Gamma Count Rate Survey in Pines, Indiana

Conducted October 10 – 15, 2009

PINES
(People in Need of Environmental Safety)

October 27, 2009

Tim – At Long last the Final Re-Formatted copy + an electronic copy too —

Paul Kysar

P.S. – Larry Jensen has not heard From your RAD person on this yet?!?

Overview

Pines, Indiana, is presently involved in a United States Environmental Protection (USEPA) Region 5 Superfund cleanup action due to ground water pollution originating from flyash disposed of by the Northern Indiana Public Service Company (NISPCO) at the Brown, Inc. landfill (Yard 520) in Pines, Indiana. Flyash is also believed to have been used in the construction of some roads in the town and the surrounding area, and as fill on some residential and commercial properties.

Because it is known that flyash can contain radionuclides of the Uranium (uranium-238) Decay Series, the Actinium (uranium-235) Decay Series, and the Thorium (thorium-232) Decay Series a decision was made by the PINES (People in Need of Environmental Safety) group to conduct a radiation survey of sites where flyash was believed to have been used.

The radiation survey was conducted over the span of October 10 through October 15, 2009, using a gamma-ray scaler/count rate meter and a sodium iodide scintillometer. Surveys were conducted by a retired USEPA Region 5 Superfund Radiation Expert. Natural background gamma count rates were established at 3 sites believed to not have any deposits of flyash. Gamma count rates were also measured at 12 sites where flyash contamination was suspected to be an issue. Further gamma count rates were measured at 3 sites where the Remedial Investigation Report showed isotopic soil concentrations exceeding cleanup levels USEPA Region 5 has used for uranium, thorium and radium sites.

Once background radiation count rates levels were established, they were compared to count rates at sites of interest. Those site levels exceeding twice the average background gamma count rate were deemed to be in need of further investigation as a potential radioactively contaminated area. Further investigation would need to include determination of the isotopic identities and the isotopic activity concentration of soil components.

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Radiation Measurements at Carolina Avenue and the Calumet Bike Trail

Measurements by Larry Jensen and Rosemary Gemperle, October 11, 2009

Intersection of Carolina Avenue and the Calumet Bike Trail
Glittering black material on the avenue
2 minute count with probe tip on contact with the ground
21,407 counts/2 minutes = 10,704 counts per minute (cpm)

Calumet Bike Trail at Carolina, looking east

Background Site

Approximately 50 feet southwest of Carolina Avenue and the Calumet Bike Trail intersection
Measurement in grassy area
2 minute count with probe tip on contact with the ground
9743 counts/2 minutes = 4872 cpm

In weeds to west of Carolina and south of Calumet Bike Trail

Measurements by Larry Jensen and Larry Silvestri, October 14, 2009

Midway between South Shore railroad tracks and Calumet Bike Trail on Carolina Avenue

** Center of Carolina Avenue
Glittering black material on the avenue
2 minute count with probe tip on contact with the ground
21,313 counts/2 minutes = 10,657 cpm

** 10 feet west of Center of Carolina Avenue
Grassy area to side of avenue
2 minute count with probe tip on contact with the ground
23,367 counts/2 minutes = 11,684 cpm

** 25 feet west of Center of Carolina Avenue
Grassy area off avenue
2 minute count with probe tip on contact with the ground
8839 counts/2 minutes = 4420 cpm

On Calumet Bike Trail, 100 feet west of Carolina Avenue

** Center of Calumet Bike Trail
"Limestone" fill on trail
2 minute count with probe tip on contact with the ground
6103 counts/2 minutes = 3052 cpm

** 10 feet south of Center of Calumet Bike Trail
Grassy area to side of trail
2 minute count with probe tip on contact with the ground
8750 counts/2 minutes = 4375 cpm

** 25 feet south of Center of Calumet Bike Trail
Grassy area off trail
2 minute count with probe tip on contact with the ground
10,459 counts/2 minutes = 5230 cpm

Radiation Measurements at [redacted]

