Arizona Game and Fish
Mr. Fred Bloom
5000 W. Carefree Highway
Phoenix, AZ 85086-5000

September 17, 2010

Dear Mr. Bloom:

Re: **NOISE STUDY FOR FOSTER RANCH SHOOTING RANGE**

ACS has been retained to assess the potential noise impact from the proposed Foster Ranch Shooting Range to the surrounding areas.

1.0 TECHNICAL TERMS:

Decibel (dB) - A unit for measuring the intensity of sound. The human hearing range is from 0 dB (the theoretical threshold of audibility) to 130 dB (the average pain threshold). {The sound pressure level in decibels is equal to 10 times the logarithm (to the base 10) of the ratio between the pressure squared divided by the reference pressure squared. The reference pressure used in acoustics is 20 microPascals.}

Changes in Intensity Level, dB	Changes in Apparent Loudness
1	Almost imperceptible
3	Just perceptible
5	Clearly noticeable
10	Twice (or half) as loud

dBA - Sound pressure level expressed in decibels, filtered or weighted at the various frequencies to approximate the response of the human ear.

Leq(h) - The equivalent energy level that is the steady state level that contains the same amount of sound energy as a time varying sound level for a sixty minute time period.

Ldn - Day Night average sound level (DNL) is the 24 hour average sound level, in decibels, obtained after the addition of 10 decibels to the sound levels occurring between 10 pm and 7 am.

2.0 NOISE STANDARDS:

Typical municipal ordinances set not-to-exceed limits and consider instantaneous noise levels below 50 to 55 dBA at night and 60 to 65 dBA during the day to be acceptable. Some suburban and rural municipalities have set nighttime limits as low as 45 dBA. (Noise and Noise Control Vol I. Crocker, Malcom & Kessler, Frederick. CRC Press, 1982, pp. 237-240.)

Aside from ARS 17-602, the Foster Ranch Shooting Range is not subject to any National, State or Local Noise Code or Ordinance. In addition to ARS 17-602, information on other Standards/Guidelines are presented for comparison purposes only:

2.1 ARIZONA REVISED STATUTES TITLE 17-602

A. The legislature finds that outdoor shooting range noise standards are a matter of statewide concern. City, town, county and any other state noise standards are preempted as applied to outdoor shooting ranges.

B. Each outdoor shooting range in this state shall measure the noise emitted from the range pursuant to subsection E at least once. In addition, the range shall measure the noise it emits if the range expands the area designed and operated for the use of firearms or explosives by more than twenty percent in size than at the time of its initial noise measurement or if the range introduces the use of a type of firearm or explosive device that will increase noise production. The range shall pay for the measurement and shall keep the results of the measurement at the range at all times. Any person may review the noise measurement during the range's business hours. Ranges that are located at least one mile from areas that are zoned for residences, schools, hotels, motels, hospitals or churches are exempt from this subsection.

C. Any person, at the person's expense, may measure the noise emitted from an outdoor shooting range pursuant to subsection E.

D. The noise emitted from an outdoor shooting range shall not exceed an Leq(h) of sixty-four (64) dBA.

E. In measuring the noise emitted from an outdoor shooting range:

1. If a range performs the measurement of noise pursuant to subsection B, sound pressure measurements shall be taken twenty feet from the nearest

occupied residence, school, hotel, motel, hospital or church, or from the nearest proposed location of a residence, school, hotel, motel, hospital or church if the property is zoned for such a structure but is currently unimproved. If a person performs the measurement of noise pursuant to subsection C, sound pressure measurements shall be taken twenty feet from the person's residence, school, hotel, motel, hospital or church, or twenty feet from the proposed location of the person's residence, school, hotel, motel, hospital or church if the property is zoned for such a structure but is currently unimproved.

2. Sound pressure measurements shall be made in a location directly between the range and the nearest existing or proposed residence, school, hotel, motel, hospital or church. If there are natural or artificial obstructions that prevent an accurate noise measurement, the measurement may be taken within an additional twenty feet radius from the initial measurement location.

3. Sound pressure measurements shall be made on the A-weighted fast response mode scale. Measurements shall be taken during the noisiest hour of peak use during the operation of the range. Measurements shall be taken according to American National Standards Institute's standard methods ANSI S1.2-1962 (R1976) American national standard method for physical measurement of sound and ANSI S1.2-1971 (R1976) American National Standard method for measuring sound pressure levels. Measurements shall be taken using a type 1 sound meter meeting the requirements of ANSI S1.4L-1971. Any part of the measurements conducted on a range shall comply with the range safety rules.

