March 7, 2018

Mr. Kain Smith Shakopee Public Schools 1200 Town Square Shakopee, MN 55379



#### RE: **Shakopee Continuous Radon Monitoring Results** IEA Project # 201710980

Dear Mr. Smith:

As requested by Shakopee Public Schools, IEA assisted with continuous radon monitoring in the following district locations:

Eagle Creek Elementary 129, 113, 110, 108, 103, 104, 105, 111, 114, 101, 130, & Admin Office Jackson Elementary 127 **Pearson Middle School** 108 Shakopee High School Kitchen

The purpose of the monitoring was to document if radon levels were within an acceptable range during typical work hours.

#### **INTRODUCTION**

Long-term radon testing, performed by IEA (see the report dated May 15, 2017), indicated radon levels above the EPA Action Level of 4.0 picoCuries per liter (pCi/L). The Minnesota Department of Health's (MDH's) Best Practices for Radon Measurement in Minnesota Schools and Commercial Buildings recommends follow-up testing in areas where initial testing results are at or above the action level. A continuous radon monitor (CRM) is recommended to determine if elevated levels are present during occupied times. Radon levels can fluctuate with the operation of the ventilation system as well as with changes in barometric pressure. The CRM provides hourly radon readings so that levels can be evaluated for periods while the room is occupied.

#### **EVAULATION CRITERIA**

The MDH and the EPA have established a recommended Action Level in frequently occupied areas of 4.0 picoCuries per liter (pCi/L) for an annual average. The average radon level over each work day was compared to the Action Level.

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BROOKLYN PARK BROOKLYN PARK 9201 West Broadway, #600 Brooklyn Park, MN 55445 763-315-7900 / FAX 763-315-7920 800-233-9513

MANKATO MANKATO 610 North Riverfront Drive Mankato, MN 56001 507-345-8818 / FAX 507-345-5301 800-233-9513

 
 ROCHESTER
 BRAINERD

 210 Woodlake Drive SE
 601 NW 5<sup>th</sup> Street, Ste. #4

 Rochester, MN 55904
 Brainerd, MN 56401

 507-281-6664 / FAX 507-281-6695
 218-454-0703 / FAX 218-454-0703
800-233-9513

800-233-9513

MARSHALL MARSHALL 1420 East College Drive Marshall, MN 56258 507-476-3599 / FAX 507-537-6985 800-233-9513

VIRGINIA 5525 Emerald Avenue Mountain Iron, MN 55768 218-410-9521 800-233-9513

#### **RESULTS & DISCUSSION**

From December 14, 2017 through February 26, 2018, the continuous radon monitoring was conducted in the district locations. The CRM was placed in each room for about 72 hours; the MDH recommends a minimum of 48 hours. The times of day when these rooms were not occupied (e.g., nights and weekends) were not included in the "Day Ranges" calculated averages. For comparison data, an "Overall Average" is displayed that did include all monitoring data. The hourly CRM data (hard copy tapes) is provided in Appendix A. The buildings floor plan maps with the locations of the continuous radon monitor locations marked are provided in Appendix B.

A summary of the continuous radon monitor data is provided in the following tables: *Long-Term testing results are shown in reference* 

Date Range	Room #	<sup>1</sup> Day 1 Range (Ave.) (pCi/L)	<sup>1</sup> Day 2 Range (Ave.) (pCi/L)	<sup>1</sup> Day 3 Range (Ave.) (pCi/L)	<sup>2</sup> Overall Average (pCi/L)	Results from the Long-Term Testing (pCi/L)
12/14/17 to 12/19/17	129	0.39	0.91	0.86	5.1*	14.4
1/4/18 to 1/8/18	113	0.87	0.55	NA	4.9*	9.4
1/8/18 to 1/10/18	110	0.64	0.66	1.15	2.5	6.6
1/10/18 to 1/12/18	108	0.80	0.71	2.42	3.5	5.3
1/12/18 to 1/17/18	103	0.16	0.31	0.38	3.7*	5.0
1/17/18 to 1/19/18	104	0.34	1.11	NA	3.9	5.0
1/19/18 to 1/25/18	105	0.64	0.21	0.17	3.4*	4.9
1/25/18 to 1/31/18	111	0.26	0.56	0.33	4.2*	4.8
1/31/18 to 2/2/18	114	0.68	0.48	1.00	2.6	4.6
2/2/18 to 2/6/18	101	0.20	0.53	NA	3.3*	4.1
2/6/18 to 2/8/18	130	0.59	0.53	0.50	2.6	4.1
2/8/18 to 2/13/18	Admin Office	0.44	0.35	0.33	4.9*	5.1

