

The Colorado Geological Survey (CGS) agrees with the applicants' consultant that the proposed lots do not contain geologic conditions that would preclude the proposed residential use and density. However, a hazard within the site from potential debris flow/hyperconcentrated (high sediment yield) flow and potential for highly erosive flow require evaluation and mitigation. RMG's report (Soil and Geology Study, 3.18.22) states, p.10, "*The gradients and source materials on the subject property site are, in general, not conducive for generation of debris flows.*" CGS visited the site (38.9087, -104.9847) on August 3, 2022, and noted that a hyperconcentrated flood and debris flow hazard exists for at least drainage OS2 (as labeled in the Preliminary Drainage Report by SMH dated 7.22). This hazard can be observed in the source area for OS2, which includes steep slopes and material available for transport, including fallen trees, boulders, and weathered granite (grus). The drainage report has calculated flows of 5.10 and 28.55 cfs for the five and 100-year storm events, respectively, in OS2. CGS recommends that these flows be bulked for high sediment and debris flow yields, as indicated in the following table of values. This table is a generalized but well-understood industry estimate of bulking factors for these types of flows.

Table 1. Flow Classification by Sediment Concentration (adapt. from Bradley, 1986).

Bulking Factor							
0	1.11	1.25	1.43	1.67	2.00	2.50	> 3.33
Sediment Concentration by Weight (100% by WT = 1 x 10 ⁶ ppm)							
0	23	40	52	63	72	80	87 to 100
Sediment Concentration by Volume (specific gravity = 2.65)							
0	10	20	30	40	50	60	70 to 100
Normal Streamflow		Hyperconcentrated Flow		Debris Flow/ Mud Flow		Landslide	

This table indicates the calculated storm events expected at this location should be bulked by 1.25 to 1.67 to predict their volume. Flows can be highly erosive and contain sediment, boulders, and trees. It should be noted that calculated flows for the five and 100-year events are greater for OS3 than for OS2 (13.74 and 76.89 cfs, respectively), with potential impacts on the existing building on the Manning Property.

Excavations (test pits) can help evaluate if flows onto the sites have historically been primarily hyperconcentrated or have included debris flows. The flows can also be age dated by carbon materials to help determine recurrence intervals. Based on the volume of flow estimated, CGS recommends setback distances from the flow channel for building locations be determined and shown on the plans. We also recommend that the area of flows is depicted on the site plans and that the conveyance of the flows is evaluated, and the applicants' engineers discuss protection from deposition and erosion to the planned roadway and homesite locations.

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