Radiation Safety Engineering, Inc.
3245 N. WASHINGTON ST. · CHANDLER, ARIZONA 85225-1121
Website: www.radsafe.com
(480) 897-9459
FAX (480) 892-5446

June 29, 2001

Ms. Barbara Sylvester
Brown and Caldwell
3636 North Central Avenue, Suite 200
Phoenix, AZ 85012

Dear Ms. Sylvester:

Results of the radiochemical analysis performed on your samples are provided in the attached tables. Many of the samples had significant concentrations of ^{226}Ra and ^{228}Ra. In addition, analysis of the counting data indicates that there may be elevated concentrations of ^{224}Ra in some of the samples. Ra-224 is a short-lived radium isotope from the Thorium chain of natural radionuclides, which is only rarely found in drinking water sources. Thorium and the daughter isotopes in this chain tend to be relatively insoluble in normal water, so significant activities of these isotopes is quite unusual. Many of the samples though, did have significant concentrations of ^{228}Ra, which is from the thorium chain. Many of the samples also had a gross alpha concentration that was abnormally high, but then disappeared on recounting. This is a common characteristic of Ra-224 (3.6 day half life). A copy of the natural decay chains is attached to help you with the interpretation of the data.

Because of the short half-life of ^{224}Ra (3.6 days), this isotope is rarely identified in the lab, but may appear in drinking water delivered to homeowners if the transit time from the well to the home is short. Analysis for ^{224}Ra must be performed immediately upon receipt of the sample with the time between sampling and receipt in the lab minimized.

If any of these sources with observable Ra-228 concentration are to be used for drinking water sources, we recommend that they be tested for Ra-224 before being put into service.

Please contact me at (480) 897-9459 if there are any questions.

Sincerely,

Robert L. Metzger, Ph.D., C.H.P.
President

Radiation Safety Engineering, Inc.

3245 N. WASHINGTON ST. · CHANDLER, ARIZONA 85225-1121 (480) 897-9459
Website: www.radsafe.com FAX (480) 892-5446

Radiochemical Activity in Water (pCi/L)

Brown & Caldwell
3636 N Central Avenue, Suite 200
Phoenix, AZ 85012

Samples Received: June 4, 2001
Analysis Completed: June 29, 2001

Sample ID	Gross Alpha Activity method 600/00-02 (pCi/L)	Uranium Activity method 00-07 (pCi/L)	Adjusted Gross Alpha Activity (pCi/L)	Radium 226 Activity method 903.1 (pCi/L)	Radium 228 Activity method 904 (pCi/L)	Total Radium Activity (pCi/L)
BHP-2	64.0 ± 5.2	7.0 ± 1.4	57 ± 5.4	2.2 ± 0.5	8.3 ± 0.7	10.5 ± 0.9
BHP-3	18.4 ± 2.2	6.0 ± 1.4	12.4 ± 2.6	1.0 ± 0.3	2.0 ± 0.3	3.0 ± 0.4
BHP-4	19.3 ± 2.3	7.2 ± 1.4	12.1 ± 2.7	2.8 ± 0.5	2.3 ± 0.3	5.1 ± 0.6
BHP-5	30.4 ± 3.3	4.7 ± 0.5	25.7 ± 3.3	1.1 ± 0.3	2.5 ± 0.3	3.6 ± 0.4
BHP-6	36.9 ± 4.2	1.8 ± 0.4	35.1 ± 4.2	2.8 ± 0.5	2.3 ± 0.3	5.1 ± 0.6
BHP-7	19.4 ± 2.7	5.4 ± 1.3	14.0 ± 2.7	1.9 ± 0.3	1.9 ± 0.3	3.8 ± 0.4

Robert L. Metzger, Ph.D., C.H.P.

Radiation Safety Engineering, Inc.

3245 N. WASHINGTON ST. · CHANDLER, ARIZONA 85225-1121 (480) 897-9459
Website: www.radsafe.com FAX (480) 892-5446

Radiochemical Activity in Water (pCi/L)

Brown & Caldwell
3636 N Central Avenue, Suite 200
Phoenix, AZ 85012

Samples Received: June 4, 2001
Analysis Completed: June 29, 2001

Sample ID	Gross Alpha Activity method 600/00-02 (pCi/L)	Uranium Activity method 00-07 (pCi/L)	Adjusted Gross Alpha Activity (pCi/L)	Radium 226 Activity method 903.1 (pCi/L)	Radium 228 Activity method 904 (pCi/L)	Total Radium Activity (pCi/L)
BHP-8	25.3 ± 3.2	18.1 ± 2.1	7.2 ± 3.8	1.1 ± 0.3	2.9 ± 0.3	4.0 ± 0.4
BHP-9	19.5 ± 1.4	5.0 ± 1.2	10.5 ± 1.8	0.8 ± 0.3	4.0 ± 0.4	4.8 ± 0.5
BHP-10	10.4 ± 1.6	---	~~10.4 ± 1.6~~ 13.5	0.7 ± 0.3	0.5 ± 0.1	1.2 ± 0.3
BHP-11	23.6 ± 2.6	4.4 ± 0.5	19.2 ± 2.6	0.8 ± 0.3	1.6 ± 0.3	2.4 ± 0.4
BHP-12	42.6 ± 3.9	10.9 ± 1.7	31.7 ± 4.2	2.2 ± 0.5	5.4 ± 0.5	7.6 ± 0.7

Robert L. Metzger, Ph.D., C.H.P.

