BERKELEY ANALYTICAL
815 Harbour Way South, Suite 6
Richmond, CA 94804
Ph. 510-236-2325; Fax 510-236-2335
E-mail info@berkeleyanalytical.com

Analysis of Field-Collected Air Samples

Customer and Project Information

Report Certification	
Report number	061-030-IH-Feb0816
Report date	February 8, 2016
Certified by (Name/Title)	Alfred T. Hodgson, Research Director
Signature	
Date	*February 8, 2016*

Methods	
U.S. EPA TO-17	Determination of Volatile Organic Compounds in Ambient…
ASTM D 5197	Std. Test Method for Determination of Formaldehyde…

Customer Information	
Customer:	US EPA
City/State/Country	San Francisco, CA, USA
Contact name/Title	Jeff Woodlee
Phone number	415-972-3740

Project Information	
Project number	Not given
Project name	IAQ
Project location	Not given
Project date	February 3, 2016

Laboratory Receiving Information	
Date samples received by lab	February 5, 2016
Condition of samples	No observed problems
Lab tracking numbers	061-030-01 to 061-030-40

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Sample Information

Sample No.	Sample Description	Sampler No.	Date Collected	Volume* (L)	Analysis Type	Specified Method
C10-01	3314	Mi193231	February 3, 2016	5.520	Caprolactam	TO-17
C10-02	3400	203144	February 3, 2016	5.837	Caprolactam	TO-17
C10-03	3363	242467	February 3, 2016	6.100	Caprolactam	TO-17
C10-04	3320	203170	February 3, 2016	5.514	Caprolactam	TO-17
C10-05	10146	203151	February 3, 2016	5.640	Caprolactam	TO-17
C10-06	10151	Mi193224	February 3, 2016	5.815	Caprolactam	TO-17
C10-07	10221	203184	February 3, 2016	5.498	Caprolactam	TO-17
C10-08	10344	Mi193288	February 3, 2016	5.326	Caprolactam	TO-17
C10-09	11137	203198	February 3, 2016	5.808	Caprolactam	TO-17
C10-10	11350	203137	February 3, 2016	5.413	Caprolactam	TO-17
C10-11	11420	242440	February 3, 2016	5.710	Caprolactam	TO-17
C10-12	11310	Mi193218	February 3, 2016	5.518	Caprolactam	TO-17
C10-13	12441	242442	February 3, 2016	5.591	Caprolactam	TO-17
C10-14	12414	Mi193227	February 3, 2016	5.549	Caprolactam	TO-17
C10-15	12351	242405	February 3, 2016	5.729	Caprolactam	TO-17
C10-16	12144	Mi193238	February 3, 2016	5.588	Caprolactam	TO-17
C10-17	14414	242500	February 3, 2016	6.506	Caprolactam	TO-17
C10-18	14364	242476	February 3, 2016	6.315	Caprolactam	TO-17
C10-19	14112	Mi193234	February 3, 2016	6.000	Caprolactam	TO-17
C10-20	14246	203107	February 3, 2016	5.737	Caprolactam	TO-17

*Volume in liters reported by customer

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Sample Information, Continued

