ROCKY MOUNTAIN GROUP

Job No. 156377

March 3, 2017

Craig Gardner
12574 Pine Valley Circle
Colorado Springs, CO 80831

Re: Geologic Hazard Report
184 Camelot Rd
Lot S-184, Crystal Park, Filing No. 2
El Paso County, Colorado

Dear Craig Gardner:

This report presents the findings of an evaluation performed by RMG – Rocky Mountain Group of the above-referenced site in El Paso County, Colorado. The purpose of our report is to evaluate the site conditions and present our opinions of the observed conditions on the proposed development with respect to the intended usage.

Revisions and modifications to the conclusions and recommendations presented in this report may be issued subsequently by RMG based upon additional observations made during grading and construction (which may indicate conditions that require re-evaluation of some of the criteria presented in this report) and/or upon receipt of review comments from El Paso County and/or any third-party reviewing agencies.

EXISTING AND PROPOSED LAND USE

The site is currently included within an approximately 1,154.82 parcel in the Crystal Park area, zoned as "PUD" (Planned Unit Development). The proposed land use is to create a new approximately 0.70 acre single-family parcel (S-184) within the Crystal Park subdivision, Filing No. 2.

QUALIFICATIONS OF PREPARERS

The principle investigators for this study are Kelli Zigler, P.G. and Tony Munger, P.E. Ms. Zigler is a professional Geologist with over 16 years of experience in the geological and geotechnical engineering field. Ms. Zigler holds a B.S. in Geology from the University of Tulsa. Ms. Zigler has supervised and performed numerous geological and geotechnical field investigations in Colorado. Tony Munger is a licensed professional engineer with over 16 years of experience in the construction engineering (residential) field. Mr. Munger and holds a Bachelor of Science in Architectural Engineering from the University of Wyoming.

This study has been prepared in accordance with the requirements outlined in the El Paso County Land Development Code (LDC) specifically Chapter 8 last updated 01/06/2015 applicable sections include 8.4.9. and the Engineering Criteria Manual (ECM), specifically Appendix C last updated July 29, 2015.

PROJECT DESCRIPTION

The proposed development of this site is to consist of the construction of a single-family dwelling with an onsite wastewater treatment system and a well. The Concept Site Plan for the proposed parcel prepared by Virginia Ownby last dated February 8, 2017 is attached with this evaluation. At the request of the client, our evaluation was limited to a review readily available public documentation pertaining to the site, the performance of a site observation, and an evaluation of visible geologic conditions that may impact the proposed development. Our evaluation did not include any subsurface investigation, soil sampling, or laboratory testing.

Unless noted otherwise in this report, our scope of services does not include, either specifically or by implication, recommendations for development (site grading, utility installation, etc.), construction recommendations (foundation design criteria, mitigation of expansive or collapsible soil, etc.), or a slope stability analysis of the site. Development of specific construction and/or mitigation recommendations is also beyond the scope of this report. If the Client desires any of the services described in this paragraph, additional studies should be undertaken.

SITE EVLAUATION TECHNIQUES

The information included in this report has been compiled from the following:

1. Field reconnaissance
2. Geologic and topographic maps
3. Review of previous reports performed by RMG in the same subdivision
4. Available aerial photographs
5. Geologic research and analysis
6. Site development plans prepared by others
7. Soils Report by Geoquest, Job No. 16-0872, sealed November 22, 2016
8. Concept Site Plan prepared by Virginia Ownbey last dated February 8, 2017.

Geophysical investigations were not considered necessary for characterization of the site geology.

SITE CONDITIONS

We performed a field reconnaissance on the referenced site on January 30, 2017. At the time of the field reconnaissance, the site consisted of vacant land generally located northwest of the intersection of Camelot Road and High Ridge View in El Paso County, Colorado. The ground surface was well vegetated and contained a moderate to high growth of coniferous trees, aspens, and native grasses. Topographically, the site is located on a hillside east of Crystal Park Lake. The slopes on the site vary from about 10 to 35 percent grade. The site has good drainage, generally in the form of surface sheet

flow directed to the south and east. A relatively shallow drainage swale with a moderate gradient was observed north of the building site. Evidence of debris flow was not observed in the drainage swale. Visual evidence of slope creep (such as tension cracks in the ground or occasional curved trees) was not observed in the vicinity of the proposed building site.

GENERAL GEOLOGY

The site geology was based upon mapping presented by the Colorado Geological Survey (CGS) ([1]Keller et al, 2003). The following paragraphs present a summary of the general mapped site geology.

