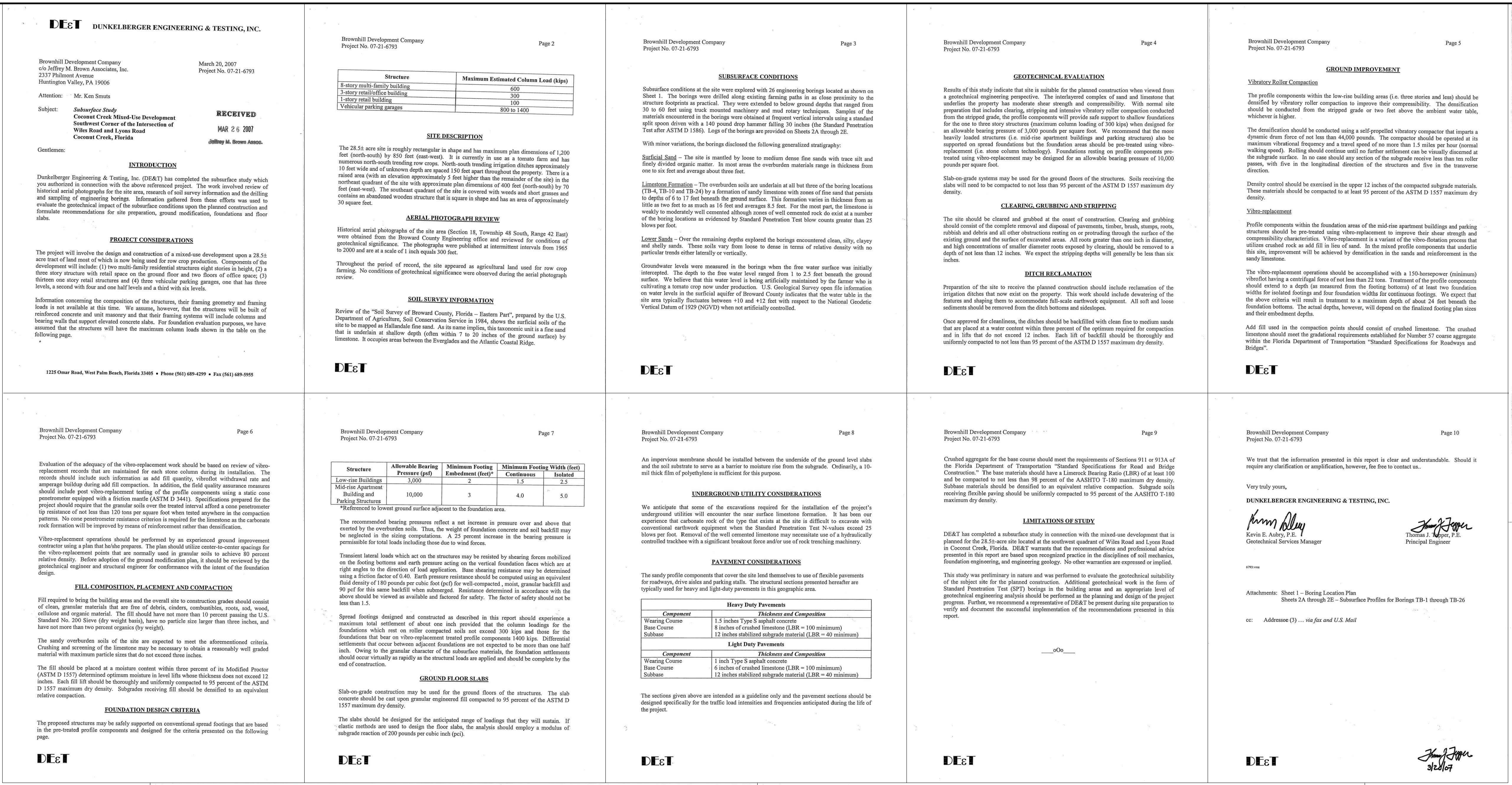


DE&T DUNKELBERGER ENGINEERING & TESTING, INC.

