SCOTT, COX & ASSOCIATES, INC. consulting engineers

December 5, 2003

Abbco
3324 Shallow Pond Drive
Fort Collins, Colorado 80528

Project No: 1526-27-05-03

Gentlemen:

On November 25, 2003, & November 26, 2003, we visually observed the excavation at Lot 18, Block 6, Fossil Lake Ranch 2nd, (3414 Shallow Drive), a subdivision of Fort Collins, Colorado. The purpose of this observation was to verify that the subsurface conditions encountered in the excavation are generally consistent with those outlined in the soils report performed by Scott, Cox & Associates, Inc., Job No. 1526-27-01-01, dated January 23, 2002. This letter is not intended to be a summary of the soils report and does not meet the disclosure requirements of Colorado Senate Bill 13, 6-6.5-101.

At the time of our observation, the excavation had been completed. The garage level excavation and the basement level excavation revealed moist silty clay. A test pit was excavated to a depth of three (3) feet below the basement excavation and revealed very moist silty clay. Bedrock strata and groundwater were not observed within three (3) feet of the bottom of the excavation.

Based on these subsurface conditions exposed in the excavation and additional sampling and testing, we recommend a balanced spread footing type foundation system as designed per the above referenced soils report. It is our opinion that an exterior perimeter drain is required for this structure and should be installed as specified in the above referenced soils report. We recommend that damp-proofing be installed at the foundation walls for all below grade, habitable living areas per UBC. All other recommendations provided in the original report, which are applicable, should be adhered to.

Thank you for consulting with us on this phase of the project. If you have any questions, please feel free to call.

Sincerely,

SCOTT, COX & ASSOCIATES, INC.

Reviewed by:

Jose Ruiz
Engineering Technician

G:\Office\Letters\Abbco\1526-27-5-3.wpd

Approved by:

R.B. "Chip" Leadbetter, III, P.E

COLORADO REGISTERED R.B. LEADBETTER III 35516 PROFESSIONAL ENGINEER 12/18/03

5110 Granite Street, Suite D • Loveland , Colorado 80538 • (970) 663-0138 • Fax: (970) 663-1660
Serving Colorado with offices in • Boulder • Longmont • Loveland

RECEIVED MAY 19 2004

SCOTT, COX & ASSOCIATES, INC. consulting engineers

OVERLOT GRADING OBSERVATION

SCA Job# 1526-27-05-09

CLIENT: ABBCO DATE: 5-10-04

LEGAL: (3414 SHALLOW POND DR.) LOT 18, BLOCK 6, FOSSIL LAKE RANCH 2ND INSP. BY: CPH

GRADING PLAN: NORTHERN ENGR #9959.00 FLF DATED 4-30-01

We have measured relative elevations at the above mentioned location. The observed elevations were compared to the Grading Plan referenced above. During our observations our representative measured the relative elevations at the lot sides and corners, top of foundation, and lowest openings. Based upon our findings it is our opinion:

☐ The elevations as measured are in general conformance with the above noted Grading Plan.

☐ The elevations as measured are in general conformance with the above noted Grading Plan with the following exceptions:

It is our opinion these exceptions, noted above, should not adversely change the grading scheme as shown on the above referenced plan.

☒ During our observations our representative noted that the as measured elevations do not conform to those indicated on the above referenced grading plan. However, it is our opinion the grades as measured should provide an adequate substitute to the above referenced grading scheme. PLEASE SEE OTHER COMMENTS BELOW.

☒ See the attached "As-Built" grading plan.

☐ The elevations measured are not in conformance to the above referenced grading plan. Deficiencies include:

Other comments and/or observations:

1. GRADE BREAK AT WEST SIDE OF BACK YARD ± 0.2' HIGHER
2. NORTHWEST PROPERTY CORNER ± 0.2' LOWER
3. NORTHEAST PROPERTY CORNER ± 0.3' LOWER
4. SWALE CREATED 1'-2' WEST OF EAST PROPERTY LINE TO ACCOMODATE EXISTING LANDSCAPING AT LOT 17, BLOCK 6.

Limitations:

It is our opinion that the subject lot, as graded on the above date, should not interfere with offsite flows unless the grades are changed or barriers are created such as fences, garden terracing, sidewalks, and/or any landscaping which may change the established flow patterns by diverting or slowing runoff flow. Backfill adjacent to the residence may settle over time and allow ponding to occur around the foundation walls. The backfill adjacent to the residence must be monitored and maintained to ensure that runoff will flow away from the foundation. The grades measured were compared only to the requirements shown on the above referenced grading plan. Other minimum grading requirements which may be specified in the soils report or by other construction documents are beyond the scope of this report.

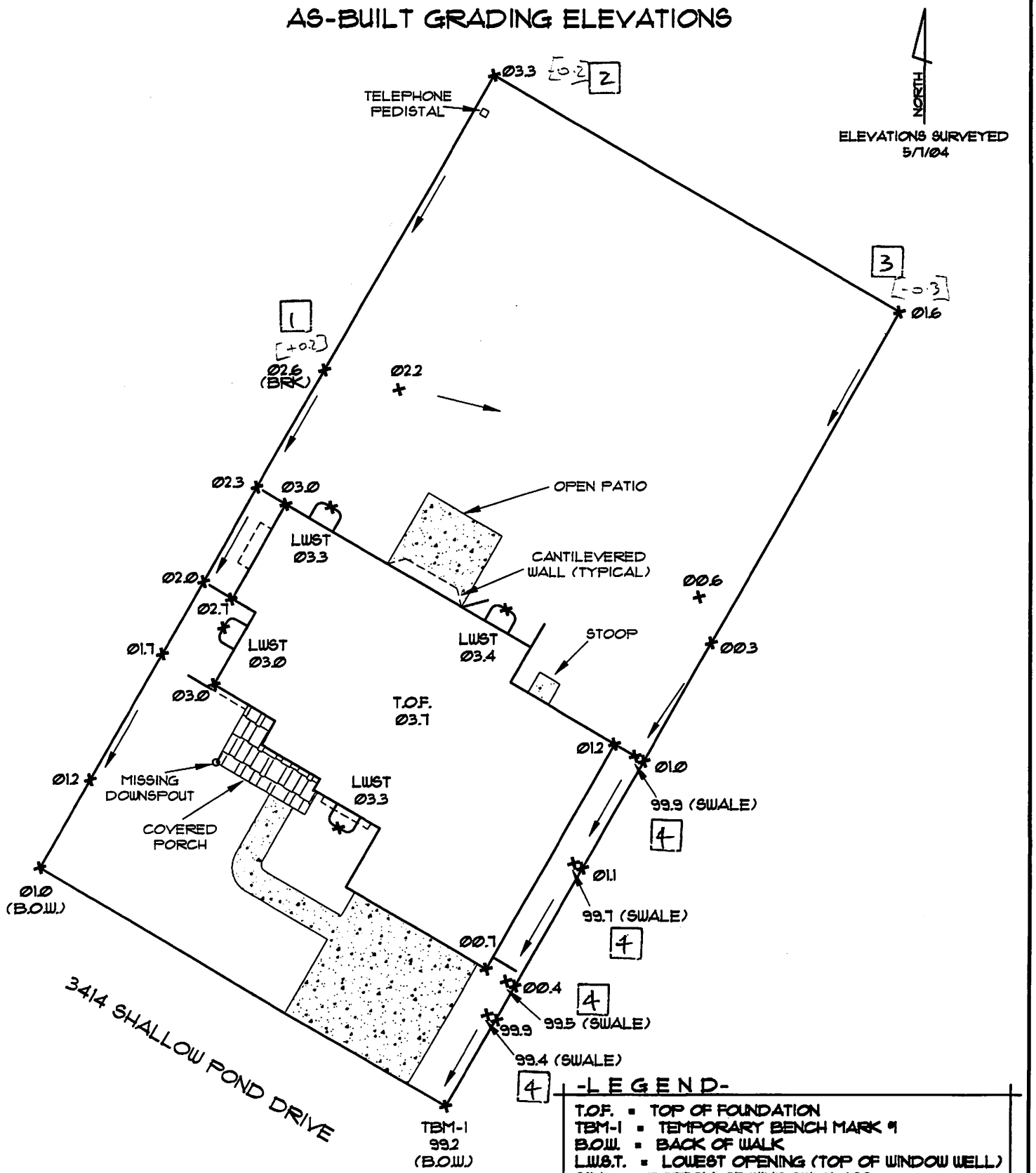
Reviewed by: [signature] Date: 5/11/04

COLORADO REGISTERED PROFESSIONAL ENGINEER

5110 Granite Street, Suite D • Loveland, Colorado 80538 • (970) 663-0138 • Fax: (970) 663-1660

Serving Colorado with offices in • Boulder • Longmont • Loveland

AS-BUILT GRADING ELEVATIONS



-LEGEND-

- T.O.F. = TOP OF FOUNDATION
- TBM-1 = TEMPORARY BENCH MARK #1
- B.O.W. = BACK OF WALK
- L.W.S.T. = LOWEST OPENING (TOP OF WINDOW WELL)
- SILL = BOTTOM OF WINDOW GLASS
- WLKOUT = BOTTOM OF WALKOUT DOOR
- XXX = ELEVATIONS SHOT
- [X] = SEE SCA LETTER 1526-27-05-09 DATED 5/10/04

