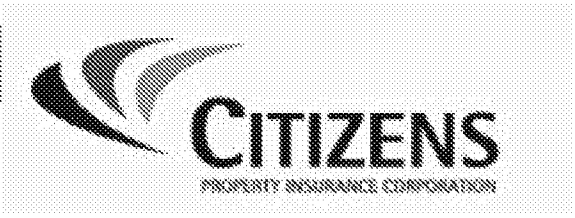
Instr #2015023005 BK: 3213 PG: 1744, Filed & Recorded: 4/20/2015 10:23 AM ERL Deputy Clk, #Pgs:68
Don Barbee Jr,Clerk of the Circuit Court Hernando CO FL Rec Fees: $579.50

CITIZENS PROPERTY INSURANCE CORPORATION
SINKHOLE FILING WORKSHEET AND COVER



Today's Date: 2/10/2015

Dear Clerk of the Court:

A Sinkhole claim has been reported and confirmed at the below parcel number. In compliance with F.S. 627.7073 (2), enclosed you will find the respective report(s) for your records.

Citizens Claim Number:	000-10-175383		
Insured/ Property Owner:	Joseph & Josephine Scovazzo Trust	Date Of Final Indemity Payment:	7/31/2013
Location Address:	10454 CASA GRANDE CIR, SPRING HILL, FL 34608	County:	Hernando
Legal Description Of Real Property:	THE GARDENS AT SEVEN HILLS PHASE 2 LOT 167		
Parcel Number:	R30 223 18 3526 0000 1670		
Total Indemnity Paid to Date:	$126,301.76		
Stabilization Complete:	YES		

Report Type & Payment Summary:		
Engineers Report (s) Pages	52	
Neutral Evaluator Report Pages:	0	
Stabilization/ Monitoring Report Pages:	15	
Total # of Pages Plus Cover Page	68	
# of Names listed on Property	2	
Fee for Citizens Cover Page	$	10.00
Total Fee for Additional Pages	$	569.50
Fee for Additional Names	$	-
Total Filing Fee-Check Enclosed	$	579.50

BEST COPY POSSIBLE

MADRID ENGINEERING GROUP, INC.
2030 State Road 60 East *Ph: (863) 533-9007*
Bartow FL 33830-4268 *Fax: (863) 533-8997*

Executive Summary - Claim Report
Citizens Property Insurance Corporation
Claim Number 445670

This report presents the results of a subsidence investigation of the **Brian Hagen residence at 12232 Bear Claw Loop in Hudson, Florida**. MEG was retained by Citizens Property Insurance Corporation to conduct a subsidence investigation at the property to determine the possible cause(s) of the cracking and specifically to identify whether or not sinkhole activity is a possible cause of the cracking within a reasonable, professional probability. This investigation was completed in accordance with Florida law, and complies with the minimum standards as specified in Florida Statute 627.707 and Florida Geological Survey Special Publication No. 57.

Site Location and Description
This residence is a single-story structure completed in 1972, according to the Pasco County Property Appraiser, utilizing stucco-clad concrete masonry unit (CMU) and wood frame construction. Specifically, the property is located in Section 3, Township 25 South, Range 16 East in Pasco County. The parcel identification is **03-25-16-051E-00000-3140**. The legal description of the property is as follows: **BEACON WOODS VILLAGE 3-B PB 11 PGS 41-42 LOT 314 OR 6121 PG 1559**.

Findings
It is MEG's professional opinion that ongoing sinkhole activity cannot be eliminated as a potential contributing factor to some of the conditions encountered at the subject property within a reasonable, professional probability. This conclusion is based upon a series of tests including: a geophysical survey consisting of Ground Penetrating Radar Survey; Floor Elevation Study; SPT borings; shallow hand auger borings; penetrometer probings; test pits; and site observations. Other proximate causes for the conditions observed, have been identified and are enumerated in the report.

Stabilization Recommendation
A stabilization program that includes low mobility grouting is recommended to fill any voids or loose rock in the upper portion of the limestone, densify loose and soft soils overlying the limestone surface. The program includes a series of 27 angled and vertical injection points installed on nominal 8 foot centers around the structure and the injection of an estimated 230 to 380 cubic yards of grout. Based on our borings, competent limestone occurs at an average depth of about 48 feet bgs, but the depth to limestone is highly variable. Also, because there are very loose soils within the zone of influence of the foundation, MEG recommends a supplementary grouting program using polyurethane injection to stabilize the shallow very loose soil conditions at the site. There will be an estimated 2,200 lbs of polyurethane grout to complete the program.

CERTIFICATION TO CITIZENS PROPERTY INSURANCE CORPORATION AND BRIAN HAGEN:

Hagen Property
Subsidence Investigation
MEG Project No. 9798

Engineering Certification

I hereby certify that I am a registered professional engineer in the State of Florida practicing with Madrid Engineering Group, Inc. under license number EB 0006509 issued by the Florida Department of Business and Professional Regulation and the Board of Professional Engineers. I certify that I, or others under my direct supervision, have prepared the geotechnical engineering evaluations, findings, opinions, and conclusions represented in this report.

SIGNATURE: _____
NAME: John E. Delashaw, P.E.
LICENSE #: 48154
DATE: 2/12/12

Geologic Certification

I hereby certify that I am a registered professional geologist in the State of Florida practicing with Madrid Engineering Group, Inc. under license number GB 0000459, issued by the Florida Department of Business and Professional Regulation and the Board of Professional Geologists. I certify that I, or others under my direct supervision, have prepared the geologic evaluations, findings, opinions, and conclusions represented in this report.

SIGNATURE: _____
NAME: Robert L. Stach, P.G.
LICENSE #: 1732
DATE: 2/13/12

Structural Engineering Certification

I hereby certify that I am a registered professional engineer in the State of Florida practicing with Madrid Engineering Group, Inc. under license number EB 0006509 issued by the Florida Department of Business and Professional Regulation and the Board of Professional Engineers. I further certify that I, or others under my direct supervision, have prepared the structural engineering evaluations, findings, opinions, calculations, conclusions, or technical advice hereby represented in this report.

SIGNATURE: _____
NAME: Lennon D. Jordan, P.E.
LICENSE #: 22407
DATE: 2/10/12

Madrid Engineering Group, Inc.

Subsidence Investigation Report

Hagen Property, Hudson, Florida

Claim Number: 445670

The EARTH is our Business!℠

Prepared for:

Brian Hagen

and

Citizens Property Insurance Corporation

Prepared by:

MADRID ENGINEERING GROUP, INC.
2030 State Road 60 East
Bartow, FL 33830
863-533-9007

Project No. 9798
February 2012

CERTIFICATION TO CITIZENS PROPERTY INSURANCE CORPORATION AND BRIAN HAGEN:

Hagen Property
Subsidence Investigation
Claim No. 445670
MEG Project No. 9798

Geotechnical Engineering Certification

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SIGNATURE: _____
NAME: John E. Delashaw, P.E.
LICENSE No. 48154
DATE: 2/17/12

Geologic Certification

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SIGNATURE: _____
NAME: Robert L. Stach, P.G.
LICENSE No. : ★ 1732 PG001732
[American Institute of Professional Geologists, No. 9276]
DATE: 2/17/12

Structural Engineering Certification

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SIGNATURE: _____
NAME: Lennon D. Jordan, P.E.
LICENSE No. : 22407
DATE: 2/10/12

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FIGURES

APPENDICES

1.0 INTRODUCTION

This report presents the results of a subsidence investigation of the Brian Hagen property located at 12232 Bear Claw Loop in Hudson, Florida. According to information provided to Madrid Engineering Group, Inc. (MEG), the insured has reported cracking to the house. MEG was retained by Citizens Property Insurance Corporation to conduct a subsidence investigation at the property to determine the possible cause(s) of the cracking and specifically to identify whether or not sinkhole activity is a possible cause of the cracking within a reasonable, professional probability.

1.1 Site Location and Description

The property is located approximately 0.7 miles northeast of the intersection of US Highway 19 and State Road 52, at the location shown on **Figure 1.** The property is relatively flat to gently sloping with the house sitting at an estimated elevation of approximately 20 feet above mean sea level (msl) based upon the referenced topographic information. A portion of the USGS GIS topographic information, where the property is located, is included as **Figure 2**. Elevations reported on boring logs are approximate only; no surveying has been performed.

Specifically, the property is located in Section 3, Township 25 South, Range 16 East in Pasco County, Florida. According to the Pasco County Property Appraiser database, the parcel identification is **03-25-16-051E-00000-3140** and the legal description of the property is: **BEACON WOODS VILLAGE 3-B PB 11 PGS 41-42 LOT 314 OR 6121 PG 1559**. A copy of the database printout for this property that was obtained from the Pasco County Property Appraiser is included in **Appendix C**.

1.2 Structure Description

The structure is generally described as a single-story structure completed in 1972 and acquired by the insured in November 2004, according to the Pasco County Property Appraiser. The house was built utilizing concrete masonry unit (CMU) construction with painted stucco cladding. Portions of the structure are wood frame with painted plywood sheathing. There is a wood frame addition, (current master bedroom), with painted stucco cladding located at the back of the house. The foundation was constructed using concrete as a monolithic slab-on-grade with a thickened edge, as discussed subsequently in **Section 2.2**. The structure is geometrically rectangular with the long axis oriented north-south. There is a covered patio within an aluminum framed vinyl screen enclosure at the northeast quadrant. The addition and the garage are located along the south side of the structure. The addition extends into the garage with a CMU wall built at the northeast quadrant to create additional space for the addition bathroom. The front entry is centrally located on the west side of the structure. The homeowner reported that the house is serviced by municipal water and sewer. See **Figure 3** for a plan view of the site and improvements.

The roof system is a gable configuration constructed with manufactured roof trusses spaced 24 inches on center. Roof sheathing is CDX plywood installed with edge clips and roofing material is fiberglass composite shingles installed over asphalt impregnated felt. According to the homeowner, the roof was re-shingled prior to purchase of the house in 2004; an exact date was not known. The homeowner reported no issues with the roof, thus, a more detailed evaluation of the roof framing was determined not to be necessary. During the inspection we noted that the drip edges of the roof did not include a system of rain gutters and downspouts to divert rain water away from the foundation.

1.3 Site Inspection and Observations

On January 11, 2012, a representative of MEG conducted a site inspection and assessment of the property. The inspection and assessment consisted of preparing a Site Map **Figure 3,** documenting the condition of the structure, taking inventory of visible cracking, and obtaining a photographic record of relevant features. In addition, MEG interviewed the homeowner, completed hand auger borings, excavated test pits, and evaluated the relative soil density beneath the foundation using a hand cone penetrometer. Selected photographs follow the Photo Log, **Figure 4**.

The homeowner indicated that moisture and mold were first noticed in the addition closet within the last month prior to the site inspection. The mold was cleaned up by the homeowner. The homeowner proceeded to investigate the area outside the house near the closet and noticed cracks on the exterior wall. These cracks were at the location of the addition to main house construction joint. The homeowner also noticed cracks in the garage below the south window, on the north edge of the concrete slab (approximately four years ago), and at the garage door header joints. He also noticed cracks in the ceiling and on the wall of the addition. The exterior was last painted between four and five years prior to the site inspection while several areas of the interior have been painted as recently as the past year. Portions of some of the cracks contained paint while other portions appeared to be relatively recent. With a lack of other indicators, the exact timing of the cracking cannot be determined but some of the observed conditions appear to have formed recently, while others appear to be old and/or on-going.

The cracking observed in the addition and garage, and the moisture/mold observed in the addition closet was the homeowner's primary concern. During the inspection we noted that the most visible cracking was located within the interior and on the exterior of the addition and within the garage.

At the time of our inspection, the following conditions were observed:

Interior Observations

- There were multiple hairline cracks tracking several of the ceiling and wall drywall panel joints in the addition (master bedroom). Two cracks were observed below the window on the east wall, one crack on the south wall, as well as several on the ceiling. Some of the cracks also tracked corners joints in the ceiling. **Photo 2** shows an example of the cracking.
- There was moisture staining on the baseboard and wall in the master bedroom closet. **(Photo 3)** There also appeared to be a previously repaired section of drywall above the moisture staining.
- There was a hairline ceiling crack in the family room that had previously been patched. **(Photo 4)** There was a moisture stain observed at one location along the crack.
- There was a short vertical drywall panel joint crack above the door to the patio.
- There were two patched cracks in the ceiling in the kitchen. **(Photo 5)**
- There was a hairline ceiling crack in the front living room.
- The front door was reported as not opening properly. The door was inspected and found to have a neoprene gasket/seal on the bottom of the door that was rubbing against the floor tile when opened fully. **Photo 6** shows the condition. The door jambs and header were checked and found to be plumb and level, respectively.
- There was a hairline ceiling crack in the hallway to the guest bedrooms.
- There were cracks tracking the ceiling joints in the guest bathroom. These cracks appeared to be either aging caulk or cracking of the thick texture finish applied to the ceiling.

Garage and Driveway

- There was a weathered shrinkage crack/construction cold joint on the north edge of the garage **(Photo 7)** that was measured to be up to 3/16-inch wide at the accessible areas.
- There was a hairline vertical crack below the garage south window. **(Photo 8)**
- There were cracks tracking the construction joints of the CMU wall addition **(Photo 9)** that served as the expansion of the addition (master bedroom) bathroom.
- There were stairstep cracks ranging between hairline and 1/8-inch in width that tracked the garage door header joints. **Photo 10** shows the south header joint.

- There were multiple weathered shrinkage and wheel load stress cracks in the concrete slab of the driveway. **Photo 11** shows some of the cracking at the beginning of the driveway. There was also an additional slab on the south side that appeared to be continuous along the south side of the garage. During the site inspection stormwater was observed to be staging on the south side of the garage. **Photo 17** shows the water staging. This are is where stormwater runoff routes out and away from the subject house as well as from the adjacent house to the south. The water did not runoff sufficiently during the rainfall that occurred during the site inspection. As a general observation, the rain event that occurred during the inspection could be described as being a higher intensity, short duration event with lower intensity medium duration event at the tail end. Actual rainfall data was not researched. This appears to be the source of much of the water intrusion.

Exterior Observations

Front (West)

- There were stairstep cracks tracking the garage header joints on the west wall. **Photo 12** shows the south end of the garage door.
- There was a hairline horizontal crack that appeared to have been previously patched at the northwest corner. There was also a hairline horizontal crack at the corner that extended around to the north wall.

Left Side (North)

- There was a long horizontal crack near the bottom of the wall that was discontinuous at several points along the north wall.
- There was a short hairline stairstep crack at the northeast corner. **(Photo 13)** There was also a horizontal crack that extended around the northeast corner.

Back (East)

- There was a hairline stairstep crack below the east family room window that appeared to have been previously patched. **(Photo 14)**
- There was a vertical hairline crack tracking the addition to original structure north construction joint.
- There was a patched vertical crack at the northeast corner of the addition on the north facing wall.
- There was a meandering hairline vertical crack on the east wall of the addition at the southeast corner.

Right Side (South)

- There was a short vertical hairline crack at the approximate midpoint of the addition south wall.
- There was a hairline to slightly wider vertical crack closer to the west side of the addition on the south wall.
- There was a vertical crack tracking the construction joint on the south wall. The crack appeared to have been previously patched. **(Photo 15)**
- There was a hairline horizontal crack above the garage pedestrian door.
- There was a hairline horizontal crack to the west of the garage pedestrian door.
- There was a hairline stairstep crack that transitioned to vertical below the south garage window. **(Photo 16)**

Patio

- There was moisture staining at the house eave to low slope/flat roof joint on the south side of the patio.

1.4 Soil Survey Map Review

Soils data from the Natural Resources Conservation Service (NRCS; formerly the Soil Conservation Service, or SCS) were reviewed as part of the investigation. Based on a review of the available information, the mapped soil unit in the vicinity of the property was identified as **Candler-Urban land complex, 0 to 8 percent slopes** (map unit 36), as shown on **Figure 5**.