Brownhill Development Company
c/o Jeffrey M. Brown Associates, Inc.
2337 Philmont Avenue
Huntington Valley, PA 19006

March 20, 2007
Project No. 07-21-6793

Attention: Mr. Ken Smuts

Subject: *Subsurface Study*
Coconut Creek Mixed-Use Development
Southwest Corner of the Intersection of
Wiles Road and Lyons Road
Coconut Creek, Florida

RECEIVED
MAR 26 2007
Jeffrey M. Brown Assoc.

Gentlemen:

INTRODUCTION

Dunkelberger Engineering & Testing, Inc. (DE&T) has completed the subsurface study which you authorized in connection with the above referenced project. The work involved review of historical aerial photographs for the site area, research of soil survey information and the drilling and sampling of engineering borings. Information gathered from these efforts was used to evaluate the geotechnical impact of the subsurface conditions upon the planned construction and formulate recommendations for site preparation, ground modification, foundations and floor slabs.

PROJECT CONSIDERATIONS

The project will involve the design and construction of a mixed-use development upon a 28.5± acre tract of land most of which is now being used for row crop production. Components of the development will include: (1) two multi-family residential structures eight stories in height, (2) a three story structure with retail space on the ground floor and two floors of office space; (3) thirteen one story retail structures and (4) three vehicular parking garages, one that has three levels, a second with four and one half levels and a third with six levels.

Information concerning the composition of the structures, their framing geometry and framing loads is not available at this time. We assume, however, that the structures will be built of reinforced concrete and unit masonry and that their framing systems will include columns and bearing walls that support elevated concrete slabs. For foundation evaluation purposes, we have assumed that the structures will have the maximum column loads shown in the table on the following page.

1225 Omar Road, West Palm Beach, Florida 33405 • Phone (561) 689-4299 • Fax (561) 689-5955

Structure	Maximum Estimated Column Load (kips)
8-story multi-family building	600
3-story retail/office building	300
1-story retail building	100
Vehicular parking garages	800 to 1400

SITE DESCRIPTION

The 28.5± acre site is roughly rectangular in shape and has maximum plan dimensions of 1,200 feet (north-south) by 850 feet (east-west). It is currently in use as a tomato farm and has numerous north-south trending row crops. North-south trending irrigation ditches approximately 10 feet wide and of unknown depth are spaced 150 feet apart throughout the property. There is a raised area (with an elevation approximately 5 feet higher than the remainder of the site) in the northeast quadrant of the site with approximate plan dimensions of 400 feet (north-south) by 70 feet (east-west). The southeast quadrant of the site is covered with weeds and short grasses and contains an abandoned wooden structure that is square in shape and has an area of approximately 30 square feet.

AERIAL PHOTOGRAPH REVIEW

Historical aerial photographs of the site area (Section 18, Township 48 South, Range 42 East) were obtained from the Broward County Engineering office and reviewed for conditions of geotechnical significance. The photographs were published at intermittent intervals from 1965 to 2000 and are at a scale of 1 inch equals 300 feet.

Throughout the period of record, the site appeared as agricultural land used for row crop farming. No conditions of geotechnical significance were observed during the aerial photograph review.

SOIL SURVEY INFORMATION

Review of the "Soil Survey of Broward County, Florida – Eastern Part", prepared by the U.S. Department of Agriculture, Soil Conservation Service in 1984, shows the surficial soils of the site to be mapped as Hallandale fine sand. As its name implies, this taxonomic unit is a fine sand that is underlain at shallow depth (often within 7 to 20 inches of the ground surface) by limestone. It occupies areas between the Everglades and the Atlantic Coastal Ridge.

SUBSURFACE CONDITIONS

Subsurface conditions at the site were explored with 26 engineering borings located as shown on Sheet 1. The borings were drilled along existing farming paths in as close proximity to the structure footprints as practical. They were extended to below ground depths that ranged from 30 to 60 feet using truck mounted machinery and mud rotary techniques. Samples of the materials encountered in the borings were obtained at frequent vertical intervals using a standard split spoon driven with a 140 pound drop hammer falling 30 inches (the Standard Penetration Test after ASTM D 1586). Logs of the borings are provided on Sheets 2A through 2E.