The surficial deposits, as observed during our site visit, consist of residuum and colluvium generally composed of sands and gravels with varying amounts of silt and clay. Several large outcrops of boulders on the order of 4- to 6-foot in diameter were observed on the property, generally below the proposed building area. However, based on our observations, these do not appear to have originated within the slope above this site.

The bedrock underlying the subject site is comprised of the Pikes Peak Granite of the Middle Proterozoic Era. The Pikes Peak Granite is comprised of light-gray to pink and reddish brown, coarse grained, porphyritic granite. The Pikes Peak Granite often produces grus (disaggregated loose mass of constituent minerals) when weathered. Resistant outcrops typically are round and bouldery. The principal minerals comprising the Pikes Peak Granite are perthitic microcline, quartz, biotite and plagioclase (oligoclase).

POTENTIAL GEOLOGIC CONDITIONS

The El Paso County Engineering Criteria Manual recognizes and delineates the difference between hazards and constraints. A geologic hazard is one of several types of adverse geologic conditions capable of causing significant damage or loss of property and life. Geologic hazards are defined in Section C.2.2 Sub-section E.1 of the ECM. A geologic constraint is one of several types of adverse geologic conditions capable of limiting or restricting construction on a particular site. Geologic constraints are defined in Section C.2.2 Sub-section E.2 of the ECM. The following sections discuss potential geologic conditions that commonly exist within El Paso County, Colorado.

Landslides

Landslides are a form of mass wasting slope failure that consists of relatively rapid downward sliding, falling, or flowing of a mass of soil, rock, or a mixture of the two. Landslides typically have one or more distinct failure surfaces. They typically occur on slope sides where the shear strength of a material is exceeded by the driving mass or weight of the material and may be induced by the presence of groundwater, heavy precipitation, and seismic events.

[1] Keller, John W., Siddoway, Christine, Morgan, Matthew L., Route, Erik E., Grizzell, Matthew T., Sacerdoti, Raffaello, and Stevenson, Adair, 2003 ***Geologic Map of the Manitou Springs Quadrangle, El Paso and Teller Counties, Colorado,*** Colorado Geological Survey, Open File Map 03-19.

RMG reviewed the electronic (online) version of the Colorado Landside Inventory map prepared by the Colorado Geological Survey (CGS). The subject site is not in an area identified as a previously mapped landslide.

The CGS is in the process of digitizing all mapped landslides that have been published in geologic and geologic hazard maps of Colorado. However, the site appears to lie outside the boundaries of the study area prepared by CGS. Based on the site conditions observed, landslides were not identified on the subject parcel.

Rockfall

Rockfall is the falling of a newly detached mass of rock from a cliff or down a very steep slope, and is considered to be a type of landslide with a very rapid rate of down-slope movement. It usually occurs on mountainsides or other steep slopes during periods of abundant moisture and frequent freeze-thaw cycles, and is caused by the loss of support from underneath or detachment from a larger rock mass. Ice wedging, root growth, or ground shaking, erosion or chemical weathering may start the fall. The rocks may freefall, bounce, tumble, roll, or slide down slope and can vary considerably in size.

The subject site does not have exposed cliffs or very steep slopes above it to generate rockfall. The subject property is not considered to be prone to rockfall.

Debris Flows and Debris Fans

Debris flows consist of water with a high sediment load of sand, cobbles and boulders flowing down a stream, ravine, canyon, arroyo or gully, and are typically activated by heavy or long-term rains or snowmelts which cause rapid erosion and transport of surficial materials down slope of drainages. Debris fans are created when debris flows reach a valley with a much lower gradient. As the energy level drops, the sediment load is deposited creating the fan shape.

The presence of debris fans or the potential for the development of significant debris flows was not observed on the surface of the property.

Faults and Seismicity

Faults are a discontinuity in a volume of rock, across which there has been significant displacement as a result of rock mass movement.

It appears the Ute Pass Fault is approximately half a mile to the east of the site. There are several geologic faults within and near the site associated with the Ute Pass Fault complex. According to the CGS, these faults are not considered to be recently active. However, they have been active during geologic times and could affect the site if they did rupture.

According to information presented by the CGS, several earthquakes have occurred in the vicinity of the Ute Pass Fault near Colorado Springs and Woodland Park. The earthquakes, with magnitudes in the range of 3.0 to 3.9, occurred approximately from 1962 to 2007.

