

August 27, 2019

TO: Members of the Transportation Policy Committee
THROUGH: Eric Anderson, Executive Director
FROM: John Bullen, Transportation Economic and Finance Program Manager
SUBJECT: REGIONAL FREEWAY SYSTEM PAVEMENT TEST SECTIONS

All of the region's urban freeway system is covered in a layer of Asphalt Rubber Asphaltic Concrete Friction Course, better known as a rubberized asphalt or quiet pavement. Rubberized asphalt provides a smooth ride for motorists and helps mitigate freeway noise. Much of the region's rubberized asphalt was installed between 2003 and 2008, and is either approaching or has exceeded its 10-year life cycle. The deterioration of the rubberized asphalt has been exacerbated by the heavy rains last winter and spring, which caused potholing and pavement raveling throughout the system. The cost to replace the rubberized asphalt is about \$2.0 million per mile for a typical eight-lane section of freeway.

The Freeway Life Cycle Program is responsible for oversight of the construction of the freeway and highway network in Maricopa County while the Arizona Department of Transportation (ADOT) funds rehabilitation and maintenance of the system. One of ADOT's primary mechanisms for funding rehabilitation and maintenance activities throughout the state is the Highway User Revenue Fund (HURF), about half of which is comprised of revenues from state gas taxes. The state has not increased the gas tax since 1991 and HURF revenues continue to decrease with steady increases in fuel efficiency and rising use of alternate fuel vehicles. As a result, ADOT has fewer revenue resources available for rehabilitation and maintenance. ADOT is now testing alternatives to rubberized asphalt that have lower life cycle costs.

A more robust policy discussion on rubberized asphalt and alternative pavement treatments will occur at the Transportation Policy Committee this fall. The purpose of this memorandum is to distribute information on three alternative test sections that ADOT has temporarily applied in anticipation of these conversations. All three sections are within

the limits of the State Route 101L, I-17 to Pima Road project. These test sections include diamond grind, whisper grind next generation concrete surface, and Skidabrader treatments; additional information on each treatment is provided later in this memorandum and a summary table is provided below. A map detailing the location of the test sections has also been attached. Additional information on rubberized asphalt and alternative treatments will be provided this fall.

Treatment	Noise at Install (Decibels)	Noise at End of Life (Decibels)	Life Span (years)	Costs ¹			
				Per Lane Mile	Corridor ²	Life Cycle (Corridor) ³	System ⁴
Concrete (untreated)	104-107	104-107	--	--	--	--	--
Rubberized Asphalt	97	103	10	\$171,000	\$29.9 m	\$89.8 m	\$590.4 m
Diamond Grind	100-104	100-104	12-14	\$123,000	\$21.5 m	\$43.0 m	\$424.7 m
Whisper Grind	99-101	99-101	12-14	\$150,000	\$26.3 m	\$52.5 m	\$517.9 m
Skidabrader	104-107	104-107	7-10	\$90,000	\$15.8 m	\$47.3 m	\$310.7 m

1. Diamond grind, whisper grind and Skidabrader would require additional bridge joint replacement work; these costs are not reflected in the table.
2. Corridor costs based on a 15-mile, eight lane section (four lanes in each direction) with 11 foot shoulders. This is comparable to I-17 between I-10 and SR-101L (14.4 miles in length).
3. Life cycle costs based on the corridor costs over a period of 30-years.
4. System costs based on a one-time, full replacement cost for the entirety of the system that currently has a rubberized asphalt overlay.

Rubberized Asphalt: History and Noise Reduction Benefits

In the early 2000s, ADOT worked with the Federal Highway Administration (FHWA) to develop the Quiet Pave Pilot Program (QPPP) to research the viability of using rubberized asphalt overlays to mitigate freeway noise. As part of the pilot program, ADOT measured noise produced by concrete cement pavement and then measured the noise produced with the rubberized asphalt overlay on the same freeway segment. ADOT also measured noise levels of the rubberized asphalt incrementally throughout the 12-year program to observe any changes in noise reduction over the lifespan of the rubberized asphalt.

ADOT found that when first laid, rubberized asphalt registered at 97 decibels while the pavement prior to the overlay registered between 104 and 107. The average reduction of rubberized asphalt was 8.2 decibels. However, ADOT also found that the noise reduction qualities of rubberized asphalt diminish over time as the pavement deteriorates. Compared to the pavement prior to the overlay, the average reduction of rubberized asphalt at the end of its lifespan was only 3.2 decibels.