According to the USDA-NRCS, *Candler-Urban land complex, 0 to 8 percent slopes is described as nearly level to sloping Candler fine sand and of areas of Candler fine sand that have been altered for use as Urban land. About 45 to 65 percent of the complex is Candler fine sand. About 20 to 45 percent of the complex is Urban land. This land is covered by streets, driveways, houses and other buildings, parking lots and other similar structures. Typically, the surface layer of this Candler soil is gray fine sand about 4 inches thick. The subsurface layer consists of pale brown, brown, and light yellowish brown fine sand to a depth of about 60 inches. Between 60 and 80 inches is a very pale brown fine sand that contains lamellae of dark yellowish brown sandy loam and loamy fine sand that range from 1/16 to 1 inch in thickness and have a total thickness of about 4 inches. The water table is below a depth of 80 inches. In the upper 60 inches of this soil, the available water capacity is very low and permeability is very rapid. Below 60 inches, the available water capacity is low and permeability is rapid.*

1.5 FEMA Flood Plain Evaluation

Flood zones are geographic areas that the FEMA has defined according to varying levels of flood risk. These zones are depicted on a community's Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map. Each zone reflects the severity or type of flooding in the area. The subject residence is in Zone C which is described as an area of minimal flooding. The FIRM map is presented as **Figure 6**.

1.6 Hydrogeologic Overview

According to the Florida Geological Survey (FGS) lithologic GIS database, the property lies on the edge of mapped areas identified as **undifferentiated Quaternary Beach Ridge and Dune (map symbol Qbd), and Suwannee Limestone (map symbol Ts)**. The FGS describes the Qbd formation as undifferentiated siliciclastics of light gray, tan, and brown to black poorly consolidated variably clayey sands. Where mapped, this unit is comprised of sediments more than 20 feet thick which formed as paleo beach ridges and dunes during late Pleistocene to early Holocene epochs. According to the FGS, the Suwannee Limestone (Ts) consists of white to cream-colored variably indurated fossiliferous limestone deposited during the early Oligocene epoch. Portions of the Suwannee Limestone have been dolomitized to gray or light to moderate brown, and may have been silicified.

A review of published USGS GIS information shows the Floridan Aquifer potentiometric surface in the site vicinity to be at about 5 feet above mean sea level. A water table was not encountered in the hand auger borings and was not discernable in the samples from the surficial 10 feet of the SPT borings. As such, the vertical hydraulic gradient between the surficial water table and Floridan Aquifer could not be evaluated.

1.7 Sinkhole Database Review

In accordance with the recommended Subsidence Investigation Protocols as provided in Florida Geological Survey Special Publication 57, MEG has reviewed the Florida Geologic Survey's sinkhole database (updated May 17, 2010). That review revealed nineteen (19) reported sinkholes within approximately one mile of the subject property. It should be noted that the number of sinkholes is based on information reported to the FGS and does not necessarily reflect the number of sinkholes confirmed by public or private industry. Sinkholes reported by the FGS within one mile of the site should be considered from a regional perspective and not a site-specific perspective. While important, subsurface conditions at the specific site are more important in determining cause of damage.

2.0 GEOTECHNICAL INVESTIGATION

2.1 Hand Auger Borings

Two hand auger borings, HA-1 and HA-2, were completed during the site inspection at the locations shown on **Figure 3**. The borings were advanced to a depth of 7 feet below ground surface (bgs) using a bucket auger, and were completed in general accordance with ASTM D 1452. In general, the borings encountered light gray brown and yellow brown fine sand. A surficial water table was not encountered in these borings at the time of our investigation. Hand auger boring logs are included in **Appendix A**.

2.2 Test Pit Excavations

Five shallow test pits, TP-1 through TP-5, were excavated during the site inspection to evaluate the type and condition of the foundation beneath the structure and associated slabs. The test pit locations are shown on **Figure 3**.

- Test pit TP-1 was excavated on the east side of the addition and revealed a monolithic concrete slab on grade with thickened edge foundation and 18 inches of embedment. We noted that the top of slab elevation was estimated to be at ground surface. This was checked by measuring the height of the inside window sill to floor of 12 inches and outside bottom of window to ground surface of approximately 11 inches. This is also a water intrusion source. The finished floor elevation should be a minimum of 6 inches above grade with grade falling away from the house at 2 to 5 percent depending on exterior grade surface. There were also bricks observed adjacent to the footing. These may have been used as a plaster stop.
- Test pit TP-2 was excavated on the east side of the house and revealed a monolithic concrete slab on grade with thickened edge foundation and approximately 6 inches of embedment. There was a strip of concrete "collar" around the exterior of the house that did not appear to be included in the footing but was at or near the bottom of the slab edge elevation. See **Photo 18**.
- Test pit TP-3 was excavated on the north side of the house and revealed a monolithic concrete slab on grade with thickened edge foundation and approximately 6 inches of embedment.
- Test pit TP-4 was excavated on the south side of the driveway and revealed a 3-inch thick concrete slab on grade with full embedment.
- Test pit TP-5 was excavated on the west side of the circular driveway portion and revealed a 3.5-inch thick concrete slab on grade with full embedment.

2.3 Hand Cone Penetrometer Probes

A series of hand cone penetrometer probes were made using a Digital Static Cone Penetrometer (DSCP) at the base of the test pits to investigate soil density near and below the footing. Using correlations based on probe data collected immediately adjacent to SPT borings performed within the region and manufacturer recommendations, the penetrometer readings can provide an assessment of the relative density (SPT N-value) for sandy soils. Detailed penetrometer readings are presented with the boring logs in **Appendix A**. In general, the penetrometer indicated very loose to loose soil conditions at the base of the foundation up to a depth of 3.5 feet bgs.

2.4 Spirit Level

A spirit level was placed along the front door jambs and header to evaluate whether these elements of the structure are plumb or level. These elements checked plumb or level as is appropriate for their respective orientation.

2.5 Geophysical Survey

MEG subcontractor GeoView, Inc. completed a geophysical investigation consisting of a ground penetrating radar (GPR) survey along with a floor elevation study. The results of the surveys are summarized in a report from GeoView dated January 31, 2012. A copy of this report is included in **Appendix B** and excerpts from that report are provided below.

A GPR survey was conducted both inside and outside of the structure. The GPR survey outside of the structure was conducted along a series of perpendicular transects spaced 10 ft apart. The GPR survey was performed in the inside areas of the home that were accessible (Figure 1 in **Appendix B**).

Results of the GPR survey indicated the presence of a well-defined, relatively continuous set of GPR reflectors at an approximate depth range of 8 to 13 ft bls. This GPR reflector set is below the depth of the hand auger borings, and accordingly cannot be correlated to any lithological contact. However, the reflector set is most likely associated with some change in lithological conditions at that depth range.

Two GPR anomaly areas were identified around the exterior of the residence. The anomaly areas are designated as GPR Anomalies 1 and 2 on Figure 1 in **Appendix B**. *The anomalies are numbered in order of significance with GPR Anomaly 1 being the most significant and GPR Anomaly 2 being the least significant. A description of each of the anomalies is as follows:*

GPR Anomaly 1 is elliptical in shape with total area of approximately 150 square ft. The anomaly is located south of the residence. The apparent vertical relief of the upper portion of the anomaly area is 3 to 4 ft as characterized by the observed downwarping of the GPR reflector set. A localized increase in the depth of penetration of the GPR signal was also observed within the anomaly area. The apparent center of the feature is characterized as the area of maximum downwarping of the previously referenced GPR reflectors.

GPR Anomaly 2 is irregular in shape with total area of approximately 650 square ft. The anomaly is located east of the residence. The apparent vertical relief of the upper portion of the anomaly area is 1 to 2 ft as characterized by the observed downwarping of the GPR reflector set. A localized increase in the depth of penetration of the GPR signal was also observed within the anomaly area. The apparent center of the feature is characterized as the area of maximum downwarping of the previously referenced GPR reflectors.

2.6 Floor Elevation Study

A floor elevation study was conducted by GeoView, Inc. to evaluate the relative variation in elevation of the concrete slab of the structure. Floor elevation measurements were collected on an approximate 5-foot by 5-foot grid system. Changes in the flooring material were recorded and two readings were collected across areas where these changes occurred. This was done to determine the necessary correction to account for a change in floor elevations due to changes in floor coverings. Floor elevations of garages, attachments, sunken rooms and/or elevated rooms were measured and treated independently from the main floor elevation. A base station was established and elevation readings were collected at the beginning and end of the study.

The results of the elevation study of the accessible portions of the main floor of the house found a total differential of 1.5 inches between the low area, in the southeastern portion of the home and the highest area in the southwestern portion of the home. The bedroom addition was found to slope a maximum of 0.7 inches to the south. The screened patio was found to slope a maximum of 1.8 inches to the north. The accessible portions of the garage sloped a maximum of 1.3 inches toward the southwestern corner. Results of the floor elevation study are presented as Figure 2 in **Appendix B**.

2.7 Standard Penetration Test Borings

Four standard penetration test (SPT) soil borings, SPT-1 through SPT-4, were completed on January 23, 2012, using the mud-rotary drilling method. Soil samples

were collected from the boreholes in general accordance with ASTM D1586 using a 1.4-inch I.D. split-spoon sampler driven with a 140-pound slide hammer falling a distance of 30 inches.

Boring SPT-1 was located within GPR anomaly 2 and was completed to a depth of 55 feet bgs. Boring SPT-2 was located at the southwest corner of the garage and was completed to a depth of 30 feet bgs. Boring SPT-2 was originally intended to be completed within Anomaly 1; however the main utility corridor and close adjacent property line necessitated relocation of the boring. Boring SPT-3 was located at the northwest building corner and was completed to a depth of 40 feet bgs. Boring SPT-4 was located at the northeast corner of the house and was completed to a depth of 75 feet bgs. Boring SPT-4 was terminated at 75 feet due to repeated sloughing of the borehole and multiple re-drilling at depths of up to 30 ft. The locations of the SPT borings are shown on **Figure 3**.

Soil samples collected from the SPT borings were placed in sealed containers and returned to MEG's laboratory for examination, classification in accordance with the USCS (United Soil Classification System - ASTM D2487), and selected laboratory testing. Upon completion, each borehole was filled from bottom to top with cement grout and bentonite chips. Soil boring logs are included in **Appendix A**.

3.0 SUBSURFACE CONDITIONS

In general, the SPT borings encountered very loose sand from the surface to a depth of 10 feet bgs. Underlying this sand unit was very loose to medium dense sand to depths ranging between 17 to 75 feet bgs. Below this layer, boring SPT-1 encountered very soft to soft clay while boring SPT-3 encountered loose clayey sand. Borings SPT-1 through SPT-3 encountered medium dense limestone at depths ranging between 17 and 39 feet. Boring SPT-4 did not encounter limestone and terminated in medium dense sand at 75 feet. SPT-4 encountered a low density interval in the form of a fast-drop, 3-foot weight-of-rod (WOR) at the 43.5 to 45 sample interval with a loss of drilling fluid circulation above at 38.5 feet. Boring SPT-1 encountered a 6-inch weight-of-rod followed by 18-inch weight-of hammer (WOH) at the 33.5 to 35 foot sample interval. This was followed by a 6-inch weight-of-rod in the seating interval at the subsequent sampling depth.

A water table was not discernable in the samples obtained within the surficial 10 feet of the SPT borings. A loss of drilling fluid circulation was noted in each of the borings.

4.0 CONCLUSIONS

At the time of the inspection the owner's primary concern was the cracking observed in the addition and garage, and the moisture/mold observed in the addition closet. It is MEG's opinion that the conditions and minor cracking observed are the result of multiple causes as discussed in detail below. All of the conditions observed can be attributed to causes other than sinkhole activity. However, based on the results of the SPT boring program, MEG cannot eliminate the possibility that sinkhole activity may also be a contributing factor to some of the conditions observed within a reasonable professional probability.

Our conclusions are based on the following:

1. The moisture problem in the closet appears to be the result of a finished floor elevation that is not sufficiently above existing grade which is allowing moisture entry at the wall to slab joint. In addition, water stages on the south side of the house due to poor grading and drainage patterns which appears to be the main source of moisture intrusion.

2. The cracking observed at the time of the inspection is not indicative of significant distress. Most homes, and especially masonry structures, exhibit minor cracking due to various factors. The amount of cracking tends to increase in direct relation to the age of the home. The causes of minor cracking are often a reflection of a multitude of small factors. Among these are differential settlements caused by slight variations in loading (e.g. walls supporting different sections of roof, concentrated loading points either side of windows and doors, and corners, etc.); normal shrinkage of masonry materials; differential contraction of mortar and concrete; thermal expansion-contraction; and small variations in soil types. Also, shrinking and swelling of wood products caused by changes in humidity have also been implicated in affecting sensitive finishes such as interior drywall on wood frame partition or stucco on wood frame exteriors. A combination of all these factors results in minor flexure and fatigue of the materials. Frequently, there is no discrete time of failure. The stress and fatigue simply accumulate over time until the stress exceeds the strength of the material and results in the "sudden" appearance of a crack. Once a crack has formed, it serves as a weak point where additional movement is manifested. In short, minor cracking is a normal and natural "aging" process of any structure.

3. Based on ASTM C 926 for CMU structures and depending on the application method selected, stucco should be applied in at least two coats, and typical

thickness is expected to be from 1/2 to 5/8 inch, with a finish coat of 1/4 inch thickness, or more. Installation of stucco cladding on wood frame shall comply with ASTM C 1063, according to the Florida Building Code, which describes proper procedures for installing exterior lathing, framing, and cladding. Since this residence features both CMU and wood framing, both standards apply.

Stucco cracking on both CMU and wood frame structures is fairly common because of failure to follow these procedures. There are three main contributing causes for this cracking.

One is thermal expansion and contraction; all materials have a thermal coefficient of expansion which controls the amount of expansion the material undergoes in response to changes in temperature. Stucco on a wood frame expands and contracts at a different rate to that of the wood frame. The same is true for stucco cladding on CMU. This differential expansion creates stress which may lead to cracking. Control joints should be installed at least every 144 square feet because cementitious cladding such as stucco will expand and contract at a different rate than the substrate and provisions for this movement must be provided in the form of control (expansion) joints. Control joints should also be installed where different framing materials connect such as where a wood frame wall connects to CMU. We noted no control joints on this residence.

A second factor, for wood framed structures in particular, is that of humidity since wood will expand and contract in response to changes in humidity or moisture whereas the stucco is not affected as much. This differential movement will also often lead to cracking. Weep screeds should be installed at the bottom of the application as plaster stops and allow incidental moisture that penetrates the cladding to drain out through the bottom and not collect within the assembly. Water intrusion into the stucco will cause corrosion of the metal lath that then leads to cracking of the stucco itself. Proper stucco application requires two layers of grade D or equivalent paper to be applied over the wall sheathing prior to installation of the metal lath and this serves as the secondary drainage plane for the exterior wall. Also, it is important to stop stucco cladding approximately 2 inches above shingles or other water shedding surfaces so as to not splash water up into the stucco which can also cause metal lath to corrode. We did not detect weep screeds at any location on this residence.

A third factor, for wood framed structures, is that stucco is brittle while wood is much more flexible; the wood frame will bend or flex slightly to pressure such as that caused by wind loads. It is for this reason that stucco cladding should be applied

more thickly over wood framing than when applied directly to CMU. The brittle stucco will not be able to mimic the bending of the wood support and will crack as a result so a stiffer section is desired. Normally, stucco is applied in 3 coats, consisting of a scratch coat followed by a brown coat and then a finish coat, for a total thickness of 7/8 inch. There are requirements for mix formulas on each coat, as well as proper hydration of the applied coating between coats and verification of proper pH between coats to ensure compatibility between coats and finishes. The Florida Building Code specifies no fewer than 2 coats and a minimum total thickness of 7/8 inch for stucco cladding over wood frame. It is important in cases of stucco on wood frame structures that any cracks which do form be sealed to prevent insect and additional moisture infiltration which will aggravate the cracking by causing the metal lath to corrode. Also, moisture intrusion into interior wall cavities in the wood framing can lead to mold and mildew formation.

