INDOOR ENVIRONMENTAL QUALITY EVALUATION

GAMBOA RESIDENCE
130 VILLA GRANDE, BLUERIDGE
SAN ANTONIO, TEXAS

Prepared for

SAN ANTONIO HOUSING AUTHORITY
SAN ANTONIO, TEXAS

by

ETC INFORMATION SERVICES, LLC

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Project No. 7A-020
May 17, 2007

Mr. Timothy Alcott
San Antonio Housing Authority
1315 N. Elmendorf
San Antonio, Texas 78207

Re: Indoor Environmental Quality Evaluation
Gamboa Residence 130 Villa Grande, San Antonio, Texas

Dear Mr. Alcott:

A copy of the report for the investigation of the referenced property is being forwarded to you for your information and necessary action. This report is part of a more comprehensive report on ten properties in the Villas at Fortuna, Blueridge, and Sunflower subdivisions. The comprehensive report should be used for a full introduction, discussion of field operations, and discussion.

We will be happy to answer any questions concerning this report. It has been a pleasure working with you on this important assignment. We look forward to being of continuing service to you.

Sincerely,

ETC INFORMATION SERVICES, LLC

Donald J. Schaezler, Ph.D., P.E., CIH
President

1.0 INTRODUCTION AND BACKGROUND

1.1 Purpose of the Evaluation

The subject residence was evaluated for indoor environmental quality conditions April 17, 2007. The purposes of the evaluation were as follows:

- To interview residents about their complaints with respect to water damage, mold, health symptoms, and other indoor environmental issues
- To collect indoor air samples for identification and enumeration of airborne fungal spores and culturable fungi
- To collect indoor air samples for enumeration of fiber glass and other mineral fibers, pollen, skin cell fragments, and other particles
- To measure indoor air quality with respect to common chemical and physical parameters
- To evaluate apparent sources of water damage and visible mold in the residence
- To document areas with excess moisture content in building materials
- To assess, in a preliminary manner, the condition and performance of the HVAC system
- If necessary, to recommend remediation, including preparation of a Mold Remediation Protocol

The investigations were performed at a screening level and were designed to obtain information on the overall condition of the residence. They were not intended to be in-depth investigations of all potential conditions that affect the indoor environment.

The investigations were conducted by Donald J. Schaezler, Ph.D., P.E., CIH, with assistance from other ETC staff. Dr. Schaezler is a licensed Mold Assessment Consultant (MAC), a licensed professional engineer (P.E.), and a Certified Industrial Hygienist (CIH).

1.2 Subject Residence

The subject residence was in the Blueridge subdivision. The residence was apparently built by KB Homes in about 2000. It has been leased to the Gamboa family but is owned by SAHA. Over the past several years, the residents in similar homes had complained to SAHA and KB about a variety of structural and indoor environmental issues. These complaints have triggered investigations by several consultants, including this report.

2.0 FIELD OPERATIONS

2.1 Description of Residence

The subject residence is approximately seven years old and is a single-family dwelling located in west San Antonio, between West Commerce and Culebra Road, near St. Mary's University. It appears to have a reinforced concrete foundation, Hardiplank® siding external wall finish, conventional wood framing, and a complex hip and gable roof with composition shingles. It is a two-story structure with five bedrooms, two bathrooms, one half-bath, Kitchen, Dining Room, Living Room, Utility Closet, and an attached one-car Garage. The layout of the subject residence is shown schematically in Figure 4.

The residence had carpeting in the Living Room, the Dining Room, the Master Bedroom, and the hallways. It had vinyl flooring in the Entry, Kitchen, bathrooms, other bedrooms, and the Utility Closet. Interior finishes were typically textured and painted gypsum board.

