EP-21-0084 Frindt Residence (Crystal Park Site S-124)

NW¼ NW¼ SE¼ Section 17, T14S, R67W, 6th Meridian

38.8318, -104.9112

The applicant proposes a single-family residence at 5291 Neeper Valley Road in the Crystal Park development. With the original referral, we received the Site Plan (Haddon Architecture, April 14, 2021), Elevations (Hadden Architecture, April 14, 2021), and Soils Report (Geoquest, LLC, stamped November 3, 2020). The resubmittal documents include a Geologic Hazard Study (Rocky Mountain Group, March 17, 2021). RMG states, "Based on our evaluation of the geologic conditions, it is our professional opinion that the proposed residential development is feasible."

Photo 1: Northern outcrop with detached rocks

I visited the site on May 24, 2021. Site observations and available LiDAR show slopes ranging from 20 to 40 percent upslope and downslope from the proposed residence. While onsite, I did not observe signs of slope instability, such as soil creep or surface cracking. Two large outcrops are associated with the site. The outcrop on the northern portion of the site included some detached, precarious rocks (Photo 1). However, this outcrop is located approximately 65 feet to the north of the proposed building footprint and does not appear to be a risk to the proposed building. The outcrop to the east and upslope of the proposed structure includes some detached rocks; however, most are lichen-covered and partially embedded (see Photo 2). I also observed scattered rocks further upslope from this outcrop (Photo 3).

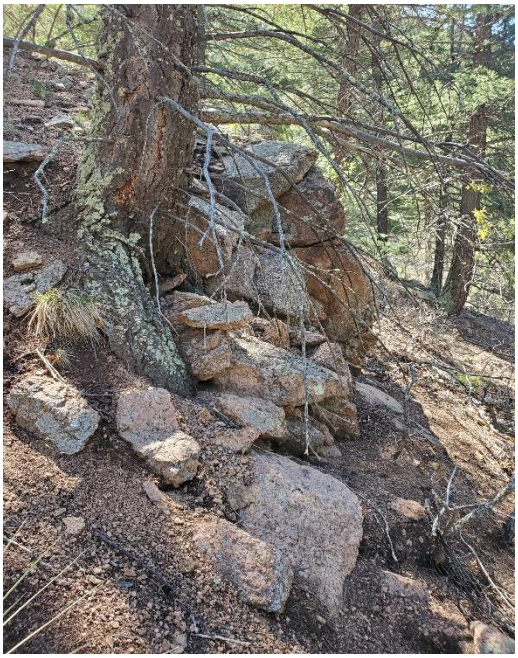

Photo 2: Upslope Outcrop, some detached rocks

Photo 3: Scattered rocks observed upslope

CGS offers the following comments and recommendations during the planning and development of this site.

Site Geology. The site is underlain at variable depths by relatively loose material (commonly known as "Grus" or "Colluvium") weathered from the underlying Pikes Peak Granite. Pikes Peak Granite is typically not problematic from a geotechnical or foundation performance perspective. However, the rock is fractured and weathered, sometimes extensively. Both of these rock quality characteristics can impact slope stability and erosion potential. Additionally, Grus is weaker than the bedrock and can be highly variable in depth.

Rockfall. The site is mapped as containing a rockfall hazard. The risk of rockfall was first recognized and mapped at this site in the geologic hazard mapping conducted for El Paso County in the 1970s according to House Bill 1041 concerning geologic hazards in Colorado. Even a low probability rockfall can have significant risk to permanent structures even after many decades without previous rockfall resulting in significant property damage and fatalities.

As previously stated, the bedrock at the site is the Pikes Peak Granite, forming outcrops directly upslope (to the east) and adjacent to the proposed building footprint (to the north) as well as scattered throughout the site. The existing rocks and boulders are likely to be disturbed during construction activities and/or freeze/thaw, resulting in an increased potential for a rockfall hazard. It may be prudent to remove such rocks during construction.

The RMG geohazard study states (page 4), "a steep slope to the west (uphill) of the proposed build area along the roadway cut for Oak Ridge Road. The slope to the east (downhill) of the proposed home is also steep." This appears to be inaccurate; as on the provided plans the rock outcrops are located to the north and east of the building site. Also, Neeper Valley Road is located to the west and downslope of the lot, not Oak Ridge Road. CGS disagrees with RMG's assessment, "The subject property is not considered to be prone to rockfall."