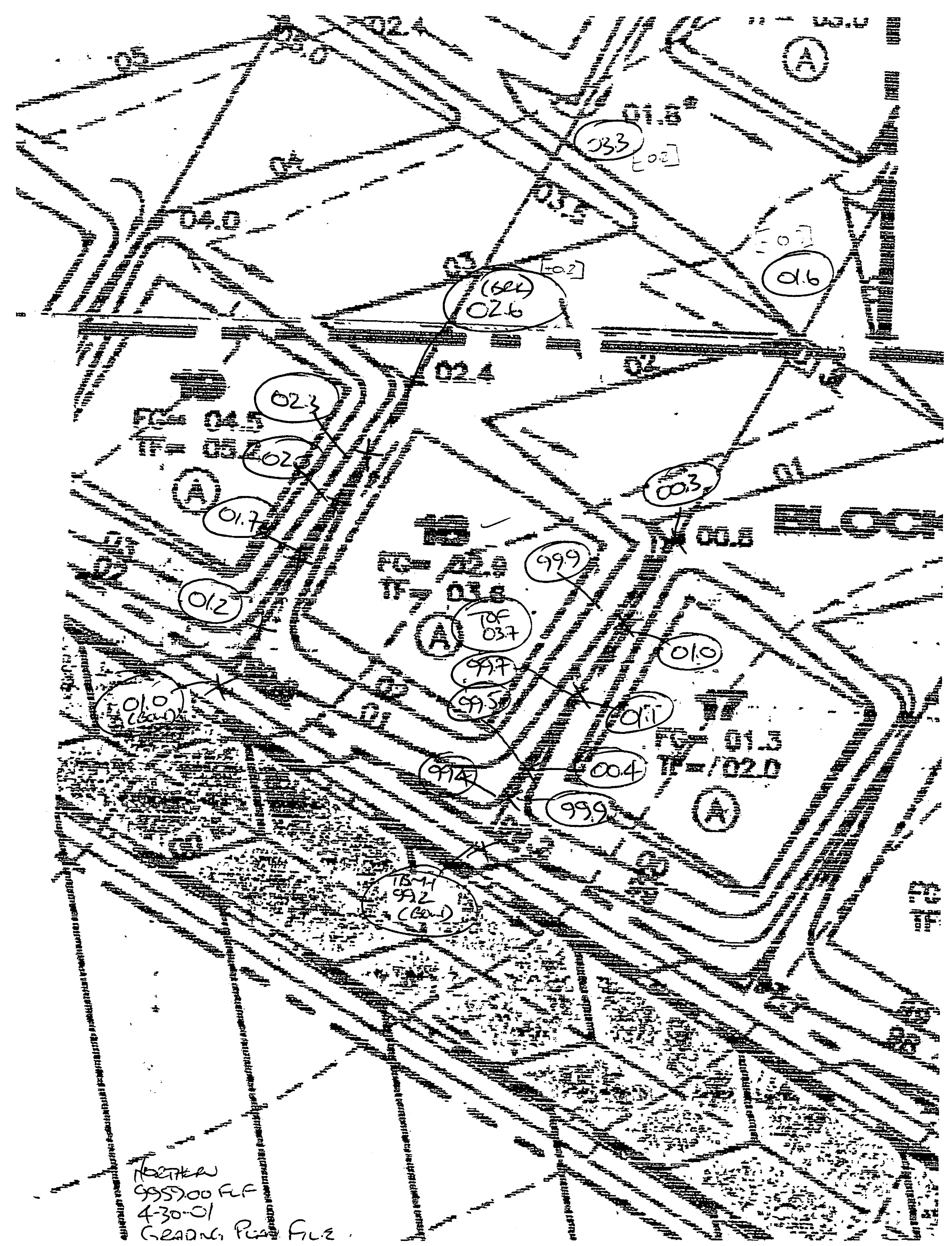
NOTE:
THE ELEVATIONS SHOWN HERE ON ARE BASED ON THE SURVEY PERFORMED ON 5/1/04.

JOB NO. 1526-27-5-9
DATE 5/10/04
SCALE 1"=20.0'
DRAWN: CPH

SCOTT, COX & ASSOCIATES, INC.
Consulting Engineers
3110 Granite Street, Suite D • Loveland, Colorado 80538
(970) 663 - 0138
Serving Colorado with Offices in • Boulder • Longmont • Loveland

ABBCO
LOT 18, BLOCK 6, FOSSIL LAKE PUD 2ND
FORT COLLINS

G:CIVIL/GRADINGCERTS/ABBCO/1526-27-5-9.DWG



NORTHERN
99559.00 FLF
4-30-01
GRADING PLAN FILE

GEOTECHNICAL INVESTIGATION
FOR LOTS 10 AND 18, BLOCK 6;
LOTS 10 AND 20, BLOCK 7; AND
LOTS 7 AND 16, BLOCK 13;
FOSSIL LAKE P.U.D., SECOND FILING,
LARIMER COUNTY, COLORADO

Prepared for:

ABBCO Builders, Inc.
2100 Whitewood Drive
Fort Collins, Colorado 80525

January 23, 2002
Project No.:1526-27-01-01

Prepared By
SCOTT, COX & ASSOCIATES, INC.
5110 Granite Street, Suite D
Loveland, Colorado 80538

SCOTT, COX & ASSOCIATES, INC. consulting engineers

January 23, 2002
Project No.:1526-27-01-01

ABBCO Builders, Inc.
2100 Whitewood Drive
Fort Collins, Colorado 80525

Gentlemen:

The enclosed report presents the results of a geotechnical investigation for Lots 10 and 18, Block 6; Lots 10 and 20, Block 7; and Lots 7 and 16, Block 13; Fossil Lake P.U.D., Second Filing, Larimer County, Colorado. This report contains the results of our investigation and recommendations concerning design and construction of the foundation, ground-level floor systems and slabs-on-grade.

In summary, fill materials and clays were encountered over claystone bedrock strata to the depths explored. Although the soils and/or rock appear to be suitable for support of the proposed homes, care will be needed in both the design and construction of the buildings to minimize the potential for foundation and floor slab movement.

We appreciate the opportunity to be of service to you on this project. If you have any questions, please feel free to call.

SCOTT, COX & ASSOCIATES, INC.

Respectfully,

Kristin M. Richardson

Kristin M. Richardson,
Geologist

Approved by:

2/4/02

R.B."Chip" Leadbetter, III, P.E.,
Chief Geotechnical Engineer

G:\Geotechnical Reports\ABBCO\1526-27-01\Lots 10,18B6\Lots 10,20B7\Lots 7,16B13\soils report.wpd
01/30/02

5110 Granite Street, Suite D • Loveland, Colorado 80538 • (970) 663-0138 • Fax: (970) 663-1660
Serving Colorado with offices in • Boulder • Longmont • Loveland

TABLE OF CONTENTS

LIST OF FIGURES

SCOPE

The following report presents the results of our geotechnical investigation for Lots 10 and 18, Block 6; Lots 10 and 20, Block 7; and Lots 7 and 16, Block 13; Fossil Lake P.U.D., Second Filing, Larimer County, Colorado. The buildings are anticipated to be of typical wood frame construction. Walkout basement, full basement, garden-level and/or crawlspace level construction with cast-in-place concrete foundations are anticipated for these structures. The depths of foundation construction are anticipated to range from two (2) to seven (7) feet below grades which existed at the time of this investigation. It is anticipated that final grades may be adjusted to accommodate drainage and construction depths. It is recommended that we review the final grading plan to determine if any revisions to the recommendations presented in this report are necessary.

