Technical Memorandum: Estimates of Air Quality Impacts of Radon in Landfill Gas Seaway Site, Areas A, B and C, Tonawanda, New York, USACE, June 22, 2000

Questions and Answers

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Questions and Answers

The subject Technical Memorandum evaluated the impacts of radon from the MED-related residues on the landfill gases from the Seaway Site. The specific requirement from 40 CFR Part 192, Subpart A, 192.02 states "Control of residual radioactive materials and their listed constituents shall be designed to:…(b) Provide reasonable assurance that releases of radon-222 from residual radioactive material to the atmosphere will not:…(2) increase the annual average concentration of radon-222 in air at or above any location outside the disposal site by more than one-half picocurie per liter." Although this standard is only for the residual radioactive materials resulting from the uranium mill tailings and associated processing, USACE wanted to be conservative and be able to address the concerns of the public with respect to the total radon emissions from the entire landfill, not just the MED-related residues, at the Seaway Site. The USACE assessment considered radon from both the MED-related materials and non-MED materials (e.g., soils, gypsum, etc.) and estimated the maximum radon-222 air concentrations at the property boundary. If the maximum concentrations at the property boundary meet the standard, then the standard would be met "at or above any location outside the disposal site." The following sections discuss further anticipated questions and the associated answers regarding radon at the Seaway Site.

1.0 QUESTION CONCERNING BACKGROUND LEVELS OF RADON IN LANDFILL GAS GENERATED IN THE SEAWAY (NIAGARA) LANDFILL

Question: In the United States Army Corps of Engineers (USACE) Technical Memorandum (TM) on radon impacts, background concentrations of radon are reported to be present in landfill gas from the Seaway (Niagara) Landfill. Are background concentrations of radon included in the estimates of radon impacts that are described in the TM?

Answer: Yes.[1] In October 1996, the New York State Department of Environmental Conservation (NYSDEC) sampled radon concentrations in landfill gas being conveyed from the existing gas collection system to the existing landfill gas flare at the Seaway Landfill. Table 1 summarizes the results of NYSDEC sampling. As a starting point in their estimates of potential impacts of radon released from the existing flare, NYSDEC assumed that a radon concentration of 200 pCi/L exists in the landfill gas prior to the flare (NYSDEC 1996).

[1] "Regional background concentrations of radon in ambient air are not considered in the assessment since the 40 CFR Part 192, Subpart A standard addresses increases in radon concentrations.

In the USACE TM, a radon concentration of at least 200 pCi/L is assumed to exist in any landfill gas collected/vented at the landfill. Landfill gas from a gas well or vent in the FUSRAP area is assumed to contain radon at a concentration of 200 pCi/L plus the radon estimated to be released to the gas due to the presence of FUSRAP material. Appendix B of the TM provides an example of how these estimates were calculated.

The NYSDEC data from 1996 shows radon at about 200 pCi/L in landfill gas samples from the collection system, which was not designed to collect gas from the FUSRAP area. [The landfill gas collection system was originally designed to collect gas from the entire landfill. At the request of NYSDEC, four (4) gas wells that would have been located near the FUSRAP area were deleted from the original plans (NYSDEC 1996).]

It was concluded that use of a 200 pCi/L radon concentration as "background" for any gas collected or vented at the Seaway Landfill is appropriate. As described in the TM, sources of radon emissions to gas in areas of the landfill not associated with FUSRAP material include soil used as cover material, gypsum board, coal ash, etc.

2.0 QUESTIONS CONCERNING THE RADON IMPACTS OF VENTING IN THE NON-FUSRAP AREAS AND RADON IMPACTS CONSIDERING THE FLARE ALONG WITH PASSIVE VENTING

Question: In the TM section on the impacts of passive venting, what are the impacts if venting of the non-FUSRAP area is also considered? What are the impacts if the flare is considered along with passive venting?

Answer: The answers to these questions are provided in the following sections.

2.1 Impacts of Passive Venting, Including the Non-FUSRAP Area Vents

In Section 6 of the TM, it is assumed that all 12 passive vents in the FUSRAP area are placed at the same location, 80 meters (m) from the property line and then property line impacts are assessed assuming the impacts of all 12 vents are additive. The TM notes that these are very conservative assumptions.