With minor variations, the borings disclosed the following generalized stratigraphy:

Surficial Sand – The site is mantled by loose to medium dense fine sands with trace silt and finely divided organic matter. In most areas the overburden materials range in thickness from one to six feet and average about three feet.

Limestone Formation – The overburden soils are underlain at all but three of the boring locations (TB-4, TB-10 and TB-24) by a formation of sandy limestone with zones of fine sand that persists to depths of 6 to 17 feet beneath the ground surface. This formation varies in thickness from as little as two feet to as much as 16 feet and averages 8.5 feet. For the most part, the limestone is weakly to moderately well cemented although zones of well cemented rock do exist at a number of the boring locations as evidenced by Standard Penetration Test blow counts greater than 25 blows per foot.

Lower Sands – Over the remaining depths explored the borings encountered clean, silty, clayey and shelly sands. These soils vary from loose to dense in terms of relative density with no particular trends either laterally or vertically.

Groundwater levels were measured in the borings when the free water surface was initially intercepted. The depth to the free water level ranged from 1 to 2.5 feet beneath the ground surface. We believe that this water level is being artificially maintained by the farmer who is cultivating a tomato crop now under production. U.S. Geological Survey open file information on water levels in the surficial aquifer of Broward County indicates that the water table in the site area typically fluctuates between +10 and +12 feet with respect to the National Geodetic Vertical Datum of 1929 (NGVD) when not artificially controlled.

GEOTECHNICAL EVALUATION

Results of this study indicate that site is suitable for the planned construction when viewed from a geotechnical engineering perspective. The interlayered complex of sand and limestone that underlies the property has moderate shear strength and compressibility. With normal site preparation that includes clearing, stripping and intensive vibratory roller compaction conducted from the stripped grade, the profile components will provide safe support to shallow foundations for the one to three story structures (maximum column loading of 300 kips) when designed for an allowable bearing pressure of 3,000 pounds per square foot. We recommend that the more heavily loaded structures (i.e. mid-rise apartment buildings and parking structures) also be supported on spread foundations but the foundation areas should be pre-treated using vibro-replacement (i.e. stone column technology). Foundations resting on profile components pre-treated using vibro-replacement may be designed for an allowable bearing pressure of 10,000 pounds per square foot.

Slab-on-grade systems may be used for the ground floors of the structures. Soils receiving the slabs will need to be compacted to not less than 95 percent of the ASTM D 1557 maximum dry density.

CLEARING, GRUBBING AND STRIPPING

The site should be cleared and grubbed at the onset of construction. Clearing and grubbing should consist of the complete removal and disposal of pavements, timber, brush, stumps, roots, rubbish and debris and all other obstructions resting on or protruding through the surface of the existing ground and the surface of excavated areas. All roots greater than one inch in diameter, and high concentrations of smaller diameter roots exposed by clearing, should be removed to a depth of not less than 12 inches. We expect the stripping depths will generally be less than six inches.

DITCH RECLAMATION

Preparation of the site to receive the planned construction should include reclamation of the irrigation ditches that now exist on the property. This work should include dewatering of the features and shaping them to accommodate full-scale earthwork equipment. All soft and loose sediments should be removed from the ditch bottoms and sideslopes.

Once approved for cleanliness, the ditches should be backfilled with clean fine to medium sands that are placed at a water content within three percent of the optimum required for compaction and in lifts that do not exceed 12 inches. Each lift of backfill should be thoroughly and uniformly compacted to not less than 95 percent of the ASTM D 1557 maximum dry density.

GROUND IMPROVEMENT

Vibratory Roller Compaction

The profile components within the low-rise building areas (i.e. three stories and less) should be densified by vibratory roller compaction to improve their compressibility. The densification should be conducted from the stripped grade or two feet above the ambient water table, whichever is higher.

The densification should be conducted using a self-propelled vibratory compactor that imparts a dynamic drum force of not less than 44,000 pounds. The compactor should be operated at its maximum vibrational frequency and a travel speed of no more than 1.5 miles per hour (normal walking speed). Rolling should continue until no further settlement can be visually discerned at the subgrade surface. In no case should any section of the subgrade receive less than ten roller passes, with five in the longitudinal direction of the structures and five in the transverse direction.