Radiation Safety Engineering, Inc.
3245 N. WASHINGTON ST. · CHANDLER, ARIZONA 85225-1121 (480) 897-9459
FAX (480) 892-5446
Website: www.radsafe.com

Radiochemical Activity in Water (pCi/L)

Brown & Caldwell
3636 N. Central Ave, Suite 200
Phoenix, AZ 85012

Samples Received: June 5, 2001
Analysis Completed: July 17, 2001

Sample ID	Gross Alpha Activity method 600/00-02 (pCi/L)	Uranium Activity method 00-07 (pCi/L)	Adjusted Gross Alpha Activity (pCi/L)	Radium 226 Activity method 903.1 (pCi/L)	Radium 228 Activity method 904 (pCi/L)	Total Radium Activity (pCi/L)
OWB-1	10.4 ± 1.6	---	---	0.8 ± 0.1	0.6 ± 0.3	1.4 ± 0.3
OWB-4	39.0 ± 3.6	5.0 ± 0.6	34.0 ± 3.6	5.6 ± 0.5	1.3 ± 0.3	6.9 ± 0.6
OWB-5	16.4 ± 2.1	6.5 ± 0.6	9.9 ± 2.2	1.3 ± 0.2	1.5 ± 0.4	2.8 ± 0.4
BHP-13	28.1 ± 2.9	3.1 ± 0.4	25.2 ± 2.9	2.2 ± 0.2	2.9 ± 0.4	5.1 ± 0.6

— Analysis not required.

Pierre Pouquette, Staff Chemist

Radiation Safety Engineering, Inc.

3245 N. WASHINGTON ST. · CHANDLER, ARIZONA 85225-1121 (480) 897-9459
Website: www.radsafe.com FAX (480) 892-5446

Radiochemical Activity in Water (pCi/L)

Brown & Caldwell
3636 N. Central Ave, Suite 200
Phoenix, AZ 85012

Samples Received: June 5, 2001
Analysis Completed: June 29, 2001

Sample ID	Gross Alpha Activity method 600/00-02 (pCi/L)	Uranium Activity method 00-07 (pCi/L)	Adjusted Gross Alpha Activity (pCi/L)	Radium 226 Activity method 903.1 (pCi/L)	Radium 228 Activity method 904 (pCi/L)	Total Radium Activity (pCi/L)
OWB-3	8.2 ± 1.4	---	---	1.3 ± 0.2	0.8 ± 0.3	2.1 ± 0.4
CH1-R	12.3 ± 1.8	---	---	2.0 ± 0.3	< 0.5	2.0 ± 0.3
CH1-B	8.4 ± 1.4	---	---	0.8 ± 0.1	< 0.4	0.8 ± 0.1
CH2-R	11.3 ± 1.0	8.1 ± 0.7	3.2 ± 1.2	2.5 ± 0.3	2.3 ± 0.4	4.8 ± 0.5

— Analysis not required or requested.

Robert L. Metzger, Ph.D., C.H.P.

Radiation Safety Engineering, Inc.

3245 N. WASHINGTON ST. · CHANDLER, ARIZONA 85225-1121 (480) 897-9459
Website: www.radsafe.com FAX (480) 892-5446

Radiochemical Activity in Water (pCi/L)

Brown & Caldwell
3636 N. Central Ave, Suite 200
Phoenix, AZ 85012

Samples Received: June 5, 2001
Analysis Completed: June 29, 2001

Sample ID	Gross Alpha Activity method 600/00-02 (pCi/L)	Uranium Activity method 00-07 (pCi/L)	Adjusted Gross Alpha Activity (pCi/L)	Radium 226 Activity method 903.1 (pCi/L)	Radium 228 Activity method 904 (pCi/L)	Total Radium Activity (pCi/L)
CH2-G	15.3 ± 2.9	8.5 ± 0.7	6.8 ± 3.0	2.2 ± 0.3	1.4 ± 0.4	2.6 ± 0.5
CH2-B	13.5 ± 1.1	2.9 ± 0.4	10.6 ± 1.2	2.5 ± 0.3	3.5 ± 0.5	5.0 ±0.6

Robert L. Metzger, Ph.D., C.H.P.

