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Acting Commissioner

Niagara Landfill Gas Extraction System
Second Quarterly Sampling and Evaluation of Radon Releases
January 22, 1997

by

[redacted]

May 30, 1997

Summary

Bureau of Pesticides & Radiation staff collected four samples of landfill gas from the Niagara Landfill on January 22, 1997. These samples of landfill gas were collected from a sampling port located in the piping leading from the blower to the flare before the flame arrestor. Radon concentrations measured in the samples were all less than 180 pCi/l and were similar to concentrations measured in previous sampling efforts. Annual average radon concentrations due to landfill gas emissions would be indistinguishable from background at ground level.

Background

History of Site

The Niagara Landfill is located in the Town of Tonawanda, Erie County (Figure 1). The site was an operating landfill in 1978 when Part 360 went into effect. Niagara Landfill, a subsidiary of Browning-Ferris Industries (BFI), operated the facility under NYSDEC Permit No. 9-1464-00147/00001-0. The land itself is owned by Seaway Industrial Development, Inc. The landfill ceased accepting waste in 1993 and is now closed. As part of closure operations, 6 NYCRR Part 360 requires a landfill gas venting system to be installed. At present, the landfill gas is actively being pumped to a flare system authorized under NYSDEC permit No. 9-0464-00184/00001.

The Niagara Landfill is one of the four properties designated as the Tonawanda Site by the United States Department of Energy (DOE) under the DOE's Formerly Utilized Sites Remedial Action Program (FUSRAP). The Niagara Landfill Site comprises approximately 100 acres located in an industrialized area in northwestern Tonawanda, New York. In 1974, uranium ore residues processed during the Manhattan Engineering District (MED) project

were excavated from the Ashland 1 Site, which is adjacent to the Niagara Landfill, and relocated onto the Niagara Landfill Site in three areas identified as Areas A, B, and C (see Figure 2). Area A is the largest, covering about 10 acres. A fourth area, Area D, also contains MED waste. It is continuous with an area of contamination on the Ashland 1 site. The DOE has estimated that there are 91,100 cubic yards of FUSRAP material in Areas A and D and another 25,900 cubic yards of FUSRAP material in Areas B and C. At some point in time, the 2 acres in Areas B and C were covered with about 20 - 40 feet of refuse.

Gas Extraction System

The Niagara Landfill has 34 methane extraction wells (see Figure 3), which are collectively routed through a blower unit to a flare. Figure 4 shows the location of each of the 34 gas wells. BFI had originally designed the gas extraction system to cover the entire landfill. At DEC's recommendation, BFI deleted from the original plans four wells that would have been located near the contaminated soil. Thus, none of the wells in the gas extraction system collect gas directly from the FUSRAP material.

Sampling Procedure

In order to measure the radon released from the landfill, a plan was developed for sampling the radon in the gas pipe line after (i.e., downstream of) the blower and prior to (i.e., upstream of) the flare. Figure 5 shows the relationship of the sampling port to the rest of the system.

To take a sample, first a fitting was installed into the sample port and tygon tubing was connected to the fitting. The sampling train then consisted of an inline membrane filter, a drierite cartridge, the Lucas cell and finally the 5 liter/minute air pump, all connected together using tygon tubing. Gas was pumped through the Lucas cell for five minutes to flush all of the high purity nitrogen out of the Lucas cell and replace it with landfill gas. (Note: high purity nitrogen is routinely used to flush out the cell after use.)

In the planning stages for this sampling event it was decided that a minimum of three samples would be required to make a determination of the radon concentration. In addition to our sampling, BFI arranged to have Wilkes University analyze three samples as well. We originally planned to collect landfill gas samples on two days, as we had during the October 1996 sampling event. Three DEC samples and the Wilkes University samples were to be collected on the afternoon of January 21, 1997, and three more DEC samples on the morning of January 22, 1997.

This procedure was followed on January 21, 1997, and after the sampling was completed, DEC staff packaged the Wilkes University Lucas cells and had Federal Express pick up the package for shipment to Wilkes University.