The purpose of this investigation was to identify subsurface conditions and obtain the test data necessary to provide recommendations for design and construction of foundations, below-grade floor systems and slabs-on-grade. The conclusions and recommendations presented in this report are based upon the acquired field and laboratory data and on previous experience with subsurface conditions in this area. A preliminary subsurface exploration report conducted by Earth Engineering Consultants, Inc. (#1962023, dated May 6, 1999) was reviewed as part of this investigation.

SITE DESCRIPTION

The site is located southeast of Fort Collins, south of County Road 36, east of County Road 9 and on Green Spring Drive, Shallow Pond Drive, Wild View Drive and Copper Spring Drive. The site is generally in a plains area north of Fossil Creek Reservoir. At the time of our investigation the site was partially developed with utilities and paved roads. The building sites are relatively level and have no existing structures or rock outcrops.

FIELD INVESTIGATION

The field investigation was conducted on January 9, 2002 and January 15, 2002. The field investigation consisted of drilling, logging and sampling one (1) boring near the center of each lot. The borings were drilled to depths ranging from twenty (20) to twenty six (26) feet using a truck-mounted continuous flight auger drilling rig.

The boring locations were established by Scott, Cox & Associates, Inc. personnel based on a site plan provided by the client. Distances from the referenced features are approximate and were made by pacing. Angles for locating the borings were estimated. The boring locations should be considered accurate only to the degree implied by the methods used to make those measurements.

Logs of the boring operations were compiled by a representative of our firm as the borings were advanced. The graphical logs of the borings are presented in Figure No. 3. Soil sampling was concentrated at approximate foundation-influence elevations. The approximate location of soil and rock contacts, free groundwater levels, samples and standard penetration tests are shown on

each boring log. The transition between different strata can be, and often is, gradual. The descriptions of the soil and/or bedrock strata are based, primarily, on visual and tactual methods which are subject to interpretation pending other methods, classification systems and/or tests.

An index of relative density and consistency was obtained in general accordance with the procedures of the standard penetration test, ASTM Standard Test D-1586. The penetration test result listed on the log is the number of blows required to drive the two (2) inch diameter split-spoon sampler twelve (12) inches (or as shown) into undisturbed soil by a one hundred forty (140) pound hammer dropped thirty (30) inches.

Undisturbed samples for use in the laboratory were collected using three (3) inch O.D. thin wall samplers (Shelby) in general accordance with sections of ASTM D-1587. In this procedure, a seamless steel tube with a beveled cutting edge is pushed hydraulically into the ground to obtain a relatively undisturbed sample of cohesive or moderately cohesive soil. A two and one-half (2½) inch O.D. California Barrel Sampler was also used to collect partially disturbed samples. All samples were sealed in the field and preserved at natural moisture content prior to testing.

LABORATORY TESTING PROCEDURES

The recovered samples were tested in the laboratory to measure their dry unit weights, natural water contents, and for classification purposes. Selected samples were tested to determine strength and stability characteristics such as swelling, compressibility, collapse and shear strength.

One dimensional swell/consolidation tests were performed on selected samples to evaluate the expansive, compressive and collapsing nature of the soils and/or bedrock strata. In the swell/consolidation test, a trimmed specimen is placed in a one-dimensional confinement ring and a vertical load of 100 psf or 500 psf is applied. The sample is allowed to air-dry for the 100 psf tests. The sample is then inundated with water and allowed to swell or consolidate until no further change in volume is recorded. The confining load is then incrementally increased until the specimen is compressed to its original volume. Results of those tests are presented at the end of this report.

A calibrated hand penetrometer was used to estimate the approximate unconfined compressive strength of selected samples. The calibrated hand penetrometer has been correlated with unconfined compression tests and provides a better estimate of soil consistency than visual examination alone.

SUBSURFACE CONDITIONS

In summary, fill materials and clays were encountered over claystone bedrock strata to the depths explored. Free groundwater was encountered in one (1) of the borings. Refer to the attached boring logs and summary of laboratory tests.

FILL-Fill materials consisting of clay with moderate amounts of silt, slight to moderate amounts of sand and trace amounts of gravel were encountered from the surface to a depths ranging from two (2) to four (4) feet below grade in Test Hole Nos. 10 6, 20 7 and 7 13. The fill materials

appear to be moist, very stiff to hard and brown to reddish-brown. **It is not known if the fill materials on these lots were placed and controlled for structural support. Moderate to high swelling fill materials have been detected in the samples obtained during the drilling operation. We therefore recommend the fill materials not be used for structural support.**

CLAY- Clays with moderate amounts of silt and trace to moderate amounts of sand and gravel were encountered from surface or from below the upper fill materials to depths ranging from seven (7) feet to twenty (20) feet of Test Hole Nos. 18/6, 10/7, 7/13 and 16/13 and to the depths explored of Test Hole Nos. 10/6 and 20/7. The clays appear to be slightly moist to moist, stiff to hard, porous and brown to olive to tan in color. The clays exhibit low to moderate bearing capacities with low to high swell potentials as detected in our tests.

CLAYSTONE- Claystone bedrock strata with moderate amounts of silt were encountered from below the upper soils to the depths explored. The upper four (4) to eight (8) feet, or more, appear to be moderately to severely weathered. The competent claystone bedrock strata exhibits high bearing capacities with swell potentials ranging from low to high. Our experience with the bedrock in this area has shown it to have low to high swell potential.

Due to the often variable nature of soil deposits and sedimentary bedrock formations, it is impossible to fully characterize the strength and swelling properties of these materials at all depths at any given site. Strata may exist at the site which possess higher or lower swell potentials than these tests indicate.

GROUNDWATER- Groundwater levels were recorded as the borings were advanced, immediately after completion several days after the drilling operation. At the time of our field investigation, free groundwater was encountered in Test Hole No. 16/13 at depths ranging from fourteen (14) feet to eighteen (18) feet. The groundwater table can be expected to fluctuate throughout the year depending on variations in precipitation, surface irrigation and runoff on the site.

The groundwater levels recorded and/or described represent the free, static water levels after equalization of hydrostatic pressures in the borings. This means that the groundwater levels recorded in the borings may not be present at those levels in the excavations. Flow rates, seepage paths, hydrostatic pressures, seasonal groundwater fluctuations, water quality and other factors were not determined in this investigation. A program, which may include special well construction, test procedures, long-term monitoring program and analysis, would be necessary to determine these factors.

FOUNDATION RECOMMENDATIONS

Some of the soils and bedrock strata encountered during this investigation exhibited moderate to high swell potentials. Two different types of foundation systems are applicable to this site. First, drilled straight-shaft pier foundations are recommended where moderate to highly expansive soils will be located within four (4) feet of the lowest foundation bearing elevation. Second and as a higher risk option, a spread footing foundation could be utilized over an approved, compacted

structural mat. Some differential movement can be expected where the structural mat is utilized. If minor cracking and/or movement can not be tolerated in the building, a drilled straight-shaft pier foundation system shall be utilized. **We recommend that additional swell tests be conducted from samples obtained from the bottom of the over-excavation during the open hole inspections to verify the thickness of the mat.**

Moderate to high swelling fill materials were detected on some lots during this investigation. **We, therefore, recommend the fill materials not be used for structural support.**

DRILLED STRAIGHT-SHAFT PIERS- Due to the swell potential of the upper clays and proximity of the clays and claystone bedrock strata to the foundation, we recommend the use of a drilled straight-shaft pier foundation system. The piers should be designed for a maximum end bearing pressure of 15,000 pounds per square foot (psf) and using a skin friction value of 1500 psf for that portion of the pier in competent bedrock. Piers should be designed to resist a swell pressure of 9000 psf. The piers should be drilled a minimum length of twenty (20) feet with a minimum penetration of six (6) feet into competent bedrock. All piers should be reinforced full-length with a minimum of three (3) #5 Grade 40 or three (3) #4 Grade 60 bars. A six (6) inch continuous void space should be constructed beneath all grade beams to ensure load concentration on the piers and to isolate the foundation from the expansive soils. The bottom of the grade beams should be located at least three (3) feet above the groundwater levels.