Radiation Safety Engineering, Inc

3245 North Washington Street
Chandler, AZ 85225
07/17/01

Quality Assurance Report
Brown & Caldwell
BHP-2 through BHP-12

Standards

Analysis	Ratio of O/E (O/E ± 2σ)	Acceptable limits
Alpha	0.92	0.85 – 1.15
Beta	NA	0.85 - 1.15
Uranium	0.91	0.85 - 1.15
Radon	NA	0.85 – 1.15
Radium-226	0.90	0.85 - 1.15
Radium-228	0.98	0.85 - 1.15
Strontium	NA	0.85 – 1.15
Tritium	NA	0.85 – 1.15

Blanks

Analysis	Observed	Expected	Acceptable
Alpha	0.2 ± 0.2	< 1.0	< 1.0
Beta	NA	< 3.0	< 3.0
Uranium	< 0.1	< 0.8	< 0.8
Radon	NA	< 150	< 200
Radium-226	< 0.1	< 0.7	< 0.9
Radium-228	< 0.4	< 0.7	< 0.9
Strontium	NA	< 0.8	< 0.9
Tritium	NA	< 400	< 500

NA Not applicable.

Pierre Pouquette, Staff Chemist

Radiation Safety Engineering, Inc

3245 North Washington Street
Chandler, AZ 85225
07/17/01

Quality Assurance Report
Brown & Caldwell
OWB-1, OWB-4, OWB-5, & BHP-13

Standards

Analysis	Ratio of O/E (O/E ± 2σ)	Acceptable limits
Alpha	0.99	0.85 – 1.15
Beta	NA	0.85 - 1.15
Uranium	0.91	0.85 - 1.15
Radon	NA	0.85 – 1.15
Radium-226	0.90	0.85 - 1.15
Radium-228	0.98	0.85 - 1.15
Strontium	NA	0.85 – 1.15
Tritium	NA	0.85 – 1.15

Blanks

Analysis	Observed	Expected	Acceptable
Alpha	< 0.2	< 1.0	< 1.0
Beta	NA	< 3.0	< 3.0
Uranium	< 0.1	< 0.8	< 0.8
Radon	NA	< 150	< 200
Radium-226	< 0.1	< 0.7	< 0.9
Radium-228	< 0.4	< 0.7	< 0.9
Strontium	NA	< 0.8	< 0.9
Tritium	NA	< 400	< 500

NA Not applicable.

Pierre Pouquette, Staff Chemist

Radiation Safety Engineering, Inc

3245 North Washington Street
Chandler, AZ 85225
07/17/01

Quality Assurance Report
Brown & Caldwell
OWB-3, CH1-R, CH1-B, & CH2-R.

Standards

Analysis	Ratio of O/E (O/E ± 2σ)	Acceptable limits
Alpha	1.03	0.85 – 1.15
Beta	NA	0.85 - 1.15
Uranium	0.91	0.85 - 1.15
Radon	NA	0.85 – 1.15
Radium-226	0.90	0.85 - 1.15
Radium-228	0.98	0.85 - 1.15
Strontium	NA	0.85 – 1.15
Tritium	NA	0.85 – 1.15

Blanks

Analysis	Observed	Expected	Acceptable
Alpha	0.2 ± 0.1	< 1.0	< 1.0
Beta	NA	< 3.0	< 3.0
Uranium	< 0.1	< 0.8	< 0.8
Radon	NA	< 150	< 200
Radium-226	< 0.1	< 0.7	< 0.9
Radium-228	< 0.4	< 0.7	< 0.9
Strontium	NA	< 0.8	< 0.9
Tritium	NA	< 400	< 500

NA Not applicable.

Pierre Pouquette, Staff Chemist

Radiation Safety Engineering, Inc

3245 North Washington Street
Chandler, AZ 85225
07/17/01

Quality Assurance Report
Brown & Caldwell
CH2-G & CH2-B

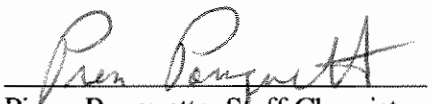
Standards

Analysis	Ratio of O/E (O/E ± 2σ)	Acceptable limits
Alpha	0.99	0.85 – 1.15
Beta	NA	0.85 - 1.15
Uranium	0.91	0.85 - 1.15
Radon	NA	0.85 – 1.15
Radium-226	0.90	0.85 - 1.15
Radium-228	0.98	0.85 - 1.15
Strontium	NA	0.85 – 1.15
Tritium	NA	0.85 – 1.15

Blanks

Analysis	Observed	Expected	Acceptable
Alpha	< 0.2	< 1.0	< 1.0
Beta	NA	< 3.0	< 3.0
Uranium	< 0.1	< 0.8	< 0.8
Radon	NA	< 150	< 200
Radium-226	< 0.1	< 0.7	< 0.9
Radium-228	< 0.4	< 0.7	< 0.9
Strontium	NA	< 0.8	< 0.9
Tritium	NA	< 400	< 500

NA Not applicable.