On the morning of January 22, 1997, three more DEC samples were collected. However, the samples were mistakenly collected in the Lucas cells that had been filled with landfill gas the day before. The error in refilling one of the cells was recognized before staff left the site, and a fourth sample was collected in one of the empty Lucas cells.

The refilling of the Lucas cells raised the concern that the initial filling may have resulted in contamination of the cell that would interfere with the measurement of radon from the refilling. This was considered in determining whether the data from the refilled Lucas cells could be relied upon, or the sampling should be repeated.

When the cells were refilled with landfill gas, the gas in the Lucas cells was flushed out by the new sample. The radon from the initial filling reached equilibrium with its progeny after about 4 hours, and the progeny plated out on the sides of the cell. When the cell was refilled, the progeny remained on the sides of the cell. The amount of progeny from the first filling began to radioactively decay with an effective half-life of 0.5 hours (NCRP Report No.97). There is a minimum of 6 hours between when the Lucas Cells are filled to when the counting begins. In this time the amount of progeny from the first filling decays as follows:

$$P(t) = P_0 2^{-t/T_{1/2}}$$

where P_0 = *the initial amount of progeny,*
t = *the amount of time since refilling,*
$T_{1/2}$ = *the half-life of radon progeny,*
$P(t)$ = *the amount of progeny remaining.*

The amount of radon progeny from the first filling that remains in the Lucas Cell at the time of the counting is 2.4×10^{-4} of the initial amount. Therefore, the effect of initial filling the cells on the measurement of the amount of radon in the cell from the refilling is negligible. It was not necessary to collect new samples. We have revised our procedures to prevent a recurrence of this error.

Bureau staff analyzed the samples for radon on January 23, 1997.

Results of Analysis

The samples were analyzed by the Bureau on our instrumentation, which consists of a Ludlum Model 182 Radon Flask Counter connected to a Ludlum 2000 Portable Scaler. The following table gives the analysis results (decay corrected to the time the gasses were extracted from the sampling port):

Lucas Cell No.	Sampling Date	Bureau's Analysis (pCi/l)
1194	01/22/97	172 +/- 3.3
1197	01/22/97	166 +/- 3.3
1198	01/22/97	160 +/- 3.1
1199	01/22/97	175 +/- 3.4

Discussion

The average radon concentration of the samples collected on January 22, 1997 was 168 pCi/l. The gas flow rate, as measured by BFI was 965 cubic feet per minute (cfm). This was less than the flow measured in October 1996 (1200 cfm), and less than the maximum flow predicted before the flare went into operation (1600 cfm).

Comparison to Previous Results

In February 1996, before the flare was operating, DEC sampled the gas in six of the gas wells, which were then venting directly to the atmosphere, under natural pressure. The results are presented in DEC's March 20, 1996 report. That report acknowledged that the operation of the flare could change the concentration of radon in the landfill gas, but also stated that the effect could be determined only by analyzing the gas once the flare was in operation. One purpose of the October 1996 and January 1997 sampling was to begin to answer that question.

The concentration of radon in the six wells sampled in February 1996 ranged from 87 to 193 pCi/l. The range in the samples collected in October 1996 was 175 to 194 pCi/l. These most recent samples (January 1997) range from 160 to 175 pCi/l. The collective range of radon concentrations measured since the flare began operating is from 160 to 194 pCi/l. The October 1996 and January 1997 samples were in effect drawn from all 34 wells, so detailed comparisons between these two data sets and the pre-flare February 1996 data cannot be made. However, it is apparent that the operation of the flare has not substantially increased the concentration of radon in the landfill gas. The data from this most

recent sampling effort also indicate that the concentration of radon in the landfill gas has not increased since the flare went into operation.

Applicability of Previous Computer Model Studies

Our November 1996 report of the October 1996 sampling results included the results of computer modeling studies performed to estimate the radiological impacts of the radon emissions from the flare. Three models were used to assess dispersion of the emitted radon, ground level concentrations, and the radiation dose to the maximally exposed individual in the general public: US Environmental Protection Agency's SCREEN3 model, DEC's Air Guide 1 model, and the US Environmental Protection Agency's CAP88.