The following design and construction details should be observed:

1. All grade beams should be located below frost depth. Frost depth in this area is considered to be thirty (30) inches.

2. Grade beams should be designed to span the unsupported distance between piers.

3. Pier shafts should be drilled plumb to within 1.5% of the shaft length.

4. All piers should be carefully cleaned and de-watered before pouring concrete. In our opinion, casing and/or de-watering may be required. In the event that more than four (4) inches of water appears at the bottom of a shaft, concrete shall be placed from the bottom up with a pump truck or other approved method of displacing the water.

5. Reinforcement should be placed immediately after drilling each pier to ensure concrete coverage over the steel. Concrete shall be placed immediately after placement of the reinforcement steel to prevent deterioration or contamination of the friction surfaces.

6. Care should be exercised to ensure that "mushrooming" does not occur at the top of the piers. A short section of sonotube or pier caps topping each boring is recommended to maintain a straight shaft.

7. A representative number of pier holes should be inspected by a representative of our firm prior to the placement of concrete to ensure that the required penetration and depths are met, that no loose materials remain in the holes, and that the holes are properly cleaned, de-watered and plumb.

8. Most of the bedrock at the site can be drilled with normal heavy commercial-size pier drilling rigs. In the event drilling refusal is encountered, a larger drill rig should be used, or the structural engineer may adjust the depth of penetration into bedrock if design criteria are adjusted accordingly.

9. All concrete shall be composed of Type I II sulfate resistant cement.

10. Refer to the *FLOOR SYSTEMS AND SLABS-ON-GRADE* section of this report for recommendations for below-grade floor systems and slabs-on-grade.

11. We recommend the performance of an excavation inspection for each lot to make a final determination of foundation type.

12. The drilled pier depths recommended may be deeper than the test holes drilled for this investigation. Should the owner or contractor desire information not provided in this report regarding groundwater depths or drillability below the depths of this investigation. we could provide additional test holes for an additional fee.

SPREAD FOOTINGS- As a higher risk option and if minor cracking and/or movement can be tolerated in the building. we feel that the structures on these lots could be supported by continuous spread footing and isolated pad foundations provided at least four (4) feet of soils are over-excavated and replaced with approved structural fill prior to placement of the footings. If bedrock strata is present within the over-excavation. a drilled pier foundation system shall be utilized. The compacted structural mat should be comprised of approved. imported material and should be at least four (4) feet thick. We recommend additional swell tests be conducted at the bottom of the over excavation during the open hole inspection to verify the thickness of the mat. The footings should be placed on the compacted structural mat and should be kept at least three (3) feet above the groundwater. The footings should be **tentatively** designed for a maximum allowable bearing pressure of 1500 pounds per square foot (dead load plus live load) with a minimum dead load of 500 pounds per square foot.

The compacted soil mat should be comprised of imported materials approved by the Geotechnical Engineer prior to delivery or placement. The mat shall be at least four (4) feet thick (thickness verified at open hole inspection) and should extend a minimum 1½ times the footing width beyond the edges of the footings. The mat under the pads should extend a minimum of two (2) feet beyond the edges of the pads. The compacted. structural mat could also be constructed under floor slab areas to reduce the amount of slab movement. Potential movement can be reduced but

will not be eliminated. The soils should be placed and compacted to the moisture and density specifications described in Appendix A of this report. The soils shall be adequately broken, crushed and the moisture well blended prior to placement. Each twelve (12) inches of compacted soils should be tested and approved prior to placing each succeeding lift. The fill shall be evaluated after placement to verify the bearing values and swell potentials assigned above.

If isolated areas of unacceptable soils, fill or trash are exposed during final footing excavation, these areas should be removed down to acceptable soils prior to placement of the compacted structural mat.

The following recommendations should be followed in the design of the foundation system:

1. All footings and pads should bear below frost depth. Frost depth in this area is considered to be thirty (30) inches.

2. Foundation walls should be reinforced with rebar to span an unsupported length of ten (10) feet. Rebar should be run continuously around corners and should be properly spliced. Foundations should be designed by a Registered Engineer for the conditions described in this report.

3. All footings and pads should bear on a compacted, structural soil mat.

4. **We recommend the performance of an excavation inspection for each lot to make a final determination of foundation type and validate these recommendations.** A test pit should be excavated at least three (3) feet deeper than the foundation elevations to expose the supporting soils for the inspection. The test pit shall be excavated at least five (5) feet away from any footing or pad locations. The test pits shall be filled and well compacted after all observations have been made.

5. Refer to the *FLOOR SYSTEMS AND SLABS-ON-GRADE* section of this report for recommendations for below-grade floor systems and slabs-on-grade.

6. To prevent over-drying, over-moistening or deterioration of the exposed soils prior to placement of the footings, the excavation should not be left open for an extended period of time. In the event that the excavation is left open for more than one week after the open hole inspection, or if rain, snow melt or groundwater has accumulated in the excavation, the engineer shall be notified for a re-inspection to determine the condition of the supporting materials and make recommendations for remediation accordingly.

7. Footings or pads shall not be constructed on frozen ground, topsoil, unapproved fills or other deleterious materials. Loose soil shall be removed from the footing forms prior to placing concrete.

8. Footing and pads shall not be placed on sloped surfaces unless provisions for dowels or keyways are designed to accommodate these conditions.

The assignment of foundation types and these recommendations should not be considered absolute. Due to the inherent variability of soil conditions at any given site, the type of foundation is subject to change if conditions encountered in the actual excavation are inconsistent with the findings of this report. We recommend the completed excavation be observed by a member of our technical staff to identify the groundwater level and to verify that the actual soil conditions are consistent with those encountered during this investigation.

LATERAL PRESSURES- Lateral earth pressures are affected by wetting of the backfill soils, backfill compaction densities, type and slope of backfill materials, allowable wall movements and surcharge loading. Hydrostatic pressures could also be imposed from water collecting behind the foundation walls. Additional lateral forces may be imposed from the equipment used during backfilling operations. All of these factors shall be taken into account when calculating the backfill pressures and designing the foundation walls. We recommend a perimeter drain system

as outlined in the *BASEMENTS AND SUBDRAINS* section of this report to minimize the accumulation of water behind foundation walls. A minimum equivalent fluid density of 45 pcf (active) should be used for normally compacted, on-site soils when designing the foundation walls and/or retaining structures. The design lateral earth pressure reported may need to be revised pending the outcome of the open hole inspection.

FLOOR SYSTEMS AND SLABS-ON-GRADE

The samples of the soils and/or bedrock strata encountered at the site exhibited low to high swell potentials as moisture contents are increased. Strata may be present which could exhibit higher and lower swelling than detected during this investigation. Floor slabs placed on or near potentially swelling soils are expected to heave and crack to some degree. Most of the movement will be differential or uneven. It is impossible, with the current state of technology, to predict with certainty how much slab movement will actually occur. From an engineering perspective, slab movements on the order of ½ inch or so would be considered low, whereas 1½ inches or more would be considered moderate to high. Ultimately, though, it should be the owner who determines whether ½ inch of slab heave is low or high. In some cases, the amount of movement may be considered to be intolerable. Slabs placed on a compacted structural mat may experience a moderate degree of heaving and cracking which, in our opinion, may be excessive. Slabs placed on the moderately or higher swelling native, unaltered clays or bedrock strata may experience excessive heaving and cracking.

We recommend that structural floors be constructed in place of slabs-on-grade where these areas are to be finished. Structural wood floors are typically constructed eighteen (18) inches or more above the natural soils, creating a zone of separation (crawl-space) between the floor and the soil. This allows the soil to expand and contract independently of the floor and any interior fixtures. Structural concrete and structural steel floors require less than the eighteen (18) inch void space required for wood floors. Areas with slabs-on-grade placed within four (4) feet of the native, unaltered soils at this site are to be considered non-habitable, therefore should not be finished. A method which can reduce the amount of movement and cracking of interior and exterior slabs would be to remove at least four (4) feet of the soil under the slab and replace with moisture and density controlled imported soil approved by the Engineer prior to delivery. Refer to Appendix A of this report for compaction, testing guidelines. All fill shall be tested, inspected and approved by the Engineer. The soil replacement method will reduce the risk of slab movement and cracking but will not eliminate potential damage. This method would also benefit garage slabs, exterior slabs and sidewalks.

