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HEPWORTH - PAWLAK GEOTECHNICAL

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July 11, 2013

Abrika Properties, LLC
Attn: Ric Newman
P.O. Box 772289
Ocala, Florida 34477
ric@newmancomm.com

Job No. 113 097A

Subject: Debris Flow and Flood Mitigation Design Information for the Small Tributary Drainage Basins at the Proposed Phase A1 Development, Haymeadow Development, Brush Creek Road, Eagle, Colorado.

Dear Mr. Newman:

As requested by Alpine Engineering, we have developed debris flow and flood design information for the small tributary drainage basins at the proposed Phase A1 Development. The project site location is shown on Figure 1. We have previously submitted a debris flow and flood review for the entire Haymeadow property (Hepworth-Pawlak Geotechnical, 2013). This report provides additional design information for the proposed bicycle path/debris barrier shown on Figure 2.

Proposed Mitigation Concept: Alpine Engineering is in the process of designing the proposed bicycle path uphill of the Phase A1 Development and uphill of the future school/recreation parcel to function as a debris barrier. The barrier will mitigate the potential debris flow and flood risk to downhill development associated with the small tributary drainage basins shown on Figure 2. A conceptual cross section of the bicycle path/debris barrier is presented on Figure 3. The barrier will be designed to stop and store the design flows uphill of the Phase A1 Development and uphill of the future school/recreation parcel.

Design Volumes: Total design debris volumes of the eleven, small tributary drainage basins (Basins S5 through S15) uphill of the proposed Phase A1 Development and uphill of the future school/recreation parcel are presented on Table 1. Information presented on Table 1 is from our previous debris flow and flood review. The total design volumes are the amount of debris expected to be produced by the 100-year, 1-hour thunderstorm rainfall of 1.18 inches (Hepworth-Pawlak Geotechnical, 2013) and are the expected

debris volumes at the fan heads. As the design flows travel down the fans, deposition will occur. Estimated design debris volumes that are expected to reach the proposed bicycle path/debris barrier design point are presented on Table 2 along with the expected flow front widths at the design point.

Barrier Height and Slope: The barrier height (Hb on Figure 3) may be based on the design volumes and flow front widths presented on Table 2 and a minimum freeboard of 1.5 feet above the estimated top of the stored debris surface. The barrier height should be at least 4 feet to accommodate the dynamic debris flow run-up at the barrier. This minimum barrier height is based on the previous estimated design flow depths and velocities on the small fans, see Table 3 in our previous debris flow and flood review (Hepworth-Pawlak Geotechnical, 2013). A stored debris surface slope of 0.04 ft./ft. down toward the barrier may be used in sizing the debris storage area uphill of the barrier. Cut and fill slopes for the barrier and debris storage area should be no steeper than 1.5:1 (horizontal to vertical).

Embankment Fill Compaction: The on-site fan deposits should be suitable for barrier embankment fill. Topsoil and organic matter should not be placed in the embankment fill. Also rocks in the fan deposits larger than 6-inches should be removed from the embankment fill before placement. The embankment fill should be placed in lifts and compacted to at least 95 percent of the maximum standard Proctor density near optimum moisture content. Prior to berm fill placement, the subgrade should be carefully prepared by removing all vegetation and topsoil and compacted the subgrade to 95 percent of standard Proctor density. The embankment fill foundation should be benched into the hillside where the slope is steeper than 20 percent.

Other Design Considerations: The debris flow and flood barrier should be protected from erosion. Erosion control in graded areas not subject to flowing debris can be accomplished by revegetation. Design of erosion controls in areas subject to flowing debris may be designed based on conventional clear water flow analysis using a statistical recurrence time acceptable to your civil engineer and government regulatory agencies.

Limitations: This study was conducted according to generally accepted geotechnical engineering principles and practices in this area, at this time. We make no warranty either express or implied. Information submitted in this report is based on our previous review study at the project site the proposed mitigation concept proposed by your designer, and our experience. If the barrier design differs substantially from that

described in this report, we should be notified to evaluate if the information presented in this report is still applicable. We are not responsible for technical interpretations by others of our information.

If there are questions, please contact us.

Respectfully Submitted,

HEPWORTH - PAWLAK GEOTECHNICAL, INC.

Ralph G. Mock
Engineering Geologist

And by:

Steven L. Pawlak P.E.