Sample No.	Sample Description	Sampler No.	Date Collected	Volume* (L)	Analysis Type	Specified Method
F10-01	3314	Waters Cart	February 3, 2016	51.05	Formaldehyde	D 5197
F10-02	3400	Waters Cart	February 3, 2016	55.47	Formaldehyde	D 5197
F10-03	3363	Waters Cart	February 3, 2016	55.15	Formaldehyde	D 5197
F10-04	3320	Waters Cart	February 3, 2016	51.33	Formaldehyde	D 5197
F10-05	10146	Waters Cart	February 3, 2016	53.73	Formaldehyde	D 5197
F10-06	10151	Waters Cart	February 3, 2016	52.37	Formaldehyde	D 5197
F10-07	10221	Waters Cart	February 3, 2016	51.97	Formaldehyde	D 5197
C10-08	10344	Waters Cart	February 3, 2016	51.00	Formaldehyde	D 5197
F10-09	11137	Waters Cart	February 3, 2016	52.95	Formaldehyde	D 5197
F10-10	11350	Waters Cart	February 3, 2016	51.56	Formaldehyde	D 5197
F10-11	11420	Waters Cart	February 3, 2016	54.92	Formaldehyde	D 5197
F10-12	11310	Waters Cart	February 3, 2016	50.56	Formaldehyde	D 5197
F10-13	12441	Waters Cart	February 3, 2016	54.14	Formaldehyde	D 5197
F10-14	12414	Waters Cart	February 3, 2016	54.16	Formaldehyde	D 5197
F10-15	12351	Waters Cart	February 3, 2016	52.94	Formaldehyde	D 5197
F10-16	12144	Waters Cart	February 3, 2016	54.21	Formaldehyde	D 5197
F10-17	14414	Waters Cart	February 3, 2016	62.65	Formaldehyde	D 5197
F10-18	14364	Waters Cart	February 3, 2016	60.38	Formaldehyde	D 5197
F10-19	14112	Waters Cart	February 3, 2016	58.09	Formaldehyde	D 5197
F10-20	14246	Waters Cart	February 3, 2016	55.51	Formaldehyde	D 5197

*Volume in liters reported by customer

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Analytical Information

Sample No.	Lab Track. No.	Method	Date Analyzed	Analyst	Data File
C10-01	061-030-01	TO-17	February 5, 2016	R. Gill	T160205_14
C10-02	061-030-02	TO-17	February 5, 2016	R. Gill	T160205_15
C10-03	061-030-03	TO-17	February 5, 2016	R. Gill	T160205_16
C10-04	061-030-04	TO-17	February 5, 2016	R. Gill	T160205_17
C10-05	061-030-05	TO-17	February 5, 2016	R. Gill	T160205_18
C10-06	061-030-06	TO-17	February 5, 2016	R. Gill	T160205_19
C10-07	061-030-07	TO-17	February 5, 2016	R. Gill	T160205_20
C10-08	061-030-08	TO-17	February 5, 2016	R. Gill	T160205_21
C10-09	061-030-09	TO-17	February 5, 2016	R. Gill	T160205_22
C10-10	061-030-10	TO-17	February 5, 2016	R. Gill	T160205_23
C10-11	061-030-11	TO-17	February 5, 2016	R. Gill	T160205_24
C10-12	061-030-12	TO-17	February 5, 2016	R. Gill	T160205_25
C10-13	061-030-13	TO-17	February 5, 2016	R. Gill	T160205_26
C10-14	061-030-14	TO-17	February 5, 2016	R. Gill	T160205_27
C10-15	061-030-15	TO-17	February 5, 2016	R. Gill	T160205_28
C10-16	061-030-16	TO-17	February 5, 2016	R. Gill	T160205_29
C10-17	061-030-17	TO-17	February 5, 2016	R. Gill	T160205_30
C10-18	061-030-18	TO-17	February 5, 2016	R. Gill	T160205_31
C10-19	061-030-19	TO-17	February 5, 2016	R. Gill	T160205_32
C10-20	061-030-20	TO-17	February 5, 2016	R. Gill	T160205_33

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Analytical Information, Continued