Stucco cladding thickness for this residence was not measured, but is estimated to be less than 1/4 inch based on observations made while completing the test pits. This condition can be aggravated by an aging and weathering paint film which was also observed. Paint serves as the primary moisture barrier. As it weathers, its moisture shedding properties diminish and water is allowed to penetrate into the underlying substrate; in this case, stucco plaster. Without proper weep screeds and drainage channels, entrained moisture can only escape the plaster matrix by evaporation and concentrates at the mortar joints causing them to darken and emphasizes their presence. Entrained moisture also accelerates weathering of the paint film as it attacks the paint from the underside.

All of the cracking observed in exterior stucco cladding on this residence is hairline, unfocused, discontinuous, widely dispersed, and completely random. All of the cracking observed in exterior stucco cladding appears to be confined to the cladding itself and is not being propagated from physical movement of the structure to which it is applied. It is consistent with simple shrinkage cracking from expansion and contraction due to thermal forces.

4. As noted in the geology discussion, the house is located in an area mapped as ancient sand dunes formed in a geologic time when shorelines were different from the modern setting. Sand dunes are windblown deposits of very loose sand. As anyone who has ever walked on sand dunes along the shore line knows, the sand is very loose. The surface morphology and the density of the surficial sand are consistent with the geologic map prepared by the Florida Geological Survey. All of the soil borings completed at this site indicate the presence of very loose sands in the surficial 10 feet where the majority of the structural load is dissipated. SPT "N-

Values" ranged from 2 to 4 blows per foot with an average of 3 blows per foot. Very loose sands like this would be expected to undergo long-term settlement and densification under a structural load. This densification would result in minor cracking as seen in this case. It is anticipated that some slight settlement due to soil densification may still occur in the future.

5. The house does not have gutters to route rain runoff down from the roof and away from the foundation. Rain impacting near the foundation, where no other source of erosion protection or surface water routing exists, will cause two problems. First, the impact of the roof runoff will splash and erode soil away from the foundation, often forming a depression and reducing the amount of embedment and the stability of the foundation. Second, concentrated runoff near the foundation will accelerate densification of the loose soils present on this property leading to differential settlement and cracking. The Florida Building Code requires that where downspouts or other rainwater collection devices impact the ground, provision be made to prevent erosion and direct the water away from the foundation. Such provision has not been made to prevent erosion or direct the flow away from the structure.

6. Another factor to consider for older structures is general fatigue or strength loss of the various materials used. Typical residential construction utilizing masonry and/or wood frame materials rely on the strength of the various materials and; what may be more important, the connections between these various materials, to maintain the original robust nature of the structure. Whether made with nails, screws, mortar, adhesives or other types of materials, connections between various structure components will fatigue over time. The result of fatigue is a general increase in small failures that manifests itself as apparent distress over time, and requires an increased maintenance regimen or material replacement. As a structure ages, these factors make it more susceptible to minor deflections, vibrations, impacts, and so forth. Accordingly, a condition or circumstance that may have occurred numerous times before without distress may now more easily cause noticeable distress to the structure. The cracking distress found at the time of the inspection is, in our opinion, typical and would be considered within accepted tolerances for a structure of this age and method of construction over similar soil conditions.

7. The minor ceiling cracks noted at the time of the inspection are a typical part of the aging of a home. The ceiling is not a structural (load bearing) element of the home. The ceiling is attached to the bottom chord of the trusses or ceiling joists in a conventionally framed roof system. The roof framing system is typically wooden construction and trusses are manufactured off site. Part of the engineering design for modern trusses typically includes allowance for vertical and horizontal deflections

However, as stated, the WOH was in clay which is not uncommon. The interval above the clay consisted of sand with a very loose relative density which begins at what could be interpreted as systematic weakening.

Boring SPT-4 encountered sand from the ground surface to the termination of the boring at 75 feet. The boring was terminated due to repeated sloughing of the borehole at depth with the borehole having to be re-drilled multiple times for sampling. There was a fast, 3-foot WOR at the 43.5 to 45 sample depth with a loss of drilling fluid circulation above, and apparent associated systematic weakening of soils above the low density interval. Based on this combination of associated indicators, it is MEG's opinion that sinkhole activity cannot be eliminated as a possible contributing factor to some of the conditions observed within a reasonable professional probably.

16. Based on a review of the data obtained during this investigation, including photographs, field notes, interview with the inspecting engineer, and other available information, the minor cracking and other finish flaws are determined to be cosmetic in nature and non-structural. We conclude that there is no structural damage; the integrity of the structural system as a whole or an individual structural component has not been compromised; and, there is no threat or imminent danger of collapse.

The borings completed on site did not encounter evidence of other common causes of differential movement such as shrink/swell clay, organic soil and/or buried debris.

5.0 STABILIZATION MEASURES

Because sinkhole activity cannot be eliminated as a potential factor to of some of the conditions observed at the property within a reasonable professional probability, Madrid Engineering Group has been requested to provide a stabilization plan to minimize the potential for future structural damage resulting from sinkhole subsidence. MEG has evaluated underpinning and low mobility grouting as possible stabilization measures. It is our opinion that the most effective stabilization is a program consisting of a combination of low mobility fill grouting and pressure grouting to fill voids or loose rock in the upper portion of the limestone, densify loose and soft soils overlying the limestone surface, and prevent overlying soils from raveling into the limestone. We also recommend that a polyurethane grouting program be implemented to stabilize the very loose to loose surficial soils immediately beneath the footing. Because the floor slab is sufficiently level, the cracking is minor, and the damage is not structural in nature, MEG has determined that lifting or underpinning is not required.

5.1 Low-Mobility Grouting

The low mobility grouting program should consist of a series of angled and vertical injection points installed to the rock surface to adequately treat the very soft soils above the limestone unit. Grout points should initially be installed on nominal 8 foot centers around the perimeter of the structure (**Figure 7**). Angled points shall only be injected after the vertical points on either side have been injected. A low-slump (less than 4 inches) grout should be utilized to fill voids in the limestone and compact soft/loose soils above the limestone. A copy of recommended specifications for the low mobility grouting program is included in **Appendix E.**

Based on data collected from the SPT borings, the top of competent limestone occurs at an estimated average depth of approximately 48 feet bgs but the depth to limestone is highly variable, ranging from 17 feet to greater than 75 feet. Grout injection points in the area of boring SPT-4 should be anticipated to be advanced to 75 feet bgs or deeper.

The intent of the low mobility grouting program is to seal off pathways to the top of the limestone and densify soft sediments over the limestone. MEG also notes that the grouting program may impact any wells in the immediate vicinity of the work. Depending on a host of variables, this impact may range from simply a period of slightly cloudy and or sandy water or, rarely, to sealing off the well entirely.

5.2 Chemical / Polyurethane Grouting

Low mobility grout injection generally stops at a depth of 10 feet or more below the ground surface because of the risk of heaving the ground surface or structure. Although there may be some benefit, the low mobility grouting program does not greatly increase the density of the soils above 10 feet depth. Because the SPT borings indicate the presence of very loose soils within the zone of influence of the foundation, MEG recommends a shallow grouting program using polyurethane injection to stabilize the very loose soil conditions immediately below the perimeter footings of this structure.

The polyurethane grout pattern will generally be on a 3- to 4-foot spacing (approximate) and multiple levels below the ground, likely between 3 and 6 feet bgs as shown on **Figure 7**. The actual spacing and depths will be determined on site. A copy of recommended specifications for the polyurethane grouting program is included in **Appendix E.**

5.3 Project Quantities

The highly variable subsurface conditions and large interval of soft sediments encountered in the SPT borings at this site make estimating grout quantities difficult.

Based on conditions encountered in the SPT borings and MEG's experience, we estimate the quantity of grout to range from 230 to 380 cubic yards. It is believed that the quantity estimate provided may be slightly conservative; however, we also recognize the potential for quantity overruns when stabilizing such subsurface conditions.

Estimated Contractor Bid Quantities	
Mobilization	1 each
Drill Casings	1,570 Linear Feet
Low Mobility Grout	380 Cubic Yards
Mobilization for Polyurethane Grout, Installation of Injection Casings, and Initial 500 lbs of Poly-Grout	1 lump sum
Additional Polyurethane Grout	1,700 pounds

We estimate the cost for this stabilization, excluding engineering monitoring of the contractor's activities and any cosmetic repairs, to be approximately $127,000. The quantities were estimated based on our investigation at the site, and experience with similar projects in the west central Florida area. Final project costs and quantities may differ from the estimate based on competitive bidding, any modifications during implementation, varying soil and rock conditions, etc. In order to ensure the stabilization program is properly bid according to the written specifications, we recommend MEG review all bids prior to award. It is recommended that only contractors with demonstrated experience with the particular nature of the work being provided be selected to perform the work. In addition, we recommend that MEG be retained to provide project monitoring and oversight services during the grouting operations. Estimates for engineering monitoring will be furnished upon request. At least two weeks notification is required to schedule monitoring services.

5.4 Recommended Post-Grouting Delay Period

The low mobility grout stabilization involves injection of materials at high pressures below the ground surface that not only fills voids, but also results in displacement and/or densification of the existing below grade soil materials. The injection of grout at very high pressures also causes the ground to move or shift near the surface which can introduce new stresses into the structure. Generally, the soil and rock will typically have an initial movement during/immediately after grouting, and then there are residual stresses that are relieved more slowly over time. Because there is so much variability in the limestone and overlying soils, the residual pressures likely vary widely across a site, as does the time to relieve these pressures. After grout injection is

complete and as the high pressures equilibrate over time, the various materials in both the ground and the structure will shift, reconfigure, and cure. During this process, there remains the opportunity for minor differential movements of the structure which can result in additional minor cracking.

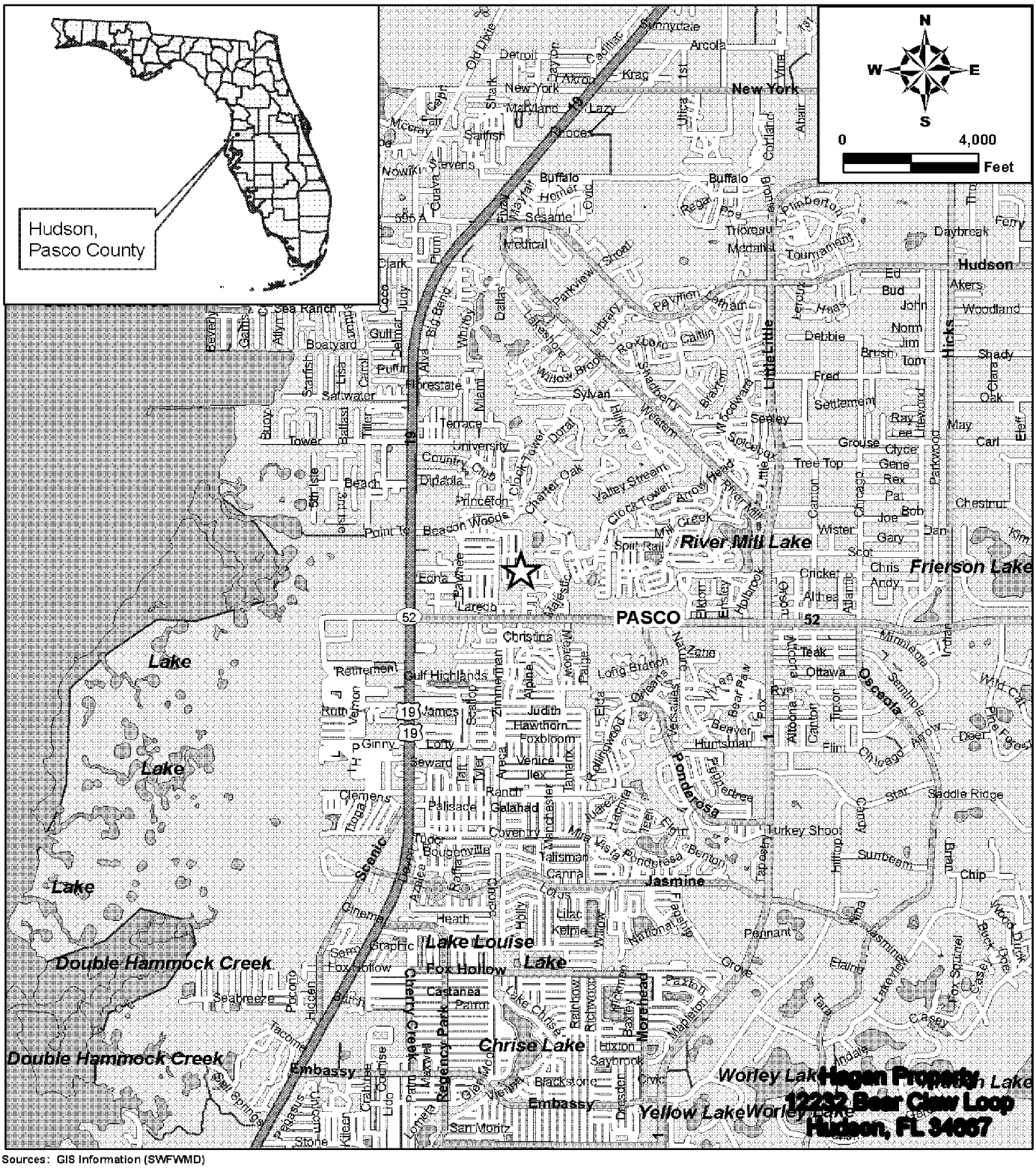
In an effort to minimize the potential for performing cosmetic repairs repeatedly due to ongoing cracking related to this phenomenon, a "cure period" is often recommended prior to initiating cosmetic repairs; this cure period usually varies from about one to three months. MEG recommends a minimum of two months following completion of low mobility grout injection prior to initiating cosmetic repairs. Since chemical grouting is also to be performed, MEG recommends a minimum delay period of two weeks after low mobility grouting prior to beginning the chemical grouting program. Other repairs that are not subject to damage associated with minor differential settlements may be performed earlier at the discretion of the insured. We also recommend that the cracking on the exterior walls of the house be patched with an appropriate sealant, and the exterior walls be repainted as necessary to help prevent the intrusion of moisture and insects. Gutters should also be installed along the drip edges of the roof, and outfitted with downspouts and extensions to divert rainwater away from the foundation.

It should be noted that the stabilization plan is intended to address and stabilize sinkhole activity near the primary structure. As discussed in **Section 4.0** above, there are other proximate causes for the cracking and other conditions observed. These factors will remain after the stabilization construction is complete and may still result in future cracking. It should also be noted that implementation of the stabilization program may result in cosmetic damage where none presently exists.

6.0 LIMITATIONS

The findings herein are based on the field exploration program conducted at the referenced site and our professional judgment. The soil conditions described within this report are accurate with respect to the location and vertical extent that the soil borings were completed. Boundaries between sediment types shown on the boring logs should be considered approximate as transitions may occur between samples collected. Because soils vary from place to place, and with depth, subsurface conditions different from those encountered in our exploration may exist. *To the best of our knowledge and belief, the analysis described in this report is of sufficient scope to either identify or eliminate sinkhole activity as a potential contributing cause of the conditions observed within a reasonable professional probability as stated herein. This investigation was completed in accordance with Florida law and complies with the minimum standards as*

specified in Florida Statute 627.707 and Florida Geological Survey Special Publication No. 57. The information in this report is intended for the sole use of the addressees and may not be relied upon, used by, or referenced by any third party. In the event conclusions and/or recommendations based on our data are made by others, such conclusions and/or recommendations are not our responsibility unless we have been given an opportunity to review and concur with them. MEG reserves the right to revise or update any of the observations, assessments, and/or recommendations as additional information becomes available or conditions change. No warranty regarding this investigation or the effectiveness of any stabilization measures presented is intended, nor should any be inferred.