Where slabs-on-grade for non-habitable areas are chosen and the owners are willing to accept the risks associated with slab movement, the following recommendations should be followed:

1. Slabs should be constructed to be "free floating". The slabs should be isolated from all structural components and utilities which penetrate the slab. Isolation may be achieved with ½ inch isolation material or by sleeving.

2. A two (2) inch void should be constructed under all partition walls located over slabs. The void should be monitored periodically by the owner for the life of the structure. The void should be immediately re-established if the voids are within one-half (½) inch of closing or have closed.

3. Eliminate underslab plumbing where feasible. Where such plumbing is unavoidable, it should be pressure tested during construction to minimize leaks which would result in wetting of the subsoils.

4. Divide slabs-on-grade into panels by use of control joints. We recommend joints be placed no more than twelve (12) feet on center. Control joints should also be located at potential weak areas such as the corners of driveway slabs. The depth of the control joints should be one-quarter (1/4) of the slab thickness.

5. Slabs should be underlain with a four (4) inch layer, or more, of clean gravel to help distribute floor loads and to provide a capillary break should moisture collect beneath the slab. No particles smaller than 3/8" should be permitted in the gravel. Other methods of moisture proofing may be required by the floor covering manufacturer.

6. All exterior slabs should be constructed using a more durable sulfate-resistant concrete containing Type I/II cement and with higher air contents and lower water-cement ratios.

7. Slabs should be reinforced with wire mesh, fiber mesh, or equivalent to help control crack separation.

8. To avoid settlement and distortion of exterior slabs due to improper compaction, we recommend that concrete slabs that must span the backfill be supported by the foundation walls. This is conventionally done by use of a brick ledge or haunch. **Exterior slabs should not be doweled to the foundation wall.** The slab should be reinforced as necessary for the span involved.

9. Slab-on-grade areas over native, unaltered subgrades should not be finished. Areas to be finished shall have a structural floor system or a compacted structural mat as described above.

10. Refer to ACI 301.R for additional recommendations for design and construction of floor slabs.

BELOW-GRADE FLOORS AND SUBDRAINS

The ambient groundwater table at the site is not expected to rise to a level which would affect walkout basement, full basement, garden-level and/or crawlspace level construction unless a

source of water not presently contributing becomes available. Due to the potential for perched water conditions and to alleviate hydrostatic pressures behind the foundation walls, below-grade floor levels should be constructed with a perimeter drainage system. The type of drain, i.e. interior (underslab), exterior or both, should be determined at the time of the excavation inspection.

The drainage system should contain a four (4) inch diameter perforated drain pipe encased in a minimum of twelve (12) inches of clean, 3/4 inch minus gravel. The drain pipe should extend around the lower level perimeter with the invert at the **high** end of the drain being placed a minimum of four (4) inches below the bottom of the footing. The drain should be run to a non-perforated sump pit or to daylight well away from the foundation at a minimum slope of ⅛ inch per foot to facilitate efficient removal of water. The gravel should be placed a minimum of eight (8) inches over the pipe for the full width of the trench. For exterior perimeter drains, the entire system should be covered with geotextile fabric to minimize clogging of the gravel by backfill material. For underslab drains, lateral drains should be installed in addition to the perimeter drain, at a maximum spacing of ten (10) feet on center.

The sump pit should be a minimum of eighteen (18) inches in diameter by three (3) feet deep and should be surrounded by at least six (6) inches of clean gravel similar to that provided around the drain. In the event that free water is observed in the sump, a pump designed to discharge all flow from the sump for a minimum of five (5) feet beyond the backfill zone should be installed.

Drains which are to discharge downslope by means of gravity (daylighted) should either be connected to a sump pit or have a cleanout installed to facilitate monitoring and maintenance. The discharge area should be protected from damage due to animal activity, vegetation and traffic. The discharge area should be placed so that it does not interfere with adjacent properties.

EARTHWORK

SITE PREPARATION- Recommendations pertaining to site grading are included below and in Appendix A of this report. The upper six (6) inches of the subgrade below paved and filled areas should be scarified and recompacted within plus or minus two percent (±2%) of optimum moisture to at least ninety-five percent (95%) of standard Proctor density ASTM D-698-78 (See Appendix A of this report). Underground water-lines, sewer-lines and perimeter drains should be bedded with at least twelve (12) inches of granular material over the pipe. The water and sewer bedding should not be used within ten (10) feet of the foundation to minimize the transfer any groundwater which may enter the bedding to the foundation. **The foundation and retaining walls should be well-cured and well braced prior to backfilling.**

FILL MATERIALS- In our opinion, some of the on-site soils encountered could be used as backfill against foundation walls and utility trenches provided the recommendations for compaction, moisture control and testing are followed. We recommend bedrock fragments not be used as backfill adjacent to proposed buildings. If imported backfill materials are used next to the foundation walls, they should be relatively impervious and non-expansive. Past experience has

shown that severe damage could occur to the foundation walls if excessively expansive material is placed for backfill and allowed to become wet. The soils should be well pulverized and the proper moisture blended prior to placement for compaction. Refer to Appendix A of this report for recommended moisture contents.

COMPACTION- Suggested recommendations pertaining to compaction of the soils are included in Appendix A of this report. Municipal codes, special construction requirements or other controlling factors may require modifications to those recommendations.

LANDSCAPING AND DRAINAGE- Every precaution should be taken to prevent wetting of the subsoils and percolation of water down along the foundation elements. Controlling the drainage will lessen the chances of water related damage. Finished grade should be sloped away from the structure on all sides to give positive drainage. A minimum of twelve (12) inches fall in the first ten (10) feet (10%) is recommended. Where asphalt or concrete adjoins the foundation walls, the slope can be reduced to four (4) inches fall in ten (10) feet (3.3%). Any cracks or joints shall be sealed and maintained so that surface waters cannot penetrate the surface. If the concrete or asphalt extends no further than five (5) feet from the foundation, the remaining slope away from the foundation should be ten percent (10%) as described above. Positive drainage away from the foundation should be maintained throughout the life of the structure. In the event that the backfill settles, the original grade must be restored so that the site drains effectively.

Planted areas are not recommended around the perimeter of the foundations. However, if the owners are willing to accept the risks of foundation and slab movement, low water-use (xeriscape) plant varieties could be used. An impervious horizontal membrane, such as polyethylene, should **not** be used next to the foundation wall. We recommend the use of a landscape fabric which will allow normal evaporation, in lieu of a plastic membrane. All plants located next to the foundation should be hand-watered using only the minimum amount of water.

Sprinkling systems should not be installed within ten (10) feet of the structure, and spray from sprinklers should not fall within five (5) feet of the foundation. Gutters and downspouts are recommended and should be arranged to carry drainage from the roof at least five (5) feet beyond the foundation walls.

SLOPE CONSIDERATIONS - The scope of this report does not include a slope stability analysis. At a minimum, the structure placed adjacent to slopes of 3h:1v (33.3%), or more, should have the setbacks from the toe of the slope as described in Section 1806.5 of the UBC 1997 Volume 2 if a slope stability analysis is not to be conducted.

GEOTECHNICAL LIMITATIONS

The data presented herein were collected to help develop designs and cost estimates for this project. Professional judgments and estimates on design alternatives and criteria are presented in this report. These are based on evaluation of technical information gathered, our understanding of the characteristics of the structure proposed, and our experience with subsurface conditions in

this area. We do not guarantee the performance of the project in any respect, but only that our engineering work and judgments rendered meet the standard of care of our profession.

