

APPROVED

December 9, 2014

By: RCR Date: 12-9-14
City of Fort Collins City of Fort Collins
Engineering Department



EARTH ENGINEERING
CONSULTANTS, LLC

Bellisimo, Inc.
3702 Manhattan Ave Suite 201
Fort Collins, Colorado 80526

Attn: Mr. Gino Campana (gcampana@bellisimoinc.com)

Re: Pavement Thickness Design Report – Addendum No. 1
Bucking Horse Filing III –Extension of Miles House Avenue
City of Fort Collins, Colorado
EEC Project No. 1134107P

Mr. Campana:

Earth Engineering Consultants, LLC (EEC) personnel performed the pavement design procedures, (i.e., the field and testing laboratory, along with the engineering analyses in 2 phases, etc.), in general accordance with the Larimer County Urban Area Street Standard (LCUASS) Pavement Design criteria for the interior roadway alignments within the Bucking Horse – Filing No. 2 residential development in Fort Collins, Colorado in November of 2013. For further information and findings thereof, please refer to our “Pavement Thickness Design Report” dated November 25, 2013, EEC Project No. 1134107. The intent of this addendum report is to provide pavement design thickness recommendations associated with the approximate 115 linear feet of Miles House Avenue to the west of the intersection with Nancy Gray Avenue within the Bucking Horse III Filing as indicated on the enclosed site plan. For this section we are assuming a similar 18-kip equivalent daily load application (EDLA) value of 25 for Mile House Avenue as that of the previous report.

PAVEMENT – DESIGN and CONSTRUCTION

The City of Fort Collins’ Engineering Department provided the estimated traffic loading information, expressed as 18-kip equivalent daily load application (EDLA), for the interior Bucking Horse Filing No. 2 roadway alignments, which have been prepared to date. As previously stated we are assuming a similar value for the Bucking Horse Filing III – Mile House Avenue roadway extension. Pavement section recommendations provided in this addendum report are based on the traffic information provided by the City of Fort Collins Engineering Department and the subgrade’s field and laboratory test results as previously presented in our Bucking Horse Filing II report dated November 25, 2013.

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A Hveem Stabilometer/R-value of 20 was determined for the rough-graded pavement subgrades completed for this portion within the Bucking Horse Filing No. 2 / Filing No. 3 development. Using the Colorado Department of Transportation (CDOT) and the current Larimer County Urban Area Street Standards (LCUASS) Pavement Design Criteria, an R-value of 20 corresponds to a resilient modulus value of 4940 psi, which was used in the pavement evaluation for the roadways included herein.

The American Association of State Highway and Transportation Officials (AASHTO) design guidelines for pavement thicknesses were used to evaluate recommended pavement sections for this project along with the current LCUASS Pavement Design Criteria. Recommended pavement sections based on those evaluations are provided on the attached summary tables included with this report.

PAVEMENT SUBGRADE PREPARATION

The subgrade soils are generally low to moderate strength sandy lean clays to gravelly lean clays exhibiting generally low swell potential characteristics and cleaner sands and/or gravels with increased depths that essentially exhibited no swell. As previously provided, we recommend the exposed subgrades within the interior roadway alignments be proof-rolled and recompact to confirm the stability of the subgrade(s) and the subgrade preparation should be completed in general accordance with the recommendations presented in the LCUASS Pavement Design Manual – Chapter 22. The proof-rolls should be observed and approved by the City of Fort Collins along with supplemental recommendations provided by geotechnical engineer, if warranted, prior to placing the approved aggregate base course (ABC) material. Soft or weak areas delineated by the proofrolling operations should be undercut or stabilized in-place to achieve the appropriate subgrade support.

The developer anticipates constructing this section of Miles House Avenue, approximately 115-foot section north of Nancy Grey, without the use of fly ash as previously performed on Filing Nos. 1 and 2. An existing stockpile of “previously fly ashed” subgrade materials is available and the intent is to use this excess material to “build-up”/prepare the final subgrade elevations for this relatively short-stretch of Miles House Avenue. The developer is fully aware that a pavement thickness reduction would not be in order.

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Care will be needed after preparation of the subgrades to avoid disturbing the subgrade materials. Positive drainage should be developed away from the structures to avoid wetting of subgrade materials. Subgrade materials becoming wet subsequent to construction of the site improvements can result in unacceptable performance. The table included below provides a minimum pavement section thickness for the extension of Miles House Avenue within the Bucking Horse Filing III area.

TABLE I: Minor Collector Roadway – MILES HOUSE AVENUE (Minimum Pavement Thicknesses)	
18 kip Equivalent Daily Load Axles (EDLA)	25
18 kip Equivalent Single Axle Loads (ESAL's) 20-year	182,500
Resilient Modulus (based on consistent R-Value of 20)	4940
Reliability	75%
Serviceability Loss (Initial = 4.5 and Terminal = 2.3)	<u>2.2</u>
Design Weighted Structural Number - S_N	2.88
Composite Section with Fly Ash: Option A	
Hot Bituminous Pavement S(75) PG 58-28	4-1/2 @ 0.44 = 1.98
Aggregate Base (Class 5 or Class 6)	<u>9" @ 0.11 = 0.99</u>
Structural Number (SN)	2.97

The recommended pavement sections provided herein are minimums and periodic maintenance should be expected. Since the cohesive soils on the site have some shrink/swell potential, pavements could crack in the future primarily because of the volume change of the soils when subjected to an increase in moisture content to the subgrade. The cracking, while not desirable, does not necessarily constitute structural failure of the pavement. Stabilization of the subgrades as provided herein will reduce the potential for cracking of the pavements.