Measurements by Larry Jensen and Paul Kysel, October 10, 2009

Background Site

Approximately 100 yards southwest of Islamic Center of Michigan City, in woods
[redacted]
2 minute count with probe tip on contact with the ground
9670 counts/2 minutes = 4835 counts per minute (cpm)

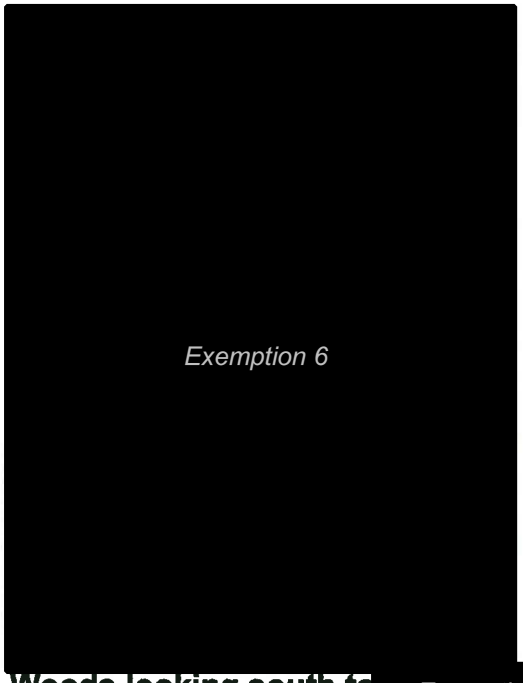
Background Site: Approximately 100 Yards southwest of Islamic Center] Of Michigan City, in woods

[redacted]

Radiation Measurements at Exemption 6

Measurements by Larry Jensen and Peggy Richardson, October 12, 2009

Background Site
Approximately 30 feet north of driveway in woods
2 minute count with probe tip on contact with the ground
8916 counts/2 minutes = 4458 counts per minute (cpm)



Woods looking south to Exemption 6

Radiation Measurements on Exemption 6 from Porter/La Porte County Line Road to 600 E

Measurements by Larry Jensen and Paul Kysel, October 10, 2009

** West of gate near County Line Road
Glittering black material on surface
9500 – 10,000 counts per minute (cpm)

** Approximately 200 feet north of 1600 N in wooded area
approximately 9000 cpm

** Exemption 6
2 minute count with probe tip on contact with the ground
21,387 counts/2 minutes = 10,694 cpm

** At farmer's vehicle entrance to field, on north side
approximately 9000 cpm

East gate at Exemption 6

East of gate on Exemption 6 between gate And Porter / LaPorte County Line Road, Looking northeast

Radiation Measurements at [redacted]

Measurements by Larry Jensen and Paul Kysel, October 10, 2009

Measurements at Islamic Center of Michigan City

** Paved parking lot
Approximately 7000 counts per minute (cpm)

** South side, grassy area
7000 – 8000 cpm

** Gravel drive on south side
3000 – 3500 cpm

** West side, grassy area towards the south end
3500 – 5000 cpm

** West side, grassy area towards the near north side / tree line
8000 – 8500 cpm

** North side, grassy area
4500 – 5000 cpm

** Far east side in grassy area
4000 – 5000 cpm

** Apron of parking lot on east edge – in line with crack running east/west in alignment with north wall of building
10,000 – 10,500 cpm

** In limited grassy area in east near [redacted]
10,000+ cpm

** East side, approximately 50' from parking lot edge
7500 – 8000 cpm
(appears to be a seam that runs north / south along parking lot edge)
8500 – 10,000 cpm

** South side of drive entrance next to asphalt patch
about 11,000 cpm
2 minute count with probe tip on contact with the ground
21,121 counts / 2 minutes = 10,561 cpm

Grassy area, south side of mosque

South of entrance drive patch

Radiation Measurements at Exemption 6

Measurements by Larry Jensen and Paul Kysel, October 10, 2009

** Parking area by tree holding security light
Approximately 4500 counts per minute (cpm)
** South side of front yard
5000 – 6000 cpm

