NorthWest Colorado Consultants, Inc.
Geotechnical / Environmental Engineering • Materials Testing

May 8, 2008

Western Security Systems
c/o Frank and Clara Bradley
P.O. Box 775222
Steamboat Springs, CO 80477

Job Number: 08-7948

Subject: Subsoil and Foundation Investigation, Proposed Western Security Systems Building, Lot 3, Filing 4, Copper Ridge Business Park, Steamboat Springs, Colorado.

Ladies and Gentlemen:

This report presents the results of the Subsoil and Foundation Investigation for the proposed Western Security Systems Building to be constructed within Lot 3 in Filing 4 of the Copper Ridge Business Park in Steamboat Springs, Colorado. The approximate location of the project site is shown in Figure #1.

The scope of our work included obtaining data from cursory observations made at the site, the logging of two test holes, the sampling of the probable foundation soils and the laboratory testing of the samples obtained. This report presents recommendations for economically feasible and safe type foundations, as well as allowable soil pressures and other design and construction considerations that are advisable, but not necessarily routine to quality design and building practices.

Proposed Construction: The building plans were not available at the time of this investigation. Therefore, we have assumed that the proposed building will consist of a one to two story wood or metal framed structure utilizing concrete slab-on-grade construction placed near or slightly above the existing ground surface.

For design purposes, we have assumed that the building loads will be light to moderate typical of this type of commercial construction. If loadings or conditions are significantly different from those above, we should be notified to reevaluate the recommendations in this report.

Site Conditions: The project site is situated northwest of the intersection of Copper Ridge Circle and Copper Ridge Spur located within the northeast portion of the Copper Ridge Business Park in Steamboat Springs, Colorado. The site was vacant at the time of this investigation and covered by one to two feet of snow. It appears that some site grading operations have occurred at the site and all of the vegetation has been removed.

The topography of the site was variable and generally slopes gently down to the south-southeast on the order of 1 to 3 percent. It appears that an elevation difference of approximately 2 to 4 feet exists across the proposed building site.

Subsurface Conditions: To investigate the subsurface conditions at the site, two test holes were drilled on April 1, 2008 with an all terrain drill rig using 4-inch diameter continuous flight augers. The approximate test hole locations are shown in Figure #2.

The subsurface conditions encountered were variable and generally consisted clays overlying claystone-shale bedrock materials to the maximum depth investigated, 40 feet. Graphic logs of the exploratory test holes are presented in Figure #3, and the associated Legend and Notes are presented in Figure #4.

Natural clays were encountered at the ground surface in both of the test holes and extended to a depth of 25 feet in test hole 2, as well as extending to the maximum depth investigated in test hole 1, 40 feet. The clays were slightly sandy to sandy with occasional gravels, low to moderately plastic, medium stiff to stiff, moist to wet and brown to gray in color with calcareous stringers. Samples of the natural clays classified as CL Soils in accordance with the Unified Soil Classification System. Claystone-shale bedrock materials were encountered beneath the clays in test hole 2 and extended to the maximum depth investigated, 30 feet. The claystone-shale bedrock materials were slightly sandy, fine-grained, low to moderately plastic, hard to very hard, moist and gray to dark gray in color.

Swell-consolidation tests conducted on samples of the natural clays indicate that the materials tested exhibited a moderate to high swell potential when wetted under a constant load. The swell-consolidation test results are presented in Figures #5, #6, and #7, and all of the other laboratory test results are summarized in the attached Table 1.

Groundwater seepage was encountered in the test holes at depths of 7 and 11 ½ feet beneath the existing ground surface at the time of drilling. It should be noted that the groundwater conditions at the site can be expected to fluctuate with changes in precipitation and runoff.

Foundation Recommendations: Based on the subsurface conditions encountered in the test holes, the results of the field and laboratory investigations and our understanding of the proposed construction, we believe an economically feasible and safe type of foundation system is a helical screw pile foundation system bearing on the natural clays or bedrock materials. The helical screw pile foundation system should be designed by a qualified engineer, using industry standards and be installed by a licensed/certified installer. We strongly recommend that at least two test piles be advanced at the site so that the torque versus depth relationships can be established and the proper shaft and helix size and type can be determined. A representative of this office should observe the test pile installations, as well as observe the permanent piles installed for the building.

Alternate Foundation Recommendations: If the owner is aware of the risks associated with placing shallow foundations on swelling soils and can tolerate and/or design for the differential movements, which could result if the expansive clays swell an/or consolidate, then the structure may be supported by spread

footings founded on a minimum of 3 feet of properly compacted structural fill materials. The design and construction details presented below should be observed if a shallow foundation system is opted for. The precautions and recommendations itemized below will not prevent the movement of the foundations if the underlying clays swell or consolidate; however, they should reduce the amount of differential movement beneath the foundation system. Differential movements on the order of 1 to 3 inches could still occur if the clays undergo moisture changes.

1) The footings placed on a minimum of 3 feet of properly compacted structural fill materials should be designed using an allowable soil bearing pressure of 3,000 psf. The footings should also be designed using a minimum dead load pressure of at least 1,000 psf.

2) The footings or pad sizes should be computed using the above soil pressures and placed on the structural fill materials placed over the natural clays. If footings are used, they may have to be narrow or interrupted to maintain the minimum load. The foundation should be closely checked to assure that it distributes the loads per the allowable pressures given. In order not to exceed the maximum allowable load while maintaining the minimum dead loads, the difference between the live load and dead load conditions should be minimized. Increasing the dead load with heavy construction materials or reducing the live load with well-pitched metal roof can accomplish this.

3) Any topsoil and organics, existing fill materials, loose or soft pockets of soil found beneath or within the footings when the excavations are opened should be removed and the footings should be extended down to more competent natural clays prior to structural fill placement.

4) The structural fill materials placed beneath the foundations should consist of a non-expansive granular soil approved by this office prior to placement. The structural fill materials should be placed and compacted in 6 to 8 inch loose lifts to at least 100 percent of the maximum standard Proctor density and within 2 percent of the optimum moisture content determined in accordance with ASTM D698. The structural fill materials should extend out from the edges of the footing at a 1 (Horizontal) to 1 (Vertical) or flatter slope.

5) The foundation walls should be designed and reinforced to span an unsupported distance of 10 feet or the length between pads, whichever is greater.

6) The footing or pads should be placed well enough below final backfill grades to protect them from frost heave. Forty-eight (48) inches is typical for this location considering normal snow cover and other winter factors.

7) Care should be taken when excavating the foundations to avoid disturbing the supporting materials. Hand excavation or careful backhoe soil removal may be required in excavating the last few inches.

8) Based on experience, we estimate total settlement for footings and pads designed and constructed as discussed in this section will be approximately 1 inch. Additional bearing capacity values along with the associated settlements are presented in Figure #8.

9) An engineer from this office should be called to the site when the foundation excavations are near completion to identify the bearing soils and confirm the recommendations in this report, as well as test the structural fill materials placed beneath the footings for compaction.

