Bear Valley Design, Ltd.
Engineers - Consultants

P. O. Box #770475
STEAMBOAT SPRINGS, COLORADO, 80477-0475
MOBILE: (970) 879-5454
E-MAIL: <bearbvd@mindspring.com>

November 7, 2020

Mr. Jake Kruse
Kruse Construction, LLC
175 Clay Avenue
Craig, Colorado, 81625

Subject: Soil investigation and LTAR evaluation for an OWTS for a proposed residence to be located at 28395 Yellowjacket Drive, in Routt County, Colorado.

Dear Mr. Kruse,

Per your request, we visited the subject site on November 4 of this year. The investigation was performed for the purpose of providing both design parameters for the design of a residential foundation and for evaluating the subsoils on the site for the purpose of designing an Onsite Wastewater Treatment System (OWTS) for a single family residence per CDOPH code requirements.

The proposed structure is anticipated to be of typical site built, wood framed, construction, possibly of split level design as dictated by the topography of the buiding site with reinforced concrete stem walls bearing on reinforced concrete spread footers, with a crawl space beneath the main floor and with an attached garage with a slab on grade floor.

The anticipated building site is situated on a part of the lot which is covered with a mixture of grass and sage vegetation and which slopes downward toward the west at a reasonably uniform, approximately 7 to 1 slope. The proposed location of the absorption field (and of the profile hole) is to the west of the anticipated location of the residence.

Three test pits (inclusive of a profile hole) were advanced on the site, two near the location where the owner has indicated the residence

is likely to be situated, and the third (profile hole) where the absorption field is expected to be situated. The two test pits near the location of the residence revealed very similar soil conditions. These pits revealed very slightly moist medium brown sandy, silty topsoil approximately 12 inches thick overlying a medium brown gravelly silty, very slightly clayey fine sand with cobbles, which graded denser with increasing depth and became extremely dense at a depth of 4.5 feet. We did not observe any free ground water, in either of these pits. Both of these pits were advanced using a rubber tire mounted backhoe.

Our experience with similar soils in the area, taken together with our observations in the test pit, have led us to form the opinion that the very dense, rocky subsoil exposed in the pits is very mildly expansive, and will provide stable bearing for the foundation of a structure of the proposed type.

The excavation for the anticipated foundation is quite likely to reach a depth such that the footers will bear on the underlying extremely dense, subsoil material. Spread footers for the proposed structure should be designed to bear on this dense subsoil material with a maximum net bearing pressure of 3.5 KSF, as well as with a minimum dead load of 0.7 KSF, with the latter intended to control any tendency of the bearing soils to swell lest they ever experience a significant increase in their moisture content. Any retaining structures should be designed to retain pressure equivalent to that which would be exerted by a fluid weighing 45 PCF.

The foundation's footers must be surrounded with a footer drain. This footer drain must be constructed using 4" diameter D-2729 perforated PVC pipe (with the perforations located at 4 and 8 'o'clock'), bedded and covered with ¾" screened rock with the rock underlain by a relatively impervious membrane and covered with a geo-fabric such as 'Mirafi' #140N. The footer drain must run from a pair of clean-outs, with a minimum 0.5 % slope around the foundation to a corner opposite the clean-outs, and be wyed together there and connected to a drain to daylight via a non-perforated 4" diameter PVC pipe. This drain must be located at a grade low enough to insure that it will prevent any water which might penetrate the backfill from soaking the bearing soil beneath the footers. The daylighted end of this drain should be protected from intrusion by critters by means of a screen and cobbles.

Frost protection for the foundation must be provided by maintaining a minimum of 48" of earth cover over them, measured in

any direction. Material bermed up against the exterior of the stem walls may be included in the calculation of the depth of coverage of the footers. The finish grade should provide for a minimum of 2% slope away from the structure in all directions for a minimum of 10 feet, as well as for positive and continuous drainage away from the building without any ponding. Native subsoil materials will provide appropriate backfill, but all cobbles above 4 inch size should be excluded from the backfill. This backfill may be capped with a maximum six inch thick layer of topsoil. The native backfill material must be placed in lifts a maximum of 10 inches thick, with each lift moistened and compacted to 93% of its Standard Proctor density.

In order to prevent the evaporation of ground moisture form adding to the heating cost of the building, the surface of the ground in the crawl space must be covered with a six mil thick sheet of visquene, which, for fire protection purposes must, in turn, be covered with a minimum 1-½ inch thick layer of either crusher fines or 'flow-fill'. For similar reasons as well as to provide for improved cure, the concrete for the garage slab on grade floor must be placed immediately above a minimum six mil thick sheet of visquene.

Any slabs on grade, whether in the garage or elsewhere, must be placed directly above a minimum 6 mil thick sheet of visquene, which, in turn, must be place on top of a minimum 12 inch thick layer of imported crusher fines fill placed in two lifts and compacted to 95 % of its standard Proctor density. In order to protect this fill from infiltration by fines in the underlying subsoil, it must be separated from the subsoil by a layer of 'Mirafi' @140N geofabric. If radiant heating is going to be installed in any slabs, insulation meeting code requirements for a heated slab must be provided. If this is the case, we highly recommend the use of insulation which has 'buttons' on top for the purpose of providing positive location of the hydronic heat tubing.

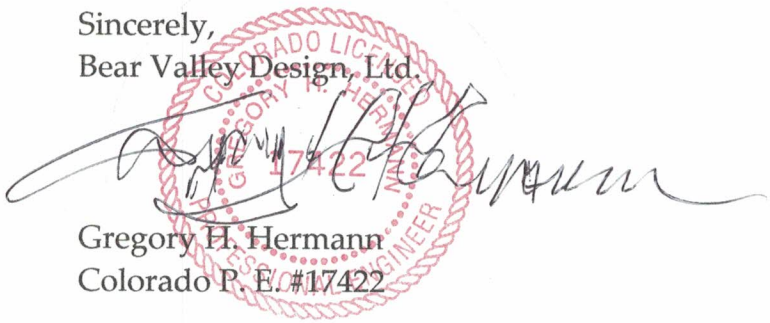
Any partitions situated immediately above slabs on grade must be provided with a 1-½ inch high expansion joint, constructed per typical local practice, in order to protect the structure above against damage in case the slab floor were ever to move upward due to expansion of the soils beneath it.

Based on the soil conditions exposed in the profile hole, we also concluded that the site is, in fact, suitable for the installation of a typical OWTS absorption field. Although no bedrock was encountered in the profile hole, the subsoil was cemented to such an extent that the backhoe encountered practical refusal before the profile hole reached a

backhoe encountered practical refusal before the profile hole reached a depth of four feet beneath the anticipated absorption surface. No free ground water was encountered in the profile hole or in the other two test pits. Our evaluation of the subsoil exposed in this profile hole is that it classifies as a Type 3A, a massive sandy clay loam loam, per Table 10.1 in Colorado's Regulation #43. Therefore, if the leach field for the proposed OWTS should be designed based on a Long Term Acceptance Rate (LTAR) of 0.3 gallons per square foot per day, it will be adequate under the applicable State regulations. Because of the high density of the deeper subsoils, careful consideration should be given both to using equipment capable of excavating to a greater depth (so as to verify the absence of bedrock within 4 feet of the bottom of absorption trenches) and to designing a mound type leach field.

Thank you for the opportunity to have been of professional service to you in this matter.

Sincerely,
Bear Valley Design, Ltd.



Gregory H. Hermann
Colorado P. E. #17422