### Eagle Creek Elementary: Continuous Radon Monitoring Results – December 14, 2017 to February 13, 2018

<sup>1</sup>Readings during occupied times: 7 a.m. to 5 p.m.

<sup>2</sup>Overall average is average for entire test period including when room was not occupied

\*Includes an entire weekend, Saturday and Sunday

pCi/L – picoCuries per liter of air

#### Jackson Elementary: Continuous Radon Monitoring Results – February 13 to 15, 2018

Date Range	Room #	<sup>1</sup> Day 1 Range (Ave.) (pCi/L)	<sup>1</sup> Day 2 Range (Ave.) (pCi/L)	<sup>1</sup> Day 3 Range (Ave.) (pCi/L)	<sup>2</sup> Overall Average (pCi/L)	Results from the Long-Term Testing (pCi/L)
2/13/18 to 2/15/18	127	1.16	1.74	NA	6.2	4.9 & 4.2

<sup>1</sup>Readings during occupied times: 7 a.m. to 5 p.m.

<sup>2</sup>Overall average is average for entire test period including when room was not occupied

pCi/L – picoCuries per liter of air

#### **Pearson Middle School: Continuous Radon Monitoring Results** – February 22 to 26, 2018

Date Range	<sup>2</sup> Overall Average (pCi/L)	Result from the Long-Term Testing (pCi/L)				
2/15/18 to 2/19/18	4.1					
<sup>1</sup> Readings during or <sup>2</sup> Overall average is *Includes an entire	ccupied tim average for weekend. S	es: 7 a.m. to 5 p.m entire test period i Saturday and Sunda	n. including when room	n was not occupied		

pCi/L – picoCuries per liter of air

#### Shakopee High School:

Continuous Radon Monitoring Results – February 20 to 22, 2018

Date Range	Room #	<sup>1</sup> Day 1 Range (Ave.) (pCi/L)	<sup>1</sup> Day 2 Range (Ave.) (pCi/L)	<sup>1</sup> Day 3 Range (Ave.) (pCi/L)	<sup>2</sup> Overall Average (pCi/L)	Results from the Long-Term Testing (pCi/L)		
2/20/18 to 2/22/18 Kitchen 0.38 0.82 1.40 0.7								
<sup>1</sup> Readings during o								

<sup>2</sup>Overall average is average for entire test period including when room was not occupied

pCi/L – picoCuries per liter of air

#### Discussion of Results

- The "Day Ranges" calculated averages show on average ranging from 0.16 to 1.85 picoCuries per liter (pCi/L); all below the EPA Action Level. These average radon levels are all over the working hours of the days during the work-week, the range of occupied time from 7am to 5 pm, in the locations denoted.
- The "Overall Average" that includes all monitoring data (including nights and weekends) ranged from 0.7 to 6.2 picoCuries per liter (pCi/L).

#### **CONCLUSIONS & RECOMMENDATIONS**

The results of the continuous radon monitoring indicate that radon levels in all the locations tested are below the action level during the working hours of the days during the work-week, the range of occupied time from 7am to 5 pm. The testing was performed during the Winter season of 2017/2018 so the testing is representative of "worst case" conditions.