There is a single, central HVAC system of split design. The condenser unit (CU) is outside on a concrete pad. The air handler unit (AHU) is in a hallway closet near the Hall Bathroom on the second floor. Return air is routed through a grille in the lower closet door and up through a supporting platform to the AHU. The AHU has a return air filter, evaporator coil, blower, and electric heating unit. Supply air is routed up to the Attic through a ductboard plenum. Flexible runouts are attached to that plenum. There are chases for ductwork to reach the first floor ceilings. The return air plenum is shared by a low profile hot water heater, which sits in an overflow pan. The ceiling penetration in the HVAC Closet is sealed with aluminum foil duct tape. There were small openings to a chase behind the AHU and, probably, to the attic behind the supply air plenum.

The Utility Closet included connections for a washer and a dryer. The dryer exhausted to a vent stack located in a wall cavity, and the vent stack continued through the roof.

For simplicity of discussion in this report, Villa Grande is assumed to run north-south. Directional references, such as front, right, rear, and left will refer to an observer facing the front of the house from the street.

2.2 Observations

1. The resident indicated there had been no plumbing leaks in the house.
2. According to the resident, there had been sewer backups, but they had not caused any overflows inside the house. The problems were solved when a tree was removed.
3. There was water damage and mold growth at the back door, including on the tackboard and the base trim.

4. There was water damage at the head of the tub in the Master Bathroom, including the lower wall and the base trim. The damage was consistent with shower overspray.
5. There was slight water damage at the head of the tub in Bathroom 2, including the lower wall and the base trim. The damage was consistent with shower overspray.
6. There was minor mold growth on several window sills, especially in the Master Bathroom.
7. The carpeting was very dirty and in poor condition.
8. There was slight dust on supply air vents downstairs but heavy dust on some vents upstairs, especially in the Master Bedroom.
9. The return air filter had small clumps of dust particles.
10. The evaporator coils had been cleaned, but there was residual dried scum at the periphery of the coils, and some of the fins had been bent by the cleaning effort.
11. There was some moisture in the bottom of the overflow pan under the hot water heater. The moisture was consistent with minor leaks of water from the water heater or of condensate from the air handler.
12. There were many aquaria in the house. They contained fish and turtles.

Areas with water damage and mold growth are summarized in Table 2, along with other characterizations of investigation results.

2.3 Field Measurements

2.3.1 Moisture Content

Moisture measurements were made for wood, sheetrock, and concrete surfaces in areas with visible or potential water damage with Delmhorst and Tramex moisture instruments. Measurements were also taken in background areas for comparison. Excess moisture was found near the back door, and near the head of both tubs.

2.3.2 Air Quality

During the survey, the indoor area was investigated by measuring general indoor air quality parameters to determine the potential for chemical and physical problems. Temperature, relative humidity, carbon dioxide, and carbon monoxide were measured using a Vulcain Safety Palm field instrument. Results are summarized in Table 3. Key points are discussed below.

1. The indoor relative humidity was unsatisfactory, but the dew point was satisfactory.
2. Carbon dioxide values were marginally high.
3. Carbon monoxide values were zero.

2.3.3 Thermal performance of Heating, Ventilation, and Air-Conditioning System (HVAC)

During the survey, the thermal performance of the HVAC system was not evaluated because of the cool outside temperatures.

2.4 Sampling

The emphasis of the sampling program was to evaluate indoor air quality. The blower in the AHU was turned on before sampling. Samples were collected from three locations, at the return air grille, in the Living Room, and in the Master Bedroom near the Master Bathroom.

2.5 Photographs

Photographs of the subject residence are available for review.

3.0 RESULTS AND DISCUSSION

All sample results are included in the comprehensive report. The results are summarized in the tables and are discussed in this section for comparison purposes.

3.1 Fungi in Air

Three sets of indoor air samples and one outdoor air sample was collected for the house. One set of indoor air samples was collected from near the return air grille, one set was collected from the Master Bedroom near the Master Bathroom, and a third was collected from the Living room. Indoor air samples were collected for indirect evidence of water damage and mold amplification and to evaluate potential exposures to occupants of the house.

Outdoor air samples from the neighborhood were used for all houses in that neighborhood on that day.

Samples were collected for total bioaerosols, using Allergenco D cassettes, which are slit impaction samplers. Sampling was at 15 liters per minute for five minutes. The slides in the cassettes were interpreted microscopically by Aerotech and were analyzed for total bioaerosols. Results of analyses are summarized in Table 5.