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Citizens Property Insurance

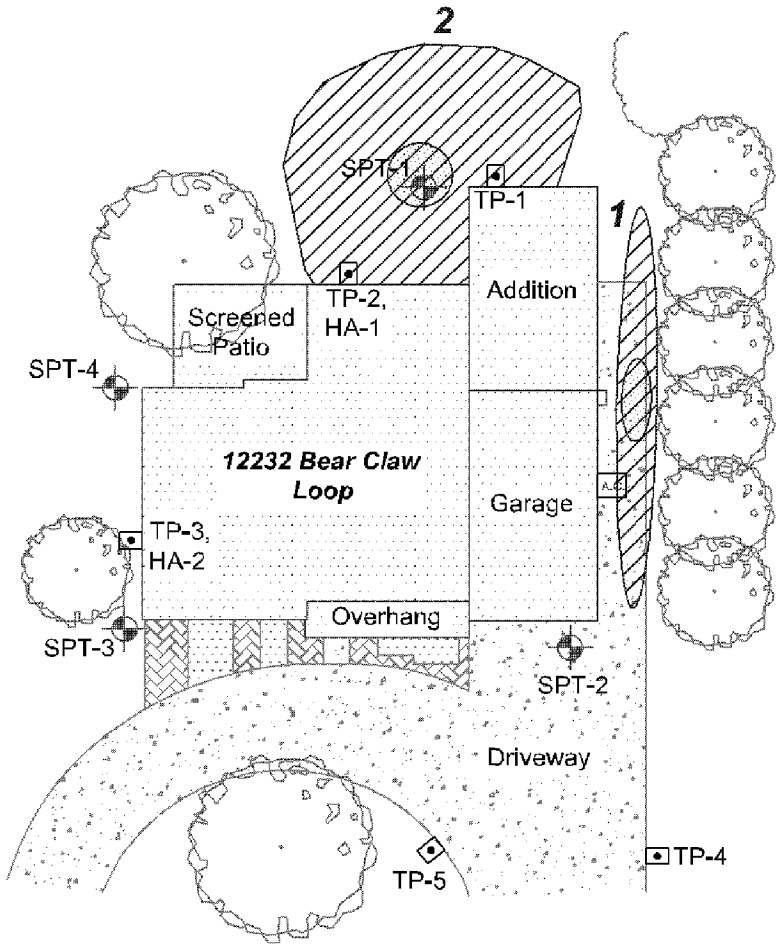
FIGURE 1
Location Map
Hagen Property
Hudson, Florida

MEG Project Number
9798

Notes:

Drawn By: BJN

Checked By: JED



Legend	
1	GPR Anomaly
TP-1, P1, HA-1	Test Pit, DSCP, Hand Auger Location
SPT-1	SPT Boring Location

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FIGURE 3
Site Map
Hagen Property
Hudson, Florida

Notes:	Drawn By: CG	Checked By: JA	Date: Feb. 2012	MEG Project Number 9798

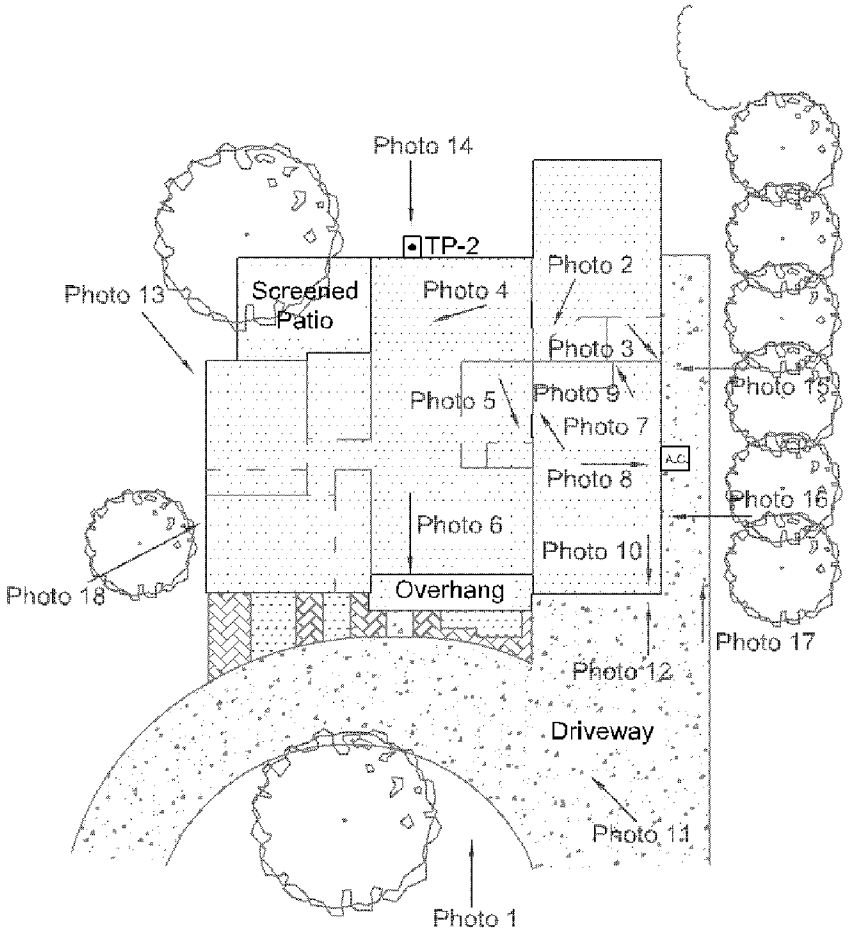

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FIGURE 4
Photo Log
Hagen Property
Hudson, Florida

Notes: Photo locations not to scale	Drawn By: CG	Checked By: JA	Date: Feb. 2012	MEG Project Number 9798

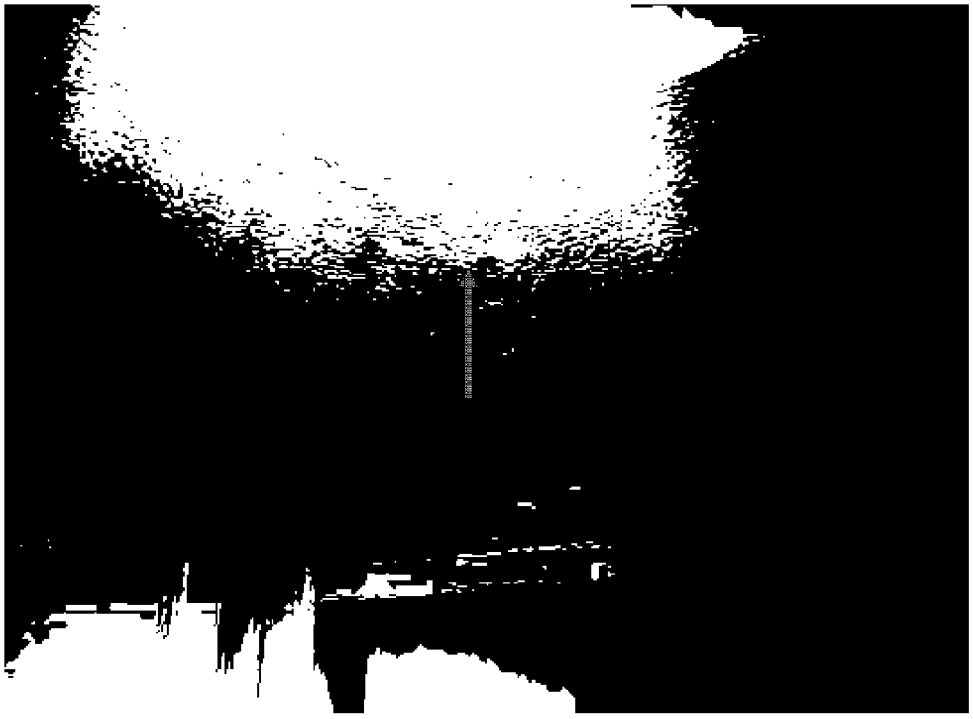


Photo 5 Patched Ceiling Crack (Kitchen)