Floor Slabs: We have assumed that the lower levels of the building will be constructed with concrete slab-on-grade floor systems. The on-site soils, with the exception of any topsoil and organic materials, should be capable of supporting slab-on-grade construction. However, floor slabs present a difficult problem where swelling materials are present near floor slab elevation because sufficient dead load cannot be imposed on them to resist the uplift pressure generated when the materials are wetted and expand. Based on the moisture-volume change characteristics of the clays encountered at the site, we believe slab-on-grade construction may be used, provided the risk of distress resulting from slab movement is recognized and special design precautions are followed.

The following measures should be taken to reduce the damage, which could result from movement should the underslab clays be subjected to moisture changes.

1) The floor slabs should be separated from all bearing walls, columns and their foundation supports with a positive slip joint. We recommend the use of ½-inch thick cellotex or impregnated felt.

2) Interior non-bearing partition walls resting on the floor slabs should be provided with a slip joint, preferably at the bottom, so that in the event the floor slab moves, this movement is not transmitted to the upper structure. This detail is also important for wallboard and doorframes and is shown in Figure #9.

3) A minimum 6-inch gravel layer should be provided beneath all floor slabs to act as a capillary break and to help distribute pressures. Prior to placing the gravel, the excavation should be shaped so that if water does get under the slab, it will flow to the low point of the excavation. In addition, all of the topsoil and organic materials should be removed prior to placement of the underslab gravels or new structural fill materials.

4) The floor slabs should be provided with control joints placed a maximum of 12 feet on center in each direction to help control shrinkage cracking. The location of the joints should be carefully checked to assure that the natural, unavoidable cracking will be controlled. The depth of the control joints should be a minimum of ¼ the thickness of the slab.

5) The underslab soils should be kept as close as possible to their in-situ moisture content. Excessive wetting or drying of these soils prior to placement of the floor slab could result in differential movement after the slabs are constructed.

6) It has been our experience that the risk of floor slab movement can be reduced by removing at least 3 feet of the expansive materials and replacing them with a well compacted, non-expansive fill. If this is done or if fills are required to bring the underslab soils to the desired grade, the fill should consist of non-expansive, granular materials. The fill should be uniformly placed and compacted in 6 to 8 inch lifts to at least 95% of the maximum standard Proctor density at or near the optimum moisture content, as determined by ASTM D-698/AASHTO T-99.

The above precautions and recommendations will not prevent floor slab movement in the event the clays beneath the floor slabs undergo moisture changes. However, they should reduce the amount of damage if such movement occurs. The only way to eliminate the risk of all floor slab movement is to construct a structural floor over a well-vented crawl space.

Underdrain System: Any lower levels or crawl space areas constructed below the existing or finished ground surfaces should be protected by an underdrain system to help reduce the problems associated with surface and subsurface drainage during high runoff periods. Localized perched water or runoff can infiltrate the lower levels of the structure at the foundation level. This water can be one of the primary causes of differential foundation and slab movement. Especially, when expansive soils are encountered. Excessive moisture in crawl space areas or lower level can also lead to rotting and mildewing of wooden structural members and the formation of mold and mold spores. The formation of mold and mold spores could have detrimental effects on the air quality in these areas, which in turn can lead to potential adverse health effects.

The drains should be located around the entire perimeter of the lower levels and be placed and at least 12 inches below any floor slab or crawl space level and at least 6 inches below the foundation voids and bottom of the foundation walls or footings. We recommend the use of perforated PVC pipe for the drainpipe, which meets ASTM D-2729 requirements, to minimize the potential for crushing the pipe during backfill operations. The holes in the drainpipe should be oriented down between 4 o'clock and 8 o'clock to promote rapid runoff of the water. The drainpipe should be surrounded with at least 12 inches of free draining gravel and should be protected from contamination by a filter covering of Mirafi 140N subsurface drainage fabric or an equivalent product. The drains should have a minimum slope of 1/8 inch per foot and should be day lighted at a positive outfall protected from freezing, or be led to a sump from which the water can be pumped. Caution should be taken when backfilling so as not to damage or disturb the installed underdrain. We recommend the drainage system include at least one cleanout, be protected against intrusion by animals at the outfall and be tested prior to backfilling. We also recommend that the client retain this firm to observe the underdrain system during construction to verify that it is being installed in accordance with our recommendations and observe a flow test prior to backfilling the system.

In addition, we recommend that an impervious barrier be constructed to keep water from infiltrating through the voided areas and/or under the foundation walls or footings. The barrier should be constructed of an impervious material, which is approved by this office and placed below the perimeter drain and up against the sides of the foundation walls. A typical perimeter/underdrain detail is shown in Figure #10. The placement of the impervious membrane and properly compacted clays in the crawl space areas to the

top of the footings or at least 12 inches above the top of the foundation voids or bottom of the foundation walls should help reduce the moisture problems in these areas.

Foundation Walls and Retaining Structures: Foundation walls and retaining structures, which are laterally supported and can be expected to undergo only a moderate amount of deflection, may be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 45 pcf for imported, free draining granular backfill and 55 pcf for the on-site materials.

Cantilevered retaining structures on the site can be expected to deflect sufficiently to mobilize the full active earth pressure condition. Therefore, cantilevered structures may be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 35 pcf for imported, free draining granular backfill and 45 pcf for the on-site materials.

The foundation walls and retaining structures should be designed for appropriate hydrostatic and surcharge pressures such as adjacent buildings, traffic and construction materials. An upward sloping backfill and/or natural slope will also significantly increase the earth pressures on foundation walls and retaining structures and the structural engineer should carefully evaluate these additional lateral loads when designing the foundation and retaining walls.

The lateral resistance of retaining wall foundations placed on undisturbed natural soils at the site will be a combination of the sliding resistance of the footings on the foundation materials and the passive pressure against the sides of the footings. Sliding friction can be taken as 0.4 times the vertical dead load. Passive pressure against the sides of the footing can be calculated using an equivalent fluid pressure of 250 pcf. The fill placed against the sides of the footings to resist lateral loads should be compacted to at least 100% of the maximum standard Proctor density and near the optimum moisture content.

We recommend imported granular soils for backfilling foundation walls and retaining structures because their use results in lower lateral earth pressures. The imported granular materials should be placed to within 2 to 3 feet of the ground surface. Imported granular soils should be free draining and have less than 7 percent passing the No. 200 sieve. The granular soils behind foundation and retaining walls should be sloped from the base of the wall at an angle of at least 45 degrees from the vertical. The upper 2 to 3 feet of fill should be a relatively impervious soil or pavement structure to prevent surface water infiltration into the backfill.

The wall backfill should be carefully placed in uniform lifts and compacted to at least 95 percent of the maximum standard Proctor density and near the optimum moisture content. Care should be taken not to overcompact the backfill since this could cause excessive lateral pressure on the walls. Some settlement of deep foundation wall backfill materials will occur even if the material is placed correctly.

Surface Drainage: Proper surface drainage at this site is of paramount importance for minimizing the infiltration of surface drainage into the wall backfill and bearing soils, which could result in increased wall pressures, differential foundation and slab movement. The following drainage precautions should be observed during construction and at all times after the structure has been completed:

1) The ground surface surrounding the structure should be sloped (minimum of 1.0 inch per foot) to drain away from the structure in all directions to a minimum of 10 feet. Ponding must be avoided. If necessary, raising the top of foundation walls to achieve a better surface grade is advisable.