2.2 U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD):

While HUD has no specific responsibility to try to reduce the noise problem at the source, it does have the responsibility to be aware of the noise problem and its impact on the housing environment. The most basic mandate which drives the department's involvement with the noise issue is the Housing Act of 1949 which sets forth the national goal of "a decent home and suitable living environment for every American family."

The noise environment at a site is determined by combining the contributions of different noise sources. Whenever possible, the analysis should assess noise environments expected at least ten years in the future. The HUD Guidelines are followed to estimate the contribution of aircraft, automobile, truck, and train noise to the

total day-night average sound level (DNL) at each site. The DNL contributions from each source are expressed in decibels. The combined DNL from all sources is the value used to determine the acceptability of the noise environment.

HUD's regulations do not contain standards for interior noise levels. Rather a goal of 45 decibels is set forth and the attenuation requirements are geared towards achieving that goal. It is assumed that with standard construction any building will provide sufficient attenuation so that if the exterior level is 65 Ldn*or less, the interior level will be 45 Ldn or less.

HUD Regulations set forth the following exterior noise standards:

65 DNL (Day/Night average) or less - Acceptable

Exceeding 65 DNL but not exceeding 75 DNL - Normally Unacceptable (To achieve an acceptable status, appropriate sound attenuation measures must be provided)

Exceeding 75 DNL - Unacceptable

*Ldn - Day Night average sound level (DNL) is the 24 hour average sound level, in decibels, obtained after the addition of 10 decibels to the sound levels occurring between 10 p.m. and 7 a.m..

3.0 METHODOLOGY:

Sound level measurements were performed at six (6) receive locations (plus a 7th for the second and third test periods) during the firing of at least three (3) rounds from seven (7) different firearms from the proposed firing location. Additionally, measurements were performed during an "all shoot" at the end of each test session. The measurements were performed with Type I (accuracy) Sound Level Meters with the following meter settings: "A" weighting, "fast" response.

Measurements of the ambient noise levels (without shooting) were conducted at all monitoring stations during each test period.

Measurements were performed during three different test periods: 7:00am, 12:00pm and 5:00pm. There were two test sessions during each of the three periods (to allow

coverage at all measurement positions). Measurements were performed at six primary receive locations (See Attached):

Position #2 - Nearest property line (north)
Position #3, 6 & 7 - Approximately 1 mile away (to the northwest, southwest and southeast)
Position #5 - Nearest existing or potential residential property (northeast)
Position #4 - Walnut Canyon National Monument (near the entry gate)

Note: Position #1 was the firing location.

Measurements were also performed at the second (east) view point along the rim trail of Walnut Canyon during one of the sessions of each of the 12:00pm and 5:00pm test periods.

4.0 MEASUREMENT RESULTS:

The measurements were performed on 8/26/10 with Type I Sound Level Meters with the following meter settings: "A" weighting, "fast" response. During the testing periods, the weather conditions were approximately:

7:00am	54°, 83% humidity, calm.
12:00am	79°, 28% humidity, light wind (~5 mph).
5:00pm	74°, 43% humidity, light wind (~9 mph).

The test results for each receive location are listed on the following pages.

Sound Measuring Location #2 - Nearest property line (north)
Minimum Ambient: 28-33 dBA
Typical Ambient Noise Level: 33 - 34 dBA
Maximum Ambient Noise Level: 49 dBA
Other Noise Sources: 67 dBA (Airplane)

Firearm	Test Period 1 (Session 1)	Test Period 2 (Session 1)	Test Period 3 (Session 1)
	Noise Level Maximum dB(A)	Noise Level Maximum dB(A)	Noise Level Maximum dB(A)
.30-06 caliber rifle	66 dBA	66 dBA	66 dBA
7mm Remington magnum caliber rifle	68 dBA	69 dBA	64 dBA
.3 Winchester magnum caliber rifle	69 dBA	66 dBA	65 dBA
.44 magnum caliber revolver	66 dBA	64 dBA	61 dBA
.45 ACP caliber semi-automatic pistol	61 dBA	60 dBA	60 dBA
.40 S&W caliber semi-automatic pistol	60 dBA	60 dBA	60 dBA
12-gauge shotgun	60 dBA	59 dBA	57 dBA
All Shoot	76 dBA	76 dBA	75 dBA

Sound Measuring Location #3 - ~1 mile away (northwest)
Minimum Ambient: 30-33 dBA
Typical Ambient Noise Level: 31 - 36 dBA
Other Noise Sources: 44, 44 dBA (Airplane) (Train)