Sample No.	Lab Track. No.	Method	Date Analyzed	Analyst	Data File
F10-01	061-030-21	D 5197	February 5, 2016	T.Cheng	160205\160205003.D
F10-02	061-030-22	D 5197	February 5, 2016	T.Cheng	160205\160205004.D
F10-03	061-030-23	D 5197	February 5, 2016	T.Cheng	160205\160205005.D
F10-04	061-030-24	D 5197	February 5, 2016	T.Cheng	160205\160205006.D
F10-05	061-030-25	D 5197	February 5, 2016	T.Cheng	160205\160205007.D
F10-06	061-030-26	D 5197	February 5, 2016	T.Cheng	160205\160205008.D
F10-07	061-030-27	D 5197	February 5, 2016	T.Cheng	160205\160205009.D
C10-08	061-030-28	D 5197	February 5, 2016	T.Cheng	160205\160205010.D
F10-09	061-030-29	D 5197	February 5, 2016	T.Cheng	160205\160205011.D
F10-10	061-030-30	D 5197	February 5, 2016	T.Cheng	160205\160205012.D
F10-11	061-030-31	D 5197	February 5, 2016	T.Cheng	160205\160205013.D
F10-12	061-030-32	D 5197	February 5, 2016	T.Cheng	160205\160205014.D
F10-13	061-030-33	D 5197	February 7, 2016	T.Cheng	160207B\160207005.D
F10-14	061-030-34	D 5197	February 7, 2016	T.Cheng	160207B\160207006.D
F10-15	061-030-35	D 5197	February 7, 2016	T.Cheng	160207B\160207007.D
F10-16	061-030-36	D 5197	February 7, 2016	T.Cheng	160207B\160207008.D
F10-17	061-030-37	D 5197	February 7, 2016	T.Cheng	160207B\160207009.D
F10-18	061-030-38	D 5197	February 7, 2016	T.Cheng	160207B\160207010.D
F10-19	061-030-39	D 5197	February 7, 2016	T.Cheng	160207B\160207011.D
F10-20	061-030-40	D 5197	February 7, 2016	T.Cheng	160207B\160207012.D

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Project Specific Information

Air samples for the analysis of formaldehyde (CAS # 50-00-0) and caprolactam (CAS # 105-60-2) were received by the laboratory on February 5, 2016. There were twenty DNPH cartridges for the analysis of formaldehyde and there were twenty multi-sorbent tubes for Caprolactam analysis. The analytical results for caprolactam are presented in Table 1. The analytical results for formaldehyde are presented in Table 2. All laboratory data, including but not limited to raw instrument files, calibration files, and quality control checks used to generate the results will be made available to the customer upon request.

Formaldehyde was analyzed by HPLC following ASTM Standard Method D5197. Formaldehyde was quantified using a multi-point (4 or more points) calibration curve.

Cartridge Blank – The average DNPH cartridge blank for formaldehyde is 40 ng. The average cartridge blank was subtracted from a measured mass to determine a blank subtracted sample mass.

MDL and LOQ – A Method Detection Limit (MDL) for formaldehyde of 15 ng was determined from the analysis of ten replicates of a low level standard spiked onto DNPH cartridges. The practical lower limit of quantitation (LOQ) is three times the MDL.

Uncertainty – The laboratory uses the ISO GUM method to estimate the uncertainties associated with the measurement of formaldehyde. The expanded uncertainty is equal to two times the relative standard deviation. For 2015, the expanded uncertainty estimated for formaldehyde was <9.0%.

Caprolactam was analyzed by thermal desorption GC/MS following U.S. EPA Compendium Method TO-17. Caprolactam was quantified using a multi-point (4 or more points) calibration cure prepared with a pure standard.

MDL and LOQ – A Method Detection Limit (MDL) for caprolactam of 3.9 ng was determined from the analysis of three replicates of the low level standard spiked onto multisorbent air sampling tubes.The practical lower limit of quantitation (LOQ) is three times the MDL.

Uncertainty – The laboratory uses the ISO GUM method to estimate the uncertainties associated with the measurement of VOCs . The expanded uncertainty is equal to two times the relative standard deviation. For 2015, the expanded uncertainty estimated for caprolactam was 11%.

All test methods used in this project are contained in the scope of Berkeley Analytical's ISO/IEC 17025 accreditation (TL-383, International Accreditation Service, Inc.).

Results

Table 1. Quantitative analysis of Caprolactam (CAS # 105-60-2).

