Raba Kistner

Project No. ASR08-058-00
October 6, 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
440 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 indentify 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 reinforced concrete beam and slab-on-ground foundation. This document presents our observations and opinions in accordance with our approved scope of work presented in **R-K** proposal No. PSR08-099-00, dated June 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, 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 July 7, 2000 marked 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, pages 1 through 14 and Appendices A-1 through A-6.
- Inspection Report page 2 of 9 prepared by Amerispec Home Inspection Service, (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. 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 18, 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. Matthew Michulka with the San Antonio Housing Authority, we were provided the following information:

- The home was constructed sometime during 1998 and has been vacant for approximately 1-year.
- The hot water heater and the heating, ventilation, and air-conditioning (HVAC) units were replaced earlier this year.
- The exterior ground surface was recently regarded to promote positive drainage away from the foundation.
- The horizontal sliding windows were replaced and new windows and the wall penetrations were flashed, and sealed.

GENERAL INFORMATION

All directional descriptions of the home are determined by 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 "floating" foundation. The exterior wood frame of the home is covered with a fiber cement siding system 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 spaced about 24-inches on center. At the time of our visit, the slab on ground concrete was exposed with the exception of the kitchen, utility room, and bathrooms which were covered with a vinyl

floor system. The garage is exposed concrete located on the left 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 of this document.

EXTERIOR OBSERVATIONS

During our site visit performed on June 18, 2008, the following observations were noted while walking around the exterior of the home:

Front

- Surface grading is considered good with the ground sloping away from the foundation as shown on Photograph 1 in Attachment B.
- The downspout located at the right-front corner of the garage exits onto the concrete walkway located along the right side of the garage as shown on Photographs 5 and 6 in Attachment B.
- New sod was noted within the front yard.
- There is one medium size tree located approximately 27 ft from the foundation.
- No vertical or horizontal movements existed between the concrete foundation and driveway slab or the entrance sidewalk slab.
- No foundation cracks were noted from the soil line up to the cement board siding.

Left

- Surface grading is considered good with the ground sloping away from the foundation as shown on Photograph 2 in Attachment B.
- There is a horizontal separation between the soil and the perimeter grade beam along the left side of the home as shown on Photograph 7 in Attachment B.
- The new polyvinyl chloride (PVC) temperature/pressure relief (T/P R) valve drain lines are located on this side of the home.
- Installing fence posts for privacy wood fence.
- No foundation cracks were noted from the soil line up to the cement board siding.

Back

- Surface grading is considered good with the ground sloping away from the foundation as shown on Photograph 3 in Attachment B.
- The new sod, located along the perimeter grade beam, is placed high up against the grade beam as shown on Photograph 8 in Attachment B.
- Dry soil conditions were observed in the yard where shrinkage cracks have formed in the ground surface as shown on Photograph 9 in Attachment B.
- No foundation cracks were noted from the soil line up to the cement board siding.

Right

- The ground surface grading along the right side of the home is relatively flat as shown on Photograph 4 in Attachment B.
- New sod has been installed along the right side of the home and extends about 3-ft away from the grade beam.
- The PVC condensate drain line, located approximately 6-ft to the rear of the kitchen side door, has been cut off where it exits the perimeter grade beam as shown on Photograph 10 in Attachment B.
- A hairline crack in the concrete beam was observed adjacent to the PVC condensate drain line.
- Installing new wood fencing.
- No relative movements between the foundation and the small concrete slab.

INTERIOR OBSERVATIONS

At the time of our site visit, the concrete floor slab within the residence was bare, with the exception of the entry, kitchen, laundry room, and the hallway and master bathrooms which had vinyl floor covering. While performing visual observations of the interior of the home, the following observations were noted:

Kitchen

- No signs of cracking or separations were noted.

Utility Room

- No signs of cracking or separations were noted.

Living Room

- Several previously patched diagonal and transverse cracks were observed on the surface of the living room floor slab as shown on Photograph 11 in Attachment B. These cracks vary up to about 0.05-inches in width.