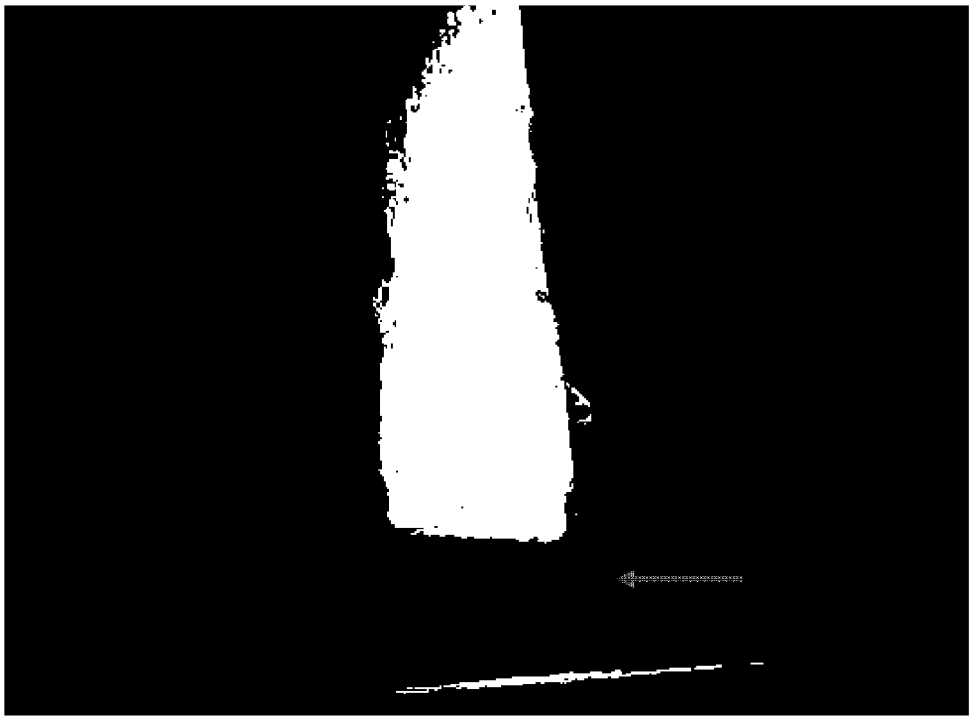


Photo 6 Front Door Stop/Seal Rubbing Tile

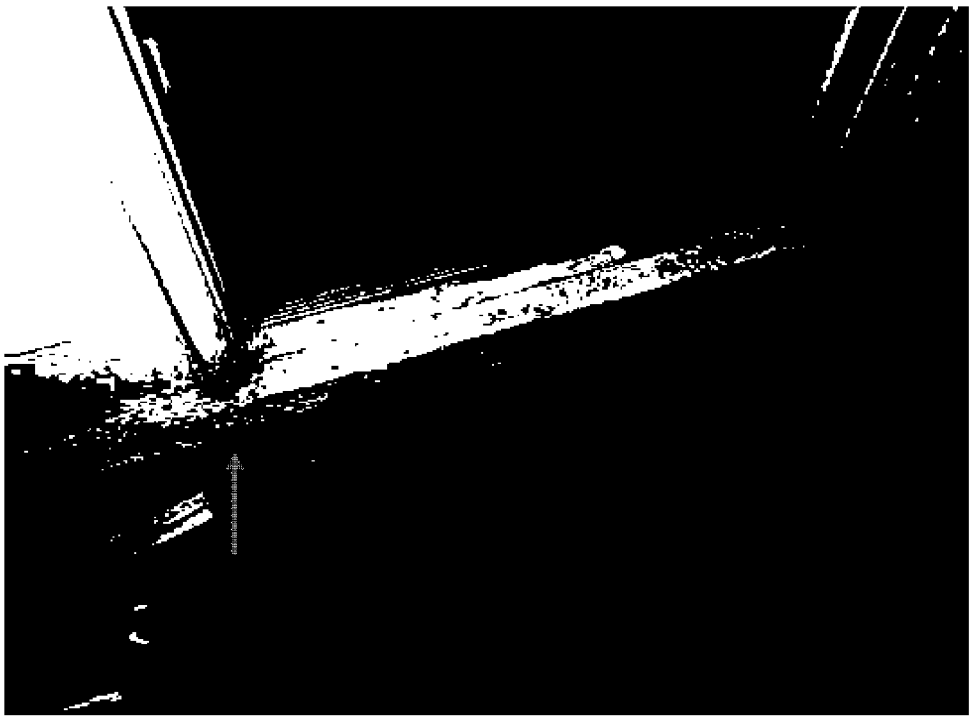


Photo 7 Weathered Crack in Garage Slab

Photo 8 Vertical Crack below Garage Window

Photo 17 Water Staging on South Side of Garage

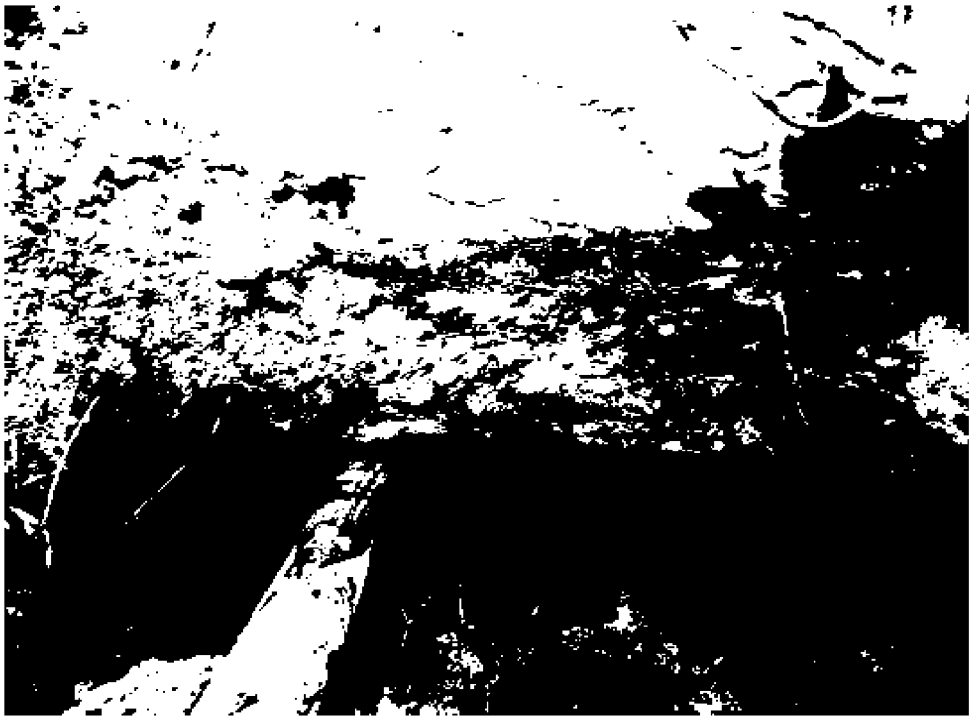
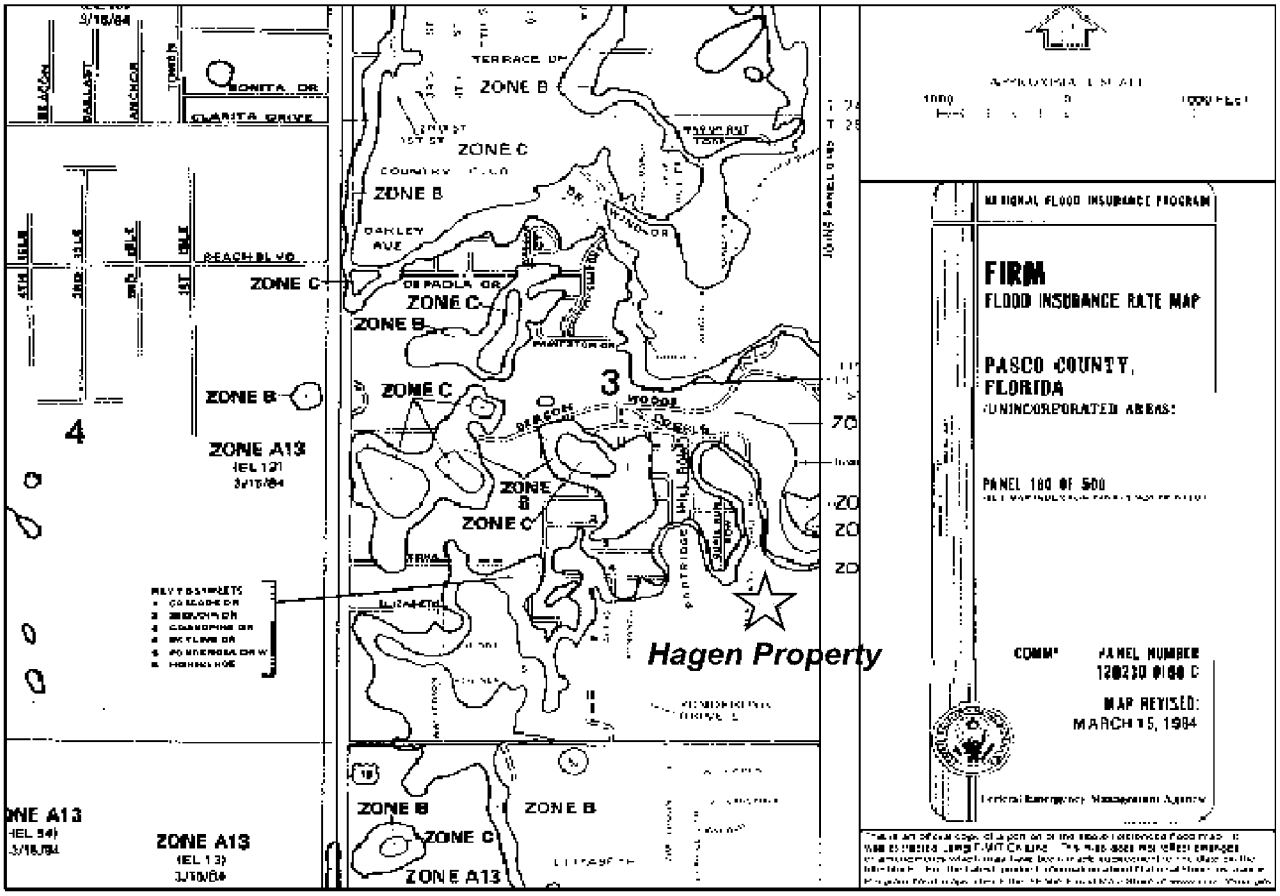


Photo 18 Test Pit TP-3



NOT TO SCALE SOURCE: map1.msc.fema.gov FIRM # 1202300180C

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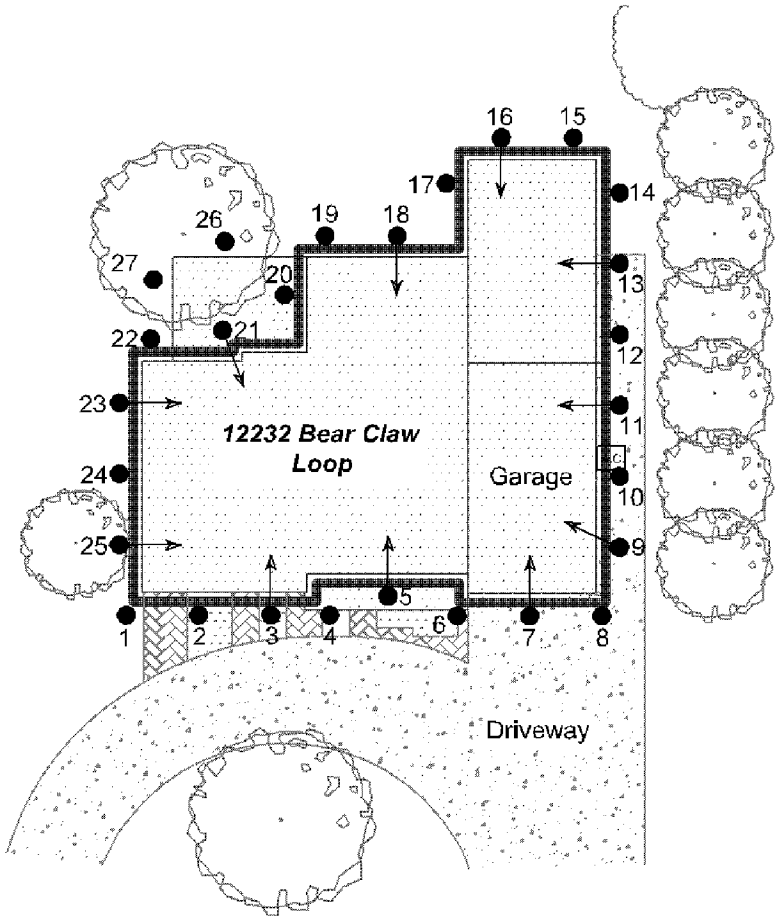
FIGURE 6
FEMA Flood Hazard Zone
Hagen Property
Hudson, Florida

MEG Project Number
9798

Notes: NOT TO SCALE | Drawn By: CG | Checked By: JA



Note: Based on soil boring information,injection points in the area of SPT-4 will likely extend to 75 feet below ground surface and may extend deeper.Angle points are generally installed at 15 degrees from vertical unless otherwise noted. It is the responsibility of the contractor to inspect the site and raise any issues with access/pricing prior to bid submission.

Legend

- Injection Point
- Angled Injection Point
- Poly Grout Extent

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FIGURE 7
Stabilization Plan
Hagen Property
Hudson, Florida

Notes:	Drawn By: CG	Checked By: JA	Date: Feb. 2012	MEG Project Number 9798

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DIGITAL STATIC CONE PENETROMETER PROBE DATA

Project Name: Hagen Subsidence Investigation
Project Location: Hudson
Claim Number: 445670 / FRJH1351258
Client: Citizens Property Insurance Corporation

Project Number: 9798
Date Tested: 11-Jan
Completed By: JA

Probe No.	P-1	
Location:	Test Pit 1. 3 ft. South of NE addition corner.	
Depth (in)	**Max. Resistance (kg/cm^2)**	**Equivalent SPT N**
0 - 6	4	1
6 - 12	9	2
12 - 18	13	3
18 - 24	14	4
24 - 30	13	3
30 - 36	16	4
36 - 42	19	5
42 - 48		

Probe No.	P-2	
Location:	Test Pit 2. 4.5 ft. south of patio/house joint, east wall of house.	
Depth (in)	**Max. Resistance (kg/cm^2)**	**Equivalent SPT N**
0 - 6	17	4
6 - 12	20	5
12 - 18	20	5
18 - 24	19	5
24 - 30	17	4
30 - 36	15	4
36 - 42	16	4
42 - 48		

Probe No.	P-3	
Location:	Test Pit 3. 9 ft. east of NW corner.	
Depth (in)	**Max. Resistance (kg/cm^2)**	**Equivalent SPT N**
0 - 6	19	5
6 - 12	40	10
12 - 18	Refusal	
18 - 24	Possible	
24 - 30	Root	
30 - 36		
36 - 42		
42 - 48		

Probe No.	P-4	
Location:	Test Pit 4. 26.5 ft. west of garage, south edge of driveway	
Depth (in)	**Max. Resistance (kg/cm^2)**	**Equivalent SPT N**
0 - 6	16	4
6 - 12	Term	
12 - 18	Possible	
18 - 24	Util or	
24 - 30	other	
30 - 36	obstruction	
36 - 42		
42 - 48		

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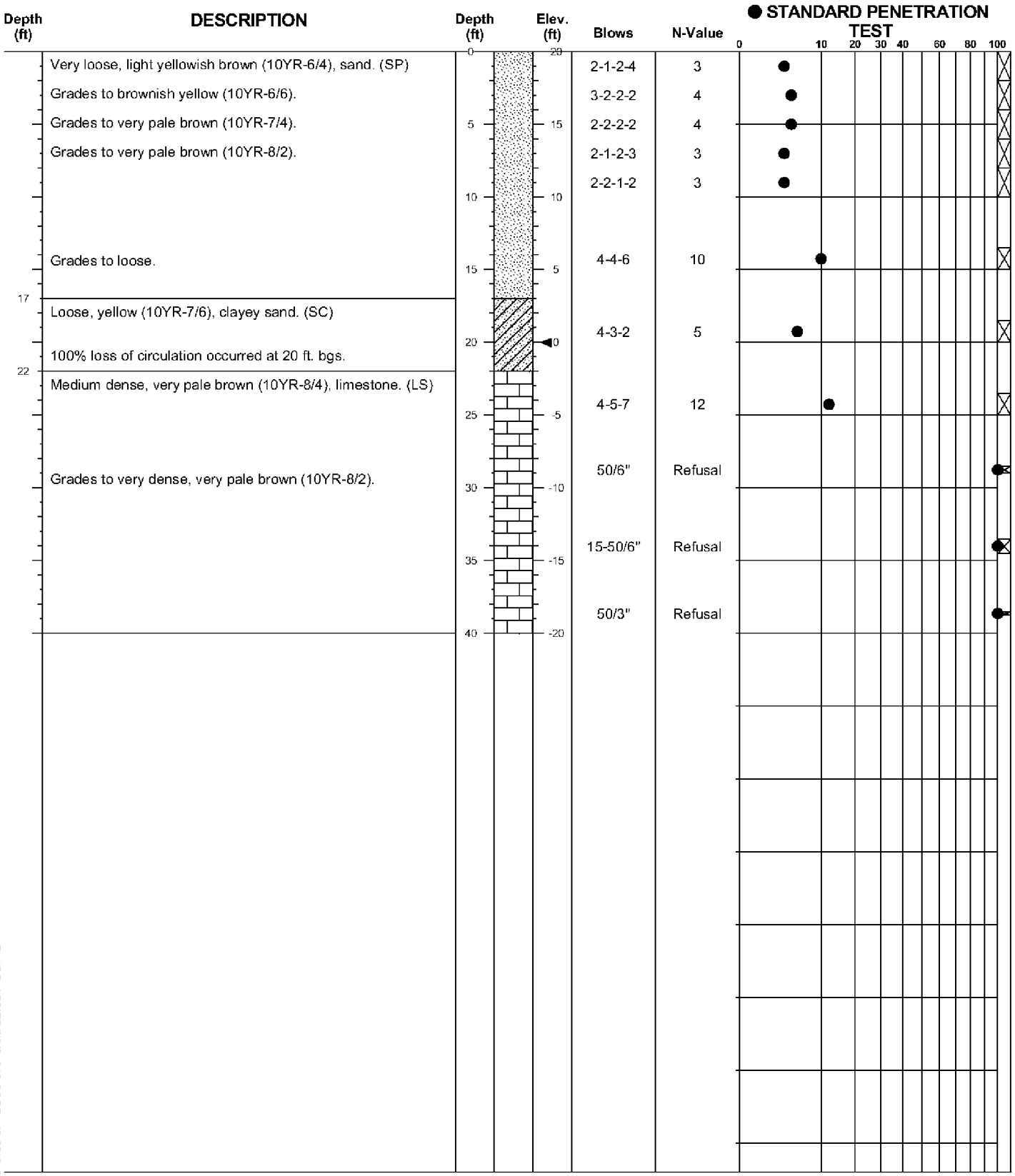
DIGITAL STATIC CONE PENETROMETER PROBE DATA

Project Number: 9798
Date Tested: 11-Jan

Probe No.	P-5	
Location:	Test Pit 5. 25 west of garage west edge of circle drive.	
Depth (in)	**Resistance (kg/cm^2)**	**Equivalent SPT N**
0 - 6	19	5
6 - 12	24	6
12 - 18	41	10
18 - 24	Refusal	
24 - 30		
30 - 36		
36 - 42		
42 - 48		



MEG WITH BLOW COUNTS 9798 SPT LOGS GPJ SAMPLE.GDT 2/21/12

BORING LOCATION: 1 ft. W by 2 ft. N of NW corner of house.

BORING NUMBER	SPT-3
DATE DRILLED	1/23/2012
PROJECT NUMBER	9798
PROJECT	Hagen Property
PAGE 1 OF 1	

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TEST BORING RECORD
Madrid Engineering

REMARKS: 100% loss of circulation occurred at 20 ft. bgs. A discernible water table was not encountered.

1.0 Introduction

A geophysical investigation and a floor elevation study were conducted at the Hagen residence located at 12232 Bear Claw Loop in Hudson, Florida. The investigation was performed on January 11 and January 13, 2012.

The purpose of the geophysical investigation was to help characterize near-surface geological conditions in the area of the residence and to identify subsurface features that may be associated with sinkhole activity. The purpose of the floor elevation study was to determine the relative elevation of the concrete floor in the home. The location of the geophysical survey area is provided on Figure 1. The location of the floor elevation study is provided on Figure 2. A discussion of the field methods used to generate the report figures is provided in Appendix A2.1.

2.0 Description of Geophysical Investigation

2.1 Ground Penetrating Radar Survey

A GPR survey was conducted both inside and outside of the residence. The GPR survey outside of the residence was conducted along a series of perpendicular transects spaced 10 ft apart. The GPR survey was performed in the inside areas of the home that were accessible. The locations of the GPR lines are shown on Figure 1. The GPR data was collected with a Mala radar system. The GPR settings used for the survey are presented in Table 1.

Table 1
GPR Equipment Settings Used for Exterior and Interior GPR Surveys

Location	Antenna Frequency	Time Range (nano-seconds)	Estimated Depth of GPR Signal Penetration
Exterior	250 MHz [1/]	227	20 to 25 ft bls
Exterior	500 MHz	100	12 to 15 ft bls
Interior	500 MHz	100	11 to 14 ft bls

1/ MHz means mega-Hertz and is the mid-range operating frequency of the GPR antenna.

A description of the GPR technique and the methods employed for geological characterization studies is provided in Appendix A2.2.

2.2 Floor Elevation Study

Floor elevation measurements were collected on an approximate 5-foot by 5 foot grid system. Changes in the flooring material were recorded and two readings were collected across areas where these changes occurred. This was done to determine the necessary correction to account for a change in floor elevations due to changes in floor coverings. Floor elevations of attachments, sunken rooms and/or elevated rooms were measured and treated independently from the main floor elevation. A base station was established and elevation readings were collected at the beginning and end of the survey. The floor elevation study was conducted in accordance with Florida Geological Survey Special Publication 57. A further discussion of the methods used for the floor elevation study is provided in Appendix A2.3.

2.3 Hand Auger Boring

Several hand auger borings were performed at the project site by Madrid personnel. The purpose of the hand auger borings was to obtain information regarding near-surface soil conditions. This information was used to assist in the interpretation of the GPR data. The general results are presented in Table 2.

Table 2
Hand Auger Results

Depth Interval	Soils Description
0 to 7 ft bls	Sand

3.0 Identification of Possible Sinkhole Features Using GPR

The features observed on GPR data that are most commonly associated with sinkhole activity are:

- A downwarping of GPR reflector sets, that are associated with suspected lithological contacts, toward a common center. Such features typically have a bowl or funnel shaped configuration and can be associated with a deflection of overlying sediment horizons caused by the migration of sediments into voids in the underlying limestone. If the GPR reflector sets are sharply downwarping and intersect, they can create "bow-tie" shaped GPR reflection feature, which often designates the apparent center of the GPR anomaly.