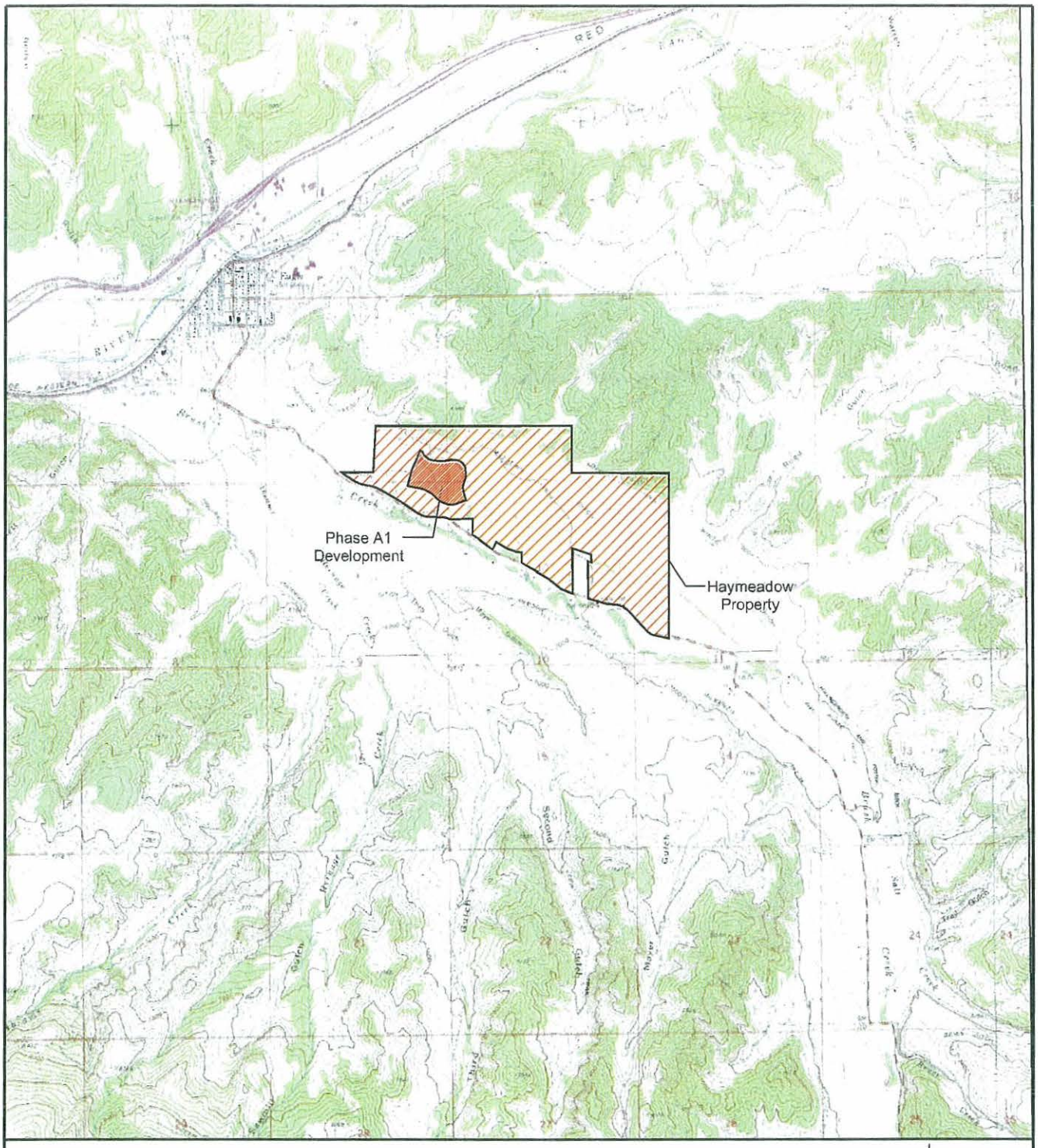
RGM/ksw

cc: Alpine Engineering – Gary Brooks (brooks@alpinecivil.com)

Attachments: Figure 1 - Project Site Location
Figure 2 - Debris Flow and Flood Mitigation on Small Fans
Figure 3 - Conceptual Debris Barrier Mitigation Concept
Table 1 - Small Tributary Drainage Basin Information Phase A1 Development
Table 2 - Estimated Design Debris Volume at Bicycle Path /Debris Barrier Design Point

REFERENCE

Hepworth-Pawlak Geotechnical, 2013, *Debris Flow and Flood Review, Proposed Haymeadow Development, Brush Creek Road, Eagle, Colorado:* Prepared for Abrika Properties LLC, Ocala, Florida (Job No. 113 097A, dated June 12, 2013).