Samples were also collected for culturable fungi, using a single stage Anderson-type impactor with potato dextrose agar plates. Sampling was at 28.3 liters per minute for three minutes. The plates were then reassembled, sealed with tape, and shipped to Aerotech for incubation and interpretation. Results of analyses are summarized in Table 6.

1. Outdoor air had low levels of total fungal spores, relative to levels typical in outdoor air.
2. Indoor air in the Gamboa residence had low levels of total fungal spores, relative to outdoor air, but the diversity of spore types was different.
3. In the Living Room, *Aspergillus/Penicillium*-like spores were the most numerous type, whereas these were only present at a trace level in outdoor air. *Alternaria* in the Living Room was also elevated compared to outdoor air.
4. Outdoor air had low levels of total culturable fungi, dominated by *Cladosporium*.
5. *Aspergillus* and *Cladosporium* were the most numerous culturable fungi in the Living Room air, and *Penicillium* was the most numerous at the return air grille, followed by *Aspergillus* and *Cladosporium*.
6. These results indicate that there are likely sources of *Alternaria*, *Aspergillus* and *Penicillium* growth that are affecting the indoor environment.

3.2 Swab Samples

Surface samples were taken with sterile swabs. These samples were analyzed by microscopic examination and by culturing. Results of analyses are summarized in Tables 7 and 8.

3.2.1 Return Air Filter Samples

Return air plenums and filters collect airborne material over an extended period of time. The fungal spores and viable fungi in these locations may represent those that have been present in indoor air over extended periods of time prior to sampling. If conditions are moist where the sample is collected, then the sample may represent a source of microbial amplification.

The return air filter in the Gamboa residence had low levels of total fungal spores but *Alternaria* and *Aspergillus/Penicillium*-like spores were the most numerous types. The spores in the return air filter may reflect the diversity of spores in the indoor air.

The culturable fungi in the return air filter were dominated by *Aureobasidium* and *Penicillium*. *Aureobasidium* requires moist environments, and its presence may reflect high humidity in the indoor environment and on the filter. The *Penicillium* may reflect culturable fungi in the indoor air or growth on the filter.

3.3 Fibers and Other Particles in Air Samples

The Allergenco D slides were evaluated by Aerotech for the presence of fibers and particles of potential interest other than fungal spores and mycelial fragments. The fibers found were compared specifically to attic insulation. The results are summarized in Table 5. Compared to samples collected from other houses, there were low concentrations of fibers in the three samples. There were high levels of skin fragments in two of the three indoor air samples.

3.4 Sources of Water Damage

Based on field observations and measurements, apparent sources of water causing damages at the subject residence include the following:

1. Rain water intrusion at the back door
2. High relative humidity in the indoor air
3. Condensation at windows
4. Water intrusion at windows
5. Overspray from showers onto nearby walls and floors, including the upper wall for the Master shower

4.0 CONCLUSIONS

1. The residence had unsatisfactory relative humidity during the preliminary investigation.
2. The house had inadequate filtration within the air handler unit (AHU). This condition will contribute to problems with excess dust in the house.
3. The residence had somewhat inadequate ventilation with fresh, outdoor air (moderately high carbon dioxide concentrations).
4. The residence had some water damage and mold growth at several window sills. This damage is consistent with condensation that would occur during cold weather.
5. Water damage and mold growth were present at the lower walls near the back door. The damage is consistent with rain water infiltration at the door.
6. The cleanliness of the AHU system was poor.
7. There were elevated levels of *Aspergillus/Penicillium*-like spores and culturable *Alternaria*, *Aspergillus*, and *Penicillium* in the indoor air samples in the living room and at the return air grille.
8. These results indicate that there are likely sources of *Alternaria*, *Aspergillus* and *Penicillium* growth that are affecting the indoor environment.
9. There were low concentrations of fibers in the three samples. There were high levels of skin cell fragments in two of the three indoor air samples.

