Raba Kistner

Project No. ASR08-061-00
September 18, 2008

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Mr. Edward Pape
San Antonio Housing Authority
459 Precious Drive
San Antonio, Texas 78237

RE: Consulting Engineering Services
Residential Study
142 Villa Grande
San Antonio, Texas

Dear Mr. Pape:

Raba-Kistner Consultants, Inc. (R-K) is pleased to submit this report of engineering services provided for the above referenced project. It is our understanding that this work is being performed to assess the general physical condition of the above referenced home and to indentify conditions that are influencing the performance of this monolithic concrete foundation. To accomplish this objective we conducted visual observations of the structural frame and foundation along with relative floor elevation measurements and some non-destructive testing of the foundation. This document presents our observations and findings in accordance with our approved scope of work presented in **R-K** proposal No. PSR08-090-00, dated July 2, 2008, as well as the amended agreement, **R-K** Proposal No. PSR08-090-00A, dated August 6, 2008.

INFORMATION REVIEW

Prior to our on-site observation, **R-K** was provided with the following information:

- Construction documents for the San Antonio Housing Authority Mirasol Hope VI Revitalization Program Single Family Housing to include:
  - Architectural Floor Plans and Elevations, Site Plans, Wall Sections, Soffit, Fascia, and Door Details, Door/Window Schedule, Electrical and Roof Plans prepared by Bartholomew & Company of San Antonio, Texas, dated between February 19, 1999 and February 28, 2002, Sheets A100 to A-103; A-200 to A-220; A-300, A-301, A-303, and A-304; A-400, A-401, and ELEC-1, 2, and 3;
  - A Foundation Plan prepared by Unitech Consulting Engineers, Inc., of San Antonio, Texas, dated August 15, 2000. Sheet S-1;
  - MEP Drawings prepared by INCE Distributing of San Antonio, Texas, Sheets HVAC-1, 2, and 3, (not dated);
  - Plumbing Drawings prepared by Ashley Plumbing of San Antonio, Texas, Sheets MECH-1, 2, and 3, (not dated); and
  - Truss/Wall Panel Design Drawings prepared by Structural Lumber Company of San Antonio, Texas, Sheets RF-1 to RF-9 (not dated).
- Geotechnical Report prepared by Nova Consulting Group, Inc. of San Antonio, Texas, dated September 30, 1999.

- Inspection Report page 2 of 9 prepared by Amerispec Home Inspection Service, (not dated).
- *Geotechnical Engineering Services Report of Findings Mirasol Hope VI Revitilization Program* prepared by SynchroPile, Inc., dated July 15, 2007, Pages 1 through 3
- Report on Geotechnical Study Various Properties San Antonio, Texas, prepared by Fugro Consultants, Inc., dated June 14, 2007, Pages 1 and 2, and Plates 1 through 9 with ten grain size curves provided in the attached appendix
- A one page document titled *Grade Beam Measurements Various Properties San Antonio, Texas* prepared by Fugro Consultants, Inc., (not dated)

LIMITATIONS

The information provided in this document is directed to the Client, San Antonio Housing Authority, and may not contain information for others and/or for other uses. Construction documents were provided to us by our Client prior to our site visit; however, a complete set of the "as-built" construction drawings was not available. Some of our observations were limited due to building finishes, room contents, etc. Additional conditions may exist or may have existed at the time of our observations. Illustrative photographs were taken by **R-K** and are included in this document. This document includes observation information as obtained by **R-K** and from various other sources. Our comments and opinions are based upon that data. If information provided by others is incorrect, or if additional information becomes available, **R-K** may need to revise the comments and opinions presented in this document.

BACKGROUND INFORMATION

On Tuesday, June 24, 2008, Jesse H. Aguilar, P.E., and Ignacio Vivanco, E.I.T., of **R-K**, performed a site visit to the home to make visual observations of the home and to conduct relative floor elevation measurements of the floor slab. On the basis of the meeting held at the home with Mr. and Mrs. Lopez, the homeowners, and Mr. Matthew Michulka with the San Antonio Housing Authority, we were provided the following information:

- Mr. and Mrs. Lopez moved into the home on August 16, 2007.
- Shortly after moving into the home, the homeowners noticed a vertical, tape joint compression bulge beneath the bottom-front corner of the living room window frame.
- In April 2008, a plumbing leak occurred in the dishwasher drain line. At about the same time, a leak occurred at the right side kitchen sink drain, which was replaced. Both of these leaks were in pipe lines above the foundation.
- Mr. Michulka stated that over the past year, repairs have been made to the home. These repairs include replacing the hot water heater and the heating, ventilation, and air-conditioning (HVAC) units, relocating the water heater to the garage, replacing the doors (with the exception of the door leading from the entry to the garage), replacing the sliding windows with new windows, and installing new flashing at the wall penetrations.