Pierre Pouquette, Staff Chemist

Thorium Series (4n)*

Nuclide	Historical name	Half-life	Major radiation energies (MeV) and intensities†		
			α	β	γ
$^{232}_{90}Th$	Thorium	$1.41X10^{10}$y	3.95 (24%) 4.01 (76%)	---	---
$^{228}_{88}Ra$	Mesothorium I	6.7y	---	0.055 (100%)	---
$^{228}_{89}Ac$	Mesothorium II	6.13h	---	1.18 (35%) 1.75 (12%) 2.09 (12%)	0.34c‡ (15%) 0.908 (25%) 0.96c (20%)
$^{228}_{90}Th$	Radiothorium	1.910y	5.34 (28%) 5.43 (71%)	---	0.084 (1.6%) 0.214 (0.3%)
$^{224}_{88}Ra$	Thorium X	3.64d	5.45 (6%) 5.68 (94%)	---	0.241 (3.7%)
$^{220}_{86}Rn$	Emanation Thoron (Tn)	55s	6.29 (100%)	---	0.55 (0.07%)
$^{216}_{84}Po$	Thorium A	0.15s	6.78 (100%)	---	---
$^{212}_{82}Pb$	Thorium B	10.64h	---	0.346 (81%) 0.586 (14%)	0.239 (47%) 0.300 (3.2%)
$^{212}_{83}Bi$	Thorium C	60.6m	6.05 (25%) 6.09 (10%)	1.55 (5%) 2.26 (55%)	0.040 (2%) 0.727 (7%) 1.620 (1.8%)
64.0% / 36.0%					
$^{212}_{84}Po$	Thorium C'	304ns	8.78 (100%)	---	---
$^{208}_{81}Tl$	Thorium C''	3.10m	---	1.28 (25%) 1.52 (21%) 1.80 (50%)	0.511 (23%) 0.583 (86%) 0.860 (12%) 2.614 (100%)
$^{208}_{82}Pb$	Thorium D	Stable	---	---	---

*This expression describes the mass number of any member in this series, where n is an integer.
Example: $^{232}_{90}Th$ (4n).....4(58) = 232

†Intensities refer to percentage of disintegrations of the nuclide itself, not to original parent of series.

‡Complex energy peak which would be incompletely resolved by instruments of moderately low resolving power such as scintillators.

Data taken from: Lederer, C. M., Hollander, J. M., and Perlman, I., Table of Isotopes (6th ed.; New York: John Wiley & Sons, Inc., 1967) and Hogan, O. H., Zigman, P. E., and Mackin, J. L., Beta Spectra (USNRDL-TR-802 [Washington, D.C.: U.S. Atomic Energy Commisaion, 1964]).

Uranium Series (4n + 2)*

Nuclide	Historical name	Half-life	Major radiation energies (MeV) and intensities†		
			α	β	γ
$^{238}_{92}U$	Uranium I	4.51×10^{9}y	4.15 (25%) 4.20 (75%)	---	---
$^{234}_{90}Th$	Uranium X_1	24.1d	---	0.103 (21%) 0.193 (79%)	0.063c‡ (3.5%) 0.093c (4%)
$^{234}_{91}Pa^{m}$	Uranium X_2	1.17m	---	2.29 (98%)	0.765 (0.30%) 1.001 (0.60%)
99.87% | 0.13%					
$^{234}_{91}Pa$	Uranium Z	6.75h	---	0.53 (66%) 1.13 (13%)	0.100 (50%) 0.70 (24%) 0.90 (70%)
$^{234}_{92}U$	Uranium II	2.47×10^{5}y	4.72 (28%) 4.77 (72%)	---	0.053 (0.2%)
$^{230}_{90}Th$	Ionium	8.0×10^{4}y	4.62 (24%) 4.68 (76%)	---	0.068 (0.6%) 0.142 (0.07%)
$^{226}_{88}Ra$	Radium	1602y	4.60 (6%) 4.78 (95%)	---	0.186 (4%)
$^{222}_{86}Rn$	Emanation Radon (Rn)	3.823d	5.49 (100%)	---	0.510 (0.07%)
$^{218}_{84}Po$	Radium A	3.05m	6.00 (~100%)	0.33 (~0.019%)	---
99.98% | 0.02%					
$^{214}_{82}Pb$	Radium B	26.8m	---	0.65 (50%) 0.71 (40%) 0.98 (6%)	0.295 (19%) 0.352 (36%)
$^{218}_{85}At$	Astatine	~2s	6.65 (6%) 6.70 (94%)	? (~0.1%)	---
$^{214}_{83}Bi$	Radium C	19.7m	5.45 (0.012%) 5.51 (0.008%)	1.0 (23%) 1.51 (40%) 3.26 (19%)	0.609 (47%) 1.120 (17%) 1.764 (17%)
99.98% | 0.02%					
$^{214}_{84}Po$	Radium C'	164μs	7.69 (100%)	---	0.799 (0.014%)
$^{210}_{81}Tl$	Radium C''	1.3m	---	1.3 (25%) 1.9 (56%) 2.3 (19%)	0.296 (80%) 0.795 (100%) 1.31 (21%)
$^{210}_{82}Pb$	Radium D	21y	3.72 (.000002%)	0.016 (85%) 0.061 (15%)	0.047 (4%)
$^{210}_{83}Bi$	Radium E	5.01d	4.65 (.00007%) 4.69 (.00005%)	1.161 (~100%)	---
~100% | .00013%					
$^{210}_{84}Po$	Radium F	138.4d	5.305 (100%)	---	0.803 (0.0011%)
$^{206}_{81}Tl$	Radium E''	4.19m	---	1.571 (100%)	---
$^{206}_{82}Pb$	Radium G	Stable	---	---	---

