

**RESULTS OF RADIOLOGICAL AND VIDEO
SURVEYS USING THE PIPE EXPLORER™ SYSTEM
AT THE BATTELLE [REDACTED]
[REDACTED] WEST JEFFERSON SITES**

August, 2000

**Prepared for
Battelle Memorial Institute**

**Work Performed Under
Purchase Order No. 155285**



Science & Engineering Associates, Inc.
5651-B Jefferson, NE
Albuquerque, NM 87109
505-884-2300

1.0 Introduction

Science & Engineering Associates, Inc. (SEA), under contract with the Battelle Memorial Institute, Columbus, Ohio provided personnel and equipment to conduct radiological and video surveys in pipes at the Battelle [REDACTED] and West Jefferson sites. The work was carried out under Battelle Purchase Order #155285. This report serves to document the results of those surveys and to provide background information on the techniques used to gather data.

In order to carry out the necessary pipe surveys, SEA made use of the Pipe Explorer™ survey system equipped with a sensor package. The package included a video camera and a radiation detector capable of monitoring internal pipe surface activity due to radiological contamination. The surveys took place in underground piping at the Battelle Columbus West Jefferson [REDACTED] sites. The goal of the pipe survey effort was to determine representative levels of radiological contamination on internal surfaces.

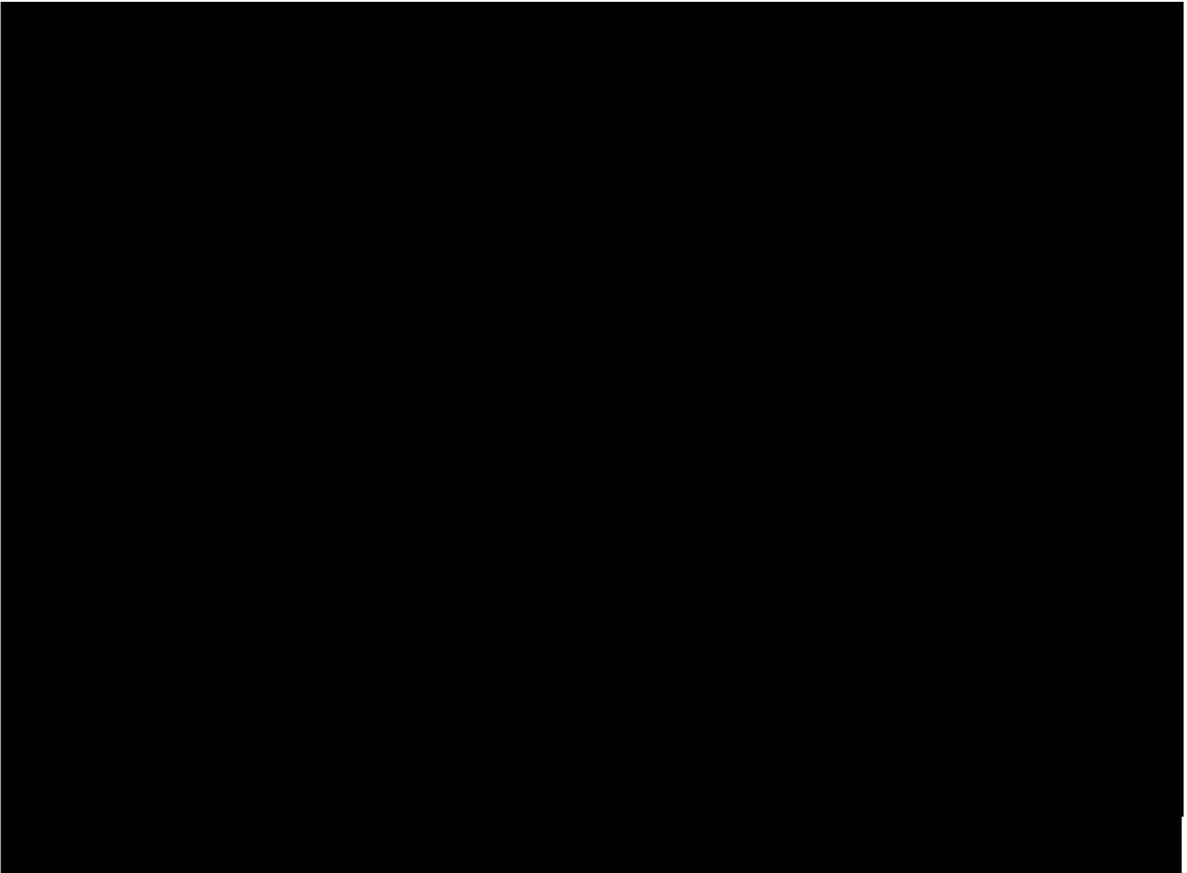
This report is structured to first provide background information on the site, the Pipe Explorer™ technology, and work scope. This information is provided in Sections 2-4 respectively. Information related to the radiological survey, such as detector calibration, data precision, and various measurement procedures, is provided in Sections 5 through 10. The core of the report consists of the radiological survey data obtained during the project. This survey data is provided in Appendix [REDACTED] B for the data collected at [REDACTED] West Jefferson [REDACTED]. The data is presented in both graphical and tabular formats. [REDACTED]

[REDACTED] Discussions of some of the results are provided in Sections 11 and 12.

Videocassette recordings of the pipe interiors obtained during the pipe surveys are vital accompaniments to this report. Comparison of the video images to the radiological survey data can provide substantial insight while interpreting the data. These videos were left with the Battelle technical representative at the conclusion of each survey.

2.0 Site Description

Since the early 1950s, research with nuclear materials has taken place at the Battelle Columbus facilities [REDACTED] at West Jefferson. In addition, a reactor was operated at the West Jefferson site. These facilities are now being transitioned to unrestricted use facilities. As part of this process, drain lines and sewer lines in and around the facilities must be surveyed to determine if they can be released for unrestricted use or must be remediated or controlled.



West Jefferson

The West Jefferson site is a rural setting with building complexes separated by several hundred feet. Therefore, a majority of the survey runs at this site were conducted in pipe runs crossing open fields. A few pipes that were surveyed ran underneath or directly adjacent to buildings and one pipe that was surveyed ran beneath the West Jefferson Lake and dam. The pipes of interest at the West Jefferson site consisted of sanitary sewer lines and process sewer lines. Pipe sizes ranged from 3-inches to 15-inches in diameter. Process knowledge and prior isotopic evaluation of contamination samples indicated that likely contamination would consist of an isotopic mix consistent with reactor fuel burn-up (i.e., fission product inventory). Of that isotopic mix, Cs-137 is a principal constituent and it is a readily measurable isotope. Therefore, all radiological calibrations and measurements were tailored toward the measurement of Cs-137.

An identification system was developed in order to include descriptive information about the pipe runs. The system is based on the following elements;

- Building number from which a pipe originates
- Pipe system (SS = storm sewer, PS = Process sewer) and Pipe diameter
- Direction from manhole (given as the azimuth)
- Sequential order of the survey run

For example, the sixth pipe surveyed at West Jefferson is located next to building JN1 and is a 15-inch diameter storm sewer with an initial direction from a manhole of azimuth 310 degrees. This particular survey was given the identifier JN1-SSD15-A310-6. For simplicity, the West Jefferson survey runs are often described in this report with an abbreviated format, where only the sequential order of the run is referenced. For instance, in the example given above for run JN1-SSD15-A310-6, the abbreviated format would refer to survey #6. Forty-one surveys were completed at West Jefferson. A map showing the location of each survey run completed at the West Jefferson site is included as Figure 1.

The survey data provided in Appendix A and B include references to numbered manholes. At the start of the survey efforts no numbering system was known for the manholes. Therefore, in order to facilitate documenting the results and coordinating the order in which survey efforts were to be completed, SEA began numbering the manholes according to the sequence in which surveys were anticipated. In order for Battelle to compare the SEA reference system to the location of each manhole and pipe entrance point, pictures were taken of each one. These pictures are included in Appendix C for reference.

3.0 Description of the System Used

The Pipe Explorer™ is a system designed to tow various characterization sensors into piping and duct work through the use of an inverting membrane technology. In this application, the Pipe Explorer™ system was used to tow either a 4-element GM probe or a 2x2 NaI gamma scintillation detector into pipes. A video camera was integrated with both types of radiation detectors so that a simultaneous video survey could be conducted.

Figure 2 illustrates how the Pipe Explorer™ uses inverting membrane technology to deploy radiation detectors into pipes. The core of the system is an airtight membrane that is initially spooled inside of a canister. This membrane consists of an inexpensive 4-mil thick polyethylene sleeve that can be obtained in lengths up to 1,500 ft. The membrane is purchased in diameters intended to match the pipe to be surveyed and is cut to the length of the pipe to be surveyed.

The end of the membrane protruding out of the canister is folded over and sealed around the outlet of the canister (Stage 1). When the canister is pressurized in this configuration, the air pressure on the membrane causes it to be pulled from the spool (Stage 2). Thus, as membrane is fed from the deployment canister it travels inside of the membrane that has been deployed ahead of it until it reaches the inversion point. The inversion point continually advances in the pipe as the membrane unfolds against the pipe wall. This continues until the membrane is completely off the spool. At this point in the deployment sequence half of the membrane is deployed against the pipe wall, while the other half is still inside of the deployed membrane (Stage 3). A characterization tool such as a radiation detector is attached to the end of the membrane and is towed into the pipe as the

membrane continues to invert. The detector cabling is also fed from the spool and towed into the pipe (Stage 4).

To retrieve the system, the cabling is wound back onto the spool, which pulls the detector back, and the membrane back inside of itself. Since the membrane is inverting, it is retrieved inside out. This is analogous to the method that a radiological worker removes potentially contaminated gloves.

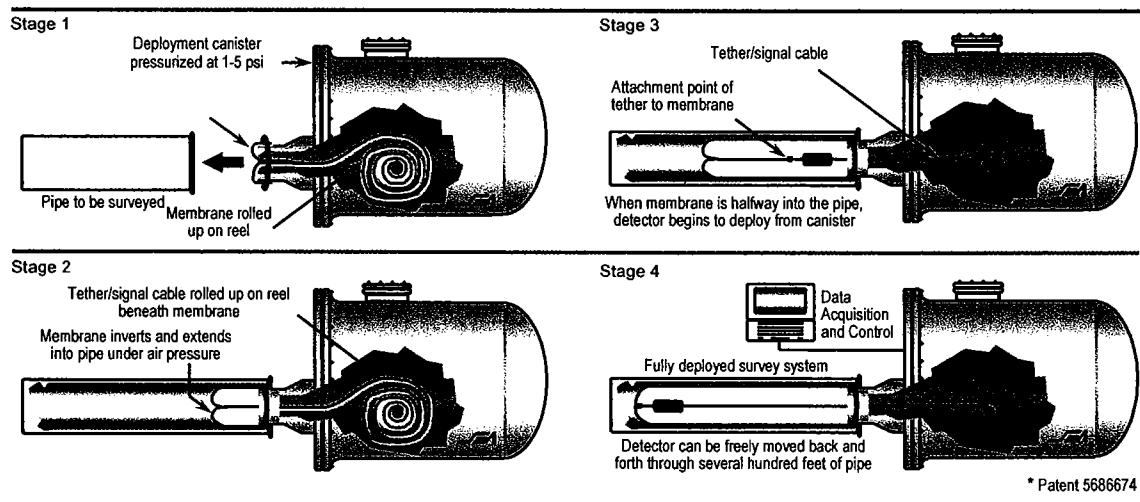


Figure 2. Sketch showing the Pipe Explorer™ system deployment sequence.

Although not shown in the figure above, a short length of pipe is used to connect the outlet of the Pipe Explorer™ system to the pipe to be surveyed. This pipe is referred to as the *pre-pipe*. Use of pre-pipe allows the Pipe Explorer™ canister to be located at a convenient height and distance from the pipe access point, usually a pipe termination within a manhole.

4.0 Work Scope

The work performed by SEA was divided into four tasks. Listed below are short descriptions of each task and what was accomplished as part of the task.

Task 1 – Work Package Preparation and Reporting:

In this Task SEA prepared all of the work plans and supporting documentation required before the field surveys could begin. This included preparation of a Quality Assurance Project Plan (QAPP) that describes the measurement program and procedures that were

used to assure the survey results met Battelle's project objectives. Furthermore, interface with the Battelle Quality Assurance manager and integration of recommended modifications to the QAPP as prescribed by Battelle were included in this task.

Task 2: Mobilization/Demobilization

SEA readied the necessary equipment and materials to conduct the survey work, such as backup detectors, membrane materials, and field support equipment. Detector calibrations were also carried out in this task. Details of the detector calibrations are provided in Section 5.0.

Task 3: Video and Radiological Surveys:

This task represented the bulk of the effort where the purpose was to obtain a video record of the interior surfaces and conduct radiological surveys of pipes at the Battelle [REDACTED] West Jefferson site.

To accomplish the video taping, SEA employed a forward-looking CCD video camera that was deployed with the Pipe Explorer™ system. The live image from this camera was recorded on a VHS tape as a permanent record of the video inspection. To accomplish the radiological surveys, SEA used either 2x2 NaI gamma scintillation detector or a 4-element Geiger-Mueller detector. The radiation detectors were used to assess and record surface contamination as a function of distance into the pipe.

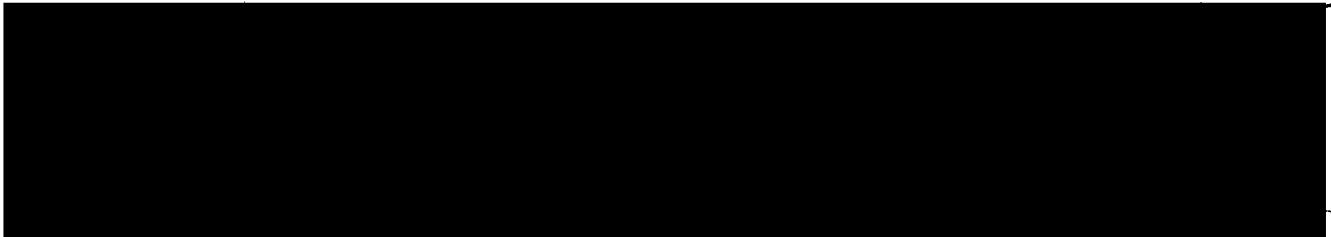
Task 4: Preparation of the Survey Report

This task was devoted to documenting the results of the surveys. This included preparation of this data report that describes the survey activities and presents the radiological survey data.

5.0 Detector Calibrations

The radiation detectors used in this project were calibrated prior to field deployment. All calibrations were carried out in accordance with the SEA Technology Sector Technical Procedure SEATP-09, *Pipe Explorer™ Radiation Detector Calibration*. The technical procedure used to perform the calibration is provided in Appendix D. Also included in Appendix D are copies of the NIST traceable calibration certificates for the sources used and the calibration summary sheets that detail the calibration results.

The objective of the calibration procedure is to determine an empirical Yield Factor that relates the detector response, in net counts per second (cps), to a surface activity density in disintegrations per minute per 100 square centimeters ($dpm/100\text{ cm}^2$). This Yield Factor is used to both reduce raw data and to determine the lower detection limit of the measurement conditions. The calibrations are carried out by dividing the interior surface area of a pipe into approximately $2\times 2\text{ cm}$ grids. A NIST traceable source is moved to each of these grid nodes while the detector response is recorded.



The remaining calibrations were carried out to determine detector response for conditions anticipated at the West Jefferson site. Two detectors were calibrated. The first was a 2×2 NaI gamma scintillation detector calibrated for Cs-137 response. The second was a 4-element Geiger-Mueller detector calibrated for Cs-137 response. The gamma scintillation detector was used in the majority of the West Jefferson surveys. The 4-element GM detector was only used in pipes that were too small for the scintillation detector to be able to fit in to. The Yield Factors resulting from all of the detector calibrations are listed in Table 2. A 1×1 NaI detector was also calibrated. However, since no survey data was used from the detector, the calibration results are not included here.

The survey data obtained at West Jefferson was analyzed with respect to the video images obtained during the surveys. This provided a correlation between the data obtained and the physical conditions in the pipe. This analysis provided strong evidence that contamination was restricted to the lower portions of the pipe. For example, consider survey run #JN3-PSD8-A45-13B shown in Figure 3. The data shows an area of elevated activity at about 45 feet. An analysis of the video survey of this pipe shows a gradual increase in standing water from 0 to 40 feet, with the most water encountered at 45 feet. This was followed by a gradual decrease in the amount of standing water in the pipe. Therefore, it was concluded that there was a low point in the pipe at 45 feet where contamination had accumulated, thus indicating that contaminants would tend to settle to the lower portions of a pipe. Based on this and other such analyses, the assumption was made that any contamination would be restricted to the lower third of a pipe. Therefore, the Cs-137 detector response for the gamma scintillation detector was determined from

data obtained at +/- 50.5 degrees from bottom. Similarly, data obtained at +/- 60 degrees from bottom was used to determine the Cs-137 yield factor for the 4-element GM detector. In addition, the methodology was applied to [REDACTED] detector calibrations and data reduction, where the yield factor for the 4-element GM detector for 6-inch and 8-inch pipe was determined from data obtained at +/- 50.4 degrees from bottom and +/- 52.3 degrees from bottom respectively.

Table 2. Detector yield factors.

Detector	Calibration Isotope	Pipe Size	Yield Factor (cps/dpm/100 cm ²)
4-element GM detector LND Model 72319 - S/N 1	Sr/Y-90	6-inch	2.23e-3
4-element GM detector LND Model 72319 - S/N 1	Sr/Y-90	8-inch	2.43e-3
4-element GM detector LND Model 72319 - S/N 1	Cs-137	4-inch	9.07e-4
2x2 NaI scintillator detector Ludlum Model 44-10 S/N PR165908	Cs-137	8-inch	5.45e-3

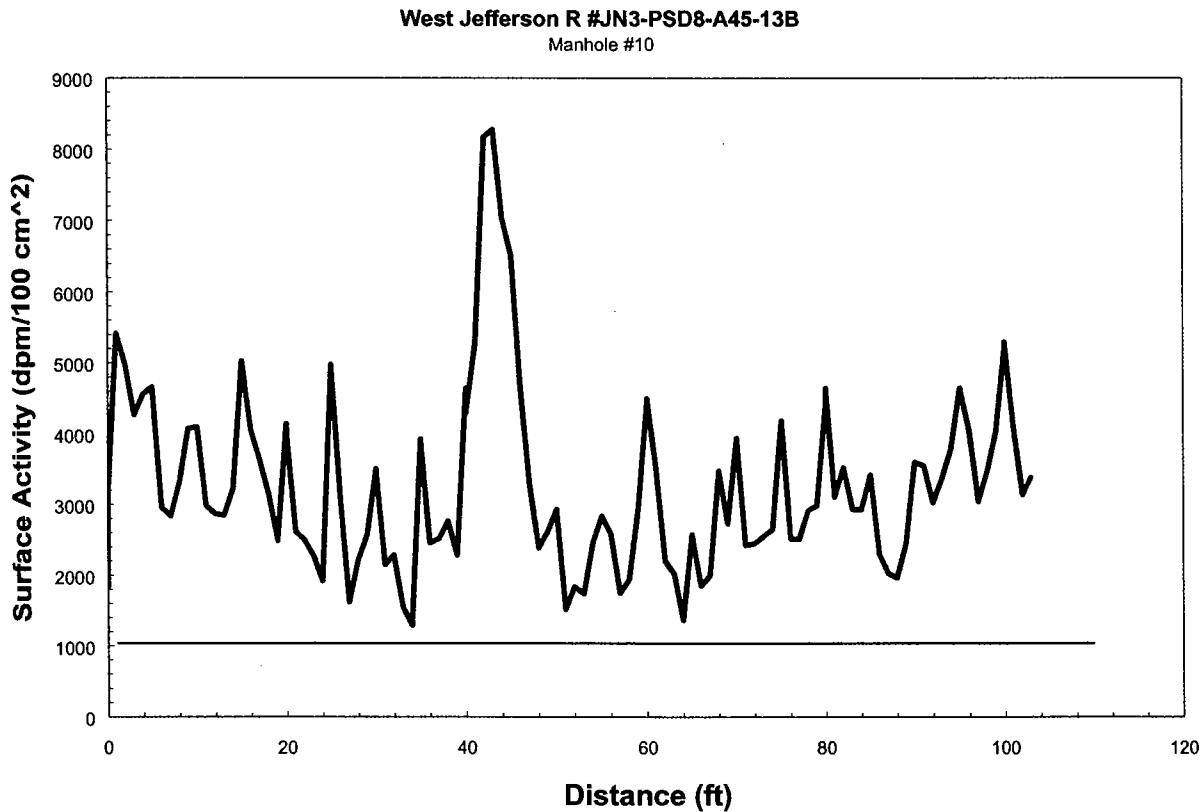


Figure 3. Data plot of West Jefferson survey JN3-PSD8-A45-13B.

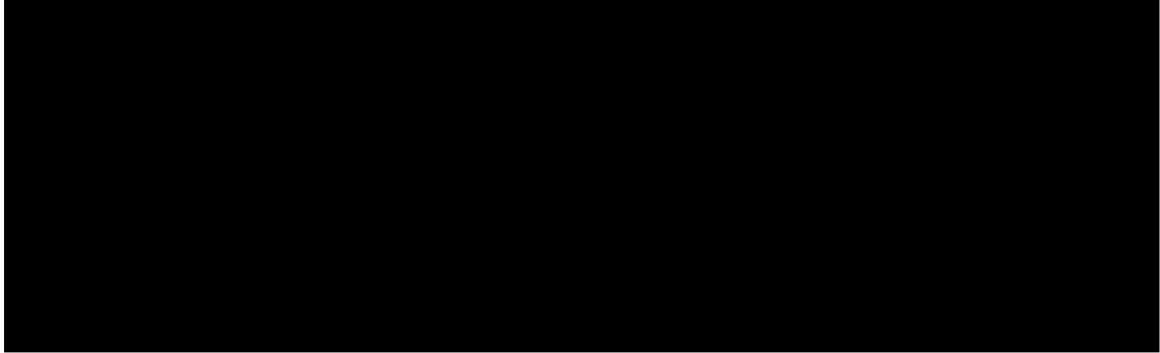
6.0 Data Precision

A direct measure of the overall precision available from the survey procedures used in this project was obtained by implementing a scheme of replicate measurements. In all of the radiological surveys conducted, at least one of the measurement locations was selected for replicate measurement. By performing the replicate measurements the overall precision, including uncertainties associated with detector positioning, were included in the assessment.

The precision for each replicate pair is calculated as the difference between the two count results (X_1 and X_2) divided by the mean of the two results (\bar{X}), expressed as a percentage, given in the following equation:

$$\text{Precision} = \frac{|X_1 - X_2|}{\bar{X}} \cdot 100$$

The average precision [REDACTED] was found to be [REDACTED] 7.3% for the data obtained at West Jefferson. Careful scrutiny of the data plots shown in the Appendices will show that, in general, the fluctuations seen in the data along the length of a pipe varied substantially more than the data precision. As such, it can be confidently concluded that the features in the data are indicative of actual changes in surface activity and not due to randomness in the measurement process. Detailed discussions of the precision for [REDACTED] West Jefferson are presented below.



Data Precision from West Jefferson Surveys

The average data precision for the surveys conducted at West Jefferson is 7.3%. In general it was found that data precision degraded when data was obtained in areas where the surface activity was changing rapidly with position. In areas where the surface activity was stable with distance, the data precision was very good. For example a replicate measurement was obtained at the 160-foot position during run #20. This particular position corresponded to a location where spot contamination was found. Therefore the surface activity gradient was very high at this location, where the surface activity varied by 85% within +/- 10-feet from the replicate measurement position. The resulting data precision in this instance was 19%. Conversely, a replicate measurement taken at the 40-foot position of run #2 resulted in a data precision of 1.7%. The surface activities measured within +/- 10-feet of this replicate measurement position deviated by no more than 10%. Therefore, it is concluded that positioning of the detector was the dominant factor in determining the data precision.

The replicate measurement data for all of the survey runs conducted at the West Jefferson site are shown in Table 4. There were 106 replicate measurements obtained. Three out of the 106 resulted in a data precision greater than the 30% data precision target described in the project QA plan. In one of the three cases, the replicate measurement at 20-feet during run #39, the count rates were very low. As such, the data precision was higher than the 30% target precision, but within 2-sigma of the average gross counts obtained at the replicate position.

Table 4. Replicate measurements from pipe surveys at the West Jefferson site.

Run ID	Position	First Measurement (Raw Counts)	Second Measurement (Raw Counts)	Precision
1	20	6376	6587	3.3%
	40	6525	7111	8.6%
	60	5989	6126	2.3%
2	20	5760	5382	6.8%
	40	5596	5499	1.7%
	60	6525	6353	2.7%
3	15	5158	5216	1.1%
	30	5130	5115	0.3%
	45	4840	4927	1.8%
4	15	4162	4446	6.6%
5	20	5215	5065	2.9%
	40	4540	4562	0.5%
	60	4278	4460	4.2%
6	15	5329	5272	1.1%
	30	5603	5717	2.0%
	45	5419	5219	3.8%
8	5	142	132	7.3%
9	5	134	162	18.9%
11	40	6146	6230	1.4%
	80	5528	5336	3.5%
	120	5054	4790	5.4%
13B	20	6564	6528	0.5%
	40	6726	6613	1.7%
	60	6663	6679	0.2%
	80	6651	6728	1.2%
	100	6913	6940	0.4%

Table 4 (cont.). Replicate measurements obtained during pipe surveys at the West Jefferson site.