Front yard at Exemption 6

Radiation Measurements on 500 E at US Interstate-94

Measurements by Larry Jensen and Paul Kysel, October 10, 2009

South of I-94, west of 500 E
Stone pile / asphalt patch area

** West of berm where materials have been removed
8000 – 8500 counts per minute (cpm)

** Area in front of barbed wire fence to west
N 41° 39.254' / W 086° 58.25'8'
4000 – 4500 cpm

South of I-94, west of 500 E –
Stone pile / asphalt patch area

Radiation Measurements at Connecticut Avenue

Measurements by Larry Jensen and Peggy Richardson, October 12, 2009

Approximately halfway between 2nd Place and Highway 12
N 41° 41.442' – W 086° 56.315'
Glittering black material on center of avenue
2 minute count with probe tip on contact with the ground
27,079 counts/2 minutes = 13,540 counts per minute (cpm)

Connecticut Avenue looking south toward 2nd Place

Approximately 2/3 distance north of 2nd Place towards Highway 12

** Center of Connecticut Avenue
Glittering black material on the avenue
11,000 – 14,000 cpm

** Approximately 15 feet east of center of avenue in grassy area
approximately 12, 000 cpm

** Approximately 25 feet east of center of avenue in woods
4500 – 5000 cpm

Connecticut Avenue at 2nd Place looking north

Radiation Measurements at [redacted]

Measurements by Larry Jensen and Peggy Richardson, October 13, 2009

[redacted]

Open field, north of driveway
4000 – 8500 counts per minute (cpm)
Higher counts on band near south center of field

Open field, south of driveway
4000 – 5000 cpm

No picture

Radiation Measurements on Railroad Avenue

Measurements by Larry Jensen and Peggy Richardson, October 13, 2009

675 Railroad Avenue, north side, on west side of driveway, along berm
11,000 – 12, 000 counts per minute (cpm)

675 Railroad Avenue, north side, to east side of driveway, along berm
9000 – 11,000 cpm

675 Railroad Avenue on south side of avenue, between avenue and railroad tracks
8000 – 11,000 cpm

West of 664 Railroad Avenue, south side of avenue, between avenue and railroad tracks
2 minute count with probe tip on contact with the ground
15,912 counts/2 minutes = 7956 counts per minute (cpm)

West of 664 Railroad Avenue, north side of avenue, on grass
2 minute count with probe tip on contact with the ground
13,311 counts/2 minutes = 6656 counts per minute (cpm)

656 Railroad Avenue, north side, walking west on berm to 650 Railroad Avenue
4500 – 11,000 cpm
(lowest count rate at large tree on 656 Railroad Avenue)

