Raba Kistner

Project No. ASR08-044-00
September 22, 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
402 Precious Drive
San Antonio, Texas

Dear Mr. Pape:

Raba-Kistner Consultants, Inc. (R-K) is pleased to submit this document of our engineering services provided for the above referenced residence. It is our understanding that this work is being performed to assess the general physical condition of the above referenced residence and to identify specific items that maybe influencing the performance of this monolithic concrete foundation and wood frame. To accomplish this objective we conducted visual observations of the structural condition of the building frame and foundation along with relative floor elevation measurements and some non-destructive testing of the foundation. This document presents our observations and opinions in accordance with our approved scope of work presented in **R-K** proposal No. PSR08-080-00, dated May 16, 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, Facia, 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 July 8, 2000. Sheet S-1;
  - MEP Drawings prepared by INCE Distributing of San Antonio, Texas, not dated, Sheets HVAC-1, 2, and 3;
  - Plumbing Drawings prepared by Ashley Plumbing of San Antonio, Texas, Sheets MECH-1, 2, and 3; and
  - Truss/Wall Panel Design Drawings prepared by Structural Lumber Company of San Antonio, Texas, not dated, Sheets RF-1 to RF-9.

- Geotechnical Report prepared by Nova Consulting Group, Inc. of San Antonio, Texas, dated September 30, 1999, pages 1 through 14 with Boring Logs B-1 through B-38.
- 79-G Letter for Earthwork Fill Evaluation Villas of Fortuna Subdivision Lots 1 Thru 17 and Lots 1 Thru 27 San Antonio, Texas prepared by Integrated Testing and Engineering Company of San Antonio, L.P., (InTEC), dated October 27, 2000.

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 set of the "as-built" construction drawings were not available. Some of our observations were limited due to building finishes, 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

During a telephone conversation on Thursday, May 22, 2008 between Mr. Edward Pape, Client, and Mr. Ignacio Vivanco, E.I.T. of **R-K**, it is our understanding that repairs have been performed to this residence between the months of April and May, 2008. On the basis of this conversation, we were provided with the following information:

- The hot water heater and the heating, ventilation, and air-conditioning (HVAC) units were replaced.
- The roof and roof vents were repaired.
- The horizontal sliding windows were replaced with new windows and the wall penetrations were flashed and sealed. Additionally, the front and right side exterior doors were replaced.
- All penetrations through the exterior walls were flashed and sealed.
- Vinyl flooring was installed in the kitchen, laundry room, and bathrooms.
- Wall-to-wall carpet was within the living spaces of the home.

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. The exterior wood frame of the home is covered with a fiber cement siding material on all sides. 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. At present, the slab-on-ground is covered with wall-to-wall carpet, with the exception of the kitchen, laundry room, and bathrooms, where it is covered with vinyl tile floor covering. The garage is exposed concrete located on the left side of the home. 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

On Thursday, May 29, 2008, Ignacio Vivanco of **R-K** was present at the above referenced home to make visual observations of the structural condition of the building frame and foundation. While walking around the exterior of the home, the following observations were noted:

- The ground surface grading around the home is generally good along the front. Surface grading along the left, right, and back of the residence is relatively flat.
- A layer of neat cement coating was applied to the exposed portion of the concrete perimeter beams.
- A horizontal separation between the soil and the perimeter grade beam along the right side of the home near the kitchen side door as shown on Photographs 5 and 6, and at the left-front corner of the garage, as shown on Photograph 7 in Attachment B.
- The polyvinyl chloride (PVC) water heater temperature/pressure relief (T/P R) drain pipe exits adjacent to the left exterior concrete grade beam as shown on Photograph 8 in Attachment B. The copper drain line, located along the right perimeter grade beam was abandoned once the hot water heater was replaced and two new PVC drain lines were installed.
- The HVAC condensate drain line empties adjacent to the right exterior concrete grade beam as shown on Photograph 9 in Attachment B. We encountered water directly underneath this line.
- There is only one gutter and one downspout along the roof eaves of this residence. This gutter collects rainwater from the right portion of the garage roof and redirects the runoff to a downspout located on the right-front corner of the garage. The downspout, in turn, drains the rainwater directly onto the concrete walkway as shown on Photograph 10 in Attachment B.
- The sanitary sewer cleanout is located in the front yard, approximately 4 feet from the front covered porch.
- There is previously patched random concrete cracking on the porch slab as shown on Photograph 11 in Attachment B.