*This expression describes the mass number of any member in this series, where n is an integer.
Example: $^{206}_{82}Pb$ (4n + 2).....4(51) + 2 = 206

†Intensities refer to percentage of disintegrations of the nuclide itself, not to original parent of series.

‡Complex energy peak which would be incompletely resolved by instruments of moderately low resolving power such as scintillators.

Data taken from: Table of Isotopes and USNRDL-TR-802.

Actinium Series (4n + 3)*

Nuclide	Historical name	Half-life	Major radiation energies (MeV) and intensities†		
			α	β	γ
$^{235}_{92}U$	Actinouranium	7.1×10^{8}y	4.37 (18%) 4.40 (57%) 4.58c‡ (8%)	---	0.143 (11%) 0.185 (54%) 0.204 (5%)
$^{231}_{90}Th$	Uranium Y	25.5h	---	0.140 (45%) 0.220 (15%) 0.305 (40%)	0.026 (2%) 0.084c (10%)
$^{231}_{91}Pa$	Protoactinium	3.25×10^{4}y	4.95 (22%) 5.01 (24%) 5.02 (23%)	---	0.027 (6%) 0.29c (6%)
$^{227}_{89}Ac$	Actinium	21.6y	4.86c (0.18%) 4.95c (1.2%)	0.043 (~99%)	0.070 (0.08%)
98.6% | 1.4%					
$^{227}_{90}Th$	Radioactinium	18.2d	5.76 (21%) 5.98 (24%) 6.04 (23%)	---	0.050 (8%) 0.237c (15%) 0.31c (8%)
$^{223}_{87}Fr$	Actinium K	22m	5.44 (~0.005%)	1.15 (~100%)	0.050 (40%) 0.080 (13%) 0.234 (4%)
$^{223}_{88}Ra$	Actinium X	11.43d	5.61 (26%) 5.71 (54%) 5.75 (9%)	---	0.149c (10%) 0.270 (10%) 0.33c (6%)
$^{219}_{86}Rn$	Emanation Actinon (An)	4.0s	6.42 (8%) 6.55 (11%) 6.82 (81%)	---	0.272 (9%) 0.401 (5%)
$^{215}_{84}Po$	Actinium A	1.78ms	7.38 (~100%)	0.74 (~.00023%)	---
~100% | .00023%					
$^{211}_{82}Pb$	Actinium B	36.1m	---	0.29 (1.4%) 0.56 (9.4%) 1.39 (87.5%)	0.405 (3.4%) 0.427 (1.8%) 0.832 (3.4%)
$^{215}_{85}At$	Astatine	~0.1ms	8.01 (~100%)	---	---
$^{211}_{83}Bi$	Actinium C	2.15m	6.28 (16%) 6.62 (84%)	0.60 (0.28%)	0.351 (14%)
0.28% | 99.7%					
$^{211}_{84}Po$	Actinium C'	0.52s	7.45 (99%)	---	0.570 (0.5%) 0.90 (0.5%)
$^{207}_{81}Tl$	Actinium C''	4.79m	---	1.44 (99.8%)	0.897 (0.16%)
$^{207}_{82}Pb$	Actinium D	Stable	---	---	---

*This expression describes the mass number of any member in this series, where n is an integar.
Example: $^{207}_{82}Pb$ (4n + 3).....4(51) + 3 = 207

†Intensities refer to percentage of disintegrations of the nuclide itself, not to original parent of series.

‡Complex energy peak which would be incompletely resolved by instruments of moderately low resolving power such as scintillators.

Data taken from: Table of Isotopes and USNRDL-TR-802.

Client Information

Name: Barb Sylvester
Company: Brown and Caldwell
Address: 3636 N Central Ave Suite 200 Phx. 85012
Phone: 602 222 4476
PWS#:
Sampler Sig. / Phone #: Barbara Sylvester

Radiation Safety Engineering, Inc.