Front-to-Back Hallway

- Several previously patched transverse cracks were observed on the surface of the living room floor slab as shown on Photograph 12 in Attachment B.

Hallway Bathroom

- Water damage was observed along the wood molding located behind the water closet as shown on Photograph 13 in Attachment B.

Master Bedroom

- Previously patched longitudinal and transverse cracks were observed across the floor slab as shown on Photograph 14 in Attachment B. These cracks vary up to about 0.03-inches in width.

Master Closet

- A transverse crack was observed across the closet floor slab as shown on Photograph 15 in Attachment B. This crack varies up to about 0.02-inches in width.

Master Bathroom

- Water damage was observed along the wood molding located behind the water closet.

Left-Rear Bedroom

- Previously patched longitudinal and transverse cracks were observed across the floor slab as shown on Photographs 16 and 17 in Attachment B. These cracks vary up to about 0.03-inches in width.

Left-Middle Bedroom

- Previously patched transverse cracks were observed across the floor slab as shown on Photographs 18 and 19 in Attachment B. These cracks vary up to about 0.016-inches in width.

Garage

- Transverse cracks were observed across the floor slab as shown on Photographs 20 and 21 in Attachment B. These cracks vary up to about 0.040-inches in width.

RELATIVE FLOOR ELEVATIONS

During our site visit, relative floor elevations were measured by **R-K** using standard elevation measuring equipment placed at various locations on the floor surfaces throughout the home. Presented on Figure 2 of 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 temporary 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 drawing are relative to this assigned value of 4 feet.

From Figure 2, the highest relative floor elevation measurement on the concrete floor slab, within the home's footprint, was determined to be at elevation 4.40 feet, recorded near the right-rear corner of the master bedroom. The lowest measurement on the concrete floor slab was determined to be at elevation 4.31 feet, recorded near the middle of the master bedroom closet. The maximum floor differential between the highest and lowest elevation on the concrete floor slab was determined to be 1.08 inches or about 1-inch over a 15 foot distance (about 3/8 inch over a 5 foot distance). The garage floor slab was built to drain wash water from back-to-front and out onto to driveway slab.

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 living room and master bedroom floor slabs 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 is about 16 inches on center each way in front-to-back and left-to-right directions.

SOILS INFORMATION

On the basis of the information provided in the geotechnical report prepared by Nova Consulting Group, Inc., it is our understanding that the soils conditions encountered within this subdivision consist of undocumented fill materials comprised of highly plastic clay soils with gravel that range in thickness from about 1 foot to 6 feet. In general, we understand that the thickness of the fill materials generally increased across the site from south to north, 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. Further, we understand that the Potential Vertical Rise (PVR) values calculated for this area ranged between 5 to 6-inches.

A 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 residences. According to the density test reports performed within the lot where the subject residence is located, 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 1 foot of the fill materials was tested.

On August 27, 2008, **R-K** performed a second site visit to the home to obtain 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 gray 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 gray clay with sand. 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	25.9%	30.5%
Liquid Limit	64	67
Plastic Limit	18	19
Plasticity Index	46	48
Clay particles passing a #200 sieve	*	82.0%

* 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 absorb water (damp to wet). The foundation design Plasticity Index on the foundation drawing sheet marked S-1 dated July 6, 2000 is 59. The average Plasticity Index determined by our soils testing was 47. The design Plasticity Index is 12 points greater than the site specific soils.

COMMENTS

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 concrete cracking conditions observed in the floor slab at the time of our site visits are considered to be normal and not structural deficiency.

There are several factors that can cause and/or influence cracking of beam and slab-on-ground foundations including; soil-related movements, 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 name a few. Based on our preliminary observations, the random cracking has not negatively affected the performance of the foundation system.