Run ID	Position	First Measurement (Raw Counts)	Second Measurement (Raw Counts)	Precision
14	30	6434	6310	1.9%
	60	7174	7041	1.9%
	90	6412	6388	0.4%
15	25	172	173	0.6%
16	40	8722	8866	1.6%
	80	9349	9445	1.0%
17	30	8022	8284	3.2%
	60	8819	9309	5.4%
	90	9538	9898	3.7%
	125	9337	9592	2.7%
18	18	9222	9582	3.8%
19	35	10424	11769	12.1%
	71	9688	10792	10.8%
	107	9359	10293	9.5%
	141	9523	9957	4.5%
20	80	5009	5359	6.8%
	120	6481	6375	1.6%
	160	12355	14954	19.0%
	200	12601	12693	0.7%
20A	40	3874	3731	3.8%
	80	4200	4210	0.2%
21	32	7087	6641	6.5%
	60	6899	6314	8.9%
	90	6832	6563	4.0%
	130	7331	7110	3.1%
22	50	145	207	35.2%
	101	149	174	15.5%
	162	196	169	14.8%
	180	193	179	7.5%
	200	169	136	21.6%

Table 4 (cont.). Replicate measurements obtained during pipe surveys at the West Jefferson site.

Run ID	Position	First Measurement (Raw Counts)	Second Measurement (Raw Counts)	Precision
23	15	159	192	18.8%
	30	201	247	20.5%
24	30	6468	6587	1.8%
25	20	7377	7272	1.4%
26	40	6279	7272	14.7%
	80	6354	5927	7.0%
	120	6891	6769	1.8%
	160	7094	6613	7.0%
	200	7827	7668	2.1%
	30	257	217	16.9%
27	60	262	203	25.4%
	52	8623	8189	5.2%
28	100	8287	8276	0.1%
	150	8750	8789	0.4%
	200	9228	9245	0.2%
	40	5955	6719	12.1%
29	80	5636	6681	17.0%
	120	4976	5369	7.6%
	160	7030	7623	8.1%
	200	4155	4288	3.2%
	240	3702	3919	5.7%
	30	89	86	3.4%
31	5	9370	9172	2.1%
	10	9357	9053	3.3%
	15	8842	8767	0.9%
32	20	117	123	5.0%
33	3	4911	5267	7.0%
	6	6433	6461	0.4%
	9	5550	5737	3.3%
	12	6009	5979	0.5%

Table 4 (cont.). Replicate measurements obtained during pipe surveys at the West Jefferson site.

Run ID	Position	First Measurement (Raw Counts)	Second Measurement (Raw Counts)	Precision
34	25	51	53	3.8%
	50	159	159	0.0%
	75	174	156	10.9%
	100	137	133	3.0%
	125	135	130	3.8%
	150	172	173	0.6%
35	5	89	67	28.2%
36	25	133	122	8.6%
	50	89	93	4.4%
37	90	216	144	40.0%
	120	231	188	20.5%
38	25	185	178	3.9%
	50	178	186	4.4%
	65	184	158	15.2%
39	10	78	68	13.7%
	20	75	51	38.1%
40	25	144	114	23.3%
41	22	213	177	18.5%
	34	181	151	18.1%
	45	175	152	14.1%

7.0 Radiological Measurements Procedure

The Pipe Explorer™ survey procedures for a point-to-point radiological measurement survey require the operator to record the following parameters on data entry worksheets: total preset count time in seconds used for the survey in question, the total gross counts obtained for each measurement point, and the distance from the point of pipe access for each measurement point. These data, recorded on the worksheet during the measurement process are combined with the yield factor, determined during the detector calibration, and the measured background count rate, to reduce the raw gross count data to a measurement of activity density, i.e. dpm/100 cm². The following equation was used to reduce the raw gross count data:

$$A_d = \frac{\left(\left(C_g / T_c \right) - BKG_{CR} \right)}{Y}$$

Where:

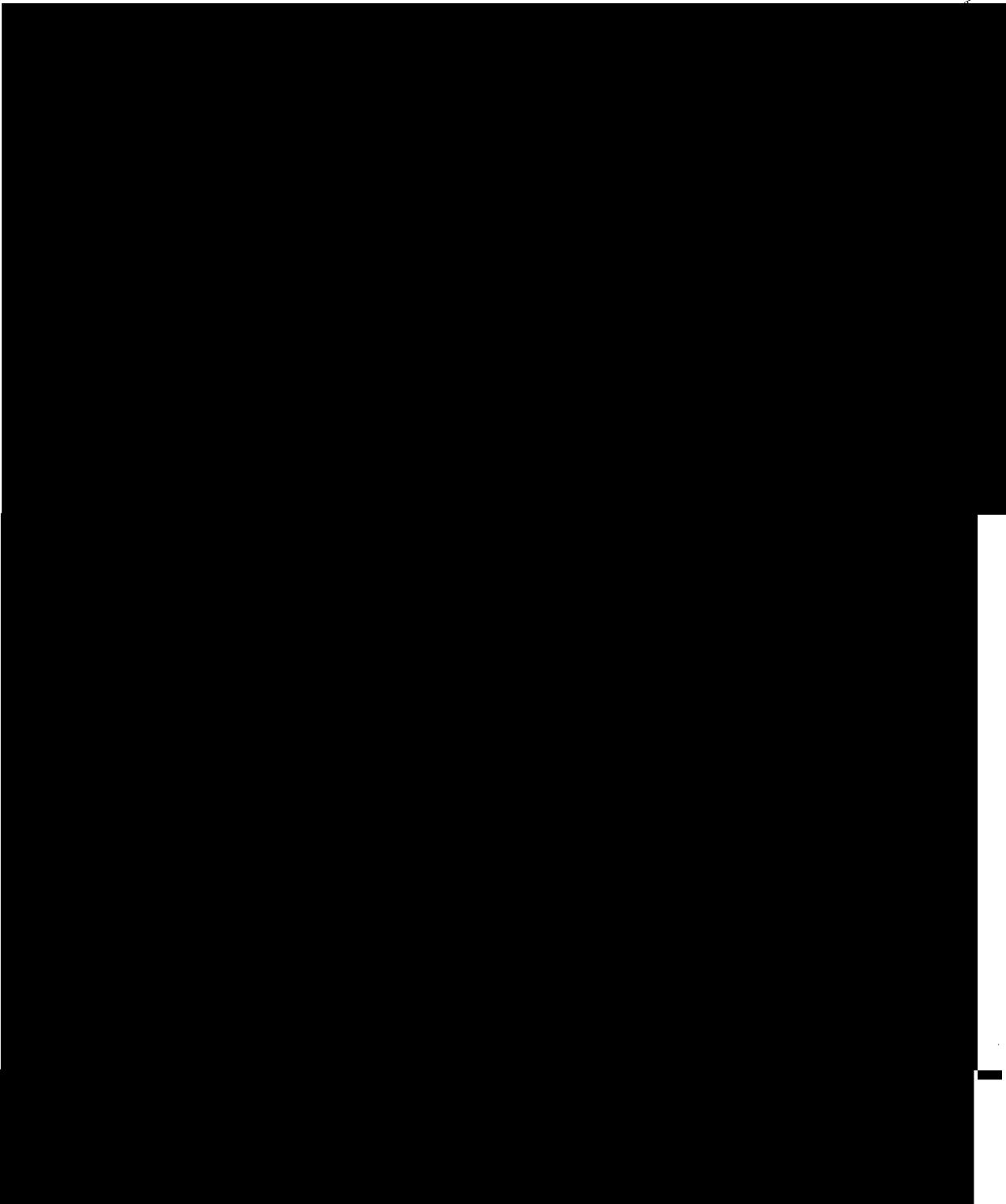
- | | |
|-------------------|--|
| A _d | = activity density (dpm/100 cm ²) |
| C _G | = gross counts for the measurement point |
| T _C | = count time for the measurement point (s) |
| BKG _{CR} | = background count rate for the survey (counts per second) |
| Y | = detector yield factor (net counts per second)/(dpm/100 cm ²) |

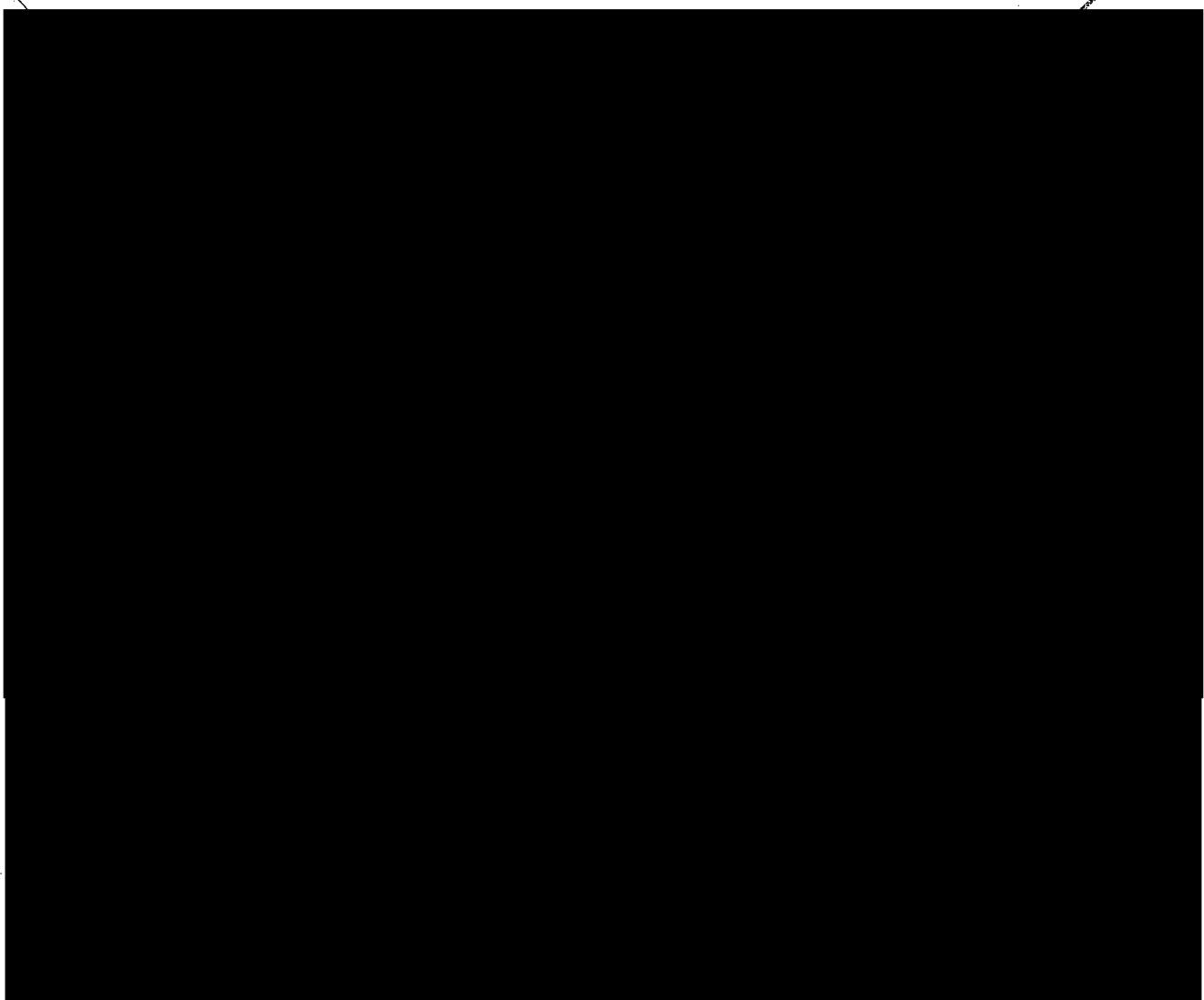
8.0 Background Determination

In any effort designed to assess residual radiological contamination levels it is necessary to determine an appropriate value for the response of the measurement system to background radiation. The detectors used for the surveys respond to terrestrial sources of background radiation, which must be taken into consideration during data reduction. Numerous background measurements were obtained throughout the survey efforts at [REDACTED]

West Jefferson. The conditions under which the background readings

were obtained and the results that were used in the determination of surface activity levels are discussed below.





West Jefferson Background Determinations

Background determinations at the West Jefferson site were complicated due to a wide variety of pipe types encountered and high ambient background levels. Background determinations for some of the detectors were done in a manner very similar to that used at the [REDACTED] site. Representative clean pipes were buried in clean soil in a field behind the back gate of the West Jefferson North facility. Background measurements were obtained by placing the detector in a short section of the 4-mil polyethylene sleeve material used with the Pipe Explorer™ deployment system and then sliding the detector into the buried pipes and obtaining one minute readings. Ten measurements would be

obtained and then the detector would be moved approximately 1-foot to a new position and another ten measurements would be obtained. This was repeated for a third position resulting in a net of 30 background measurements per pipe type. This method was used for the following detector/pipe combinations;

- 4-element GM detector in 6-inch PVC
- 2x2 NaI detector in 6-inch PVC
- 4-element GM detector in 4-inch cast iron

To determine the background sensitivity of both the 2x2 NaI detector and the 4-element GM detector to vitrified clay piping (VCP), the Pipe Explorer™ equipment was set up at a manhole next to building JS-3 at the West Jefferson South site. An 8-inch VCP drain line known to be free from contamination was surveyed and the readings were averaged to determine background. In addition, a 12-inch concrete pipe was surveyed with the 2x2 NaI detector to determine background sensitivity in this pipe type.

The average background readings obtained and standard deviations for each of the pipe types are listed in Table 6. Chauvenet's Criteria was applied to the background readings for all detector/pipe configurations. All but 23 of the 180 background measurements fell within the criteria. The data listed in Table 6 were calculated after Chauvenet's Criteria was applied.

Table 6. West Jefferson background readings (obtained with count times of 60 seconds).

Detector Configuration	Pipe Type and Diameter	Average (cpm)	Standard Deviation (cpm)
2x2 NaI scintillator detector Ludlum Model 44-10 S/N PR165908	12-inch concrete	4123	74
	6-inch PVC	7510	77
	8-inch VCP	9233	141
4-element GM detector LND Model 72319 - S/N 1	6-inch PVC	97	8
	4-inch cast iron	90	11
	8-inch VCP	128	13

One of the piping systems surveyed was constructed of VCP, but exhibited a substantially lower background activity than that encountered with any other VCP systems surveyed at the West Jefferson site. Only the 2x2 NaI detector was used in this particular piping system. If the background for VCP obtained from the south site was applied to data from this system, all surface activity was reported as negative numbers even in areas where contamination was probable. Therefore, it was concluded that this piping system was likely constructed from a different type of clay with lower naturally occurring radioactivity. Many attempts were made to locate piping of similar construction, but were unsuccessful. As such, a method was employed where background was arrived at by analyzing portions of the pipe survey data where surface activity was low and fairly constant. This method resulted in a determination of a background sensitivity of the 2x2 NaI detector of 86.8 cps. The piping system affected included the following survey runs

- JN3-PSD8-A315-2
- JN3-PSD8-A60-3
- JN3-PSD8-A65-11
- JN3-PSD8-A255-12
- JN3-PSD8-A45-13B
- JN3-PSD8-A225-14

Two other surveys conducted in clay tile pipe also exhibited anomalous background levels. These survey runs, #20 and #21, were conducted in pipes located beneath the West Jefferson lake and dam. As such, lower background levels were noted in these pipe runs. A similar method as discussed above was used to determine background for these pipes, where background was arrived at by analyzing portions of the pipe survey data where surface activity was low and fairly constant. This method resulted in a determination of background sensitivity for the 2x2 NaI detector of 62.9 cps for run #20 and 107.7 cps for run #21.

Run #20 is lower since the pipe ran directly beneath the dam and under a portion of the lake. Care should be taken in the analysis of this particular run, since the depth of the pipe beneath the surface changed dramatically over the length of the survey. Therefore, while the background level of 62.9 cps may be appropriate for the section of pipe located approximately 50 feet under the dam, it may not be appropriate for the section of pipe near manhole #4 where the pipe was on the order of 5 feet below surface.

9.0 Count Times and Minimum Detectable Activity

In conducting surveys for radiological contamination it is necessary to use count times that are long enough to determine the activity concentration (in dpm/100 cm²) to an appropriate precision. The figure of merit for this is the minimum detectable activity, or MDA. The MDA is an *A Priori* estimate of the lowest surface activity level that can be measured with statistical certainty of 95% above the random fluctuations of background. The MDA is a function of the detector yield factor, counting time, and background rate. For the Pipe Explorer™ measurement system it is determined by the following formula;

$$MDA = \frac{3 + 4.65\sqrt{B_r t}}{Yt} \left(\text{dpm / } 100 \text{ cm}^2 \right)$$

where B_r = background count rate (cps)

t = counting time (s)

Y = detector yield factor (cps/(dpm/100 cm²))

The tabular data sets provided in Appendix X B include the resulting MDA for each survey situation. In addition, a line is drawn on each data plot showing the MDA level.

10.0 Measurement System Verification

In order to verify that the radiation detection system was performing correctly, a check source was measured immediately before and after each survey run. The result of this in-field measurement of the check source was compared to a measurement of the same check source performed immediately following detector calibrations that were carried out in the laboratory. If the in-field measurement was found to be within 10% of the measurement obtained at the time of calibration, proper operation of the measurement system was considered validated. In all cases the check source reading was within the requisite 10%.

In addition, the accuracy of the distance measurement components of the Pipe Explorer™ system was confirmed before and after the field activities at [REDACTED] the [REDACTED] and West Jefferson site[REDACTED]. The measurement distance recorded in the surveys is arrived at by measuring the length of the Pipe Explorer™ tether that has been deployed. The measurement is made by passing the tether through a set of pinch rollers that are coupled to an optical rotary encoder. The encoder is connected to a digital readout that displays the deployment distance in feet. Verification of proper operation of the distance measurement components was carried out through comparison of the digital readout to a 100-foot long tape measure. Comparisons were made at roughly 25, 50, 75, and 100 feet. Table 7 lists the results of those comparisons. The largest variance was 1%, which is well within the ability to accurately read the tape measure.

Table 7. Results from tests to validate proper operation of the Pipe Explorer™ distance measurement components.

Description	Tape Measure	Pipe Explorer™ Encoder Reading	Variance (Tape/Encoder)
Measurements on 1/12/00 prior to commencement of surveys at West Jefferson	25.2	25.37	99.3%
	49.9	50.16	99.5%
	74.8	75.19	99.5%
	100	100.83	99.2%
Measurements on 12/17/99 after surveys at West Jefferson completed	27	27.14	99.5%
	55	55.31	99.4%
	75.9	76.43	99.3%
	99.5	100.07	99.4%
	75.6	76.12	99.3%
	48.8	49.16	99.3%
	24.3	24.54	99.0%

11.0 Survey Results

The results of the individual surveys are presented in both tabular and graphical form in Appendix B for the West Jefferson surveys. The tabular format provides the following header information:

- Run ID
- Pre Pipe length
- Detector used
- The yield factor used to reduce the raw count data
- The measurement count time
- The detector background count rate

The tabular listing of the data includes the following columns:

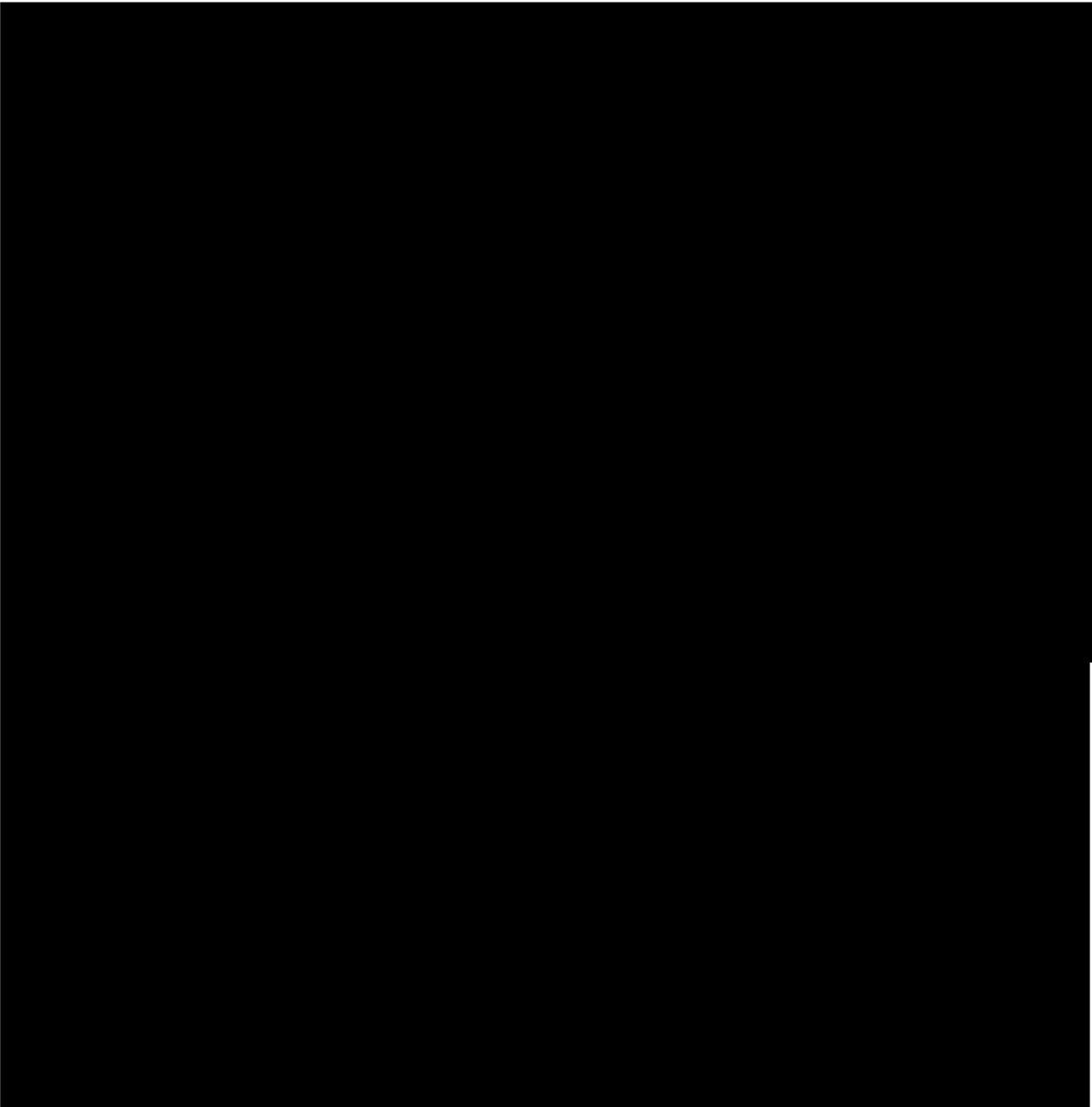
- Distance into the pipe in feet
- Raw gross counts for the count time specified
- Gross count rate in counts per second
- Measured surface activity (dpm/100 cm²)

In many of the pipes standing water or flowing water was present. The presence of water affects radiological readings from both beta-emitting contaminants present on the bottom of a pipe and contributions to the natural background from pipe material such as clay piping.

An electronic format of these results is also included with this report. The electronic format is Microsoft Excel 97. The tabular listing of measurement results is provided on a separate worksheet for each survey. The worksheets are named following the survey run ID nomenclature. Each plot is also provided as a separate worksheet, identified using the survey run nomenclature. An additional worksheet summarizes the background measurement results used to compute the background count rate for the beta measurements.

12.0 Narrative of Survey Runs

In this section a discussion is provided of all the survey runs completed. [REDACTED] This is followed by a discussion of the runs completed at the West Jefferson site. At the West Jefferson site there were two primary piping systems that were surveyed through multiple runs. For simplicity these survey runs are discussed as a whole rather than discussing each individual segment.



West Jefferson Survey Data

Because of the large number of survey runs completed at the West Jefferson site, a narrative is not provided for every pipe surveyed. Rather, discussions are provided where features were noted or it was deemed that a discussion was appropriate. Discussions of several of the survey runs are combined because the runs represent segments of an overall continuous piping system. The foldout map of Figure 1 on page 5 should be used as a reference for the discussions.

Survey Runs 2, 3, 11, 12, 13, and 14

These survey runs were individual segments of a main process sewer line originating from the west corner of Building JN3. The overall pipe run begins at a manhole next to the former site of the JN3 cooling tower. The direction of fluid flow is to the southeast where it intersects with manhole #2. The pipeline then runs to the northeast. The line intersects three manholes before intersecting with manhole # 3 at the west corner of JN4. The final section of the pipe runs toward the west where it terminates in a septic tank.

The entire pipeline was surveyed through the combination of runs 2, 3, 11, 12, 13, and 14. For convenience the results of these individual surveys are combined into one graph in Figure 4. Note that distance displayed in the graph is arbitrarily determined as a net distance from the first data point. Distances are also somewhat approximate in that exact dimensions between pipe access points were not measured in the field.

In cases where data is included from points close to the exit or entrance of the pipe into a manhole, a sharp decrease is seen in the data. This is due to changes in the effective background contribution from elements in the clay tile pipe as the detector is removed from the pipe.

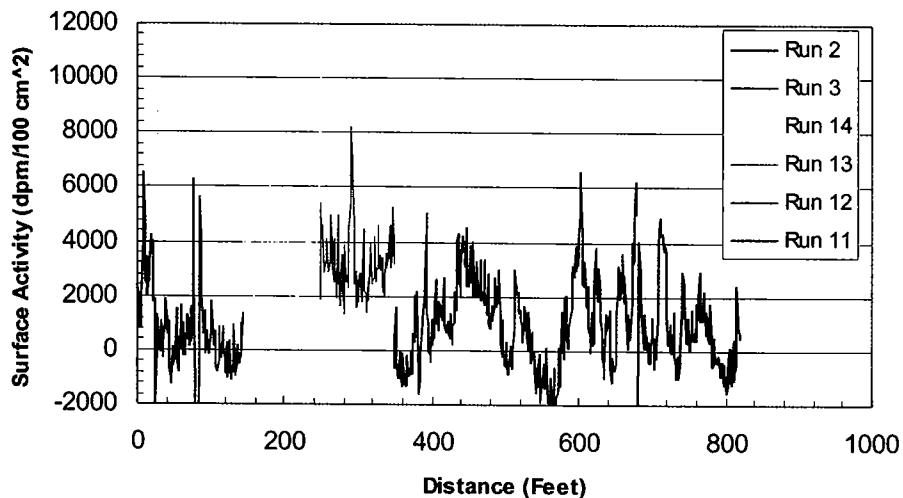


Figure 4. Composite plot of survey runs 2, 3, 11, 12, 13, and 14.