113 097A	HP Geotech HEPWORTH-PAWLAK GEOTECHNICAL	Haymeadow Proposed Phase A1 Development Project Site Location	Figure 1

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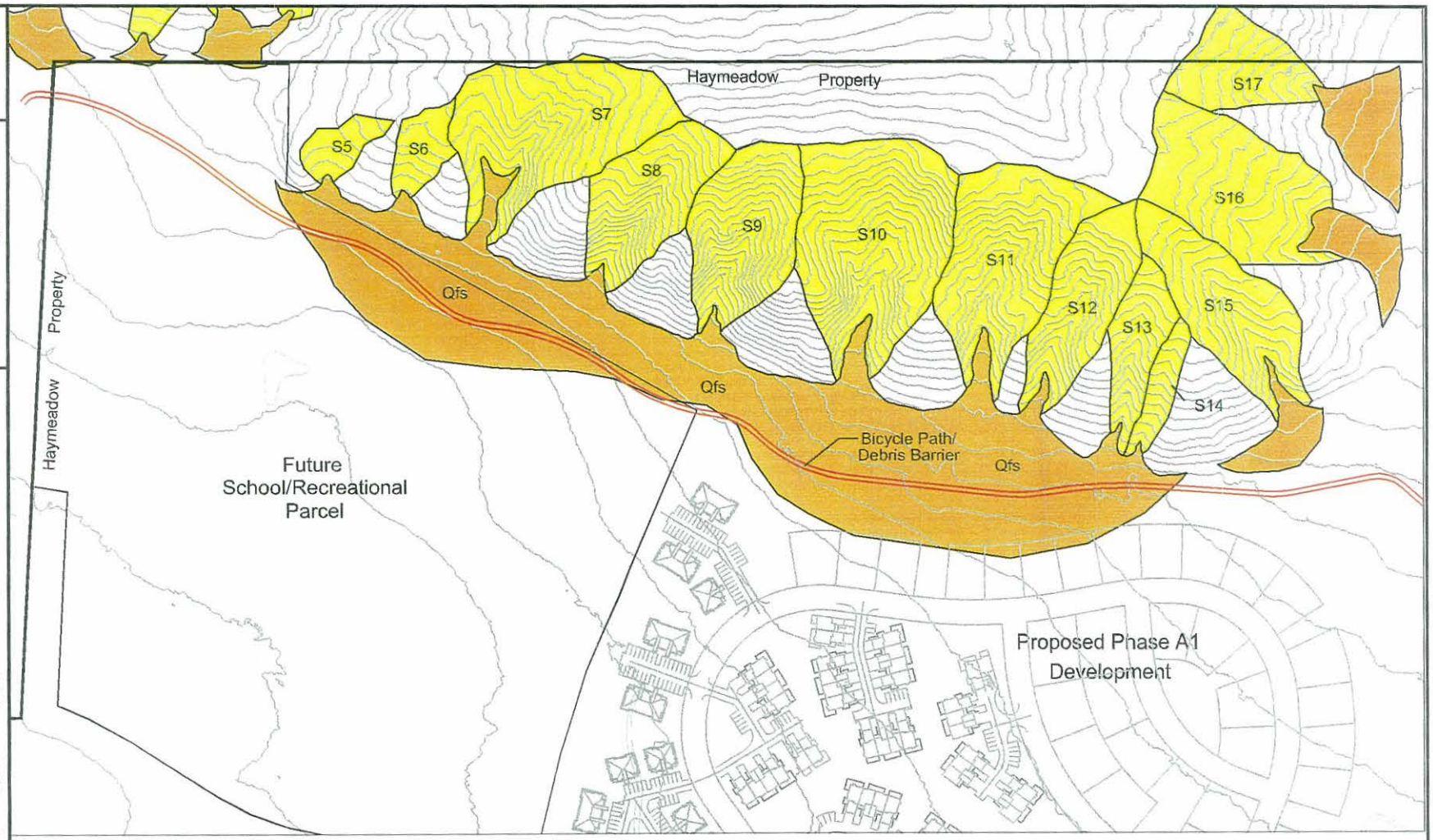
Haymeadow Proposed Phase A1 Development
Debris Flow and Flood Mitigation on Small Fans

Figure 2



Explanation:

S1 **Small Tributary Drainage Basins:**
See Table 1 for basin information.

Qfs **Small Fans:**
Potential site of future debris flow and flood deposition.

Contact:
Approximate boundary of map units.

Bicycle Path/Debris Barrier:
See Table 2 for design debris volumes and other design information.

N

0 300 ft.