3245 North Washington Street
Chandler, Arizona 85225

Analysis Request

pg 1/3

Sample ID & Location (DWR#)	Collection Date	Collection Time	Media (DW* WW* Other)	Drinking Water Compliance	Gross Alpha	Gross Beta	Total Uranium	Isotopic Uranium	Ra-226	Ra-228	H-3	Gamma Spectroscopy	Sr-89/Sr-90	Radon in Water	Radon in Air
BHP-11	6-4-01	0900	AQ (DW)	✓											
BHP-8		0820		✓											
BHP-2		0840		✓											
BHP-6		0920		✓											
BHP-3	6-9-00	0940	AQ (DW)	✓											

Sample Receipt

Total No. of Containers:
Chain of Custody Seals:
Container Condition:
Lab No.:

Invoice to:
BHP Accounts Payable
7400 N Oracle Rd
Suite 200
Tucson, AZ 85704

Instructions/Comments
P.O.#
3401942

Relinquished by:
Signature: Barbara Sylvester
Printed Name: Barbara Sylvester
Company: Brown & Caldwell
Date: 6/4/01

Received by:
Signature:
Printed Name: LANNIE B. HEELAN
Company: Radiation Safety Engineering, Inc.
Date: 06/04/01

* DW = Drinking Water, WW = Waste Water.

Client Information

Name: Barb Sylvester
Company: Brown and Caldwell
Address: 3636 N Central Ave Suite 500
Phone: Phx. 85012 602 222 4476
PWS#:
Sampler Sig. Phone #: Barbara Sylvester

Radiation Safety Engineering, Inc.

3245 North Washington Street
Chandler, Arizona 85225

Analysis Request

pg 2/3

Sample ID & Location (DWR#)	Collection Date	Collection Time	Media (DW* WW* Other)	Drinking Water Compliance	Gross Alpha	Gross Beta	Total Uranium	Isotopic Uranium	Ra-226	Ra-228	H-3	Gamma Spectroscopy	Sr-89/Sr-90	Radon in Water	Radon in Air
BHP-10	6-4-01	1020	AQ	✓											
BHP-9		1100		✓											
BHP-5		1130		✓											
BHP-12		1200		✓											
BHP-4	6-4-00	1230	AQ	✓											

Sample Receipt

Total No. of Containers	
Chain of Custody Seals	
Container Condition	
Lab No.	

Invoice to:
BHP Records Reply
7400 N Oracle Rd
Suite 200
Tucson, AZ 85704

Instructions/Comments
PO #
34015142

Relinquished by:
Signature: Barbara Sylvester
Printed Name: Barbara Sylvester
Company: Brown and Caldwell
Date: 6-4-01

Received by:
Signature: Annie B. Heelan
Printed Name: ANNIE B. HEELAN
Company: Radiation Safety Engineering, Inc.
Date: 06/04/01

* DW = Drinking Water, WW = Waste Water.

Client Information

Name: Barb Sylvester
Company: Brown and Caldwell
Address: 3636 N Central Ave Suite 500
Phone: Phx. 85012 (602) 222 4476
PWS#:
Sampler Sig. Phone #: Barbara Sylvester

Radiation Safety Engineering, Inc.

3245 North Washington Street
Chandler, Arizona 85225

Analysis Request

pg 3/3

Sample ID & Location (DWR#)	Collection Date	Collection Time	Media (DW* WW* Other)	Drinking Water Compliance	Gross Alpha	Gross Beta	Total Uranium	Isotopic Uranium	Ra-226	Ra-228	H-3	Gamma Spectroscopy	Sr-89/Sr-90	Radon in Water	Radon in Air
BHP-7	6-4-01	1300	AQ	✓											
	↓			✓											
				✓											
				✓											
	6-4-00			✓											

Sample Receipt

Total No. of Containers	
Chain of Custody Seals	
Container Condition	
Lab No.	

Invoice to:
BHP Accounts Payable
7400 N Oracle Rd
Suite 200
Tucson, AZ 85704

Instructions/Comments
PO #
3401-742

Relinquished by:
Signature: Barbara Sylvester
Printed Name: Barbara Sylvester
Company: Brown & Caldwell
Date: 6-4-01

Received by:
Signature: Laurie B. Heelan
Printed Name: LAURIE B. HEELAN
Company: Radiation Safety Engineering, Inc.
Date: 06/04/01

* DW = Drinking Water, WW = Waste Water.

Client Information

Name: Barbara Sylvester
Company: Brown and Caldwell
Address: 3636 N Central Ave Suite 200 Phoenix AZ 85012
Phone: 602 222 4476
PWS#:
Sampler Sig.
Phone #

Radiation Safety Engineering, Inc.