Poor drainage conditions observed along the right side 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. 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 and may pond 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. Rain water that ponds adjacent to the foundation may soak into the soils located along the perimeter grade beam and could possibly wet the soils beneath 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. Possible plumbing leaks beneath the foundation may also contribute to differential foundation movements. We recommend that plumbing leak testing be performed to assess if leaks are occurring beneath the foundation.

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 soil test information, our non-destructive test information, 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 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 differential elevation movements are not associated with plumbing leaks; however, this should be confirmed by performing plumbing leak testing on both domestic water supply lines and the sanitary sewer lines within and beneath the foundation.
- The foundation cracks are normal, with crack widths of less than 1/16-inch.
- The foundation and frame do not demonstrate 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 foundation. The moisture content of the surface clay soils should be maintained at a uniform 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. 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 12-foot long garden hoses that are 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 bibbs. Watering should be controlled so that there is no trapped or ponded water near 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 document, or if we may be of additional service, please call.

Very truly yours,

RABA-KISTNER CONSULTANTS, INC.

STATE OF TEXAS
JESSE H. AGUILAR
100290
LICENSED
PROFESSIONAL ENGINEER
10-6-08

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 21

Copies Submitted: Above (3 Originals and 1 Electronic Copy)

ATTACHMENT A

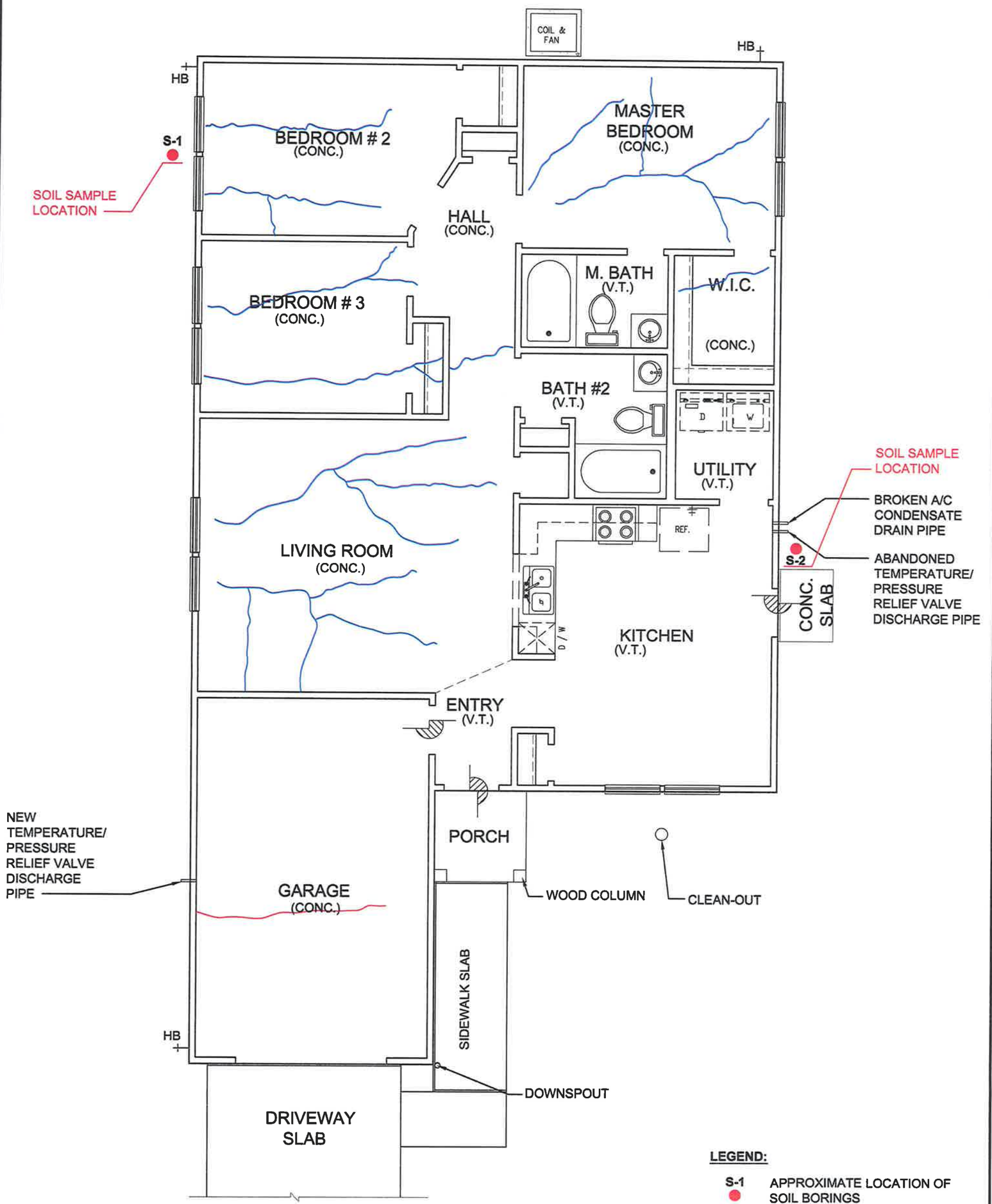

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FIG. 1

GENERAL SITE PLAN

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

LEGEND:

- S-1 — APPROXIMATE LOCATION OF SOIL BORINGS
- APPROXIMATE LOCATION OF PREVIOUSLY REPAIRED CRACKS
- APPROXIMATE LOCATION OF VISIBLE CRACKS

