July 16, 2023

Mr. Bennett Stewart, Project Manager
Teramore Development
165 Big Star Drive
Thomasville, Georgia 31757

Subject: **Report of Independent Assessment of Geotechnical Conditions**
Dollar General – Zephyrhills Store
Zephyrhills, Florida
NOVA Project Number 10106-2023053

Dear Mr. Stewart:

NOVA Engineering and Environmental, LLC (NOVA) has completed the authorized report review of *Geotechnical Exploration Dollar General SR 39* prepared by Universal Engineering Sciences (Universal) and dated November 2, 2022. The purpose of this study was to independently assess subsurface conditions using the aforementioned report and provide alternative recommendations for ground improvement and foundation design, if applicable, for the Dollar General store building, as well as comment on pavement design and drainage pond impacts. This work was performed in general accordance with NOVA Proposal Number 006-20226498, dated December 6, 2022. This report briefly discusses our understanding of the project, describes the geotechnical engineering services completed to-date, and presents our findings, conclusions and recommendations.

We appreciate your selection of NOVA and the opportunity to be of service on this project. If you have any questions, or if we may be of further assistance, please do not hesitate to contact us.

Sincerely,
NOVA ENGINEERING AND ENVIRONMENTAL, LLC

ANDRES F. ALBERDI ★ LICENSE No 42449 ★ STATE OF FLORIDA ★ PROFESSIONAL ENGINEER

Andres F. Alberdi, State of Florida, Professional Engineer, License No. 42449. This item has been digitally signed and sealed by Andres F. Alberdi, P.E. on the date indicated here. Printed copies of this document are not considered signed and sealed, and the signature must be verified on any electronic copies.

Digitally signed by Andres F Alberdi
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PROJECT OVERVIEW

It is our understanding that the proposed development will include the construction of a 10,640 square foot Dollar General store with thirty-six asphalt paved parking spaces and associated drives, a 1,000 sf septic drain field and a stormwater pond. Universal assumed that the construction would proceed at existing grade (minimal cutting or filling) and that structural loads would not be greater than 5 kips per lineal foot for continuous wall founations and 50 kips for individual column foundations.

Universal recommended the use of deep foundations with a post-tensioned floor slab to support the structure because of the risk of karst activity (sinkholes) suggested by conditions in some of the test borings. as a result of the significant expense associated with these foundation recommendations, an independent assessment of conditions was requested.

GEOTECHNICAL SERVICES AND CONCLUSIONS

NOVA Engineering and Environmental, LLC

NOVA conducted a shallow subsurface exploration study utilizing test pit excavations in September 2022. Shallow subsurface conditions were characterized to depths on the order of 4-1/2 to 7 feet within proposed building, pavement, drainage pond and septic drainfield areas. NOVA concluded that suitable shallow subsurface conditions were present for support of the planned pavements and the structure on conventional shallow foundations but recommended a final geotechnical study utilizing Standard Penetration testing (SPT Borings) and auger borings within planned building, pavement and drainage areas.

Universal Engineering Sciences

Universal conducted a supplemental geotechnical study in October and November 2022 that included the following:

- Building Area: Two SPT borings (ASTM D 1586) advanced to nominal depths of 50 feet and 20 feet;
- Pavement Area: Four hand auger borings (ASTM D 1452) manually advanced to a nominal depth of 5 feet.
- Drainage Ponds (2): In each pond, one SPT boring advanced to a nominal depth of 20 feet; one hand auger boring performed to a nominal depth of 5 feet; one Double Ring Infiltrometer Test (DRI – ASTM D 3385) performed at a depth of 1 foot.

Universal concluded that some of the soil borings encountered conditions suggestive of karst development, including 1) apparent raveling soils, 2) lower than anticipated resistances to sampler penetration (weight of hammer conditions) and 3) 100% loss of drilling fluid circulation. Each of these are suggestive of potential sinkhole activity. Because of these conditions, Universal recommended the use of a deep foundation system consisting of ductile iron pipe piles or helical piles to support the building, along with a series of grade beams and post-tensioned floor slabs.

