRD) built a 3.1 mile road surfacing test section consisting of ground shingles mixed with aggregate, for the purpose of investigating short and long term benefits of using recycled asphalt shingles (RAS) on gravel roads. The materials used to build the test section included:

- RAS obtained from the Scott Area Landfill (made from tear-off shingles with one pass through the grinder)
- Aggregate typically used for surfacing (Scott County Modified Class 'D' Crushed Stone which is defined as 100% passing the 1¼" sieve, 90-100% passing the 1" sieve, 10-30% passing the No. 8 sieve, 5-12% passing the No. 200 sieve, the abrasion shall not be more than 45%, the mudball maximum is 4%, and the freeze/thaw loss shall not be more than 10%.)

The 3.1 mile gravel road was divided into 9, approximately equal in size, test sections. Varying mixing proportions were placed and are shown below:

Section 1: 2 parts RAS: 1 part aggregate – Delivered Mixed – Compacted
Section 2: 2 parts RAS: 1 part aggregate – Delivered Mixed
Section 3: No application
Section 4: 2 parts RAS: 1 part aggregate – Mixed on Road
Section 5: 1.5 parts RAS: 1 part aggregate - Delivered Mixed – Compacted
Section 6: 2 parts RAS: 1 part aggregate – Mixed on Road – Compacted
Section 7: 1.5 parts RAS: 1 part aggregate - Delivered Mixed
Section 8: 1.5 parts RAS: 1 part aggregate – Mixed on Road – Compacted
Section 9: 1.5 parts RAS: 1 part aggregate – Mixed on Road

The "Mixed on Road" sections were built by scarifying existing aggregate from the road and blading it into a windrow along the edge of the road using a motor grader. RAS was delivered to the road with a dump truck and placed along the center of the road. The motor grader mixed the RAS and aggregate together and spread

it uniformly across the road. After monitoring the mixed on road sections for the past two and a half years, the SCSRD has determined that by scarifying existing rock from the road and placing it in a windrow it is difficult to determine the quantity of aggregate that is obtained from the scarification process. Each section that is built on the road using this process does not appear to have a uniform mix design. This variation appears to be contributing toward instability of the road surface. During the summer of 2019, our motor grader operator bladed the mixed on road sections nearly twice as often as the delivered mixed sections. In 2020, our motor grader operator bladed all sections approximately bi-weekly. The majority of the blading season in 2021 was very dry. Therefore, the road was not bladed as frequently due to lack of moisture to properly blade the road. The "Mixed on Road" sections had washboards, scaling, potholes, loose aggregate, and material build-up along the edges of the road. Sections 8 and 9 also had a very fine, powder like, aggregate-RAS mixture on the surface of the road that was loose and dusty.

The "Delivered Mixed" sections were built by placing pre-mixed RAS and aggregate on the existing road surface. The SCSRD delivered RAS and virgin aggregate to General Asphalt Construction Company (GACC.) GACC blended the RAS and virgin aggregate together using mixing equipment that consisted of two bins to store the materials separately, mixing wheel, weigh belt, and conveyor belt. GACC pre-mixed the materials into the two different ratios described above and conveyed the material into a stockpile. The material was loaded into SCSRD dump trucks. The dump trucks delivered the pre-mixed material to the road and placed the material along the center of the road. The motor grader spread the material uniformly across the road. After monitoring the delivered mixed sections for the past two and a half years, the SCSRD has determined that these sections required less maintenance blading for the first year and a half and then approximately the same frequency of maintenance blading as the other road sections. As mentioned above, the majority of the blading season in 2021 was very dry and the road was not bladed as frequently due to lack of moisture to properly blade the road. Throughout the year, the "Delivered Mixed" sections had washboards and potholes. Towards the end of summer and fall, these sections also had loose aggregate and material build-up along the edges of the road. Sections 1 and 2 had the poorest ride quality throughout the year.

The sections noted above as "Compacted" were compacted with a rubber tired roller after the motor grader finished spreading the material. After monitoring the sections for the past three and a half years, the compacted sections require the same amount of maintenance as the non-compacted sections and do not readily show any reduction in maintenance due to compaction.