A notable feature of the data presented in this format is that survey runs 13 and 14 have an offset from the surrounding data. As such, this data is suspect. The exact cause of the offset is unknown, but a power source problem may be the cause. The basis for this is that in all of the surveys conducted, except for these two survey runs, power was provided by either a grounded generator or the internal battery of the Ludlum model 2200. For the two survey runs in question, 13 and 14, the detector instrumentation was provided by building power in JN3. The effect on the data is consistent with instrumentation anomalies SEA has observed before with older building electrical systems, where grounding problems have led to erroneous counts. The erroneous counts are of an order that would manifest themselves as an elevated background level, but would not affect check source readings. Alternatively, the offset could be due to a section of pipe constructed from clay with a different level of naturally occurring radioactivity.

In general, elevated activity was noted in many areas throughout the process sewer line. Video images obtained during the surveys provide additional evidence as to the presence of contamination in the lines. For example, on run #11 it was noted that the highest activity recorded corresponds to a low elevation point in the pipe where contaminants washing down the pipe would tend to collect. This was evidenced by the fact that standing water in the pipe was deepest at the point where the activity was the highest. The same phenomenon was observed in the data from survey run #13.

Survey Runs 16, 17, 18, 19, 20, 21, and 28

These survey runs were individual segments of a main sanitary sewer line originating from the northwest corner of JN2. The line proceeds north from JN2 and makes a 45-degree turn toward the northeast until it intersects with manhole #6 in front of JN1. A 6-

inch VCP sanitary sewer line intersects the line approximately 90 feet prior to manhole #6. A significant spike in the surface activity was measured at this intersecting point.

From manhole #6 the sanitary sewer line runs to the southeast until it intersects with manhole #5. The pipeline makes a 90-degree turn toward the northeast at this point toward manhole #16. The pipe then runs to the west through manhole #4 and then runs underneath a portion of the lake and the site dam. The line intersects with manhole #7 and then runs to the north where the sewer line is terminated at the North Site Filter.

Figure 5 shows the composite data plot of the seven survey runs conducted on the sanitary sewer line. Note that distance displayed in the graph is arbitrarily determined as a net distance from the first data point. Distances are also somewhat approximate in that exact dimensions between pipe access points were not measured in the field.

Several localized areas of elevated activity are noted. In particular, the highest activity noted during all of the Pipe Explorer surveys was recorded in this sewer line. Another notable feature is that data collected in the pipe segment running underneath the lake and dam is affected by a decrease in terrestrial activity. Run #21 was affected in a similar manner by the dam fill, but to a lesser extent.

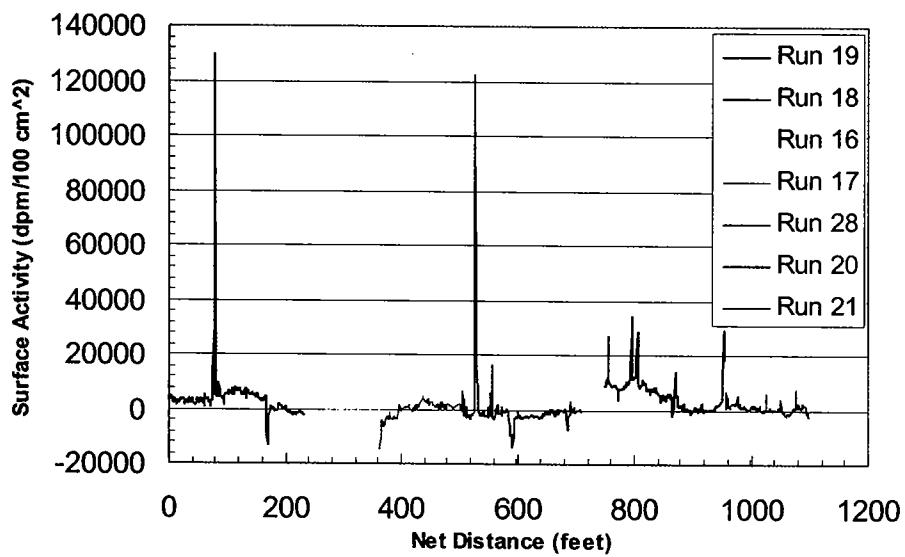
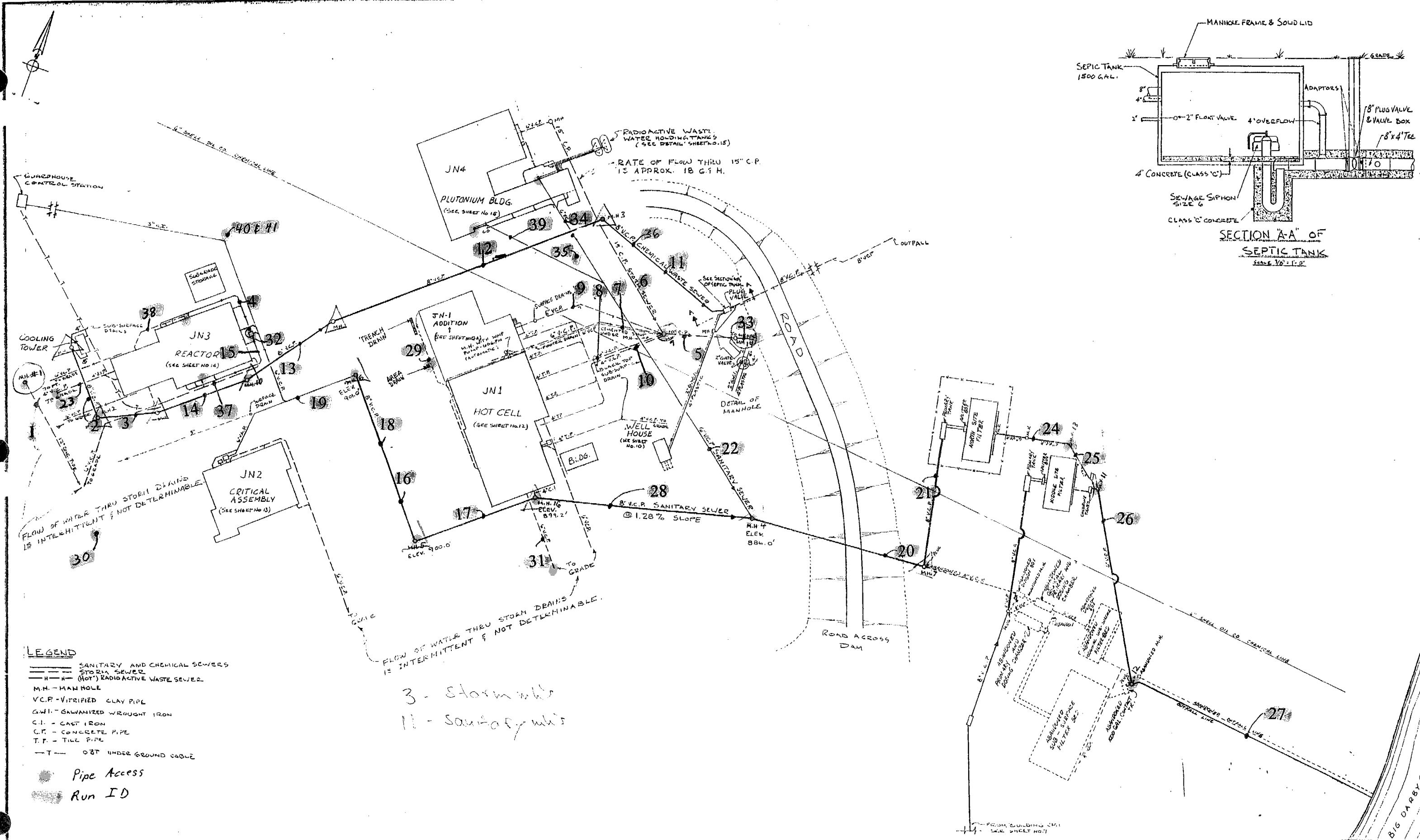


Figure 5. Composite plot of survey runs 16, 17, 18, 19, 20, 21, and 28.



**EMERGENCY
DWG FILE**

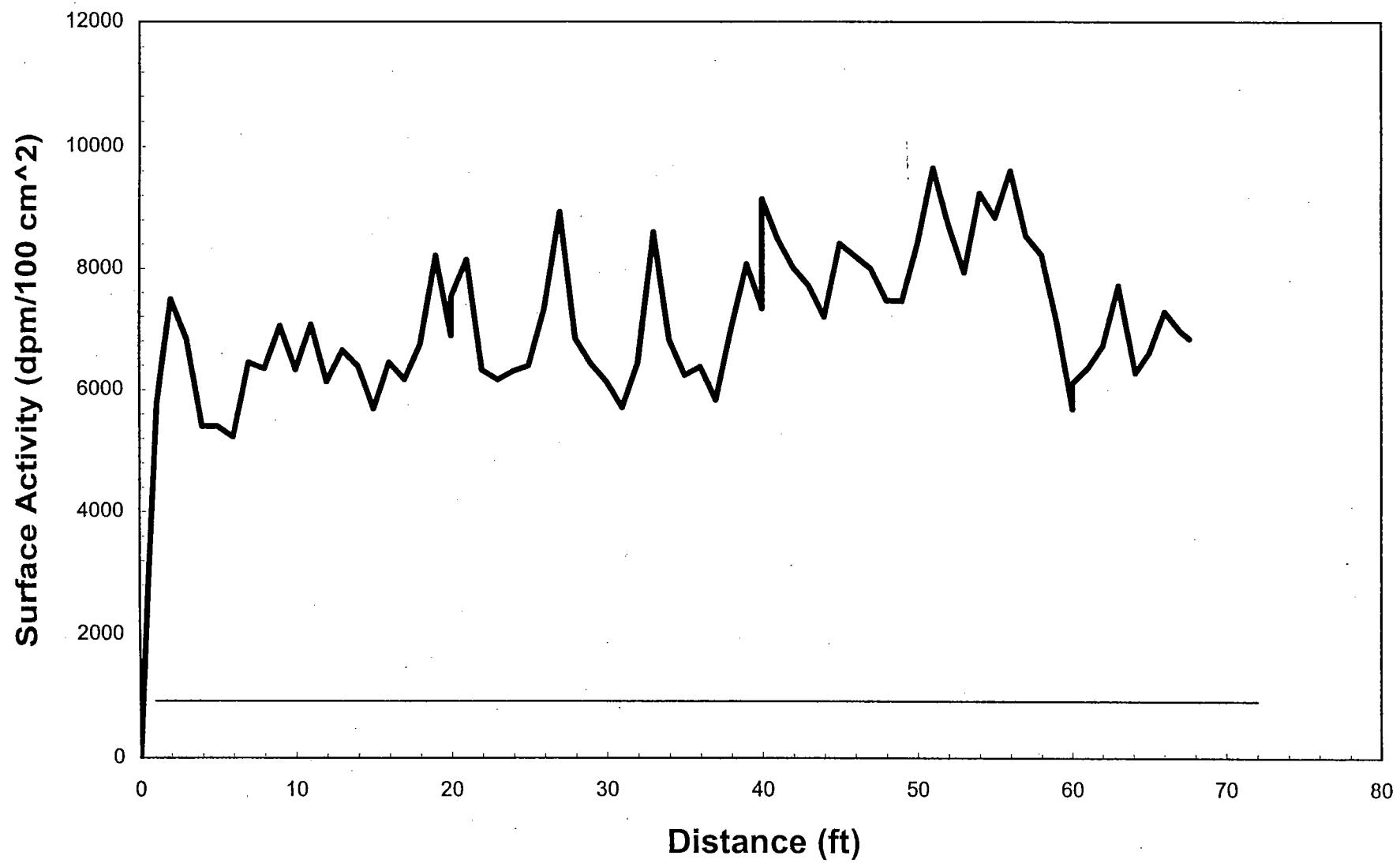
REVISIONS				SCALE 1"=50'	BATTELLE MEMORIAL INSTITUTE COLUMBUS LABORATORIES 505 KING AVENUE COLUMBUS, OHIO 43201	
No.	Date	Rev.	Approved	Description	Date 8-12-70	DRAWN BY [Signature]
A	10-16-70	JEA	100	DETAIL OF SEWER LINE JN1-JN2		
B	10-22-70	DJA	1	JN1 ADDITION ADDED		
C	8-12-70	JEA	100	CONNECT THE JN1 TO JN2 FALL OUT GROUNDSITE		
D	8-12-70	KA		CONSTRUCTION OF JN1 THRU JN4		

APPROVED BY

PLOT PLAN AREA OF JN SEWER SYSTEM
BUILDING JN1 THRU JN4

DRAWING NO. BM-W-1-F6 SHEET 11 OF 13 RETURN TO ENG. & DESIGN

West Jefferson R #JN3-SSD12-A130-1
Manhole West of JN-1



Pipe Explorer™

01/13/2000

Building: JN-3

Run Description: Manhole West of JN-1

Run ID: JN3-SSD12-A130-1

Pipe Type: Concrete

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

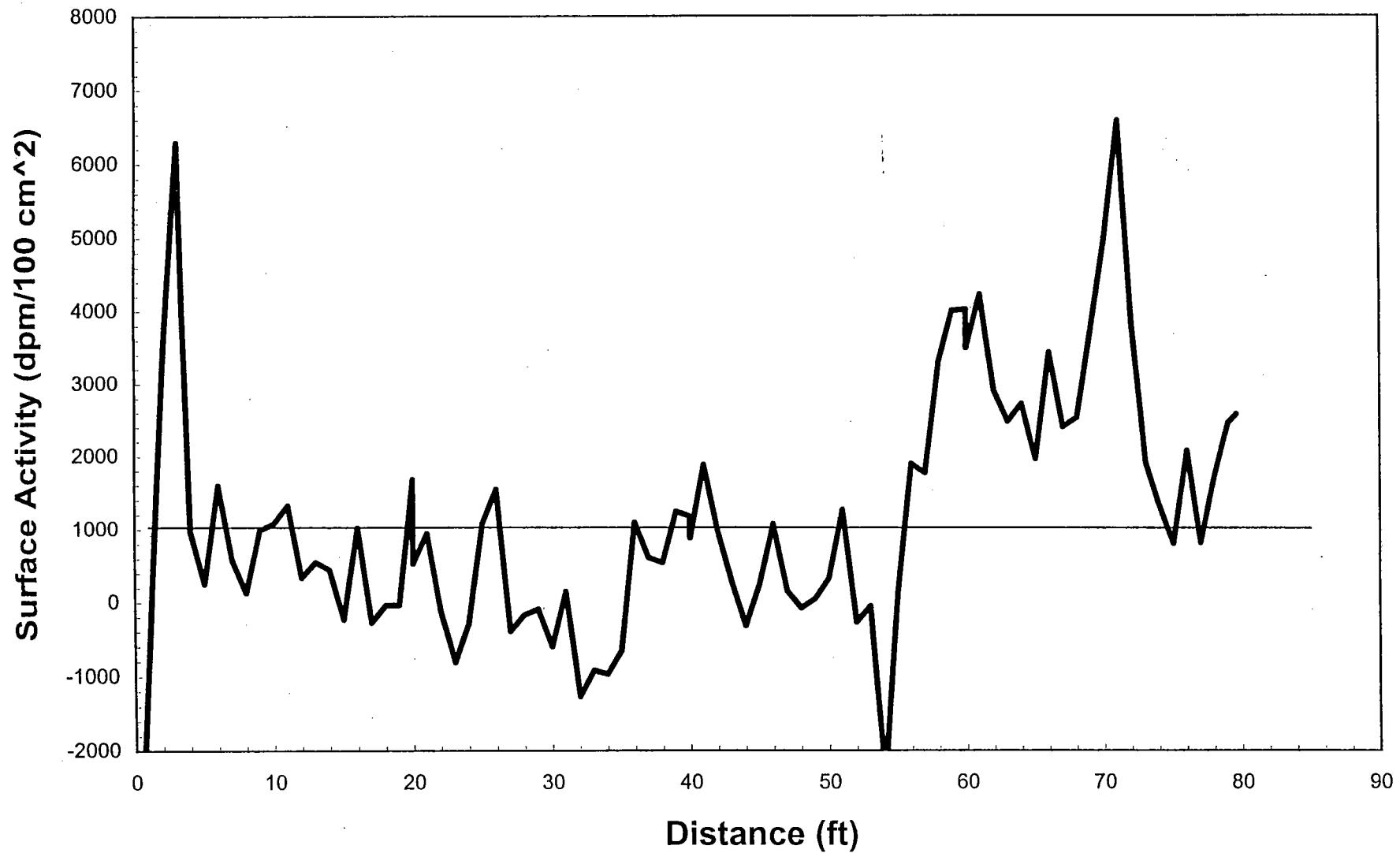
Background (cps): 68.7

MDA (dpm/100cm²): 921

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	4141	69.02	58
1.1	6011	100.18	5777
2	6571	109.52	7489
3	6356	105.93	6832
4	5889	98.15	5404
5	5888	98.13	5401
6	5832	97.20	5229
7	6231	103.85	6450
8	6197	103.28	6346
9	6429	107.15	7055
10	6192	103.20	6330
11	6437	107.28	7080
12	6128	102.13	6135
13	6297	104.95	6651
14	6211	103.52	6388
15	5984	99.73	5694
16	6233	103.88	6456
17	6140	102.33	6171
18	6329	105.48	6749
19	6808	113.47	8214
20	6376	106.27	6893
20	6587	109.78	7538
21	6786	113.10	8147
22	6191	103.18	6327
23	6140	102.33	6171
24	6185	103.08	6309
25	6215	103.58	6401
26	6520	108.67	7333
27	7042	117.37	8930
28	6359	105.98	6841
29	6226	103.77	6434
30	6129	102.15	6138

31	5992	99.87	5719
32	6230	103.83	6446
33	6934	115.57	8599
34	6356	105.93	6832
35	6165	102.75	6248
36	6209	103.48	6382
37	6034	100.57	5847
38	6416	106.93	7015
39	6763	112.72	8076
40	6525	108.75	7349
40	7111	118.52	9141
41	6899	114.98	8492
42	6746	112.43	8024
43	6648	110.80	7725
44	6480	108.00	7211
45	6873	114.55	8413
46	6806	113.43	8208
47	6740	112.33	8006
48	6568	109.47	7480
49	6565	109.42	7471
50	6874	114.57	8416
51	7278	121.30	9651
52	6974	116.23	8722
53	6720	112.00	7945
54	7143	119.05	9239
55	7014	116.90	8844
56	7264	121.07	9609
57	6916	115.27	8544
58	6815	113.58	8235
59	6454	107.57	7131
60	5989	99.82	5709
60	6126	102.10	6128
61	6206	103.43	6373
62	6327	105.45	6743
63	6650	110.83	7731
64.1	6182	103.03	6300
65	6290	104.83	6630
66	6511	108.52	7306
67	6407	106.78	6988
67.6	6366	106.10	6862

West Jefferson R #JN3-PSD8-A315-2
Manhole #2



Pipe Explorer™

01/14/2000

Building: JN-3

Run Description: Manhole #2

Run ID: JN3-PSD8-A315-2

Pipe Type: VTP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

Background (cps): 86.8

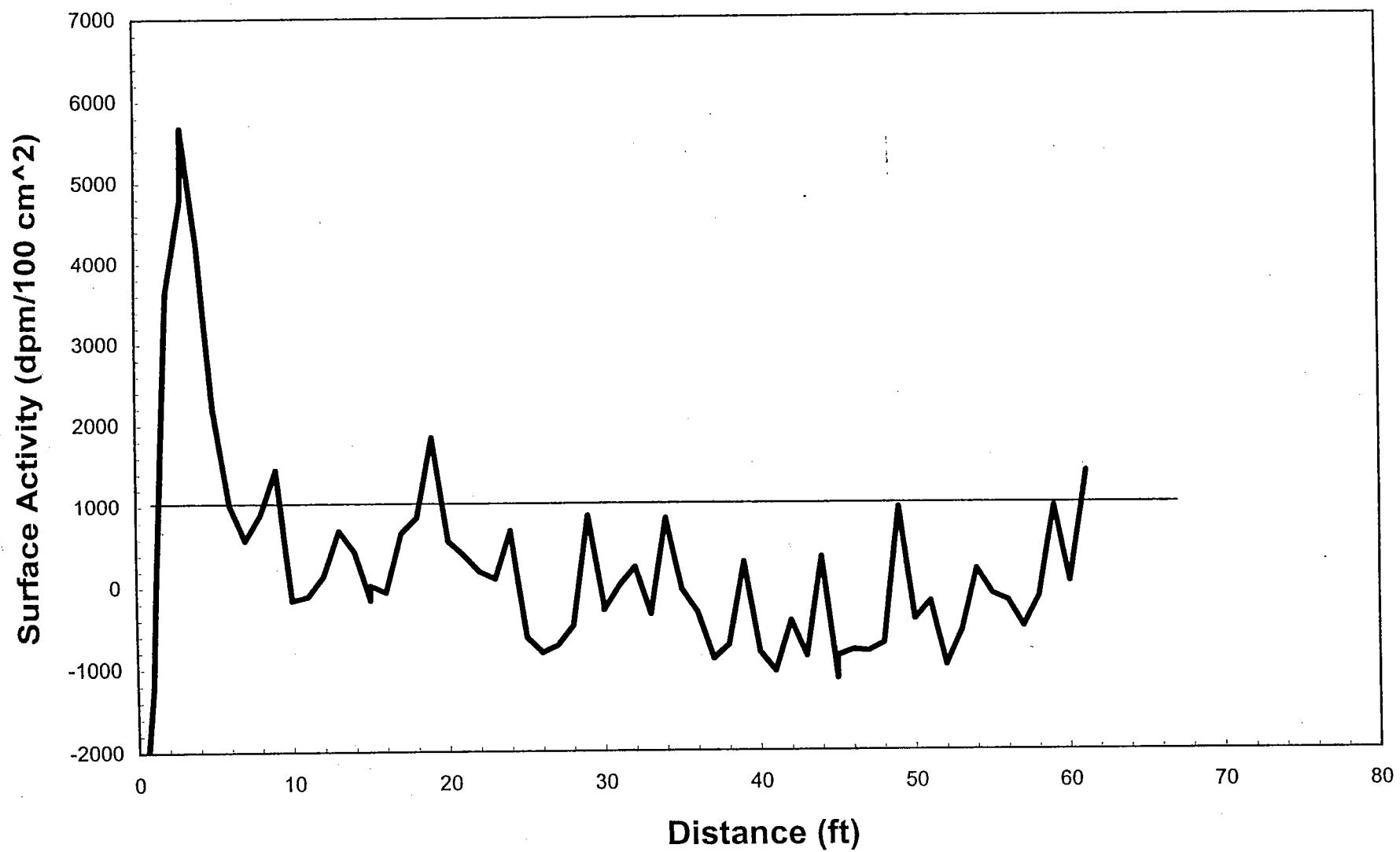
MDA (dpm/100cm²): 1035

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
-3	3761	62.68	-4425
0	3879	64.65	-4064
1	4980	83.00	-697
2	6270	104.50	3248
3	7266	121.10	6294
4	5526	92.10	972
5	5292	88.20	257
6	5733	95.55	1606
7	5399	89.98	584
8	5251	87.52	131
9	5534	92.23	997
10	5563	92.72	1086
11	5643	94.05	1330
12	5320	88.67	343
13	5389	89.82	554
14	5356	89.27	453
15	5134	85.57	-226
16	5545	92.42	1031
17	5121	85.35	-266
18	5196	86.60	-37
19	5198	86.63	-31
20	5760	96.00	1688
20	5382	89.70	532
21	5519	91.98	951
22	5169	86.15	-119
23	4945	82.42	-804
24	5115	85.25	-284
25	5564	92.73	1089
26	5716	95.27	1554
27	5081	84.68	-388
28	5154	85.90	-165
29	5179	86.32	-89

30	5013	83.55	-596
31	5258	87.63	153
32	4795	79.92	-1263
33	4909	81.82	-914
34	4893	81.55	-963
35	4994	83.23	-654
36	5568	92.80	1101
37	5410	90.17	618
38	5388	89.80	550
39	5618	93.63	1254
40	5596	93.27	1187
40	5499	91.65	890
41	5827	97.12	1893
42	5531	92.18	988
43	5300	88.33	281
44	5106	85.10	-312
45	5289	88.15	248
46	5561	92.68	1080
47	5260	87.67	159
48	5184	86.40	-73
49	5225	87.08	52
50	5317	88.62	333
51	5627	93.78	1281
52	5122	85.37	-263
53	5193	86.55	-46
54	4441	74.02	-2346
55	5253	87.55	138
56	5833	97.22	1911
57	5792	96.53	1786
58	6289	104.82	3306
59	6520	108.67	4012
60	6525	108.75	4028
60	6353	105.88	3502
61	6593	109.88	4235
62	6161	102.68	2914
63	6023	100.38	2492
64	6102	101.70	2734
65	5855	97.58	1979
66	6334	105.57	3443
67	5999	99.98	2419
68	6040	100.67	2544
69	6423	107.05	3716
70	6839	113.98	4988
71	7361	122.68	6584
72	6458	107.63	3823
73	5838	97.30	1927
74	5645	94.08	1336
75	5475	91.25	817
76	5892	98.20	2092