2) Non-structural backfill placed around the structure should be compacted to at least 95% of the maximum standard Proctor density at or near the optimum moisture content in order to minimize future settlement of the fill. The backfill should be placed immediately after the braced foundation walls are able to structurally support the fill. Puddling or sluicing must be avoided.

3) The top 2 to 3 feet of soil placed within 10 feet of the foundation should be impervious in nature to minimize infiltration of surface water into the wall backfill.

4) Roof downspouts and drains should discharge well beyond the limits of all backfill. Roof overhangs, which project two to three feet beyond the foundation, should be considered if gutters are not used.

5) Landscaping, which requires excessive watering and lawn sprinkler heads, should be located a minimum of 10 feet from the foundation walls of the structure.

6) Plastic membranes should not be used to cover the ground surface adjacent to foundation walls.

Limitations: The recommendations given in this report are based on the soils encountered at this site and our assumptions regarding the proposed construction. We believe that this information gives a high degree of reliability for anticipating the behavior of the proposed structure; however, our recommendations are professional opinions and cannot control nature, nor can they assure the soil profiles beneath those or adjacent to those observed. No warranties expressed or implied are given on the content of this report.

Swelling soils were encountered at this site. These soils are stable at their natural moisture content but can shrink or swell with changes in moisture. The behavior of swelling soils is not fully understood. The swell potential of any particular site can change erratically both in lateral and vertical extent. Moisture changes also occur erratically, resulting in conditions, which cannot always be predicted. The recommendations presented in this report are based on the current state of the art for foundations and floor slabs on swelling soils. The owner should be aware that there is a risk in construction on these types of soil. Performance of the structure will depend on following the recommendations and in proper maintenance after construction is complete. As water is the main cause for volume change in the soils, it is necessary that the changes in moisture content be kept to a minimum. This requires judicious irrigation and providing positive surface drainage away from the structure. Any distress noted in the structure should be brought to the attention of a professional engineer.

This report is based on the investigation at the described site and on the specific anticipated construction as stated herein. If either of these conditions is changed, the results would also most likely change. Therefore, we strongly recommend that our firm be contacted prior to finalizing the construction plans so that we can verify that our recommendations are being properly incorporated into the construction plans. Man-made or

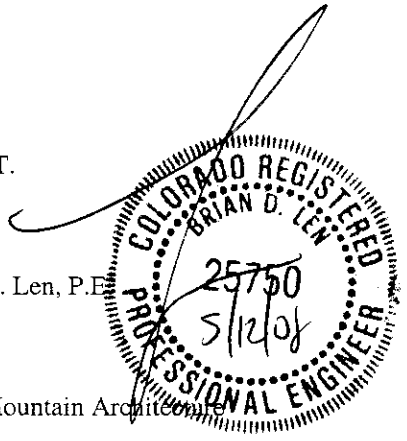
natural changes in the conditions of a property can also occur over a period of time. In addition, changes in requirements due to state of the art knowledge and/or legislation do from time to time occur. As a result, the findings of this report may become invalid due to these changes. Therefore, this report is subject to review and not considered valid after a period of 3 years or if conditions as stated above are altered.

It is the responsibility of the owner or his representative to insure that the information in this report is incorporated into the plans and/or specifications and construction of the project. It is advisable that a contractor familiar with construction details typically used to dealing with the local subsoils and climatic conditions be retained to build the structure. If you have any questions regarding this report or if we may be of further service, please do not hesitate to contact us.

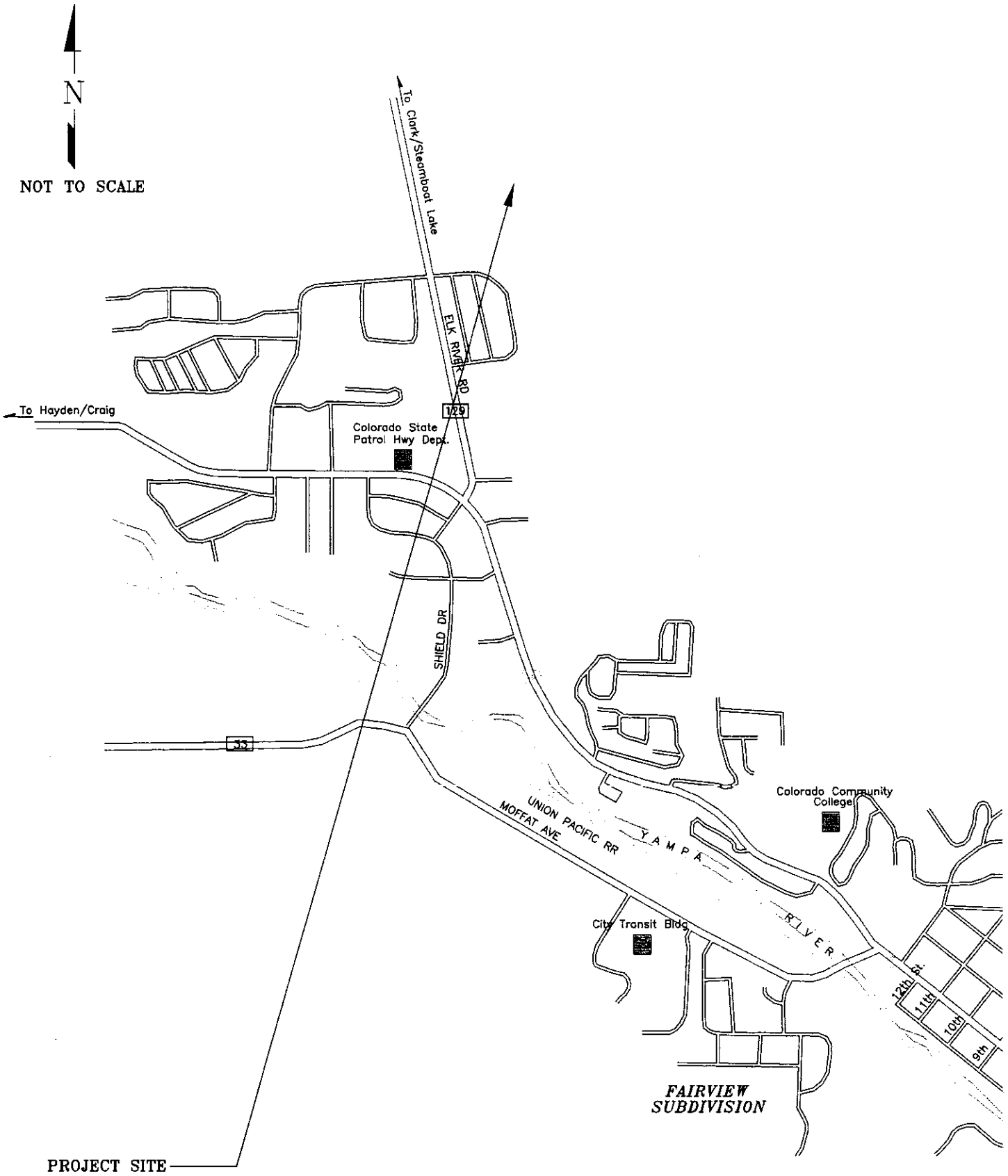
Sincerely,
NWCC, INC.