- The homeowners mentioned that rain water tends to pond in the back yard during heavy rainfall events.
- Sometime during May 2008, the homeowners noticed that the back left bedroom door was sticking to the door frame and would not close correctly. At approximately the same time, they noted that the master bedroom closet door has the same sticking condition to the door frame.

GENERAL INFORMATION

All directional descriptions of the home assume the viewer is facing the front door of the residence. The home is a single family, single story wood frame dwelling supported on a reinforced concrete beam and slab-on-ground foundation. With the exception of the front side of the home, the wood exterior frame is covered with a fiber cement siding material. Along the front side of the home, the wood exterior frame is covered with a fiber cement siding material and some brick veneer siding. The exterior and interior wall framing is supporting a wood roof framing system with a composition shingle roof covering. The framing of the perimeter walls consists of standard pressure treated 2x4 wood studs spaced about 16-inches on center. The roof framing system consists of prefabricated wood trusses with galvanized metal connections spaced about 24-inches on center. The slab on ground was covered with wall to wall carpet with the exception of the kitchen, utility room, and bathrooms which were covered with a vinyl tile floor covering. The garage is exposed concrete and is located on the right side of the residence. Views of the outside of the residence as it exists today are shown on Photographs 1 through 4 included in Attachment B in this document.

EXTERIOR OBSERVATIONS

During our site visit performed on June 24, 2008, the following observations were noted while walking around the exterior of the home:

Front

- With the exception of the planter bed located along the front porch, the surface grading is considered good with the ground sloping away from the foundation as shown on Photograph 1 in Attachment B.
- There is a gutter located along the left garage roof eave and along the porch roof eave as shown on Photograph 1 in Attachment B. The gutter empties into two downspouts located at the left-front corner of the garage and at the left-front corner of the porch.
- The concrete walkway has moved away from the grade beam along the left side of the garage as shown on Photographs 7 and 8 in Attachment B. It appears that the walkway has settled approximately 3/4-inch along the joint. This has torn the elastomeric sealant along the joint.
- The metal border edging located along the planter bed traps water against the porch foundation as shown on Photograph 9 in Attachment B.
- There are some isolated spots in the front yard where the soil has settled as shown on Photograph 10 in Attachment B.

- Dry soil conditions were observed in the yard along where cracks in the ground surface varying up to about 1-1/4 inches in width and as much as 20 inches in depth as shown on Photographs 11 and 12 in Attachment B.
- The wood porch columns are twisted as shown on Photograph 13 in Attachment B.

Left

- There is a low spot in between the cedar fence and the porch slab as shown on Photograph 14 in Attachment B.
- There polyvinyl chloride (PVC) condensate drain line extends approximately 4-ft from the perimeter grade beam as shown on Photograph 15 in Attachment B.
- There is a vertical separation between the electric meter box and the conduit pipe that varies up to about 1-inch as shown on Photograph 16 in Attachment B.
- Dry soil conditions were observed along the perimeter grade beam where a horizontal separation has developed between the soil and the grade beam as shown on Photograph 17 in Attachment B.

Back

- The ground surface grading is considered fair to poor with a relatively flat surface, sparse ground cover, and several low spots along the foundation as shown on Photographs 2 and 18 in Attachment B.
- Dry soil conditions were observed along the perimeter grade beam where a horizontal separation has developed between the soil and the grade beam as shown on Photographs 18 and 19 in Attachment B.

Right

- Surface grading is considered good with the ground sloping away from the foundation as shown on Photograph 2 in Attachment B.
- Dry soil conditions were observed along the perimeter grade beam where a horizontal separation has developed between the soil and the grade beam as shown on Photographs 20 and 21 in Attachment B. The separation varies up to about 1-1/4 inches in width and as much as 6 inches in depth.
- Vertical cracks were observed along the exposed portion of the concrete grade beam as shown on Photograph 22 in Attachment B. In general, these cracks vary up to about 0.016 inches in width.