- A localized significant increase in the depth of the penetration and/or amplitude of the GPR signal response. The increase in GPR signal penetration depth or amplitude is often associated with either a localized increase in sand content at depth or decrease in soil density.
- An apparent discontinuity in GPR reflector sets, that are associated with suspected lithological contacts. The apparent discontinuities and/or disruption of the GPR reflector sets may be associated with the downward migration sediments.

The greater the severity of these features or a combination of these features the greater the likelihood that the identified feature is a sinkhole. It is not possible based on the GPR data alone to determine if an identified feature is a sinkhole or, more important, whether that feature is an active sinkhole.

4.0 Survey Results

4.1 Discussion of GPR Survey Results

Results of the GPR survey indicated the presence of a well-defined, relatively continuous set of GPR reflectors at an approximate depth range of 8 to 13 ft bls. This GPR reflector set is below the depth of the hand auger borings, and accordingly cannot be correlated to any lithological contact. However, the reflector set is most likely associated with some change in lithological conditions at that depth range.

Description of GPR Anomalies

Two GPR anomaly areas were identified around the exterior of the residence. The anomaly areas are designated as GPR Anomalies 1 and 2 on Figure 1. The anomalies are numbered in order of significance with GPR Anomaly 1 being the most significant and GPR Anomaly 2 being the least significant. A description of each of the anomalies is as follows:

GPR Anomaly 1

GPR Anomaly 1 is elliptical in shape with total area of approximately 150 square ft. The anomaly is located south of the residence. The apparent vertical relief of the upper portion of the anomaly area is 3 to 4 ft as characterized by the observed downwarping of the GPR reflector set. A localized increase in the depth of penetration of the GPR signal was also observed within the anomaly area. The apparent center of the feature is characterized as the area of maximum downwarping of the previously referenced GPR reflectors.

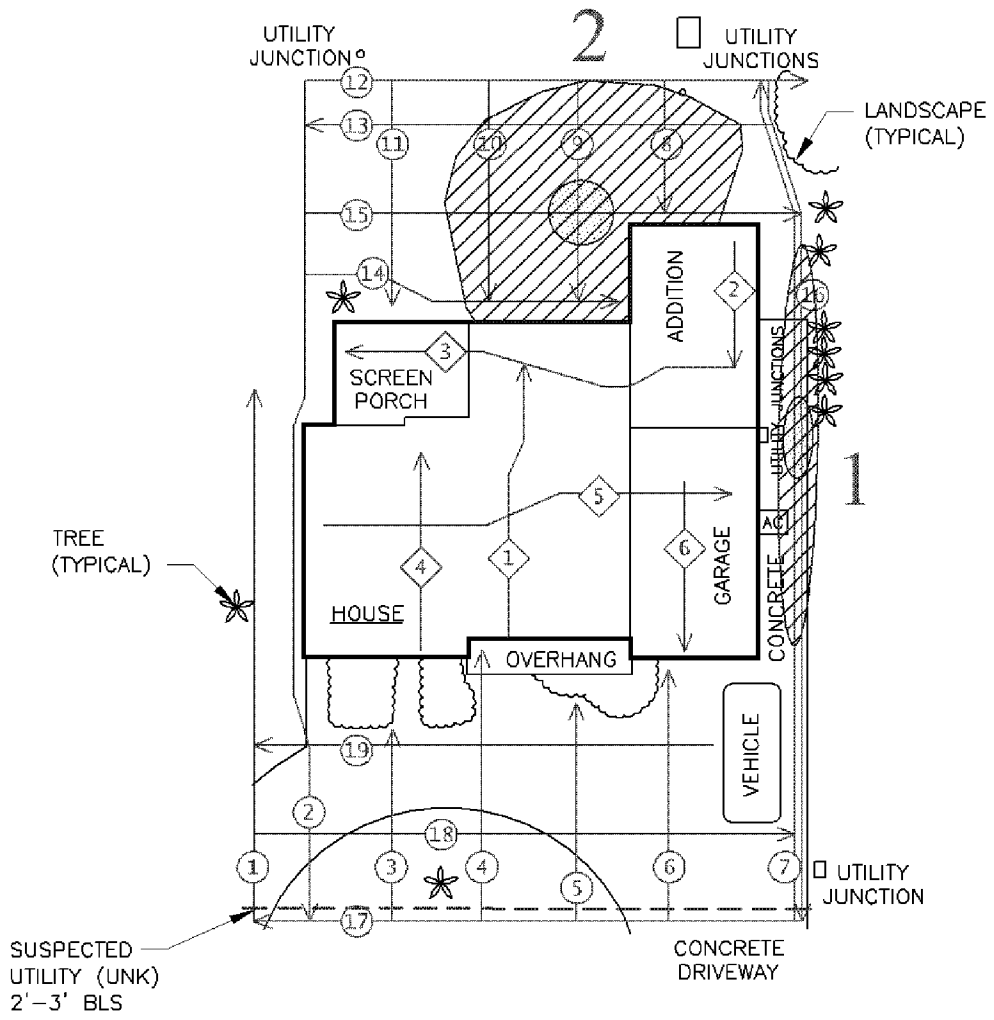
GPR Anomaly 2

GPR Anomaly 2 is irregular in shape with total area of approximately 650 square ft. The anomaly is located east of the residence. The apparent vertical relief of the upper portion of the anomaly area is 1 to 2 ft as characterized by the observed downwarping of the GPR reflector set. A localized increase in the depth of penetration of the GPR signal was also observed within the anomaly area. The apparent center of the feature is characterized as the area of maximum downwarping of the previously referenced GPR reflectors.

This GPR investigation was not designed to locate buried utilities. However, a suspected utility was identified west of the residence at a depth range of approximately 2 to 3 ft bls (Figure 1). A discussion of the limitations of the GPR technique in geological characterization studies is provided in Appendix 2.

4.2 Floor Elevation Study Results

The results of the elevation study of the accessible portions of the main floor of the house found a total differential of 1.5 inches between the low area, in the southeastern portion of the home and the highest area in the southwestern portion of the home. The bedroom addition was found to slope a maximum of 0.7 inches to the sout. The screened patio was found to slope a maximum of 1.8 inches to the north. The accessible portions of the garage sloped a maximum of 1.3 inches toward the southwestern corner. Results of the floor elevation study are presented as Figure 2.



EXPLANATION

PATH OF EXTERIOR GPR TRANSECT LINES WITH DESIGNATION NUMBER

PATH OF INTERIOR GPR TRANSECT LINES WITH DESIGNATION NUMBER

LOCATION OF GPR ANOMALIES WITH DESIGNATION (1 MOST SIGNIFICANT, 2 LEAST SIGNIFICANT)

APPARENT CENTER OF GPR ANOMALY

0 20'

SCALE: 1"=20' APPROXIMATE

GeoView	FIGURE 1 SITE MAP SHOWING RESULTS OF GEOPHYSICAL INVESTIGATION	HAGEN RESIDENCE 12232 BEAR CLAW LOOP HUDSON, FLORIDA MADRID ENGINEERING GROUP, INC. BARTOW, FLORIDA PROJECT: 15573 DATE: 01/30/12

APPENDIX 2
DESCRIPTION OF GEOPHYSICAL METHODS, SURVEY METHODOLOGIES AND LIMITATIONS

A2.1 On Site Measurements

The measurements that were collected and used to create the site map were made using a fiberglass measuring tape. Right angles were estimated using the exterior walls of the residence. The degree of accuracy of such an approach is typically +/- 5% for lengths and +/- 2.5 degrees for angles.

A2.2 Ground Penetrating Radar

Ground Penetrating Radar (GPR) consists of a set of integrated electronic components that transmits high frequency (200 to 1500 megahertz [MHz]) electromagnetic waves into the ground and records the energy reflected back to the ground surface. The GPR system consists of an antenna, which serves as both a transmitter and receiver, and a profiling recorder that both processes the incoming signal and provides a graphic display of the data. The GPR data can be reviewed as both printed hard copy output or recorded on the profiling recorder's hard drive for later review. GeoView uses a Mala GPR system.

A GPR survey provides a graphic cross-sectional view of subsurface conditions. This cross-sectional view is created from the reflections of repetitive short-duration electromagnetic (EM) waves that are generated as the antenna is pulled across the ground surface. The reflections occur at the subsurface contacts between materials with differing electrical properties. The electrical property contrast that causes the reflections is the dielectric permittivity that is directly related to conductivity of a material. The GPR method is commonly used to identify such targets as underground utilities, underground storage tanks or drums, buried debris, voids or geological features.

The greater the electrical contrast between the surrounding earth materials and target of interest, the greater the amplitude of the reflected return signal. Unless the buried object is metal, only part of the signal energy will be reflected back to the antenna with the remaining portion of the signal continuing to propagate downward to be reflected by deeper features. If there is little or no electrical contrast between the target interest and surrounding earth materials it will be very difficult if not impossible to identify the object using GPR.

The depth of penetration of the GPR signal is very site specific and is controlled by two primary factors: subsurface soil conditions and selected antenna frequency. The GPR signal is attenuated (absorbed) as is passes through earth

materials. As the energy of the GPR signal is diminished due to attenuation, the energy of the reflected waves is reduced, eventually to the level that the reflections can no longer be detected. As the conductivity of the earth materials increases, the attenuation of the GPR signal increases thereby reducing the signal penetration depth. In Florida, the typical soil conditions that severely limit GPR signal penetration are near-surface clays and/or organic materials.

The depth of penetration of the GPR signal is also reduced as the antenna frequency is increased. However, as antenna frequency is increased the resolution of the GPR data is improved. Therefore, when designing a GPR survey a tradeoff is made between the required depth of penetration and desired resolution of the data. As a rule, the highest frequency antenna that will still provide the desired maximum depth of penetration should be used. For areas outside of the home, a low-frequency (250 MHz) antenna is used. This allows for maximum signal penetration and thereby maximum depth from which information will be obtained. For GPR surveys conducted inside of a home a 500 MHz antenna is often used. The 500 MHz antenna sometimes provides higher quality data on concrete surfaces.

A GPR survey is conducted along survey lines (transects) that are measured paths along which the GPR antenna is moved. An integrated survey wheel electronically records the distance of the GPR system along the transect lines.

For geological characterization surveys, the GPR survey is conducted along a set of perpendicularly orientated transects. The survey is conducted in two directions because subsurface features such as sinkholes are often asymmetric. Spacing between the transects typically ranges from 10 to 50 ft. Closely spaced grids are used when the objective of the GPR survey is to identify all sinkhole features within a project site. Coarser grids are used when the objective is to provide a general overview of site conditions. After completion of a survey using a given grid spacing, additional more-closely spaced GPR transects are often performed to better characterize sinkhole features identified by the initial survey. This information can be used to provide recommended locations for geotechnical borings.

Depth estimates to the top of lithological contacts or sinkhole features are determined by dividing the time of travel of the GPR signal from the ground surface to the top of the feature by the velocity of the GPR signal. The velocity of the GPR signal is usually obtained from published tables of velocities for the type and condition (saturated vs. unsaturated) of soils underlying the site. The accuracy of GPR-derived depths typically ranges from 20 to 40 percent of the total depth.

Interpretation and Limitations of GPR data

The analysis and collection of GPR data is both a technical and interpretative skill. The technical aspects of the work are learned from both training and experience. Having the opportunity to compare GPR data collected in numerous settings to the results from geotechnical studies performed at the same locations develops interpretative skills for geological characterization studies.

The ability of GPR to collect interpretable information at a project site is limited by the attenuation (absorption) of the GPR signal by underlying soils. Once the GPR signal has been attenuated at a particular depth, information regarding deeper geological conditions will not be obtained. In addition, GPR data can only resolve subsurface features that have a sufficient electrical contrast between the feature in question and surrounding earth materials. If an insufficient contrast is present, the subsurface feature will not be identified. GeoView can make no warranties or representations of geological conditions that may be present beyond the depth of investigation or resolving capability of the GPR equipment or in areas that were not accessible to the geophysical investigation.

A2.3 Floor Slab Studies

Floor elevation studies are conducted with the Zip Level Pro-2000 Elevation Measurement System. The Pro-2000 system consists of a small base unit and a hand held measurement module connected by an approximately 100-ft flexible gas-filled cord. The base unit is placed in an area that is easily reoccupied for subsequent mapping and the base location is recorded. The system measures the elevation difference between the two units with an effective resolution of 0.1 inches. The Pro-2000 has several distinct advantages over other survey instruments such as a transit or laser level. These advantages include: 1) It can be used efficiently in very tight spaces where it would be impossible to use an optical instrument, 2) It can be used in "blind" areas obscured from a direct line of sight to the reference elevation (base module). This advantage allows surveying in areas behind walls inside buildings or closets. The floor elevation study data is contoured using Surfer^{tm}, a computer-contouring program. The Kriging method was used to develop the contour map.

Data Current as Of:	Weekly Archive - Saturday, December 31, 2011
Parcel ID	03-25-16-051E-00000-3140 (Card: 001 of 001)
Classification	01 - Single Family

Mailing Address
HAGEN BRIAN F & STACI A
12232 BEAR CLAW LOOP
HUDSON FL 34667-2303

Physical Address
12232 BEAR CLAW LP
HUDSON FL 34667-2303

Legal Description (First 4 Lines)
See Plat for this Subdivision
BEACON WOODS VILLAGE 3-B
PB 11 PGS 41-42
LOT 314
OR 6121 PG 1559

Property Value

Ag Land	$0
Land	$10,969
Building	$49,690
Extra Features	$375
Just Value	$61,034
Assessed (Save Our Homes)	$61,034
Homestead 196.031	- $25,000
Non-School Additional Homestead Exemption	- $11,034
Non-School Taxable Value	**$25,000**
School District Taxable Value	**$36,034**

Warning: A significant taxable value increase may occur when sold. Click here for details and info. regarding the posting of exemptions.

Land Detail (Card: 001 of 001)

Line	Use	Description	Zoning	Units	Type	Price	Condition	Value
1	0100	SFR	0PUD	4,268.00	SF	$2.57	1.00	$10,969

Additional Land Information

Acres	0.10	Tax Area	6200	FEMA Code	X	Residential Code	BCWOLP1

Building Information - **Use** 01 - Single Family Residential (Card: 001 of 001)

Year Built	1972	**Stories**	1.0
Exterior Wall 1	Concrete Block Stucco	**Exterior Wall 2**	None
Roof Structure	Gable or Hip	**Roof Cover**	Asphalt or Composition Shingle
Interior Wall 1	Plastered	**Interior Wall 2**	None
Flooring 1	Carpet	**Flooring 2**	None
Fuel	Electric	**Heat**	Forced Air - Ducted
A/C	Central	**Baths**	2.0

Line	Description	Sq. Feet	Repl. Cost New
1	BAS	1,445	$59,823
2	FSA	173	$2,525
3	FOP	72	$745
4	UGR	364	$4,513

Extra Features (Card: 001 of 001)

Line	Description	Year	Units	Value
1	DWSWC	1972	1,000	$375

Sales History

Previous Owner	TERRY SHANNA ROONEY			
Year	**Month**	**Book/Page**	**Type**	**Amount**
2004	11	6121 / 1559	WD	$125,000
2002	12	5194 / 1250	WD	$0
2000	03	4337 / 0592	WD	$63,000

Madrid Engineering Group, Inc.
Bartow, FL 33830
863-533-9007

LOW MOBILITY GROUTING SPECIFICATIONS

A. INTENT OF THE GROUTING PROGRAM

The proposed grouting program shall be sufficient to fill any voids or loose rock in upper portion of the limestone and to densify loose and soft soils overlying the limestone surface to minimize further karst related settlement of the structure.