#### **Recommendations:**

- Continue with the HVAC settings used for working hours of the days during the work-week, the range of occupied time from 7am to 5 pm, for these tested locations.
- For occupied time outside of the working hours of the days during the work-week, the range of occupied time from 7am to 5 pm, such as nights and weekends, when the buildings will be occupied for various functions in the tested rooms, IEA recommends implementing the HVAC settings used for working hours of the days during the work-week, the range of occupied time from 7am to 5 pm.
- The known methods for the radon reduction could include processes such as either diluting or pressurizing these areas to limit radon entry, or by implementing a combination of the two techniques. Increasing fresh air while keeping the return air unchanged or reduced can help pressurize work areas to limit radon entry. Knowledge of your systems and your buildings will guide your adjustments.
- For any future adjustments made to the HVAC system in the rooms tested, IEA recommends repeating this testing, keeping in mind to plan any retested to be during the winter heating season (i.e. under "closed" conditions) which is typically "worst case" conditions.
- Per Minnesota Statutes, section 123B.571, school districts are now required to report radon test results at a school board meeting and report results to the MDH. IEA is able to assist with presenting results to the school board, and the MDH reporting.

#### **GENERAL COMMENTS**

The analysis and opinions expressed in this report are based upon data obtained from continuous radon monitoring at district locations and are representative of those locations and time periods sampled. This report does not reflect variations in conditions that may occur across the site, property, or facility. Actual conditions may vary and may not become evident without further assessment.

The report is prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted radon testing practices. Other than as provided in the preceding sentence and in our proposal #6419 dated September 14, 2017, regarding radon testing services, including the General Conditions attached thereto, no warranties are extended or made. IEA appreciates the opportunity to submit this analysis to Shakopee Public Schools.

Should you require additional radon testing or have any questions regarding radon or any other health- or safety-related concerns, please do not hesitate to contact our office.

Sincerely,

Sincerely, IEA, INC.

6 Ben LaFond, CSPI

EHS Account Manager

BL/ep 3/07/18

Enc.

en Weihlen

Karen Weiblen EHS/IEQ Consultant

## Appendix A

Continuous Radon Monitor Hourly Data

< RADON TEST REPORT >

1/D \_\_\_\_\_ Almy office

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START	TIME	8:21

OPERATOR DOP

SERI C/F SKG	IAL NO (CPM∠pC (pCi∠l)	i/1	) )	RM510(	5150 .380 .5
Hr	Conc. ⊳Ci∕l	/ ) 	L RH 3=:%	B∕P ″Hg	deg F
1 2 3 4 5 6 7 8 9 0 11 12 13 14 5 6 7 8 9 0 11 12 13 14 5 6 7 8 9 0 11 12 13 14 5 6 7 8 9 0 11 12 13 14 5 6 7 8 9 0 11 12 13 14 5 16 7 8 9 0 11 12 15 16 7 8 9 0 11 12 16 7 8 9 0 11 12 15 16 17 10 10 10 10 10 10 10 10 10 10 10 10 10	2.2 1.5 .3 .5 .2 .3 .0 .1 .3 .7 .8 1.6 3.1 3.0 5.7 6.4 7.0 7.1 6.5		6 10 12 11 12 13 13 10 9 9 9 10 10 10 10 10 10 10 10 10 10 10 10 10	29.0 29.2 29.2 29.3 29.3 29.3 29.3 29.3 29.3	69 69 70 71 72 72 72 71 70 69 69 69 68 68 68 68 68 68 68 68 68 68 68 68 68

24 25 27 28 30 31 32 33 35 37 38 30 41 42 45 46 47 48 50	$\begin{array}{c} 2.7\\ 2.0\\ .2\\ .6\\ .0\\ .5\\ .4\\ 1.7\\ 2.2\\ .4\\ 1.7\\ 2.2\\ .4\\ 0\\ 3.0\\ 4.5\\ 4.0\\ 4.5\\ 4.6\\ 3.9\\ 1.6\\ .7\\ .7\\ .7\\ .7\\ .7\\ .7\\ .7\\ .7\\ .7\\ .7$		10 29 11 29 14 29 14 29 16 29 16 29 16 29 18 29 18 29 18 29 14 29 13 29 14 29 13 29 14 28 13 28	.2 $67.2$ $68.2$ $68.2$ $69.2$ $70.2$ $72.2$ $.2$ $.2$ $.2$ $.2$ $.2$ $.2$ $.2$
Elapse Total Avg. (	d Time Count ⊳Ci∕l)	(m	in.)	3000 3509 2.5