5.0 RECOMMENDATIONS

1. A technically competent HVAC contractor should evaluate the Gamboa residence for the size of the HVAC equipment, the capacity of the blower, the size of the plenums, the size and orientation of the ductwork, the size of the registers, the connections of all supply air components, the sealing of the HVAC Closet and return air plenum, the cleanliness of the system and the need for cleaning, the thermal performance of the system, the balance of the supply air system, the operation of the thermostat, the level of refrigerant in the system, and other aspects of the design and operation of the system. All deficiencies should be corrected, including cleaning of the evaporator coils outside of the house.
2. The Gamboa residence should use high performance pleated return air filters, rated as MERV 8 or better.
3. Deficiencies in installation of doors and windows should be corrected as necessary. All windows with visible damage, and the back door, should be remediated from the inside and repaired from the outside as necessary.
4. Remediation of damaged areas near the heads of the tubs should be performed at the same time.
5. The work described above should be done with source and/or local containment, air-scrubbing, and with a HEPA-vacuum for collection of dust as it is generated.
6. Mold contamination likely affects areas with less than 25 contiguous square feet. Therefore, the mold assessment and the remediation work may not be required to follow the Texas Mold Assessment and Remediation Rules (TMARR). A mold Remediation Protocol is not being prepared for the work recommended above. If during remediation it is determined that the TMARR must be followed, work should cease, and work should then be completed in full compliance with the TMARR.
7. During the evaluation of the HVAC system and investigation/remediation of door, window, and bathtub areas, the Mold Assessment Consultant should evaluate the condition of the system with respect to mold contamination.
8. Following remediation procedures, the residence should be thoroughly cleaned. HEPA-vacuuming of all surfaces and HEPA-vacuuming plus hot water extraction of upholstery and carpeting by a professional cleaning company may be very useful to reduce the inventory of dust in the houses. Badly soiled carpet should be discarded. Together with use of high performance return air filters, this should help to correct the dust problems.
9. All penetrations of the ceilings (such as peripheral edges of supply air ducts and vents and exhaust fans) and chases (such as at the HVAC closet) should be sealed.

10. Improperly finished sheetrock/shower-surround junctions should be properly repaired.
11. Because of the multiple areas of remediation and the need to clean the residence after remediation, it would be practical for the residents to move from the home during the remediation and cleaning procedures.

TABLE 1 – SUMMARY OF RESIDENCE CHARACTERISTICS

TABLE 1 – SUMMARY OF RESIDENCES INVESTIGATED

No.	Street	Resident	Owner	Yr. Built	SF	Stories	Garage	Floor Plan	Subdivision	Date Investigated
130	Villa Grande	Gamboa	SAHA	2000	690(1)/1000(2)	2	1-car	IV	Blueridge	17-Apr

TABLE 2 – SUMMARY OF MOLD GROWTH, WATER DAMAGE AND MOISTURE CONTENT

No.	Street	Resident	Visible Mold Growth	Visible Water Damage	High Moisture Content
130	Villa Grande	Gamboa	Window sills (slight), especially in MBR Lower walls at head of both bathtubs Trim and tackboards at back door	Window sills (slight), especially in MBR Lower walls at head of both bathtubs Trim and tackboards at back door	Base trim near the back door Lower walls at the head of both tubs

Yellow-highlighted boxes indicate conditions that may be significant in evaluation of indoor environmental issues.

Table 3
Summary of Air Quality Measurements

Location	Temp ºF	RH %	CO_2 Ppmv	CO Ppmv	Dew Point ºF
April 17, 2007					
Outside Air	65.1	94	459	0	62.5
Inside Air					
130 Villa Grande (Gamboa) MBR	64.5	68	1390	0	53
130 Villa Grande (Gamboa) K	63.7	66	1350	0	51.5

Yellow-highlighted boxes indicate conditions that may be significant in evaluation of indoor environmental issues.