INTERIOR OBSERVATIONS

On Friday, May 16, 2008, Mr. Brandon Koropsak of **R-K** was present at the above referenced residence to conduct visual observations of the general physical condition of the inside of the home and perform a relative floor elevation survey of the floor slab. At the time of Mr. Koropsak's visit, the concrete floor slab within the residence was bare, with the exception of the kitchen, laundry room, and the hallway and master bathrooms which had recently been

covered with vinyl tile floor covering. Additionally, on Thursday, May 29, 2008, Mr. Vivanco was present at this home to gather additional information. At the time of Mr. Vivanco's visit, the floor in the living room, hallway, and bedrooms had been covered with wall-to-wall carpet. Our observations are the following:

- We noted cracks in the concrete floor slab along the right side of the hallway, as shown on Photographs 12 and 13 in Attachment B.
- Several random plastic shrinkage cracks were observed on the surface of the living room floor slab as shown on Photographs 14, 15, and 16 in Attachment B.
- We also noticed a concrete crack near the hallway bathroom as shown on Photograph 17 in Attachment B. Since there is vinyl floor covering within the bathroom, we do not know where this crack extends in the bathroom.
- Within the master bedroom, there are several random cracks in the floor slab as shown on Photograph 18 in Attachment B.
- We did not note any cracks in the sheetrock covered walls or ceilings throughout the home.

RELATIVE FLOOR ELEVATIONS

On Friday, May 16, 2008, Mr. Koropsak performed the relative floor elevations using standard elevation measuring equipment placed at various locations on the concrete floor surface throughout the home. As stated earlier in this document, the kitchen, laundry room, and the hallway and master bathrooms had been recently covered with vinyl tile; and, all measurements obtained in these are on the floor covering surface. 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, near the right front corner of the home. 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 referenced 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 was determined to be at elevation 4.35 feet near the right wall of the hallway bathroom. The lowest measurement within the living space footprint was measured in the master bathroom, between the commode and the bathtub, at about 4.28 feet. The maximum floor differential between the highest and lowest elevation on the floor slab was determined to be 0.84 inches or about 7/8 inches over a 6 foot distance.

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 16 to 20 inches on center each way in front to back and left to right directions.

SOILS INFORMATION

The geotechnical data reported by Nova Consulting Group, Inc., identified the soils conditions encountered within this subdivision consist of undocumented fill materials generally comprised of highly plastic, tan and brown clay soils with gravel that range in thickness from about 1 foot to 6 feet. We understand that the thickness of the fill materials generally increased across the site from left to right, Fortuna Street to Zarzamora Creek, respectively. These fill materials are underlain by hard, dark gray to gray to tan and gray, highly plastic natural clay soils. Additionally, we understand that the Potential Vertical Rise (PVR) values calculated for this area ranged in the magnitude of 5 to 6-inches.

From our review of the 79-G Letter prepared by InTEC, revealed that 108 field density (compaction) tests were performed throughout the subdivision as part of the site grading activities prior to the construction of the residential concrete foundations. According to the density test reports performed within the lots located in close proximity to the subject residence, compaction tests were performed on the native subgrade soils as well as 2 lifts of fill materials placed on top of the subgrade soils. Assuming that the fill materials were placed in 6-inch to 8-inch lifts, then only the top foot of the fill materials was tested demonstrating compliance with good construction compliance.

On August 29, 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 highly plastic dark brown clay with traces of 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	30.4%	23.2%
Liquid Limit	64	57
Plastic Limit	20	15
Plasticity Index	44	42

The clay soils that exist beneath the home are considered to be highly expansive soils. Expansive soils are clay soils that can exhibit 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 July 6, 2000 was 59. The average Plasticity Index determined by our soils testing was 43. The design Plasticity Index is 16 points greater than the site specific soils.

COMMENTS

With the exception of some localized movements that have occurred between the hallway bathroom and the master bathroom, the floor slab is relatively flat and is performing within the boundaries for floor slab elevation differentials in the San Antonio locale. In general, the random cracking conditions observed in the floor slab at the time of our site visits 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.

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 right side of the garage, 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.

A review of the density test reports and the 79-G letter prepared by InTEC, revealed that at most, only about 1 foot of the fill materials was tested during the site grading activities performed within the residential lots located in close proximity to the subject residence. If the fill soils were not correctly compacted, settlement related movements could occur resulting in possible cracking of the foundation and interior/exterior finishes. On the basis of the soils information and testing documentation provided to us, we do not have enough information to assess the possible contribution of other causes of cracking to the foundation and structural frame of the home.

OPINIONS

On the basis of our observations/measurements, measured relative floor elevations, site specific soils test information, our non-destructive test information, 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 foundation are plastic shrinkage and dry shrinkage cracking and crack widths are related to soil movements supporting the foundation and will not impact good long term performance of the foundation.