The SCSRD is continuing to measure dust generated from traffic along the project corridor utilizing the Colorado Dust Collector. Listed below are those results:

Location	1-Jun-18 Dust Generated (g)	30-Oct-18 Dust Generated (g)	28-Feb-19 Dust Generated (g)	28-Mar-19 Dust Generated (g)	16-May-19 Dust Generated (g)	18-Jun-19 Dust Generated (g)	23-Jul-19 Dust Generated (g)
Section 1	0.3	1.2	0.3	0.2	0.7	0.3	0.3
Section 2	0.5	0.6	0.2	0.2	0.9	0.6	0.4
Section 3	1.9	2.3	0.1	1.0	1.6	1.3	1.7
Section 4	0.2	0.3	0.3	0.1	0.5	0.5	0.1
Section 5	0.1	0.5	0.5	0.3	0.8	0.6	0.5
Section 6	0.6	0.4	0.7	0.5	1.8	0.6	0.2
Section 7	0.8	0.6	0.4	0.3	1.2	0.3	0.9
Section 8	0.2	0.4	0.1	0.5	1.5	0.1	0.3
Section 9	0.6	0.8	0.4		0.2	0.2	0.4

Location	21-Apr-20 Dust Generated (g)	7-Jul-20 Dust Generated (g)	14-Oct-20 Dust Generated (g)	3-Dec-20 Dust Generated (g)	7-Jul-21 Dust Generated (g)	23-Nov-21 Dust Generated (g)
Section 1	0.6	2.2	1.9	2.4	2.7	1.8
Section 2	0.8	2.8	2.5	2.7	3.8	1.7
Section 3	1.0	3.7	4.3	1.7	6.7	3.7
Section 4	0.3	1.6	1.1	1.8	2.8	2.1
Section 5	0.5	3.4	3.7	2.3	3.6	2.9
Section 6	0.5	2.8	2.4	2.2	4.4	3.1
Section 7	0.8	4.9	3.7	3.4	4.1	4.8
Section 8	-	1.5	1.6	3.2	2.4	3.3
Section 9	-	2.0	1.7	1.5	1.4	2.2

Location	Average Dust Generated-2018 (g)	Average Dust Generated-2019 (g)	Average Dust Generated-2020 (g)	Average Dust Generated-2021 (g)
Section 1	0.8	0.4	1.8	2.3
Section 2	0.6	0.5	2.2	2.8
Section 3	2.1	1.1	2.7	5.2
Section 4	0.3	0.3	1.2	2.5
Section 5	0.3	0.5	2.5	3.3
Section 6	0.5	0.8	2.0	3.8
Section 7	0.7	0.6	3.2	4.5
Section 8	0.3	0.5	2.1	2.9
Section 9	0.7	0.3	1.7	1.8

The dust collection results show that the untreated section generated the highest amount of dust each year over the study period. Although, Section 7 began to generate a similar amount of dust as Section 3 over the past two years. Once the sections became bladed more frequently, they generated a higher amount of dust. The SCSRD received complaints each year about the “black” dust. A few adjoining residents stated concerns about negative health impacts with breathing the RAS dust.

The SCSRD is also monitoring the condition of the road. A road condition rating report was developed for our maintenance blading operator to document the road condition prior to performing maintenance blading. Each section of road that requires blading is scored based on the severity of rutting, washboarding, potholes, loose aggregate, scaling and crown shape. Shown below is a report of the road condition on August 27, 2018:

Road Surface Condition Rating Report

Road Name: 190th Street **Date: 08/27/18** **Inspector Name: Angie Kersten** **Road Condition: Dry**