INTERIOR OBSERVATIONS

While performing visual observations of the interior of the home, the following observations were noted:

Entry

- No signs of distress were noted.

Kitchen

- There is a horizontal hairline crack near the top-front corner of the doorframe located near the left-front corner of the kitchen as shown on Photograph 23 in Attachment B.

Utility Room

- No signs of cracking or separations were noted.

Living Room

- There is a vertical, tape joint compression bulge located beneath the bottom-front corner of the right living room wall window as shown on Photograph 24 in Attachment B.

Hallway

- No signs of cracking or separations were noted.

Hallway Bathroom

- The hallway bathroom door closes on its own. The homeowners use an exercise ball to keep the door open as shown on Photograph 25 in Attachment B.

Master Bedroom

- There is a slight, vertical tape joint compression bulge located along the back wall, approximately 27-inches from the left-rear corner of the master bedroom as shown on Photograph 26 in Attachment B.

Master Bathroom

- No signs of cracking or separations were noted.

Right-Rear Bedroom

- No signs of cracking or separations were noted.

Right-Front Bedroom

- No signs of cracking or separations were noted.

Garage

- The door to the garage sticks to the door frame. It should be noted that this particular door was not replaced with the other doors throughout the home.

RELATIVE FLOOR ELEVATIONS

During our site visit, relative floor elevations were measured by using standard elevation measuring equipment placed at various locations on the floor surfaces throughout the home. Presented on Figure 2 in Attachment A are the relative floor elevation measurement values to the nearest hundredth of a foot. The relative floor elevation measurements were tied to a reference benchmark located on the concrete entry porch slab. To facilitate the relative floor elevation survey and for the purposes of this document an arbitrary value of 4 feet has been assigned to the reference benchmark. All other floor elevation measurements used in producing the elevation drawing are relative to this assigned value of 4 feet.

From Figure 2, the highest relative floor elevation measurement within the home's footprint on carpet surface was determined to be at elevation 4.88 feet, recorded near the left back corner of the master bedroom. The lowest measurement on carpet surface within the home's footprint was determined to be at elevation of 4.48 feet near the left-front corner of the living room. The maximum floor differential between the highest and lowest elevation on carpet was determined to be 4.80 inches or about 4-3/4 inches over a 38-1/2 foot distance (about 3/4 inch over a 6 foot distance). In general, the overall floor elevation profile exhibits a tilt of the foundation, sloping downward from back to front.

GENERAL FOUNDATION INFORMATION

Using a Schmidt rebound hammer, **R-K** measured the in-place relative compressive strength of the surface concrete within the garage floor slab to be in excess of 3,000 psi. Additionally, **R-K** determined the location and spacing of the slab reinforcing steel using a reinforcing steel detector. The steel in the garage floor slab is estimated to be about 3 inches below the finished floor surface. The spacing of the reinforcing bars in the garage floor slab of the foundation varies from about 15 to 18 inches on center each way in front to back and left to right directions.

Our review of the findings provided in the documents prepared by SynchroPile, Inc., and Fugro, Inc., stated that the Schmidt rebound hammer test results were measured to be in excess of 3,800 psi. In addition, it is our understanding that three concrete cores were obtained from the floor slab. These cores were measured to range in thickness from about 3-1/4 inches to 5-1/2 inches. The spacing between reinforcing steel was measured to be about 18-inches to 20-inches. A vapor barrier was also encountered between the bottom of the slab and the underlying soils that make-up the building pad.

Grade beam measurements recorded by Fugro, Inc., at two excavations along the perimeter of the concrete grade beam establish the depth of the beams. From the excavation performed near the right-front corner of the home (southwest corner) we understand that the embedment depth of the grade beam into the native soils was measured to be about 11 inches. In addition,

the excavation performed near the right-rear corner of the foundation revealed an embedment depth of about 4 inches.