Earthquakes felt at this site will most likely result from minor shifting of the granite mass within the Pikes Peak Batholith, which includes pull from minor movements along faults found in the Denver

basin. Ground motions resulting from small earthquakes are more likely to affect structures at this site and will likely only affect slope stability to a minimal degree.

The Pikes Peak Regional Building Code, 2011 Edition, indicates maximum considered earthquake spectral response accelerations of 0.185g for a short period (S_s) and 0.059g for a 1-second period (S_1). Based on the results of our experience with similar subsurface conditions, we recommend the site be classified as Site Class B, with average shear wave velocities ranging from 2,500 to 5,000 feet per second for the materials in the upper 100 feet.

Steeply Dipping Bedrock

Review of the Geologic Map of the Manitou Springs Quadrangle indicates areas near the site have bedding of the Pikes Peak Granite generally dips to the southeast at an angle ranging between 50 and 81 degrees. The granite possesses low expansion potential. Therefore, the hazards associated with expansion potential of upturned or steeply dipping bedrock are not anticipated to be present at this site. The dipping of the granite bedrock is not expected to adversely affect the proposed residential structure.

Unstable or Potentially Unstable Slopes

Based on our site observations, the site generally slopes moderately from the northwest down to the southeast across the entire site. The approximate elevation change from the northern property line to the proposed structure is approximately 20 to 30 feet, based on visual observation. The Concept Site Plan provided by Virginia Ownbey does not provide topographic data for the site. The slope inclination at the site of the proposed new structure varies from approximately 3:1 to 2:1 (horizontal:vertical).

Downslope creep, which is the slow downslope movement of superficial soil and rock materials, is common to the area. However, the potential for relatively rapid downslope movement at the site is considered to be low. Nevertheless, the structural design of the residence should consider its placement on the hillside and the additional pressures that could be generated by downslope creep and by retaining upslope materials. Proper surface grading and positive drainage away from the structure will reduce (but not eliminate) the potential for downslope creep to impact the proposed residence. Any landscaping should utilize xeriscape techniques in order to minimize needed irrigation to maintain landscaping. Further, stormwater and snowmelt runoff from parking areas should be directed towards drainage channels and away from potentially unstable slopes, both during construction activities and upon completion of site development.

According to the LDC, Chapter 8.4.2 Section B.3 Unsuitable Building Areas, areas that are identified as having certain characteristics, "... *shall be deemed unsuitable for building and shall be identified as no build areas on the plat."* One such characteristic is *"Areas where slopes are greater than 30%."*

Unstable slopes or apparent signs of ongoing slope movement were not observed around or on the property. However, the proposed residence shall be constructed on slopes less than 30%. Slopes greater than 30% shall be designated as "No Build".

Ground Subsidence

Subsidence is the motion of the ground surface (usually, the Earth's surface) as it shifts downward relative to a datum such as sea-level.

Common causes of land subsidence from human activity are pumping water, oil, and gas from underground reservoirs; dissolution of limestone aquifers (sinkholes); collapse of underground mines; drainage of organic soils; and initial wetting of dry soils (hydrocompaction).

The presence of sinkholes and collapse were not observed on the site. The site lies outside of the Colorado Springs Subsidence Investigation report (Dames and Moore, 1985). The site is generally not considered to be prone to ground subsidence.

Hydrocompactive and Potentially Expansive Soils (Moisture Sensitive Soils)

Hydrocompactive soils are prone to collapse (settlement) when exposed to increases in moisture content and/or loads from foundations. Hydrocompactive characteristics are typical of depositional soils (alluvium or colluvium deposits).

Based on the review of the Soils Report for Palace Homes performed by Geoquest, Job No. 16-0872, sealed November 22, 2016, the subsurface materials at the site generally consist of a poorly graded silty sand matrix (decomposed granite) extending to the 15-foot termination depth of the boring. These materials generally are considered to have low collapsibility potential. Based on the Geologic Map of Manitou Springs Quadrangle, the poorly graded silty sand matrix is underlain by the Pikes Peak Granite formation, which generally is also considered to have low collapsibility potential.

Radon Gas

*"**Radon Act 51** passed by Congress set the natural outdoor level of radon gas (0.4 pCi/L) as the target radon level for indoor radon levels. The US EPA has set an action level of 4 pCi/L. At or above this level of radon, the EPA recommends you take corrective measures to reduce your exposure to radon gas".*

Most of Colorado is generally considered to have the potential of high levels of radon gas, based on the information provided at: http://county-radon.info/CO/El_Paso.html. There is not believed to be unusually hazardous levels of radon from naturally occurring sources at this site.