Josh P. Frappart, E.I.T.

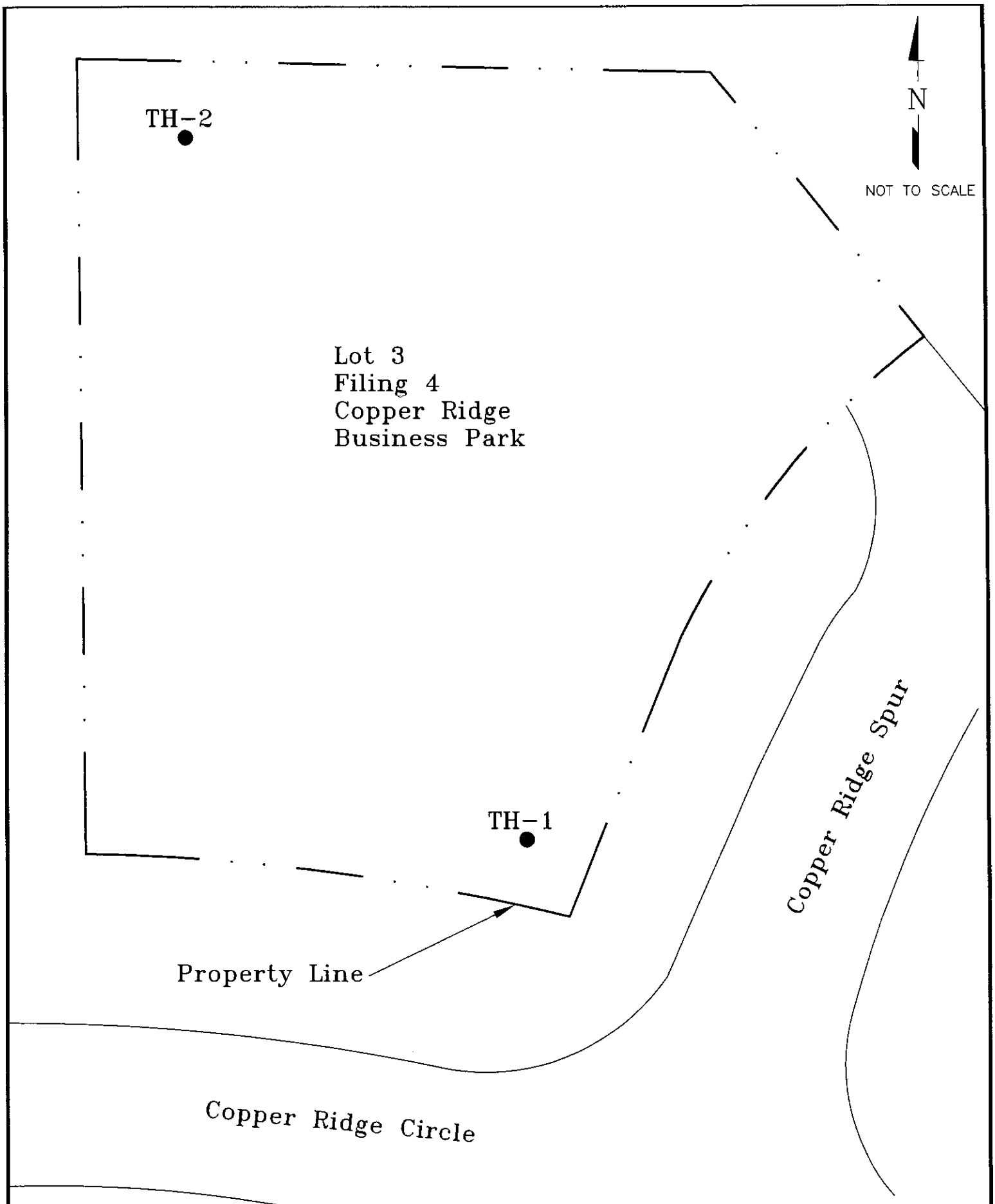
Reviewed by Brian D. Len, P.E.



xc: Jan Kaminski – Mountain Architecture



Title: VICINITY MAP	**Date:** 5/1/08	NWCC Northwest Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing
Job Name: Western Security Systems Building	**Job No.:** 08-7948	(970)879-7888 - Fax (970)879-7891 2580 Copper Ridge Drive -P.O. Box 775226 Steamboat Springs, Colorado 80477
Location: Lot 3, Fil. 4, Copper Ridge Bus. Park, Steamboat Spr	**Figure:** #1	



Title: SITE PLAN–LOCATION OF TEST HOLES	Date: 5/1/08	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing
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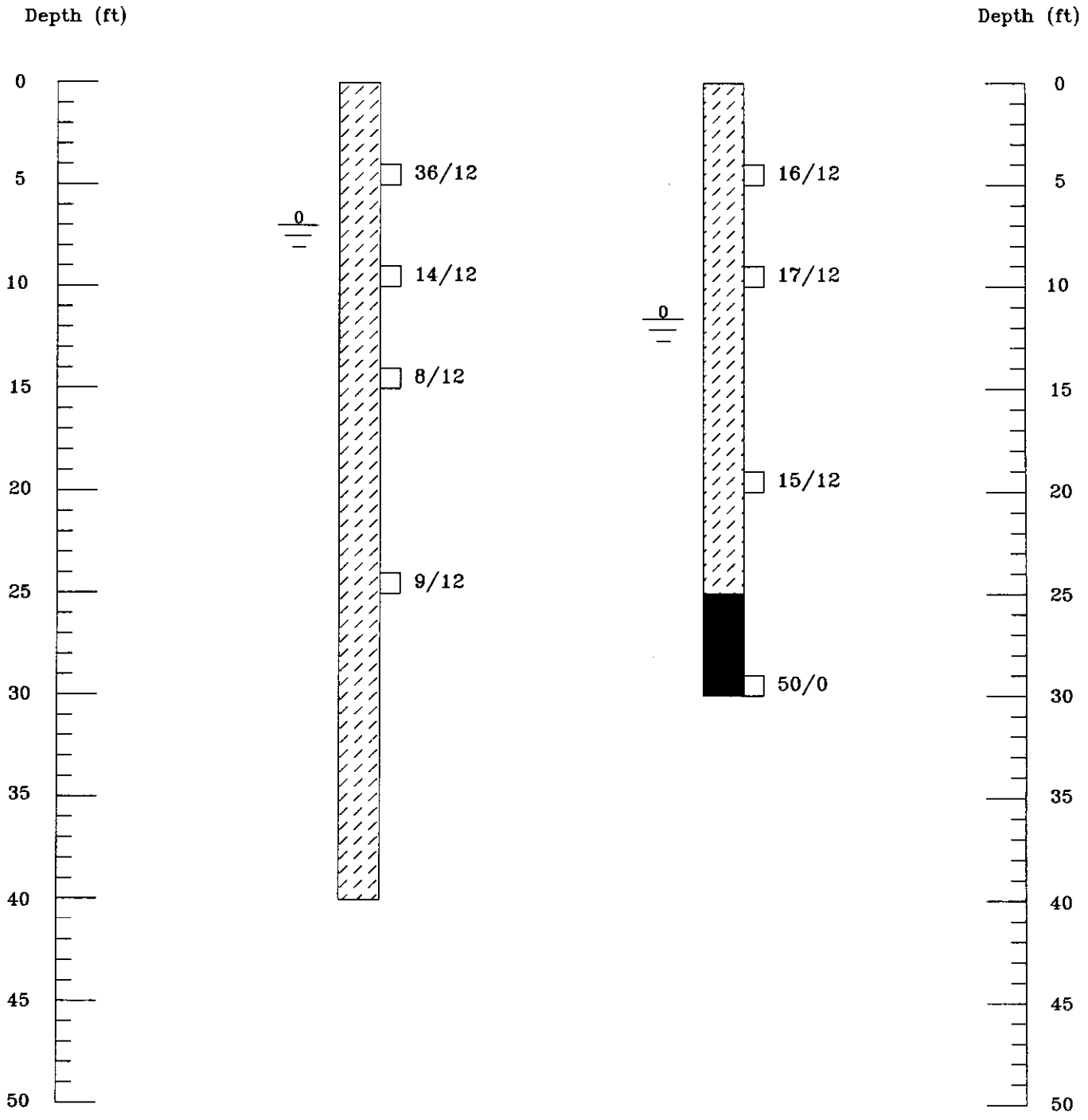
Location: Lot 3, Fil. 4, Copper Ridge Bus. Park, Steamboat Spr	Figure #2	