Score	Rutting	Washboarding	Potholes	Loose Aggregate	Scaling	Crown
9	No or negligible ruts	No or negligible corrugations	No or negligible potholes	No or negligible loose aggregate	No or negligible scaling	Cross slope 4%; Good rooftop shape
8	Ruts less than 1" deep and less than 5% of the roadway surface area	Less than 1" deep; less than 10% of the roadway surface area	Most small potholes less than 1" deep and less than 1' in diameter	Berms less than 1" deep; Loose aggregate less than 3/4" thick	Scaling less than 1/4" deep; less than 10% of roadway surface area	
7						
6	Ruts between 1"-3" deep and 5% to 15% of the roadway surface area	1"-2" deep; 10% to 25% of the roadway surface area	Considerable potholes less than 3" deep and less than 2' in diameter	Berms less than 2" deep; Loose aggregate less than 1.5" thick	1/4"-1/2" deep; 10% to 25% of the roadway surface area	
5						
4	Ruts between 3"-6" deep and 10% to 40% of the roadway surface area	2"-3" deep; over 25% of the roadway surface area	Many potholes up to 4" deep and 3' in diameter	Berms between 2"-4" deep	1/4"-1/2" deep; 25% to 50% of the roadway surface area	Cross slope 3% to 4%; Good rooftop shape
3						
2	Ruts between 6"-12" deep	Deeper than 3"; over 30% of the roadway surface area	Up to 8" deep and greater than 4' in diameter	Berms greater than 4" deep	1/4"-1/2" deep; 50% to 75% of the roadway surface area	1% to 3%
1	Ruts over 12" deep	Impassable	Impassable	Sand Dunes	Over 75% of the roadway surface area	Less than 1%

Section #	Rutting	Washboarding	Potholes	Loose Aggregate	Scaling	Crown
1						
2						
3						
4	9	9	6.5	9	8	9
5	9	9	7	8.5	7	9
6						
7						
8	9	4	8	8	6	9
9	9	5	8.5	8	6	9

Notes:

Roger Hamann (Blade Operator) lightly bladed Sections 7-9 one time a few months after the sections were built, due to washboarding and potholes.

These reports were completed in 2018 and 2019 each time the road was bladed. In 2020, the road was bladed approximately bi-weekly and received the same frequency of maintenance as the un-treated section. Therefore, the blade operator discontinued completing the reports.

Photo 1: Section 4, August 27, 2018

Photo 2: Section 5, August 27, 2018

Photo 3: Section 8, August 27, 2018

Photo 4: Section 4, August 13, 2019

Photo 5: Section 5, August 13, 2019

Photo 6: Section 8, August 13, 2019

Photo 7: Section 4, January 13, 2021

Photo 8: Section 5, January 13, 2021

Photo 9: Section 8, January 13, 2021

Photo 10: Section 4, November 23, 2021

Photo 11: Section 5, November 23, 2021

Photo 12: Section 8, November 23, 2021

Starting in August 2018 and through 2019, the SCSRD performed maintenance blading along the project corridor in various sections approximately once per month. The sections that were mixed on the road required approximately twice as much maintenance than the delivered mixed sections. The 1.5:1 delivered mixed sections were performing the best and had been spot bladed the least amount of time. All sections

tended to lose aggregate that forms a berm along the edges of the road. Section 4 has had the most problems with scaling. The section that received no application was bladed weekly throughout the summer and fall.

In 2020, all sections were bladed approximately bi-weekly. Depending on the severity of conditions the sections were spot bladed when appropriate. The sections with a higher percentage of RAS to rock mixture required more time and effort to loosen the more tightly packed surface to fill potholes and eliminate rumble strips. In 2020, a portion of Section 6 received two separate surface applications (May and July) of calcium chloride to reduce dust. The adjacent homeowner requested and contracted for the dust control applications. Periodic dust collections have continued and all sections are producing more dust in 2020. This could be contributed to the increase in frequency of blading and breakdown of granular material. The SCSRD has received minimal feedback from residents over the past three years. The feedback is both positive and negative. Annually, a few residents have shared that they are favorable of the road condition and are most happy with Sections 1 and 2. In addition, a few different residents have shared that the road rides rough and they are not favorable of the road condition.

