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November 12, 2012

Mitch Thompson
Hyalite Foothills HOA
PO Box 1994
Bozeman, MT 59771

**RE: Executive Summary
Hyalite Foothills - Asphalt Coring**

Dear Mr. Thompson,

Asphalt coring for the Hyalite Foothills was completed on November 7, 2012 by Gary Fox, EI of Allied Engineering under the direct supervision of Erik Garberg, PE. A summary of results and field notes are included in this report.

Fifteen asphalt cores were taken overall. The thickness of these cores was then measured pursuant to the standard test method ASTM D3549: Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens. The depth of gravel was also estimated in six of the core locations and is summarized in the report.

Average Core Thickness (inch)	2.91
*Average Base Thickness (inch)	Greater than 5.81

*Approximately 3" of milled asphalt and 3" of crushed material

The HOA reported a specified asphalt mat thickness of 2.5 inches. Montana Public Works Standard Specifications (MPW) requires that actual thickness must be no less than ¼-inch of the specified thickness. Additionally, it is industry standard that no asphalt mat be placed in a lift greater than 3 inches to achieve the required compaction. The data indicates two issues with the existing asphalt:

1. The amount of variance in core thickness, especially in adjacent cores.
2. Cores exceeding 3-inches in thickness.

The variance in core thickness could indicate several problems:

- Poor quality control during placement
- Non-compliant or insufficient surface preparation
- Weak/inadequate sub-base and/or base material
- Combination of the factors above

Some of the most problematic issues for the long-term durability of paved surfaces are related to the quality and quantity of the sub-base and base material; thus most specifications require removal of substandard material prior to paving.

MPW requires that variation not exceed 5/16 of an inch in 10 feet for base course preparation prior to paving. This means that within any 10 feet, core thickness variance should not exceed 5/16 of an inch.

Allied took two sets of samples approximately 10 feet apart. These sets of cores varied in thickness by $\frac{9}{16}$ and $1\frac{3}{16}$ of an inch. Additionally, the average variance of all samples is .51 inches; this exceeds the $\frac{5}{16}$ inch tolerance in MPW. If the surface was prepared per MPW standards, then it is likely the sub-base yielded during paving and created the variance in the core samples. This would be an indicator of poor subgrade, sub-base, and base material and likely premature surface failure.

This fact is further complicated by the limited road section provided. It was reported that the design thickness for the asphalt mat was 2.5 inches; Gallatin County subdivision requirements specify a minimum of 3 inches for paved subdivision roads. It is also not typical to provide a cross-section with such limited base and/or sub-base thickness. Allied would expect to see a total road section closer to 12 to 15 inches not the 8.72 inches (average) observed. We would recommend requesting the designer's calculations to review the assumptions and criteria used to support the provided section.

Ultimately, if issues exist with the sub-base, base and section thickness, the asphalt will likely fail before its predicted life cycle. Please feel free to call if you have any questions or comments.

Respectfully submitted by,

Allied Engineering Services, Inc.

Erik Garberg, PE
Project Manager

enc: Hyalite Foothills Asphalt Testing Report