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GENERAL SITE PLAN

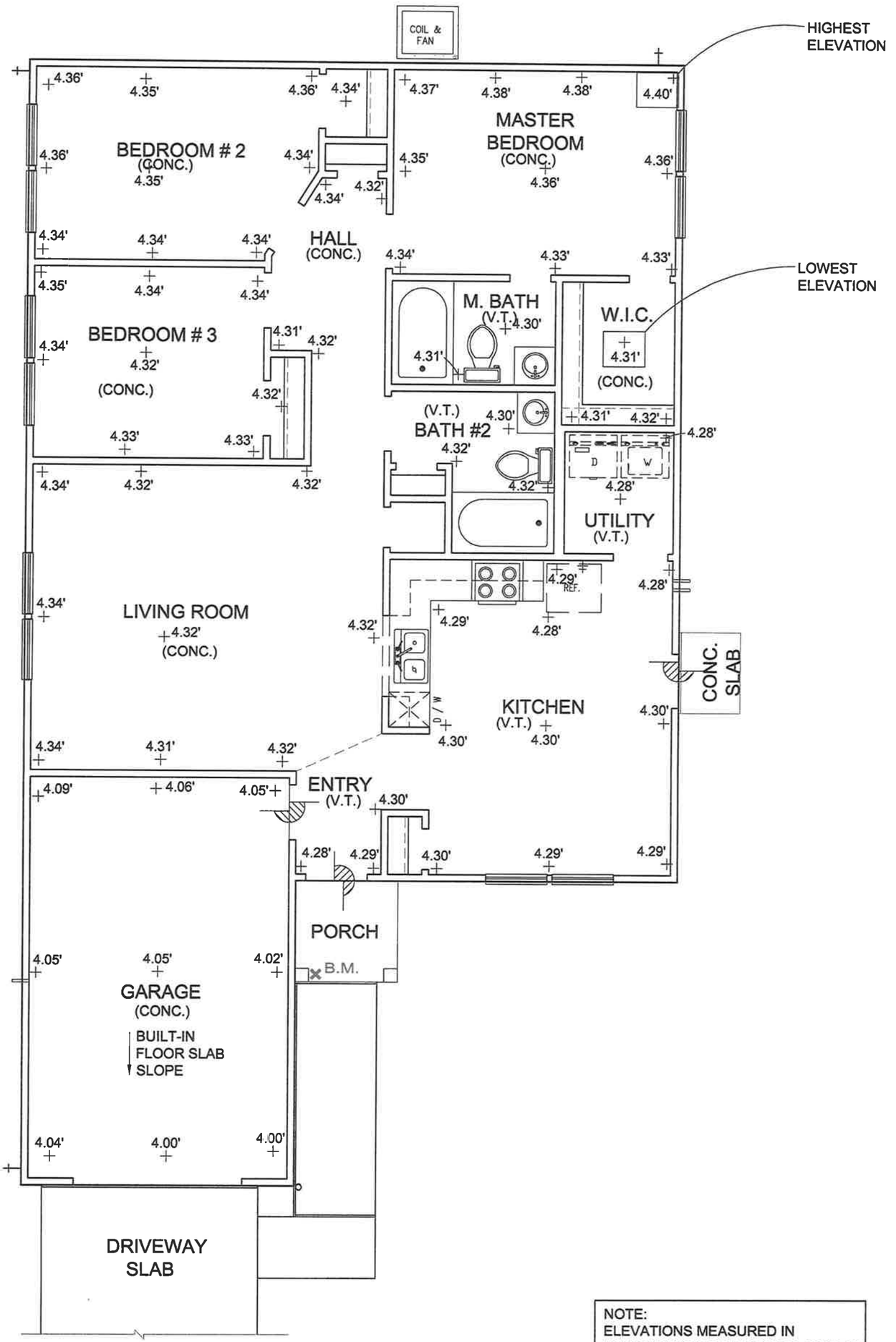
RESIDENTIAL STUDY

440 PRECIOUS DRIVE
SAN ANTONIO, TEXAS

REVISIONS: No.	DATE	DESCRIPTION

PROJECT No.:	ASR08-058-00
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 JUNE 18, 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