Title: LOGS OF EXPLORATORY TEST HOLES		Date: 5/1/08	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing (970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive -P.O. Box 775226 Steamboat Springs, Colorado 80477
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LEGEND:

CLAY: Slightly sandy to sandy with occasional gravels, low to moderately plastic, medium stiff to stiff, moist to wet and brown to gray in color with calcareous stringers.

CLAYSTONE-SHALE BEDROCK: Slightly sandy, fine-grained, low to moderately plastic, hard to very hard, moist and gray to dark gray in color.

Drive Sample, 2-inch I.D. California Liner Sampler.

36/12 Drive Sample Blow Count, indicates 36 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 12 inches.

0 Indicates depth at which groundwater was encountered at the time of drilling.

NOTES:

1) The test holes were drilled on April 1, 2008 with an all terrain drill rig using 4-inch diameter continuous flight power augers.

2) Locations of the test holes were determined in the field by pacing from topographic features at the site.

3) Elevations of the test holes were not measured and logs are drawn to the depths investigated.

4) The lines between materials shown on the logs represent the approximate boundaries between material types and transitions may be gradual.

5) The water level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water levels will probably occur with time.

Title: LEGEND AND NOTES	Date: 5/1/08	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing
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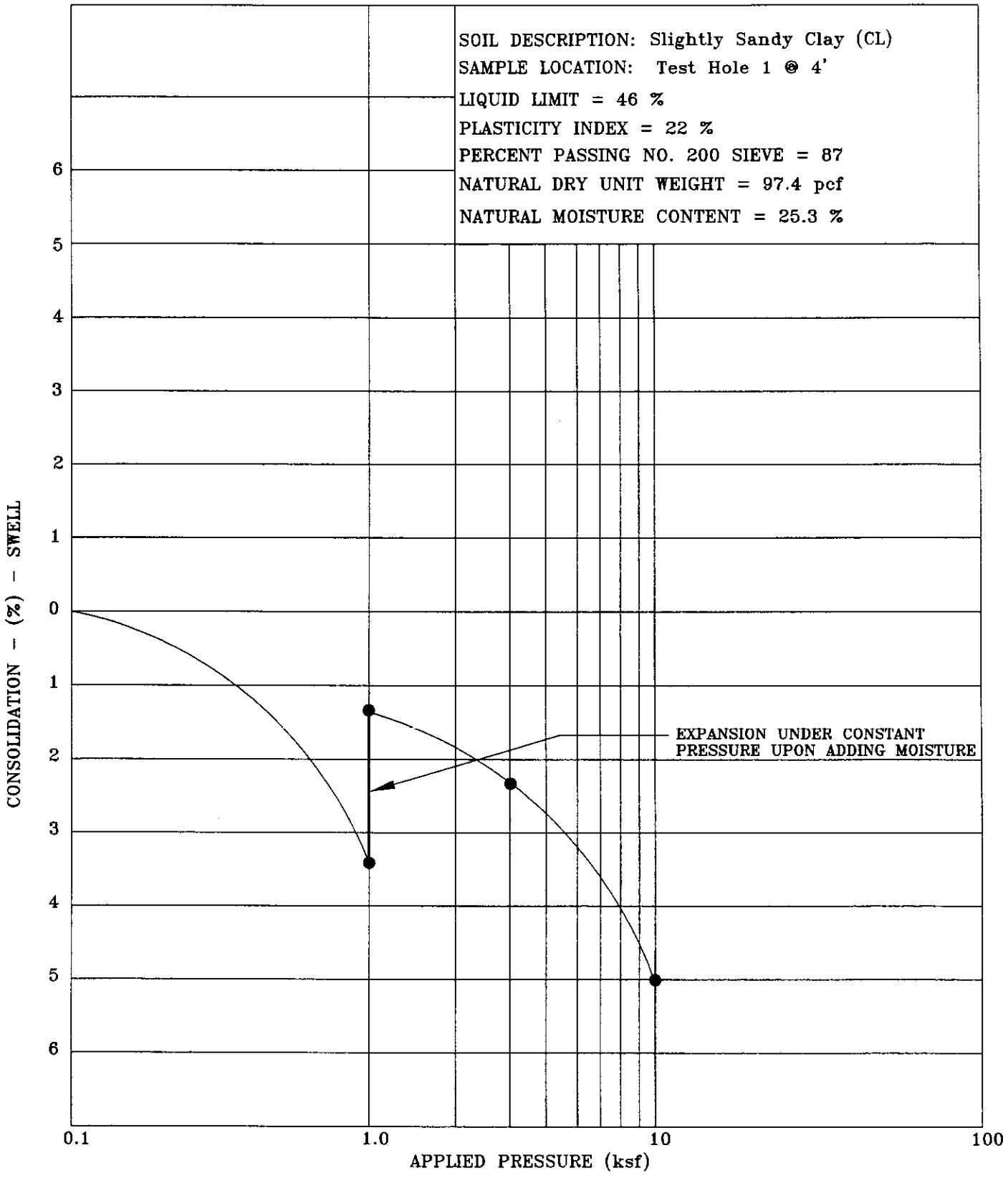
Location: Lot 3, Fil. 4, Copper Ridge Bus. Park, Steamboat Spr	Figure #4	



Title: SWELL-CONSOLIDATION TEST RESULTS		Date: 5/1/08	
Job Name: Western Security Systems Building		Job No. 08-7948	
Location: Lot 3, Fil. 4, Copper Ridge Bus. Park, Steamboat Spr		Figure #5	