	18 19 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 489 140	1.9543731899753960398956	33235466778899990010 101111 1108	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	70 67 66 66 67 66 63 61 61 61 60 60 60 60 60 60 60 60 60 60 60 60 60

v

2.0	9 20.J D/
Elapsed Time Total Count Avs. (pCi/1)	(min.) 8400 15321 4.2
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cont. | ||

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IZE	Closer	tooun 113 EggleC
STA	RT DATE	1/04/18
STA	RT TIME	8:21
OPE	RATOR	92
SER C/F BKG	AL NO (CPM/PC (PCi/l)	- CRM5106160 Ci/l) .380
Ηr	Conc. ₽Ci∕l	/ L RH B/P dea B % "Ha F
1234567890112345678901234567890123456789012345678901	2.9603423653528788852777822555310481099894050 1.2245674	1 29.6 66 2 29.5 68 2 29.6 70 2 29.6 71 2 29.6 72 1 29.6 72 0 29.6 71 1 29.6 70 0 29.5 67 0 29.3 62 1 29.3 60 2 29.3 59 2 29.3 59 2 29.3 58 2 29.3 58 3 29.3 58 1 29.5 62 0 29.6 66 0 29.6 66 0 29.6 66 0 29.6 65 0 29.5 58 1 2

ERA	R S ROT	SP			
RIA C/F G G	4L. NO (CPM/P( (PCi/l	- Ci/l) > ==== ===	CRM ==== RH	151,06 	160 380 .5 dag
Ar	PCi/l	Ē	%	"Hg 	F
	1 2 3 9 0 1 2 3 14 15 16 17 18 19 20 21 22 23 24	2970847.52489332774241732 	8 10 9 7 10 10 10	28.9 28.9 29.0 29.0 29.0 29.0 29.0 29.0 29.0 29	69 70 67 67 67 67 67 67 67 5.2 67 67 5.2 67 5.3 66 67 9.3 66 66 67 9.3 66 66 67 9.3 66 66 67 9.3 66 70 7

$\begin{array}{c} 25\\ 26\\ 29\\ 30\\ 32\\ 34\\ 36\\ 78\\ 30\\ 41\\ 42\\ 44\\ 45\\ 46\\ 49\\ 49\end{array}$	.6 .9 .8 .3 .1 .0 5 .8 .6 .2 .4 .1 .2 .0 5 .8 .6 .2 .4 .1 .2 .0 5 .8 .6 .2 .4 .1 .2 .0 5 .8 .6 .2 .4 .4 .1 .2 .0 .5 .8 .6 .5 .5 .5 .5 .5 .5 .5 .5 .5 .5 .5 .5 .5	3 29.5 4 29.5 3 29.5 1 29.6 2 29.6 2 29.6 2 29.6 1 29.6 2 29.6 1 29.5 2 29.5 2 29.5 2 29.6 3 29	
Elaps	ed Time	(min.)	2940
Total	Count		3550
Avg.	(pCi/l)		2.6

< RADON TEST REPORT > , Eagle Crock Classicsom 114

ART DATE

ART TIME

1/31/18

3:37

< radon test report > /2.9

I/D \_\_\_\_\_

START	DATE	12/14/17
START	TIME	9:59

An

OPERATOR \_\_\_\_\_

SERI C/F BKG	AL NO (CPM/pC (pCi/l)	i/l)	CI	RM5108	5160 .380
TULCI	(FOI/1)				
-  µ-	Conc. ₽Ċi∕l	∕ L B	RH %	B∕P "H9	dea F
$\begin{array}{c}1&2&3&4&5&6&7\\&8&9&0&1&1&2&3&4&5&6&7\\&1&1&1&1&1&1&1&2&2&2&2&2&2&2&2&3&3&3&3&3$	785120356313848521625467767541087220223876255 2457765666686421 1237777777668867		555544435678900111122219888888888901122345566777777	$\begin{array}{c} 29.2\\$	999997070865444322111368899900170866654444332221 699777766654443221113668999001777866654444332221