Density control should be exercised in the upper 12 inches of the compacted subgrade materials. These materials should be compacted to at least 95 percent of the ASTM D 1557 maximum dry density.

Vibro-replacement

Profile components within the foundation areas of the mid-rise apartment buildings and parking structures should be pre-treated using vibro-replacement to improve their shear strength and compressibility characteristics. Vibro-replacement is a variant of the vibro-flotation process that utilizes crushed rock as add fill in lieu of sand. In the mixed profile components that underlie this site, improvement will be achieved by densification in the sands and reinforcement in the sandy limestone.

The vibro-replacement operations should be accomplished with a 150-horsepower (minimum) vibroflot having a centrifugal force of not less than 22 tons. Treatment of the profile components should extend to a depth (as measured from the footing bottoms) of at least two foundation widths for isolated footings and four foundation widths for continuous footings. We expect that the above criteria will result in treatment to a maximum depth of about 24 feet beneath the foundation bottoms. The actual depths, however, will depend on the finalized footing plan sizes and their embedment depths.

Add fill used in the compaction points should consist of crushed limestone. The crushed limestone should meet the gradational requirements established for Number 57 coarse aggregate within the Florida Department of Transportation "Standard Specifications for Roadways and Bridges".

Evaluation of the adequacy of the vibro-replacement work should be based on review of vibro-replacement records that are maintained for each stone column during its installation. The records should include such information as add fill quantity, vibroflot withdrawal rate and amperage buildup during add fill compaction. In addition, the field quality assurance measures should include post vibro-replacement testing of the profile components using a static cone penetrometer equipped with a friction mantle (ASTM D 3441). Specifications prepared for the project should require that the granular soils over the treated interval afford a cone penetrometer tip resistance of not less than 120 tons per square foot when tested anywhere in the compaction patterns. No cone penetrometer resistance criterion is required for the limestone as the carbonate rock formation will be improved by means of reinforcement rather than densification.

Vibro-replacement operations should be performed by an experienced ground improvement contractor using a plan that he/she prepares. The plan should utilize center-to-center spacings for the vibro-replacement points that are normally used in granular soils to achieve 80 percent relative density. Before adoption of the ground modification plan, it should be reviewed by the geotechnical engineer and structural engineer for conformance with the intent of the foundation design.

FILL COMPOSITION, PLACEMENT AND COMPACTION

Fill required to bring the building areas and the overall site to construction grades should consist of clean, granular materials that are free of debris, cinders, combustibles, roots, sod, wood, cellulose and organic material. The fill should have not more than 10 percent passing the U.S. Standard No. 200 Sieve (dry weight basis), have no particle size larger than three inches, and have not more than two percent organics (by weight).

The sandy overburden soils of the site are expected to meet the aforementioned criteria. Crushing and screening of the limestone may be necessary to obtain a reasonably well graded material with maximum particle sizes that do not exceed three inches.

The fill should be placed at a moisture content within three percent of its Modified Proctor (ASTM D 1557) determined optimum moisture in level lifts whose thickness does not exceed 12 inches. Each fill lift should be thoroughly and uniformly compacted to 95 percent of the ASTM D 1557 maximum dry density. Subgrades receiving fill should be densified to an equivalent relative compaction.

FOUNDATION DESIGN CRITERIA

The proposed structures may be safely supported on conventional spread footings that are based in the pre-treated profile components and designed for the criteria presented on the following page.

Structure	Allowable Bearing Pressure (psf)	Minimum Footing Embedment (feet)*	Minimum Footing Width (feet)	
			Continuous	Isolated
Low-rise Buildings	3,000	2	1.5	2.5
Mid-rise Apartment Building and Parking Structures	10,000	3	4.0	5.0

*Referenced to lowest ground surface adjacent to the foundation area.

The recommended bearing pressures reflect a net increase in pressure over and above that exerted by the overburden soils. Thus, the weight of foundation concrete and soil backfill may be neglected in the sizing computations. A 25 percent increase in the bearing pressure is permissible for total loads including those due to wind forces.