Sample No.	Sample Name	Volume (L)	Mass (ng)	Conc ($\mu g/m^3$)	Conc* (ppb)
C10-01	3314	5.520	49.6	9.0	1.9
C10-02	3400	5.837	13.9	2.4	0.5
C10-03	3363	6.100	55.8	9.1	2.0
C10-04	3320	5.514	25.7	4.7	1.0
C10-05	10146	5.640	30.5	5.4	1.2
C10-06	10151	5.815	26.1	4.5	1.0
C10-07	10221	5.498	22.0	4.0	0.9
C10-08	10344	5.326	22.0	4.1	0.9
C10-09	11137	5.808	27.4	4.7	1.0
C10-10	11350	5.413	29.3	5.4	1.2
C10-11	11420	5.710	29.8	5.2	1.1
C10-12	11310	5.518	49.0	8.9	1.9
C10-13	12441	5.591	29.0	5.2	1.1
C10-14	12414	5.549	31.1	5.6	1.2
C10-15	12351	5.729	53.1	9.3	2.0
C10-16	12144	5.588	44.3	7.9	1.7
C10-17	14414	6.506	44.7	6.9	1.5
C10-18	14364	6.315	63.4	10.0	2.2
C10-19	14112	6.000	51.8	8.6	1.9
C10-20	14246	5.737	56.7	9.9	2.1

*Concentration in ppb calculated assuming standard conditions of 25° C and 101.3 kPa.

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Results, Continued

Table 2. Quantitative analysis of formaldehyde (CAS #50-00-0)

Sample No.	Sample Name	Volume (L)	Measured Mass (ng)	Mass – Blank* (ng)	Conc ($\mu g/m^3$)	Conc** (ppb)
F10-01	3314	51.05	677	637	12.5	10.2
F10-02	3400	55.47	496	456	8.2	6.7
F10-03	3363	55.15	583	543	9.9	8.0
F10-04	3320	51.33	411	371	7.2	5.9
F10-05	10146	53.73	950	910	16.9	13.8
F10-06	10151	52.37	844	804	15.4	12.5
F10-07	10221	51.97	879	839	16.1	13.2
C10-08	10344	51.00	884	844	16.5	13.5
F10-09	11137	52.95	477	437	8.3	6.7
F10-10	11350	51.56	484	444	8.6	7.0
F10-11	11420	54.92	616	576	10.5	8.5
F10-12	11310	50.56	558	518	10.3	8.4
F10-13	12441	54.14	554	514	9.5	7.7
F10-14	12414	54.16	623	583	10.8	8.8
F10-15	12351	52.94	409	369	7.0	5.7
F10-16	12144	54.21	457	417	7.7	6.3
F10-17	14414	62.65	733	693	11.1	9.0
F10-18	14364	60.38	672	632	10.5	8.5
F10-19	14112	58.09	605	565	9.7	7.9
F10-20	14246	55.51	678	638	11.5	9.4

*Measured mass corrected for typical 40 ng formaldehyde cartridge blank.

**Concentration in ppb calculated assuming standard conditions of 25° C and 101.3 kPa.

END OF REPORT

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Berkeley Analytical Associates, LLC
815 Harbour Way South, Suite 6
Richmond, CA 94804-3612
Phone: 510-236-2325 Fax: 510-236-2335
e-mail: baalab@berkeleyanalytical.com

CHAIN-OF-CUSTODY RECORD for ANALYTICAL SERVICES

2009 Update

Client Information*			
Company:	US EPA		
Street Address:	75 HAWTHORNE		
City/State/Zip Code:	SF 94105		
Country:	Contact (for reporting): Jeff Woodlee		
Project/Job Name:	IAQ		
Project/Job #:		P.O. #:	
Phone:		Fax:	
E-mail address:			

Received from BAA (check if applicable)	
Multi-sorbent tube samplers	☒
Aldehyde cartridge samplers	☐
Sampling pump(s)	☐
Other materials (specify):	☐

BAA Analysis Code	
Total VOCs by GC/MS total-ion-current method (TIC)	a
Qualitative GC/MS of individual VOCs	b
Qualitative GC/MS plus quantitation of up to 15 individual VOCs	c
Quantitative GC/MS analysis of target list of compounds	d
Quantitative GC/MS Total VOCs plus 4-PCH	e
Quantitative HPLC analysis of formaldehyde	f
Quantitative HPLC analysis of formaldehyde & acetaldehyde	g
Quantitative HPLC analysis of formaldehyde & C2-C9 carbonyls	h
Quantitative HPLC analysis of glutaraldehyde	i
	k
Other (specify):	z