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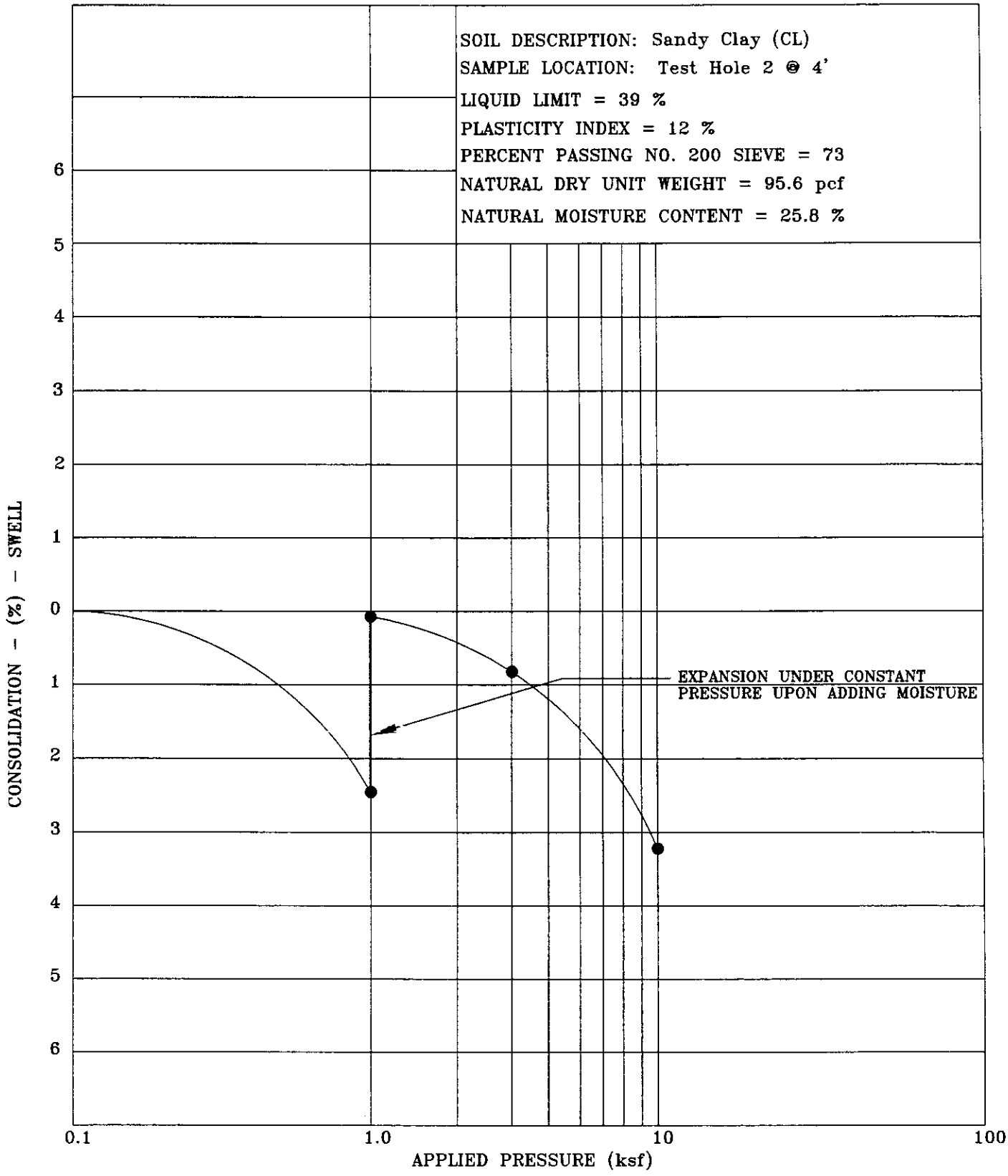

Title: SWELL–CONSOLIDATION TEST RESULTS		Date: 5/1/08	
Job Name: Western Security Systems Building		Job No. 08-7948	
Location: Lot 3, Fil. 4, Copper Ridge Bus. Park, Steamboat Spr		Figure #6	

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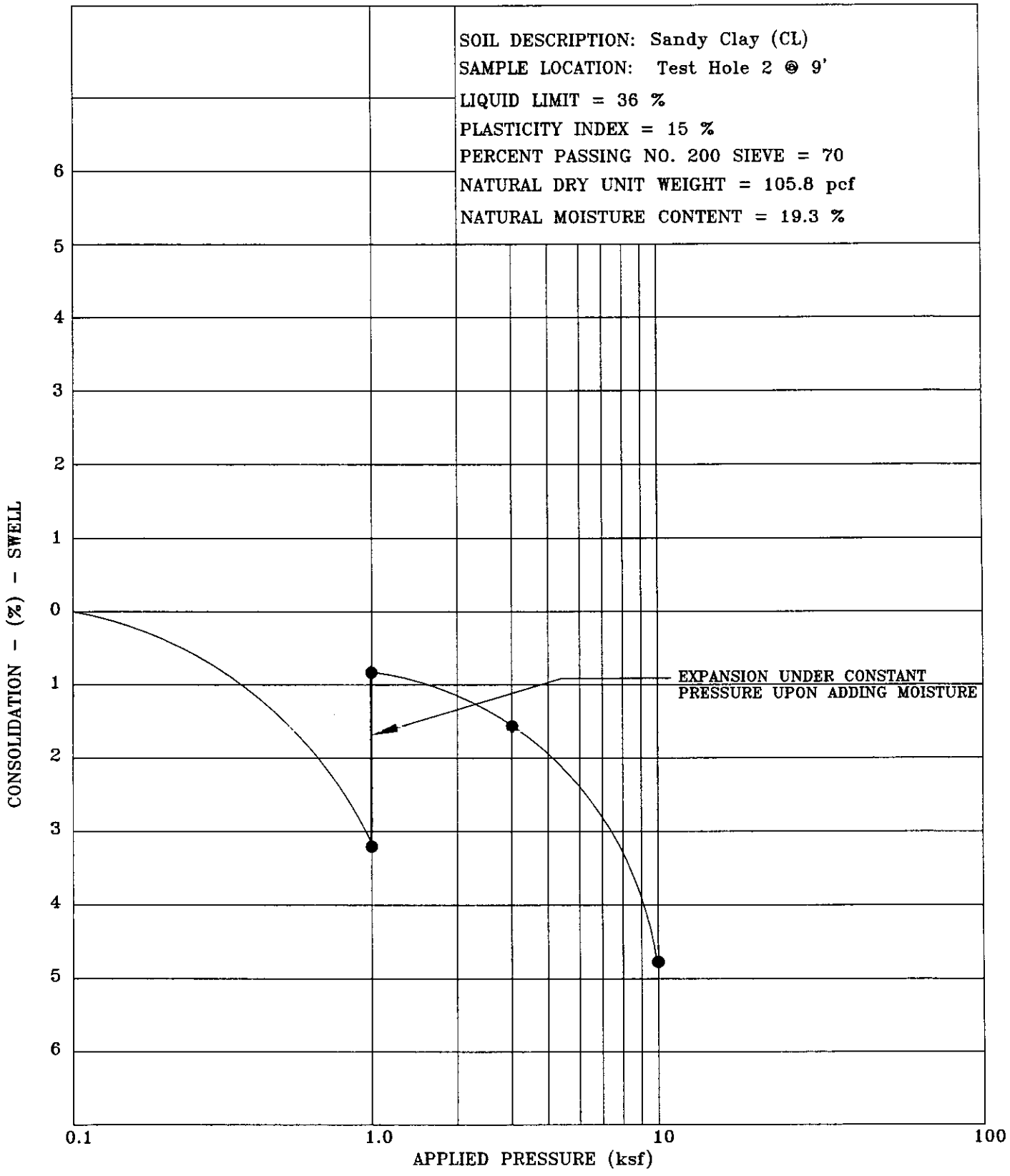