77	5480	91.33	832
78	5780	96.33	1749
79	6017	100.28	2474
79.6	6056	100.93	2593

West Jefferson R #JN3-PSD8-A60-3
Manhole #2



Pipe Explorer™

01/15/2000

Building: JN-3

Run Description: Manhole #2

Run ID: JN3-PSD8-A60-3

Pipe Type: VTP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

Background (cps): 86.8

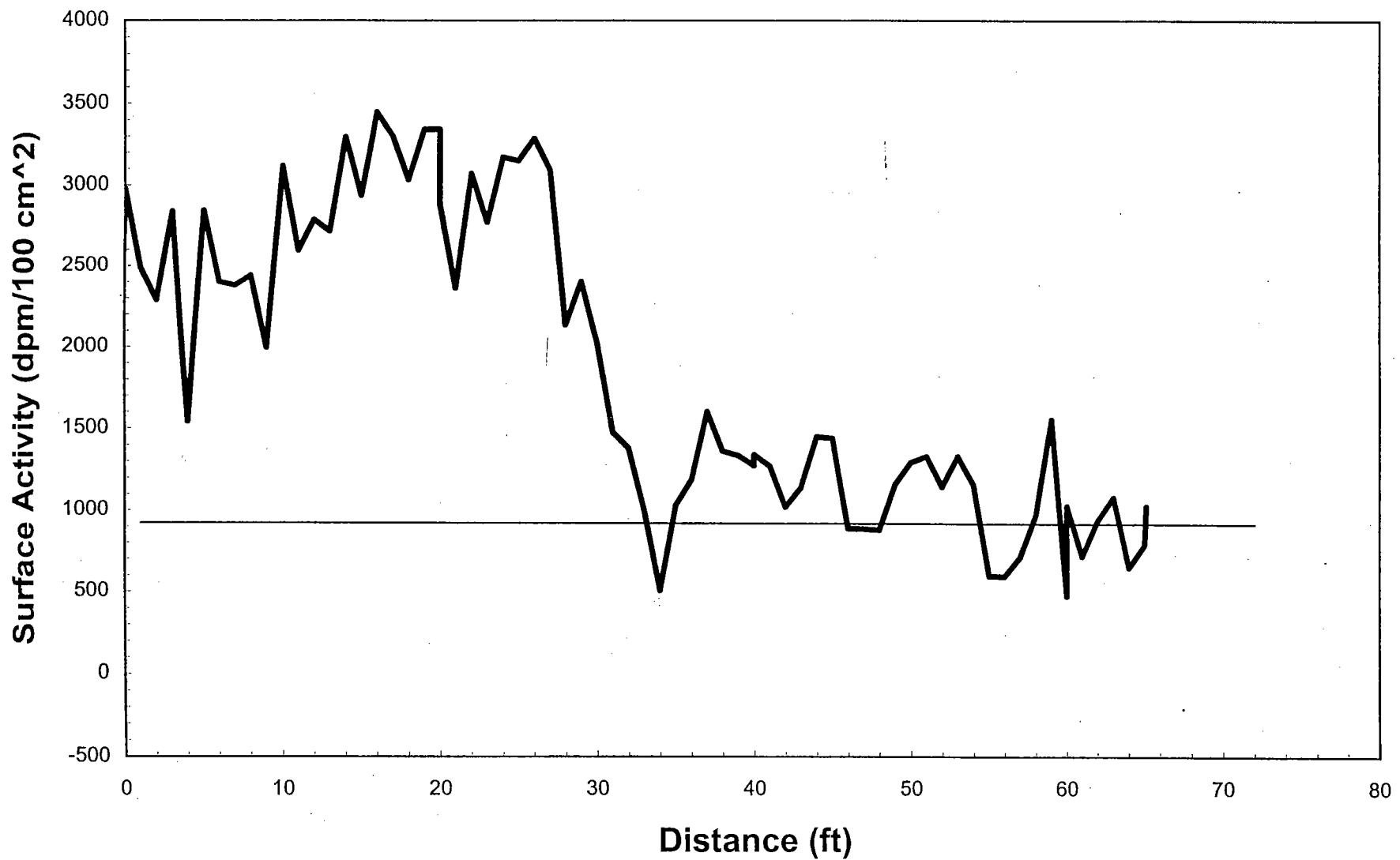
MDA (dpm/100cm²): 1035

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	4211	70.18	-3049
0	4173	69.55	-3165
1	4806	80.10	-1229
2	6401	106.68	3648
3	6787	113.12	4829
3	7066	117.77	5682
4	6590	109.83	4226
5	5926	98.77	2196
6	5541	92.35	1018
7	5399	89.98	584
8	5502	91.70	899
9	5682	94.70	1450
10	5157	85.95	-156
11	5173	86.22	-107
12	5254	87.57	141
13	5437	90.62	700
14	5352	89.20	440
15	5158	85.97	-153
15	5216	86.93	24
16	5189	86.48	-58
17	5426	90.43	667
18	5489	91.48	859
19	5811	96.85	1844
20	5394	89.90	569
21	5339	88.98	401
22	5272	87.87	196
23	5242	87.37	104
24	5436	90.60	697
25	5006	83.43	-618
26	4944	82.40	-807
27	4973	82.88	-719
28	5053	84.22	-474

29	5495	91.58	878
30	5130	85.50	-239
30	5115	85.25	-284
31	5213	86.88	15
32	5288	88.13	245
33	5098	84.97	-336
34	5484	91.40	844
35	5196	86.60	-37
36	5104	85.07	-318
37	4917	81.95	-890
38	4972	82.87	-722
39	5309	88.48	309
40	4942	82.37	-813
41	4867	81.12	-1043
42	5069	84.48	-425
43	4927	82.12	-859
44	5328	88.80	367
45	4840	80.67	-1125
45	4927	82.12	-859
46	4950	82.50	-789
47	4945	82.42	-804
48	4978	82.97	-703
49	5528	92.13	979
50	5075	84.58	-407
51	5146	85.77	-190
52	4890	81.50	-972
53	5028	83.80	-550
54	5276	87.93	208
55	5177	86.28	-95
56	5148	85.80	-183
57	5045	84.08	-498
58	5167	86.12	-125
59	5531	92.18	988
60	5227	87.12	58
61.1	5670	94.50	1413

West Jefferson R #JN1-SSD10-A75-5

Manhole #9



Pipe Explorer™

01/17/2000

Building: JN-1

Run Description: Manhole #9

Run ID: JN1-SSD10-A75-5

Pipe Type: CP 10"

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

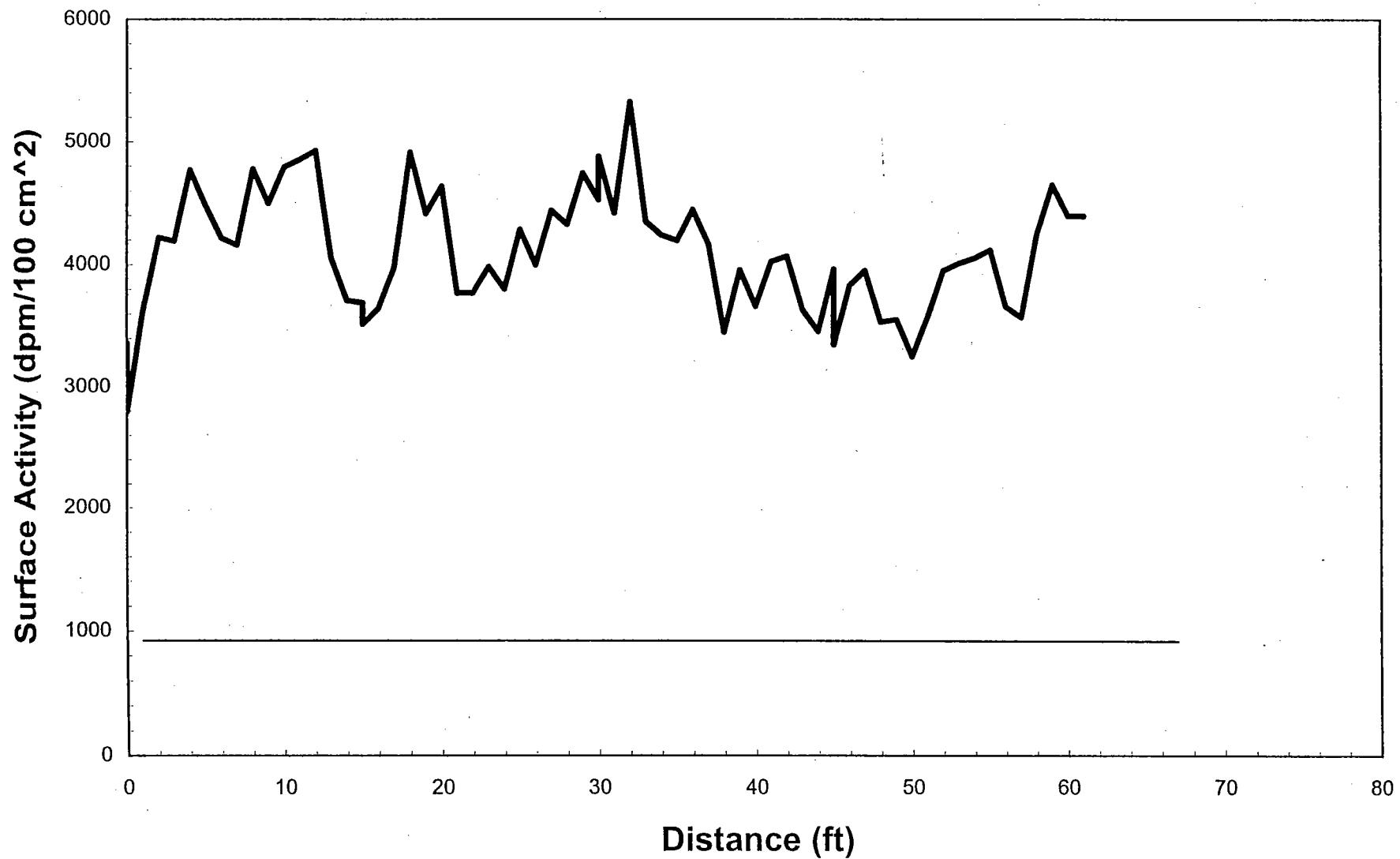
Background (cps): 68.7

MDA (dpm/100cm²): 921

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
-1	4095	68.25	-83
0	5090	84.83	2960
0	5096	84.93	2979
1	4935	82.25	2486
2	4871	81.18	2291
3	5050	84.17	2838
4	4626	77.10	1541
5	5052	84.20	2844
6	4907	81.78	2401
7	4900	81.67	2379
8	4920	82.00	2440
9	4775	79.58	1997
10	5142	85.70	3119
11	4971	82.85	2596
12	5033	83.88	2786
13	5010	83.50	2716
14	5200	86.67	3297
15	5083	84.72	2939
16	5249	87.48	3446
17	5202	86.70	3303
18	5114	85.23	3034
19	5215	86.92	3343
20	5215	86.92	3343
20	5065	84.42	2884
21	4895	81.58	2364
22	5126	85.43	3070
23	5028	83.80	2771
24	5159	85.98	3171
25	5152	85.87	3150
26	5197	86.62	3287
27	5133	85.55	3092
28	4822	80.37	2141

29	4908	81.80	2404
30	4786	79.77	2031
31	4606	76.77	1480
32	4574	76.23	1382
33	4449	74.15	1000
34	4288	71.47	508
35	4460	74.33	1034
36	4511	75.18	1190
37	4647	77.45	1606
38	4569	76.15	1367
39	4560	76.00	1339
40	4540	75.67	1278
40	4562	76.03	1346
41	4539	75.65	1275
42	4457	74.28	1024
43	4496	74.93	1144
44	4598	76.63	1456
45	4595	76.58	1446
46	4414	73.57	893
47	4413	73.55	890
48	4411	73.52	884
49	4503	75.05	1165
50	4547	75.78	1300
51	4559	75.98	1336
52	4498	74.97	1150
53	4559	75.98	1336
54	4502	75.03	1162
55	4318	71.97	599
56	4317	71.95	596
57	4356	72.60	716
58	4441	74.02	976
59	4633	77.22	1563
60	4278	71.30	477
60	4460	74.33	1034
61	4358	72.63	722
62	4431	73.85	945
63	4478	74.63	1089
64	4336	72.27	654
65	4381	73.02	792
65.1	4460	74.33	1034

West Jefferson R #JN1-SSD15-A310-6
Manhole #9



Pipe Explorer™

01/18/2000

Building: JN-1

Run Description: Manhole #9

Run ID: JN1-SSD15-A310-6

Pipe Type: C.P. 15" (cement)

Detector: 44-10 S/N

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

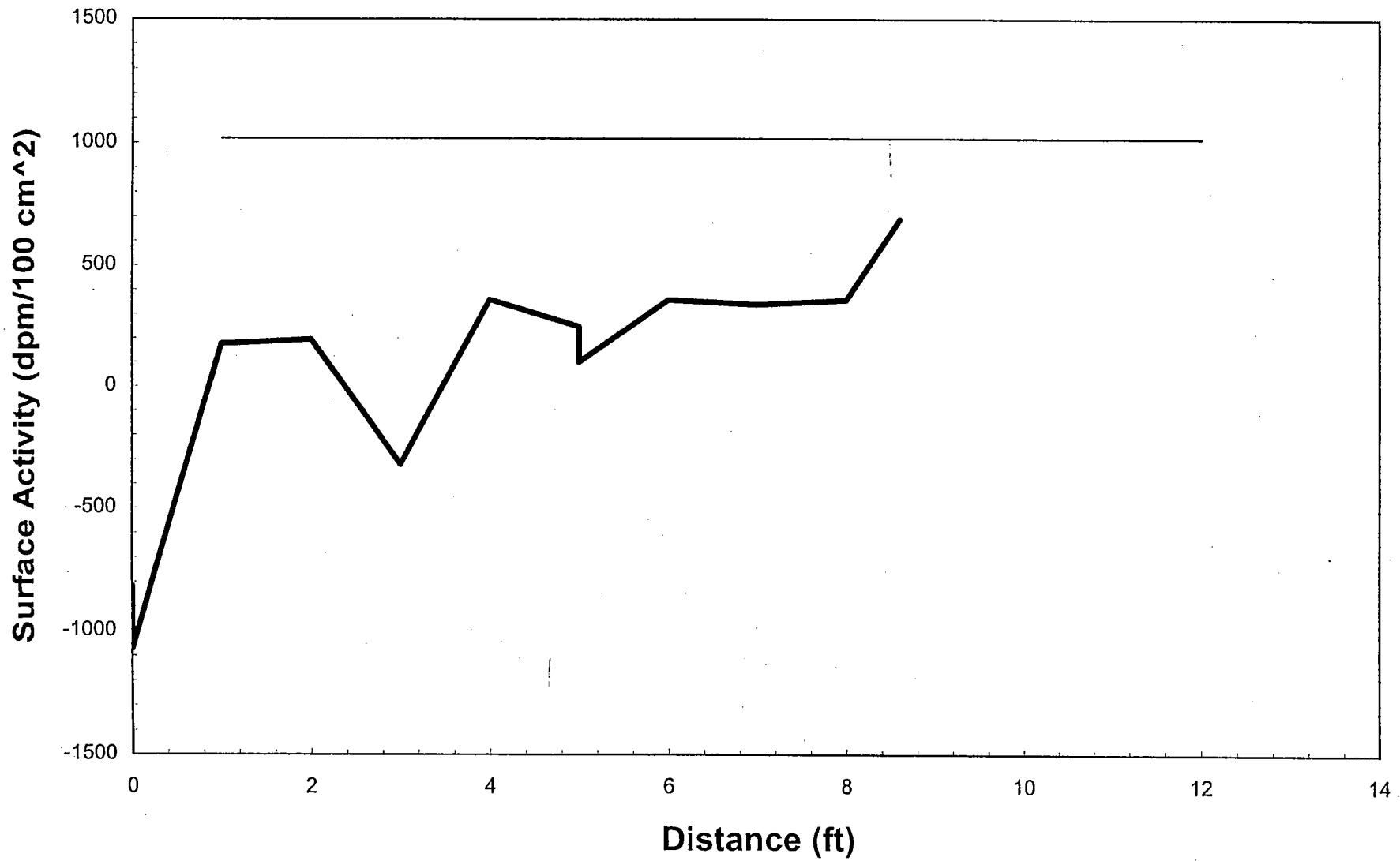
Background (cps): 68.7

MDA (dpm/100cm²): 921

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
-1	4441	74.02	976
0	5221	87.02	3361
0	5036	83.93	2795
1	5307	88.45	3624
2	5502	91.70	4220
3	5493	91.55	4193
4	5681	94.68	4768
5	5587	93.12	4480
6	5501	91.68	4217
7	5482	91.37	4159
8	5684	94.73	4777
9	5593	93.22	4498
10	5689	94.82	4792
11	5709	95.15	4853
12	5733	95.55	4927
13	5449	90.82	4058
14	5335	88.92	3709
15	5329	88.82	3691
15	5272	87.87	3517
16	5314	88.57	3645
17	5423	90.38	3979
18	5729	95.48	4914
19	5566	92.77	4416
20	5639	93.98	4639
21	5355	89.25	3771
22	5355	89.25	3771
23	5425	90.42	3985
24	5366	89.43	3804
25	5524	92.07	4287
26	5430	90.50	4000
27	5574	92.90	4440
28	5538	92.30	4330

29	5673	94.55	4743
30	5603	93.38	4529
30	5717	95.28	4878
31	5568	92.80	4422
32	5863	97.72	5324
33	5545	92.42	4352
34	5510	91.83	4245
35	5495	91.58	4199
36	5577	92.95	4450
37	5484	91.40	4165
38	5252	87.53	3456
39	5417	90.28	3960
40	5321	88.68	3667
41	5439	90.65	4028
42	5453	90.88	4070
43	5313	88.55	3642
44	5254	87.57	3462
45	5419	90.32	3966
45	5219	86.98	3355
46	5376	89.60	3835
47	5416	90.27	3957
48	5279	87.98	3538
49	5286	88.10	3560
50	5188	86.47	3260
51	5294	88.23	3584
52	5416	90.27	3957
53	5435	90.58	4015
54	5449	90.82	4058
55	5470	91.17	4122
56	5321	88.68	3667
57	5293	88.22	3581
58	5514	91.90	4257
59	5643	94.05	4651
60	5561	92.68	4401
61	5561	92.68	4401

West Jefferson R #JN1-SSD6-A175-8
Manhole #9



Pipe Explorer™

01/19/2000

Building: JN-1

Run Description: Manhole #9

Run ID: JN1-SSD6-A175-8

Pipe Type: VTP 6"

Detector: LND 4 element S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

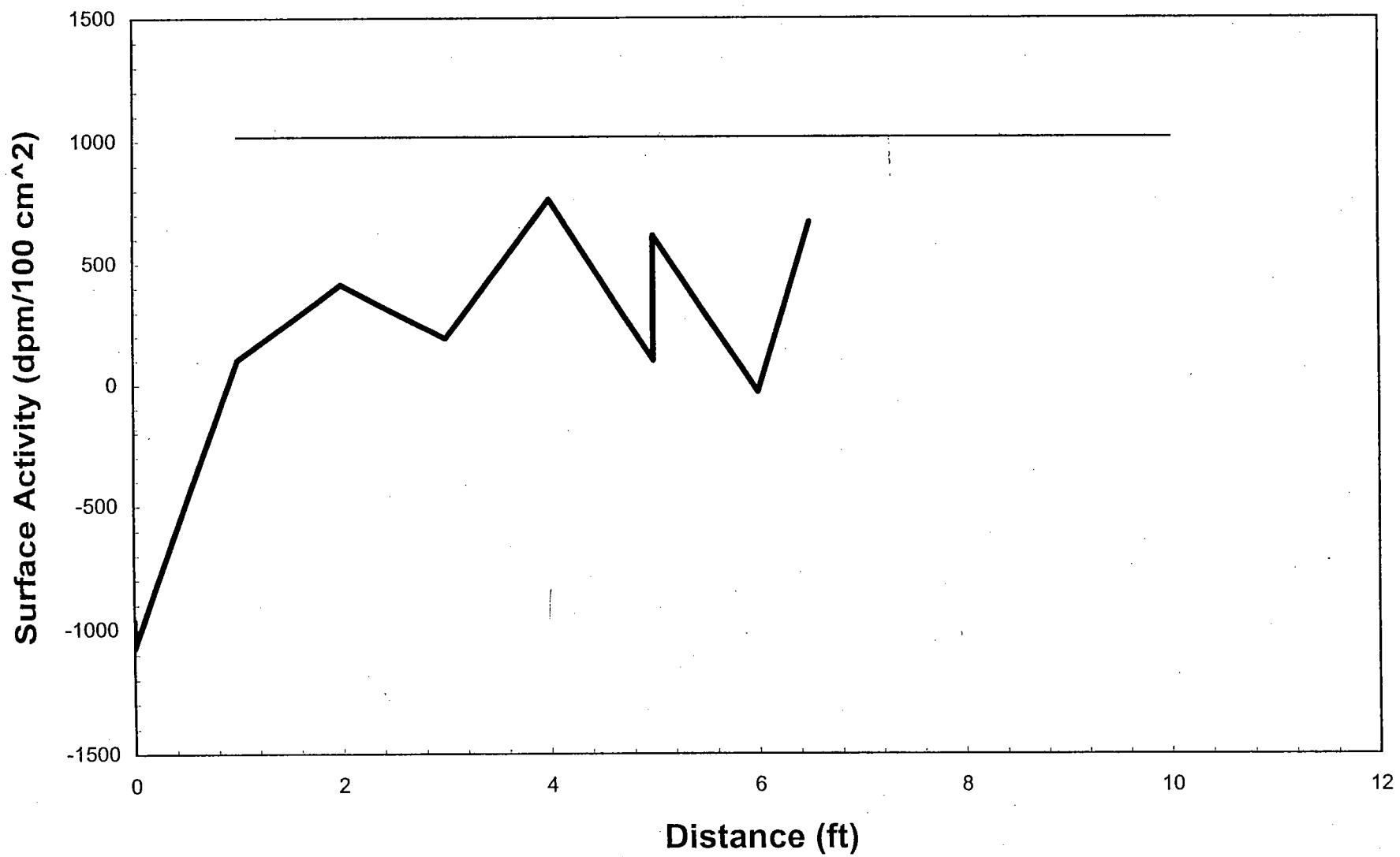
Count Time (s): 60.0

Background (cps): 2.14

MDA (dpm/100cm²): 1018

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	84	1.40	-816
0	70	1.17	-1073
1	138	2.30	176
2	139	2.32	195
3	111	1.85	-320
4	148	2.47	360
5	142	2.37	250
5	134	2.23	103
6	148	2.47	360
7	147	2.45	342
8	148	2.47	360
8.6	166	2.77	691

West Jefferson R #JN1-SSD6-A185-9
Manhole #9



Pipe Explorer™

01/19/2000

Building: JN-1

Run Description: Manhole #9

Run ID: JN1-SSD6-A185-9

Pipe Type: VTP 6"

Detector: LND 4 element S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

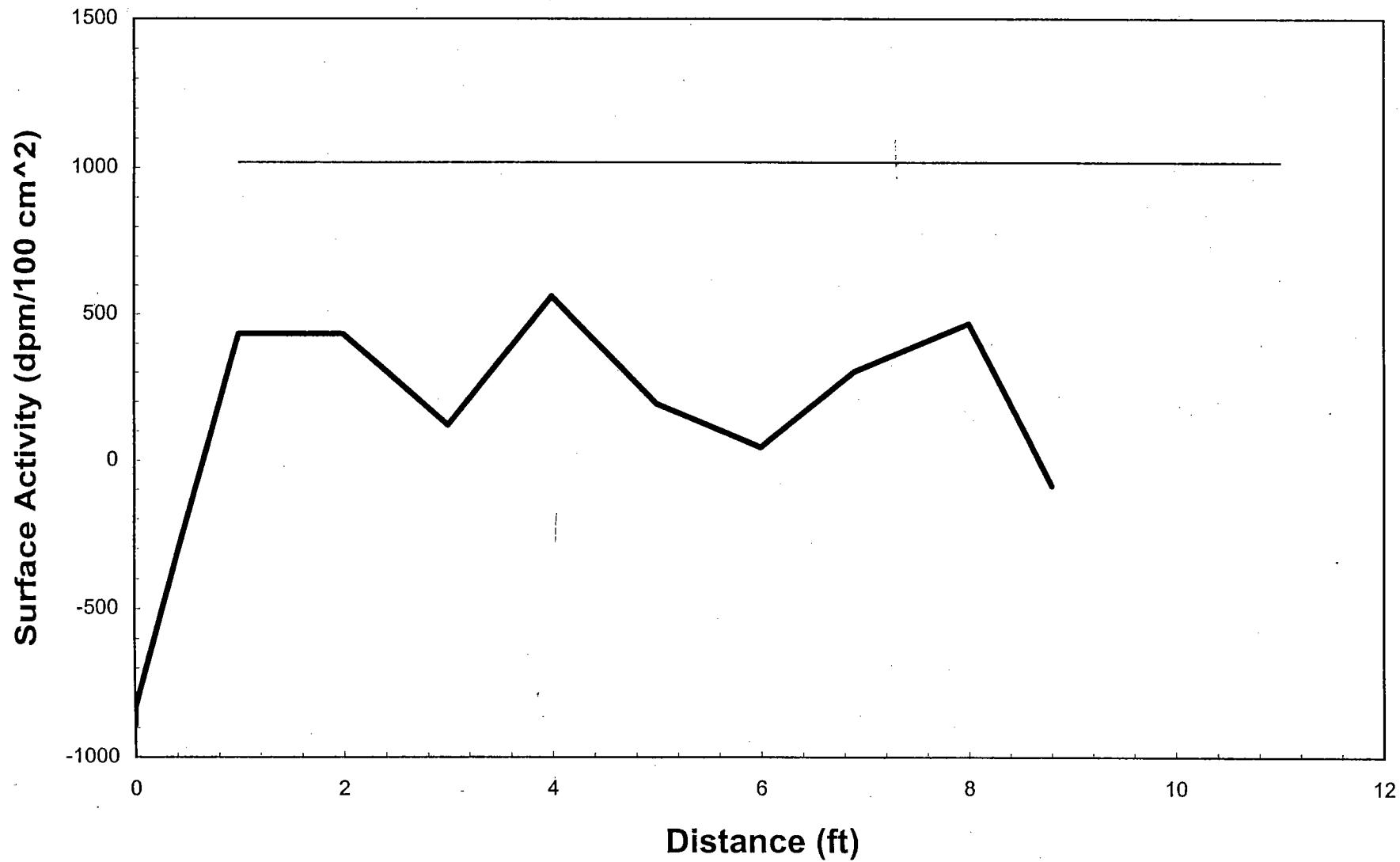
Count Time (s): 60.0

Background (cps): 2.14

MDA (dpm/100cm²): 1018

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	76	1.27	-963
0	70	1.17	-1073
1	134	2.23	103
2	151	2.52	415
3	139	2.32	195
4	170	2.83	764
5	134	2.23	103
5	162	2.70	617
6	127	2.12	-26
6.5	165	2.75	673