Based upon a Map of Radon Zones by the Colorado Department of Public Health and Environment (CDPHE) (Ref. 11), two zones of radon potential are indicated in Colorado, Zone 1 - High Radon Potential (probable indoor radon average >4 pCi/L) and Zone 2 -Moderate Radon Potential (probable indoor radon average 2-4 pCi/L). El Paso County is located within Zone 1.

Potential radon hazards are best mitigated at the building design and construction phases. Providing increased ventilation of basements, crawlspaces, creating slightly positive pressures within structures, and sealing of joints and cracks in the foundations and below-grade walls can help mitigate radon hazards.

Flooding and Surface Drainage

Based on our review of the Federal Emergency Management Agency (FEMA) Community Panel No. 08041C0725F and the online ArcGIS El Paso County Risk Map, the site does not lie within the 500-year floodplain of Sutherland Creek.

Springs and High Groundwater

Based upon review of the Manitou Springs Quadrangle 7.5 minute series dated 2005 and our site reconnaissance, the presence of springs or potential springs were not observed at or adjacent to the site.

Seasonal variations in groundwater conditions are expected. It is assumed groundwater beneath the subject site predominates in colluvial deposits or in fractured weathered consolidated granite bedrock located at depth.

The presence of shallow groundwater was not observed at or adjacent to the site at the time of our site reconnaissance.

Fluctuations in groundwater and subsurface moisture conditions may occur due to variations in rainfall and other factors not readily apparent at this time. Development of the property and adjacent properties may also affect groundwater levels.

Erosion and Corrosion

The sands encountered at the site are susceptible to erosion by wind and flowing water. The sand at this site typically are not likely to be potentially corrosive to buried, ferrous metal piping and other structures.

The permeability of the sands and gravels at the site is generally considered to be high. Surface runoff could also be rapid and the potential for rapid erosion of unvegetated slopes could be high. Long-term slopes should not be steeper than 3:1 (horizontal:vertical) in both cut and fill areas. Revegetation of any disturbed areas should be performed as soon as possible with revegetation/erosion mats placed as required. Excavation cuts and soil disturbance should be kept to a minimum. Proper surface drainage, as recommended in a geotechnical engineering report should be provided and maintained by the Homeowner.

General Geologic Considerations

Based upon our evaluation of the geologic conditions, it is our opinion that the proposed development is feasible. The geologic hazards identified are not considered unusual for mountainous regions of Colorado. Mitigation of geologic hazards is most effectively accomplished by avoidance. However, where avoidance is not a practical or acceptable alternative, geologic hazards should be mitigated by implementing appropriate planning, engineering, and local construction practices.

CONCLUSIONS

Based upon information obtained from our field reconnaissance, geologic maps of the site, and geologic research, the site may be considered suitable for the proposed subdivision. However, the Concept Site plan by Virginia Ownbey did not depict topography within the proposed location of the new residential structure or for the proposed site.

The proposed structures shall not be located in an area of greater than 30% slope. The geologic conditions identified at the site are not uncommon to the west side of Colorado Springs, and most of these conditions can be accommodated by implementing planning, engineering, and construction practices typical for the area.

The foundation and floor slabs of the structure should be designed using the recommendations provided in the site specific Subsurface Soil Investigation (SSI). In addition, recommendations for surface drainage should be established during construction and maintained by the homeowner.

We believe the surficial soils will classify as Type C materials as defined by OSHA in 29CFR Part 1926, date January 2, 1990. OSHA requires temporary slopes made in Type C materials be laid back at ratios no steeper than 1.5:1 (horizontal to vertical) unless the excavation is shored or braced.

CLOSING

This report has been prepared for the exclusive use by **Craig Gardner** for application as an aid in the design and construction of the proposed development in accordance with generally accepted geotechnical and geological engineering practices. The information in this report is based in part upon data obtained from our site observations and the information presented in referenced reports. The nature and extent of variations may not become evident until construction. If variations then become evident, RMG should be retained to review the recommendations presented in this report considering the varied condition, and either verify or modify them in writing.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by geotechnical engineers practicing in this or similar localities. RMG does not warrant the work of regulatory agencies or other third parties supplying information which may have been used during the preparation of this report. No warranty, express or implied is made by the preparation of this report. Third parties reviewing this report should draw their own conclusions regarding site conditions and specific construction techniques to be used on this project.

The scope of services for this project does not include, either specifically or by implication, environmental assessment of the site or identification of contaminated or hazardous materials or conditions. Development of recommendations for the mitigation of environmentally related conditions, including but not limited to biological or toxicological issues, are beyond the scope of this report. If the Client desires investigation into the potential for such contamination or conditions, other studies should be undertaken.

