PRELIMINARY SUBSURFACE INVESTIGATION

BOULDER CREEK COMMONS
ON 55TH STREET
WITHIN SECTION 4, T.1S., R.70W.
BOULDER COUNTY, COLORADO

PREPARED FOR:

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APRIL 8, 2010

PROJECT 2008-49/2010

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Purpose

This report presents the results of a preliminary subsurface investigation accomplished for the property currently being referenced as the Boulder Creek Commons project, located on 55th Street, within Section 4, T1S., R.70W. of the 6th PM in Boulder County, Colorado. This investigation was made to provide preliminary design criteria for the foundation systems of the new buildings to be constructed on the site and other pertinent geotechnical engineering recommendations. As part of the field investigation, thirteen backhoe test pits were excavated throughout the subject site. Tests Pits 1-5 were accomplished in May of 2003, and Test Pits 6-13 were accomplished in August of 2008. The locations of the test pits are shown on Figure 1.

Factual data gathered during the field and laboratory work is summarized in Figure 2 and Table 1 attached. The results of this investigation and our opinions which are based on this investigation and our experience in the general area are summarized in this report.

Investigation Details

The test holes were excavated with a backhoe. The soil profiles were carefully logged by the project engineer. Hand driven samples were taken at selected intervals throughout the test pits. Samples obtained from the test pits were returned to our lab for testing. The test results are indicated on Table 1.

Proposed Development

It is our understanding that the conceptual plan is to construct approximately 70 single family detached units and two senior housing multi-unit buildings on the property. We were informed that the plan is to use slab-on-grade construction or concrete structural floors for the buildings. Approximately 1 to 2 feet of over-fill will be placed above the existing ground surface throughout the building pads. The slabs will be above the outside finished grades and will be 2 feet above the 100 year flood plain elevation. No below grade space, such as crawlspaces or basements, are planned for at this time. The buildings will be constructed using conventional wood framing techniques and will be

supported by poured in place reinforced concrete foundation walls. The loadings are anticipated to be light to moderate with no unusual loading conditions.

If actual building plans differ from the above description, we should be notified so that our recommendations can be reviewed and revised, if necessary.

Soil Conditions

Generally, a layer of topsoil was encountered at the surface, underlain by a relatively thin deposit of clayey, sandy silt, or silty sandy clay. These soils continued down approximately 1 to 3 feet below the existing ground surface and were underlain by a deposit of sand and gravel soil intermixed with cobbles. The sand and gravel soils continued to the maximum depth of the test holes, 8 feet beneath the existing ground surface.

A detailed description of the soils encountered in this investigation is presented in the Test Pit Logs (Figure 2).

Groundwater Conditions

Groundwater seepage was encountered in the test pits at approximately 8 inches to 6 feet beneath the existing ground surface. The groundwater level will fluctuate throughout the year depending upon the season, the amount of precipitation and runoff and the application of irrigation water. Two seasonal irrigation ditches are present along the south and west sides of this property. The ditches typically recharge the naturally occurring high groundwater level on this property when they are flowing full of water.

Foundation Recommendations

Based on the soil conditions encountered in the test holes, it is our opinion that the buildings can be supported on spread footings, either continuous spread footings or isolated pad footings, as long as the recommendations provided in this report are adhered to.

We recommend that all footings be over-excavated through any over-lot fill, topsoil and the overburden layers of silts and clays and should bear directly upon the native sand and gravel soils. All footing bearing surfaces should be thoroughly compacted with a vibratory compactor to densify the soils loosened as part of the excavation activities. This must be done prior to pouring the concrete for the footings. All footings must also be placed deep enough for frost protection, a minimum of 32 inches

below the outside grade. For preliminary design purposes, the footings constructed on the sand and gravel soils should be designed for a maximum bearing pressure of 1500 psf, based on dead load plus full live load.

If groundwater seepage is encountered at the footing bearing elevations, it will be necessary to dewater the excavation during the construction of the footings. This can typically be accomplished by the use of 1 or 2 dewatering pits excavated 2 to 3 feet below the bottom of the excavations and temporary sump pumps used to discharge the water. If any fill is needed to elevate the footing bearing surface above the groundwater level, a 1 to 1 ½ inch washed, crushed rock should be used for this purpose. Any fill placed for support of footings should be placed in loose lifts not to exceed 9 inches and compacted to 100% of maximum dry density as determined by the ASTM-D698 specification, within 2 % of optimum moisture content.