West Jefferson East of JN1 R #JN1-SSD4-A210-10
Manhole #9



Pipe Explorer™

01/20/2000

Building: JN-1

Run Description: Manhole #9

Run ID: JN1-SSD4-A210-10

Pipe Type: VTP 4"

Detector: LND 4 element S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

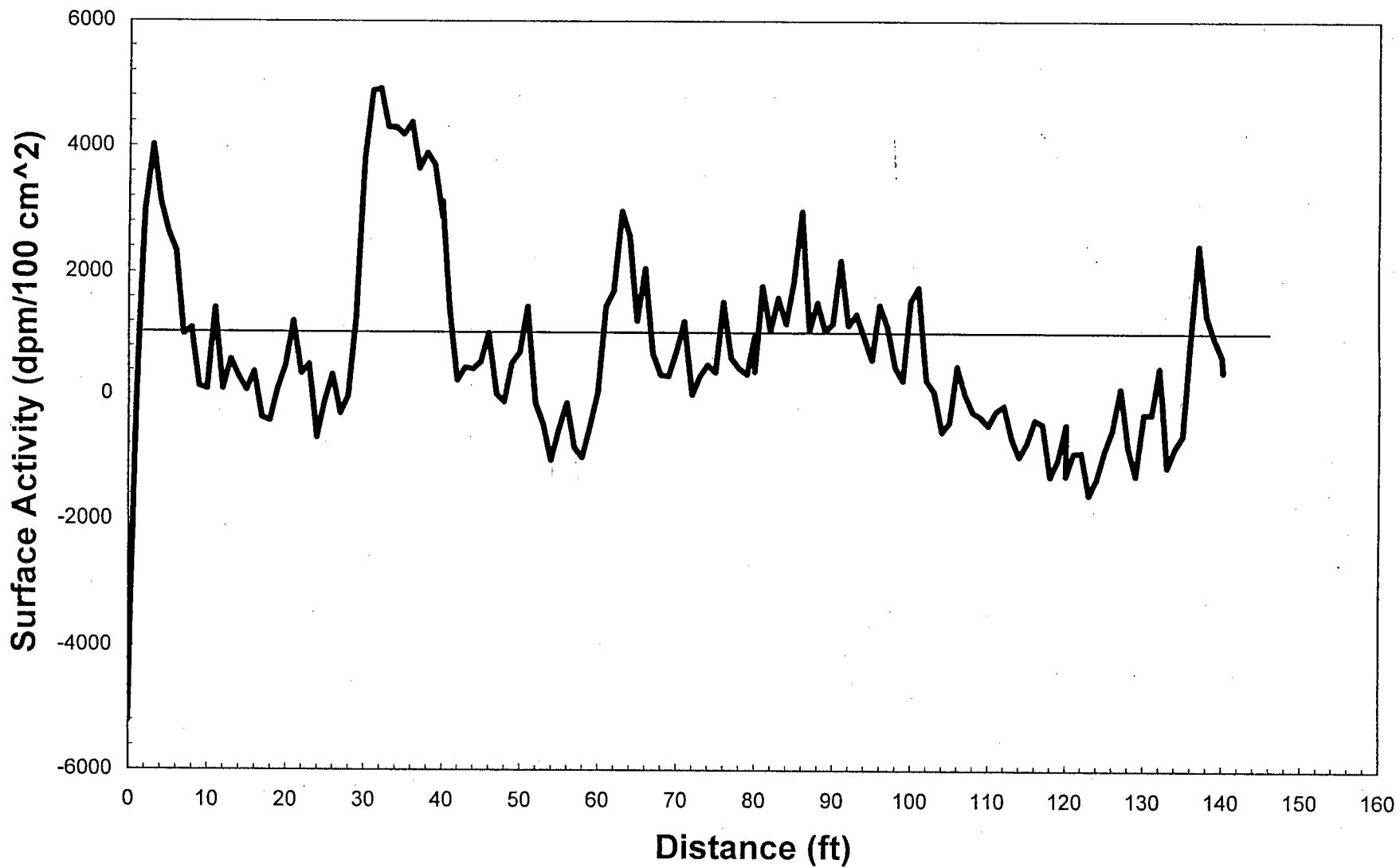
Count Time (s): 60.0

Background (cps): 2.14

MDA (dpm/100cm²): 1018

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	80	1.33	-889
0	83	1.38	-834
1	152	2.53	434
2	152	2.53	434
3	135	2.25	121
4	159	2.65	562
5	139	2.32	195
6	131	2.18	48
6.9	145	2.42	305
8	154	2.57	470
8.8	124	2.07	-81

West Jefferson R #JN3-PSD8-A65-11
Manhole #3



Pipe Explorer™

01/25/2000

Building: JN-3

Run Description: Manhole #3

Run ID: JN3-PSD8-A65-11

Pipe Type: 8" VTP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

Background (cps): 86.8

MDA (dpm/100cm²): 1035

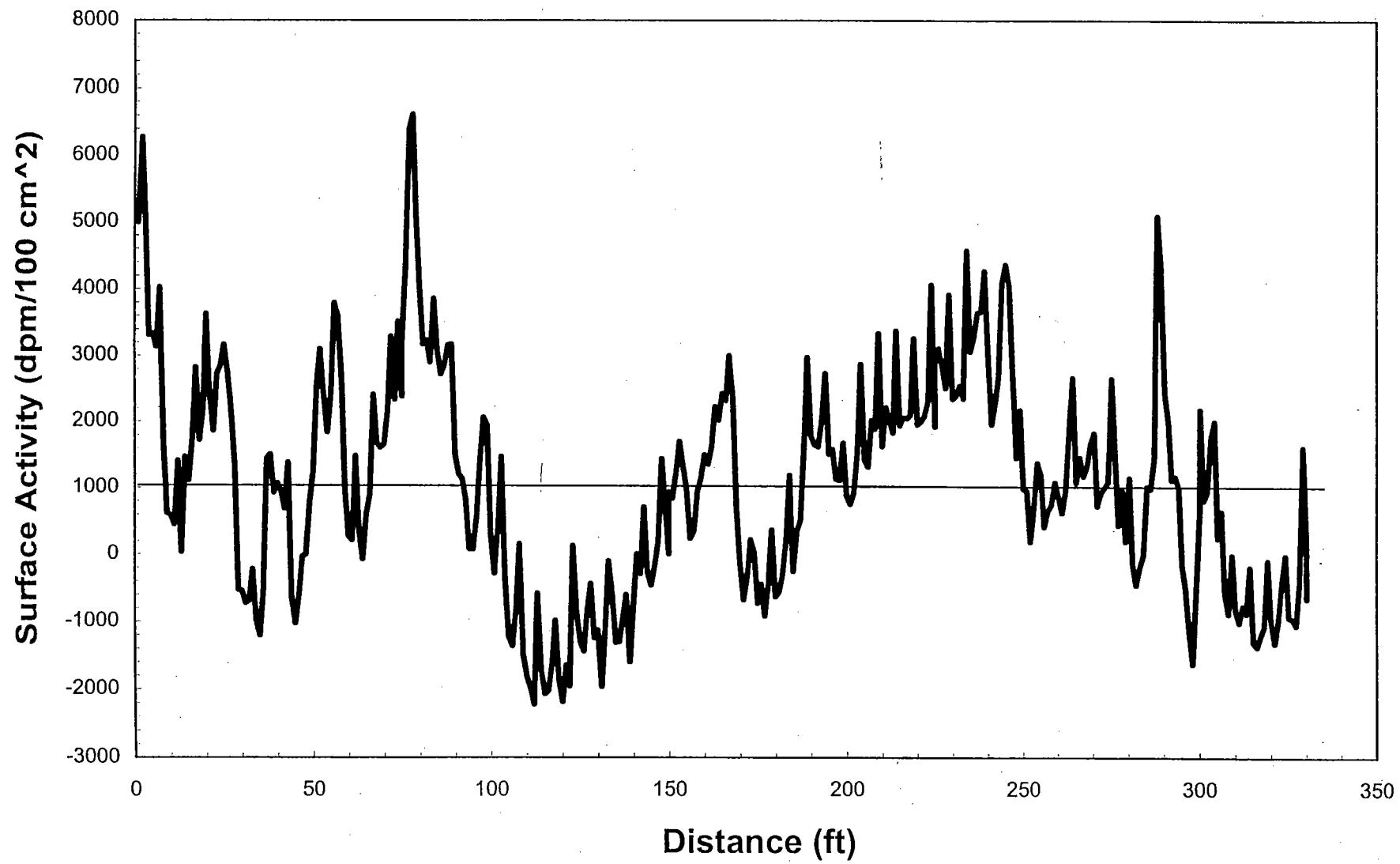
Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	4508	75.13	-2141
0	3505	58.42	-5208
1	5161	86.02	-144
2	6187	103.12	2994
3	6520	108.67	4012
4	6225	103.75	3110
5	6072	101.20	2642
6	5969	99.48	2327
7	5535	92.25	1000
8	5567	92.78	1098
9	5251	87.52	131
10	5236	87.27	86
11	5673	94.55	1422
12	5237	87.28	89
13	5397	89.95	578
14	5306	88.43	300
15	5230	87.17	67
16	5330	88.83	373
17	5083	84.72	-382
18	5067	84.45	-431
19	5239	87.32	95
20	5365	89.42	480
21	5604	93.40	1211
22	5323	88.72	352
23	5371	89.52	498
24	4980	83.00	-697
25	5171	86.18	-113
26	5316	88.60	330
27	5106	85.10	-312
28	5197	86.62	-34
29	5624	93.73	1272
30	6447	107.45	3789
31	6803	113.38	4878
32	6814	113.57	4911
33	6614	110.23	4300

34	6612	110.20	4294
35	6575	109.58	4180
36	6638	110.63	4373
37	6401	106.68	3648
38	6480	108.00	3890
39	6418	106.97	3700
40	6146	102.43	2869
40	6230	103.83	3125
41	5665	94.42	1398
42	5285	88.08	235
43	5354	89.23	446
44	5348	89.13	428
45	5386	89.77	544
46	5543	92.38	1024
47	5211	86.85	9
48	5169	86.15	-119
49	5380	89.67	526
50	5439	90.65	706
51	5683	94.72	1453
52	5161	86.02	-144
53	5053	84.22	-474
54	4864	81.07	-1052
55	5022	83.70	-569
56	5161	86.02	-144
57	4929	82.15	-853
58	4877	81.28	-1012
59	5042	84.03	-508
60	5223	87.05	46
61	5686	94.77	1462
62	5765	96.08	1703
63	6178	102.97	2966
64	6050	100.83	2575
65	5608	93.47	1223
66	5882	98.03	2061
67	5436	90.60	697
68	5317	88.62	333
69	5311	88.52	315
70	5443	90.72	719
71	5604	93.40	1211
72	5209	86.82	3
73	5311	88.52	315
74	5370	89.50	495
75	5332	88.87	379
76	5706	95.10	1523
77	5408	90.13	612
78	5353	89.22	443
79	5321	88.68	346
80	5528	92.13	979
80	5336	88.93	391
81	5791	96.52	1783
82	5554	92.57	1058
83	5731	95.52	1599

84	5595	93.25	1183
85	5815	96.92	1856
86	6178	102.97	2966
87	5558	92.63	1070
88	5705	95.08	1520
89	5557	92.62	1067
90	5594	93.23	1180
91	5925	98.75	2193
92	5585	93.08	1153
93	5644	94.07	1333
94	5526	92.10	972
95	5401	90.02	590
96	5693	94.88	1483
97	5581	93.02	1141
98	5362	89.37	471
99	5289	88.15	248
100	5716	95.27	1554
101	5785	96.42	1765
102	5293	88.22	260
103	5231	87.18	70
104	5016	83.60	-587
105	5067	84.45	-431
106	5365	89.42	480
107	5213	86.88	15
108	5119	85.32	-272
109	5092	84.87	-355
110	5049	84.15	-486
111	5126	85.43	-251
112	5155	85.92	-162
113	4990	83.17	-667
114	4890	81.50	-972
115	4960	82.67	-758
116	5078	84.63	-398
117	5056	84.27	-465
118	4785	79.75	-1294
119	4873	81.22	-1024
120	5054	84.23	-471
120	4790	79.83	-1278
121	4907	81.78	-920
122	4911	81.85	-908
123	4691	78.18	-1581
124	4773	79.55	-1330
125	4923	82.05	-872
126	5031	83.85	-541
127	5248	87.47	122
128	4939	82.32	-823
129	4791	79.85	-1275
130	5109	85.15	-303
131	5108	85.13	-306
132	5358	89.30	459
133	4835	80.58	-1141
134	4937	82.28	-829

135	5001	83.35	-633
136	5533	92.22	994
137	6004	100.07	2434
138	5640	94.00	1321
139	5516	91.93	942
140	5420	90.33	648
140.1	5338	88.97	398

West Jefferson R #JN3-PSD8-A255-12
Manhole #3



Pipe Explorer™

01/26/2000

Building: JN-3

Run Description: Manhole #3

Run ID: JN3-PSD8-A255-12

Pipe Type: 8" VTP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

Background (cps): 86.8

MDA (dpm/100cm²): 1035

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
1	6842	114.03	4997
2	7260	121.00	6275
3	6861	114.35	5055
4	6292	104.87	3315
5	6300	105.00	3339
6	6234	103.90	3138
7	6524	108.73	4024
8	5765	96.08	1703
9	5412	90.20	624
10	5401	90.02	590
11	5356	89.27	453
12	5671	94.52	1416
13	5221	87.02	40
14	5691	94.85	1477
15	5572	92.87	1113
16	5778	96.30	1743
17	6132	102.20	2826
18	5775	96.25	1734
19	5921	98.68	2180
20	6395	106.58	3630
21	5979	99.65	2358
22	5821	97.02	1875
23	6100	101.67	2728
24	6142	102.37	2856
25	6243	104.05	3165
26	6107	101.78	2749
27	5910	98.50	2147
28	5658	94.30	1376
29	5036	83.93	-526
30	5030	83.83	-544
31	4972	82.87	-722
32	4982	83.03	-691

33	5136	85.60	-220
34	4885	81.42	-988
35	4816	80.27	-1199
36	5036	83.93	-526
37	5683	94.72	1453
38	5703	95.05	1514
39	5513	91.88	933
40	5558	92.63	1070
41	5519	91.98	951
42	5435	90.58	694
43	5661	94.35	1385
44	4990	83.17	-667
45	4873	81.22	-1024
46	5009	83.48	-609
47	5197	86.62	-34
48	5209	86.82	3
49	5458	90.97	765
50	5613	93.55	1239
51	6044	100.73	2557
52	6222	103.70	3101
53	5986	99.77	2379
54	5814	96.90	1853
55	6006	100.10	2440
56	6449	107.48	3795
57	6388	106.47	3609
58	6088	101.47	2691
59	5539	92.32	1012
60	5299	88.32	278
61	5280	88.00	220
62	5696	94.93	1492
63	5320	88.67	343
64	5186	86.43	-67
65	5408	90.13	612
66	5501	91.68	896
67	5997	99.95	2413
68	5759	95.98	1685
69	5738	95.63	1621
70	5757	95.95	1679
71	5917	98.62	2168
72	6285	104.75	3294
73	5972	99.53	2336
74	6360	106.00	3523
75	5988	99.80	2385
75	6261	104.35	3220
76	6603	110.05	4266
77	7306	121.77	6416
78	7371	122.85	6615
79	6864	114.40	5064
80	6534	108.90	4055

81	6246	104.10	3174
82	6268	104.47	3242
83	6160	102.67	2911
84	6471	107.85	3862
85	6220	103.67	3095
86	6101	101.68	2731
87	6143	102.38	2859
88	6241	104.02	3159
89	6246	104.10	3174
90	5703	95.05	1514
91	5606	93.43	1217
92	5581	93.02	1141
93	5477	91.28	823
94	5237	87.28	89
95	5236	87.27	86
96	5399	89.98	584
97	5681	94.68	1446
98	5883	98.05	2064
99	5849	97.48	1960
100	5310	88.50	312
101	5117	85.28	-278
102	5336	88.93	391
103	5694	94.90	1486
104	5100	85.00	-330
105	4809	80.15	-1220
106	4765	79.42	-1355
107	4937	82.28	-829
108	5261	87.68	162
109	4725	78.75	-1477
110	4619	76.98	-1801
111	4559	75.98	-1985
112	4483	74.72	-2217
113	5018	83.63	-581
114	4650	77.50	-1706
115	4532	75.53	-2067
116	4549	75.82	-2015
117	4669	77.82	-1648
118	4886	81.43	-985
119	4597	76.62	-1869
120	4495	74.92	-2180
121	4670	77.83	-1645
122	4571	76.18	-1948
123	5253	87.55	138
124	4931	82.18	-847
125	4783	79.72	-1300
126	4738	78.97	-1437
127	4936	82.27	-832
128	5066	84.43	-434
129	4802	80.03	-1242

130	4839	80.65	-1128
131	4568	76.13	-1957
132	4837	80.62	-1135
133	5177	86.28	-95
134	5015	83.58	-590
135	4781	79.68	-1306
136	4785	79.75	-1294
137	4897	81.62	-951
138	5012	83.53	-599
139	4687	78.12	-1593
140	4963	82.72	-749
141	5212	86.87	12
142	5115	85.25	-284
143	5443	90.72	719
144	5118	85.30	-275
145	5060	84.33	-453
146	5156	85.93	-159
147	5273	87.88	199
148	5684	94.73	1456
149	5443	90.72	719
150	5213	86.88	15
150	5518	91.97	948
151	5487	91.45	853
152	5610	93.50	1229
153	5769	96.15	1716
154	5642	94.03	1327
155	5523	92.05	963
156	5291	88.18	254
157	5324	88.73	355
158	5520	92.00	954
159	5587	93.12	1159
160	5703	95.05	1514
161	5657	94.28	1373
162	5743	95.72	1636
163	5939	98.98	2235
164	5873	97.88	2034
165	6005	100.08	2437
166	5969	99.48	2327
167	6191	103.18	3006
168	5987	99.78	2382
169	5449	90.82	737
170	5174	86.23	-104
171	4989	83.15	-670
172	5095	84.92	-346
173	5283	88.05	229
174	5221	87.02	40
175	4972	82.87	-722
176	5066	84.43	-434
177	4911	81.85	-908

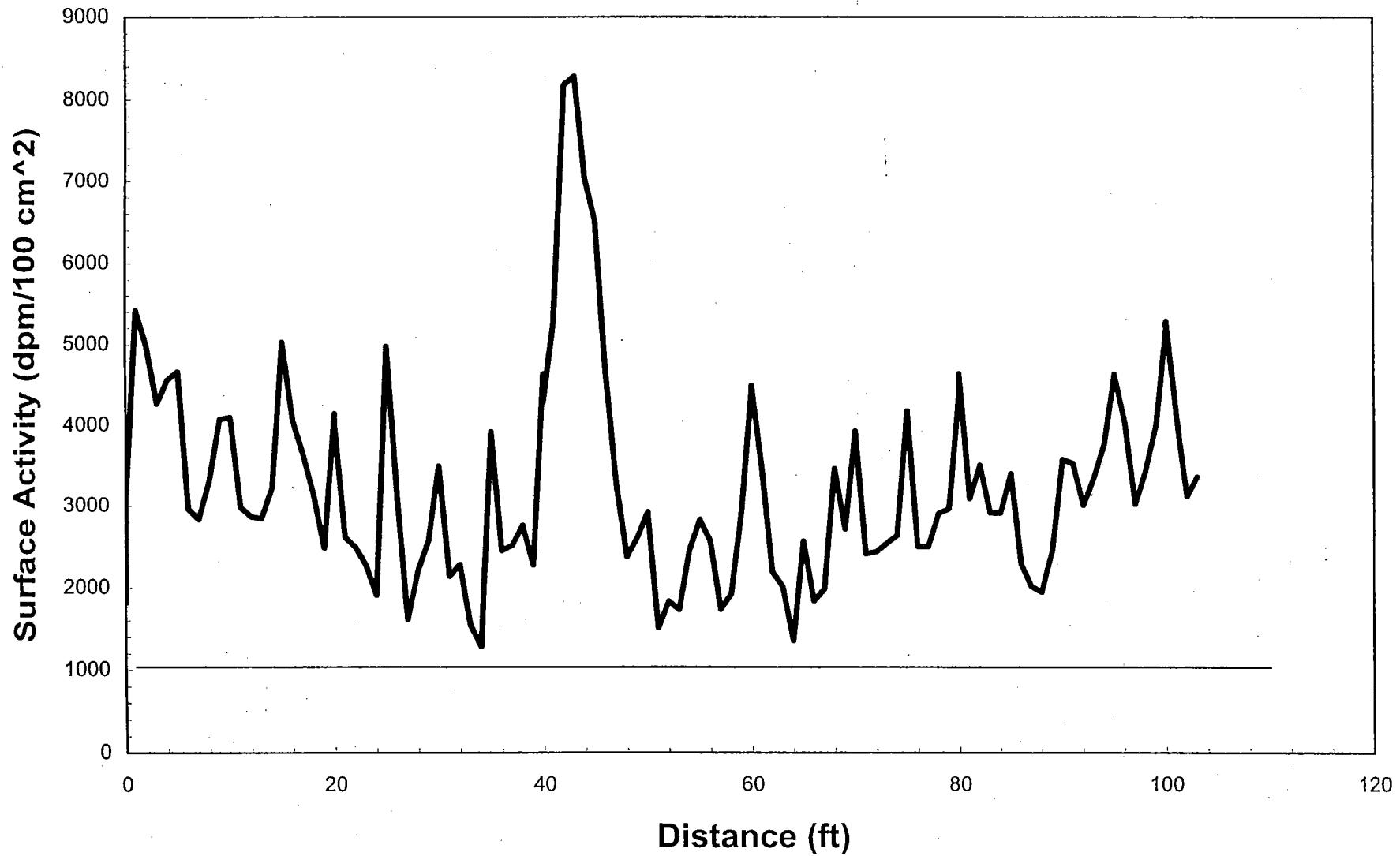
178	5057	84.28	-462
179	5331	88.85	376
180	5004	83.40	-624
181	5026	83.77	-557
182	5110	85.17	-300
183	5276	87.93	208
184	5601	93.35	1202
185	5128	85.47	-245
186	5326	88.77	361
187	5378	89.63	520
188	5730	95.50	1596
189	6184	103.07	2985
190	5796	96.60	1798
191	5756	95.93	1676
192	5746	95.77	1645
193	5876	97.93	2043
194	6106	101.77	2746
195	5710	95.17	1535
196	5733	95.55	1606
197	5584	93.07	1150
198	5577	92.95	1128
199	5763	96.05	1697
200	5500	91.67	893
201	5461	91.02	774
202	5514	91.90	936
203	5717	95.28	1557
204	6150	102.50	2881
205	5680	94.67	1443
206	5646	94.10	1339
207	5874	97.90	2037
208	5833	97.22	1911
209	6302	105.03	3346
210	5749	95.82	1654
211	5937	98.95	2229
212	5873	97.88	2034
213	5815	96.92	1856
214	6315	105.25	3385
215	5850	97.50	1963
216	5886	98.10	2073
217	5883	98.05	2064
218	5898	98.30	2110
219	6277	104.62	3269
220	5855	97.58	1979
221	5869	97.82	2021
222	5896	98.27	2104
223	5969	99.48	2327
224	6538	108.97	4067
225	5845	97.42	1948
225	6158	102.63	2905

226	6229	103.82	3122
227	6146	102.43	2869
228	6034	100.57	2526
229	6492	108.20	3927
230	5980	99.67	2361
231	5997	99.95	2413
232	6047	100.78	2566
233	5982	99.70	2367
234	6705	111.75	4578
235	6214	103.57	3076
236	6284	104.73	3291
237	6406	106.77	3664
238	6409	106.82	3673
239	6606	110.10	4275
240	6221	103.68	3098
241	5856	97.60	1982
242	5958	99.30	2294
243	6097	101.62	2719
244	6553	109.22	4113
245	6637	110.62	4370
246	6537	108.95	4064
247	6099	101.65	2725
248	5692	94.87	1480
249	5925	98.75	2193
250	5537	92.28	1006
251	5525	92.08	969
252	5276	87.93	208
253	5429	90.48	676
254	5667	94.45	1404
255	5607	93.45	1220
256	5350	89.17	434
257	5428	90.47	673
258	5456	90.93	758
259	5568	92.80	1101
260	5497	91.62	884
261	5418	90.30	642
262	5527	92.12	976
263	5847	97.45	1954
264	6086	101.43	2685
265	5568	92.80	1101
266	5694	94.90	1486
267	5600	93.33	1199
268	5645	94.08	1336
269	5761	96.02	1691
270	5813	96.88	1850
271	5455	90.92	755
272	5516	91.93	942
273	5542	92.37	1021
274	5571	92.85	1110

275	6083	101.38	2676
276	5683	94.72	1453
277	5357	89.28	456
278	5532	92.20	991
279	5278	87.97	214
280	5592	93.20	1174
281	5166	86.10	-128
282	5062	84.37	-446
283	5151	85.85	-174
284	5208	86.80	0
285	5548	92.47	1040
286	5537	92.28	1006
287	5694	94.90	1486
288	6873	114.55	5092
289	6626	110.43	4336
290	6004	100.07	2434
291	5857	97.62	1985
292	5581	93.02	1141
293	5599	93.32	1196
294	5538	92.30	1009
295	5159	85.98	-150
296	5038	83.97	-520
297	4833	80.55	-1147
298	4679	77.98	-1618
299	5055	84.25	-468
300	5453	90.88	749
300	5928	98.80	2202
301	5482	91.37	838
302	5522	92.03	960
303	5795	96.58	1795
304	5869	97.82	2021
305	5295	88.25	266
306	5427	90.45	670
307	5023	83.72	-566
308	4923	82.05	-872
309	5209	86.82	3
310	4936	82.27	-832
311	4880	81.33	-1003
312	4960	82.67	-758
313	4923	82.05	-872
314	5149	85.82	-180
315	4785	79.75	-1294
316	4763	79.38	-1361
317	4816	80.27	-1199
318	4856	80.93	-1076
319	5183	86.38	-76
320	4883	81.38	-994
321	4780	79.67	-1309
322	4886	81.43	-985