Long-term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventive maintenance. The following recommendations should be considered the minimum:

- The subgrade and the pavement surface should be adequately sloped to promote proper surface drainage.

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- Install pavement drainage surrounding areas anticipated for frequent wetting (e.g. landscaped and irrigated islands, etc.),
Install joint sealant and seal cracks immediately,
- Seal all landscaped areas in, or adjacent to pavements to minimize or prevent moisture migration to subgrade soils;
- Placing compacted, low permeability backfill against the exterior side of curb and gutter; and,
- Placing curb, gutter, and/or sidewalk directly on approved proof rolled subgrade soils without the use of base course materials.

Preventive maintenance should be planned and provided for through an on-going pavement management program. Preventive maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment. Preventive maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventive maintenance.

Site grading is generally accomplished early in the construction phase. However as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, or rainfall. As a result, the pavement subgrade may not be suitable for pavement construction and corrective action will be required. The subgrade should be carefully evaluated at the time of pavement construction for signs of disturbance, rutting, or excessive drying. If disturbance has occurred, pavement subgrade areas should be reworked, moisture conditioned, and properly compacted to the recommendations in this report immediately prior to paving.

Please note that if during or after placement of the stabilization or initial lift of pavement, the area is observed to be yielding under vehicle traffic or construction equipment, it is recommended that EEC be contacted for additional alternative methods of stabilization, or a change in the pavement section.

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We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we can be of further service to you in any other way, please do not hesitate to contact us.

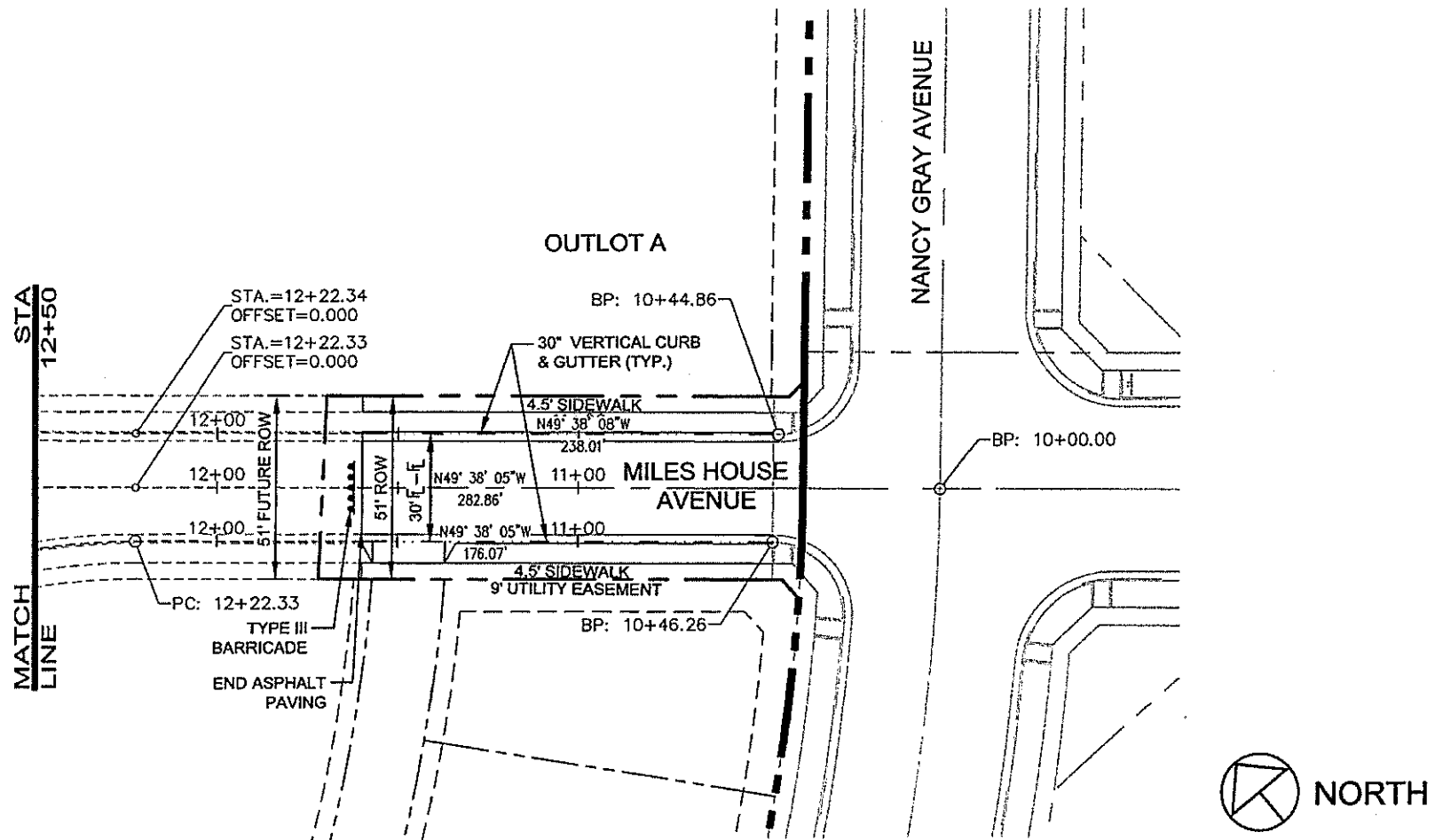
Very truly yours,
Earth Engineering Consultant, LLC



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Site Diagram
 Bucking Horse - Filing 3
 Fort Collins, Colorado
 EEC Project #: 1134107 Date: December 2014