Slabs-On-Grade Recommendations

Prior to pouring any slab or placement of fill, it is essential that all topsoil and organic materials be removed and any loose fill either removed or compacted to 95% of maximum density as determined by the standard moisture/density relationship test ASTM D698-78. If any fill is required beneath a slab, we recommend using a granular non-expansive structural fill compacted in 9" maximum lifts to the standard referenced above.

The overburden sandy clay and silt deposits are of low to very low expansive potential. Even low to very low expansive soils are capable of some heaving and cracking of lightly loaded slabs-on-grade upon fluctuation of their moisture content. Therefore, some slab movement is anticipated if the soils beneath the slab become wetted. The possibility of wetting can be mitigated by following the site drainage recommendations presented in this report. However, due to the high groundwater conditions on this site it is likely that some slab damage (such as cracking and heaving) will take place if slab-on-grade construction is utilized. The owner and all concerned parties should realize and except the risk that some slab cracking and heaving are likely to occur if slab-on-grade construction is used. In order to reduce the potential of slab movement, the overburden layers of clay and silt should be removed down to the sand and gravel soils. Then, a non-expansive granular structural fill should be placed and properly compacted back up to the slab sub-grade elevation. The use of a structural floor supported by the foundation system, with void space beneath, would eliminate the possibility of floor movement due to expansive soils.

If slab-on-grade construction is used, we would recommend that the following slab-on-grade construction techniques be utilized to help prevent secondary damage that could be caused by slab movement.

1. Separate slabs from the foundation elements with a slip joint. A slip joint should be used around the perimeter of the slab and adjacent to any other structural elements.

2. Moderately reinforce slabs with #3 rebar each way on 12-inch centers continuous through interior slab joints. Slab joints must be provided to control the cracking. The floor joint grid should be designed to allow no more than 100 square feet of continuos slab. Maximum joint spacing should be limited to 10 feet.

3. Any load bearing partitions must be provided with their own foundation system and the slab separated as outlined above.

4. Provide a 1½-inch minimum air space below any interior non-load bearing partition to provide for slab movement without damage to the structure. If unsure of the proper construction methods to achieve the recommended air space we should be contacted for further recommendations.

5. Any pipes rising through the slab should be provided with flexible couplings or other means to allow substantial movement without damage to the piping. Any ducts connecting to equipment founded on the slab should be equipped with flexible or crushable connections to allow for some slab movement. Equipment and other building appurtenances constructed on the slab should be constructed so that slab movement will not cause damage.

Following the recommendations given above will not prevent movement of the floor slabs in the event that the moisture content of the soil beneath the slab changes. However, if movement occurs, damage will have been lessened by following the recommendations above.

Site Drainage Recommendations

It is essential that proper site drainage be provided to divert all surface water runoff and water from the roofs well away from the foundation walls. Satisfactory long-term performance of any foundation system depends on prevention of infiltration of water into the soils supporting the foundation. The following methods of preventing this infiltration are recommended:

1. Mechanically compact all fill around the buildings, including the backfill. Compaction by ponding or saturation must not be permitted. The backfill should be compacted to not less than 90% of maximum density as determined by the standard moisture/density relationship ASTM D698-78. Backfill which is to support slabs should be compacted to 95% of maximum dry density. Note that some moisture may need to be added to the soils in order to obtain the proper compaction.

2. Provide an adequate grade for rapid runoff of surface water away from the structure (a minimum of 10 percent for the first 10 feet away from the structure is essential for unpaved areas).

3. A well constructed, leak-resistant series of gutters, or other roof drainage system, is essential.

4. Discharge roof downspouts and all other water collection systems well beyond the limits of the backfill, a minimum of 5 feet. We recommend against landscaping which requires watering within 5 feet of the foundation walls.