SOILS INFORMATION

Geotechnical data reported by Nova Consulting Group, Inc. identified the soils conditions encountered within this site to be 1 to 2 foot thick layer of surficial fill materials overlying highly plastic natural clay soils. Further, we understand that the Potential Vertical Rise (PVR) values calculated for this area ranged between 4-1/2 to 6-inches.

Our review of the SynchroPile, Inc., and Fugro, Inc., documents provide data on the soils encountered beneath the core holes. These soils are comprised of fill materials that vary in thickness from approximately 6-3/4 inches to 16-1/2 inches. From the laboratory tests performed by Fugro, Inc., we understand that these fill soils are plastic, clayey gravel with sand. The Atterberg Limits tests determined that these fill soils maintained a Liquid Limit of about 46, a Plastic Limit of about 11, and a Plasticity Index of 35. The clay particles passing a No. 200 sieve were determined to be about 21% of clay material and 79% silty sands and other coarse gravelly material.

On August 28, 2008, **R-K** performed a second site visit to the home to obtained two soil samples from two locations along the perimeter grade beam for physical characteristic testing (Atterberg Limits testing) using a 3-inch diameter hand auger to collect soils at a depth below the grass from 12 to 33 inches at about the depth the concrete foundation is judged to be bearing upon. Sample S-1 was obtained near the left-rear corner of the foundation and can be described as a highly plastic dark gray, sandy clay with gravel. Sample S-2 was recovered near the right-front corner of the foundation and can be described as highly plastic dark brown clay. The soil samples described above have the following physical characteristics using ASTM D 2216, D 4318 and D 1140 procedures:

Laboratory Test	S-1	S-2
Moisture Content	19.6%	31.6%
Liquid Limit	59	68
Plastic Limit	17	20
Plasticity Index	42	48
Clay Particles Passing a No. 200 Sieve	66.3%	*

* Indicates a test was not performed on this sample.

The clay soils that exist beneath the home are considered to be highly expansive soils. Expansive soils are clay soils that can experience volume changes with changes in soil water content. Expansive soils shrink or reduce their volume when they lose water (damp to dry) and swell or increase their volume when they gain water (damp to wet). The foundation design Plasticity Index on the foundation drawing sheet marked S-1 dated August 15, 2000 was 65. The average Plasticity Index determined by our soils testing was 45. The design Plasticity Index is 20 points greater than the site specific soils.

COMMENTS

The concrete foundation appears to be performing within the boundaries for floor slab elevation differentials in the San Antonio locale. In general, the random tape joint compression bulges, minor sheetrock cracking, and the vertical butt joint separations observed along the right side grade beam at the time of our site visit are considered to be architectural and not a structural deficiency.

There are several factors that can cause and/or influence cracking of beam and slab-on-ground foundations including; soil-related movements, plumbing leaks, initial drying and shrinkage related cracking during the curing of the concrete following placement, thermal expansion and contraction, internal or external restraint to shortening; settlement of the supporting soils; and the applied loading to the floor slab to identify a few. Based on our preliminary observations, the random cracking has not negatively affected the performance of the foundation and frame systems.

On the basis of our review of the grade beam measurements document, prepared by Fugro Consultants, Inc., it is our understanding that the two test pits were performed along the perimeter of the foundation to measure the depth of the perimeter grade beams at select locations from the bottom lap edge of the fiber cement siding. From this document, we gather that the penetration of the right side grade beam into natural soil was measured to be about 4-inches. In addition, the penetration of the rear grade beam into the natural soil was measured to be about 11 inches. From our review of the foundation plan document, prepared by Unitech Consulting Engineers, Inc., we understand that design called for the perimeter grade beams to extend a minimum of 12-inches into "undisturbed soil", which is also referred to as natural soil in the construction industry. As such, it does not appear that these particular beams extend to the depth specified on the foundation plan.

Poor drainage conditions observed along the exterior of the home's foundation represents that there is an increased potential for soil-related differential movements that may affect the performance of the foundation and frame. With the exception of the gutter and downspout, located along the roof eave on the left side of the garage and along the front of the porch, runoff from the rooftop falls onto the ground surface adjacent to the foundation where the ground surface grading is not sufficient to drain this water away from the perimeter of the foundation in an efficient manner. Water that ponds adjacent to the foundation will likely soak into the soils located along the perimeter grade beam and could possibly wet the soils around the home's foundation. Inconsistent watering of the yard near and along the perimeter of the foundation and changes in seasonal moisture content can also contribute to soil-related differential movements.