Since that time, two parameters have changed: (1) the radon concentrations measured in January 1997 were slightly lower than those measured in October 1996, and (2) the landfill gas flow rate in January 1997 was about 80% of the gas flow rate during the October 1996 sampling.

The reduction in the concentration of radon is small. In the modelling studies, it was assumed that the concentration of radon in the landfill gas was 200 pCi/l, which is greater than the concentrations measured in January 1997. Therefore, the concentration assumed for the modelling performed in 1996 is conservative, but valid, for modelling the results of the January 1997 samples.

The gas flow rate affects the model results in two ways: (1) it reduces the heat output of the flare, and (2) it reduces the calculated total activity of radon released. Heat output is a parameter in only one of the models we used to analyze the October 1996 sampling results, SCREEN3. That model was used only to project the dispersion of the radon under a variety of meteorological conditions (stability classes 1 through 6). In the 1996 studies, the model predicted that the concentration of radon in the plume would fall below 0.5 pCi/l within 20 meters of the stack, and below 0.1 pCi/l within 40 meters. Under the more favorable meteorological conditions, the model calculated a radon concentration less than 0.5 pCi/l within 10 meters of the stack and less than 0.1 pCi/l within 20 meters.

We repeated those SCREEN3 model runs using the reduced heat output. The results did not change, except that in three cases, the radon concentration was projected to decrease below 0.5 pCi/l or 0.1 pCi/l closer to the flare stack than had been predicted in the 1996 modeling studies.

With a lower gas flow rate, the rate of release and the calculated total activity of radon released per year would decrease. The effect of this, in all three models, is to reduce the resulting projected concentration of radon in air. Thus, the 1996 results from the Air Guide 1 model and the CAP88 model are also conservative, but valid, for estimating the impacts of the releases measured in January 1997. Those results were

1. In 1996, DEC's Air Guide 1 model was used to predict the maximum annual average concentration of radon at ground level due to emissions from the flare. The result was 0.0001 pCi/l, which is less than 0.1% of natural radon concentrations. This concentration would be indistinguishable from background concentrations of radon.

2. CAP88 was used to assess the radiation dose a member of the general public could receive due to the radon emissions from the flare. CAP88 calculates the maximum radiation dose to a member of the general public using historical meteorological data. The predicted maximum ground level concentration of radon was 0.0005 pCi/l (less than 0.1% of natural radon concentrations). This corresponds to a worst-case annual radiation dose of 0.01 millirem per year. This projected dose is less than 0.0001 of the dose due to background radiation.

Conclusions

The radon emissions measured on January 22, 1997 are slightly lower that those measured in October 1996. The conclusions presented in our report of the October 1996 sample results are valid for the January 1997 sample results:

1. The radon released through the flare disperses to a concentration indistinguishable from background radon concentrations within 40 meters of the stack.

2. The projected maximum radiation dose due to the radon emissions is less than 0.01 mrem/year and less than 0.0001 of the dose due to natural background radiation.

3. There is no adverse effect on the environment or the public health and safety from the emission of radon from the landfill.

Future Actions

The Bureau will continue to perform quarterly monitoring during the first year of operation of the flare.