Based on the current plan that all of the buildings will be constructed with slabs-on-grade or concrete structural floors placed above the outside finished grades, it is our opinion that perimeter drainage systems will not be warranted as long as the backfill is properly compacted and all surface drainage and grading is diverted well away from the foundation walls, a minimum of 5 feet. If plans change and below grade space is used, we recommend that the buildings have the protection of an exterior perimeter drain along with an interior drainage system. The perimeter drainage system should consist of 4-inch perforated pipe, surrounded by washed gravel. The pipe should be bedded on 2 inches of washed gravel and backfilled with 6 inches of gravel over and around the pipe. The drains should be at the bottom of the footings at the high point of the drainline and should drain to a positive gravity discharge, if possible, or to a sump pit equipped with a pump. We also recommend that an interior drainage system be installed beneath any slab which is below the outside finished grade or within any crawlspace excavation which is below the outside finished grade. Eight inches of washed gravel should be placed throughout the bottom of the excavation. Four-inch perforated pipe should be evenly embedded in the gravel layer forming a grid network of pipes throughout the gravel layer. A drain line should extend around the interior of the footings, offset approximately 1 foot from the footing. Lateral drainage pipes should also be connected to the interior perimeter drain line on approximately 10 to 12 foot centers throughout the excavation. These pipes should be channeled to drain into the same outfall as the perimeter drain line. Suggested details for

the drain are shown on Figure 3.

Earth Retaining Recommendations

At this site we recommend that the walls be designed using a lateral earth pressure equivalent to that developed by a fluid weighing 45 pcf plus any additional surcharge loads. Use of this value assumes that the wall will be backfilled with the site soils and that these soils will not be allowed to become saturated at any time during the life of the wall. Proper compaction of the backfill and proper site grading and drainage will help to prevent saturation of the backfill.

Excavation Considerations

In our opinion, excavation of the on-site soils can be accomplished with conventional, heavy-duty excavation equipment. The onsite sand and gravel soils can be used for the backfill, although care must be taken to assure an uniform gradation of the sands, gravels and cobbles so that no void spaces are created between the cobbles which could lead to future settlement problems. The maximum cobble size should be 6 inches.

We do anticipate groundwater seepage and caving soils within the utility trench excavations. The excavations will have to be dewatered using temporary sump pits and pumps or by constructing well points along the excavating route. The utility contractor should be made aware of the groundwater conditions in order to prepare for the construction properly. The excavations must be constructed by either sloping the sides to a safe and stable configuration or utilize a temporary shoring system in the excavations. Any excavations, in which men will be working, must comply with current OSHA standards and regulations. Excavating equipment and stockpiles of soil should be kept at a safe distance back from the edge of the excavation, at a minimum lateral distance of 1.5 times the depth of the excavation. Proper construction techniques concerning excavation, bedding material and compaction of the backfill should be followed to insure the satisfactory long term performance of the conduit and the overlying pavement structure. All fill placed in the excavations should be placed in loose lifts not to exceed 9 inches and must be compacted to 95% of maximum dry density as determined by the ASTM D6 78 specification, within 2% of optimum moisture content.

Prior to the over-lot grading, all organics and any loose fill should be stripped from the site. The stripped surface should then be scarified and compacted to at least 90% of maximum dry density for landscaped areas and to at least 95% of maximum dry density for any areas which are to be paved with concrete or asphalt. If any soft areas are encountered which can not be properly stabilized and compacted in-place, the soft

areas should be over-excavated down to the sand and gravel soils and then replaced with a properly compacted structural fill.

Density-compaction testing should be accomplished on all fill in order to verify that proper compaction is obtained.

Limitations

We believe that the test pits in this investigation present a reasonably accurate knowledge of the existing subsoils. However, variations of subsoils not indicated by the test pits are always possible. Site specific investigations should be accomplished for each building in order to confirm that the soil conditions are as indicated by this investigation and to make recommendations if differences are noted. This should be done prior to forming the footings.

An environmental assessment of the site was beyond the scope of services of this investigation.

Inspection and Quality Control

Placement of any significant thickness of fill should be tested to verify proper compaction is obtained. As previously stated, we recommend site specific investigations be accomplished for each building in order to determine if the soil conditions are consistent with these findings and appropriate for construction of the footings as designed.

If there are any questions or when we can be of further assistance, please call.

Sincerely,

Western Soils, Inc.

By: _____
Gary Rosson, P.E.

Project #2007-57
August 28, 2007

Boulder Creek Commons LLC
1919 14th Street, Suite 601
Boulder, Colorado 80302

Fees due for providing engineering services in order to produce an updated version of the preliminary subsurface investigation report for the proposed Boulder Creek Commons project, located on 55th Street, in Boulder County, Colorado.

Engineering: 5 hours @ $100/hr. = $500.00

Total Due: $500.00

Terms: This account is due the date of the invoice. Accounts are considered overdue if payment is not received within 30 days of the invoice date. A finance charge of 10% per month compounded monthly will be charged on any accounts not paid within 30 days of the invoice date.