OPINIONS

On the basis of our observations/measurements, measured relative floor elevations, the information provided by others, and our knowledge of beam and slab-on-ground "floating" foundations founded on expansive clay soils, it is our opinion that:

- The cracks in the concrete grade beams are plastic shrinkage and dry shrinkage cracking and crack widths are related to soil movements supporting the foundation.
- The movements are not associated with plumbing leaks; however, this should be confirmed by performing plumbing leak testing.
- The sheetrock butt joint separations can be corrected using standard repair materials and methods as required.
- The beam depths measured by Fugro, Inc., at two particular locations did not achieve the specified beam depth. It is our judgment that this has not adversely affected the performance of the foundation.
- The concrete foundation supporting the home and the wood frame is considered structurally adequate.

RECOMMENDATIONS

To the extent possible, all sources of water around and beneath the foundation should be controlled and regulated; therefore:

- We recommend that plumbing leak testing be performed on the domestic water lines and the sanitary sewer lines within and beneath the foundation to assess if leaks are occurring beneath the floor slab.
- Irrigation should be controlled within a 10-foot zone around the perimeter of the home. The moisture content of the surface clay soils should be maintained at a uniform water content condition year round. The ground within this area should not be allowed to become dry to the point where the ground cracks and pulls away from the foundation. This is particularly true of this residence where these conditions were noted along the left and right sides of the foundation. Water should also not be allowed to pond near the foundation.
- The soils in the yard need to be maintained adjacent to the foundation year round. This can be managed by watering along the perimeter of the foundation with soaker hoses connected to a short 12-foot long garden hose that is attached to the hose bibbs along the exterior of the home. The soaker hoses can be laid out in an "S" pattern extending preferably five feet, if property lines allow, away from the foundation as shown on Figure 3 of Attachment A of this document. Generally, slow soaking watering for a maximum of about 4 hours per week will provide a uniform water content in the yards surface soils during dry weather conditions. The flow rate of the water through the soaker hoses should be maintained at a 3/4 valve turn at the hose bibs. Watering should be controlled so that there is no trapped or ponded water near the foundation. Refer to Figure 3 of Attachment A for a proposed plan for the placement of the soaker hoses along the perimeter of the foundation.
- In order to help control the effects of surface water around the home, all water draining off the roof eaves should be collected in gutters and downspouts and redirected to drain to the street located along the front of the residence.
- The expansion joint between the front concrete walkway and the grade beam along the left side of the garage should be corrected using a reputable experienced sealant contractor using standard joint filling materials and methods.

We appreciate the opportunity to be of service to you on this project. Should you have any questions about the information presented in this document, or if we may be of additional service, please call.

Very truly yours,

RABA-KISTNER CONSULTANTS, INC.