- The movements are not associated with plumbing leaks; however, this should be confirmed by performing plumbing leak testing.
- The foundation cracks are minor in nature, with crack widths of less than 1/16-inch, and the foundation supporting the home and the wood frame are considered structurally adequate.
- The foundation and frame do not demonstrate structural failure cracking conditions.
- The concrete foundation does not demonstrate materials weakness or construction deficiencies.
- 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 right side of the foundation and at the left-front corner of the garage. 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 will allow, away from the foundation as shown on Figure 3 in Attachment A of this document. Watering should be performed once per week for about four hours maximum. The flow rate of water through the soaker hoses should be maintained at a 3/4 valve turn at the hose bibbs. Generally, 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. 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.

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

Very truly yours,

RABA-KISTNER CONSULTANTS, INC.

Jesse H Aguilar, P.E.
Project Engineer

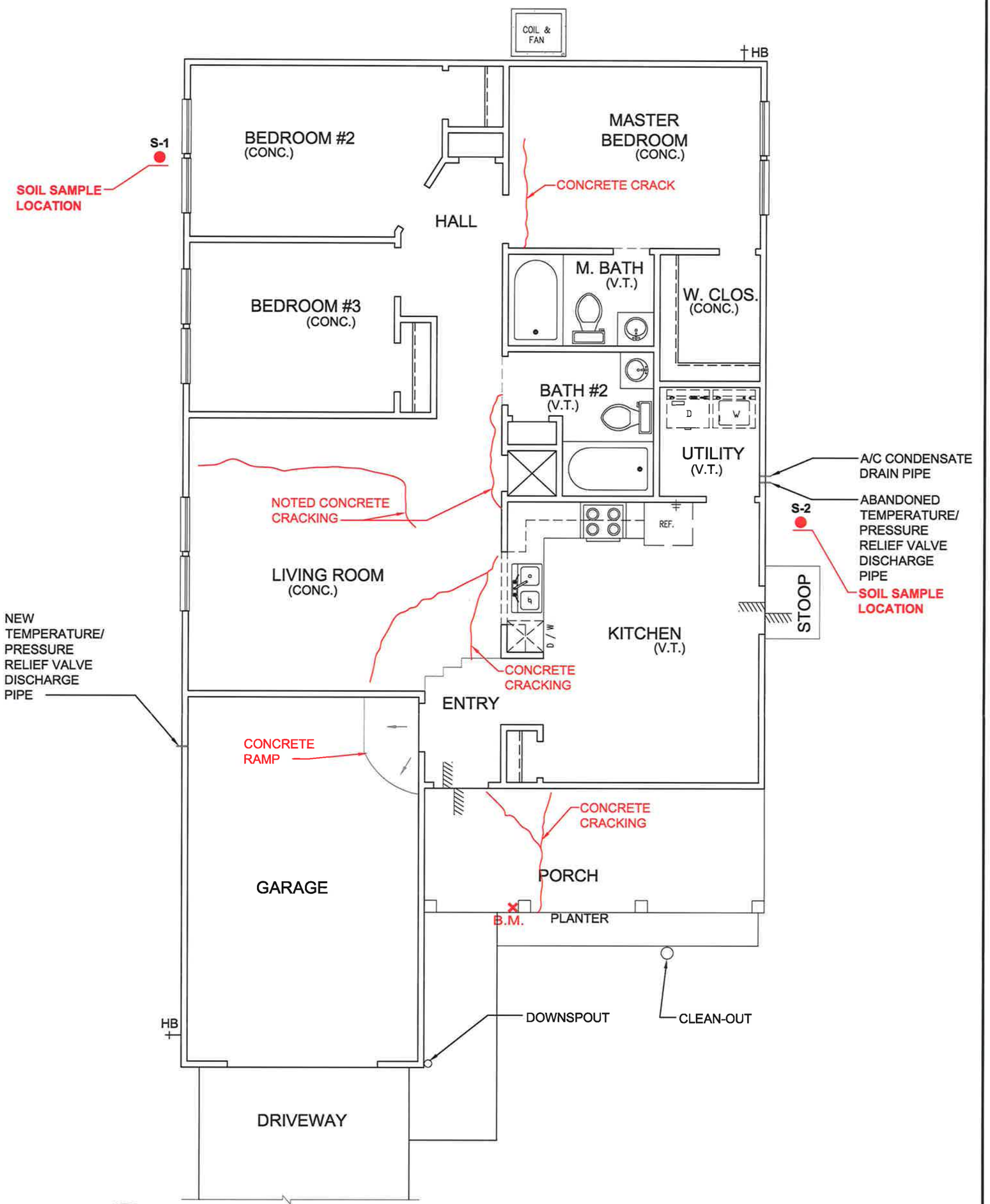
Richard W. Kistner, P.E.
Vice Chairman

JHA/RWK/jg

Attachments: A – Figures 1 through 3
B – Photographs 1 through 18

Copies Submitted: Above (2) & (1) Electronic Copy

ATTACHMENT A



1
FIG. 1

GENERAL SITE PLAN

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

LEGEND:

APPROXIMATE LOCATION OF VISIBLE CRACKS

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GENERAL SITE PLAN

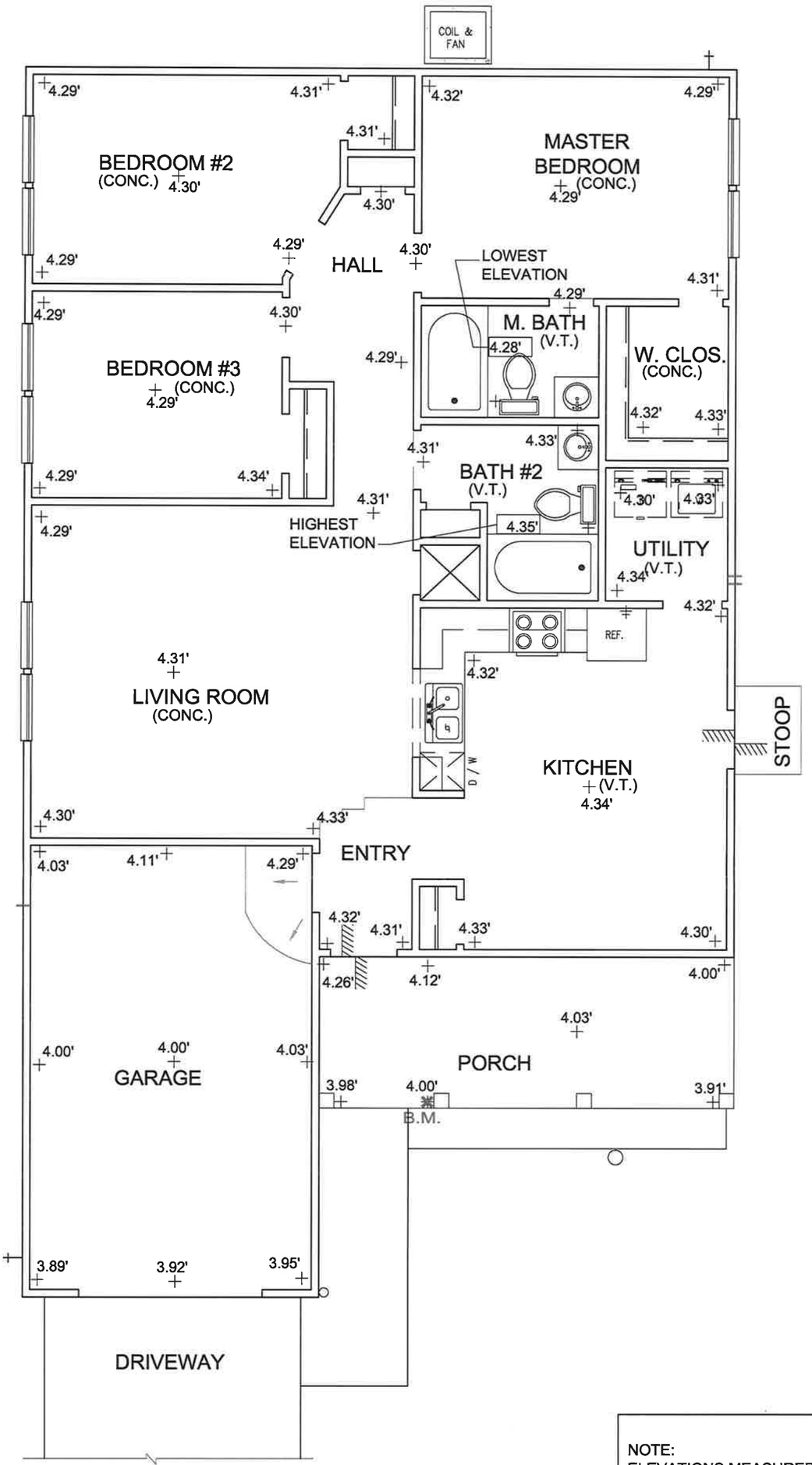
RESIDENTIAL STUDY

402 PRECIOUS DRIVE
SAN ANTONIO, TEXAS

REVISIONS: No.	DATE	DESCRIPTION

PROJECT No.:	ASR08-044-00
DRAWN BY:	
CHECKED BY:	
REVIEWED BY:	

FIGURE 1



1
FIG. 2

RELATIVE FLOOR ELEVATIONS

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

NOTE:
ELEVATIONS MEASURED IN HUNDRETHS OF A FOOT ON MAY 16, 2008 USING STANDARD ELEVATION MEASURING EQUIPMENT PLACED ON THE FLOOR SLAB COVERING OR THE EXPOSED CONCRETE SLAB.