3245 North Washington Street
Chandler, Arizona 85225

Analysis Request

Sample ID & Location (DWR#)	Collection Date	Collection Time	Media (DW* WW* Other)	Drinking Water Compliance	Gross Alpha	Gross Beta	Total Uranium	Isotopic Uranium	Ra-226	Ra-228	H-3	Gamma Spectroscopy	Sr-89/Sr-90	Radon in Water	Radon in Air
OWB-1	6-5-01	0800	AQ	✓											
OWB-5		0830		✓											
BHP-13		0900		✓											
OWB-4	6-5-01	0930	AQ	✓											

Sample Receipt
Total No. of Containers
Chain of Custody Seals
Container Condition
Lab No.

Invoice to:
BHP Accounts Payable
7400 N Oracle Rd
Suite 200
Tucson AZ 85704

Instructions/Comments
P.O. #
3401 5543

Relinquished by:
Signature
Printed Name: Barbara Sylvester
Company: Brown and Caldwell
Date: 6-5-01

Received by:
Signature
Printed Name: CAWNIE B. HEELAN
Company: Radiation Safety Engineering, Inc.
Date: 6-5-01

* DW = Drinking Water, WW = Waste Water.

Client Information

Name: Barbara Sylvester
Company: Brown and Caldwell
Address: 3636 N Central Ave Suite 200
Phone: Phoenix AZ 85012 602 222 4476
PWS#:
Sampler Sig.:
Phone #:

Radiation Safety Engineering, Inc.

3245 North Washington Street
Chandler, Arizona 85225

Analysis Request

12690 - 12693

Sample ID & Location (DWR#)	Collection Date	Collection Time	Media (DW* WW* Other)	Drinking Water Compliance	Gross Alpha	Gross Beta	Total Uranium	Isotopic Uranium	Ra-226	Ra-228	H-3	Gamma Spectroscopy	Sr-89/Sr-90	Radon in Water	Radon in Air
OWB-1	6-5-01	0800	AQ	✓		12690									
OWB-5		0830		✓		12691									
BHP-13		0900		✓		12692									
OWB-4	6-5-01	0930	AQ	✓		12693									

Sample Receipt
Total No. of Containers
Chain of Custody Seals
Container Condition
Lab No.

Invoice to:
BHP Accounts Payable
7400 N Oracle Rd
Suite 200
Tucson AZ 85704

Instructions/Comments
P.O.#
3401 5543

Relinquished by:
Signature
Printed Name: Barbara Sylvester
Company: Brown and Caldwell
Date: 6-5-01

Received by:
Signature
Printed Name: CAWNIE B. HEELAN
Company: Radiation Safety Engineering, Inc.
Date: 6-5-01

* DW = Drinking Water, WW = Waste Water.

Client Information

Name: Barbara Sylvester
Company: Brown and Caldwell
Address: 3636 N Central Ave Suite 200
Phone: Phoenix AZ 85012 602 222 9476
PWS#:
Sampler Sig. / Phone #: Barbara Sylvester

Radiation Safety Engineering, Inc.

3245 North Washington Street
Chandler, Arizona 85225

Analysis Request

Sample ID & Location (DWR#)	Collection Date	Collection Time	Media (DW* WW* other)	Drinking Water Compliance	Gross Alpha	Gross Beta	Total Uranium	Isotopic Uranium	Ra-226	Ra-228	H-3	Gamma Spectroscopy	Sr-89/Sr-90	Radon in Water	Radon in Air
DWR-3	6-5-01	1000	DW	✓											
CH1-R		1100		✓											
CH1-B		1105		✓											
CH2-R	6-5-01	1130	DW	✓											

Sample Receipt

Total No. of Containers:

Chain of Custody Seals:

Container Condition:

Lab No.:

Invoice to:
BHP Accounts Payable
7400 North Oracle Rd
Suite 200
Tucson AZ 85704

Instructions/Comments
P.O. #
3401 5613

Relinquished by:
Signature: Barbara Sylvester
Printed Name: Barbara Sylvester
Company: Brown and Caldwell
Date: 6-5-01

Received by:
Signature: Lawnie B. Heecan
Printed Name: LAWNIE B. HEECAN
Company: Radiation Safety Engineering, Inc.
Date: 6-5-01

* DW = Drinking Water, WW = Waste Water.

Client Information

Name: Barbara Sylvester
Company: Brown and Caldwell
Address: 3636 N Central Ave Suite 200
Phone: Phoenix AZ 85012 602 222 9176
PWS#:
Sampler Sig. / Phone #: Barbara Sylvester

Radiation Safety Engineering, Inc.

3245 North Washington Street
Chandler, Arizona 85225

Analysis Request

Sample ID & Location (DWR#)	Collection Date	Collection Time	Media (DW* WW* Other)	Drinking Water Compliance	Gross Alpha	Gross Beta	Total Uranium	Isotopic Uranium	Ra-226	Ra-228	H-3	Gamma Spectroscopy	Sr-89/Sr-90	Radon in Water	Radon in Air
CH2-G	6-5-01	1135	DW	✓											
GH2-B		1140		✓											
				✓											
	6-5-01		DW	—											

Sample Receipt

Total No. of Containers	
Chain of Custody Seals	
Container Condition	
Lab No.	