61 11 11 60 60 60 90 90 90 80 80 80 80 80 80 80 80 80 80 80 80 80
18  28.9    18  28.9    18  28.9    19  28.9    19  28.9    19  28.9    19  28.9    19  28.9    19  28.9    19  28.9    19  28.9    19  28.9    19  28.9    19  28.9    19  28.9    19  28.9    18  28.9    18  28.9    18  28.9    18  28.9    18  28.9    18  28.9    18  28.9    18  28.9    18  28.9    18  28.9    18  28.9    19  28.9    19  28.9    19  28.7    20  28.7    20  28.7    20  28.7    21  28.7    21  28.7    21  28

97 98 .4 13 28.9 99 .6 13 28.9 58
$\begin{array}{cccccccccccccccccccccccccccccccccccc$
Elapsed Time (min.)
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	STA	RT DATE	2/06/13				25 I g	0
	STA	RT TIME	8:51				······································	
	OPE)	RATOR D	Relates					0 29.5 E 0 29.5 E 0 29.5 E
	SERI C/F BKG	IAL NO (CPM/pCi, (pCi/1)	CRM5106150 /1) .380 .5			100 - 100 100 100 100 100 100 100 100 100 100	.5 .0 .9 1.2	0 29.5 6 0 29.5 6 0 29.5 6 0 29.5 6 0 29.3 6
	Κr	Conc. ∕ ₽Ci∕l	′LRH B/P dea B % "Ha F			25 37 38	4.0 3.7 4.4	U 29.3 6, 0 29.3 6, 0 29.3 6;
л. Т	1 2 3 4 5 6 7 8 9 0 11 12 13 14 15 6 7 8 9 0 11 2 3 4 5 6 7 8 9 0 11 2 3 4 5 6 7 8 9 0 11 2 3 4 5 6 7 8 9 0 11 2 3 4 5 6 7 8 9 0 11 2 3 4 5 6 7 8 9 0 11 2 3 4 5 6 7 8 9 0 11 2 3 4 5 6 7 8 9 0 11 2 3 4 5 6 7 8 9 0 11 2 3 4 5 6 7 8 9 0 11 2 3 4 5 6 7 8 9 0 11 2 3 4 5 6 7 8 9 0 11 2 3 4 5 6 7 8 9 0 11 2 3 4 5 5 8 9 0 11 12 2 3 4 5 10 11 2 2 3 10 11 2 2 3 10 11 2 2 3 10 11 2 2 3 10 11 2 2 3 10 11 2 2 2 11 2 2 2 2 2 2 2 2 2 2 2 2	.5 .4 .5 .9 .5 1.8 2.6 3.7 4.7 5.0 5.8 4.1 5.0 5.9 4.1 2.9	$egin{array}{ccccc} 0&29.6&70\\ 0&29.5&69\\ 0&29.5&68\\ 0&29.5&68\\ 0&29.5&68\\ 0&29.5&67\\ 0&29.5&66\\ 0&29.5&66\\ 0&29.3&65\\ 0&29.3&65\\ 0&29.3&64\\ 0&29.3&63\\ 1&29.3&63\\ 1&29.3&63\\ 1&29.3&62\\ 1&29.3&62\\ 1&29.3&62\\ 1&29.3&61\\ 2&29.5&61\\ 2&29.5&61\\ 2&29.5&61\\ 2&29.5&61\\ $	10		)9 10 41 42 43 44 45 46 47 48 49 Elaps Total Avg.	4.1 5.5 6.0 5.9 6.2 5.6 6.1 3.6 1.4 1.1 .5 sed Time (n Count (pCi/1)	1 29.3 63 1 29.3 63 1 29.3 62 2 29.3 62 2 29.3 62 2 29.3 61 1 29.3 64 0 29.5 66 0 29.5 69 0 29.5 69 11.) 2940 3533 2.6