Between 2003 and 2005, ADOT partnered with MAG, area cities and towns, and the Governor's Office to pave 115 linear miles of freeway in the MAG region with rubberized asphalt. Rubberized asphalt was laid on both reconstruction projects and new freeway construction. MAG contributed \$34 million of Proposition 300 funds to this project. In response to positive community feedback, some MAG member agencies contributed local funding to advance rubberized asphalt projects in their communities. The effort to overlay the valley freeway system with rubberized asphalt continued with the passage of Proposition 400. Proposition 400 included a provision for \$75 million for freeway noise mitigation, including \$54.5 million to pave the remainder of the freeway system in the region with rubberized asphalt. From 2006 to 2008, ADOT paved an additional 35 miles with rubberized asphalt using Proposition 400 funding. Today, the entirety of the region's urban freeway system has a rubberized asphalt overlay. Rubberized asphalt has been included as a project scope item for all freeway projects funded through the Freeway Life Cycle Program.

Rubberized Asphalt Alternatives

Rubberized asphalt overlays cover wear-and-tear on concrete pavement, thus extending the lifespan of the concrete. Rubberized asphalt also provides skid resistance, reduces road spray, and improves striping visibility. As rubberized asphalt reaches the end of its useful life, it has to be removed and either a new overlay placed or the exposed concrete rehabilitated. ADOT is considering several alternative treatments for the region's urban freeway system. These options intend to create a drivable concrete surface without the need for an overlay.

Diamond Grind

Diamond grind involves grinding or shaving concrete using diamond saw blades to create shallow grooves in the pavement with small fins protruding upward between the grooves. Diamond grinding can be an effective technique for reducing noise; it will produce between 100 to 104 decibels of noise, which is quieter than typical concrete surface textures. The noise created by this pavement stays relatively static over time though it can sometimes slightly decrease as the fins are worn down by traffic.

Diamond grinding produces a quiet and smooth surface that eliminates the need for an overlay. If asphalt prices continue to rise, the financial benefits of diamond grind relative to rubberized asphalt become more pronounced. This is especially important considering the maintenance needs of the current system. ADOT estimates that diamond grind costs \$123,000 per lane mile, which is \$48,000 cheaper than rubberized asphalt. Over the length

of a 15-mile, eight lane corridor, diamond grind costs \$21,525,000 compared to \$29,925,000 for rubberized asphalt.

Another important distinction between rubberized asphalt and diamond grind is the maintenance. When a rubberized asphalt overlay reaches its lifespan, the overlay must be removed and a new overlay added. Conversely, concrete surfaces can be diamond ground up to three times without the hassle or cost of removing an overlay or adding a new one. Diamond ground pavement has a lifespan of about 12 to 14 years in regions without freezing temperatures.

Whisper Grind Next Generation Concrete Surface

Whisper Grind Next Generation Concrete Surface is a newer version of diamond grinding, in which the same equipment is used to grind the pavement down and then install longitudinal grooves deeper than those of conventional diamond grinding.

Whisper grind has a smoother surface than conventional diamond grinding. It has registered a noise production as low as 96 decibels, but typically falls within the 99 to 101 decibel range. It is important to note that the difference in noise production between conventional diamond grind and whisper grind may not always be apparent, as the decibel ranges do not always exceed the difference needed to be noticeably audible to the human ear. When comparing noise immediately following installation, whisper grind is louder than rubberized asphalt. However, as rubberized asphalt ages, it eventually exceeds the whisper grind noise level.

The deeper grooves in the whisper grind surface also create a safer roadway in wet weather because the grooves allow water to escape, reducing the likelihood of hydroplaning. Whisper grind is thought to have a similar lifespan and maintenance profile to conventional diamond grind; since it is a newer technique, however, there is limited information on its durability over time. ADOT estimates that whisper grind costs \$150,000 per lane mile, which is \$27,000 more than conventional diamond grind but \$21,000 less than a rubberized asphalt overlay. Over the length of a 15-mile, eight lane corridor, whisper grind costs \$26,250,000 compared to \$29,925,000 for rubberized asphalt.

Skidabrader

The Skidabrader technique is also known as shot blasting. The Skidabrader machine fires steel ball bearings at the road surface which are then vacuumed off the roadway and recycled. Sections currently covered by rubberized asphalt will require some type of

treatment when the layer is removed, and like the other alternatives ADOT is testing, this method adds friction and creates a smoother road. However, little is known about the noise and longevity of Skidabrased surfaces in Arizona.

The limited existing research suggests that shot-blasted surfaces do not produce a meaningful reduction in noise and thus produce more noise than either diamond grind or whisper grind. However, Skidabrading is expected to take less time to apply than both diamond grind and whisper grind. ADOT estimates that Skidabrader costs \$90,000 per lane mile, which is \$81,000 less than rubberized asphalt. Over the length of a 15-mile, eight lane corridor, Skidabrading costs \$15,750,000 compared to \$29,925,000 for rubberized asphalt.

CC: MAG Regional Council
MAG Management Committee
MAG Transportation Review Committee
MAG Intergovernmental Representatives

SR-101L, I-17 to Pima Road – Pavement Test Sections