Air Sampling Record

Tube/Cartridge Sampler No.	Collected Sample ID	Date Collected	Collection Minutes	Collected Volume (L)	Sample Location / Description / Remarks	Analysis Code	BAA Remarks
Mi193231	C10-01	2/3/16	57	5.520	3314	b	Caprolactam
203144	C10-02		61	5.837	3400		
242467	C10-03		62	6.100	3363		
203170	C10-04		57	5.514	3320		
203151	C10-05		59	5.640	10146		
Mi193224	C10-06		59	5.815	10151		
203184	C10-07		57	5.498	10221		
Mi193288	C10-08		56	5.326	10344		
203198	C10-09		59	5.808	11137		
203137	C10-10		56	5.413	11350		

Sample(s) Handling

Relinquished By	Received By	Signature	Date	Company
[redacted]	[redacted]	[redacted]	2/5/16	USEPA
[redacted]	RTill	[redacted]	2/5/16	BAA

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815 Harbour Way South, Suite 6
Richmond, CA 94804-3612
Phone: 510-236-2325 Fax: 510-236-2335
e-mail: baalab@berkeleyanalytical.com

CHAIN-OF-CUSTODY RECORD for ANALYTICAL SERVICES

2009 Update

Client Information*	
Company:	US EPA
Street Address:	75 Hawthorne
City/State/Zip Code:	SF 94105
Country:	Contact (for reporting): Jeff Woodle
Project/Job Name:	IAQ 75 Hawthorne
Project/Job #:	P.O. #:
Phone: (415) 972-3940	Fax:
E-mail address:	woodle.jeff@epa.gov

Received from BAA (check if applicable)	
Multi-sorbent tube samplers	☒
Aldehyde cartridge samplers	☐
Sampling pump(s)	☐
Other materials (specify):	☐

BAA Analysis Code	
Total VOCs by GC/MS total-ion-current method (TIC)	a
Qualitative GC/MS of individual VOCs	b
Qualitative GC/MS plus quantitation of up to 15 individual VOCs	c
Quantitative GC/MS analysis of target list of compounds	d
Quantitative GC/MS Total VOCs plus 4-PCH	e
Quantitative HPLC analysis of formaldehyde	f
Quantitative HPLC analysis of formaldehyde & acetaldehyde	g
Quantitative HPLC analysis of formaldehyde & C2-C9 carbonyls	h
Quantitative HPLC analysis of glutaraldehyde	i
	k
Other (specify):	z

Air Sampling Record

Tube/Cartridge Sampler No.	Collected Sample ID	Date Collected	Collection Minutes	Collected Volume (L)	Sample Location / Description / Remarks	Analysis Code	BAA Remarks
242440	C10-11	2/3/16	60	5.710	11420	b	Caprolactam
M193218	C10-12		56	5.518	11310		
242442	C10-13		58	5.591	12441		
M193227	C10-14		58	5.549	12414		
242405	C10-15		58	5.729	12351		
M193238	C10-16		58	5.588	12144		
242500	C10-17		68	6.506	14414		
242476	C10-18		66	6.315	14364		
M193234	C10-19		62	6.000	14112		
203107	C10-20		60	5.737	14246		

Sample(s) Handling

Relinquished By	Received By	Signature	Date	Company
			2/5/16	US EPA
	R Still		2/5/16	BKA

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815 Harbour Way South, Suite 6
Richmond, CA 94804-3612
Phone: 510-236-2325 Fax: 510-236-2335
e-mail: baalab@berkeleyanalytical.com

CHAIN-OF-CUSTODY RECORD for ANALYTICAL SERVICES

2009 Update

Client Information*			
Company:	US EPA		
Street Address:	75 HAWTHORNE ST		
City/State/Zip Code:	SF 94105		
Country:		Contact (for reporting):	JEFF WOODLEE
Project/Job Name:	IAQ 75 HAWTHORNE		
Project/Job #:		P.O. #:	
Phone:	(415)972-3740	Fax:	
E-mail address:	woodlee.jeff@epa.gov		