2.1.1 Vent Layout

To address the question of the impacts from passive venting including the non-FUSRAP area vents, assumptions concerning the layout of the passive vents are required. [It would be unreasonable to assume that all 29 vents (one vent per acre) of the 29 acres of the northern portion of the landfill are co-located and that the impacts of these 29 vents, which would be spread over 29 acres, are additive].

Figure 1 is a schematic layout of vents in and adjacent to Area A of the landfill. The line of vents nearest the eastern property line are about 150 feet (ft)(46 m) from the property line, to reflect the set back from the property line generally maintained in the placement of the existing gas wells in the southern portion of the landfill.

As shown in Figure 1, gas vents are labeled as “F” (FUSRAP area vents) and “NF” (non-FUSRAP area vents). The vents are centered at a spacing of 236 ft. (i.e., to provide about one vent per acre as described in the TM). The other rows of vents, moving westerly from the first line of vents, are placed at intervals of 204 feet (62 m) beyond the easterly line of vents. As indicated in Figure 1, there are 10 vents covering the 9 acres of FUSRAP Area A, and there are 9 non-FUSRAP area vents. The schematic coverage in Figure 1, indicates that the entire northern part of the landfill is equipped with vents to a point from the northern boundary extending southerly about 1000 feet. This generally encompasses all of Area A as well as the non-FUSRAP areas adjacent to Area A.

2.1.2 Estimates of Radon Impacts – Multiple Vents

To estimate the radon impacts at the eastern property line, the SCREEN3 model was used. As described in the TM, the highest impact from a single vent was shown to be in the year 2000 at a height of 16 feet above the ground at the property line when the CAA default values were used. These conditions were assumed in the analysis described below.

SCREEN3 modeling runs were made to estimate impacts at 16 feet above the eastern property line at a unit emission rate of 1g/s. The distances to the property used in the modeling were: 150 ft (46 m), 354 ft (108 m), 558 ft (170 m), 762 ft (232 m), and 966 ft (295 m).

For the non-FUSRAP (NF) vents, the radon emission rate is calculated to be 6.398E+04 pCi/min per vent. [Gas flow rate of 11.3 ft^3/min (using the CAA defaults) x radon concentration of 200 pCi/L x 28.31 L/ft^3 = 6.398E+04 pCi/min.].

For the FUSRAP (F) vents, the radon emission rate is calculated to be 1.1698E+06 pCi/min per vent. [From Table 2B of the TM, the radon emission rate per acre in Area A (using the CAA defaults) is: 1.105E+06 pCi/min from horizontal surfaces plus 1.024E+03 pCi/min. directly to a well or vent plus the “background” emission rate of 6.398E+04 pCi/min., from above = 1.1698E+06 pCi/min.].

Table 2 summarizes the results of the modeling and the calculated property line impacts. As described in the TM, the impacts of a unit emission rate of 1 g/s were used along with the actual radon flux rates to determine the radon impacts in pCi/L. (See the example calculation in Section 5.3.3.1 of the TM).

Table 2 shows the impacts, at the eastern property line, of individual vents and also the total for all 19 vents, if the impacts of all 19 vents are assumed to be additive. (The assessment of additive impacts is addressed below).

As shown in Table 2, the 0.5 pCi/L radon standard of 40 CFR Part 192, Subpart A, is not exceeded even if the impacts of all 19 vents are considered to be additive.

2.1.3 Additive Impacts of Multiple Vents

The potential for the impacts of individual vents to be additive at the property line was addressed as follows.

In this part of the assessment, the values calculated by the model for Sigma Y were recorded. Sigma Y is the horizontal dispersion coefficient and represents the spread, horizontally from the center line, of a plume at a given point downwind of a source. The Sigma Y given in the model results represents about one-quarter of the total spread of the plume horizontally.

In the current assessment it was assumed that the total spread of a plume at the property line is equal to four times Sigma Y.

Table 3 lists: the coordinates of each of the vents in relationship to the eastern property line: the Sigma Y calculated by the model for each distance out (west) of the property line, 4 times Sigma Y (as described above); and the coordinates of the north and south extent of the plumes at the property line for each of the 19 vents.

A review of Table 3 indicates the following:

- The maximum spread of the plumes horizontally (4 times Sigma Y) is 145 ft at the property for vents situated 966 ft from the property line. (In the modeling results, the maximum impacts are seen under F class atmospheric stability conditions. F class stability conditions are the most stable and the extent of diffusion is limited; thus, the Sigma Y calculated by the model is relatively small).