TABLE 4 – SUMMARY OF HVAC SYSTEM OPERATION AND SPECIAL CONDTIONS

No.	Street	Resident	AC Operation	AHU Cleanliness	Dew Point	IAQ CO_2/CO	No. Occupants	Pets	Comments
130	Villa Grande	Gamboa	Not tested	Some dust Some dried scum on coils Excess dust on upstairs supply air vents	53	1390/0	6	Fish, turtles	Carpets very dirty and in poor condition

Yellow-highlighted boxes indicate conditions that may be significant in evaluation of indoor environmental issues.

TABLE 5 – SUMMARY OF AIRBORNE AND AHU PARTICLES

No.	Street	Resident	Sample Location	Total Fungal Spores	Unusual Spore Counts	Mycelial Fragments	Fiber Count	Skin Cell Fragments	Fiber-glass	Pollen	AHU
April 17, 2007											
Outdoor Air Samples – Blue Ridge											
130	Villa Grande	Gamboa	OAF	520	Asc>Bas>Sm	<13	120	333	<13	13	
Indoor Air Samples – Blueridge											
130	Villa Grande	Gamboa	LR	213	As/Pn>Alt, Bi, Cl 120 As/Pn	13	640	6,667	27	13	
130	Villa Grande	Gamboa	RA	147	Bas>Sm	53	360	3,707	<13	<13	Low spores Alt >As/Pn, Sm
130	Villa Grande	Gamboa	MBR	133	Bas	27	307	2,467	<13	40	

Yellow-highlighted boxes indicate conditions that may be significant in evaluation of indoor environmental issues.

Alt denotes *Alternaria*. As/Pn denotes *Aspergillus/Penicillium*-like spores. Asc denotes Ascospores. Bas denotes Basidiospores. Bi denotes *Bipolaris/Drechslera*. Cl denotes *Cladosporium*. Sm denotes Smuts/Myxomycetes/*Periconia*

A>B, C denotes that type A is more numerous than type B, which in turn has the same numbers as type C.

TABLE 6 – SUMMARY OF AIRBORNE CULTURABLE FUNGI AND AHU SAMPLES

No.	Street	Resident	Sample Location	Total Fungi	Unusual Counts	Return Air Filter	Supply Air Plenum
April 17, 2007							
Outdoor Samples – Villas at Fortuna							
130	Villa Grande	Gamboa	OA	235	Cl>Spo		
Indoor Air Samples – Villa at Fortuna							
130	Villa Grande	Gamboa	LR	129	As, Cl>StH, Y Slightly elevated As (36)		
130	Villa Grande	Gamboa	RA	106	Pn>As, Cl 47 Pn, 24 As	Low counts Aur>Pn, StH>Cl	
130	Villa Grande	Gamboa	MBR	82	Cl		

Yellow-highlighted boxes indicate conditions that may be significant in evaluation of indoor environmental issues.

As denotes *Aspergillus*, Aur denotes *Aureobasidium*, Bi denotes *Bipolaris*, Cl denotes *Cladosporium*, Pn denotes *Penicillium*, Spo denotes *Sporotrichum*, Y denotes yeast, and StH denotes sterile Hyphae

Table 7
Swab and Bulk Samples
Identification of Fungal Spores – Major Genera
Methods S001 and B001