Received from BAA (check if applicable)	
Multi-sorbent tube samplers	☐
Aldehyde cartridge samplers	☒
Sampling pump(s)	☐
Other materials (specify):	☐

BAA Analysis Code	
Total VOCs by GC/MS total-ion-current method (TIC)	a
Qualitative GC/MS of individual VOCs	b
Qualitative GC/MS plus quantitation of up to 15 individual VOCs	c
Quantitative GC/MS analysis of target list of compounds	d
Quantitative GC/MS Total VOCs plus 4-PCH	e
Quantitative HPLC analysis of formaldehyde	f
Quantitative HPLC analysis of formaldehyde & acetaldehyde	g
Quantitative HPLC analysis of formaldehyde & C2-C9 carbonyls	h
Quantitative HPLC analysis of glutaraldehyde	i
	k
Other (specify):	z

Air Sampling Record

Tube/Cartridge Sampler No.	Collected Sample ID	Date Collected	Collection Minutes	Collected Volume (L)	Sample Location / Description / Remarks	Analysis Code	BAA Remarks
·	F10-01	2/3/16	57	51.05	3314	f	
·	F10-02		61	55.47	3400		
·	F10-03		62	55.15	3363		
·	F10-04		57	51.33	3320		
·	F10-05		59	53.73	10146		
·	F10-06		59	52.37	10151		
·	F10-07		57	51.97	10221		
·	F10-08		56	51.00	10344		
·	F10-09		59	52.95	11137		
·	F10-10		56	51.56	11350		

Sample(s) Handling

Relinquished By	Received By	Signature	Date	Company
[redacted]	[redacted]	[signature]	2/5/16	USEPA
[redacted]	KGill	[signature]	2/5/16	BKA

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815 Harbour Way South, Suite 6
Richmond, CA 94804-3612
Phone: 510-236-2325 Fax: 510-236-2335
e-mail: baalab@berkeleyanalytical.com

CHAIN-OF-CUSTODY RECORD for ANALYTICAL SERVICES

2009 Update

Client Information*			
Company:	USEPA		
Street Address:	75 HAWTHORNE		
City/State/Zip Code:	SF 94105		
Country:		Contact (for reporting):	Jeff Woodlee
Project/Job Name:	FAQ 75 HAWTHORNE		
Project/Job #:		P.O. #:	
Phone:	(415) 972-3740	Fax:	
E-mail address:	woodlee.Jeff@epa.gov		

Received from BAA (check if applicable)	
Multi-sorbent tube samplers	☐
Aldehyde cartridge samplers	☐
Sampling pump(s)	☐
Other materials (specify):	☐

BAA Analysis Code	
Total VOCs by GC/MS total-ion-current method (TIC)	a
Qualitative GC/MS of individual VOCs	b
Qualitative GC/MS plus quantitation of up to 15 individual VOCs	c
Quantitative GC/MS analysis of target list of compounds	d
Quantitative GC/MS Total VOCs plus 4-PCH	e
Quantitative HPLC analysis of formaldehyde	f
Quantitative HPLC analysis of formaldehyde & acetaldehyde	g
Quantitative HPLC analysis of formaldehyde & C2-C9 carbonyls	h
Quantitative HPLC analysis of glutaraldehyde	i
	k
Other (specify):	z

Air Sampling Record

Tube/Cartridge Sampler No.	Collected Sample ID	Date Collected	Collection Minutes	Collected Volume (L)	Sample Location / Description / Remarks	Analysis Code	BAA Remarks
"	F10-11	2/3/16	60	54.92	11420	f	
"	F10-12		56	50.56	11310		
"	F10-13		58	54.14	12441		
"	F10-14		58	54.16	12414		
"	F10-15		58	52.94	12351		
"	F10-16		58	54.21	12144		
"	F10-17		68	62.65	14414		
"	F10-18		66	60.38	14364		
"	F10-19		62	58.09	14112		
"	F10-20		60	55.51	14246		

Sample(s) Handling

Relinquished By	Received By	Signature	Date	Company
			2/5/16	US EPA
	R Hill		2/5/16	BKA

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