- The potential for overlap of the plumes from the vents at the property line is limited to adjacent vents, and for example, the extent of the plume from NF6, located about 295 m from the property line is from coordinate 77 ft to coordinate 223 ft along the property line. The extent of the plume from NF7, also located about 295 m from the property line is from coordinate 314 ft to coordinate 459 ft. Thus, the plumes from NF6 and NF7 do not coincide at the property line.

- Since the plumes from all the vents do not coincide, the assumption that the impacts of all 19 vents are additive is conservative.

2.1.4 Conclusions Concerning Additive Impacts of Multiple Vents

Based on the findings described above and summarized in Table 3, the assumption that the radon impacts of all 19 vents are additive (as described above and summarized in Table 2) is considered to be conservative because the assessment shows that all of the plumes do not coincide at the property line. Despite this conservatism, the 0.5 pCi/L 40 CFR Part 192, Subpart A standard is not exceeded. The property line impacts of multiple vents in Areas B and C would be less than those estimated for Area A because the radon flux from vents in Areas B and C is less than about 33% of the radon flux from vents in Area A and the distance from the vents to the property line is greater.

In summary, if the radon impacts of passive vents in the FUSRAP area are considered along the radon impacts of passive vents in the non-FUSRAP areas, the 0.5 pCi/L 40 CFR Part 192, Subpart A standard is not exceeded.

2.2 Impacts of the Flare

The TM estimates the property line radon impacts of the flare (property line assumed to be 10 m from the flare) if all the gas from the landfill is collected and conveyed to the flare. As in the case of the vents, the TM estimates that the 0.5 pCi/L 40 CFR Part 192, Subpart A standard is not exceeded.

To address the question of impacts of the flare if passive venting is implemented in the northern portion of the landfill and additional landfill gas is not conveyed to the flare, additional SCREEN3 modeling was conducted as described below.

2.2.1 Year 2000 Estimates

Based on the estimates in the TM, if gas from the northern portion of the landfill is not collected and is not conveyed to the flare: gas flow to the flare in the year 2000 would be 677 ft^3/min. (using the AP-42 defaults) and 663 ft^3/min. (using the CAA defaults). See Tables 1A and 1B in the TM.

Assuming that the volumetric gas flow rate in the flare stack is 43.33 times the volumetric gas flow rate prior to the flare (see Section 5.3.1.1 of the TM), then the gas flows in the flare stack in the year 2000 would be 29,334 ft^3/min. and 27,428 ft^3/min. using the AP-42 and CAA defaults, respectively.

The radon flux rates in landfill gas from the southern portion of the landfill are shown in Tables 2A and 2B of the TM and for the year 2000 are 3.8332E + 06 pCi/min using the AP-42 defaults and 3.7539E + 06 pCi/min using the CAA defaults.

SCREEN3 modeling runs show that at the property line (10 m from the flare stack, as described in the TM) maximum impacts occur at about 195 ft above ground level, using the AP-42 defaults and about 190 ft above ground level, using the CAA defaults. As described above, the maximum radon impacts from the passive vents occur from 14 to 16 feet above the property line in the year 2000. Thus, the heights of maximum impacts from the flare do not coincide with the maximum impacts from the passive vents.

The property line location nearest the flare that is also potentially impacted by the passive vents is estimated to be about 800 m to 900 m from the flare, on the western property line. SCREEN3 modeling of the flare was conducted to determine the flare's impact at distances from the flare of 800 m and 900 m, at heights above ground level of 14 and 16 feet. The results of the modeling assuming a unit emission rate of 1 g/s are shown in Table 4.

The annual impacts of the flare at these locations are also shown in Table 4. The radon flux rates used in calculating the radon annual impacts are the flux rates cited above. (Section 5.3.3.1 of the TM provides an example of the calculations used to determine the annual impacts summarized in Table 4.)

As shown in Table 4, the modeled annual concentration of the flare is minimal at a location where the impacts from venting are potentially present. The maximum impact is 0.00007 pCi/L when the CAA defaults are used.

2.2.2 Year 2025 Estimates

Estimates of the flare's impact in the year 2025 are also shown in Table 4. As shown in Table 4, the maximum impact is 0.00005 pCi/L.

2.2.3 Conclusions Concerning Additive Impacts of the Flare and Multiple Vents

Based on these estimates, the radon from the flare will have minimal impact on air quality at locations where radon from passive vents may also be present.