Between 650 and 656 Railroad Avenue, south side on berm
6500 – 11,000 cpm

Railroad Avenue at 675 looking east

Railroad Avenue at 675 looking west

624 Railroad Avenue, looking east

624 Railroad Avenue, looking west

Railroad Avenue at 656 looking south

Railroad Avenue at 656 looking west

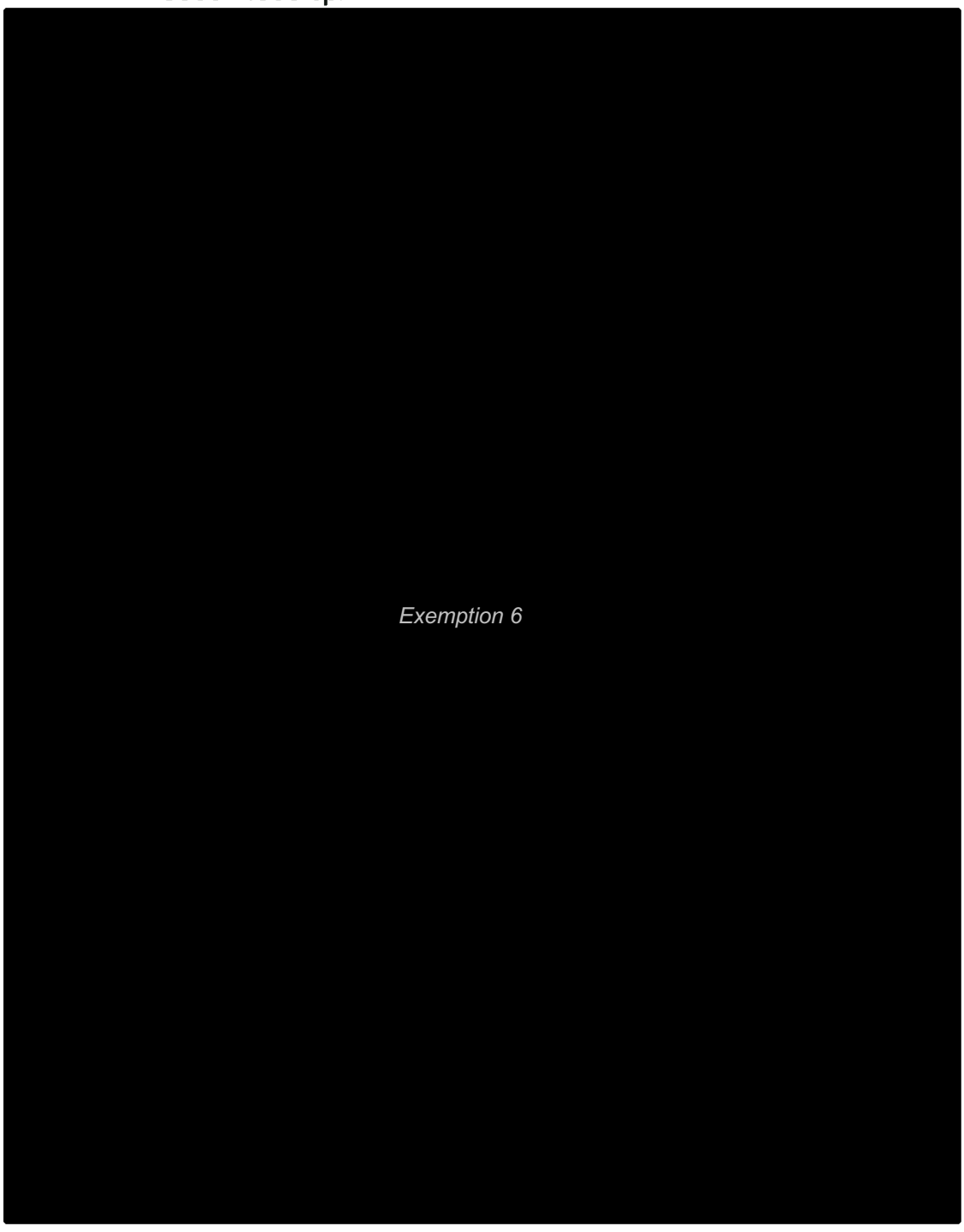
Radiation Measurements on Ardendale Road

Measurements by Larry Jensen and Peggy Richardson, October 13, 2009

[redacted] Exemption 6

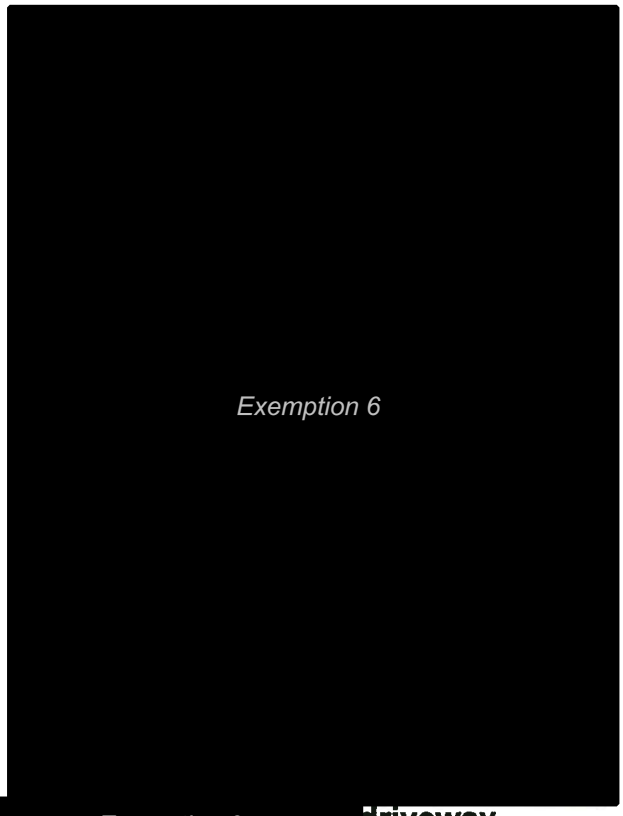
** 2 well points lying on garage floor
3500 – 4500 counts per minute (cpm)