B. GEOTECHNICAL INVESTIGATION

A geotechnical report (or Subsidence Investigation Report – SIR) has been prepared for the site. The information contained in the report is intended to assist the Contractor in preparation of the bid. Soil boring data represents subsurface conditions only at the location of each boring and soil sample. Varying degrees of heterogeneity of the horizontal and vertical soil conditions are likely to exist between boring locations. Opinions and recommendations expressed in the report are based on geological and geotechnical interpretation of the test data. For the purposes of this specification the "Engineer" refers to Madrid Engineering Group, Inc. (MEG); i.e. the project geotechnical engineer or geologist, and/or the MEG field representative. The geotechnical report or SIR provides details regarding location and depth of injection points for the grouting remediation plan. Any modifications to the number, location, and depth of the injection points must be at the discretion and approval of the Engineer. In some cases the geotechnical report is supplemented by a stabilization report; the stabilization report must be prepared by MEG and must reference the MEG geotechnical report to be valid for the project. References herein to geotechnical report shall also serve as a reference to the appropriate stabilization plan, if such a document exists for the project.

C. SCOPE OF WORK

The Contractor shall provide project control, supervision, labor, materials, and equipment to accomplish the following items of work:

1. A detailed grouting program, including a description of method(s) used to install grout casings.
2. Participation in pre-drilling and pre-grouting meetings with the Engineer and the Contractor's field supervisory staff for each respective operation.
3. Install and remove grout pipes from the locations as shown on the Grout Remediation Plan presented in the geotechnical report.
4. Monitor and record grout slumps, pumping rates, and pressures, and ground movements during grouting operations.
5. Site clean up after grouting.

The grouting Contractor will submit a description of the grouting program with the cost proposal. A description of the work procedure, ground monitoring techniques, grout mix design, fine aggregate materials, and instrumentation program shall also be included.

D. MATERIALS

The grout materials will consist of a combination of Portland cement, flyash, fine aggregate and water. Additives may be used, provided the grout mixture meets slump requirements. Hydro-active and micro-fine grouts are acceptable. For fill grouting of voids and cavities and

compaction of surrounding sands, using conventional cementitious grout, the grout mix will have a target slump of 3 inches, with a plus or minus 1-inch tolerance in the field, as measured at the truck. Grout with greater than 4-inch slump at the injection point shall be rejected. For projects with longer than typical pumping distance from the truck to the injection point, and at the discretion of the Engineer, a higher slump may be accepted at the truck provided the slump at the point of injection is measured not less than once for every 60 cy delivered to verify the amount of slump loss and acceptable slump at the head of the injection point (to remain within the 3 inch plus or minus 1-inch tolerance). The grout mix design shall have a 28-day compressive strength of at least 300 psi, or more.

Fine aggregates will consist of hard, clean, strong, durable, and uncoated particles, in accordance with ASTM C144-76. The fine aggregate will have a fines content no greater than 30 percent passing the No. 200 sieve, and shall be reviewed by the Engineer. The gradation of the mix will be such that sand blocking is eliminated at the grout working pressures specified.

Water used in the grout will be free of deleterious and organic material.

No admixture will be used without the Engineer's approval and previous testing.

The Contractor will determine the source, kind and quality of the water, cement and aggregates to be used in the work.

Metered concrete batch trucks shall not be used due to the inconsistency of the mixing system.

E. GROUT PIPE INSTALLATION

The drilling equipment will install minimum two to three inch, inside diameter, flush joint steel casing to minimize flow restrictions and prevent plugging when injecting the low-slump material and hangup upon retraction. The intent will be to intercept the limestone/soil interface. The casing will extend to competent bearing material as determined by the engineer or the maximum depth as required herein. The anticipated average depth of bedrock is as indicated in the site geotechnical report or SIR. In some cases the report may also state a minimum penetration depth requirement.

The Contractor will consult with the Engineer prior to installing casing exceeding 15 feet greater than the anticipated average depth of the bedrock and/or 15 feet into the bedrock unit.

The steel casing will have adequate strength to maintain the hole and to withstand the required jacking and pumping pressures. The casing will be installed such that there is sufficient contact with the drilled hole in order to prevent grout leakage and/or premature upward movement of the casing during injection. Pipes that wiggle excessively at the ground surface may require redrilling at the discretion of the Engineer. Rotary wash, and rotosonic drilling is acceptable; however, any subsidence damage caused by this drilling shall be at the Contractor's own risk and expense.

It is understood that field adjustments of injection point locations may be required to avoid damage to utilities, landscaping, or appurtenant facilities. Any deviations of more than two feet from plan position of injection points shall be reviewed with the Engineer and documented, including the reason(s) for the shift.

F. GROUT INJECTION PROCEDURES

Grouting shall be completed using the primary and secondary methods of grouting. In general, primary (vertical points) shall be completed first and secondary (angled points) shall be completed after the primary points on either side of it are completed. At the discretion of the engineer for special circumstances, grout injection into secondary points may commence prior to completing adjacent primary points; however, the adjacent primary points are to remain at least 5 feet above the secondary point.

In general it is recommended that grout injection commence at the deepest injection point. The selection of the initial grout injection point should be based on actual depths of grout casings as installed during construction. Any uncertainty as to location of initial grout injection should be brought to the attention of the Engineer for review and comment. Alternatively, the Engineer may require that grouting commence at a particular portion of the property to address a specific concern.

Grouting pressure will be continuously monitored at the hole and the pump with suitably protected, easily readable gauges.

Grout will be injected on a continuous basis throughout the depth of the hole with the grout casing being withdrawn in increments of 24 inches (2 feet) or less, unless otherwise approved by the Engineer. At no time shall more than 5 feet of casing be withdrawn without grout injection.

Controlled grout pumping rates of 1 to 7 cubic feet per minute will be required (equivalent to a range between 3.9 and 27 minutes per cubic yard pumped or 39 to 270 minutes per 10 cy truck). Grout quantities will be monitored and recorded on a continuous basis.

The criteria for raising the grout pipe to the next increment will be when one or more of the following occurs:

1. The grout pressure at the gauge located within 25 feet of the injection pipe exceeds 200 psi over the necessary pressure to initiate grout take, provided there is no blockage of the pipe.

2. For each five-foot injection interval, initial grout quantities should be limited to a maximum of 10 cubic yards. If the grout take exceeds 10 cubic yards in a five-foot interval, the injection point shall be raised 24 inches (2 feet) and flushed (up to a maximum of 48 inches can be accepted for special circumstances at Engineer's approval), and the initial (injected) amount of grout shall be allowed to set. Subsequently, the grout injection may be resumed the next day.

3. When surface heave and/or structure lift occurs. Contractor shall stop grout injection at any depth increment and pull up to the next 2-foot increment after 0.1 inch heave, or less, is observed at the ground surface. A maximum cumulative (not each interval) surface heave of 0.3 inch shall not be exceeded on the structure adjacent to each injection point at any time during the grout injection program. When it occurs, the magnitude of the surface heave or structure lift shall be recorded on the grouting records.

A level control system will be installed and operated by the Contractor for use during all grout injection operations. The monitoring will be carried out so as to detect any movement within 50 feet of the grouting operations whenever grouting is occurring. Other monitoring may be needed for interiors and sensitive structures. If requested by the Engineer/Monitor, the Contractor shall grant the access to the level control system and ground movement records for an independent assessment of structure lift or surface heave. The Contractor is responsible for damages associated with excessive ground heave.

H. QUALITY ASSURANCE

The Engineer will have a representative on site during grouting operations to independently monitor and document the Contractor's work. Their activities typically will include verifying drilling depths, observing the grouting activities, verifying that the grout delivered is in accordance with the mix design and any approved adjustments, confirming the grout meets the maximum slump requirement, and observing grout pressures, volumes, and depths.

I. PROTECTION AND CLEANUP

During work operations, the Contractor will take such precautions as may be necessary to prevent drill cuttings, equipment exhaust, oil, wash water, and grout from defacing and/or damaging the landscape, structures, and pools. The Contractor will furnish such pumps as may be necessary to care for wastewater and grout for his operations and clean up all waste resulting from his operations.

J. SUBMITTALS

Contractor Submittals due to the Engineer prior to commencement of the work include:

1. The Contractor will provide a list of major components to be used including pumps, hoses, pipe, fittings and drilling equipment, including manufacturers' data as to size, type, pressure rating, capacity and other critical characteristics for each item for the Engineer's approval.
2. A description of the grouting program, of the work procedure, ground monitoring techniques, grout mix design, fine aggregate materials, and instrumentation program.
3. The Contractor will provide a detailed work schedule outline mobilization, drilling, grouting, testing, and demobilization.
4. The Contractor will provide an outline of the slump testing, sampling, and other procedures to be utilized in the quality control program.

Contractor Submittals due to the Engineer during and upon completion of the work include:

1. A copy of all grout truck delivery tickets will be provided to the Engineer/Monitor on the same day of delivery. All daily drilling, grouting, and testing reports will be made available to the Engineer for review upon request during the course of the work and submitted to the Engineer within 3 business days of project completion. Any deviations from plan position of injection points shall be recorded on drilling reports.

3.2 The following ASTM Test Methods are applicable for testing:

Compressive Strength	D1621
Flexural Strength	D790
Shear Strength	C273
Density	D1622
Dimensional Stability	D2126
Coefficient of Expansion	D696
Solvent Resistance	D543
Fungus Resistance	G21
Water Absorption	D2842

3.3 The polyurethane material shall reach 90% of full compressive strength within 30 minutes from injection. The material shall be a polyurethane-forming mixture that reacts in both dry and wet environments without dilution.

3.4 The Contractor shall furnish from the manufacturer to the Engineer a certified test report for the material furnished and described in this specification indicating the material meets all specification requirements.

4.0 EQUIPMENT

The Contractor shall furnish the following equipment, as a minimum, and any additional equipment necessary to provide an acceptable job:

4.1 A method of providing *5/8-inch* (16 mm) diameter holes into the soils below footings, through floors and/or concrete slabs.

4.2 A pumping unit capable of injecting the high-density polyurethane formulation into the ground below the footing and/or between the concrete slab and the subgrade and capable of controlling the rate of flow and the rate of rise of the footing and/or slab. A certified method of measure (e.g. certified flow meter) or approved alternate must be in use during injection to measure the amount of polyurethane injected at each injection point.

4.3 Pressure and temperature control devices capable of maintaining proper temperature and proportionate mixing of the polyurethane component materials.

4.4 A laser leveling unit to ensure that the floor slab is raised to an even plane and to the required elevations or to identify movement of the slab even when lift is not required.

4.5 A hand cone penetrometer probe rod capable of measuring relative density of the soils (e.g. should be outfitted with a relative density dial for easy reading of results in the field) for on-site soils investigation to assist in location of weak sub-base soils and determination of the injection pattern to densify soils.

4.6 All necessary light towers, electric generators, compressors, heaters, hoses, containers, valves and gauges to efficiently conduct and control the work and minimize the impact to the existing structure.

5.0 CONSTRUCTION METHODS

5.1 Preparation:

A. When present, measurements of the slab shall be made, in cooperation with the

Engineer, to determine the locations required lifting and the amount of lifting required. A laser-leveling unit shall be set in place and properly adjusted prior to beginning of injection. A series of 5/8-inch (16 mm) up to ¾-inch (19 mm) diameter holes shall be drilled through the concrete slab at locations and spacing as determined by the Contractor.

B. Control joints may require cleaning of debris, dirt, etc. prior to beginning the lifting operation, at no additional compensation.

C. Prior to beginning the injection operation a survey of existing cracks or damage to the structure, floor slab and/or footings shall be documented by the Engineer and confirmed by the Contractor.

D. Prior to receiving approval to proceed with the raising and stabilizing operation, the Contractor shall satisfactorily demonstrate to the Engineer the ability to lift and stabilize for that particular application using high-density polyurethane.

5.2 Injection Point Installation/Extraction

A. Contractor shall lay out the injection point locations for review by the Engineer or his site representative.

B. If required by Engineer, Contractor shall provide a concrete profile from laser level measurements of each area where the concrete structures require attention. Each profile shall be accepted by the Engineer or his representative prior to performing the work at the project location.

C. Hand cone penetrometer testing should be conducted in the presence of the Engineer or his representative to confirm existing base soil conditions at representative locations within the treatment area. (A minimum of four tests on each side of the structure, to determine the specific grout elevations.)

D. Contractor shall install injection points through a series of 5/8" – 3/4" holes (as required for tube placement) drilled at approximately 4-6 foot spaced intervals through the concrete above the area requiring soil remediation.

E. Either steel or copper pipe shall be used for injection of the polyurethane material into the soil. The injection pipes (tubes) are to be installed with either electric roto-hammers or a pneumatic hammer to ensure intimate contact with the surrounding soils to prevent leakage along the annulus. Water jetting is not acceptable unless otherwise approved by the Engineer.

F. Injection tubing should be extracted during the injection process at uniform short intervals, progressing towards the ground surface.

G. Injection tubes are to be extracted using the method determined most suitable by the Engineer and Contractor, based on site conditions.

1) At uniform short intervals, progressing towards the ground surface

2) At one or more pre-determined depth intervals, or

3) As determined by the Engineer.

H. If they become locked into the grout, injection tubes shall be cut off a minimum of six inches below the ground surface. Within the slab the tube should be driven sufficiently below the top of slab to enable proper sealing of the hole.

5.3 Polyurethane Injection:

A. General - The injection pipes shall extend into the very loose to loose sandy soils below the footings (typical of 3 to 5 feet depth bgs with maximum depth range on te order of 6 to 8 feet bgs when very loose soils continue below typical depth during probing). High-density polyurethane foam shall be injected into the loose sands to form zones of treated, high strength cemented sand capable of supporting the locally contributing area of footing and/or floor slab. The high-density polyurethane foam shall be injected through the 5/8-inch (16 mm) diameter holes under the footing and/or slab and allowed to expand, harden, and exert the necessary stabilization and/or lifting forces. If required, the amount of rise, or lift, shall be controlled, using the pumping unit, by regulating the rate of injection of the material. Any excessive polyurethane material extruding from joints, cracks, or the drilled holes shall be removed from the slab and the drilled holes sealed with a nonexpansive cementitious grout to the full depth of the concrete slab. The laser leveling unit and, if necessary, a stringline or other method, shall be used to monitor and control the elevation change.

B. Slab leveling - As necessary, polyurethane material shall first be injected through a series of 5/8" – 3/4" drilled holes until all known or encountered voids under the structural element (slab, pool deck, etc.) are filled and the element has been leveled to the extent practical. The rate and amount of material injection shall be determined by the Contractor and Engineer based on site conditions.

C. Deep Injection/Soil Densification - The polyurethane material shall then be injected through copper injection tubes inserted into the drilled holes to the proper depth or depths as required. The exact location, spacing, hole size and depth shall be selected by the Contractor and approved by the Engineer on site. The rate and amount of material injected shall be determined by the Contractor and the Engineer to obtain proper densification of the base and sub-base soils.

5.4 Deviations:

Minor deviations to these specifications on materials, equipment, and/or installation may be submitted to the Engineer for approval prior to commencement of work, provided that the objectives and intent of the project can be achieved.

6.0 MONITORING

6.1 Continuous laser level or dial indicator micrometer readings shall be in place and monitored by the Contractor during injection to determine sufficient material usage and soil densification as indicated by any recordable movement in the ground surface or overlying structural element.

6.2 Contractor shall record the grout location, depth and the quantity of material injected at each grout point location.

7.0 SUBMITTALS

Prior to construction the Contractor shall provide a submittal package to the Engineer for review and Approval prior to mobilization. The submittal package shall include at a minimum the materials proposed for use, a general method statement indicating how the work will comply with the specification requirements, equipment used, probing method, injection tube installation method, method for quantity verification, monitoring equipment and method, etc.