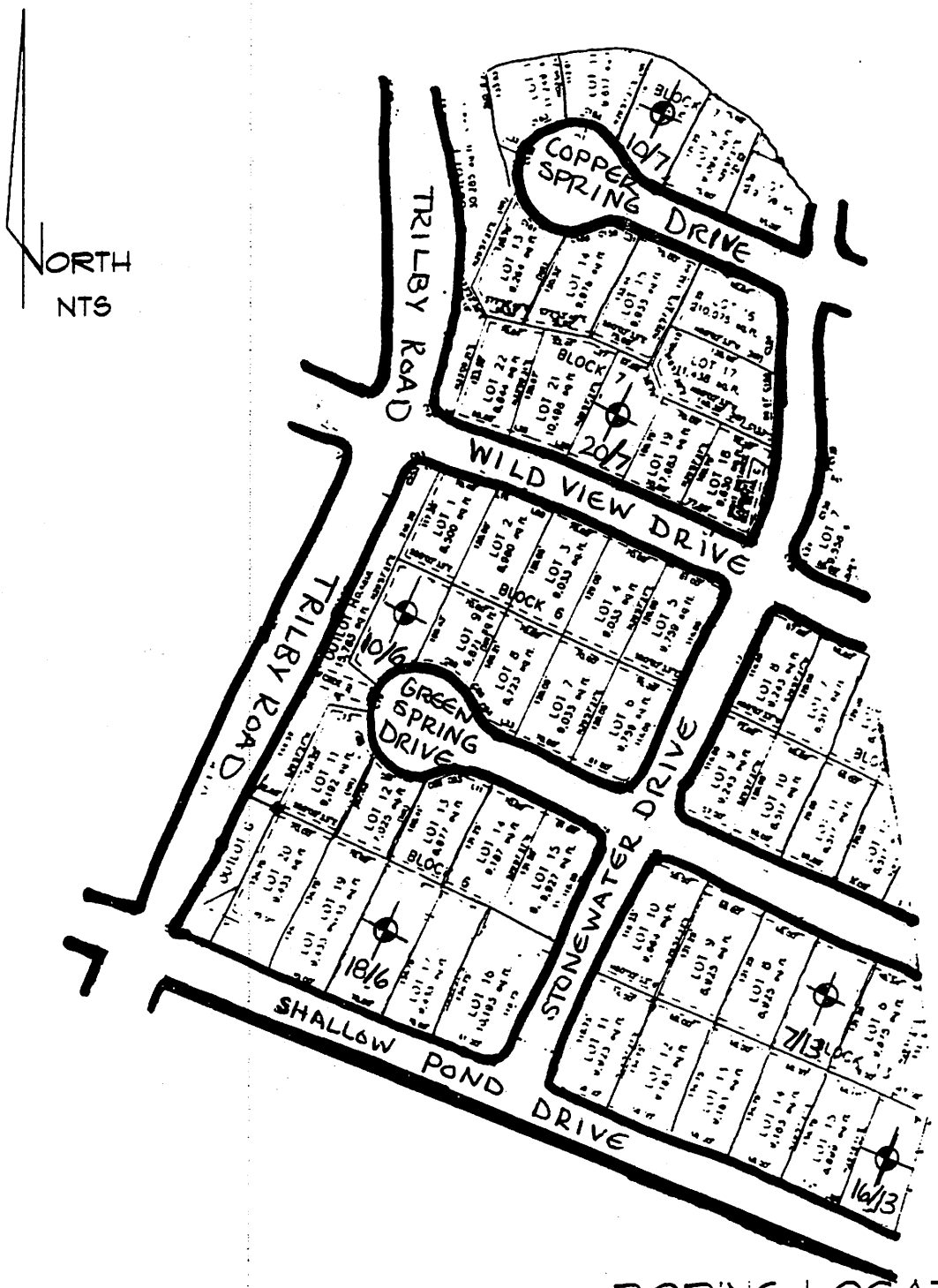
This investigation was conducted for a unique set of project specifications. In the event that the scope of the project has changed from those described in this report such as, the building orientation, location, size, types and depths/elevations of construction, risk acceptance, usage, etc. or if any part of this report is used more than one year from the date of the report, additional testing and evaluation by the geotechnical engineer may be required to validate or modify our recommendations. **It is the Contractor's and/or Owner's responsibility to inform the Engineer of any changes of the scope of this project as described in this report.** No individual, other than the client, should use this report for its intended purpose without first consulting with the geotechnical engineer.

The test holes drilled were spaced to obtain a reasonably accurate picture of subsurface conditions for design purposes. Due to the limited number of borings and samples, variations in the subsurface conditions often exist which may not be observable given the scope of this investigation. These variations are sometimes sufficient to necessitate modifications in design. The open hole inspection should be conducted and is the geotechnical engineer's last chance to determine if any subsurface conditions observed substantiate changes in these recommendations. **Additional testing and evaluation may be necessary pending the outcome of the open hole inspection.**

The methodology used to establish recommendations for construction on expansive soils is not an exact science. Engineering judgement and experience, in addition to laboratory and field analyses, are used to make these recommendations. Therefore, the recommendations and solutions made in this report cannot be considered risk-free and are not a guarantee of the performance of the structures. The recommendations included in this report are our best estimates of the measures that are necessary to help ensure that the proposed structures perform in a satisfactory manner. **The contractor and owner should discuss and understand the risks of construction at this site, and should agree on what level of risks and measures are acceptable.**

We recommend that construction be observed by a qualified soils technician trained and experienced in the field to take advantage of opportunities to recognize undetected conditions which might affect the performance of the foundation systems. It is recommended that a copy or summary of this report be provided to any new or future owners of this property. A copy of ***A Guide to Swelling Soils for Colorado Homebuyers and Homeowners, Colorado Geological Survey Special Publication 43*** should also be provided to any new or future owners of the property. The CGS publication states, "It is essential that the homeowner understands how to check and maintain all of the different systems that were designed to protect a house against swelling soil damage."

Project No. 1526-27-01-01



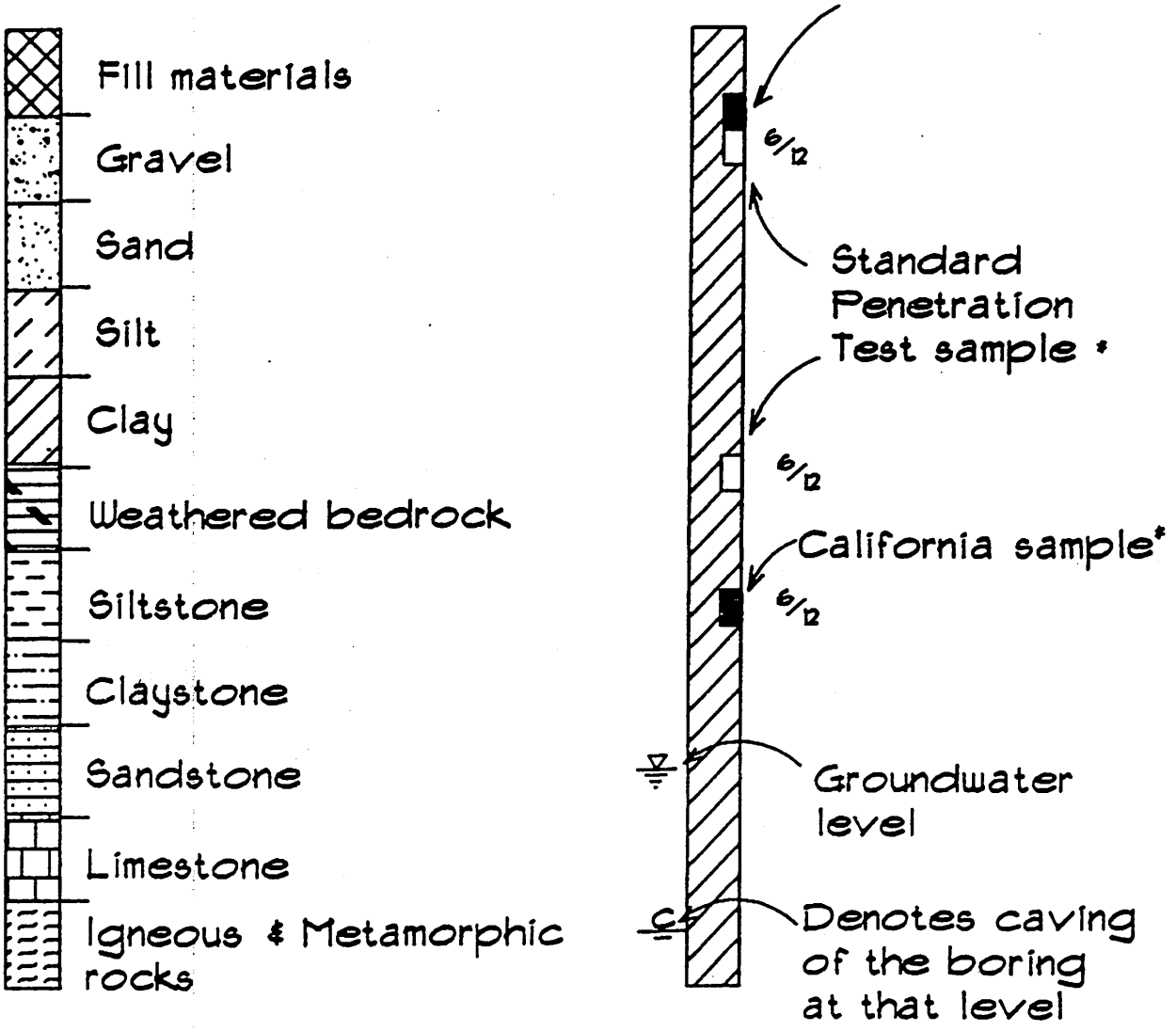
BORING LOCATION MAP

Lots 10 and 18, Block 6, Lot 20, Block 7,
Lots 7 and 16, Block 13,
Fossil Lake PUD 2nd Filing,
Larimer County, Colorado

SCOTT, COX & ASSOCIATES, INC.
Loveland, Colorado

FIGURE NO.