** garage floor approximately 10 feet from well points
3500- 4500 cpm



Exemption 6

** 7000 – 11,000 cpm



Exemption 6 driveway

Exemption 6 around tree at south end Exemption 6

** 4000 – 5000 cpm

No Picture

Radiation Measurements Monitoring well south of Yard 520

Measurements by Larry Jensen and Peggy Richardson, October 13, 2009

Monitor well on south side of landfill, on Railroad Avenue

** North side of monitor well
8500 – 9000 counts per minute (cpm)

** South side of monitor well
11,000 – 12,000 cpm

Monitor well south of Yard 520

Radiation Measurements on Illinois Avenue, between Railroad Avenue and Johns Avenue

Measurements by Larry Jensen and Larry Silvestri, October 14, 2009

Illinois Avenue from Railroad Avenue to Johns Avenue
4500 – 12,000 counts per minute (cpm)
lower count rates near Johns Avenue
higher count rates where glittering black material was present

** Center of Illinois Avenue, 200 feet north of Railroad Avenue
25,005 counts/2 minutes = 12,503 cpm

** Center of Illinois Avenue, 450 feet north of Railroad Avenue
23,191 counts/2 minutes = 11,596 cpm

Illinois Avenue at Railroad Avenue

Illinois Avenue At Johns Place looking south

Radiation Measurements at SS018 sampling site

Measurements by Larry Jensen and Larry Silvestri, October 14, 2009

Highway 20 at Mitchel Bros. Storage property

** Parking lot
on "slag" type material
8000 – 9000 counts per minute (cpm)

** Weedy field to west of parking lot
7000 – 8000 cpm

** Dumping area to north of parking lot
7000 – 8000 cpm

** Lowland area to north of dumping area and north of parking lot
5000 – 6000 cpm

At SS018 field looking west

At SS018 woods looking north

Radiation Measurements at SS021 sampling site

Measurements by Larry Jensen and Larry Silvestri, October 14, 2009

Ardendale Road, north of County Road 1600 N
West side of Ardendale in woods
South of corrugated sheet metal slab
Northeast of blue house
18,846 counts /2 minutes = 9423 counts per minute (cpm)

No picture

Radiation Measurements on Johns Avenue

Measurements by Larry Jensen and Tom Brand, October 15, 2009

Northeast corner of Johns Avenue and Idaho Avenue
8500 – 9500 counts per minute (cpm)

Northwest east corner of Johns Avenue and Idaho Avenue
4500 – 9000 cpm

Southwest corner of Johns Avenue and Idaho Avenue
11,000 – 12,000 cpm

Southeast corner of Johns Avenue and Idaho Avenue
8500 – 13,000 cpm

South side of Johns Avenue from Idaho Avenue to Florida Avenue
11,000 – 13,000 cpm

North side of Johns Avenue from Idaho Avenue to Florida Avenue
4000 – 9500 cpm

Johns Avenue looking west

Johns Avenue looking east

Discussion

It is known that many natural materials contain radionuclides. Coal is one of these. To varying degrees, based on its geological origin, coal contains three groups of radionuclides, the Uranium (U-238) Decay Series, the Actinium (U-235) Decay Series, and the Thorium (Th-232) Decay Series. These series contain isotopes of uranium, thorium, radium, radon, and others that can potentially be a health detriment. When coal is burned, the waste flyash will still contain these radionuclides.