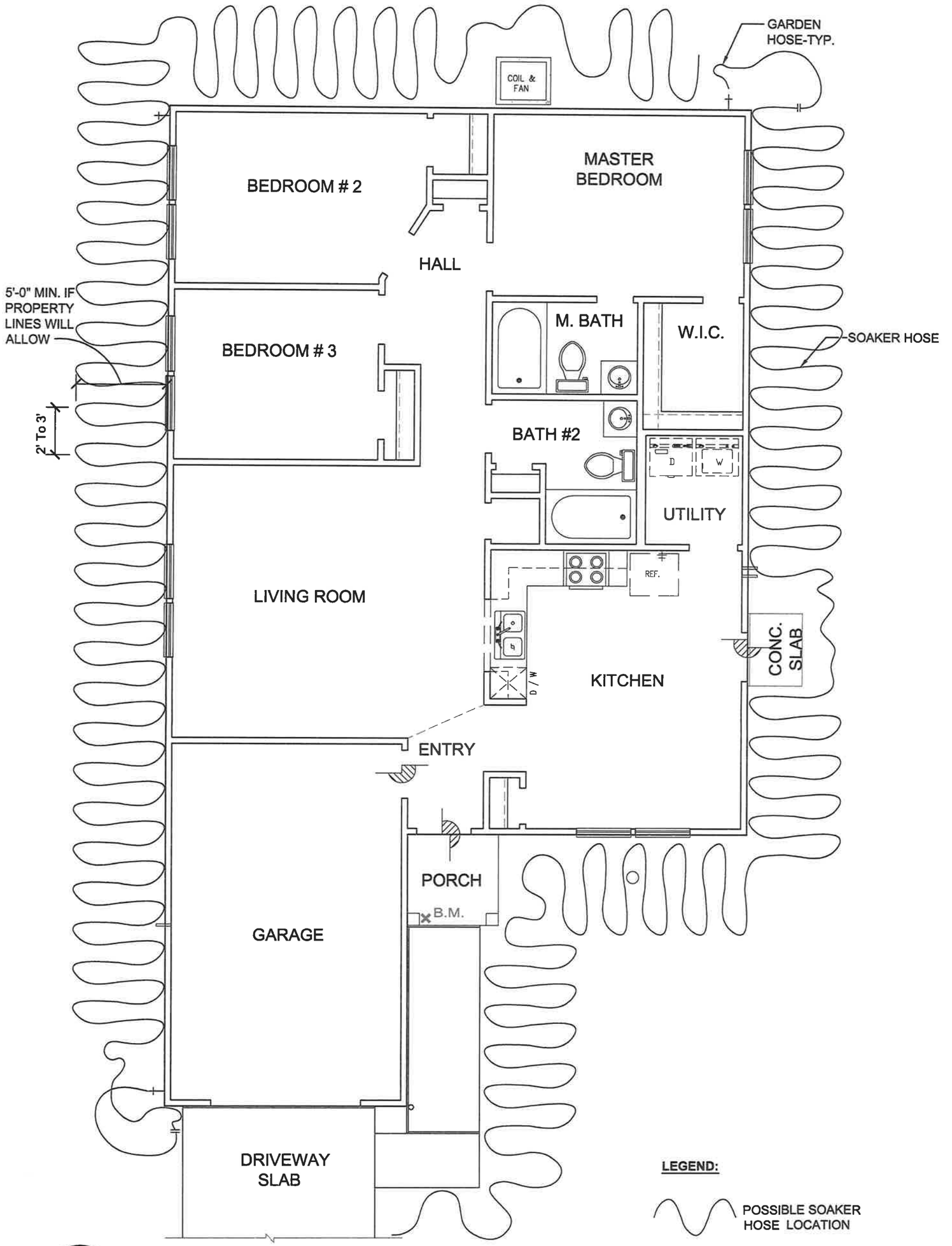

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FIG. 3

SOAKER HOSE LAYOUT

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

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FIGURE 3