3.0 REFERENCES

NYSDEC 1996. *Niagara Landfill Gas Extraction System, First Quarterly Sampling and Evaluation of Radon Releases, October 15-16, 1996.* New York State Department of Environmental Conservation, J. Mitchell, W. Tetley and B. Youngberg. November 7.

USACE 2000. *Technical Memorandum: Estimates of Air Quality Impacts of Radon in Landfill Gas, Seaway Site, Tonawanda, New York.* United States Army Corps of Engineers. June 22.

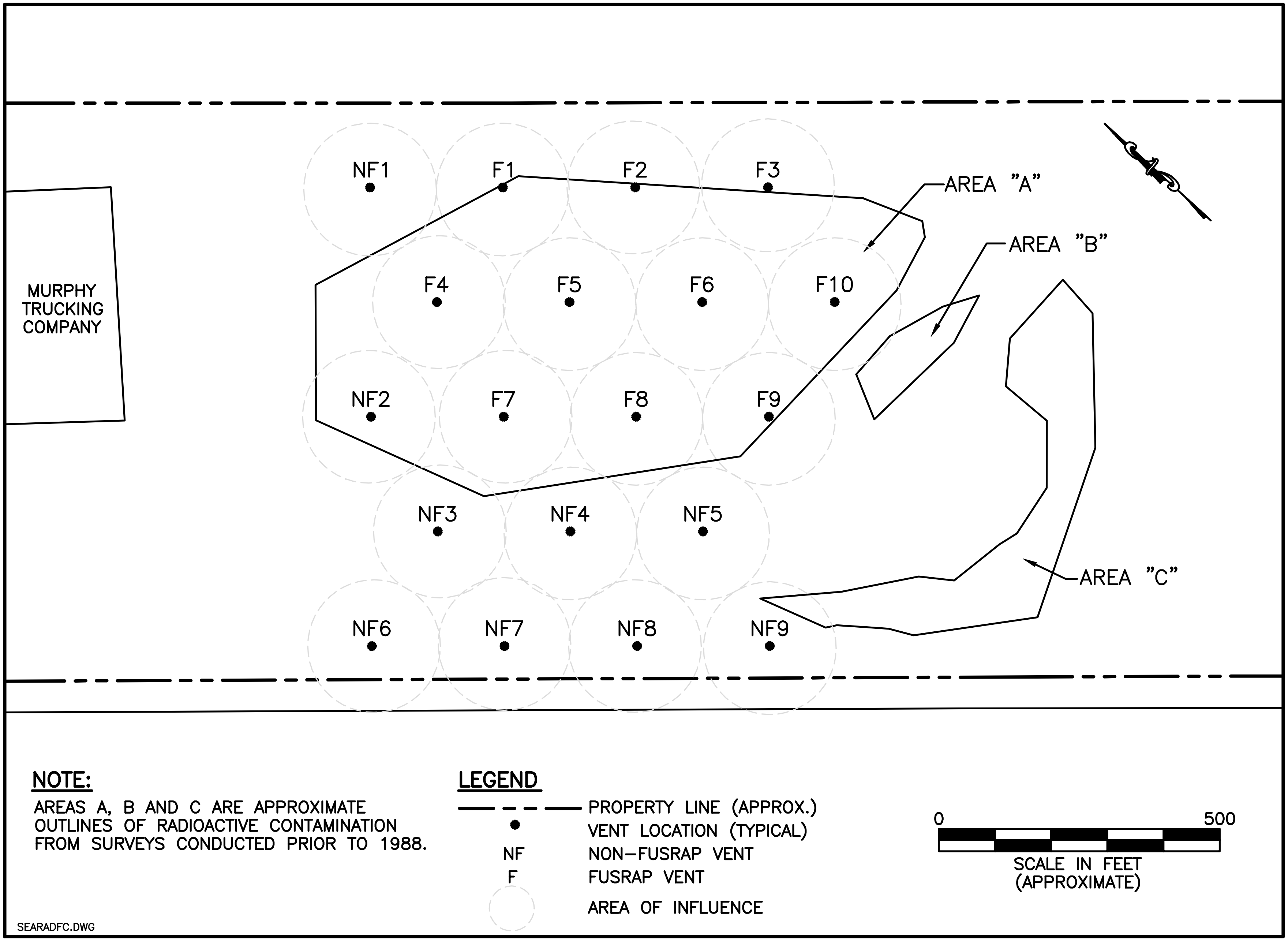

FIGURE 1
SCHEMATIC POTENTIAL LAYOUT OF PASSIVE VENTS
SEAWAY LANDFILL

TABLE 1
RESULTS OF RADON ANALYSES
SEAWAY LANDFILL GAS
GAS SAMPLES FROM GAS COLLECTION SYSTEM
PRIOR TO THE FLARE
OCTOBER 1996 - FLARE IN OPERATION