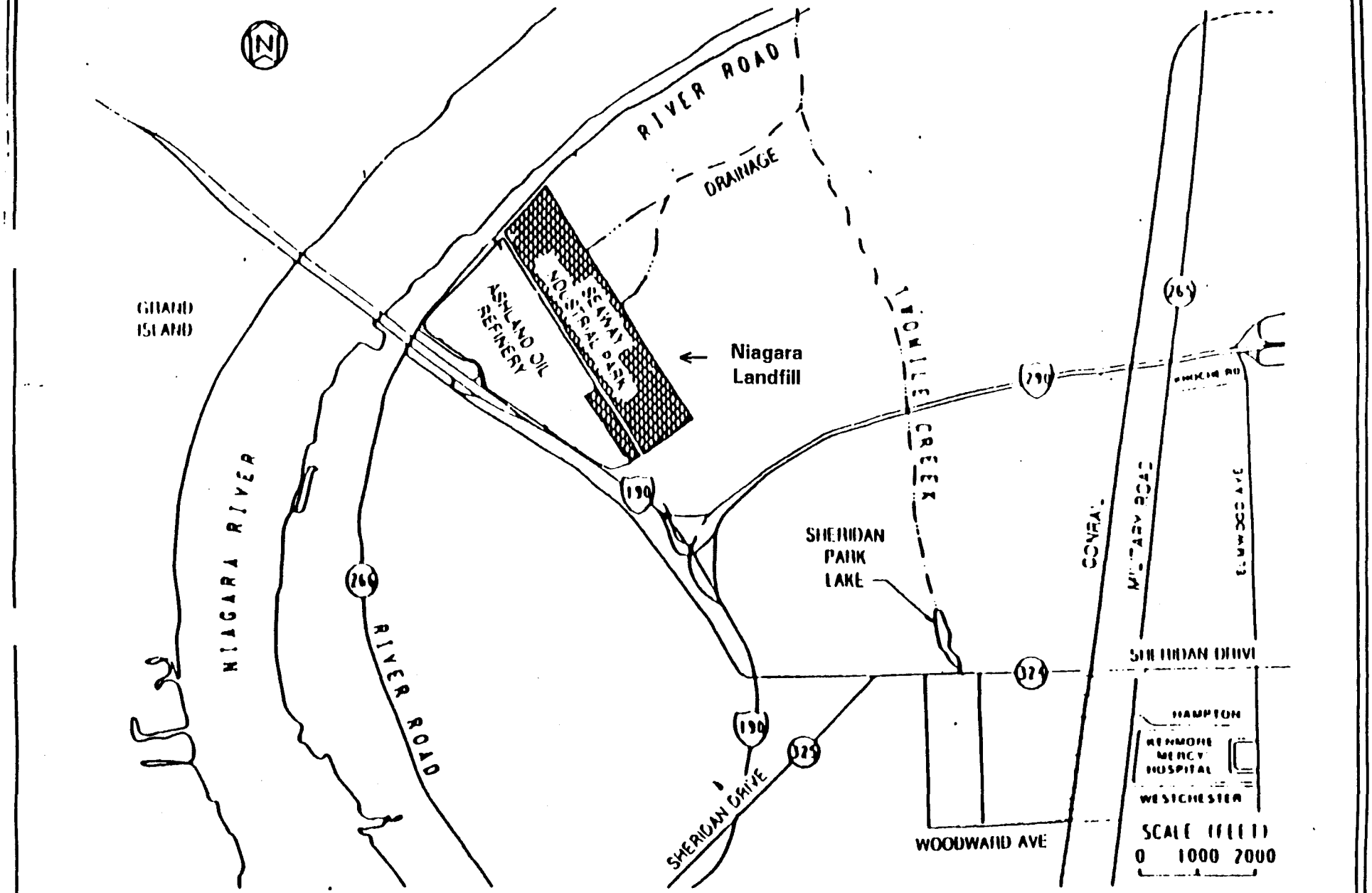
Prepared by:

[redacted]