ATTACHMENT B

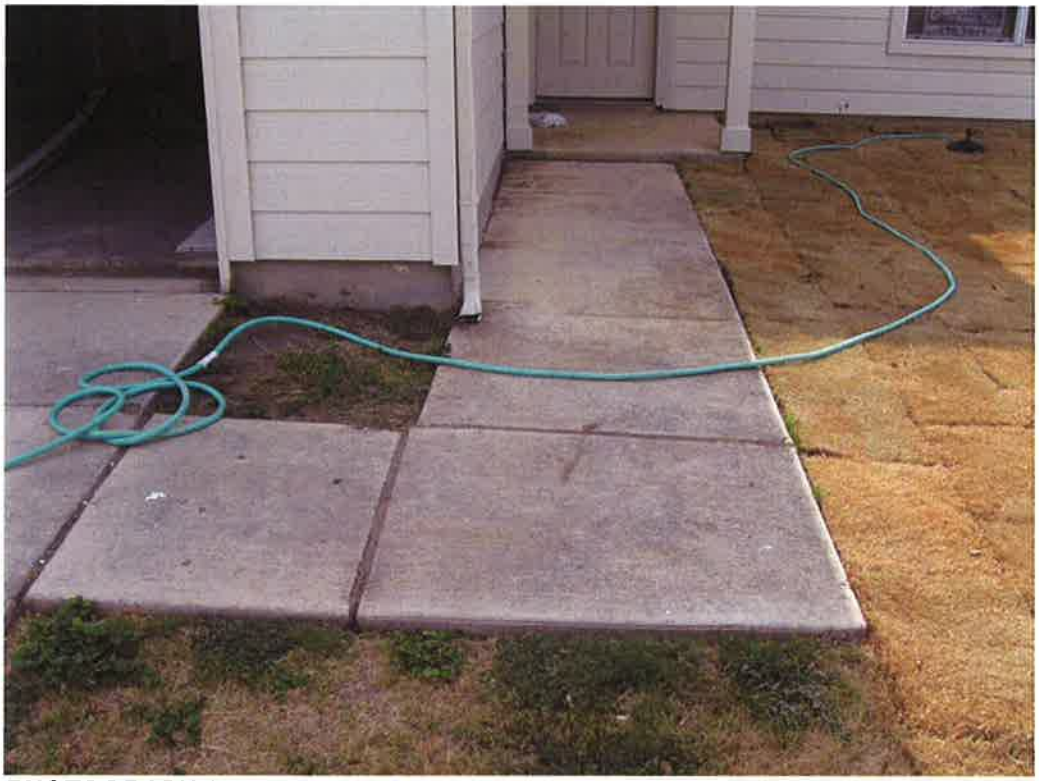
PHOTOGRAPH 1

PHOTOGRAPH 2

PHOTOGRAPH 3

PHOTOGRAPH 4

PHOTOGRAPH 5



PHOTOGRAPH 6

PHOTOGRAPH 7

PHOTOGRAPH 8

PHOTOGRAPH 9