Transient lateral loads which act on the structures may be resisted by shearing forces mobilized on the footing bottoms and earth pressure acting on the vertical foundation faces which are at right angles to the direction of load application. Base shearing resistance may be determined using a friction factor of 0.40. Earth pressure resistance should be computed using an equivalent fluid density of 180 pounds per cubic foot (pcf) for well-compacted , moist, granular backfill and 90 pcf for this same backfill when submerged. Resistance determined in accordance with the above should be viewed as available and factored for safety. The factor of safety should not be less than 1.5.

Spread footings designed and constructed as described in this report should experience a maximum total settlement of about one inch provided that the column loadings for the foundations which rest on roller compacted soils not exceed 300 kips and those for the foundations that bear on vibro-replacement treated profile components 1400 kips. Differential settlements that occur between adjacent foundations are not expected to be more than one half inch. Owing to the granular character of the subsurface materials, the foundation settlements should occur virtually as rapidly as the structural loads are applied and should be complete by the end of construction.

GROUND FLOOR SLABS

Slab-on-grade construction may be used for the ground floors of the structures. The slab concrete should be cast upon granular engineered fill compacted to 95 percent of the ASTM D 1557 maximum dry density.

The slabs should be designed for the anticipated range of loadings that they will sustain. If elastic methods are used to design the floor slabs, the analysis should employ a modulus of subgrade reaction of 200 pounds per cubic inch (pci).

An impervious membrane should be installed between the underside of the ground level slabs and the soil substrate to serve as a barrier to moisture rise from the subgrade. Ordinarily, a 10-mil thick film of polyethylene is sufficient for this purpose.

UNDERGROUND UTILITY CONSIDERATIONS

We anticipate that some of the excavations required for the installation of the project's underground utilities will encounter the near surface limestone formation. It has been our experience that carbonate rock of the type that exists at the site is difficult to excavate with conventional earthwork equipment when the Standard Penetration Test N-values exceed 25 blows per foot. Removal of the well cemented limestone may necessitate use of a hydraulically controlled trackhoe with a significant breakout force and/or use of rock trenching machinery.

PAVEMENT CONSIDERATIONS

The sandy profile components that cover the site lend themselves to use of flexible pavements for roadways, drive aisles and parking stalls. The structural sections presented hereafter are typically used for heavy and light-duty pavements in this geographic area.

Heavy Duty Pavements	
Component	***Thickness and Composition***
Wearing Course	1.5 inches Type S asphalt concrete
Base Course	8 inches of crushed limestone (LBR = 100 minimum)
Subbase	12 inches stabilized subgrade material (LBR = 40 minimum)
Light Duty Pavements	
Component	***Thickness and Composition***
Wearing Course	1 inch Type S asphalt concrete
Base Course	6 inches of crushed limestone (LBR = 100 minimum)
Subbase	12 inches stabilized subgrade material (LBR = 40 minimum)

The sections given above are intended as a guideline only and the pavement sections should be designed specifically for the traffic load intensities and frequencies anticipated during the life of the project.

Crushed aggregate for the base course should meet the requirements of Sections 911 or 913A of the Florida Department of Transportation "Standard Specifications for Road and Bridge Construction." The base materials should have a Limerock Bearing Ratio (LBR) of at least 100 and be compacted to not less than 98 percent of the AASHTO T-180 maximum dry density. Subbase materials should be densified to an equivalent relative compaction. Subgrade soils receiving flexible paving should be uniformly compacted to 95 percent of the AASHTO T-180 maximum dry density.

LIMITATIONS OF STUDY

DE&T has completed a subsurface study in connection with the mixed-use development that is planned for the 28.5±-acre site located at the southwest quadrant of Wiles Road and Lyons Road in Coconut Creek, Florida. DE&T warrants that the recommendations and professional advice presented in this report are based upon recognized practice in the disciplines of soil mechanics, foundation engineering, and engineering geology. No other warranties are expressed or implied.

This study was preliminary in nature and was performed to evaluate the geotechnical suitability of the subject site for the planned construction. Additional geotechnical work in the form of Standard Penetration Test (SPT) borings in the building areas and an appropriate level of geotechnical engineering analysis should be performed as the planning and design of the project progress. Further, we recommend a representative of DE&T be present during site preparation to verify and document the successful implementation of the recommendations presented in this report.