SAMPLE REFERENCE	SAMPLE DATE	RADON CONCENTRATION (pCi/L) *
1194	10/15/96	194 +/- 3.5
1203	10/15/96	190 +/- 3.4
1199	10/15/96	193 +/- 3.5
1198	10/16/96	175 +/- 3.2
1193	10/16/96	192 +/- 3.5
1197	10/16/96	184 +/- 3.5

* Reported ny NYSDEC (NYSDEC 1996)

TABLE 2
Rn-222 Impact Analysis
Venting Year 2000 - CAA Defaults
Estimated Impact at Property Line - East of Area A
NIAGARA LANDFILL - SEAWAY SITE

GAS WELL NUMBER	DISTANCE FROM PROPERTY LINE ft	DISTANCE FROM PROPERTY LINE m	Screen3 Max. 1-Hr Conc. ug/m3	Screen3 Max. 1-Hr Conc. g/m3	Screen3 Max. 1-Hr Conc. g/L	Rn-222 Flux pCi/min	Rn-222 Flux pCi/s	Rn-222 Max. 1-Hr Conc. pCi/L	Annual Impact Multiplier	Rn-222 Max. Annual Conc. pCi/L
NF1	150	46	5.8451E+04	5.8451E-02	5.8451E-05	6.3980E+04	1.0663E+03	6.2328E-02	0.1	0.0062
F1	150	46	5.8451E+04	5.8451E-02	5.8451E-05	1.1698E+06	1.9497E+04	1.1396E+00	0.1	0.1140
F2	150	46	5.8451E+04	5.8451E-02	5.8451E-05	1.1698E+06	1.9497E+04	1.1396E+00	0.1	0.1140
F3	150	46	5.8451E+04	5.8451E-02	5.8451E-05	1.1698E+06	1.9497E+04	1.1396E+00	0.1	0.1140
F4	354	108	1.4179E+04	1.4179E-02	1.4179E-05	1.1698E+06	1.9497E+04	2.7644E-01	0.1	0.0276
F5	354	108	1.4179E+04	1.4179E-02	1.4179E-05	1.1698E+06	1.9497E+04	2.7644E-01	0.1	0.0276
F6	354	108	1.4179E+04	1.4179E-02	1.4179E-05	1.1698E+06	1.9497E+04	2.7644E-01	0.1	0.0276
F10	354	108	1.4179E+04	1.4179E-02	1.4179E-05	1.1698E+06	1.9497E+04	2.7644E-01	0.1	0.0276
NF2	558	170	6.7660E+03	6.7660E-03	6.7660E-06	6.3980E+04	1.0663E+03	7.2148E-03	0.1	0.0007
F7	558	170	6.7660E+03	6.7660E-03	6.7660E-06	1.1698E+06	1.9497E+04	1.3191E-01	0.1	0.0132
F8	558	170	6.7660E+03	6.7660E-03	6.7660E-06	1.1698E+06	1.9497E+04	1.3191E-01	0.1	0.0132
F9	558	170	6.7660E+03	6.7660E-03	6.7660E-06	1.1698E+06	1.9497E+04	1.3191E-01	0.1	0.0132
NF3	762	232	4.3290E+03	4.3290E-03	4.3290E-06	6.3980E+04	1.0663E+03	4.6162E-03	0.1	0.0005
NF4	762	232	4.3290E+03	4.3290E-03	4.3290E-06	6.3980E+04	1.0663E+03	4.6162E-03	0.1	0.0005
NF5	762	232	4.3290E+03	4.3290E-03	4.3290E-06	6.3980E+04	1.0663E+03	4.6162E-03	0.1	0.0005
NF6	966	295	3.1710E+03	3.1710E-03	3.1710E-06	6.3980E+04	1.0663E+03	3.3813E-03	0.1	0.0003
NF7	966	295	3.1710E+03	3.1710E-03	3.1710E-06	6.3980E+04	1.0663E+03	3.3813E-03	0.1	0.0003
NF8	966	295	3.1710E+03	3.1710E-03	3.1710E-06	6.3980E+04	1.0663E+03	3.3813E-03	0.1	0.0003
NF9	966	295	3.1710E+03	3.1710E-03	3.1710E-06	6.3980E+04	1.0663E+03	3.3813E-03	0.1	0.0003
								TOTAL		0.3815