NOVA ASSESSMENT AND RECOMMENDATIONS

GENERAL

NOVA concurs with Universal that the site has an elevated potential for sinkhole development. However, we are of the opinion that a deep foundation system with a series of grade beams and post-tensioned concrete floor slab is not warranted. We believe that a less costly approach would be to improve/treat the ground with vibro-replacement or low mobility subsurface grouting. These treatments can be used to improve the bearing capacity and pre-collapse incipient sinkholes (vibro-replacement) or provide a seal between the sandy overburden and porous limestone (low mobility subsurface grouting). Following the ground improvement/treatment, conventional shallow foundation and floor slab construction can be used. We do recommend additional top reinforcement in continuous wall foundations for improved stiffness. Both of these ground improvement/treatment options are conducted by specialty contractors and NOVA can assist with the planning and implementation.

Regarding the Universal pavement section recommendations, NOVA agrees with the provided minimum pavement materials and component thicknesses. NOVA also generally agrees with the stormwater pond design soil parameters except that the seasonal high groundwater level at location DRI-1 should be 1 foot, not 3 feet. Futher, NOVA would recommend increasing the available fillable porosity of the fine sand deposits to 30 percent.

VIBRO-REPLACEMENT

Vibro-Replacement (VR) is a form of ground improvement that is primarily utilized to consistently densify and reinforce very loose to loose fine sand deposits, but in this instance will be used for densification purposes and also as a method to pre-collapse imminent sinkhole development beneath the footprint of the planned structure. VR utilizes a vibrating probe that is typically jetted to allow advancement of the probe to the required depth. As the probe is advanced and retrieved, a strong and durable aggregate is placed in the probe hole and subsequently rammed/compacted. This action increases the lateral stress in the surrounding soil, further stiffening the stabilized composite soil mass and as a result, the soils surrounding the probe are densified. The jetting of water, ramming and vibrations can also engage soil movement into weak or void zones, thus causing a small diameter ground collapse.

VR is referred to as stone columns. The stone columns can also bypass weak zones and provide load transfer to stronger materials, such as the underlying limestone formation. Vibro-Replacement can increase the allowable foundation soil bearing capacity to values on the order of 4,000 psf to 6,000 psf within the zone of significant stress influence, but for a lightly loaded, single-story building, the value of increased bearing capacity (reduction in foundation size) will not be realized since the minimum foundation sizes will be controlled by the Florida Building Code. Along with the VR stone columns, a Load Transfer Platform (LTP) should be constructed to minimize point loading from the stone columns, as discussed below.

Vibro-Replacement is performed by a specialty contractor who, along with geotechnical staff, will participate in the final determination of improvement depth requirements and number of probes to achieve the desired improvement. The VR ground improvement should be observed and documented by a NOVA engineer or engineering technician to confirm compliance with design drawings and specifications. This ground improvement method generates a substantial amount of water during the jetting of the probe and the water will have to be controlled and maintained on-site if it cannot be discharged into the drainage system, at least not without the removal of suspended soil fines.

Load Transfer Platform

Following the completion of the VR ground improvement, a Load Transfer Platform (LTP) will need to be constructed. The LTP is constructed by over-excavating the upper 12 to 18 inches of soil. This soil is then mixed with the aggregate from the stone columns and compacted in thin lifts to produce a stronger fill material immediately below the foundations and slabs-on-grade.

The LTP soils should be backfilled in 6 to 9 inch lifts, compacted to a minimum soil density of at least 98 percent of the maximum dry density as determined by the Modified Proctor test method (ASTM D-1557). Backfilling operations should be observed by a NOVA soils technician, who can confirm suitability of the LTP material, and uniformity and appropriateness of compaction efforts. The technician can also document compliance with the specifications by performing field density tests. One test per 2,000 square feet in the structure area should be performed in each lift of fill, with test locations well distributed throughout the fill mass. When filling in small areas, at least one test per day per area should be performed. One (1) test at conventional spread foundations, one (1) test per each planned column footing area, and one (1) test per 50 linear feet at continuous strip foundations are also recommended.