[redacted] 6/3/97

Chief, Bureau of Pesticides & Radiation

FIGURE 1



LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

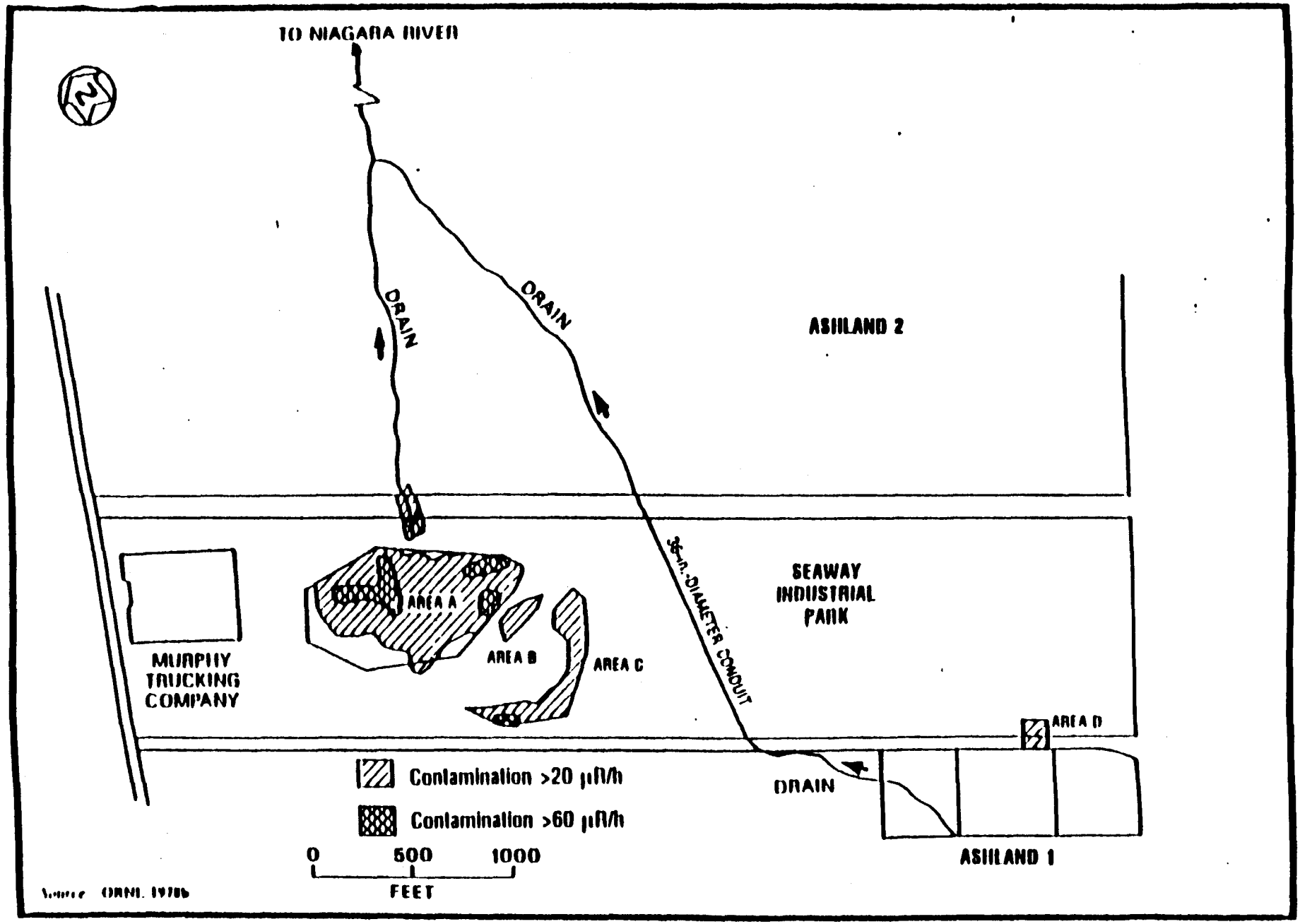
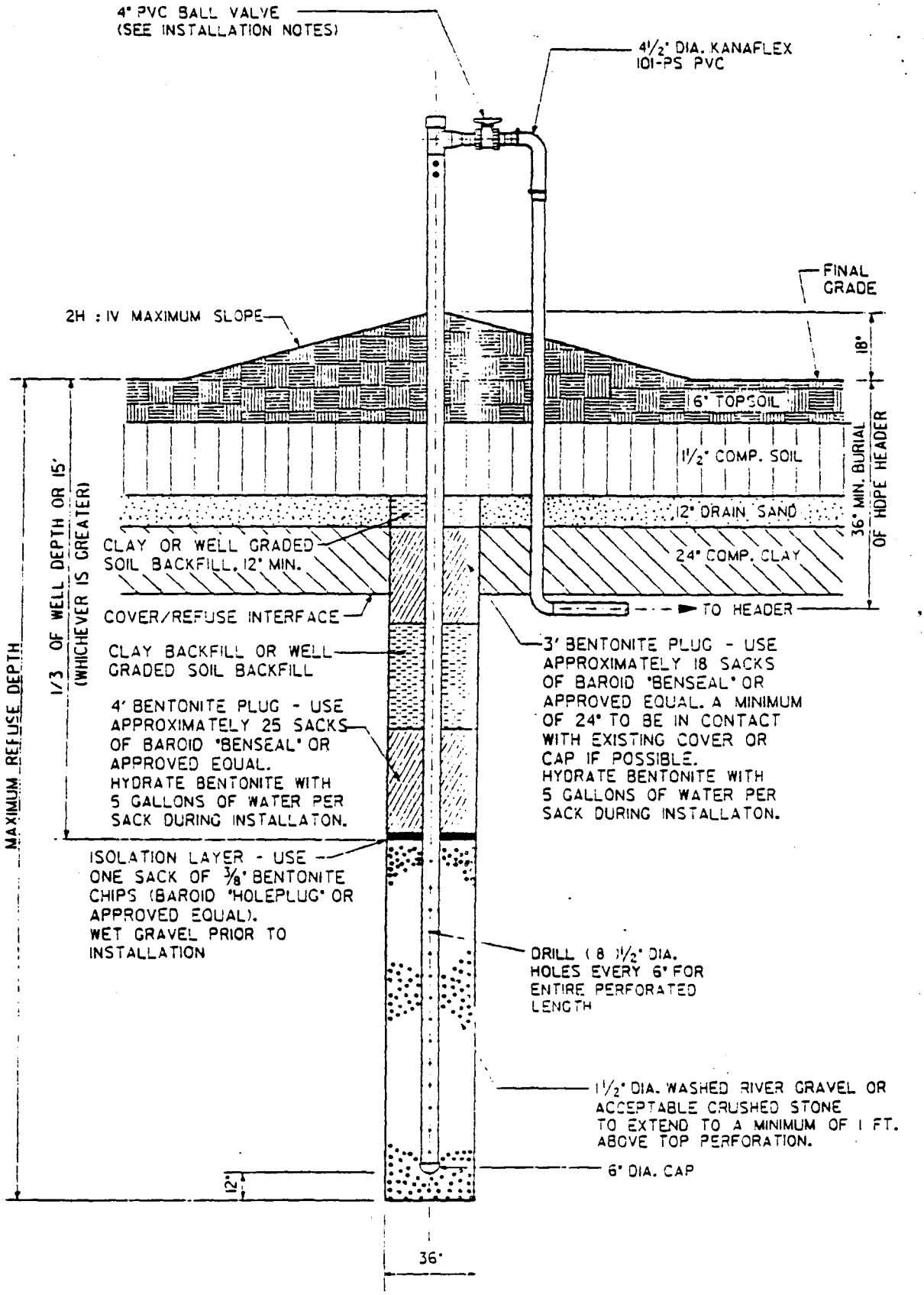