TABLE 3
Rn-222 Impact Analysis
Venting Year 2000 - CAA Defaults
Estimated Impact at Property Line - East of Area A
NIAGARA LANDFILL - SEAWAY SITE

GAS WELL NUMBER	VENT COORDINATE Y ft	VENT COORDINATE X ft	VENT COORDINATE X m	Sigma Y m	Sigma Y X4 ft	Sigma Y X4/2 ft	Property Line Impact Area Coordinate North ft	Property Line Impact Area Coordinate South ft
NF1	150	150	46	2.03	27	13	137	163
F1	386	150	46	2.03	27	13	373	399
F2	622	150	46	2.03	27	13	609	635
F3	858	150	46	2.03	27	13	845	871
F4	268	354	108	4.41	58	29	239	297
F5	504	354	108	4.41	58	29	475	533
F6	740	354	108	4.41	58	29	711	769
F10	976	354	108	4.41	58	29	947	1,005
NF2	150	558	170	6.67	88	44	106	194
F7	386	558	170	6.67	88	44	342	430
F8	622	558	170	6.67	88	44	578	666
F9	858	558	170	6.67	88	44	814	902
NF3	268	762	232	8.88	117	58	210	326
NF4	504	762	232	8.88	117	58	446	562
NR5	740	762	232	8.88	117	58	682	798
NF6	150	966	295	11.07	145	73	77	223
NF7	386	966	295	11.07	145	73	313	459
NF8	622	966	295	11.07	145	73	549	695
NF9	858	966	295	11.07	145	73	785	931

TABLE 4
RESULTS OF SCREEN3 MODELING OF RADON IMPACTS
LANDFIL GAS FLARE - NO ADDITIONAL GAS CONVEYED TO THE FLARE
SEAWAY SITE - FUSRAP AREA

Screen3 Model Run	Scenario	Default	Receptor Height ft	Receptor Distance m	Year	Screen3 Emission g/s	Screen3 Max. 1-Hr Conc. ug/m3	Screen3 Max. 1-Hr Conc. g/m3	Screen3 Max. 1-Hr Conc. g/L	Rn-222 Flux pCi/min	Rn-222 Flux pCi/s	Rn-222 Max. 1-Hr Conc. pCi/L	Annual Impact Multiplier	Rn-222 Max. Annual Conc. pC/L
NFL20014	Flare	AP-42	14	800	2000	1	1.0000E+01	1.0000E-05	1.0000E-08	3.8332E+06	6.3887E+04	6.3887E-04	0.1	0.00006
NFL20014	Flare	AP-42	14	900	2000	1	9.0000E+00	9.0000E-06	9.0000E-09	3.8332E+06	6.3887E+04	5.7498E-04	0.1	0.00006
NFL2A016	Flare	CAA	16	800	2000	1	1.1000E+01	1.1000E-05	1.1000E-08	3.7539E+06	6.2565E+04	6.8822E-04	0.1	0.00007
NFL2A016	Flare	CAA	16	900	2000	1	1.0000E+01	1.0000E-05	1.0000E-08	3.7539E+06	6.2565E+04	6.2565E-04	0.1	0.00006
NFL50012	Flare	AP-42	12	800	2025	1	2.2000E+01	2.2000E-05	2.2000E-08	1.4098E+06	2.3497E+04	5.1693E-04	0.1	0.00005
NFL50012	Flare	AP-42	12	900	2025	1	2.0000E+01	2.0000E-05	2.0000E-08	1.4098E+06	2.3497E+04	4.6993E-04	0.1	0.00005
NFL5A012	Flare	CAA	12	800	2025	1	2.7000E+01	2.7000E-05	2.7000E-08	1.0758E+06	1.7930E+04	4.8411E-04	0.1	0.00005
NFL5A012	Flare	CAA	12	900	2025	1	2.4000E+01	2.4000E-05	2.4000E-08	1.0758E+06	1.7930E+04	4.3032E-04	0.1	0.00004