Jesse H Aguilar, P.E.
Project Engineer

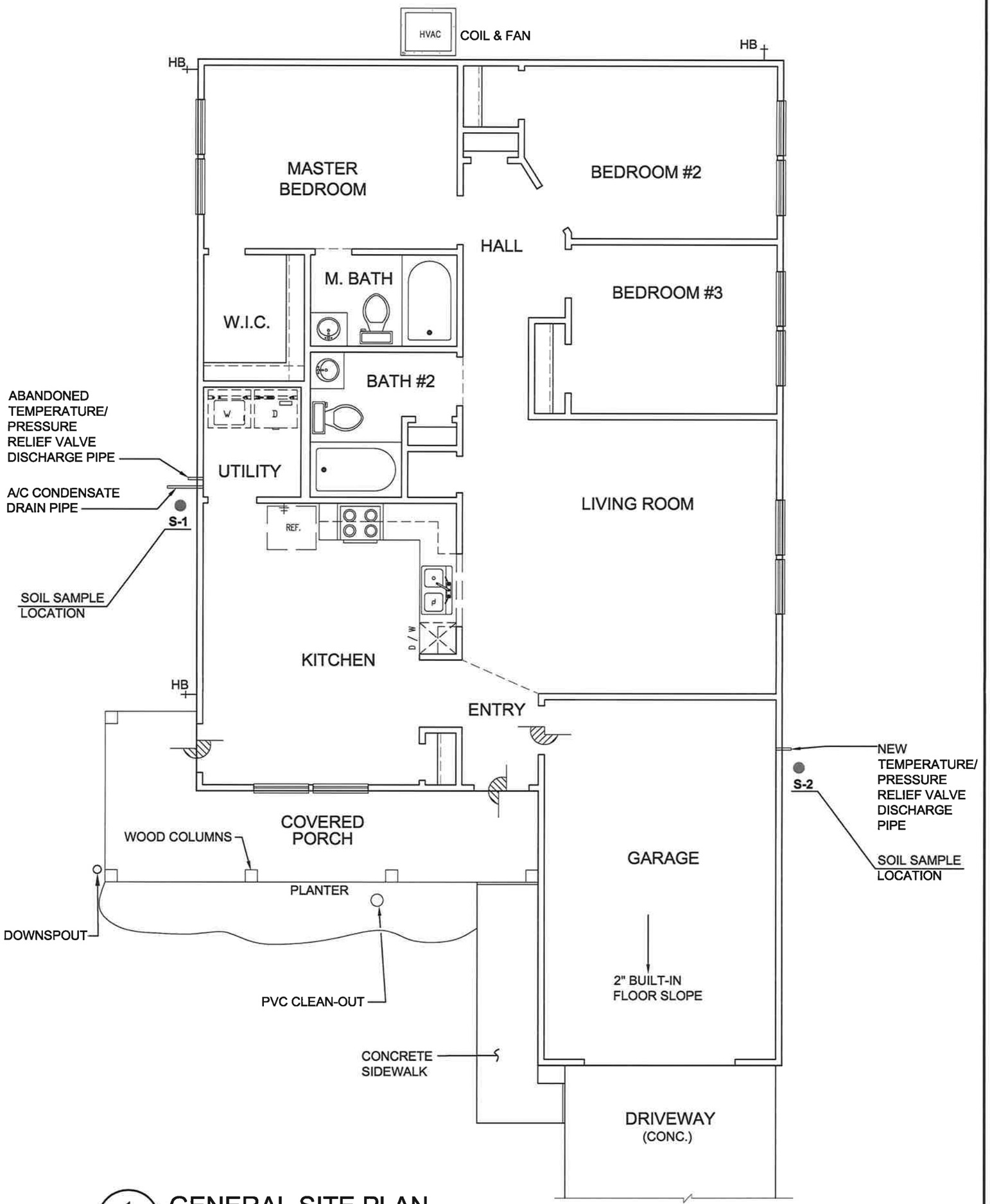
Richard W. Kistner, P.E.
Vice-Chairman

JHA/RWK/lac

Attachments: A – Figures 1 through 3
B – Photographs 1 through 26

Copies Submitted: Above (2 Originals and 1 Electronic Copy)

ATTACHMENT A



1
FIG. 1

GENERAL SITE PLAN

SCALE: 3/16"=1'-0"