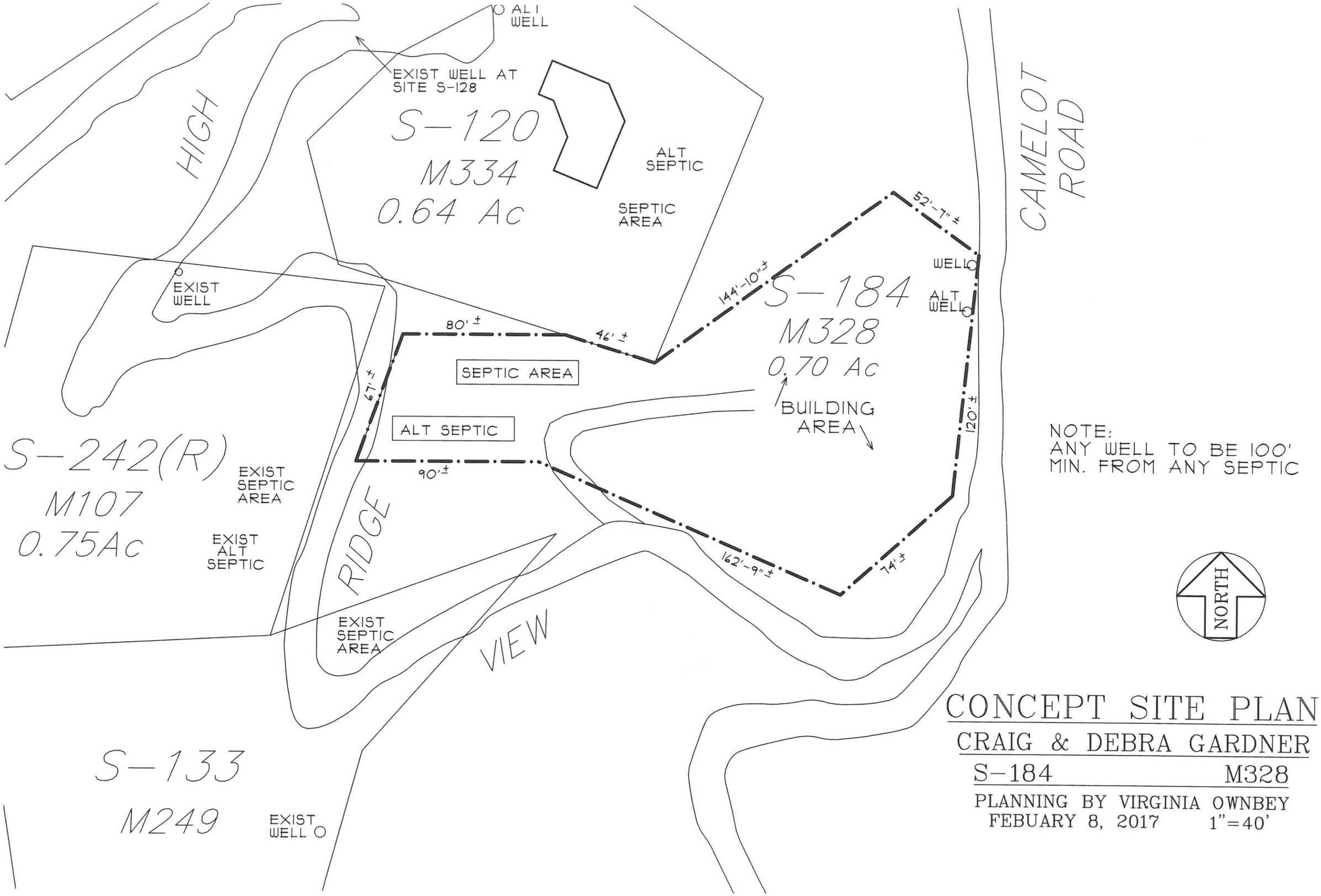
If we can be of further assistance in discussing the contents of this report or analysis of the proposed development, from a geotechnical engineering point-of-view, please feel free to contact us.

Cordially,

RMG – Rocky Mountain Group

Kelli Zigler
Project Geologist

Tony Munger, P.E.
Geotechnical Project Engineer



CONCEPT SITE PLAN

CRAIG & DEBRA GARDNER

S-184 M328

PLANNING BY VIRGINIA OWNBEY
FEBUARY 8, 2017 1"=40'