Title: SWELL–CONSOLIDATION TEST RESULTS		Date: 5/1/08	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing
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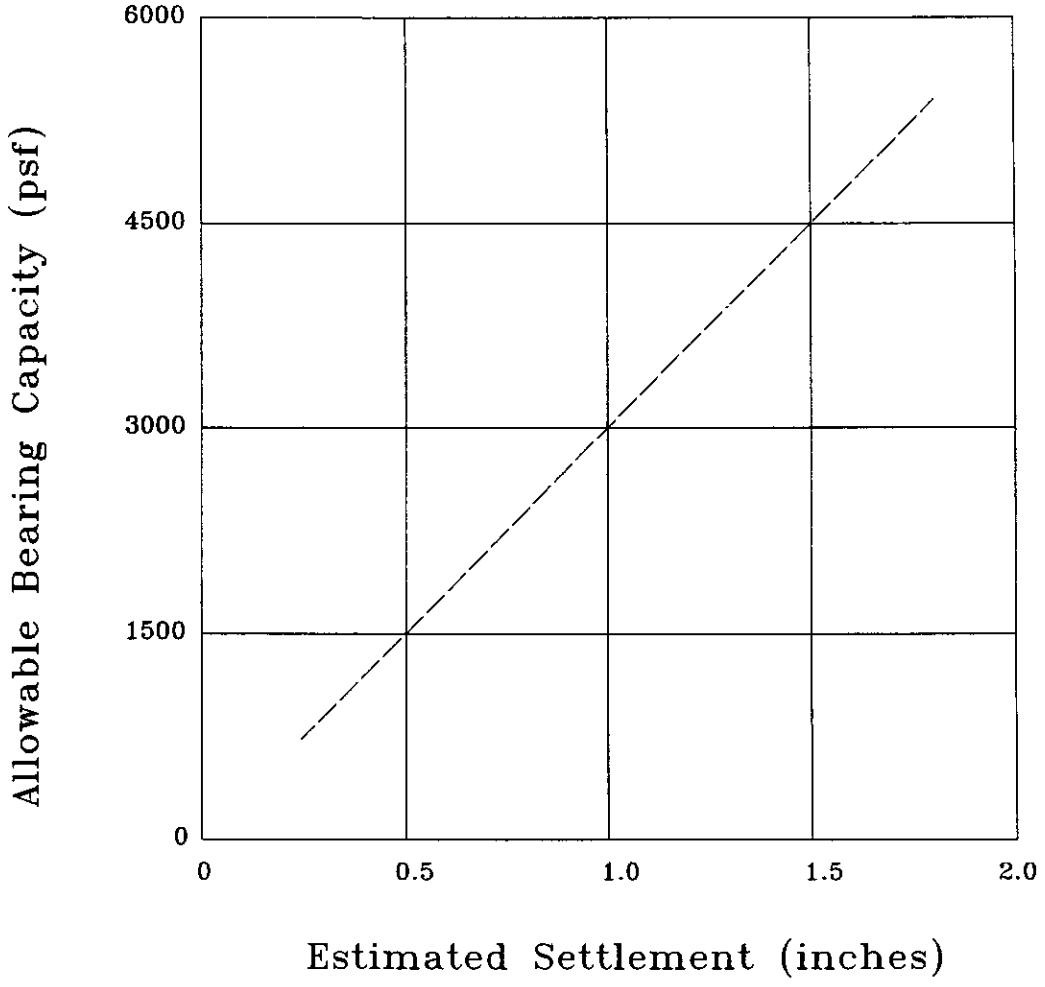
Location: Lot 3, Fil. 4, Copper Ridge Bus. Park, Steamboat Spr		Figure #7	



Note: These values are based on footing widths of 1 to 4 feet. If the footing width is to be greater than 4 feet in width, then we should be notified to re-evaluate these recommendations.

Title: BEARING CAPACITY CHART	Date: 5/1/08	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing
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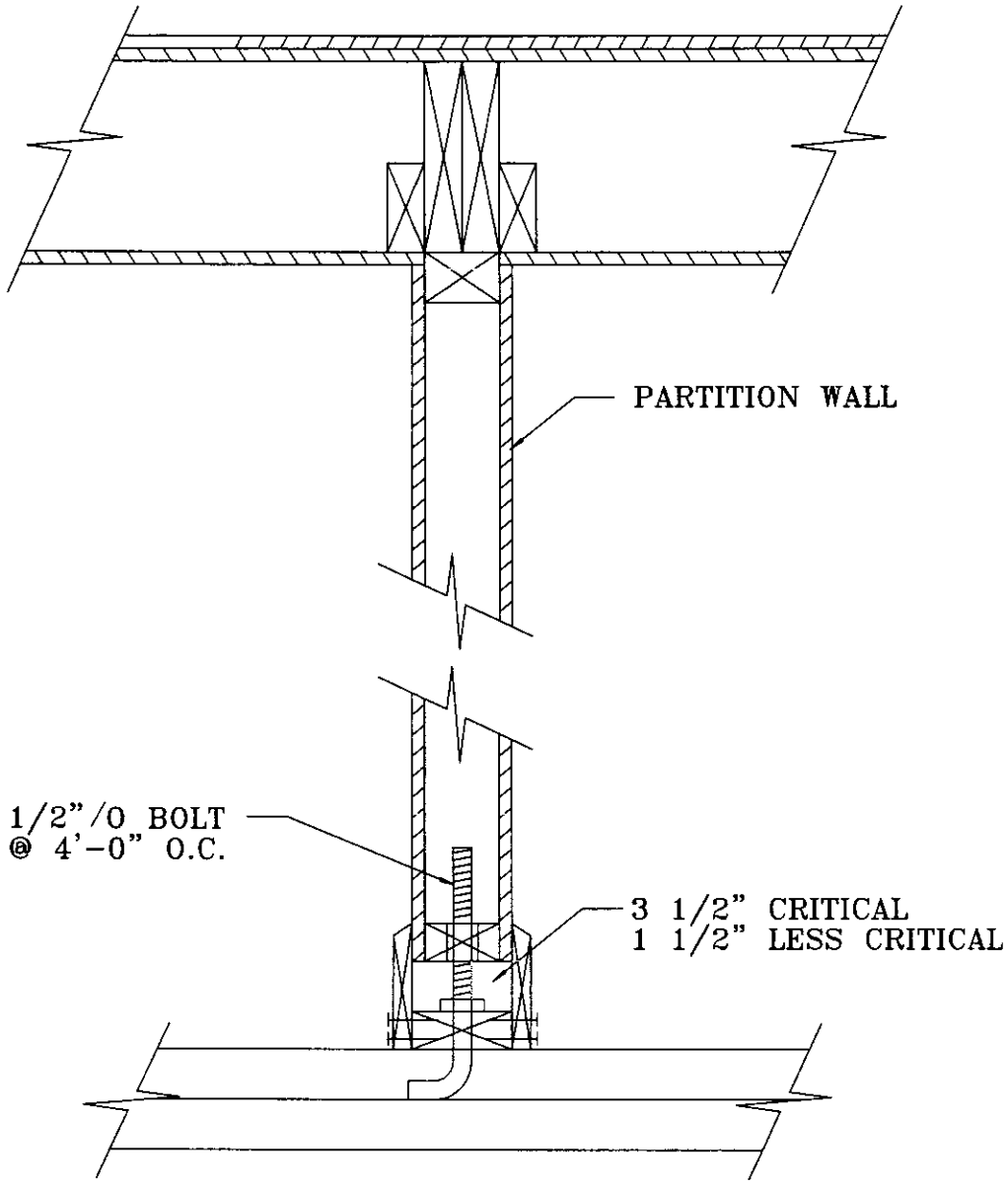
Location: Lot 3, Fil. 4, Copper Ridge Bus. Park, Steamboat Spr	Figure #8	