CGS continues to recommend the county require the risk for rockfall hazards be evaluated prior to construction and a mitigation plan established to reduce the potential risk. The appropriate mitigation measures should be noted on the project plans.

As noted on the site plan (Haddon Architecture, April 14, 2021), a proposed rock swale will be constructed upslope of the building footprint. This swale may serve as an adequate rockfall barrier; however, its effectiveness should be further evaluated during the rockfall hazard evaluation.

Steep Slopes and Construction-Related Slope Instability. There are risks associated with construction on steep slopes, such as are present at this site. While mapped landslides are not present and no evidence of existing slope instability was observed, there are risks associated with construction on these steep slopes where erosion is also a significant constraint. Presently stable slopes may become unstable as a result of reduced soil strengths if,

1) Modifications are made through the excavation of cuts, the addition of fills, and loading due to structures,
2) Significant moisture is added to the slope through residential irrigation (including infiltration from septic fields) and ample precipitation or snowmelt,
3) The existing drainage pattern is altered through grading, introducing water to previously drier areas.

To further reduce potential hazards associated with erosion, construction-related slope instability, shallow failures such as creep and slumping, and increased runoff, the following should be implemented in the design and construction:

- A qualified geotechnical professional should determine maximum allowable, unretained temporary, and permanent cut/fill heights and slope angles.

- All planned cuts exceeding four feet in height should be evaluated for slope stability using proposed slope geometry and considering all foundation and proposed cuts that will affect the slope.

- Retaining walls, building foundations, and upslope foundation walls that will function as retaining walls must be designed by a qualified geotechnical, structural, or civil engineer and must include adequate behind-wall drainage.

- The existing vegetative cover should be left intact to the extent possible, and every effort should be made to restore native vegetation within disturbed areas as quickly as possible. Irrigation beyond the bare minimum required to reestablish native vegetation should not be permitted.

As noted in the RMG geohazard study (page 4), "the potential for relatively rapid downslope movement at the site is considered to be low." CGS agrees with RMG's recommendation that "the structural design of the residence should consider its placement on the hillside and the additional surface pressures that could be generated by downslope creep and by retaining upslope materials" and recommends the structure be designed with as much rigidity as possible due to the potential of downslope creep. RMG's recommendations for proper surface grading and landscaping should be incorporated in the project design and construction.

Surface Drainage and Erosion. The onsite soil and colluvium ("Grus") are highly susceptible to erosion. Concentrated, developed flows can cause severe and damaging erosion and rapidly erode the surface material down to hard rock. Site drainage should be designed and constructed to prevent concentrated flows from being developed within the site. Proper maintenance and erosion protection of the slope face within the subject property is critical to the long-term structural integrity of the proposed structure.

Geotechnical Considerations. CGS agrees with Geoquest on page 3 of their report, "*Perimeter drains are required around all walls of the living area portion of the structure that are below finished grade including all common wall(s) adjacent to the basement."* Also, on page 4, "*an Open Hole Observation must be performed on each individual structure prior to placement of concrete, and preferably prior to the placement of forms in the excavated area*." Block slope failures in the bedrock can occur along concealed fractures and weathered zones anywhere beneath the planned building site. **CGS recommends Geoquest or another qualified geotechnical engineer carefully inspect the foundation excavation for evidence of fractures, discontinuities, and weathered zones during the open hole observations**. Should observed conditions indicate differences from those assumed in the foundation design, the structural engineer should re-evaluate the design.

Geologic Hazard Disclosure Statement. CGS recommends the geologic hazards and constraints be included in the preliminary/site plan.

In summary, we recommend:

1. The county requires the risk for a rockfall hazard to be evaluated prior to construction and a mitigation plan established to reduce the potential risk.
2. The geotechnical engineer provides maximum allowable, unretained temporary, and permanent cut/fill heights and slope angles.
3. All planned cuts exceeding four feet in height are evaluated for slope stability using proposed slope geometry and considering all foundation and proposed cuts that will affect the slope.
4. Foundation excavations are inspected for evidence of fractures, discontinuities, and weathered zones during the open hole observations.
5. The geologic hazards and constraints are included in the preliminary/site plan.

Submitted 6/4/2021 by Amy Crandall, Engineering Geologist, Colorado Geological Survey (303-384-2632 or acrandall@mines.edu)