323	5076	84.60	-404
324	5206	86.77	-6
325	4905	81.75	-927
326	4897	81.62	-951
327	4866	81.10	-1046
328	5069	84.48	-425
329	5745	95.75	1642
330	5287	88.12	242
330.1	4998	83.30	-642

West Jefferson R #JN3-PSD8-A45-13B
Manhole #10



Pipe Explorer™

01/27/2000

Building: JN-3

Run Description: Manhole #10

Run ID: JN2-PSD8-A45-13B

Pipe Type: 8" VCP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

Background (cps): 86.8

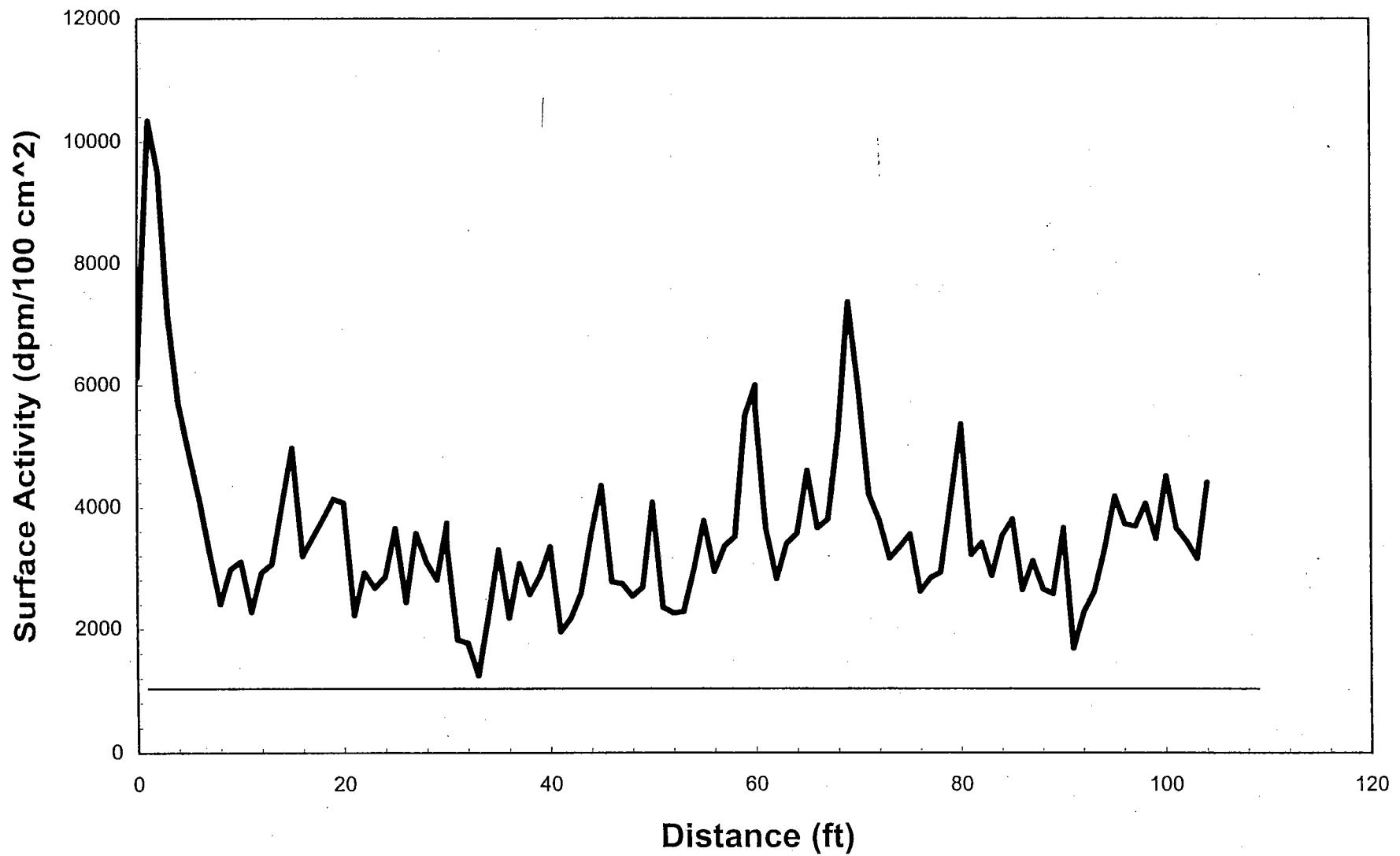
MDA (dpm/100cm²): 1035

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	5803	96.72	1820
0	6229	103.82	3122
1	6979	116.32	5416
2	6839	113.98	4988
3	6604	110.07	4269
4	6700	111.67	4563
5	6733	112.22	4664
6	6177	102.95	2963
7	6137	102.28	2841
8	6293	104.88	3318
9	6541	109.02	4076
10	6549	109.15	4101
11	6184	103.07	2985
12	6147	102.45	2872
13	6140	102.33	2850
14	6264	104.40	3229
15	6853	114.22	5031
16	6536	108.93	4061
17	6400	106.67	3645
18	6236	103.93	3144
19	6022	100.37	2489
20	6564	109.40	4147
20	6528	108.80	4037
21	6065	101.08	2621
22	6025	100.42	2498
23	5953	99.22	2278
24	5836	97.27	1920
25	6837	113.95	4982
26	6232	103.87	3131
27	5738	95.63	1621
28	5930	98.83	2208
29	6051	100.85	2578

30	6355	105.92	3508
31	5910	98.50	2147
32	5956	99.27	2287
33	5714	95.23	1547
34	5629	93.82	1287
35	6493	108.22	3930
36	6012	100.20	2459
37	6033	100.55	2523
38	6114	101.90	2771
39	5955	99.25	2284
40	6726	112.10	4642
40	6613	110.22	4297
41	6933	115.55	5275
42	7881	131.35	8174
43	7915	131.92	8278
44	7509	125.15	7037
45	7337	122.28	6511
46	6728	112.13	4648
47	6283	104.72	3287
48	5988	99.80	2385
49	6065	101.08	2621
50	6168	102.80	2936
51	5705	95.08	1520
52	5811	96.85	1844
53	5777	96.28	1740
54	6014	100.23	2465
55	6137	102.28	2841
56	6053	100.88	2584
57	5779	96.32	1746
58	5841	97.35	1936
59	6168	102.80	2936
60	6663	111.05	4450
60	6679	111.32	4498
61	6351	105.85	3495
62	5928	98.80	2202
63	5869	97.82	2021
64	5654	94.23	1364
65	6051	100.85	2578
66	5814	96.90	1853
67	5861	97.68	1997
68	6347	105.78	3483
69	6102	101.70	2734
70	6497	108.28	3942
71	6001	100.02	2425
72	6009	100.15	2450
73	6042	100.70	2550
74	6075	101.25	2651
75	6578	109.63	4190
76	6031	100.52	2517

77	6030	100.50	2514
78	6163	102.72	2920
79	6183	103.05	2982
80	6651	110.85	4413
80	6728	112.13	4648
81	6226	103.77	3113
82	6361	106.02	3526
83	6167	102.78	2933
84	6166	102.77	2930
85	6327	105.45	3422
86	5961	99.35	2303
87	5872	97.87	2031
88	5850	97.50	1963
89	6012	100.20	2459
90	6385	106.42	3599
91	6369	106.15	3550
92	6199	103.32	3031
93	6310	105.17	3370
94	6445	107.42	3783
95	6728	112.13	4648
96	6531	108.85	4046
97	6203	103.38	3043
98	6340	105.67	3462
99	6521	108.68	4015
100	6913	115.22	5214
100	6940	115.67	5297
101	6550	109.17	4104
102	6236	103.93	3144
102.94	6315	105.25	3385

West Jefferson R #JN3-PSD6-A225-14
Manhole #10



Pipe Explorer™

01/31/2000

Building: JN-3

Run Description: Manhole #10

Run ID: JN2-PSD6-A225-14

Pipe Type: 6" VCP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

Background (cps): 86.80

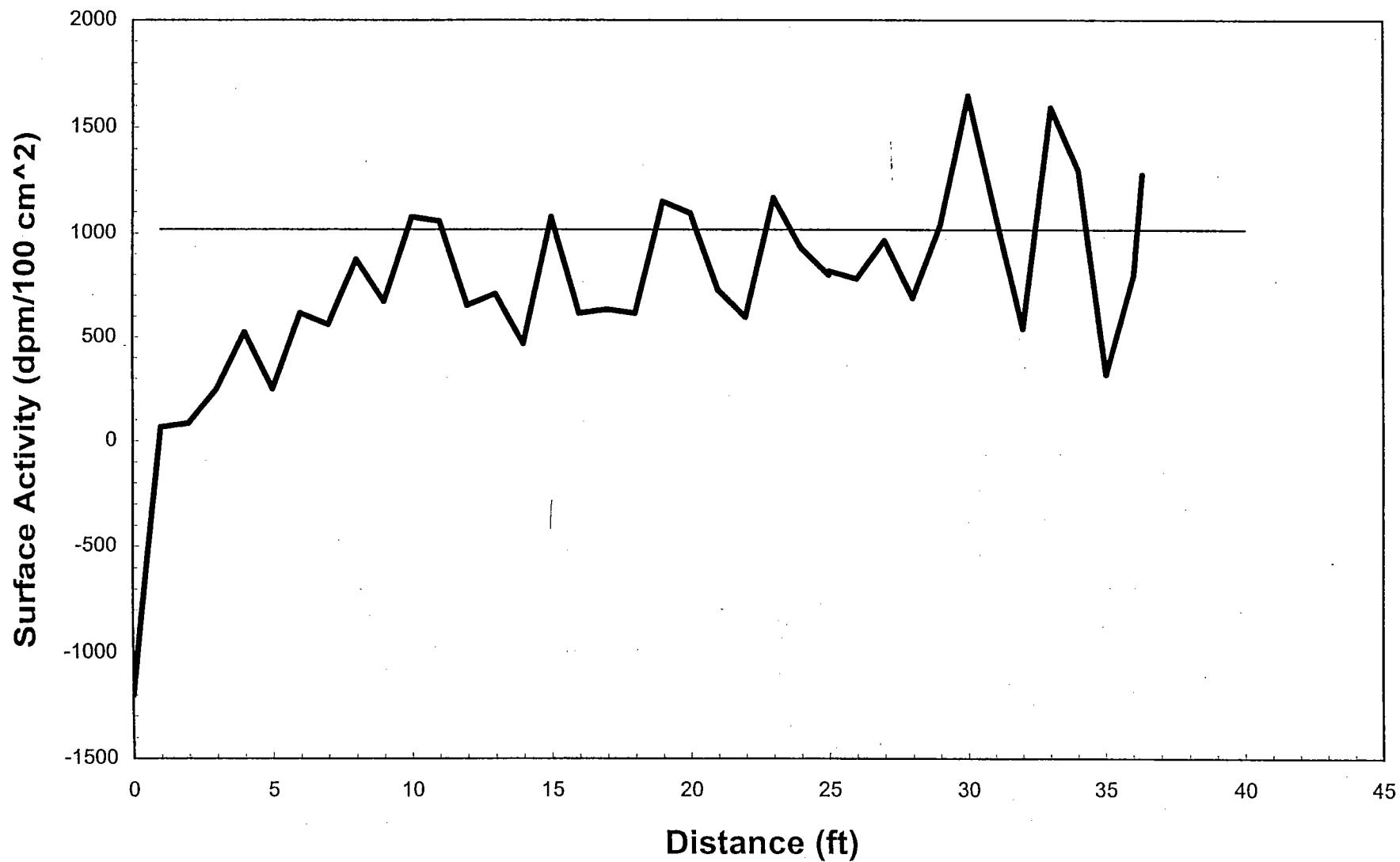
MDA (dpm/100cm²): 1035

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	7286	121.43	6355
0	7209	120.15	6119
1	8589	143.15	10339
2	8311	138.52	9489
3	7546	125.77	7150
4	7076	117.93	5713
5	6809	113.48	4896
6	6561	109.35	4138
7	6267	104.45	3239
8	5996	99.93	2410
9	6182	103.03	2979
10	6224	103.73	3107
11	5955	99.25	2284
12	6165	102.75	2927
13	6211	103.52	3067
14	6533	108.88	4052
15	6835	113.92	4976
16	6254	104.23	3199
17	6354	105.90	3505
18	6456	107.60	3817
19	6562	109.37	4141
20	6542	109.03	4080
21	5936	98.93	2226
22	6165	102.75	2927
23	6082	101.37	2673
24	6142	102.37	2856
25	6403	106.72	3654
26	6007	100.12	2443
27	6378	106.30	3578
28	6221	103.68	3098
29	6127	102.12	2810
30	6434	107.23	3749

30	6310	105.17	3370
31	5806	96.77	1829
32	5787	96.45	1771
33	5617	93.62	1251
34	5939	98.98	2235
35	6288	104.80	3303
36	5923	98.72	2187
37	6214	103.57	3076
38	6049	100.82	2572
39	6147	102.45	2872
40	6304	105.07	3352
41	5849	97.48	1960
42	5923	98.72	2187
43	6055	100.92	2590
44	6375	106.25	3569
45	6636	110.60	4367
46	6116	101.93	2777
47	6106	101.77	2746
48	6040	100.67	2544
49	6087	101.45	2688
50	6544	109.07	4086
51	5981	99.68	2364
52	5950	99.17	2269
53	5958	99.30	2294
54	6185	103.08	2988
55	6447	107.45	3789
56	6172	102.87	2948
57	6310	105.17	3370
58	6360	106.00	3523
59	7011	116.85	5514
60	7174	119.57	6012
60	7041	117.35	5606
61	6405	106.75	3661
62	6133	102.22	2829
63	6322	105.37	3407
64	6377	106.28	3575
65	6716	111.93	4612
66	6409	106.82	3673
67	6456	107.60	3817
68	6911	115.18	5208
69	7618	126.97	7370
70	7148	119.13	5933
71	6590	109.83	4226
72	6450	107.50	3798
73	6245	104.08	3171
74	6305	105.08	3355
75	6376	106.27	3572
76	6066	101.10	2624
77	6139	102.32	2847

78	6170	102.83	2942
79	6562	109.37	4141
80	6966	116.10	5376
81	6266	104.43	3235
82	6328	105.47	3425
83	6152	102.53	2887
84	6368	106.13	3547
85	6457	107.62	3820
86	6076	101.27	2654
87	6232	103.87	3131
88	6080	101.33	2667
89	6054	100.90	2587
90	6412	106.87	3682
90	6388	106.47	3609
91	5763	96.05	1697
92	5959	99.32	2297
93	6067	101.12	2627
94	6293	104.88	3318
95	6582	109.70	4202
96	6433	107.22	3746
97	6421	107.02	3709
98	6543	109.05	4083
99	6352	105.87	3498
100	6691	111.52	4535
101	6410	106.83	3676
102	6338	105.63	3456
103	6246	104.10	3174
104	6656	110.93	4428

West Jefferson R #JN3-SSD4-A130-15
Sump #1



Pipe Explorer™

02/01/2000

Building: JN-3

Run Description: Sump #1

Run ID: JN3-SSD4-A130-15

Pipe Type: 4" VTP

Detector: LND 4 Element S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

Count Time (s): 60.0

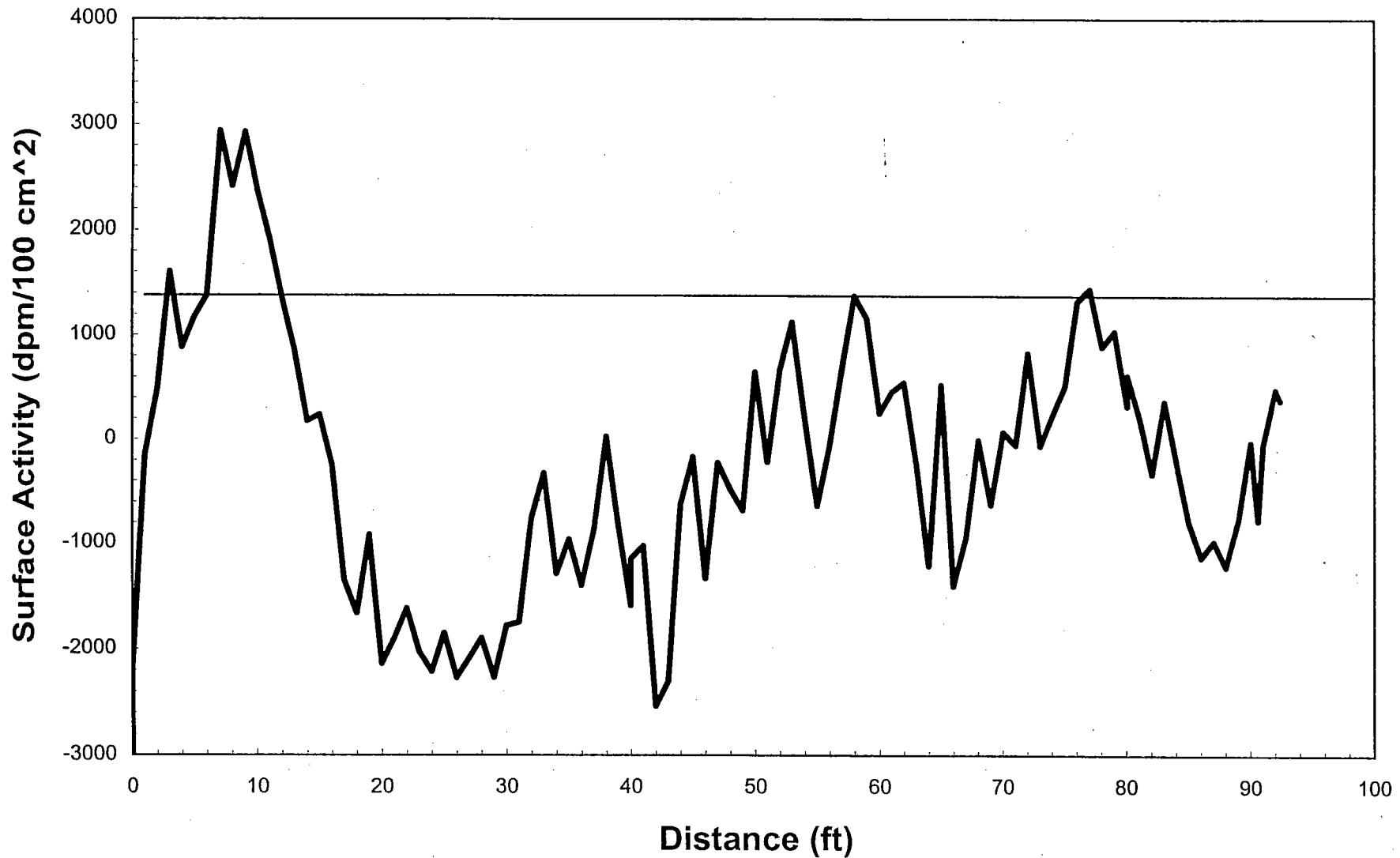
Background (cps): 2.14

MDA (dpm/100cm²): 1018

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	73	1.22	-1018
0	63	1.05	-1202
1	132	2.20	66
2	133	2.22	85
3	142	2.37	250
4	157	2.62	526
5	142	2.37	250
6	162	2.70	617
7	159	2.65	562
8	176	2.93	875
9	165	2.75	673
10	187	3.12	1077
11	186	3.10	1058
12	164	2.73	654
13	167	2.78	709
14	154	2.57	470
15	187	3.12	1077
16	162	2.70	617
17	163	2.72	636
18	162	2.70	617
19	191	3.18	1150
20	188	3.13	1095
21	168	2.80	728
22	161	2.68	599
23	192	3.20	1169
24	179	2.98	930
25	172	2.87	801
25	173	2.88	820
26	171	2.85	783
27	181	3.02	967
28	166	2.77	691
29	185	3.08	1040

30	218	3.63	1646
31	188	3.13	1095
32	158	2.63	544
33	215	3.58	1591
34	199	3.32	1297
35	146	2.43	323
36	172	2.87	801
36.3	198	3.30	1279

West Jefferson R #JN2-PSD8-A320-16
Manhole #5



Pipe Explorer™

02/02/2000

Building: JN-2

Run Description: Manhole #5

Run ID: JN2-PSD8-A320-16

Pipe Type: 8" VCP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

Background (cps): 154.00

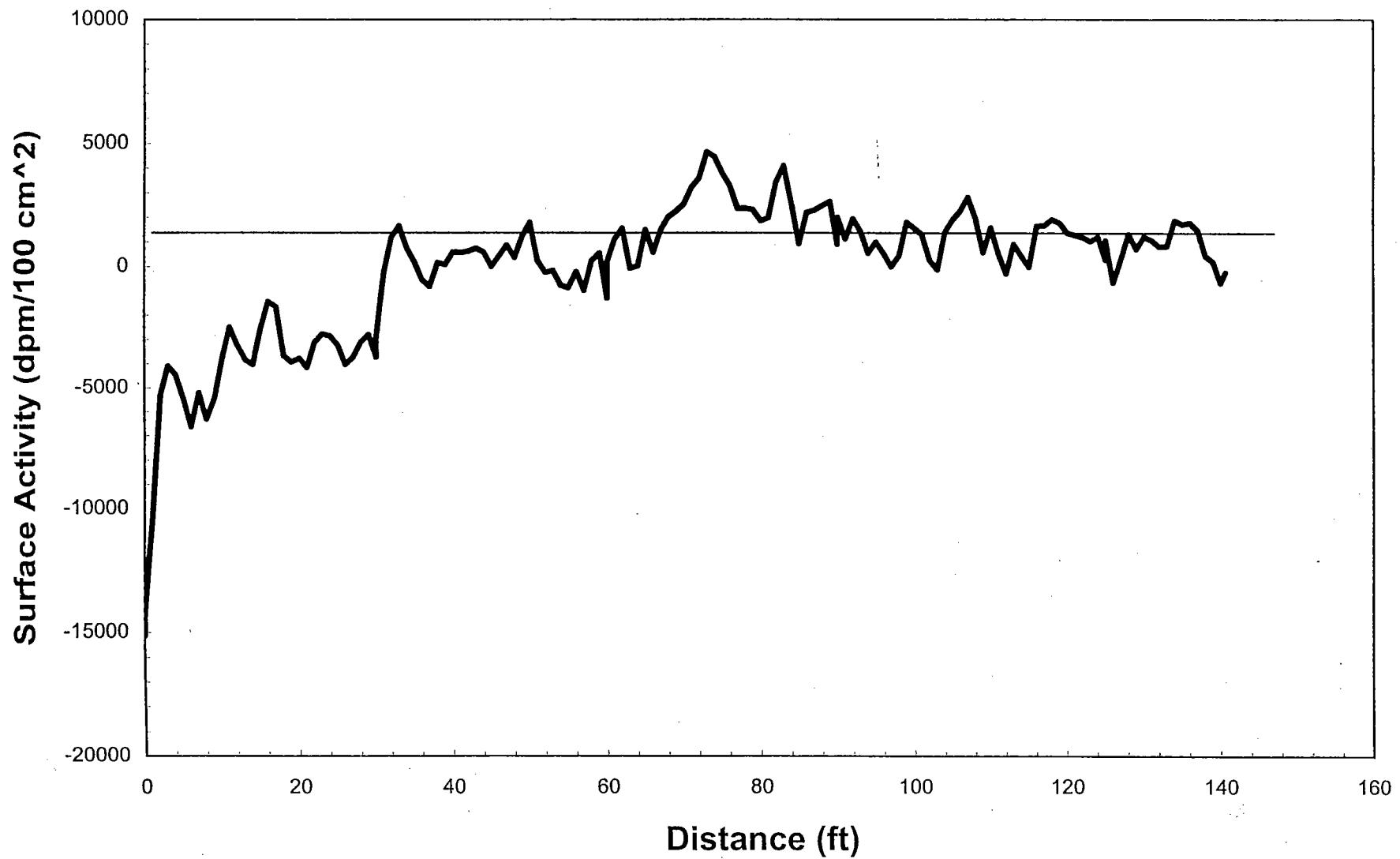
MDA (dpm/100cm²): 1375

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
-2	4734	78.90	-13780
-1	6939	115.65	-7037
0	4442	74.03	-14673
0	8526	142.10	-2183
1	9190	153.17	-153
2	9399	156.65	486
3	9765	162.75	1606
4	9529	158.82	884
5	9624	160.40	1174
6	9691	161.52	1379
7	10201	170.02	2939
8	10030	167.17	2416
9	10198	169.97	2930
10	10014	166.90	2367
11	9867	164.45	1917
12	9684	161.40	1358
13	9522	158.70	862
14	9297	154.95	174
15	9318	155.30	239
16	9162	152.70	-239
17	8799	146.65	-1349
18	8698	144.97	-1657
19	8941	149.02	-914
20	8541	142.35	-2138
21	8620	143.67	-1896
22	8712	145.20	-1615
23	8578	142.97	-2024
24	8517	141.95	-2211
25	8636	143.93	-1847
26	8498	141.63	-2269
27	8558	142.63	-2086
28	8620	143.67	-1896

29	8499	141.65	-2266
30	8659	144.32	-1777
31	8670	144.50	-1743
32	8993	149.88	-755
33	9135	152.25	-321
34	8821	147.02	-1281
35	8927	148.78	-957
36	8784	146.40	-1394
37	8957	149.28	-865
38	9250	154.17	31
39	8967	149.45	-835
40	8722	145.37	-1584
40	8866	147.77	-1144
41	8906	148.43	-1021
42	8410	140.17	-2538
43	8488	141.47	-2300
44	9037	150.62	-621
45	9187	153.12	-162
46	8806	146.77	-1327
47	9169	152.82	-217
48	9085	151.42	-474
49	9018	150.30	-679
50	9453	157.55	651
51	9171	152.85	-211
52	9457	157.62	664
53	9610	160.17	1131
54	9306	155.10	202
55	9034	150.57	-630
56	9227	153.78	-40
57	9467	157.78	694
58	9690	161.50	1376
59	9621	160.35	1165
60	9324	155.40	257
61	9392	156.53	465
62	9421	157.02	554
63	9166	152.77	-226
64	8847	147.45	-1202
65	9414	156.90	532
66	8783	146.38	-1398
67	8934	148.90	-936
68	9241	154.02	3
69	9038	150.63	-618
70	9266	154.43	80
71	9226	153.77	-43
72	9514	158.57	838
73	9224	153.73	-49
74	9320	155.33	245
75	9412	156.87	526
76	9674	161.23	1327