Firearm	Test Period 1 (Session 1)	Test Period 2 (Session 1)	Test Period 3 (Session 1)
	Noise Level Maximum dB(A)	Noise Level Maximum dB(A)	Noise Level Maximum dB(A)
.30-06 caliber rifle	57 dBA	49 dBA	46 dBA
7mm Remington magnum caliber rifle	57 dBA	48 dBA	47 dBA
.3 Winchester magnum caliber rifle	57 dBA	51 dBA	45 dBA
.44 magnum caliber revolver	58 dBA	53 dBA	45 dBA
.45 ACP caliber semi-automatic pistol	53 dBA	42 dBA	43 dBA
.40 S&W caliber semi-automatic pistol	54 dBA	47 dBA	50 dBA
12-gauge shotgun	48 dBA	46 dBA	44 dBA
All Shoot	64 dBA	55 dBA	56 dBA

Sound Measuring Location #4 - Walnut Canyon (near the entry gate)
Minimum Ambient: 31 - 36 dBA
Typical Ambient Noise Level: 39 - 52 dBA
Other Noise Sources: 54-59 dBA (Cars)

Firearm	Test Period 1		Test Period 2		Test Period 3	
	Session 1	Session 2	Session 1	Session 2 (On Rim)	Session 1 (On Rim)	Session 2
	Maximum dB(A)	Maximum dB(A)	Maximum dB(A)	Maximum dB(A)	Maximum dB(A)	Maximum dB(A)
.30-06 caliber rifle	Biased by car	<44 dBA	<39 dBA	<51 dBA	BA <47 dBA	BA <44 dBA
7mm Remington magnum	<46 dBA	<46 dBA	≤35 dBA	BA <48 dBA	BA <44 dBA	<47 dBA
.3 Winchester magnum	BA <43 dBA	<43 dBA	≤37 dBA	<50 dBA	BA <49 dBA	VI <44 dBA
.44 magnum caliber revolver	BA <41 dBA	<45 dBA	VI <40 dBA	<48 dBA	BA <53 dBA	VI <44 dBA
.45 ACP semi-automatic pistol	BA <46 dBA	BA <45 dBA	Not Audible	BA <50 dBA	BA <49 dBA	VI <45 dBA
.40 S&W semi-automatic pistol	Not Audible	BA <45 dBA	Not Audible	BA <49 dBA	BA <52 dBA	Not Audible
12-gauge shotgun	<44 dBA	BA <44 dBA	Not Audible	BA <48 dBA	VI <47 dBA	Not Audible
All Shoot	Biased by car	<43 dBA	<50 dBA	<49 dBA	<47 dBA	<44 dBA

BA = Barely Audible; VI - Virtually Inaudible

Sound Measuring Location #5 - Nearest potential residential property (northeast)
Minimum Ambient: 29-36 dBA
Typical Ambient Noise Level: 40 - 49 dBA
Other Noise Sources: 45-65 dBA (Cars)

Firearm	Test Period 1		Test Period 2		Test Period 3
	Session 1	Session 2	Session 1	Session 2	
	Maximum dB(A)	Maximum dB(A)	Maximum dB(A)	Maximum dB(A)	Maximum dB(A)
.30-06 caliber rifle	Not Audible	BA <38 dBA	BA <39 dBA	BA <38 dBA	BA <39 dBA
7mm Remington magnum	Not Audible	BA <40 dBA	BA <38 dBA	BA <35 dBA	BA <31 dBA
.3 Winchester magnum	Not Audible	BA <40 dBA	BA <42 dBA	BA <32 dBA	BA <29 dBA
.44 magnum caliber revolver	Not Audible	BA <46 dBA	BA <37 dBA	BA <30 dBA	BA <32 dBA
.45 ACP semi-automatic pistol	Not Audible	BA <40 dBA	BA <38 dBA	BA <35 dBA	BA <36 dBA
.40 S&W semi-automatic pistol	Not Audible	BA <45 dBA	BA <36 dBA	BA <33 dBA	BA <32 dBA
12-gauge shotgun	Not Audible	BA <41 dBA	BA <40 dBA	BA <35 dBA	BA <33 dBA
All Shoot	Not Audible	BA <39 dBA	BA <46 dBA	BA <36 dBA	BA <40 dBA

BA = Barely Audible

Sound Measuring Location #6 - ~1 mile away (southwest)
Minimum Ambient: 27-33 dBA
Typical Ambient Noise Level: 30 - 33 dBA
Maximum Ambient Noise Level: 47-51 dBA

Firearm	Test Period 1 (Session 2)	Test Period 2 (Session 2)	Test Period 3 (Session 2)
	Noise Level Maximum dB(A)	Noise Level Maximum dB(A)	Noise Level Maximum dB(A)
.30-06 caliber rifle	<51 dBA	40 dBA	45 dBA
7mm Remington magnum caliber rifle	43 dBA	45 dBA	44 dBA
.3 Winchester magnum caliber rifle	41 dBA	44 dBA	46 dBA
.44 magnum caliber revolver	41 dBA	45 dBA	<48 dBA
.45 ACP caliber semi-automatic pistol	39 dBA	BA <45 dBA	<47 dBA
.40 S&W caliber semi-automatic pistol	38 dBA	BA <45 dBA	<47 dBA
12-gauge shotgun	BA <35 dBA	BA <46 dBA	BA <47 dBA
All Shoot	40 dBA	43 dBA	45 dBA