Yard 520 was a disposal site for flyash. Samples collected by ENSR for USEPA Region 5 show total radium soil concentrations above the level generally used for USEPA Region 5 Superfund radiation soil cleanups [5 picocuries per gram (pCi/g) plus background for total radium (radium-226 + radium-228)]. The total radium criterion for the Yard 520 Site would be 5.618 pCi/g. Measured concentrations within Yard 520 that exceed this criterion are:

Site GP005	5.82 pCi/gm
Site GP006	6.49
Site GP007	7.09
Site GP009	7.26
Site GP010	5.96

Thus, USEPA Region 5 has established that there are excess total radium concentrations in Yard 520 wastes.

It was reasonable to assume where flyash was disposed of outside of Yard 520 there might also be elevated levels. Soil concentrations need to be measured in a laboratory but gamma-ray emissions by these radioactive materials are detectable with a hand held field meter. The PINES group sought to investigate this issue using a portable scintillometer.

It was PINES strategy that once normal (background) gamma-ray levels were established, other areas could be compared to background. It is common among radiation health physicists to use twice background gamma-ray levels as a criterion where further investigation should begin, especially the taking of soil samples for laboratory isotopic analysis.

From October 10 through October 15, gamma-ray levels (count rates) were measured at three background sites, those believed not be have been disposal areas for flyash in the Pine area. These included

Carolina Avenue & the Calumet Bike Trail	4872 counts per minute (cpm)
Exemption 6	4835
	4458
Average	4722 cpm

Using a criterion of twice background (9444 cpm), the following sites showed gamma-ray count rates exceeding twice background. Where count rates are good to 5 digits, measurements were made for exactly 2 minutes with the probe vertical on the ground. Where

count rates are a range, measurements were by observing the meter numbers as the survey walk was being conducted with the meter poised about an inch above the ground.

Exemption 6	10,694 counts per minute (cpm)
	10,561
	7000 – 11,000
Carolina Avenue near the Calumet Bike Trail	
Center of Carolina	10,657
10 feet west of center of Carolina	11,684
Connecticut Avenue	13,540
Illinois Avenue	
200 feet north of Railroad Avenue	12,503
450 feet north of Railroad Avenue	11,596
Johns Avenue at Idaho Avenue	
Southwest corner	11,000 – 12,000
Southeast corner	8500 – 13,000
South side from Idaho Avenue to Florida Avenue	11,000 – 13,000
Railroad Avenue	
Near 675, north side of avenue	4500 – 12,000
Near 675, south side of avenue	8000 – 11,000
Between 650 & 656, south side	6500 – 11,000
Yard 520, monitor well on south side	
South side of casing	11,000 – 12,000

In almost every case, excess count rates were associated with a black, glittering material. PINES surveyors called this material flyash. The survey leader was more familiar with material of this appearance being called sand blasting grit. The most elevated gamma-ray count rates were all associated with roadways and the berms adjacent to them.

One less elevated count rate area was at Exemption 6 where material looking like stone, or perhaps slag, on the east side of the parking lot had a count rate of about 7500 – 8000 cpm.

There was also a seam in an area further east of the Exemption 6 parking lot that ran about 8500 – 10,000 cpm. Buried material would show a lower count at the surface because of radiation shielding by intervening soil. The same could be said for the seam on the north side of the driveway at Exemption 6

Conclusions

USEPA showed radioactive total radium in soil concentrations above those generally used by the USEPA Region 5 for Superfund cleanups, 5 picocuries per gram (pCi/g) over background for radium-226 + radium-228. With USEPA's background of 0.618 pCi/g, this criterion would be 5.618 pCi/g. The range of USEPA measurements was 5.82 – 7.26 pCi/g. The soil material is presumed to be flyash.