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GENERAL SITE PLAN

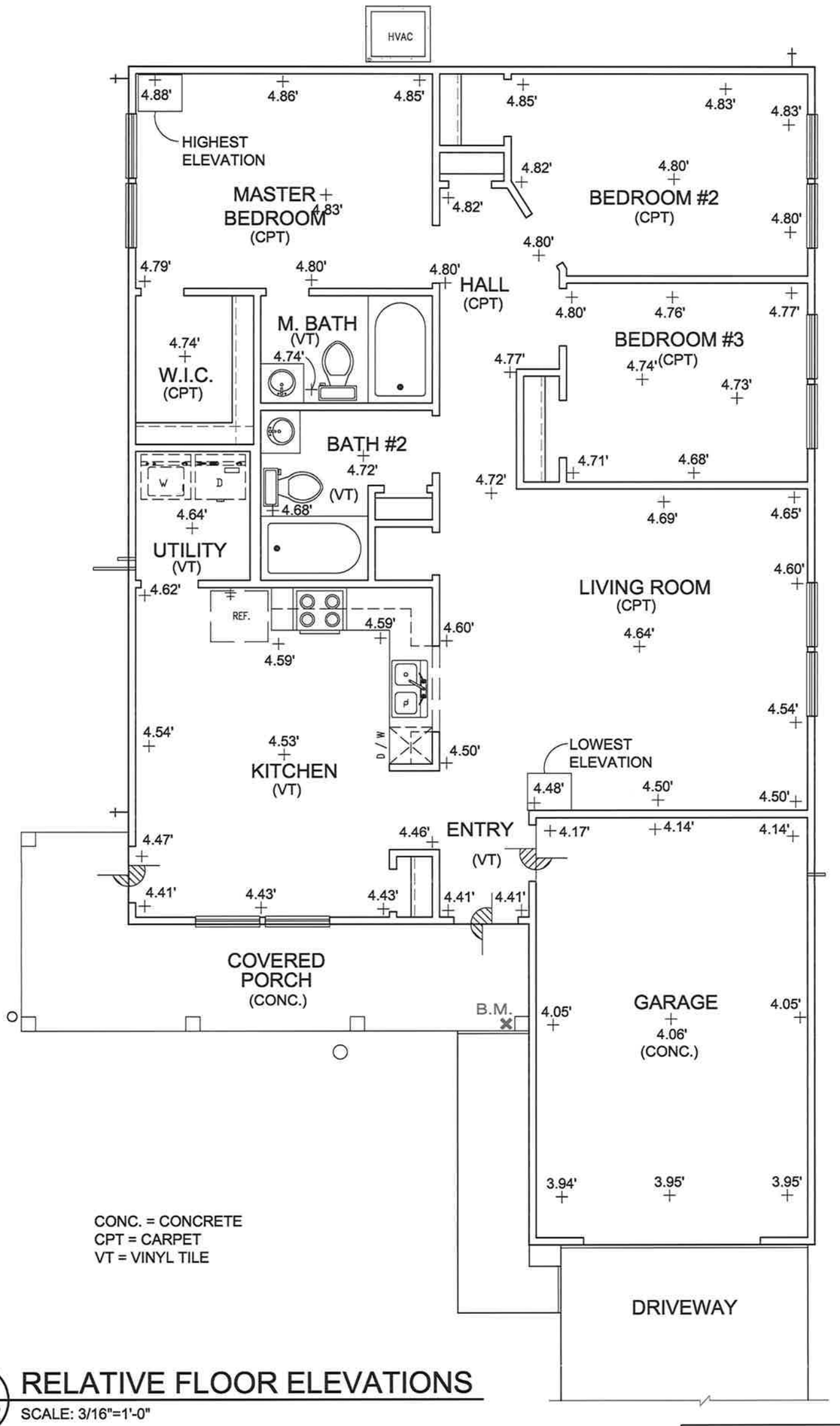
RESIDENTIAL STUDY

142 VILLA GRANDE
SAN ANTONIO, TEXAS

REVISIONS: No.	DATE	DESCRIPTION

PROJECT No.:	ASR08-061-00
DRAWN BY:	
CHECKED BY:	
REVIEWED BY:	

FIGURE 1



CONC. = CONCRETE
CPT = CARPET
VT = VINYL TILE

1
FIG. 2

RELATIVE FLOOR ELEVATIONS

SCALE: 3/16"=1'-0"

NOTE:
ELEVATIONS MEASURED IN HUNDRETHS OF A FOOT ON JUNE 24, 2008 USING STANDARD ELEVATION EQUIPMENT PLACED ON THE FLOOR SLAB COVERING OR THE EXPOSED CONCRETE SLAB.