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RELATIVE FLOOR ELEVATIONS

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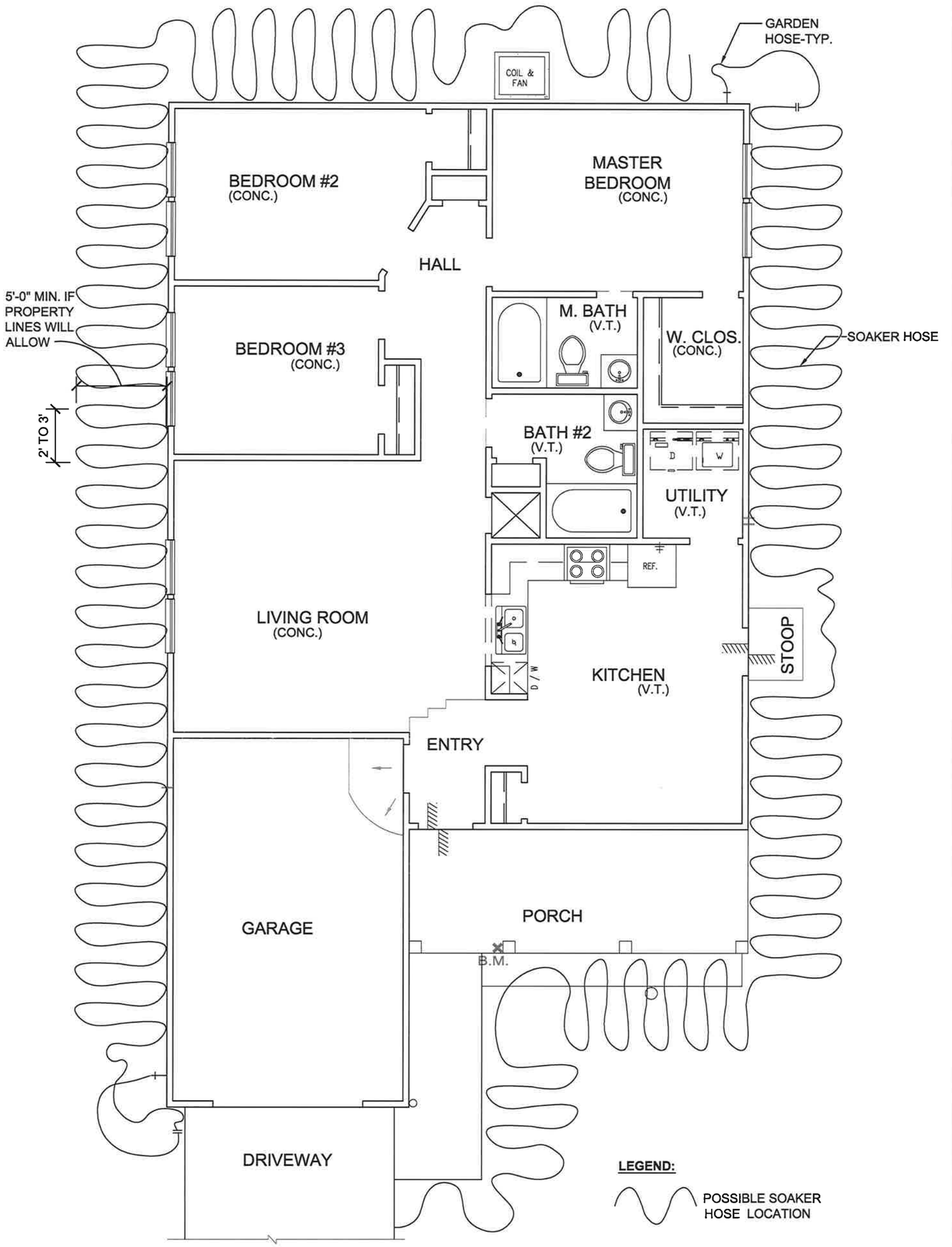
FIGURE 2



1 / FIG. 3 SOAKER HOSE LAYOUT

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

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SOAKER HOSE LAYOUT

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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