PHOTOGRAPH 10

PHOTOGRAPH 11

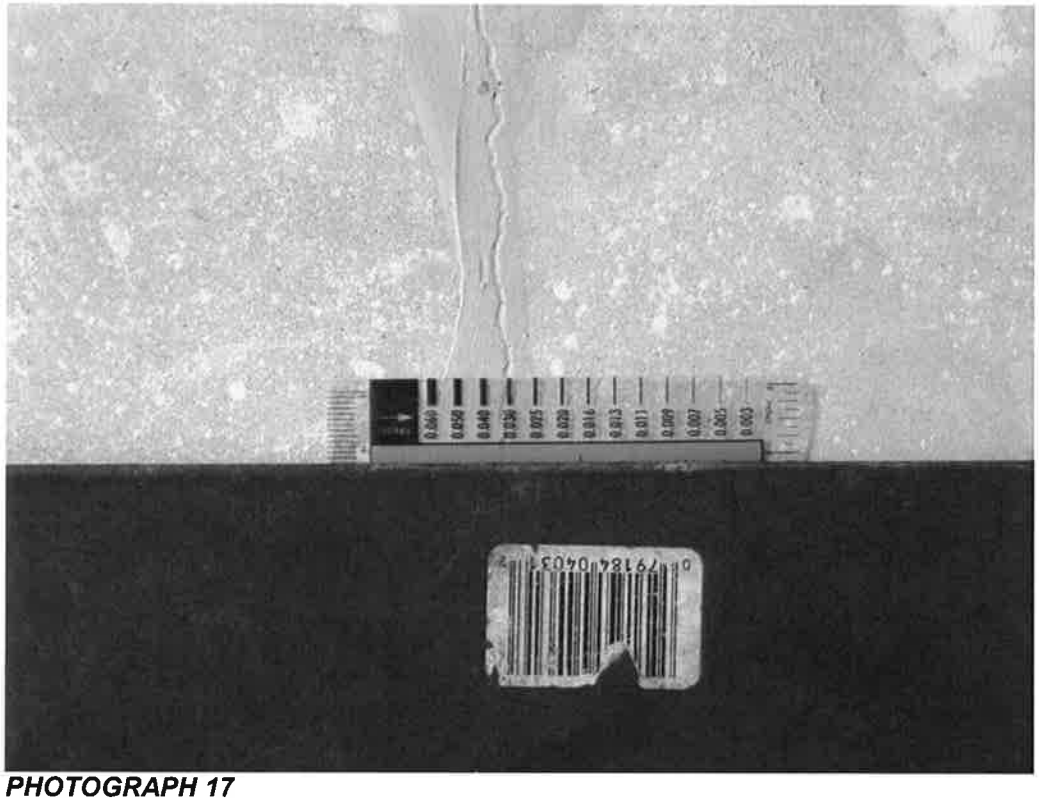
PHOTOGRAPH 12

PHOTOGRAPH 13

PHOTOGRAPH 14

PHOTOGRAPH 15

PHOTOGRAPH 16



PHOTOGRAPH 17

PHOTOGRAPH 18

PHOTOGRAPH 19

PHOTOGRAPH 20

PHOTOGRAPH 21