EP-21-0051_1 Waterbury PUD Preliminary Plan

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38.9718, -104.5693

Colorado Geological Survey has reviewed the Waterbury PUD preliminary plan referral. I understand the applicant proposes 201 single-family residential homes on approximately 62 acres located southeast of Highway 24 and Stapleton Road in Falcon.

As noted on page 9 of Entech's Soil, Geology and Geologic Hazard Study (Entech Engineering, Inc., March 22, 2013), the hazards identified on this site include floodplains, seasonally shallow groundwater areas, potentially seasonal shallow groundwater areas, areas of seepage or springs, area of ponded water, unstable slopes, artificial fill, loose soils, and expansive soils. Also, on page 15, Entech states, "The most significant problem affecting development will be that of shallow groundwater, potentially shallow bedrock, and floodplains. As noted on page 16, "Floodplains are to be either avoided by development or channelized and preserved as open space in drainage easements." Entech makes appropriate ***preliminary*** recommendations for mitigating the site's hazards.

We offer the following comments and recommendations.

Shallow groundwater and basement feasibility. Entech observed groundwater in all the borings drilled over the entire development at depths ranging from near the surface to 11.5 feet. Entech does not address if basement levels are feasible for this development. Full-depth basements should not be considered unless mitigation measures are implemented to ensure that a *minimum* separation distance of three feet between shallowest seasonal water levels and lowermost floor and crawlspace elevations can be maintained year-round. Mitigation strategies could include: 1) placing fill to raise site grades and planned basement floor levels, 2) limiting basement floor depths through the use of walk-out or garden-level basement construction, and/or 3) constructing an area underdrain system if site geometry permits a permanent gravity outfall. Entech states on page 16, "It is anticipated the majority of the areas where shallow groundwater exists on the site will be mitigated with the proposed grading." Entech also states in their addendum (Waterbury, Filings 1 and 2, December 23, 2020), "fill depths of 2 to 8 feet are proposed on the site with approximately 4 feet of fill proposed across the majority of the site." However, this mitigation strategy alone may not be an effective method to ensure groundwater levels are at least three feet from the lowermost floor levels.

Seasonal groundwater monitoring has not been conducted at this site as recommended by the Engineering Criteria Manual (ECM), and the extent of seasonal fluctuation is unknown. Without monitoring, potential impacts from groundwater are indeterminate. **CGS recommends the county require groundwater monitoring/observation to verify that proposed floor levels are at least three feet above maximum anticipated groundwater levels and maintained year-round.** This monitoring/observation program should be conducted prior to the preliminary plan's approval to determine if basements are feasible and/or if an underdrain system could be employed for this site. To be effective, however, this monitoring should include observations through fall, winter, and spring and not merely during site-specific building investigations. It is outside the scope of CGS review to determine whether the 3-ft minimum separation distance exists. If site grades cannot be raised to maintain the minimum separation distance and an area groundwater collection system (underdrain) is determined to be unworkable, then full-depth basements should not be allowed.

Entech states on page 16, "*Subsurface drains may be necessary in some areas to prevent the intrusion of water below grade*," and "*Dewatering systems may be necessary in some areas where seepage and perched water occurs*." Entech also states on page 11, "*In areas where high subsurface moisture conditions are anticipated periodically, a subsurface perimeter drain will be necessary to help prevent the intrusion of water into areas located below grade*." Individual foundation perimeter drains are needed around any below-grade (basement) space, **if determined to be feasible**, and may discharge to a positive outfall or connection to an underdrain system if constructed. Individual foundation perimeter drains are intended to handle small amounts of intermittent water and **should not be used to mitigate a persistent shallow groundwater condition**.

CGS disagrees with Entech on page 17, *"Final drainage recommendations should also be determined at the time of the observation"* (Foundation Excavation Observation). **CGS recommends that drainage systems are determined and designed at the preliminary plan stage and noted on the plans**.

Geologic Hazard Disclosure Statement. CGS recommends a geologic hazard disclosure statement is included on the preliminary plan referencing Entech's March 22, 2013 report and December 23, 2020 addendum for mitigation measures and the "Geology/Engineering Geology Map" (figure 3).

Setback from potentially unstable slopes. As noted on page 10 of Entech's report, "*areas of unstable slopes were identified along a few of the drainages on site*," and "*These areas are subject to failure due to erosion by the creeks.*" Entech states (page 10), "*A minimum setback of 20 feet should be maintained between buildings and the crest of any remaining unstable slopes*." **CGS agrees with Entech and recommends the required setback is indicated on the project plans**.

In summary, CGS recommends:

- The county requires groundwater monitoring/observation to verify that proposed floor levels are at least three feet, preferably five feet above maximum anticipated groundwater levels, and maintained year-round.
- Entech determines the feasibility of basement construction.
- Drainage systems are determined and designed at the preliminary plan stage and noted on the plans.
- A geologic hazard disclosure statement is included in the preliminary plan.
- The required setback from unstable slopes is indicated on the project plans.
- Entech's recommendations are incorporated in the project planning and design.

Submitted 5/24/21 by Amy Crandall, Engineering Geologist, Colorado Geological Survey