The PINES group was concerned that flyash with elevated radioactive soil concentrations might also be found in the Town of Pines. A gamma-ray count rate survey between October 10 and October 15, 2009 showed elevated readings in 15 locations. Background in 3 areas believed to be flyash free showed an average reading of 4722 counts per minute (cpm). Using a criterion of twice background (9444 cpm) as a point where more expansive investigation should begin, these 15 locations showed a range of readings up to 13,540 cpm.

Where readings were elevated, the area was usually covered with a black, glittery material with the appearance of finely ground obsidian. Surveyors called this material flyash. The health physicist operating the meter had seen similar material used for sandblasting.

Two other areas were found that seemed to indicate buried seams. If such seams were excavated gamma-ray count rates would probably rise. One further area showed "slag" type material that had a count rate distinct from the average background count rate.

Recommendations

Clearly, there is material along many roads and under some open fields in Pines that shows gamma-ray counts over normal background levels. Further investigation is necessary to determine what this material is, its radiation isotopic composition, its isotopic concentration, and its projected health risk. Determination should also be made as to whether Pines well water has been affected by radionuclides.

PINES makes the following recommendations.

Confirmation be made of PINES' data.

Determination be made as to the component giving elevated gamma-ray count rates (e.g., black glittery material?).

Determination be made by gamma spectroscopy as to the isotopic identities of the gamma-ray emitters.

Determination be made as to the isotopic concentration of the principal gamma-ray emitters. If, as seems probable, these are products in the three natural decay series, then concentrations should be made for radium-226, radium-228, isotopic uranium, and isotopic thorium.

Review be made of well data from Pines citizens to determine if radium-226, radium-228, uranium-238, uranium-234, and uranium-235 have been measured so that a judgment can be made as to whether the Total Radium and/or the Total Uranium concentrations can be compared to those in the Drinking Water Act.

Appendix A

Surveyors

October 10
Larry Jensen
Paul Kysel

October 11
Larry Jensen
Rosemary Gemperle

October 12
Larry Jensen
Peggy Richardson

October 13
Larry Jensen
Peggy Richardson

October 14
Larry Jensen
Larry Silvestri

October 15
Larry Jensen
Tom Brand

Appendix B

Equipment Calibration

Equipment

Ludlum Model 2221 Scaler/Rate Meter **S/N 202349**
Ludlum Model 44-10 2 by 2 NaI probe **S/N PR263806**

Procured from

Auxier & Associates, Inc.

Calibrated with National Institute of Standards and Technology (NIST) Traceable Cs-137

See in Calibration Sheets 1, 2, 3

GRIFFIN INSTRUMENTS

CALIBRATION CERTIFICATE FOR 44-10 PROBE # PR263806

Owner: AUXIER

DATE: 02/18/09 LOCATION: Griffin Inst
TECH: E.M. Glenn DATE LAST CAL EXPIRES: 03/05/09

(•) Due For Calibration ( ) Other (See Remarks) Cable Length: 39"
( ) Repair (See Remarks) ( ) Due and Repair I.S.: 35mV

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 2221 SERIAL #: 202349 CAL. DUE: 02/18/10

SOURCE #: 99-1816 ISOTOPE: Cs137 ACTIVITY: 1.23 uCi ASSAY DATE: 08/12/99

GEOMETRY: Jig upside down with source underneath, activity side up.

Physical Condition: (•) Sat ( ) Unsat

Efficiency From Last Calibration: 4.6% Previous HV Set Point: 950 V

Counts (CPM)	Background (CPM)	Net CPM:	
129160	10370	118790	AF Efficiency: 5.42%

Is the AF efficiency within 20% of the efficiency from the last calibration? (•) Yes ( ) No

Reproducibility: 117220 115200 116790 Average: 116403.33

Are the individual counts within 10% of the average? (•) Yes ( ) No

High Voltage:	Source Response (CPM):	Background (CPM):	Net CPM:
750	80760	3690	77070
800	97020	5750	91270
850	108180	7480	100700
900	112780	9620	103160
950	111850	9900	101950
1000	120500	9710	110790
1050	123360	10280	113080
1100	128570	10180	118390

HV	RESPONSE	BACKGROUND	NET CPM	
950 V	117220	9520	107700	Efficiency: 4.91%

REMARKS: Replateaued due to IS set point change.