____oOo____

We trust that the information presented in this report is clear and understandable. Should it require any clarification or amplification, however, fee free to contact us..

Very truly yours,

DUNKELBERGER ENGINEERING & TESTING, INC.

Kevin E. Aubry, P.E.
Geotechnical Services Manager

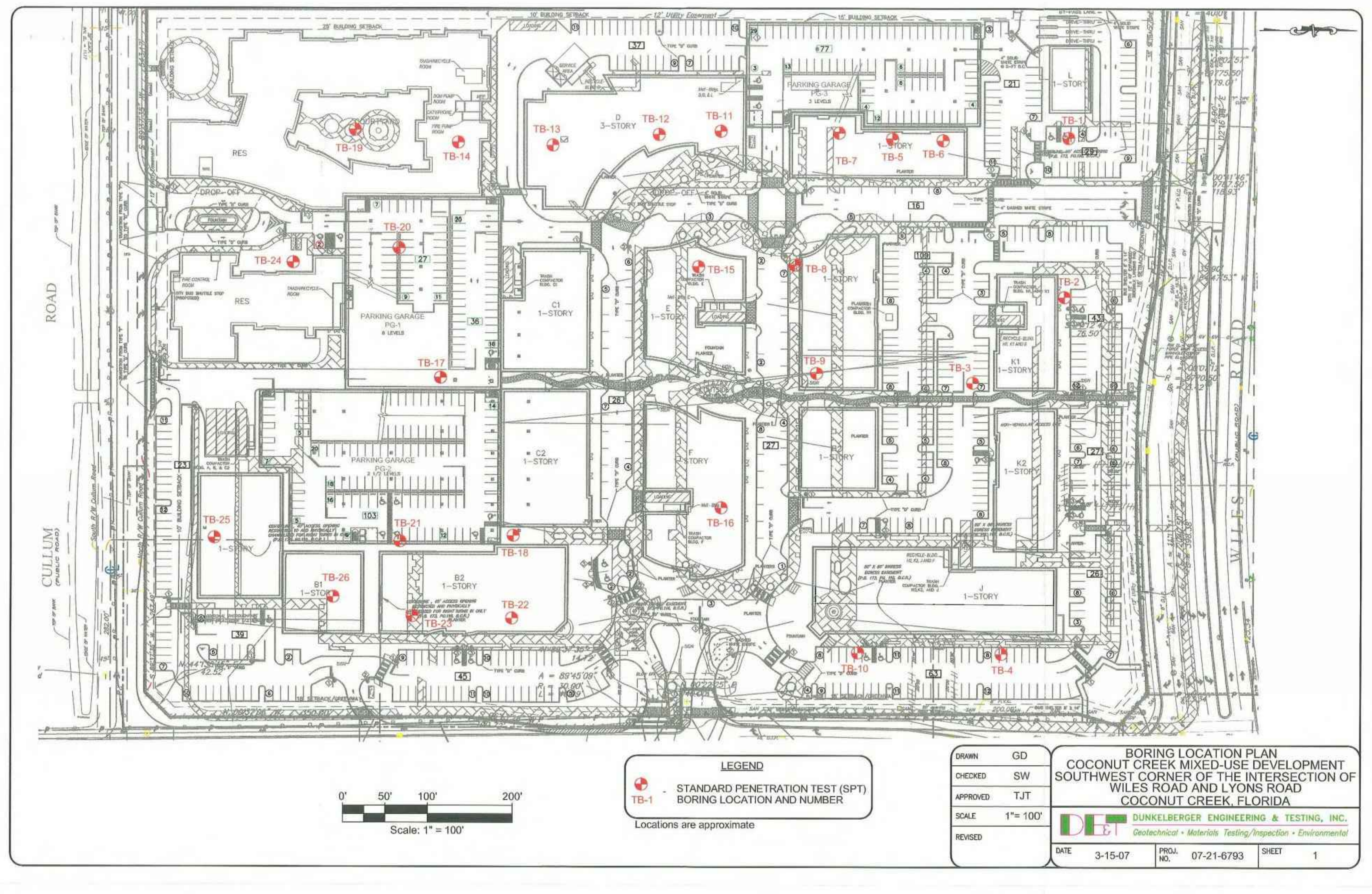
Thomas J. Tepper, P.E.
Principal Engineer