LEGEND OF SYMBOLS

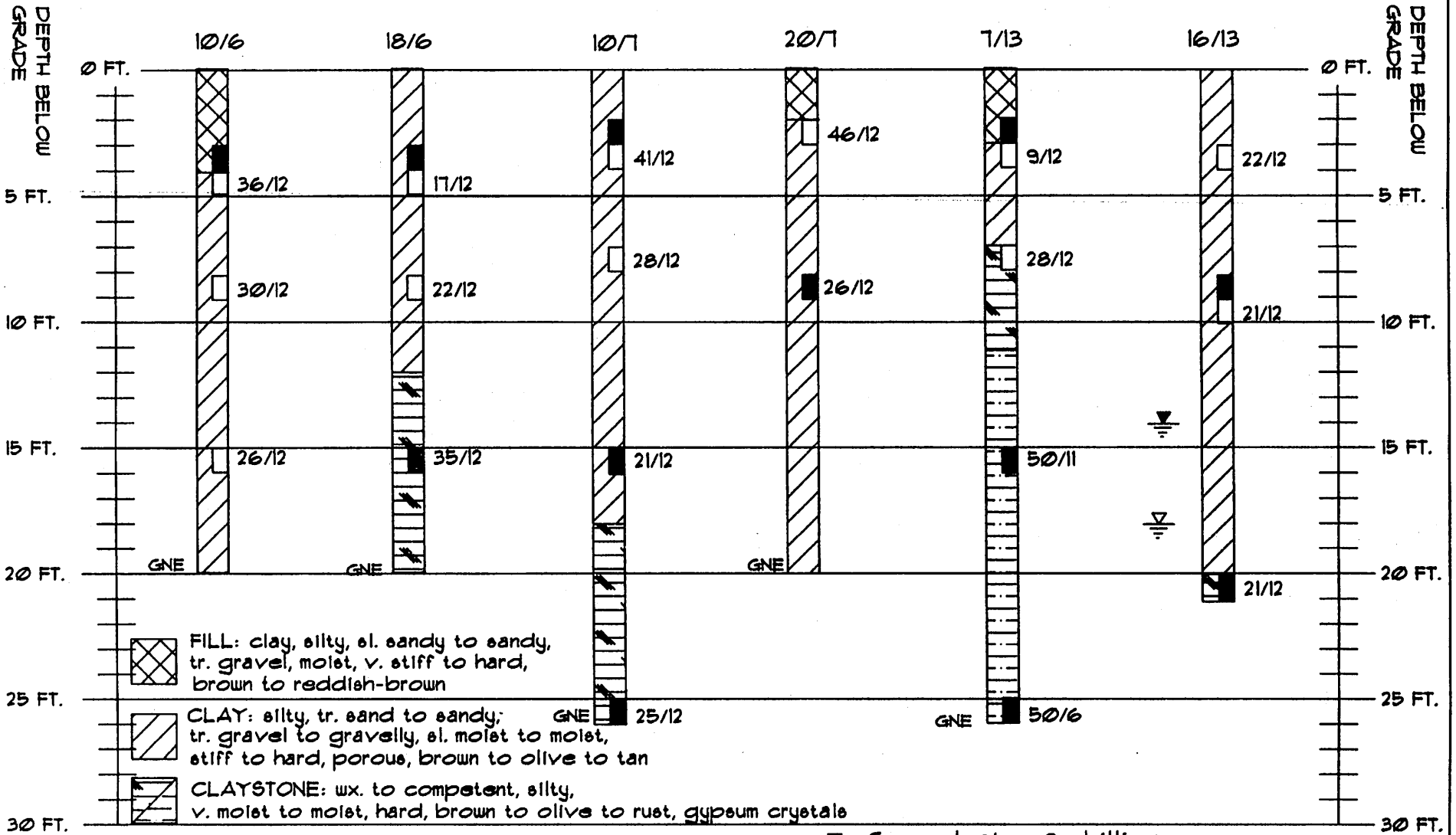


Symbols may be combined to represent mixtures.

* 6/12 indicates that 6 blows of a 140# hammer falling 30" was required to penetrate 12"

SCOTT, COX & ASSOCIATES, INC.
Loveland, Colorado

Figure No. 2



Drilled 1/9/02 & 1/15/02

All soil and/or rock contacts shown are approximate.

CLIENT: ABBCO Builders	LOCATION: Lots 10 & 18, Blk 6, Lots 10 & 20, Blk 7, Lots 7 & 16, Blk 13, Fossil Lake PUD 2nd Filing, Larimer County, Colorado	LOG OF BORINGS	SCOTT, COX & ASSOCIATES, INC. Loveland, Colorado

PROJECT NO. 1526-27-01-01

FIGURE NO. 3

Table 1
Summary of Laboratory Test Results
Project No.: 1526-27-01-01

Lot/Block	Depth (ft)	Soil Properties							Consolidation/Swell					Sample Description
		Moisture Content (%)	Dry Density (pcf)	% Passing No. 10/200	Liquid Limit	Plasticity Index	Unconfined Compressive Strength (psf)	Standard Penetration Test	Total Swell (%)	Loading (PSF)	Settlement (Dry) (%)	Settlement (Saturated) (%)	Swell (%)	
10/6	3-4	11.6	112.0				9000+		5.9	100 500 1000 2000 4000	0.0	 0.8	5.9 5.0 4.0 2.1	FILL: clay, silty, sl. sandy, moist, hard, reddish-brown to brown
10/6	4-5	11.6					9000+	36/12						CLAY: silty, tr. sand, moist hard, brown
10/6	8-9	12.7					9000+	30/12						CLAY: silty, tr. sand, moist, hard, brown
10/6	15-16	17.1					9000+	26/12						CLAY: silty, tr. sand, moist, hard, olive
18/6	3-4	14.7	101.6				7000		2.4	100 500 1000 2000 4000	0.1	 1.4 3.9	2.3 1.3 0.4	CLAY: silty, tr. sand, porous, moist, v. stiff, brown
18/6	4-5	12.8					9000+	17/12						CLAY: silty, tr. sand, tr. gravel, moist, hard, brown
18/6	8-9	9.0					9000+	22/12						CLAY: silty, sandy, tr. gravel, sl. moist, hard, brown
18/6	15-16	20.0	113.0				9000+	35/12	2.1	500 1000 2000 4000	0.1		2.0 1.6 1.0 0.0	CLAYSTONE: wx., silty, moist, hard, olive, gypsum crystals
10/7	2-3	9.9	104.5				9000+		6.2	100 500 1000 2000 4000	0.0	 2.1	6.2 4.8 3.2 0.9	CLAY: silty, tr. sand, porous, sl. moist, hard, brown to tan
10/7	3-4	9.5					9000+	41/12						CLAY: silty, sl. sandy, sl. moist, hard, brown to tan
10/7	7-8	12.3					9000+	28/12						CLAY: silty, sl. sandy, moist, hard, olive-brown
10/7	15-16	19.8					9000+	21/12						CLAY: silty, moist, hard, olive