Low Mobility Subsurface Grouting

Based upon the available information, active raveling of soils into porous limestone may be occurring at depths as shallow as around 10 feet to deeper than 20 feet or more. To mitigate this, we recommend a program of subsurface grouting beginning at or near this depth and extending upward. Subsurface grouting involves injecting a homogeneous grout mix under pressure and at low injection rates at subsurface locations in pre-designed patterns in order to fill and displace weak soils and seal the interface between the sandy overburden soils and the limestone formation. Grouting may then proceed upward toward the ground surface to compact loosened soils which will reduce further consolidation of these materials. Stabilization of the subsurface conditions utilizing subsurface grouting remediation methods should be completed by a certified contractor specializing in soil stabilization work. Prior to commencing remediation, the contractor should provide details regarding the methods to be used which includes proposed equipment and grout mix design.

We have estimated that fifty grout injection points, at 15-foot spacings, will be required throughout the building area. Additional grout points may become necessary depending on observations made during grout pipe installation and grout injection. The grout pipes should have an inside diameter of between 2- to 4-inches and should be installed to depths ranging between 10 feet to 20 feet or greater, depending upon the hardness of the limestone. Grouting operations may begin after satisfactory installation of the grout pipes. A slump ranging between 4 to 6 inches is recommended and the grout mix design should be submitted for approval. During grouting activities, the following should be monitored:

- The locations, depths and quantities of injection pipes.
- Grouting depth intervals.
- Grout quantities.
- Pumping pressures.

The pumping pressure should be monitored continuously during grout placement. A maximum pressure of 350-lbs/in^2 is recommended, but it is expected that lower pressures will be required where the limestone surface is shallow. At shallow limestone locations only a 10 foot fluid head above the ground surface may be required to mobilize the grout. The pumping rate should not exceed 6-ft^3/minute. In the event that the grout volume placed at any grout injection point exceeds 10-cubic yards in one day, the grouting at that point should cease and resume at a later date. Further, if a maximum of 50-cubic yards is injected at any point, additional injection points will likely be required around this point. We estimate that approximately 150 to 250 cubic yards of grout will be required to stabilize the subsurface conditions. The subsurface grouting should be observed and documented by a NOVA engineer or engineering technician to confirm compliance with design drawings and specifications.

SHALLOW FOUNDATIONS

Shallow foundations can be designed for a net maximum allowable soil bearing pressure of up to 3,000 pounds per square foot (psf) after satisfactory completion of the recommended ground improvement/treatment.

All exterior footings should be embedded so that the bottom of the foundation meets the requirements of the Florida Building Code or is a minimum of 18 inches below the adjacent compacted grades on all sides; interior footings may be constructed at nominal depths below the finished floor slab. Strip or wall footings should be constructed per the foundation plans.

Foundation excavations should be level and free of debris, ponded water, mud, loose, or water-softened soils. Foundation excavations should be evaluated by NOVA's Geotechnical Engineer prior to reinforcing steel placement to observe foundation subgrade preparation and confirm bearing pressure capacity. Due to variable site subsurface and construction conditions, some adjustments in isolated foundation bearing pressures, depth of foundations, or undercutting and replacement with controlled structural fill may be necessary.

Concrete should be placed as soon as is practical after the foundation is excavated, and the subgrade evaluated. Foundation concrete should not be placed on saturated soil. If a foundation excavation remains open overnight, or if precipitation is imminent, a 3- to 4-inch thick "mud mat" of lean concrete should be placed in the bottom of the footing to protect the bearing soils until reinforcing steel and concrete can be placed.

Settlements for spread foundations bearing on the aforementioned improved materials have been assessed using SPT values to estimate elastic modulus, published correlations and previous NOVA experience. Based on the provided loading, we estimate total post-construction settlements will be less than 1/2 inch, with less than 1/4 inch of the total settlement being differential between adjoining foundations.