In 2021, all sections were bladed approximately the same amount of time as the control gravel section 3. The majority of the blading season in 2021 was very dry. Therefore, the road was not bladed as frequently due to lack of moisture to properly blade the road. Throughout the year, all sections had washboards, scaling, potholes, loose aggregate, and material build-up along the edges of the road. Sections 1 and 2 had the most severe washboards that contributed to a poor ride quality. The hard packed surface was difficult to blade and the lack of moisture added to the problem. Starting in mid-summer, there was also a very fine, powder like, aggregate-RAS mixture on the surface of the road that was loose and dusty. It was most noticeable in Sections 6 and 7. Again in 2021, a portion of Section 6 received two separate surface applications (May and July) of calcium chloride to reduce dust. The adjacent homeowner requested and contracted for the dust control applications. However, this time they asked for a light layer of rock to be incorporated into the surface prior to the first application. The SCSRD has received only negative and more frequent feedback from adjacent property owners this past year. The feedback includes poor ride quality and a strong dislike for the “black” dust. Three residents have called over the past year with concerns that they have had considerably more flat tires since the RAS was placed in 2018. The control gravel section 3 was re-rocked in October of 2021, in accordance with our regular maintenance practices.

In 2018-2019, the SCSRD shared information about the project with Iowa county road departments and other professionals. The Scott County Engineer presented about the project on September 19, 2018 at the 2018 Iowa Streets and Roads Conference and on December 13, 2018 at the 72nd Iowa County Engineer’s Conference. The Assistant Scott County Engineer presented about the project on April 4, 2019 at the 2019 American Public Works Association Iowa Chapter Spring Conference. The SCSRD also received requests for information about the project from several Iowa county road departments. The SCSRD did not present on the project in 2020 or 2021. This is attributed to the cancellations of workshops and conferences due to the COVID-19 pandemic. During 2021, the SCSRD received requests for information about the project from a few Iowa county road departments.

By incorporating RAS into our aggregate surfaced roads, we strived to achieve the following goals:

1. Realize an overall cost savings by comparing before and after costs that include cost of materials, labor and equipment costs associated with maintenance blading, and reduction in loss of aggregates.
2. Reduce asphalt shingle waste going into the landfill.
3. Reduce quantity of virgin aggregates placed on the road surface.

4. Realize a reduction in the frequency of maintenance blading by mitigating wash boarding and potholes.
5. Reduce dust particulate air pollution.

In regards to Goal No. 1, the total cost to build the project was $91,574. SCSRD expended $42,534 on labor and materials. General Asphalt's costs to pre-mix the RAS and aggregate was $23,224. WCSC provided the RAS for the project at a cost of $25,816 ($8.00/ton). For the first two years, SCSRD did realize a reduction in maintenance blading of the road. However, starting in 2020, SCSRD expended the same effort and at times additional effort to maintain the road. SCSRD resurfaced Section 3 with aggregate in 2021. SCSRD is planning to resurface all of the test sections with aggregate in 2022. Therefore, SCSRD has not seen a reduction in costs associated with resurfacing the road with aggregate. SCSRD typically resurfaces each gravel road, with a similar traffic count as 190th Street, with aggregate every 3 to 5 years.

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In regards to Goal No. 2, this goal was a success. WCSC was able to keep 3,227 tons of asphalt shingles out of the landfill.

In regards to Goal No. 3, SCSRD did not reduce the amount of virgin aggregate placed on the road surface. SCSRD hauled in aggregate to build the pre-mixed sections and SCSRD is planning to place virgin aggregate on the road in 2022.

In regards to Goal No. 4, SCSRD did realize a reduction in maintenance blading for the first two years. However, the final two years required the same and at times additional effort to maintain the road. The washboards in the test sections were more difficult to fix then the washboards in the control section.

In regards to Goal No. 5, SCSRD did see a reduction in dust particulate air pollution with the test sections in comparison to the control section. Throughout the duration of the monitoring period, the control section provided the highest dust generation. However, the dust generated in the test sections was black in color and SCSRD received some negative feedback from adjoining land owners in regards to the RAS dust.

Submitted by: Angela Kerstans, Scott County Engineer, Scott County Secondary Roads

The Waste Commission and Scott County Secondary Roads concluded that at this time the best use of the recycled asphalt shingles is in the asphalt process. The Commission will continue to use the RAS on the roads at the Scott Area Landfill as a dust suppressant.