BA = Barely Audible

Sound Measuring Location #7 - ~1 mile away (southeast)
Minimum Ambient: 30-34 dBA
Typical Ambient Noise Level: 33 - 48 dBA
Other Noise Sources: 56 dBA (Bird)

Firearm	Test Period 1 (Session 2)	Test Period 2 (Session 2)	Test Period 3 (Session 2)
	Noise Level Maximum dB(A)	Noise Level Maximum dB(A)	Noise Level Maximum dB(A)
.30-06 caliber rifle	Not Audible	Not Audible	Not Audible
7mm Remington magnum caliber rifle	<46 dBA	<43 dBA	Not Audible
.3 Winchester magnum caliber rifle	<46 dBA	<43 dBA	Not Audible
.44 magnum caliber revolver	Not Audible	BA <40 dBA	Not Audible
.45 ACP caliber semi-automatic pistol	Not Audible	BA <41 dBA	Not Audible
.40 S&W caliber semi-automatic pistol	Not Audible	Not Audible	Not Audible
12-gauge shotgun	Not Audible	Not Audible	Not Audible
All Shoot	<47 dBA	<46 dBA	≤43 dBA

5.0 COMMENTS:

At the nearest property line, the shooting noise was clearly audible and easily measurable. At the locations approximately 3 miles away (the nearest residential property and Walnut Canyon), the shooting noise was often inaudible or only barely audible. At these locations, all of the testing events were not measurable. Although audible (at times), the shooting noise was always less than the ambient level.

Sound attenuation over distance - Sound levels are decreased as the distance is increased. Typically, the level will decrease by 6 decibels every time the distance is doubled. (NOTE: This is not necessarily accurate for roadway noise.) Over longer distances (more than 400-600'), the sound level is also reduced by air absorption, ground absorption (more so for soft ground - such as a pine forest), foliage attenuation, barrier (topography) attenuation, etc.

Barrier attenuation - Unless there is a direct line-of-sight from the shooting position to the receive location, the topography of the area will provide barrier attenuation. Additionally, when the shooting range is developed, the safety berms will also provide barrier attenuation.

ACS calculated the potential impact to the nearest residential property and Walnut Canyon. Based on standard propagation models (assuming the minimum noise reduction effects for each variable), the maximum projected shooting noise level in these areas is <40dBA without any barrier attenuation from topography or berms.

6.0 CONCLUSIONS:

Aside from ARS 17-602 assessed at the nearest existing or potential residential property, the Foster Ranch Shooting Range is not subject to any National, State or Local Noise Code or Ordinance.

The primary areas of concern are the nearest potential residential property and Walnut Canyon National Monument. Although noise impact to an area like Walnut Canyon is not addressed within ARS 17-602, I believe it should be protected as stringently as any other property. For both of these areas, the shooting noise was below the ambient noise level for every test event.

The maximum noise level recorded at the nearest potential residential property was 46 dBA. This measurement was dominated by the ambient and is not representative of the actual gun shot noise at this location. (Based on projections this level should not

exceed 40 dBA). Even if you assume this measurement was not biased by the ambient, this is still well within compliance with ARS 17-602 (which allows up to 64 Leq - a one-hour weighted average) and the HUD Noise Regulations (which allows up to 65 Ldn - a 24-hour weighted average).

The maximum noise level recorded at Walnut Canyon during all testing was 52 dBA. This measurement was dominated by the ambient noise. The shooting noise was barely audible during this measurement. The maximum level recorded when the shooting noise was audible (not just "barely audible") was 50 dBA. However, this level was still biased by the ambient. Even if these measurements were not biased by the ambient, the test results were well within compliance with ARS 17-602 and the HUD Noise Regulations.

Additionally, as was mentioned above, the noise level projections and measurements do not include any potential noise attenuation provided by the design of the range such as the barrier effect from berming.

Although the potential noise impact to the nearest potential residential property and Walnut Canyon is well within compliance with the standards, gun shot noise will be audible at these locations at times. Reaction to noise is subjective. It is impossible to predict an individual's sensitivity to noise. Anytime a sound is audible there is a potential for annoyance.

Please contact me if you have any questions or need additional information.

Respectfully,

Tony Sola

Tony Sola
Acoustical Consulting Services