6793:vms

Attachments: Sheet 1 – Boring Location Plan
Sheets 2A through 2E – Subsurface Profiles for Borings TB-1 through TB-26

cc: Addressee (3) … *via fax and U.S. Mail*

3/28/07



LEGEND

TB-1 - STANDARD PENETRATION TEST (SPT) BORING LOCATION AND NUMBER

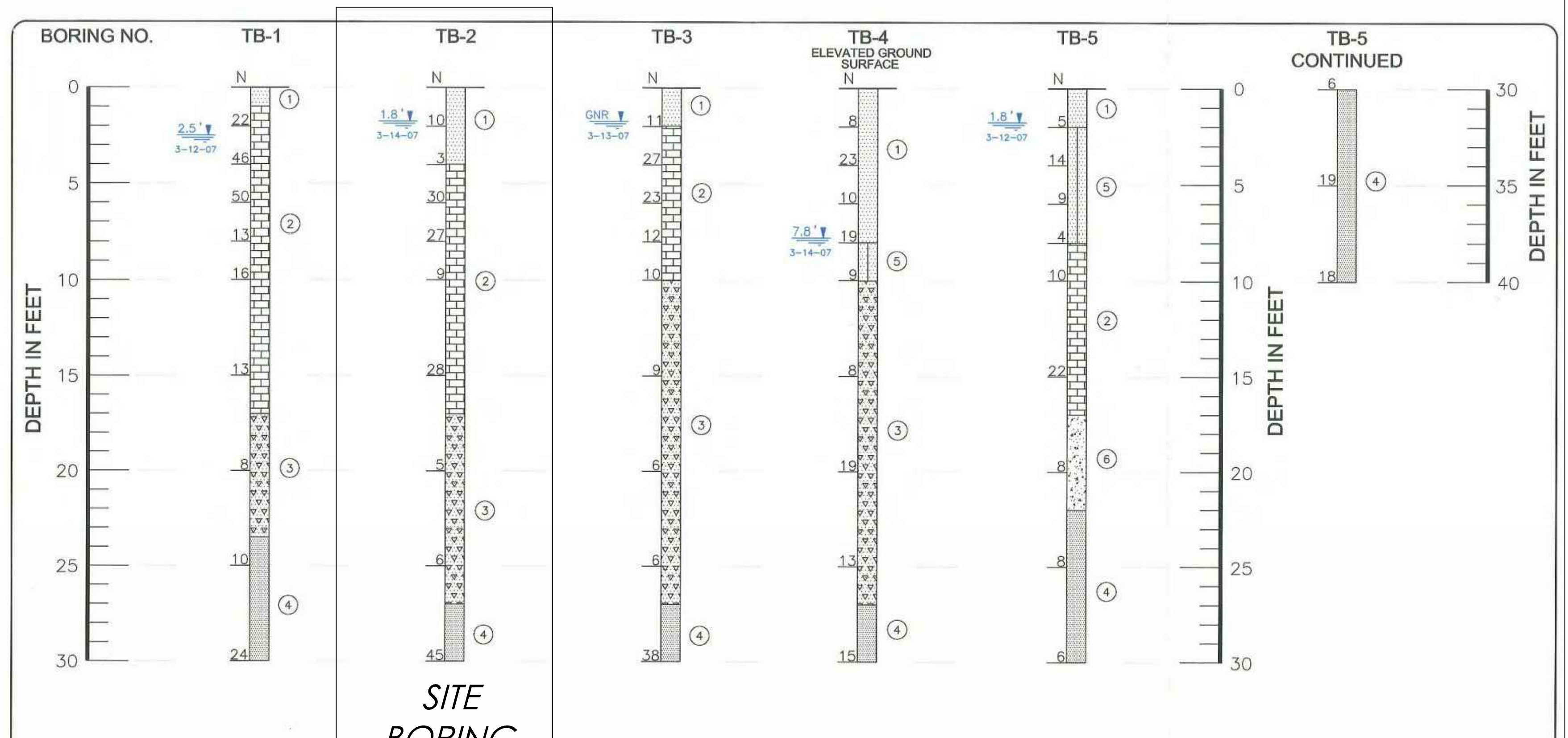
Locations are approximate

DRAWN	GD
CHECKED	SW
APPROVED	TJT
SCALE	1"= 100'
REVISED	

BORING LOCATION PLAN
COCONUT CREEK MIXED-USE DEVELOPMENT
SOUTHWEST CORNER OF THE INTERSECTION OF
WILES ROAD AND LYONS ROAD
COCONUT CREEK, FLORIDA

DUNKELBERGER ENGINEERING & TESTING, INC.
Geotechnical • Materials Testing/Inspection • Environmental

DATE 3-15-07 PROJ. NO. 07-21-6793 SHEET 1



SITE BORING

LEGEND

①	Brown to light brown fine SAND, trace silt and finely divided organic material (SP)
②	Light brown sandy LIMESTONE with zones of fine sand
③	Light brown slightly silty fine to medium SAND, trace to some sand to gravel-sized shell fragments (SP-SM, SM)
④	Light brown fine SAND, trace sand-sized shell fragments (SP)
⑤	Brown slightly silty to silty fine SAND, trace gravel-sized limestone fragments, trace root fibers (SP-SM, SM)
⑥	Gray silty to clayey fine SAND, trace sand-sized shell fragments (SM, SC, SP)

N – Indicates the number of blows of a 140 pound hammer, freely falling a distance of 30 inches, required to drive a 2-inch diameter sampler 12 inches (ASTM D 1586)

SP – Unified Soil Classification System Group Symbol (ASTM D 2487)

TB-1 – Standard Penetration Test (SPT) boring and number

2.5' 3-12-07 – Depth of groundwater (feet) & date measured

GNR 3-13-07 – Groundwater depth not recorded on date drilled