77	9712	161.87	1443
78	9535	158.92	902
79	9582	159.70	1046
80	9349	155.82	333
80	9445	157.42	627
81	9311	155.18	217
82	9136	152.27	-318
83	9363	156.05	376
84	9172	152.87	-208
85	8982	149.70	-789
86	8873	147.88	-1122
87	8923	148.72	-969
88	8844	147.40	-1211
89	8992	149.87	-758
90	9235	153.92	-15
90.6	8989	149.82	-768
91	9227	153.78	-40
92	9401	156.68	492
92.4	9367	156.12	388

West Jefferson R #JN2-PSD8-A020-17
Manhole #5



Pipe Explorer™

02/03/2000

Building: JN-2

Run Description: Manhole #5

Run ID: JN2-PSD8-A020-17

Pipe Type: 8" VCP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

Background (cps): 154.00

MDA (dpm/100cm²): 1375

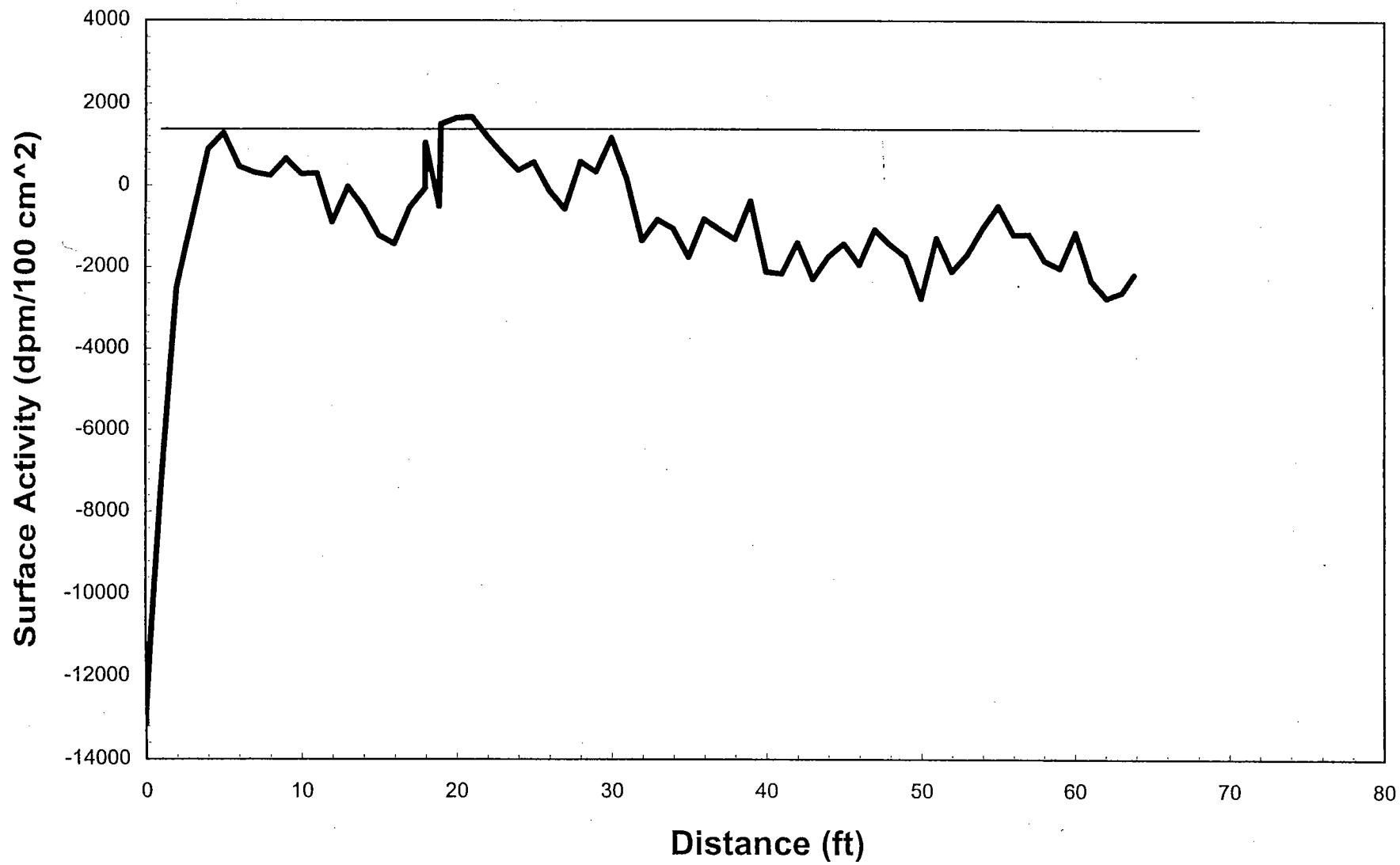
Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	4291	71.52	-15135
0	4577	76.28	-14260
1	5836	97.27	-10410
2	7507	125.12	-5300
3	7899	131.65	-4101
4	7785	129.75	-4450
5	7461	124.35	-5440
6	7074	117.90	-6624
7	7541	125.68	-5196
8	7177	119.62	-6309
9	7459	124.32	-5446
10	7994	133.23	-3810
11	8429	140.48	-2480
12	8183	136.38	-3232
13	7989	133.15	-3826
14	7919	131.98	-4040
15	8405	140.08	-2554
16	8770	146.17	-1437
17	8700	145.00	-1651
18	8040	134.00	-3670
19	7956	132.60	-3927
20	8007	133.45	-3771
21	7882	131.37	-4153
22	8220	137.00	-3119
23	8336	138.93	-2765
24	8310	138.50	-2844
25	8186	136.43	-3223
26	7924	132.07	-4024
27	8024	133.73	-3719
28	8223	137.05	-3110
29	8329	138.82	-2786
30	8022	133.70	-3725

30	8284	138.07	-2924
31	9168	152.80	-220
32	9632	160.53	1199
33	9779	162.98	1648
34	9484	158.07	746
35	9298	154.97	177
36	9065	151.08	-535
37	8972	149.53	-820
38	9294	154.90	165
39	9265	154.42	76
40	9434	157.23	593
41	9427	157.12	572
42	9443	157.38	621
43	9483	158.05	743
44	9433	157.22	590
45	9241	154.02	3
46	9384	156.40	440
47	9526	158.77	875
48	9363	156.05	376
49	9641	160.68	1226
50	9825	163.75	1789
51	9321	155.35	248
52	9162	152.70	-239
53	9189	153.15	-156
54	8990	149.83	-765
55	8957	149.28	-865
56	9173	152.88	-205
57	8922	148.70	-972
58	9320	155.33	245
59	9421	157.02	554
60	8819	146.98	-1287
60	9309	155.15	211
61	9607	160.12	1122
62	9749	162.48	1557
63	9219	153.65	-64
64	9251	154.18	34
65	9729	162.15	1495
66	9435	157.25	596
67	9729	162.15	1495
68	9903	165.05	2028
69	9976	166.27	2251
70	10073	167.88	2547
71	10295	171.58	3226
72	10413	173.55	3587
73	10760	179.33	4648
74	10701	178.35	4468
75	10487	174.78	3813
76	10321	172.02	3306
77	10016	166.93	2373

78	10019	166.98	2382
79	9997	166.62	2315
80	9851	164.18	1869
81	9890	164.83	1988
82	10364	172.73	3437
83	10581	176.35	4101
84	10076	167.93	2557
85	9547	159.12	939
86	9962	166.03	2208
87	9992	166.53	2300
88	10053	167.55	2486
89	10104	168.40	2642
90	9538	158.97	911
90	9898	164.97	2012
91	9612	160.20	1138
92	9877	164.62	1948
93	9713	161.88	1446
94	9424	157.07	563
95	9567	159.45	1000
96	9416	156.93	538
97	9241	154.02	3
98	9391	156.52	462
99	9830	163.83	1804
100	9753	162.55	1569
101	9668	161.13	1309
102	9326	155.43	263
103	9206	153.43	-104
104	9703	161.72	1416
105	9867	164.45	1917
106	9986	166.43	2281
107	10163	169.38	2823
108	9887	164.78	1979
109	9434	157.23	593
110	9761	162.68	1593
111	9422	157.03	557
112	9151	152.52	-272
113	9542	159.03	924
114	9385	156.42	443
115	9238	153.97	-6
116	9784	163.07	1664
117	9789	163.15	1679
118	9870	164.50	1927
119	9822	163.70	1780
120	9692	161.53	1382
121	9665	161.08	1300
122	9636	160.60	1211
123	9582	159.70	1046
124	9639	160.65	1220
125	9337	155.62	297

125	9592	159.87	1076
126	9029	150.48	-645
127	9344	155.73	318
128	9674	161.23	1327
129	9478	157.97	728
130	9642	160.70	1229
131	9594	159.90	1083
132	9512	158.53	832
133	9519	158.65	853
134	9853	164.22	1875
135	9806	163.43	1731
136	9822	163.70	1780
137	9726	162.10	1486
138	9390	156.50	459
139	9308	155.13	208
140	9027	150.45	-651
140.6	9167	152.78	-223

West Jefferson R #JN2-PSD8-A140-18
Manhole #6



Pipe Explorer™

02/03/2000

Building: JN-2

Run Description: Manhole #6

Run ID: JN2-PSD8-A140-18

Pipe Type: 8" VCP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

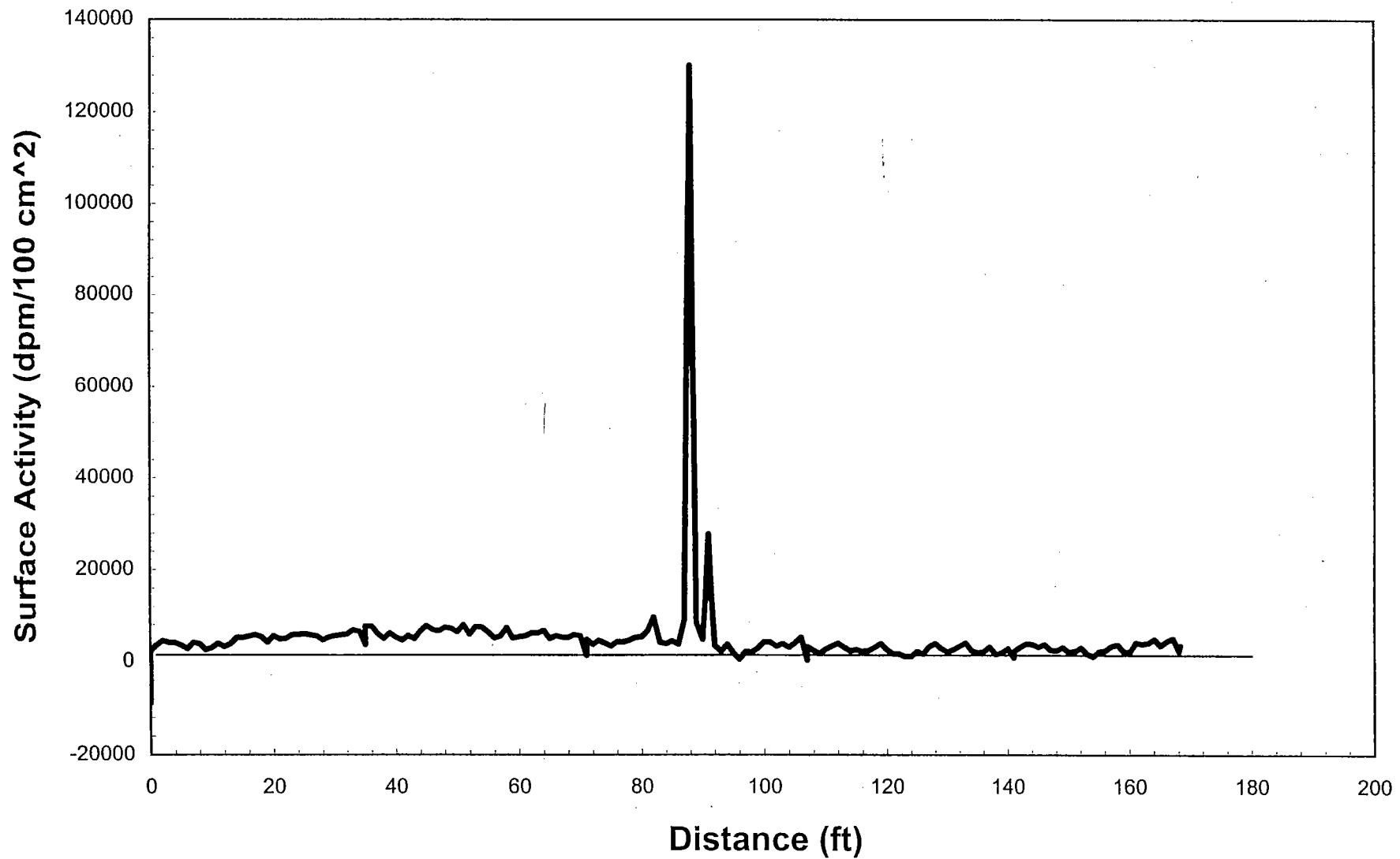
Background (cps): 154.00

MDA (dpm/100cm²): 1375

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	4940	82.33	-13150
0	5047	84.12	-12823
1	6872	114.53	-7242
2	8422	140.37	-2502
3	8984	149.73	-783
4	9533	158.88	896
5	9660	161.00	1284
6	9395	156.58	474
7	9346	155.77	324
8	9322	155.37	251
9	9458	157.63	667
10	9335	155.58	291
11	9341	155.68	309
12	8950	149.17	-887
13	9232	153.87	-24
14	9068	151.13	-526
15	8844	147.40	-1211
16	8773	146.22	-1428
17	9064	151.07	-538
18	9222	153.70	-55
18	9582	159.70	1046
18.9	9078	151.30	-495
19	9730	162.17	1498
20	9779	162.98	1648
21	9787	163.12	1673
22	9630	160.50	1193
23	9490	158.17	765
24	9365	156.08	382
25	9430	157.17	581
26	9202	153.37	-116
27	9057	150.95	-560
28	9434	157.23	593

29	9353	155.88	346
30	9623	160.38	1171
31	9297	154.95	174
32	8801	146.68	-1343
33	8970	149.50	-826
34	8898	148.30	-1046
35	8667	144.45	-1752
36	8975	149.58	-810
37	8891	148.18	-1067
38	8813	146.88	-1306
39	9120	152.00	-367
40	8552	142.53	-2104
41	8536	142.27	-2153
42	8784	146.40	-1394
43	8492	141.53	-2287
44	8672	144.53	-1737
45	8777	146.28	-1416
46	8608	143.47	-1933
47	8892	148.20	-1064
48	8770	146.17	-1437
49	8672	144.53	-1737
50	8339	138.98	-2755
51	8824	147.07	-1272
52	8554	142.57	-2098
53	8691	144.85	-1679
54	8901	148.35	-1037
55	9081	151.35	-486
56	8849	147.48	-1196
57	8854	147.57	-1180
58	8642	144.03	-1829
59	8581	143.02	-2015
60	8870	147.83	-1131
61	8482	141.37	-2318
62	8344	139.07	-2740
63	8387	139.78	-2609
63.8	8528	142.13	-2177

West Jefferson R #JN2-PSD8-A230-19
West from Manhole #6



Pipe ExplorerTM

02/04/2000

Building: JN-2

Run Description: West from Manhole #6

Run ID: JN2-PSD8-A230-19

Pipe Type: 8" VCP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

Background (cps): 154.00

MDA (dpm/100cm²): 1375

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
-2	4789	79.82	-13612
-1	6577	109.62	-8144
0	6355	105.92	-8823
0	9954	165.90	2183
1	10381	173.02	3489
2	10692	178.20	4440
3	10587	176.45	4119
4	10553	175.88	4015
5	10370	172.83	3456
6	10128	168.80	2716
7	10572	176.20	4073
8	10481	174.68	3795
9	10069	167.82	2535
10	10197	169.95	2927
11	10510	175.17	3884
12	10281	171.35	3183
13	10465	174.42	3746
14	10920	182.00	5138
15	10930	182.17	5168
16	11031	183.85	5477
17	11140	185.67	5810
18	10989	183.15	5349
19	10598	176.63	4153
20	11049	184.15	5532
21	10827	180.45	4853
22	10874	181.23	4997
23	11114	185.23	5731
24	11147	185.78	5832
25	11185	186.42	5948
26	11112	185.20	5725
27	11044	184.07	5517
28	10759	179.32	4645

29	10955	182.58	5245
30	11056	184.27	5554
31	11111	185.18	5722
32	11170	186.17	5902
33	11483	191.38	6859
34	11373	189.55	6523
35	10424	173.73	3621
35	11769	196.15	7734
36	11746	195.77	7664
37	11203	186.72	6003
38	10870	181.17	4985
39	11250	187.50	6147
40	10955	182.58	5245
41	10750	179.17	4618
42	11063	184.38	5575
43	10856	180.93	4942
44	11391	189.85	6578
45	11775	196.25	7752
46	11488	191.47	6875
47	11412	190.20	6642
48	11652	194.20	7376
49	11588	193.13	7180
50	11356	189.27	6471
51	11827	197.12	7911
52	11167	186.12	5893
53	11713	195.22	7563
54	11674	194.57	7443
55	11331	188.85	6394
56	10899	181.65	5073
57	11049	184.15	5532
58	11629	193.82	7306
59	10904	181.73	5089
60	10971	182.85	5294
61	11046	184.10	5523
62	11245	187.42	6131
63	11246	187.43	6135
64	11432	190.53	6703
65	10873	181.22	4994
66	11053	184.22	5544
67	10963	182.72	5269
68	10934	182.23	5180
69	11133	185.55	5789
70	11046	184.10	5523
71	9688	161.47	1370
71	10792	179.87	4746
72	10436	173.93	3657
73	10726	178.77	4544
74	10529	175.48	3942
75	10338	172.30	3358

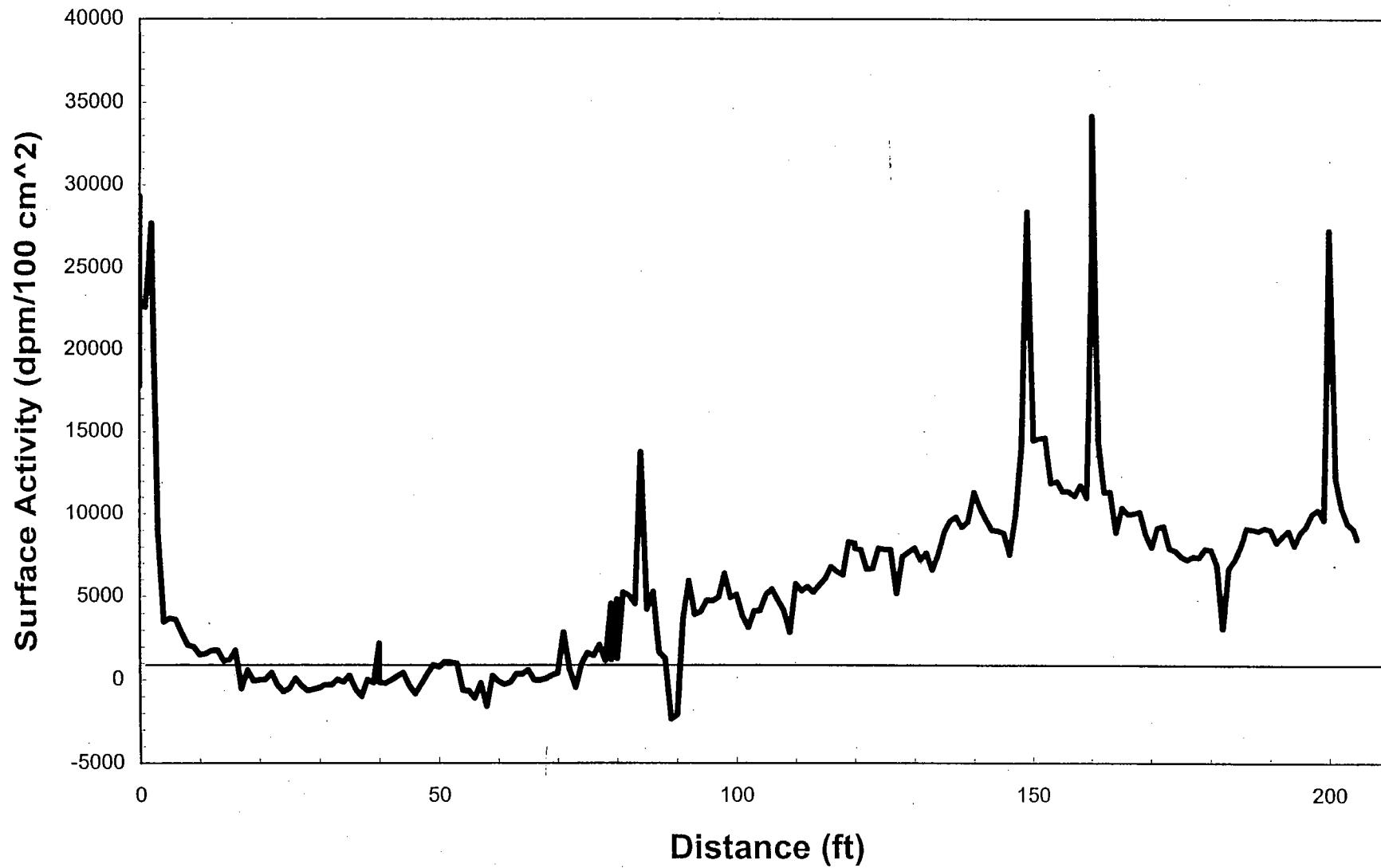
76	10609	176.82	4187
77	10625	177.08	4235
78	10745	179.08	4602
79	10940	182.33	5199
80	10975	182.92	5306
81	11428	190.47	6691
82	12407	206.78	9685
83	10608	176.80	4183
84	10486	174.77	3810
85	10694	178.23	4446
86	10451	174.18	3703
87	12233	203.88	9153
88	51795	863.25	130138
88	51052	850.87	127865
89	12020	200.33	8502
90	10807	180.12	4792
90.5	13836	230.60	14055
91	18373	306.22	27930
91.5	13824	230.40	14018
92	10373	172.88	3465
93	9972	166.20	2239
94	10431	173.85	3642
95	9840	164.00	1835
96	9423	157.05	560
97	9932	165.53	2116
98	9898	164.97	2012
99	10191	169.85	2908
100	10627	177.12	4242
101	10600	176.67	4159
102	10316	171.93	3291
103	10506	175.10	3872
104	10242	170.70	3064
105	10571	176.18	4070
106	10962	182.70	5266
107	9359	155.98	364
107	10293	171.55	3220
108	10021	167.02	2388
109	9809	163.48	1740
110	10116	168.60	2679
111	10339	172.32	3361
112	10534	175.57	3957
113	10263	171.05	3128
114	10015	166.92	2370
115	10074	167.90	2550
116	9953	165.88	2180
117	10016	166.93	2373
118	10247	170.78	3080
119	10514	175.23	3896
120	10094	168.23	2612

121	9816	163.60	1761
122	9788	163.13	1676
123	9607	160.12	1122
124	9621	160.35	1165
125	9950	165.83	2171
126	9794	163.23	1694
127	10302	171.70	3248
128	10534	175.57	3957
129	10162	169.37	2820
130	9934	165.57	2122
131	10098	168.30	2624
132	10339	172.32	3361
133	10559	175.98	4034
134	10021	167.02	2388
135	9888	164.80	1982
136	9961	166.02	2205
137	10273	171.22	3159
138	9766	162.77	1609
139	9887	164.78	1979
140	10149	169.15	2780
141	9523	158.72	865
141	9957	165.95	2193
142	10267	171.12	3141
143	10483	174.72	3801
144	10466	174.43	3749
145	10270	171.17	3150
146	10456	174.27	3719
147	10088	168.13	2593
148	10031	167.18	2419
149	10243	170.72	3067
150	9936	165.60	2128
151	9980	166.33	2263
152	10206	170.10	2954
153	9797	163.28	1703
154	9611	160.18	1135
155	9949	165.82	2168
156	10027	167.12	2407
157	10330	172.17	3333
158	10445	174.08	3685
159	9961	166.02	2205
160	9943	165.72	2150
161	10578	176.30	4092
162	10496	174.93	3841
163	10560	176.00	4037
164	10839	180.65	4890
165	10368	172.80	3450
166	10689	178.15	4431
167	10883	181.38	5024
168	9986	166.43	2281

168.2	10380	173.00	3486

West Jefferson R #JN2-PSD8-A280-20 (&20A)

West from Manhole #7 under dam



Pipe Explorer™

02/05/2000

Building: JN-2

Run Description: West from Manhole #7

Run ID: JN2-PSD8-A280-20 (&20A)