Table 1
Summary of Laboratory Test Results
Project No.: 1526-27-01-01

Lot/Block	Depth (ft)	Soil Properties							Consolidation/Swell					Sample Description
		Moisture Content (%)	Dry Density (pcf)	% Passing No. 10/200	Liquid Limit	Plasticity Index	Unconfined Compressive Strength (psf)	Standard Penetration Test	Total Swell (%)	Loading (PSF)	Settlement (Dry) (%)	Settlement (Saturated) (%)	Swell (%)	
10/7	25-26	21.2	105.3				8000	25/12	0.6	500 1000 2000 4000	0.0	 0.9 3.2	0.6 0.2	CLAYSTONE: wx., silty, v. moist, hard, olive
20/7	2-3	11.0					9000+	46/12						CLAY: silty, sandy, sl. moist, hard, brown
20/7	7-8	9.4	122.2				9000+	26/12	6.6	100 500 1000 2000 4000	0.2	 1.5	6.4 5.7 4.4 2.1	CLAY: silty, sl. sandy, sl. moist, hard, brown
7/13	2-3	13.7					9000+							FILL: clay, silty, sandy, tr. gravel, moist, v. stiff, brown
7/13	3-4	13.5					9000+	9/12						CLAY: silty, sl. sandy, tr. gravel, moist, stiff, brown
7/13	7-8	14.7					9000+	28/12						CLAYSTONE: wx., silty, moist, hard, olive-brown, gypsum crystals
7/13	15-16	19.6					9000+	50/11						CLAYSTONE: silty, moist, hard, olive
7/13	25-26	19.3	108.4				9000+	50/6	7.5	500 1000 2000 4000 8000 16000	0.3	 2.5	7.2 6.8 5.5 3.4 0.6	CLAYSTONE: silty, moist, hard, olive
16/13	3-4	16.2					9000+	22/12						CLAY: silty, sandy, moist, hard, brown
16/13	8-9	12.3					9000+							CLAY: silty, sandy, with gravel, moist, hard, brown
16/13	9-10	11.0					9000+	21/12						CLAY: silty, sandy, tr. gravel, moist, hard, brown
16/13	20-21	23.7					9000+	21/12						CLAYSTONE: wx., silty, v. moist, hard, olive-brown to rust

APPENDIX A

Suggested Specifications for Placement of Compacted Earth Fills and/or Backfills.

Note: This is intended to be used as a guideline for this project by the owner or owner's representative. Municipal codes, special construction requirements or other controlling factors may require modifications to these suggested specifications. Supervision and control of the fill operations is not within the scope of this investigation. This is not a claim that Scott, Cox & Associates is the Soils Engineer for the fill and compaction operations

GENERAL

Supervision and control of the overlot and structural fill and backfill shall be under the direction of the Soils Engineer for the project. The soils engineer shall approve all earth materials prior to their use, the methods of placing, and the degree of compaction obtained. A letter of approval from the Soils Engineer will be required prior to the owner's final acceptance of the filling operations.

MATERIALS

The soils used for compacted fill beneath interior floor slabs and backfill around foundation walls should be relatively impervious and non-swelling for the depth specified in the soils report. No material with a maximum dimension of six (6) inches or greater shall be used for fill. All fill materials shall be subject to the approval of the Soils Engineer prior to placement.

SUBGRADE PREPARATION

All topsoil, vegetation, frozen materials, old structures or other unsuitable materials, shall be removed to a depth satisfactory to the Soils Engineer before beginning preparation of the subgrade. The subgrade surface of the area to be filled shall be thoroughly scarified to a minimum depth of

six (6) inches, moistened or dried as specified in the attached tables, and compacted in a manner specified below for the subsequent layers of fill. Fill shall not be placed on frozen or muddy ground.

MOISTURE CONTROL

The fill material, while being compacted, shall as nearly as practical contain the amount of moisture as required in the attached table of this Appendix. The moisture shall be uniform throughout the fill. In the event that water must be added to the soils or that the soils must be dried to meet the specifications, the soils must be thoroughly pulverized, mixed, blended and cured prior to placement. The effort required for optimum compaction will be minimized by keeping stockpile soils near Optimum Moisture Contents. When moisture is added to dry, clayey soils, a curing period of several days may be needed to allow uniform absorption of the water into the soil. Freezing temperatures and/or inclement weather conditions may impede moisture control and compaction operations.

PLACEMENT OF FILL MATERIALS

Distribution of material in the fill shall be such as to preclude the formation of lenses of material differing from the surrounding material. The materials shall be delivered and spread on the fill or prepared surface in such a manner as will result in a level, uniformly compacted fill. Prior to compacting, each layer shall have a maximum "loose-lift" height of twelve (12) inches (or as dictated by the compaction equipment and/or soil conditions) and its upper surface shall be relatively horizontal. Test areas are recommended to determine the optimum lift thickness.

Thinner lifts may be necessary in order to achieve the required compaction. Each lift shall be approved by the Engineer prior to placing each succeeding lift.

COMPACTION

When an acceptable uniform moisture content is obtained. each lift shall be compacted by a method acceptable to the Soils Engineer to the densities and moisture contents specified in the foregoing report or the attached table of this Appendix and as determined by the standard Proctor test (procedures in ASTM D698). Compaction shall be performed by rolling or tamping with approved tamping rollers. pneumatic-tired rollers, three-wheel power rollers, or other equipment suited to the soil being compacted. If a sheepsfoot roller is used. it shall be provided with cleaner bars attached in a manner which would prevent the accumulation of material between the tamper feet. The roller should be so designed that the effective weight can be increased. If the required compaction cannot be achieved with the equipment supplied. thinner "loose-lifts" and/or heavier equipment are recommended.

MOISTURE-DENSITY DETERMINATION: STANDARD AND MODIFIED PROCTORS

Samples of representative materials to be used for fill shall be furnished by the contractor to the Soils Engineer at least forty-eight (48) hours prior to compaction testing. Wetter samples will require extra time for test results due to the required drying for sample preparation. The sample is to be tested for determination of the maximum dry densities and optimum moisture contents (Proctor test) for these materials. Tests for these determinations will be made using methods conforming to the most recent procedures of ASTM D698 and AASHTO T99 (standard Proctor)

or ASTM D1557 and AASHTO T180 (modified Proctor), whichever applies. Copies of the "Proctor Curves" will be furnished to the contractor. These test results shall be the basis of control for the field moisture/density tests.

DENSITY TESTING

A 24-hour notice shall be given to the Soils Engineer or testing agency for scheduling compaction tests. The density and moisture content of each layer of compacted fill will be determined by the Soils Engineer, or qualified technician, in accordance with ASTM D2167 and D3017 (nuclear method). Any material found not to comply with the minimum specified density shall be reworked and recompacted until the required density is obtained. Additional lifts shall not be placed until each underlying lift has been approved. The results of all density tests will be furnished to both the owner and the contractor by the soils engineer.

A minimum of one compaction test should be conducted for each twelve (12) inch of compacted lift. Trenches should have a minimum of one test every three hundred (300) feet with a minimum or two (2) tests per trench. Sub-excavations have a minimum of one test every twenty-five (25) lineal feet of footing with a minimum of three (3) tests per pad.

TRENCH SAFETY

All excavations shall comply with current OSHA standards for the soil conditions encountered. The Soils Engineer shall be consulted if there is a question regarding classification of the soils.

Compaction Specifications For GW-GC & SW-SC Soils		
On-site Soils or Approved Imported Soils	Minimum Compaction (ASTM D698)	Acceptable Deviation From Optimum Moisture Content
Beneath Interior Slabs	95% +	±3%
Beneath Garage and Exterior Slabs	95% +	±3%
Backfill and Trenches in Open Areas	90% +	±3%
Backfill and Trenches under Structures, Slabs, etc.	95% +	±3%

Compaction Specifications For ML, CL, MH, & CH Soils		
On-site Soils or Approved Imported Soils	Minimum Compaction (ASTM D698)	Acceptable Deviation From Optimum Moisture Content
Beneath Interior Slabs*	93% - 98%	0% to +3%
Beneath Garage and Exterior Slabs*	93% - 98%	0% to +3%
Backfill and Trenches in Open Areas	90% +	0% to +3%
Backfill and Trenches under Structures, Slabs, etc.*	95% - 98%	0% to +3%

* MH and CH soils are not recommended in these areas

Note: This is a standard table and should not be separated from the report. The specifications in the attached soils report supersede the criteria presented in this table.