NOTES

(1) Borings were drilled on March 12, 13 and 14, 2007 using Central Mine Equipment Model 55 (CME 55) and CME 45 drilling rigs.

(2) Strata boundaries are approximate and represent soil strata at each test hole location only. Soil transitions may be more gradual than implied.

(3) Groundwater depths shown on the subsurface profiles represent groundwater surfaces on the dates shown. Groundwater level fluctuations should be anticipated throughout the year.

DRAWN	GD
CHECKED	SW
APPROVED	TJT
SCALE	1" = 5'
REVISED	

SUBSURFACE PROFILES
COCONUT CREEK MIXED-USE DEVELOPMENT
SOUTHWEST CORNER OF THE INTERSECTION OF
WILES ROAD AND LYONS ROAD
COCONUT CREEK, FLORIDA

DUNKELBERGER ENGINEERING & TESTING, INC.
Geotechnical Materials Testing/Inspection Environmental

DATE 3-15-07 PROJ. NO. 07-21-6793 SHEET 2A

NOTE:
CONTRACTOR IS RESPONSIBLE TO OBTAIN ALL GEOTECHNICAL REPORTS AND REQUIREMENTS AND ADHERE TO ALL NECESSARY CONSTRUCTION ASPECTS

LICENSE No. 71653 STATE OF FLORIDA
Ron T. crump
Digitally signed by Ron T. crump
DN: C=US, E=RonC@TheContineoGroup.com, O="Contineo Group, LLC", CN=Ron T. crump
Date: 2016.03.02 01:09:51-05'00'

ISSUED FOR SITE PLAN REVIEW

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#	DATE	REVISIONS	BY

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COOPER'S HAWK
WINERY & RESTAURANT
AT THE PROMENADE AT COCONUT CREEK

JURSIDICTION: CITY OF COCONUT CREEK
LANDLOT: SECTION 18, TOWNSHIP 48 SOUTH, RANGE 42 EAST, BROWARD COUNTY
LOCATION: PROMENADE AT COCONUT CREEK
4473 LYONS ROAD
COCONUT CREEK, FL 33073

GEOTECHNICAL INFORMATION

JOB NO: 15-187
DATE: 02/16/16
SHEET C6.2
PLAN REVIEW