### < radon test report >

I/D		
START	DATE	2/20/18

START TIME Kitchen 9:16 OPERATOR David Hollar

SERI	IAL	NC		CF	2M5108	180	
C/F	(CP	MzpC	i/1)			380	
BKG	(pC	i 210				5	
11	0		. 7	<b>T</b> 11	D /D	1	
$\Box K$		NU -		лл	D/Y	aee	
	РC	1/i	B	%	"Hg	<u>+</u> -	
1234567890142345673	PC	1/1 953755200251030131	, B	% 14 19 23 22 17 18 14 12 13 12 12 12 12 12 12	"He 28.9 28.7 28.7 28.7 28.9 29.0 29.0 29.0 29.0 29.2 29.2 29.2 29	F 58 59 50 60 61 61 60 59 59 58 55 55 55 55 55 55 55 55 55 55 55 55	
19 20 21 22 23 24 25 26 27 26 27 28 29 30 31	1			$\begin{array}{c} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 $	29.2 29.3 29.2 29.2 29.2 29.2 29.2 29.2	58 58 51 47 55 55 55 55 59 59 59	

Elapsed Time (min.) 2940	32 33 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49	.9 1.6 1.5 .9 1.2 1.2 1.2 1.2 1.2 1.2 1.2 1.2 1.2 1.2	15 15 13 8 11 12 12 12 12 12 12 12 12 12 12 12 12	29.3 29.3 29.3 29.3 29.3 29.3 29.3 29.3	59 59 61 60 59 50 59 50
Avg. (pCi/l) .7	Elapsed Total ( Avg. (p	d Time Count =Ci/l) =======	(min.)	29 10	348 383 .7

< RADON TEST REPORT >

IND JACKSON School Room 127

START DATE 2/13/18 START TIME 8:29

OPERATOR Monty Schmitt

SERI C/F BKG	IAL NO (CPM/pCi/l) (pCi/l)			CRM5106160 .380 .5		
Hz	Conc. ⊳Ci∕l	/	L B	RH %	B∕P ″H9	deg F
1 2 3 4 5 6 7 8 5 0 11 2 3 4 5 6 7 8 5 0 11 2 3 4 5 6 7 8 9 0 12 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1.84732-8240876862840855482 4433356942840855482	1		879888888888889998889 1088888888888889998889	29.5 29.5 29.5 29.5 29.3 29.3 29.3 29.3 29.3 29.3 29.2 29.2	669 700 722 700 700 722 700 709 709 709 709 709 709 709 709 709

20	2.3	11	29.0	70
27	1.4	31	29.0	70
28	1.3	9	29.0	70
29	- 2	2.1	29.0	70
30	1.0	12	28.9	70
31	1.0	31	28.9	70
32	- a -	4	28.7	69
33	2.0	11	28.7	69
34	2.8	Jacon la provide	28.7	59
35	3.8	1	28.7	69
36	4.4	11	28.7	69
37	6.5	1-1	28.7	69
38	8.2	12	28.7	S9
39	9.3	12	28.7	69
40	8.3	12	28.7	69
41	8.2	12	28.7	69
42	14	12	28.7	69
43	11.7	12	28.7	69
44	10.5	12	28.7	69
45	11.9	12	28.7	69
46	11.7	12	28.9	69
47	7.3	12	28.9	69
Flaps	od Timo	(min )	-	con
Total	Coupt	Soli 2 E i e J		020 '980
Ava.	(pCi/1)		(	200 6 0
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# Appendix B

Maps







![](_page_28_Figure_0.jpeg)

![](_page_29_Figure_0.jpeg)