FIGURE 2 AREAS OF RADIOACTIVE CONTAMINATION AT NIAGARA LANDFILL (SEAWAY INDUSTRIAL PARK)



TYPICAL LANDFILL GAS EXTRACTION WELL DETAILS

NOTE 1: ADJUST PLUG AND BEDDING HEIGHTS AS NECESSARY
TO MEET ACTUAL FEILD CONDITIONS

FIGURE 3

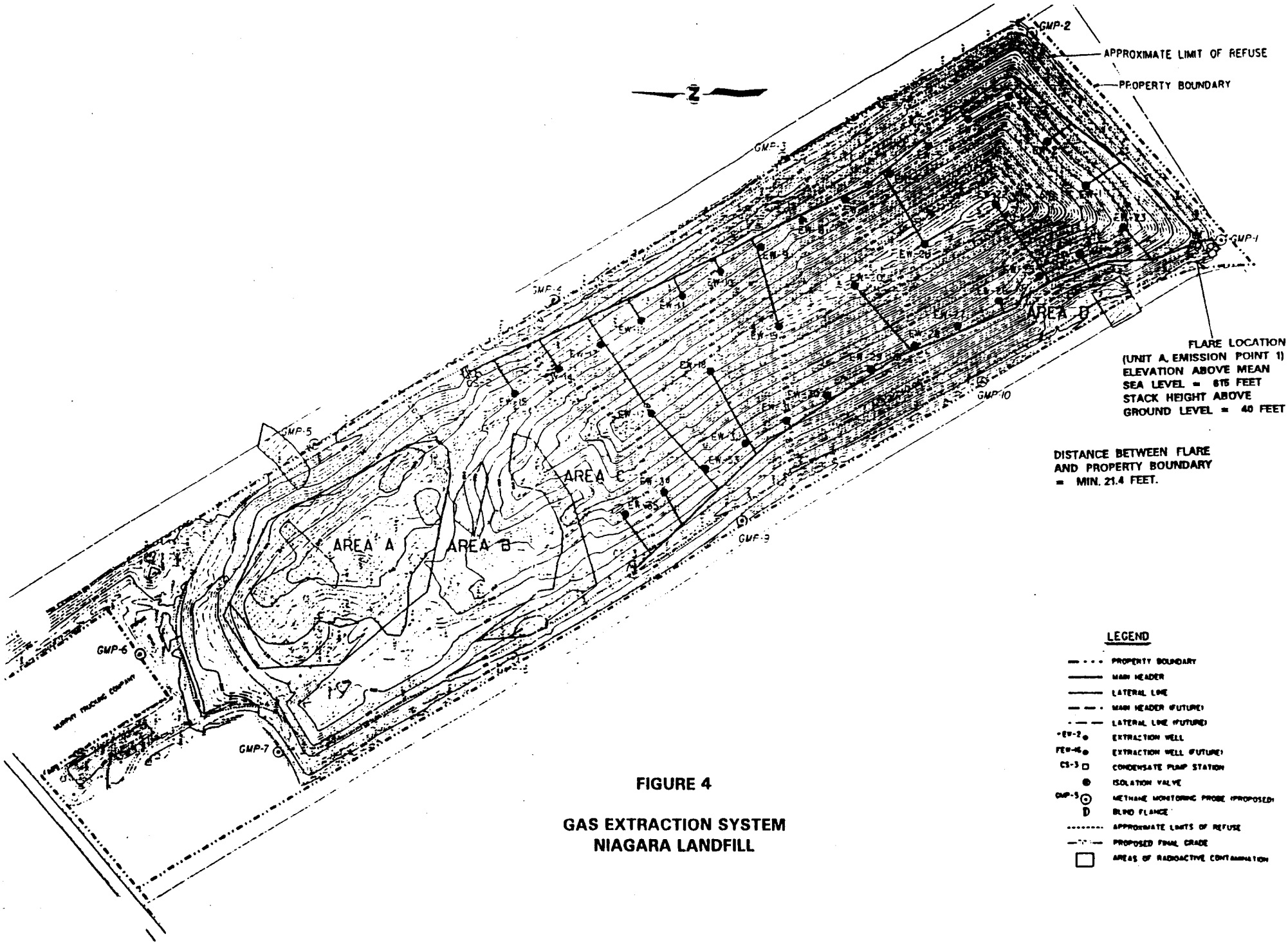
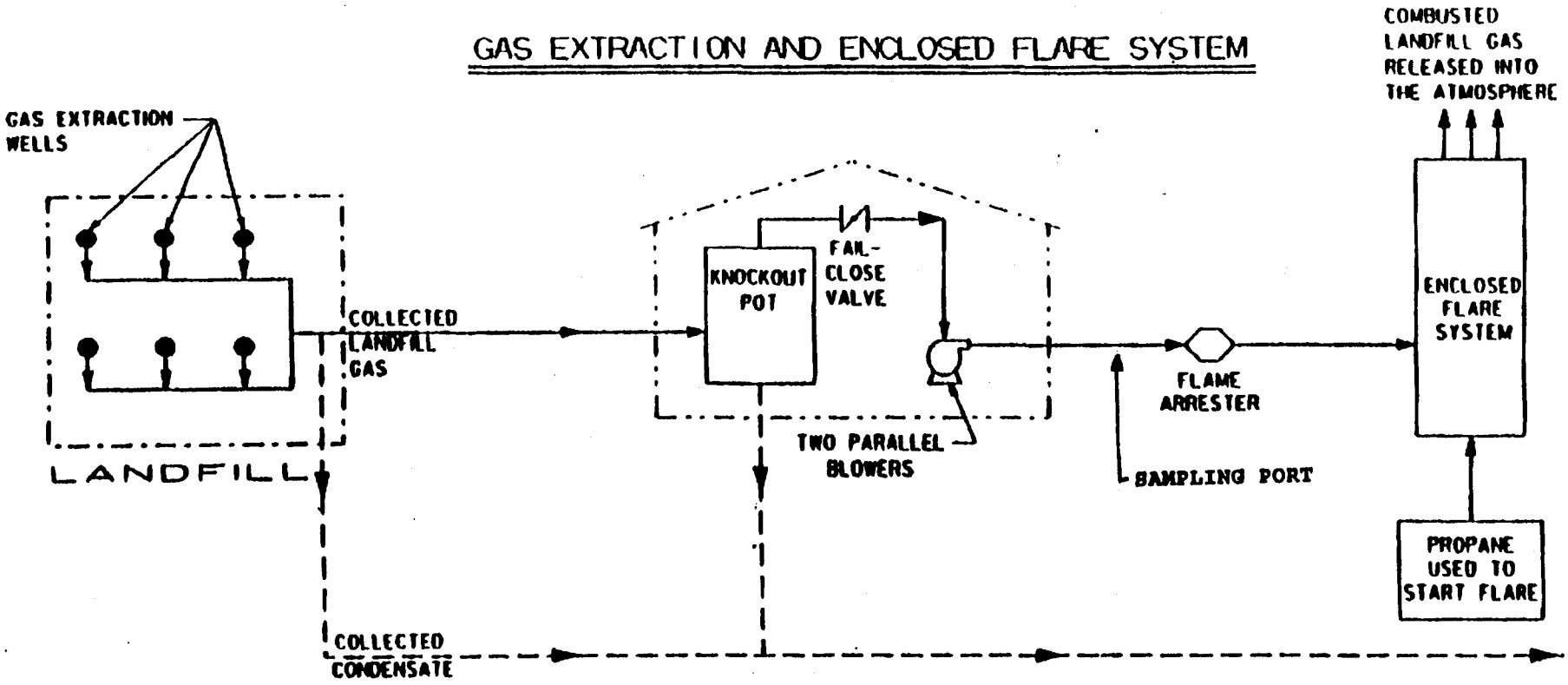


FIGURE 4

GAS EXTRACTION SYSTEM
NIAGARA LANDFILL

FIGURE 5


GAS EXTRACTION AND ENCLOSED FLARE SYSTEM
COMBUSTED LANDFILL GAS RELEASED INTO THE ATMOSPHERE
GAS EXTRACTION WELLS
LANDFILL
COLLECTED LANDFILL GAS
KNOCKOUT POT
FAIL-CLOSE VALVE
TWO PARALLEL BLOWERS
FLAME ARRESTER
SAMPLING PORT
ENCLOSED FLARE SYSTEM
PROPANE USED TO START FLARE
COLLECTED CONDENSATE