Scale: 1 in. = 300 ft.
Contour Interval: 10 ft.
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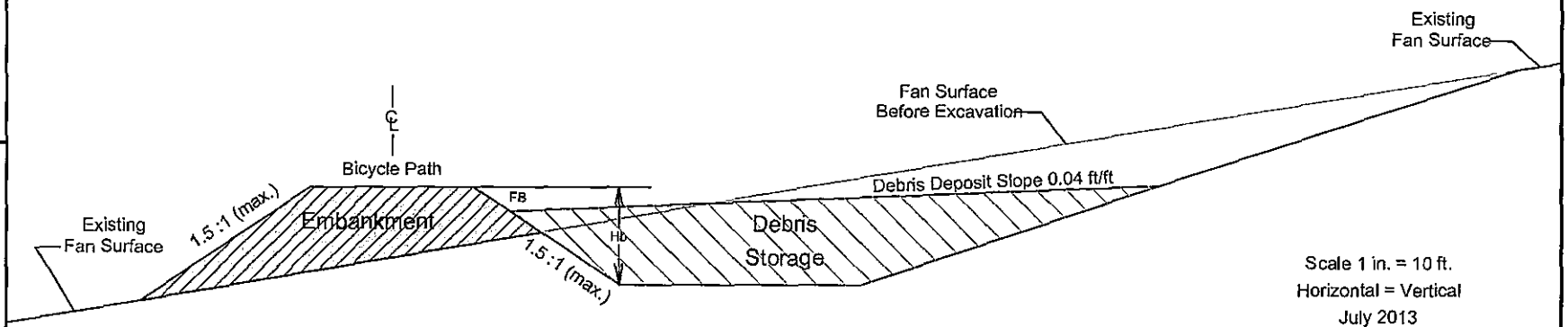
Haymeadow Proposed Phase A1 Development
Conceptual Debris Barrier Mitigation Concept

Figure 3

Bicycle Path/Debris Barrier
Conceptual Cross Section



Scale 1 in. = 10 ft.
Horizontal = Vertical
July 2013

Explanation:

Compacted Earth Fill

Debris Deposition Area

FB = Freeboard (1.5 ft. minimum)

Hb = Barrier Height (4 ft. minimum)

Notes:

1. Information presented on this figure is conceptual. Design information is presented on Table 2 and discussed in the report.
2. Location of bicycle path/debris barrier is presented on Figure 2.

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Table 1

Small Tributary Drainage Basin Information
Haymeadow Phase A1 Development

Basin Number	Basin Area	Basin Slope	Basin Melton's Number	Percent Basin Area Steeper than 30 Percent	Total Design Debris Volume
S5	0.3 ac	0.26 ft/ft	0.43	100%	130 yd^3
S6	0.3 ac	0.21 ft/ft	0.39	100%	145 yd^3
S7	2.2 ac	0.36 ft/ft	0.49	100%	424 yd^3
S8	1.3 ac	0.45 ft/ft	0.75	100%	307 yd^3
S9	1.5 ac	0.43 ft/ft	0.66	100%	336 yd^3
S10	2.7 ac	0.40 ft/ft	0.43	100%	474 yd^3
S11	2.0 ac	0.26 ft/ft	0.40	100%	398 yd^3
S12	1.2 ac	0.32 ft/ft	0.59	100%	291 yd^3
S13	0.6 ac	0.38 ft/ft	0.81	100%	208 yd^3
S14	0.3 ac	0.40 ft/ft	0.92	100%	133 yd^3
S15	1.5 ac	0.25 ft/ft	0.41	100%	333 yd^3

Notes:

1. Basin locations are shown on Figure 2.
2. Design debris volumes are for 100-yr., 1-hr. thunderstorm rainfall of 1.18 inches.

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Table 2

**Estimated Design Debris Volumes
at Bicycle Path/Debris Barrier Design Point
Haymeadow Phase A1 Development**

Basin/Fan Number	Total Design Debris Volume	Design Debris Volume at Design Point	Percent Total Volume at Design Point	Flow Front Width at Design Point	Distance from Fan Head to Design Point	Percent Total Fan Length at Design Point
S5	130 yd^3	68 yd^3	52 %	28 ft.	123 ft.	69 %
S6	145 yd^3	105 yd^3	72 %	16 ft.	139 ft.	53 %
S7	424 yd^3	208 yd^3	49 %	37 ft.	316 ft.	69 %
S8	307 yd^3	170 yd^3	55 %	37 ft.	202 ft.	71 %
S9	336 yd^3	68 yd^3	20 %	68 ft.	219 ft.	89 %
S10	474 yd^3	187 yd^3	39 %	47 ft.	333 ft.	78 %
S11	398 yd^3	183 yd^3	46 %	34 ft.	335 ft.	74 %
S12	291 yd^3	174 yd^3	60 %	26 ft.	243 ft.	63 %
S13	208 yd^3	161 yd^3	77 %	20 ft.	125 ft.	48 %
S14	133 yd^3	75 yd^3	57 %	32 ft.	100 ft.	66 %
S15	333 yd^3	0 yd^3	0 %	0 ft.	n/a	n/a

Notes:

1. Design point is the bicycle path shown on Figure 2.
2. Design debris volumes are for 100-yr., 1-hr. thunderstorm rainfall of 1.18 inches.