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RELATIVE FLOOR ELEVATIONS

RESIDENTIAL STUDY
142 VILLA GRANDE
SAN ANTONIO, TEXAS

REVISIONS: No.	DATE	DESCRIPTION

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FIGURE 2

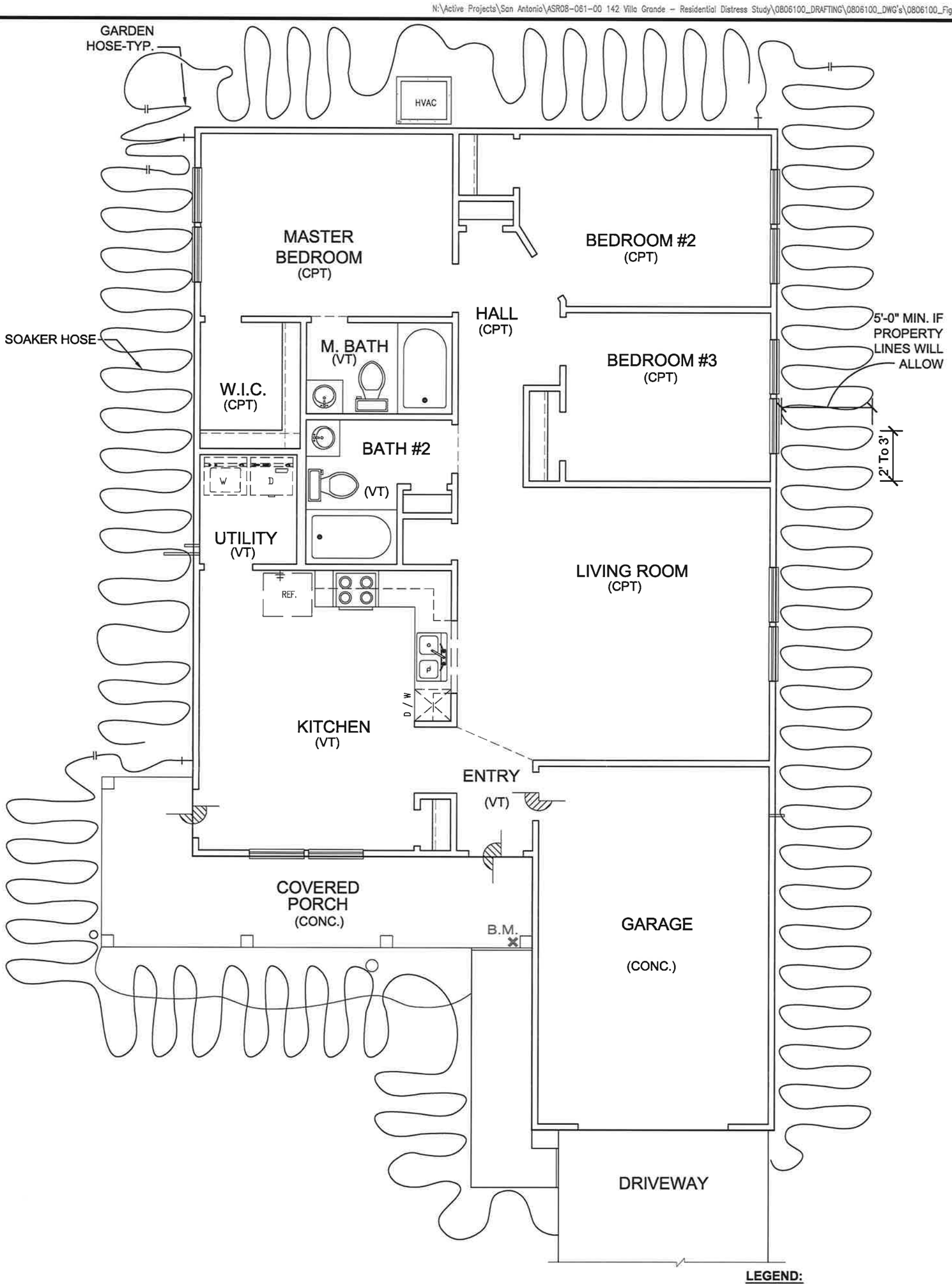

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FIG. 3

SOAKER HOSE LAYOUT

SCALE: 3/16"=1'-0"

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SOAKER HOSE LAYOUT

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REVIEWED BY:	

FIGURE 3

ATTACHMENT B

PHOTOGRAPH 1

PHOTOGRAPH 2

PHOTOGRAPH 3

PHOTOGRAPH 4

PHOTOGRAPH 5

PHOTOGRAPH 6

PHOTOGRAPH 7

PHOTOGRAPH 8

PHOTOGRAPH 9

PHOTOGRAPH 10

PHOTOGRAPH 11

PHOTOGRAPH 12

PHOTOGRAPH 13

PHOTOGRAPH 14

PHOTOGRAPH 15

PHOTOGRAPH 16

PHOTOGRAPH 17

PHOTOGRAPH 18

PHOTOGRAPH 19

PHOTOGRAPH 20

PHOTOGRAPH 21

PHOTOGRAPH 22