Does Instrument Meet Final Acceptance Criteria?: (•) Yes ( ) No

Calibration Sticker Attached?: (•) Yes ( ) No

Date Instrument is Due For Next Calibration: 02/18/10

INSTRUMENT MARRIED WITH E.G. #

Performed/Reviewed by: E. M. Glenn Date: 2/18/2009 Entered by: ____ Initials

Calibrations performed to ANSI N323A-1997 standards

GRIFFIN INSTRUMENTS

CALIBRATION CERTIFICATE FOR 2221 SERIAL# 202349

Owner: AUXIER

DATE: 02/18/09 LOCATION: Griffin Inst

TECH: E.M. Glenn DATE LAST CAL EXPIRES: 03/05/09

Reason For Calibration: • Due For Calibration Repair (See Remarks)

Other (See Remarks) Due and Repair (See Remarks)

NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: M-500 SERIAL #: 42386 CAL. DUE: 05/15/09

MODEL: SERIAL #: CAL DUE:

☑ Fast/Slow Switch working properly ☑ Audio Response ☑ Geotropism CABLE LENGTH 5'

CONDITION: Sat AF MECHANICAL ZERO: 0 AL MECHANICAL ZERO: 0

NEW BATTERIES: Yes • No BATT. CHECK >4.8V: 5.3V

HV (+/-10%)	AS FOUND HV	AS LEFT HV
600 V:	626	605
1200 V:	1233	1200
1800 V:	1846	1801

AF INPUT SENSITIVITY (mV): 36 AL INPUT SENSITIVITY (mV): 35

RATE METER

SCALER

SCALE	RATE CPM	AS FOUND	% ERROR	AS LEFT	% ERROR
x.1 or x1	100	100	0.0%	A.F.	
	250	250	0.0%	A.F.	
	400	400	0.0%	A.F.	
x1 or x10	1000	1000	0.0%	A.F.	
	2500	2500	0.0%	A.F.	
	4000	4000	0.0%	A.F.	
x10 or x100	10K	10 K	0.0%	A.F.	
	25K	25 K	0.0%	A.F.	
	40K	40 K	0.0%	A.F.	
x100 or x1000	100K	100 K	0.0%	A.F.	
	250K	250 K	0.0%	A.F.	
	400K	400 K	0.0%	A.F.	

AS FOUND	% ERROR	AS LEFT	% ERROR
248	0.8%	A.F.	

Is the As Found Data Within 20% of the Set Point?: • Yes No

LOG SCALE

SCALE	RATE CPM	AS FOUND	% ERROR	AS LEFT	% ERROR
Log	200	200	0.0%	A.F.	
	2000	2000	0.0%	A.F.	
	20K	20 K	0.0%	A.F.	
	200K	200 K	0.0%	A.F.	

Is the As Found Data Within 20% of the Set Point?: • Yes No

GRIFFIN INSTRUMENTS

SERIAL # 202349
02/18/09

Audio Divide:	(•) Sat ( ) Unsat	Push Buttons:	(•) Sat ( ) Unsat
Lamp:	(•) Sat ( ) Unsat	Scaler/Digital:	(•) Sat ( ) Unsat

Remarks:

Does Instrument Meet Final Acceptance Criteria?: (•) Yes ( ) No

Calibration Sticker Attached?: (•) Yes ( ) No

Date Instrument is Due For Next Calibration: 02/18/10

INSTRUMENT MARRIED WITH #

Performed/Reviewed by: E.G. E. M. Glenn Date: 2/18/2009 Entered by: _____ Initials

Appendix C

Various Materials Seen

Stones from Mosque

Black, Glittery Material

Glassy Material

Calumet Bike Trail Stone