Contractor Bid Form: Stabilization Plan
Hagen Property
Hudson, Florida

Bid Due Date: _____

Task	Description	Estimated Quantity	Unit Price	Total Price
1.	Mobilization	1	$	$
2.	Install Grout Casings	1,570 feet	$	$
3.	Low Mobility Grout Material	380 cubic yards	$	$
4.	Polyurethane Grout Mobilization, installation of casings, and initial 500 lbs of poly-grout.	1	$	$
5.	Additional poly-grout	1,700 lbs	$	$
6.	Other		$	$
			Total Price	$

Estimated number of days to complete:_____ days

Comments:_____

Alternate Bid:

Rimkus Consulting Group, Inc.
7851 Woodland Center Boulevard
Tampa, Florida 33614
(813) 289-3060 Telephone
(813) 289-5440 Facsimile
Certificate of Authorization No. 8301

THE ORIGINAL OF THIS REPORT, SIGNED AND SEALED BY THE PROFESSIONALS WHOSE NAMES APPEAR ON THIS PAGE, IS RETAINED IN THE FILES OF RIMKUS CONSULTING GROUP, INC.

Report of Findings

SCOVAZZO RESIDENCE
SOILS IMPROVEMENT BY SUBSURFACE GROUTING
CLAIM NO: 408965

RCG FILE NO: 41108229
PARCEL ID NO: R30 223 18 3526 0000 1670

Prepared For:

CITIZENS PROPERTY INSURANCE CORPORATION
POST OFFICE BOX 172729
TAMPA, FLORIDA 33672-0729

Attention:

MR. DENNIS YOUNG

Matthew T. Staffeld, P.E. 6/24/13
FL Licensed Engineer No. 72461
Consultant

Daniel P. Barton, P.E.
Division Manager

June 24, 2013

TABLE OF CONTENTS

Section I
INTRODUCTION

It was reported by Mr. Scovazzo that there was damage to the interior and exterior of his residence. The Scovazzo residence was located at 10454 Casa Grande Circle in Spring Hill, Florida.

Rimkus Consulting Group, Inc. was originally retained by Citizens Property Insurance Corporation to determine the cause of the damage and provide general recommendations for remedial repairs as applicable. Our conclusions and recommendations were presented in a report entitled "Scovazzo Residence Foundation Investigation", dated November 10, 2011. The services of Rimkus Consulting Group, Inc. were subsequently expanded to include monitoring of the recommended soil improvement program.

The following sections of this report will summarize our observations made during monitoring of the subsurface grouting program performed around the perimeter of the residence.

This report was prepared for the exclusive use of Citizens Property Insurance Corporation and was not intended for any other purpose. Our report was based on the information available to us at this time and on conditions visibly evident and accessible. Please note that the site and structure conditions may change with the passage of time. Should additional information become available, we reserve the right to determine the impact, if any, the new information may have on our opinions and conclusions and to revise our opinions and conclusions if necessary and warranted.

Section II
CONCLUSIONS

1. It is our opinion that the limited mobility displacement grouting program performed by Florida Living, LLC at the Scovazzo residence located at 10454 Casa Grande Circle in Spring Hill, Florida was performed in substantial accordance with our recommendations, and with local industry practices for the improvement of subsurface soils, and was sufficient to mitigate the effects of sinkhole activity.

Section III
DISCUSSION

Grout Observations

Florida Living, LLC performed the drilling and grouting operations at the Scovazzo residence from February through April of 2013. The program was divided into two phases, drilling and grouting. The drilling crew was on-site between the dates of February 6 and March 28, 2013, and performed the grout casing installation. The grouting crew was on-site between the dates of February 13 and April 18, 2013, and performed the grouting operations.

Florida Living, LLC utilized rotary wash drilling equipment to drill holes that allowed the installation of the grout casing. Thirty-one (31), 3 inch diameter holes were drilled until rock was encountered and the casing simultaneously inserted. The holes varied in depth from 38 to 102 feet, with an average depth of 70 feet. A total of 2,161 lineal feet was drilled and 3 inch diameter flush joint casing was installed. A total of 202 feet of casing was re-drilled, and 56 feet of casing was lost. Refer to **Section V(A), As-Built Grout Location Plan**, for the approximate grout injection locations and **Section V(B), Grout Summary Sheet**, for the depth of each hole.

A diesel powered positive displacement piston pump was used to inject the grout into the ground. Line pressure developed during grouting typically ranged between 100 and 500 pounds per square inch (psi). A sand, cement, and flyash grout mix was supplied by B.E.T.-ER Mix, Inc., and was identified on the delivery tickets as "GROUT FILLER". Field tests to determine the slump of the grout material were performed and revealed that the slump ranged from 4.5 to 6 inches. Cylinders of the grout material were cast on March 18, 2013, to evaluate the compressive strength of the material. The cylinder breaks revealed the following compressive strengths: 3 day strength was 500 psi, 7 day strength was 720 psi, 14 day strength was 980 psi, and 28 day strength was 1,830

psi. Copies of the grout delivery tickets are included in **Section V(C), Concrete Delivery Tickets**.

Grout was placed using a stage-up procedure. By this method, grout placement started at the casing bottom. The casing was withdrawn in increments when movement of the structure was detected and/or the grout pressure significantly increased. The contractor monitored vertical movement of the structure with a tripod-mounted level during grout placement. Pumping was terminated when vertical displacement of the structure was measured to be between 1/16 and 1/8 inch, and/or when the hole would no longer take grout.

Grout takes (i.e., the quantity of grout injected) varied at each location and depended upon the subsurface conditions. The quantities of grout injected into each hole ranged from 1.0 to 27.4 cubic yards. A total of approximately 394.9 cubic yards of grout was injected on this project. A total of 435.0 cubic yards of grout was delivered to the project. Approximately 40.1 cubic yards of grout were returned for various reasons as listed below. Detailed information concerning the drilling and grout quantities is maintained in our file and is available upon request.

The following is a brief summary of items that are noteworthy, that occurred on the project:

- The highest grout takes occurred in grout injection points 1, 3, 20 and 31 with respect to the grout ratio of the other grout injection points.

- The actual quantity of grout casing installed on this project was approximately 26.7 percent higher than our estimated quantity of 1,705 linear feet. The actual quantity of grout material injected on this project was approximately 43.6 percent higher than our estimated quantity of 275 cubic yards.

- Approximately 4.6 cubic yards of grout were returned from truck number 6 on February 15, 2013, due to a malfunction in the grout pump.

- Approximately 3.6 cubic yards of grout were returned from truck number 13 on February 20, 2013, due to a malfunction in the grout pump.

- Approximately 6.6 cubic yards of grout were returned from truck number 22 on March 6, 2013, due to a malfunction in the grout pump.

- Approximately 2.6 cubic yards of grout were returned from truck number 26 on March 19, 2013, due to excessive standby time of the truck; the supplier recalled the truck.

- Approximately 3.9 cubic yards of grout were returned from truck number 33 on March 25, 2013 due to excessive standby time of the truck (timed out).

- 10 cubic yards of grout were returned from truck number 36 on April 3, 2013, because Hernando County shut the job down due to the conditions of the public roadway.

- Approximately 5 cubic yards of grout were returned from truck number 39 on April 15, 2013, due to excessive standby time of the truck.

- Approximately 0.8 cubic yards of grout were returned from truck number 40 on April 16, 2013, due to excessive standby time of the truck.

- Approximately 3 cubic yards of grout were returned from truck number 45 on April 18, 2013, due to the completion of the project.

It must be remembered that the subsurface grouting procedure is intended to treat the subsurface soils for only sinkhole activity. The grouting program is not intended to mitigate the effects of other subsurface conditions, such as normal settlements of surface sands or the effects of clays that may expand and contract in response to seasonal moisture conditions.

Any noteworthy, new, or reoccurring cracking or movement should be brought to our attention prior to the commencement of any building repairs. Cosmetic repairs should

be completed by a licensed contractor who is qualified to perform the work in accordance with standardized installation and repair techniques for the various materials encountered on this project.

Section IV
BASIS OF REPORT

1. Review of conclusions and recommendations of the initial investigative report by Rimkus Consulting Group, Inc., dated November 10, 2011.

2. Observation of grouting techniques and procedures used by Florida Living, LLC.

3. Review of the grout delivery tickets.

4. Review of grout injection locations.

5. Review of field logs of drill depth, pressures, and grout quantities.

Section V
ATTACHMENTS

A. As-Built Grout Location Plan

B. Grout Summary Sheet

C. Concrete Delivery Tickets

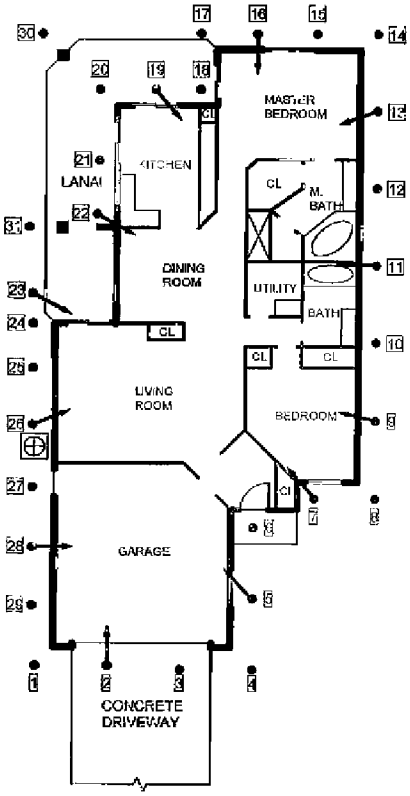
D. CVs

Section V

ATTACHMENT A

As-Built Grout Location Plan

June 24, 2013
RCG File No. 41108229



Notes:

1. This plan is drawn approximately to scale, however, copies of this drawing should not be relied upon to calculate quantities.
2. Grout point locations are approximate.
3. ● Grout Point Location.
4. ●→ Angled Grout Point.

RIMKUS CONSULTING GROUP, INC. TAMPA, FL

Title: AS-BUILT GROUT LOCATION PLAN

SCOVAZZO RESIDENCE

SPRING HILL FLORIDA

SCALE:	NTS
File No.	41108229
Drawing No.	1

Drawn by:	DPB
Reviewed by:	MTS
Date:	06/06/13
Sheet:	1 OF 1

Section V

ATTACHMENT C

Concrete Delivery Tickets

B.E.T.-ER MIX, INC. (EST. 1972)

concrete & related products

Mailing Address: PO Box 5577, Hudson, FL 34674-5577
Administrative Office: 16551 Scheer Blvd., Hudson, FL 34667
Central Dispatch: 9301 Denton Ave., Hudson, FL 34667

Dispatch: (800) 232-6833
phn (727) 863-6072 fax (727) 863-5520

Accounting: (866) 962-3827
phn (727) 862-2239 fax (727) 868-5617

(2)

CAUTION

May cause eye or skin injury. Contains Portland Cement. Freshly mixed cement, mortar, concrete, or grout may cause skin injury. TAKE THESE PRECAUTIONS:

1. Avoid all contact with eyes.
2. Wear rubber boots and gloves, and avoid prolonged contact directly with skin or through porous materials.
3. In case of contact with skin or eyes, FLUSH THOROUGHLY WITH WATER.
4. If irritation persists, get medical attention promptly.
5. Keep children away.

UNLOADING

Drivers are prohibited from delivering concrete except under the truck's own power, and where site conditions permit the safe and proper operation of their equipment. Drivers are not permitted to add water to the mix to exceed the maximum slump nor to drive beyond the curb line, except upon the authorization of the customer and his acceptance of the risk for any loss or damage.

Water added: Ø Gallons

Del & Rec OK by Jose 12.

Customer's representative

CUSTOMER ID	P.O. NUMBER	COUNTY	JOB NUMBER	TIME	DATE	TICKET
0002213			000045	10:41	12/13/2013	

SOLD TO	DELIVER TO
10454 → FLORIDA LIVING, LLC	14455 CASA GRANDE CIR SPRING

Order No: 092223

QUANTITY THIS LOAD	QUANTITY ORDERED	QUANTITY DELIVERED	PRODUCT CODE	PRODUCT DESCRIPTION	UNIT OF MEASURE	UNIT PRICE	EXTENDED PRICE
10.00	4.00	20.00	ZGROUT	GROUT FILLER	yd		
10.00	4.00	20.00	F10000	ENVIRONMENTAL	CY		
1.00	1.00	2.00	F77000	FUEL SURCHARGE	LD		

TRUCK	PLANT	SLUMP	DUE AT JOB	USE OF CONCRETE		
					SUB TOTAL	
CALCIUM	AIR ENTRAIN	SUPER PLAS			TAX	
					TOTAL	

DRIVER	SIG. 1	SIG. 2	WAITING TIME	SIG. 3	SIG. 4	SIG. 5	SIG. 6	SIG. 7
RAMIREZ, JOSE	1110	1135	05	1140	1215	1225		

SPECIAL INSTRUCTIONS:
GOING TO MARINER L/CASA GRANDE
CIRCLE L

ADDITIONAL DROP LOCATIONS:

WHITE - OFFICE YELLOW - BILLING PINK - DELIVERY

B.E.T.-ER MIX, INC. (EST. 1972)

concrete & related products

Mailing Address: ***PO Box 5577, Hudson, FL 34674-5577***
Administrative Office: *16551 Scheer Blvd., Hudson, FL 34667*
Central Dispatch: *9301 Denton Ave., Hudson, FL 34667*

Dispatch: (800) 232-6833
phn (727) 863-6072 fax (727) 863-5520

Accounting: (866) 962-3827
phn (727) 862-2239 fax (727) 868-5617

5

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TAKE THESE PRECAUTIONS:

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3. In case of contact with skin or eyes, FLUSH THOROUGHLY WITH WATER.
4. If irritation persists, get medical attention promptly.
5. Keep children away.

UNLOADING

Drivers are prohibited from delivering concrete except under the truck's own power, and where site conditions permit the safe and proper operation of their equipment. Drivers are not permitted to add water to the mix to exceed the maximum slump nor to drive beyond the curb line, except upon the authorization of the customer and his acceptance of the risk for any loss or damage.

Water added:

__________ Gallons ____________________
Customer's representative

CUSTOMER ID	P.O. NUMBER	COUNTY	JOB NUMBER	TIME	DATE	TICKET
000213			000040	11:04	02/14/2013	[illegible]

SOLD TO	DELIVER TO	
FLORIDA LIVING, LLC	1045 CASA GRANDE CIR SO.HTL	Order No: 00257

QUANTITY THIS LOAD	QUANTITY ORDERED	QUANTITY DELIVERED	PRODUCT CODE	PRODUCT DESCRIPTION	UNIT OF MEASURE	UNIT PRICE	EXTENDED PRICE
10.00	0.00	30.00	00GROUT	GROUT FILLER	yd		
10.00	0.00	30.00	10000	ENVIRONMENTAL	CY		
1.00	0.00	3.00	7000	FUEL SURCHARGE	LD		

TRUCK	PLANT	SLUMP	DUE AT JOB	USE OF CONCRETE
[illegible]	01	[illegible]		

CALCIUM	AIR ENTRAIN	SUPER PLAS	
			SUB TOTAL TAX TOTAL

DRIVER	SIG. 1	SIG. 2	WAITING TIME	SIG. 3	SIG. 4	SIG. 5	SIG. 6	SIG. 7
MERCADO, RAUL	1120	1139		1233				

SPECIAL INSTRUCTIONS:
GO LINE TO MARINER L/CASA GRANDE
CIRCLE

ADDITIONAL DROP LOCATIONS:

WHITE - OFFICE YELLOW - BILLING PINK - DELIVERY