Title: HUNG PARTITION WALL DETAIL		Date: 5/1/08	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing
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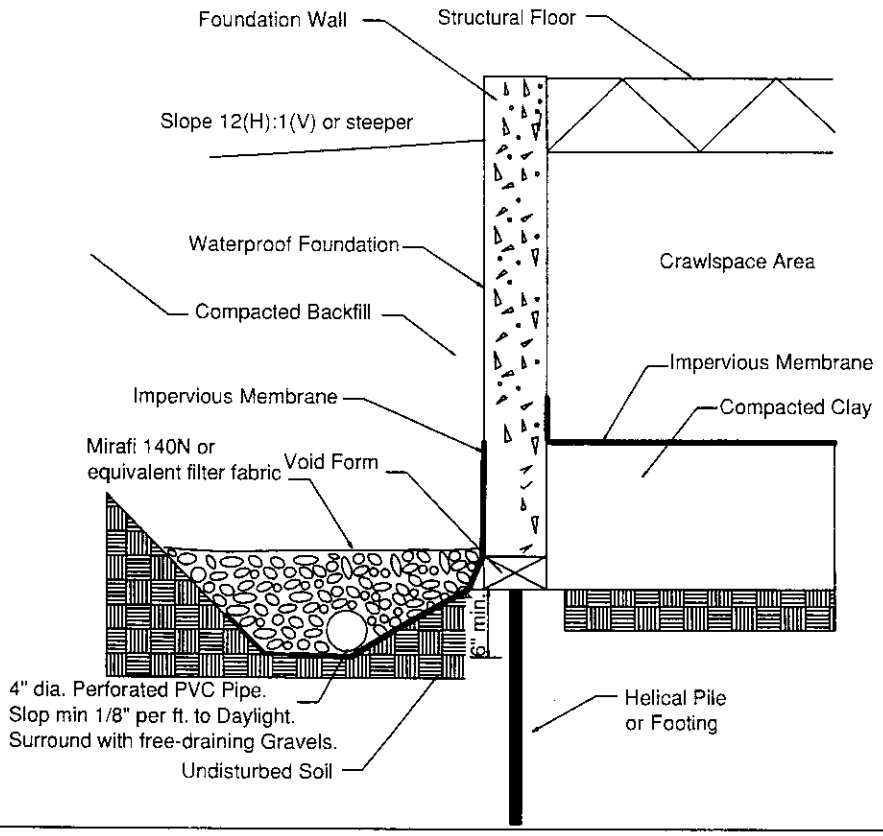
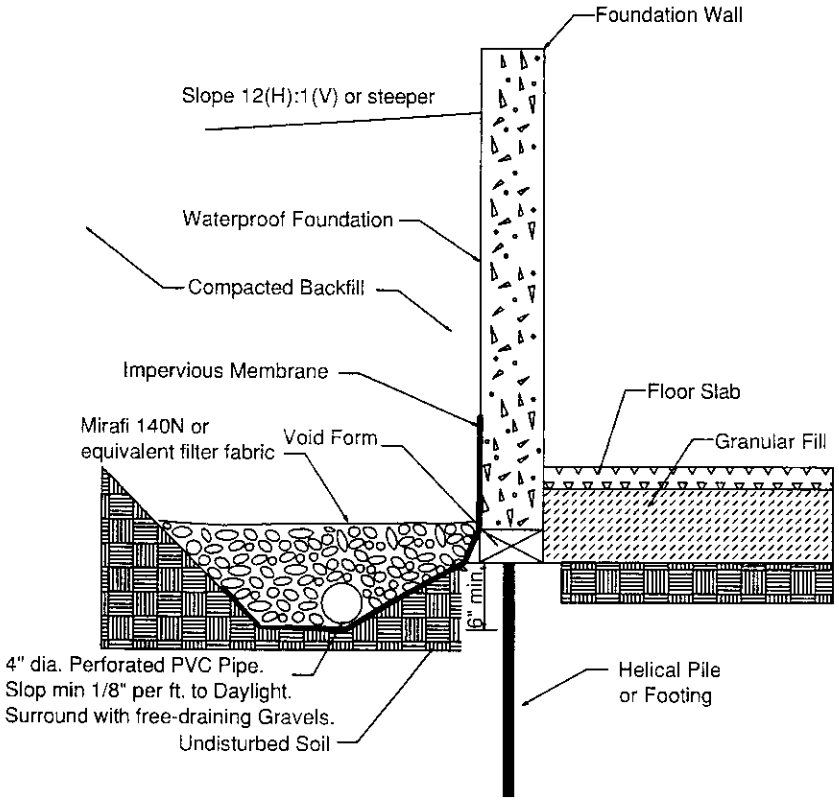
Location: Lot 3, Fil. 4, Copper Ridge Bus. Park, Steamboat Spr		Figure #9	



Crawlspace Area



Lower Level with
Floor Slab

Title: PERIMETER/UNDERDRAIN DETAIL	**Date:** 5/1/08	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing
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Location: Lot 3, Fil. 4, Copper Ridge Bus. Park, Steamboat Spr	**Figure** #10	

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TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	ATTERBERG LIMITS		GRADATION		PERCENT PASSING No. 200 SIEVE	UNCONFINED COMPRESSIVE STRENGTH (psf)	SOIL or BEDROCK DESCRIPTION	UNIFIED SOIL CLASS.
TEST HOLE	DEPTH (feet)			LIQUID LIMIT (%)	PLASTICITY INDEX (%)	GRAVEL (%)	SAND (%)				
1	4	25.3	97.4	46	22	7	6	87		Slightly Sandy Clay	CL
1	14	95.5	27.2							Sandy Clay	CL
2	4	25.8	95.6	39	12	2	25	73		Sandy Clay	CL
2	9	19.3	105.8	36	15	3	27	70		Sandy Clay	CL

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