Invoice to:
BHP Accounts Payable
7500 North Dobson Rd
Suite 200
Tucson AZ 85704

Instructions/Comments
P.O.#
3101503

Relinquished by:
Signature: Barbara Sylvester
Printed Name: Barbara Sylvester
Company: Brown and Caldwell
Date: 6-5-01

Received by:
Signature: Lannie B. Heecan
Printed Name: LANNIE B. HEECAN
Company: Radiation Safety Engineering, Inc.
Date: 6-5-01

* DW = Drinking Water, WW = Waste Water.

Radiation Safety Engineering, Inc.
3245 N. WASHINGTON ST. · CHANDLER, ARIZONA 85225-1121 (480) 897-9459
Website: www.radsafe.com FAX (480) 892-5446

Radiochemical Activity in Water (pCi/L)

Brown & Caldwell
3636 N Central Avenue, Suite 200
Phoenix, AZ 85012

Samples Received: July ~~10~~ 12, 2001
Analysis Completed: July 27, 2001

Sample ID	Gross Alpha Activity method 600/00-02 (pCi/L)	Uranium Activity method 00-07 (pCi/L)	Adjusted Gross Alpha Activity (pCi/L)	Radium 226 Activity method 903.1 (pCi/L)	Radium 228 Activity method 904 (pCi/L)	Total Radium Activity (pCi/L)
OWB-2	6.5 ± 1.2	---	---	< 0.3	< 0.4	< 0.4
BHP-1	14.4 ± 2.0	---	---	0.9 ± 0.2	< 0.4	0.9 ± 0.2
M19.3	13.3 ± 1.8	---	---	< 0.4	< 0.4	< 0.4

--- Analysis neither required nor requested.

Pierre Pouquette, Staff Chemist

Radiation Safety Engineering, Inc

3245 North Washington Street
Chandler, AZ 85225
7/31/2001

Quality Assurance Report
Sample ID: OWB-2, BHP-1, & M19.3

Standards

Analysis	Ratio of O/E (O/E ± 2σ)	Acceptable limits
Alpha	1.03	0.85 – 1.15
Beta	NA	0.85 - 1.15
Uranium	NA	0.85 - 1.15
Radon	NA	0.85 – 1.15
Radium-226	1.05	0.85 - 1.15
Radium-228	1.02	0.85 - 1.15
Strontium	NA	0.85 – 1.15
Tritium	NA	0.85 – 1.15

Blanks

Analysis	Observed	Expected	Acceptable
Alpha	< 0.4	< 1.0	< 1.0
Beta	NA	< 3.0	< 3.0
Uranium	NA	< 0.8	< 0.8
Radon	NA	< 150	< 200
Radium-226	< 0.2	< 0.7	< 0.9
Radium-228	< 0.3	< 0.7	< 0.9
Strontium	NA	< 0.8	< 0.9
Tritium	NA	< 400	< 500

NA Not applicable.

Pierre Pouquette, Staff Chemist

Client Information

Name: Barbara Sylvester
Company: Brown & Caldwell
Address: 3636 N Central Ave Suite 200 Phx 85012
Phone: 602 222 9476
PWS#:
Sampler Sig. Phone #: Barbara Sylvester

Radiation Safety Engineering, Inc.

3245 North Washington Street
Chandler, Arizona 85225

Analysis Request

RJ 1/1

Sample ID & Location (DWR#)	Collection Date	Collection Time	Media (DW* WW* Other)	Drinking Water Compliance	Gross Alpha	Gross Beta	Total Uranium	Isotopic Uranium	Ra-226	Ra-228	H-3	Gamma Spectroscopy	Sr-89/Sr-90	Radon in Water	Radon in Air
OWB-2	7-12-01	0840	AQ	✓		12925									
BHP-1	7-12-01	0910	AQ	✓		12926									
MW-3	7-12-01	0910	AQ	✓		12927									

Sample Receipt

Total No. of Containers: 3

Chain of Custody Seals:

Container Condition:

Lab No.:

Invoice to:
BHP Accounts Payable
P.O. Box N
San Manuel AZ 85631
[redacted]
P.O. # 3401G142
Instructions/Comments

Relinquished by:
Signature: Barbara Sylvester
Printed Name: Barbara Sylvester
Company: Brown & Caldwell
Date: 7-12-01

Received by:
Signature: Pam Poncette
Printed Name: PPoncette
Company: Radiation Safety Engineering, Inc.
Date: 7-12-01 14:00

u/client/forms

* DW = Drinking Water, WW = Waste Water.