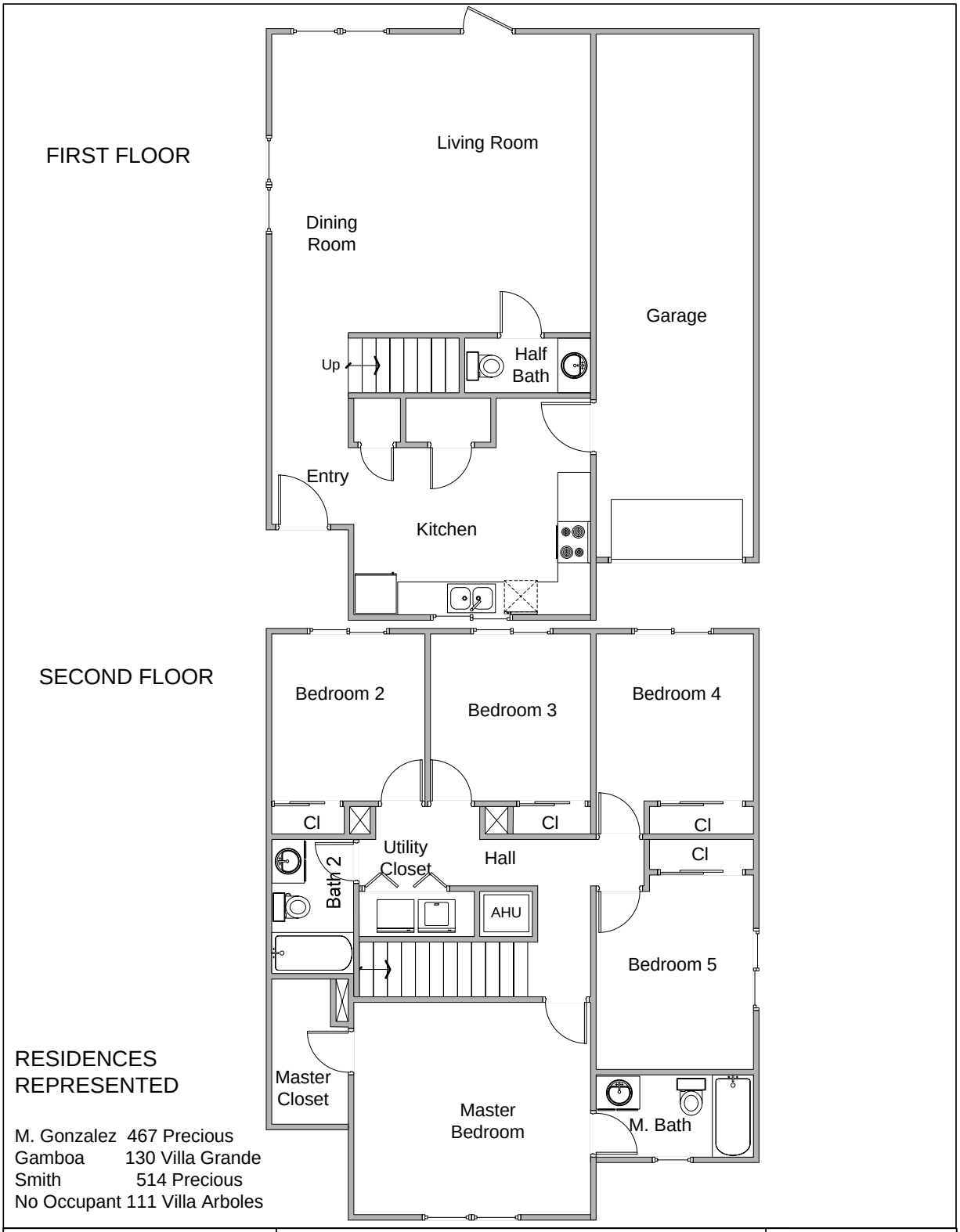
Ref. No.	Description of Swab Samples	Concentration, Cts/cm^2 (%)					
		Alternaria	***Aspergillus/ Penicillium*-like spores**	**Basidio-spores**	***Cladosporium***	**Total fungal spores**	**Mycelial Fragments**
SB-4-S[1]	RAF Gamboa	20 (55)	3 (9)	2 (4)	2 (4)	36	25

Yellow-highlighted boxes indicate conditions that may be significant in evaluation of indoor environmental issues.

[1] Yeast observed on swab sample.

Table 8
Swab and Bulk Samples
Identification of Cultural Fungi – Major Genera
Methods S002 and B002

Ref. No.	Description of Swab Samples	Concentration, CFU/cm^2 (%)						
		***Aspergillus* species**	***Aureobasidium***	***Cladosporium***	***Penicillium* Species**	***Fusarium***	**Sterile Hyphae**	**Total fungi**
SB-4-S	RAF Gamboa		20 (30)	10 (15)	12 (18)		12 (18)	65



ETC Information Services, LLC	**MIRASOL RESIDENCES**	**FIGURE 4**
	LAYOUT 4	Scale: Approx. 1/8" = 1'
		Drawn By: DJS 050107