Pipe Type: 8" VCP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

Background (cps): 62.90

MDA (dpm/100cm²): 882

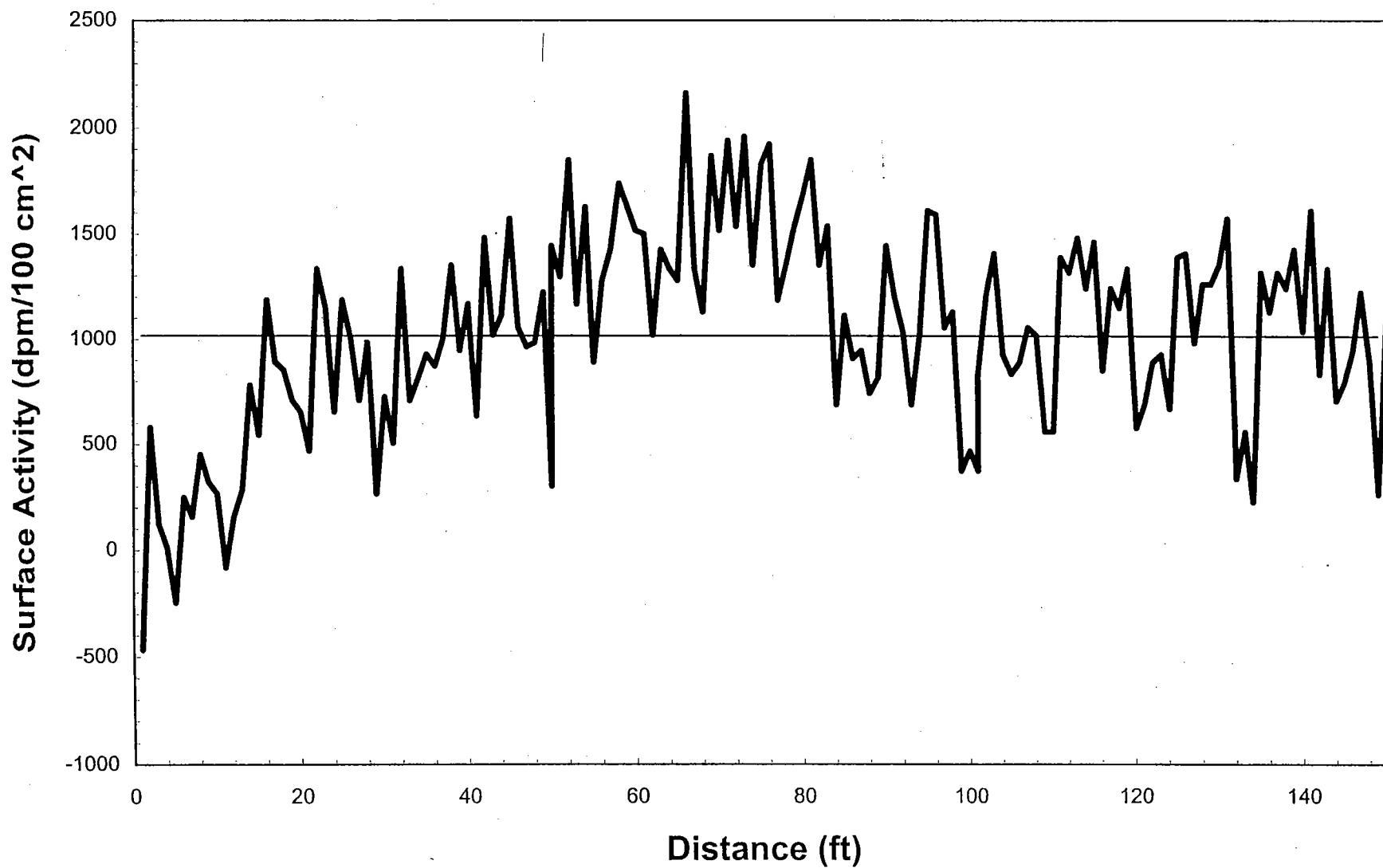
Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	13365	222.75	29330
0	9589	159.82	17783
0	9816	163.60	18477
0	11212	186.87	22746
1	11159	185.98	22584
2	12824	213.73	27676
3	6712	111.87	8985
4	4918	81.97	3498
5	4985	83.08	3703
6	4958	82.63	3621
7	4709	78.48	2859
8	4465	74.42	2113
9	4429	73.82	2003
10	4275	71.25	1532
11	4294	71.57	1590
12	4355	72.58	1777
13	4360	72.67	1792
14	4156	69.27	1168
15	4175	69.58	1226
16	4363	72.72	1801
17	3611	60.18	-498
18	3968	66.13	593
19	3756	62.60	-55
20	3775	62.92	3
21	3784	63.07	31
22	3916	65.27	434
23	3675	61.25	-303
24	3552	59.20	-679
25	3616	60.27	-483
26	3802	63.37	86
27	3661	61.02	-346
28	3572	59.53	-618

29	3597	59.95	-541
30	3627	60.45	-450
31	3684	61.40	-275
32	3680	61.33	-287
33	3787	63.12	40
34	3734	62.23	-122
35	3862	64.37	269
36	3600	60.00	-532
37	3460	57.67	-960
38	3781	63.02	21
39	3722	62.03	-159
40	4495	74.92	2205
40	3874	64.57	306
40	3731	62.18	-131
41	3713	61.88	-187
42	3774	62.90	0
43	3853	64.22	242
44	3916	65.27	434
45	3663	61.05	-339
46	3509	58.48	-810
47	3695	61.58	-242
48	3893	64.88	364
49	4069	67.82	902
50	4034	67.23	795
51	4132	68.87	1095
52	4123	68.72	1067
53	4100	68.33	997
54	3580	59.67	-593
55	3566	59.43	-636
56	3428	57.13	-1058
57	3714	61.90	-183
58	3269	54.48	-1544
59	3858	64.30	257
60	3749	62.48	-76
61	3693	61.55	-248
62	3736	62.27	-116
63	3896	64.93	373
64	3892	64.87	361
65	3971	66.18	602
66	3778	62.97	12
67	3777	62.95	9
68	3806	63.43	98
69	3869	64.48	291
70	3911	65.18	419
71	4716	78.60	2881
72	3980	66.33	630
73	3634	60.57	-428
74	4082	68.03	942
75	4308	71.80	1633

76	4258	70.97	1480
77	4472	74.53	2135
78	4161	69.35	1183
79	5270	87.83	4575
79	4176	69.60	1229
80	5009	83.48	3777
80	5359	89.32	4847
80	4200	70.00	1303
80	4210	70.17	1333
81	5495	91.58	5263
82	5428	90.47	5058
83	5279	87.98	4602
84	8297	138.28	13832
85	5172	86.20	4275
86	5509	91.82	5306
87	4327	72.12	1691
88	4198	69.97	1297
89	3015	50.25	-2321
90	3101	51.68	-2058
91	4992	83.20	3725
92	5724	95.40	5963
93	5069	84.48	3960
94	5127	85.45	4138
95	5334	88.90	4771
96	5332	88.87	4765
97	5403	90.05	4982
98	5871	97.85	6413
99	5396	89.93	4960
100	5454	90.90	5138
101	5042	84.03	3878
102	4818	80.30	3193
103	5136	85.60	4165
104	5149	85.82	4205
105	5455	90.92	5141
106	5561	92.68	5465
107	5350	89.17	4820
108	5146	85.77	4196
109	4721	78.68	2896
110	5666	94.43	5786
111	5528	92.13	5364
112	5609	93.48	5612
113	5503	91.72	5287
114	5634	93.90	5688
115	5772	96.20	6110
116	6006	100.10	6826
117	5919	98.65	6560
118	5846	97.43	6336
119	6508	108.47	8361
120	6481	108.02	8278

120	6375	106.25	7954
121	6349	105.82	7875
122	5965	99.42	6700
123	5978	99.63	6740
124	6379	106.32	7966
125	6355	105.92	7893
126	6350	105.83	7878
127	5485	91.42	5232
128	6216	103.60	7468
129	6300	105.00	7725
130	6388	106.47	7994
131	6151	102.52	7269
132	6283	104.72	7673
133	5945	99.08	6639
134	6248	104.13	7566
135	6694	111.57	8930
136	6927	115.45	9642
137	7007	116.78	9887
138	6800	113.33	9254
139	6911	115.18	9593
140	7506	125.10	11413
141	7202	120.03	10483
142	6954	115.90	9725
143	6745	112.42	9086
144	6727	112.12	9031
145	6682	111.37	8893
146	6258	104.30	7596
147	7035	117.25	9972
148	8410	140.17	14177
149	13063	217.72	28407
150	8536	142.27	14563
151	8574	142.90	14679
152	8587	143.12	14719
153	7692	128.20	11982
154	7728	128.80	12092
155	7526	125.43	11474
156	7523	125.38	11465
157	7437	123.95	11202
158	7643	127.38	11832
159	7401	123.35	11092
160	12355	205.92	26242
160	14954	249.23	34190
161	8497	141.62	14443
162	7511	125.18	11428
163	7521	125.35	11459
164	6701	111.68	8951
165	7197	119.95	10468
166	7072	117.87	10086
167	7080	118.00	10110

West Jefferson R #JN4-PSD8-A290-22
Manhole #4 to JN4



Pipe Explorer™

02/10/2000

Building: JN-4

Run Description: Manhole #7 Towards Filter Bed

Run ID: JN2-PSD8-A290-22

Pipe Type: 6" VCP

Detector: LND 4-element GM S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

Count Time (s): 60.0

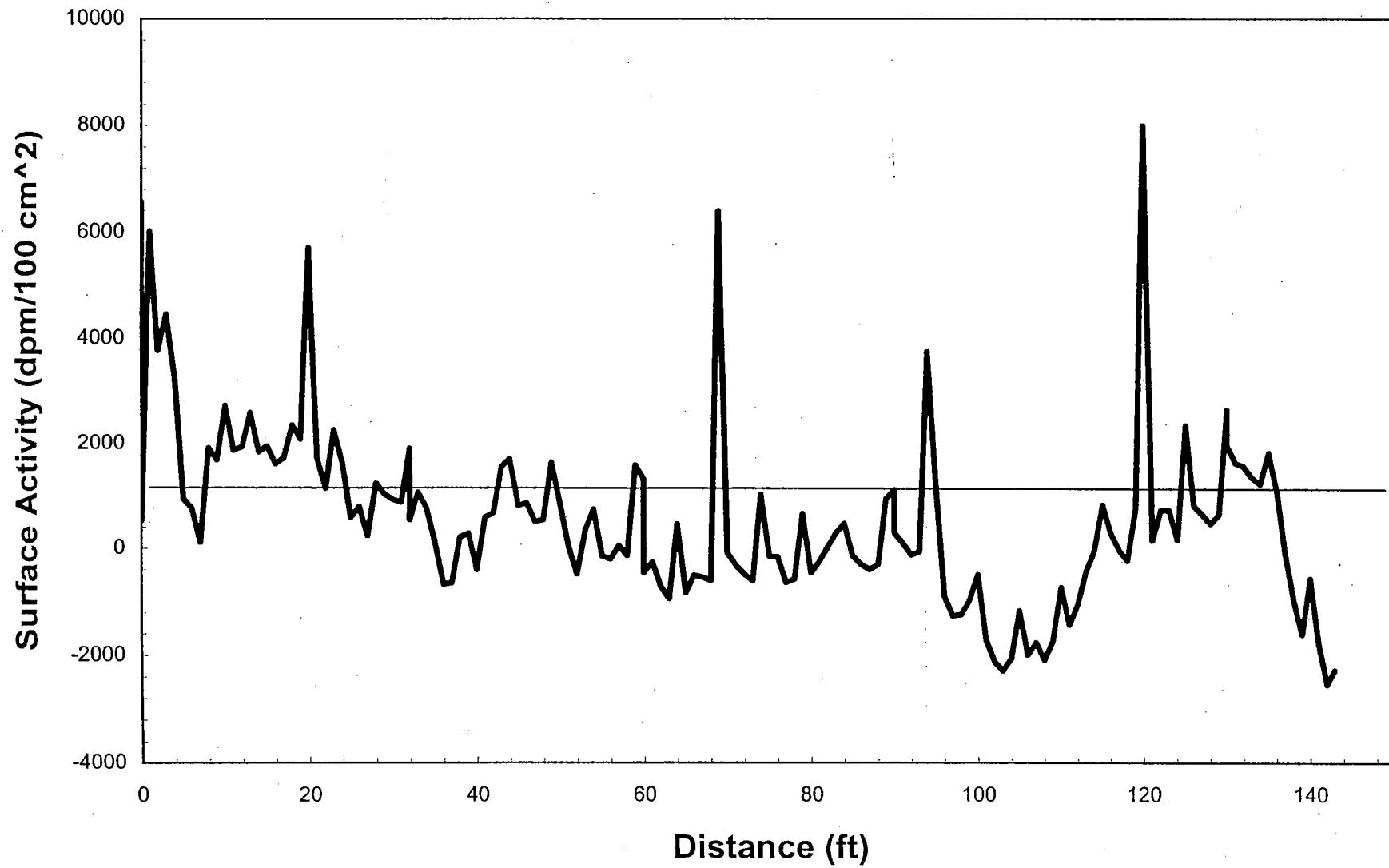
Background (cps): 2.14

MDA (dpm/100cm²): 1018

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
1	103	1.72	-467
2	160	2.67	581
3	135	2.25	121
4	129	2.15	11
5	115	1.92	-246
6	142	2.37	250
7	137	2.28	158
8	153	2.55	452
9	146	2.43	323
10	143	2.38	268
11	124	2.07	-81
12	137	2.28	158
13	144	2.40	287
14	171	2.85	783
15	158	2.63	544
16	193	3.22	1187
17	177	2.95	893
18	175	2.92	856
19	167	2.78	709
20	164	2.73	654
21	154	2.57	470
22	201	3.35	1334
23	191	3.18	1150
24	164	2.73	654
25	193	3.22	1187
26	183	3.05	1003
27	167	2.78	709
28	182	3.03	985
29	143	2.38	268
30	168	2.80	728
31	156	2.60	507
32	201	3.35	1334

168	7116	118.60	10220
169	6667	111.12	8847
170	6408	106.80	8055
171	6789	113.15	9220
172	6823	113.72	9324
173	6385	106.42	7985
174	6336	105.60	7835
175	6218	103.63	7474
176	6161	102.68	7300
177	6219	103.65	7477
178	6206	103.43	7437
179	6378	106.30	7963
180	6350	105.83	7878
181	6052	100.87	6966
182	4804	80.07	3150
183	5984	99.73	6758
184	6158	102.63	7291
185	6427	107.12	8113
186	6777	112.95	9183
187	6760	112.67	9131
188	6734	112.23	9052
189	6783	113.05	9202
190	6753	112.55	9110
191	6503	108.38	8346
192	6626	110.43	8722
193	6731	112.18	9043
194	6448	107.47	8177
195	6692	111.53	8924
196	6819	113.65	9312
197	7075	117.92	10095
198	7162	119.37	10361
199	6956	115.93	9731
200	12601	210.02	26994
200	12693	211.55	27275
201	7797	129.95	12303
202	7213	120.22	10517
203	6878	114.63	9492
204	6777	112.95	9183
204.6	6577	109.62	8572

West Jefferson R #JN2-PSD8-A20-21
Manhole #7 Towards Filter Bed



Pipe Explorer™

02/08/2000

Building: JN-2

Run Description: Manhole #7 Towards Filter Bed

Run ID: JN2-PSD8-A20-21

Pipe Type: 8" VCP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

Background (cps): 107.70

MDA (dpm/100cm²): 1151

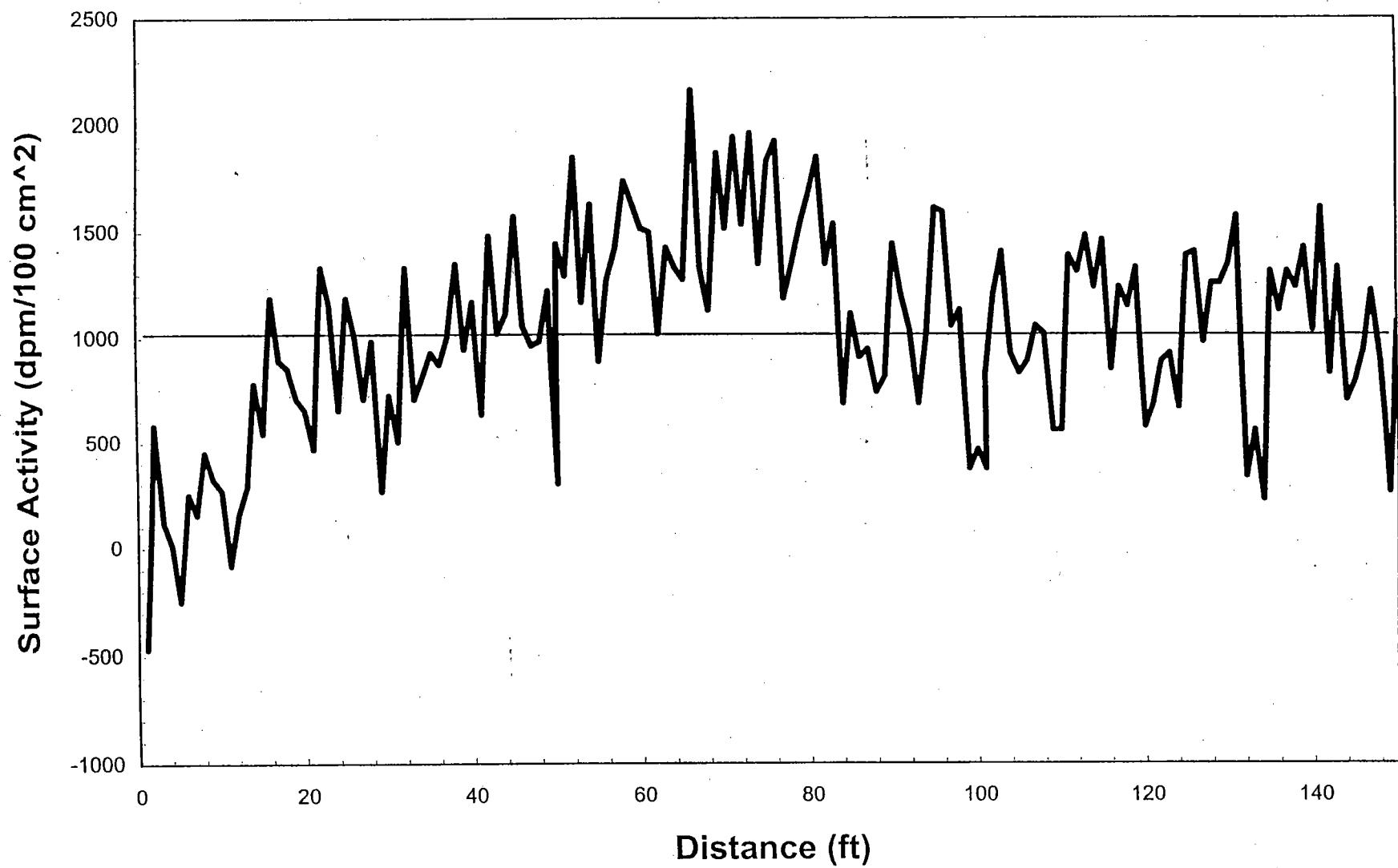
Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	8610	143.50	6569
0	6635	110.58	529
1	8431	140.52	6021
2	7698	128.30	3780
3	7920	132.00	4459
4	7525	125.42	3251
5	6770	112.83	942
6	6709	111.82	755
7	6501	108.35	119
8	7090	118.17	1920
9	7016	116.93	1694
10	7353	122.55	2725
11	7075	117.92	1875
12	7097	118.28	1942
13	7308	121.80	2587
14	7066	117.77	1847
15	7101	118.35	1954
16	6992	116.53	1621
17	7027	117.12	1728
18	7231	120.52	2352
19	7144	119.07	2086
20	8330	138.83	5713
21	7028	117.13	1731
22	6837	113.95	1147
23	7201	120.02	2260
24	6998	116.63	1639
25	6654	110.90	587
26	6722	112.03	795
27	6543	109.05	248
28	6868	114.47	1242
29	6800	113.33	1034
30	6766	112.77	930

31	6749	112.48	878
32	7087	118.12	1911
32	6641	110.68	547
33	6810	113.50	1064
34	6712	111.87	765
35	6504	108.40	128
36	6241	104.02	-676
37	6250	104.17	-648
38	6531	108.85	211
39	6557	109.28	291
40	6333	105.55	-394
41	6655	110.92	590
42	6684	111.40	679
43	6973	116.22	1563
44	7021	117.02	1709
45	6729	112.15	817
46	6746	112.43	869
47	6630	110.50	514
48	6641	110.68	547
49	7001	116.68	1648
50	6750	112.50	881
51	6479	107.98	52
52	6305	105.08	-480
53	6579	109.65	358
54	6705	111.75	743
55	6417	106.95	-138
56	6399	106.65	-193
57	6481	108.02	58
58	6421	107.02	-125
59	6985	116.42	1599
60	6899	114.98	1336
60	6314	105.23	-453
61	6378	106.30	-257
62	6230	103.83	-709
63	6157	102.62	-933
64	6614	110.23	465
65	6191	103.18	-829
66	6296	104.93	-508
67	6285	104.75	-541
68	6265	104.42	-602
69	8550	142.50	6385
70	6437	107.28	-76
71	6358	105.97	-318
72	6304	105.07	-483
73	6263	104.38	-609
74	6799	113.32	1031
75	6418	106.97	-135
76	6412	106.87	-153
77	6254	104.23	-636

78	6275	104.58	-572
79	6681	111.35	670
80	6314	105.23	-453
81	6382	106.37	-245
82	6473	107.88	34
83	6561	109.35	303
84	6619	110.32	480
85	6420	107.00	-128
86	6366	106.10	-294
87	6336	105.60	-385
88	6365	106.08	-297
89	6774	112.90	954
90	6832	113.87	1131
90	6563	109.38	309
91	6500	108.33	116
92	6426	107.10	-110
93	6447	107.45	-46
94	7690	128.17	3755
95	6863	114.38	1226
96	6170	102.83	-893
97	6053	100.88	-1251
98	6062	101.03	-1223
99	6145	102.42	-969
100	6303	105.05	-486
101	5903	98.38	-1709
102	5770	96.17	-2116
103	5716	95.27	-2281
104	5791	96.52	-2052
105	6084	101.40	-1156
106	5812	96.87	-1988
107	5888	98.13	-1755
108	5781	96.35	-2083
109	5895	98.25	-1734
110	6224	103.73	-728
111	5999	99.98	-1416
112	6123	102.05	-1037
113	6322	105.37	-428
114	6452	107.53	-31
115	6738	112.30	844
116	6561	109.35	303
117	6457	107.62	-15
118	6391	106.52	-217
119	6718	111.97	783
120	9075	151.25	7991
121	6518	108.63	171
122	6704	111.73	740
123	6704	111.73	740
124	6523	108.72	187
125	7233	120.55	2358

126	6734	112.23	832
127	6677	111.28	657
128	6622	110.37	489
129	6679	111.32	664
130	7331	122.18	2657
130	7110	118.50	1982
131	7004	116.73	1657
132	6983	116.38	1593
133	6912	115.20	1376
134	6872	114.53	1254
135	7064	117.73	1841
136	6830	113.83	1125
137	6430	107.17	-98
138	6151	102.52	-951
139	5940	99.00	-1596
140	6281	104.68	-554
141	5877	97.95	-1789
142	5633	93.88	-2535
142.9	5719	95.32	-2272

West Jefferson R #JN4-PSD8-A290-22
Manhole #4 to JN4



Pipe Explorer™

02/10/2000

Building: JN-4

Run Description: Manhole #7 Towards Filter Bed

Run ID: JN2-PSD8-A290-22

Pipe Type: 6" VCP

Detector: LND 4-element GM S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

Count Time (s): 60.0

Background (cps): 2.14

MDA (dpm/100cm²): 1018

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
1	103	1.72	-467
2	160	2.67	581
3	135	2.25	121
4	129	2.15	11
5	115	1.92	-246
6	142	2.37	250
7	137	2.28	158
8	153	2.55	452
9	146	2.43	323
10	143	2.38	268
11	124	2.07	-81
12	137	2.28	158
13	144	2.40	287
14	171	2.85	783
15	158	2.63	544
16	193	3.22	1187
17	177	2.95	893
18	175	2.92	856
19	167	2.78	709
20	164	2.73	654
21	154	2.57	470
22	201	3.35	1334
23	191	3.18	1150
24	164	2.73	654
25	193	3.22	1187
26	183	3.05	1003
27	167	2.78	709
28	182	3.03	985
29	143	2.38	268
30	168	2.80	728
31	156	2.60	507
32	201	3.35	1334

33	167	2.78	709
34	173	2.88	820
35	179	2.98	930
36	176	2.93	875
37	183	3.05	1003
38	202	3.37	1352
39	180	3.00	948
40	192	3.20	1169
41	163	2.72	636
42	209	3.48	1481
43	184	3.07	1022
44	189	3.15	1114
45	214	3.57	1573
46	186	3.10	1058
47	181	3.02	967
48	182	3.03	985
49	195	3.25	1224
50	145	2.42	305
50	207	3.45	1444
51	199	3.32	1297
52	229	3.82	1849
53	192	3.20	1169
54	217	3.62	1628
55	177	2.95	893
56	198	3.30	1279
57	206	3.43	1426
58	223	3.72	1738
59	217	3.62	1628
60	211	3.52	1518
61	210	3.50	1499
62	184	3.07	1022
63	206	3.43	1426
64	201	3.35	1334
65	198	3.30	1279
66	246	4.10	2161
67	201	3.35	1334
68	190	3.17	1132
69	230	3.83	1867
70	211	3.52	1518
71	234	3.90	1940
72	212	3.53	1536
73	235	3.92	1959
74	202	3.37	1352
75	228	3.80	1830
76	233	3.88	1922
77	193	3.22	1187
78	202	3.37	1352
79	212	3.53	1536
80	220	3.67	1683

81	229	3.82	1849
82	202	3.37	1352
83	212	3.53	1536
84	166	2.77	691
85	189	3.15	1114
86	178	2.97	911
87	180	3.00	948
88	169	2.82	746
89	173	2.88	820
90	207	3.45	1444
91	194	3.23	1205
92	185	3.08	1040
93	166	2.77	691
94	184	3.07	1022
95	216	3.60	1610
96	215	3.58	1591
97	186	3.10	1058
98	190	3.17	1132
99	149	2.48	379
100	154	2.57	470
101	149	2.48	379
101	174	2.90	838
102	194	3.23	1205
103	205	3.42	1408
104	179	2.98	930
105	174	2.90	838
106	177	2.95	893
107	186	3.10	1058
108	184	3.07	1022
109	159	2.65	562
110	159	2.65	562
111	204	3.40	1389
112	200	3.33	1316
113	209	3.48	1481
114	196	3.27	1242
115	208	3.47	1463
116	175	2.92	856
117	196	3.27	1242
118	191	3.18	1150
119	201	3.35	1334
120	160	2.67	581
121	166	2.77	691
122	177	2.95	893
123	179	2.98	930
124	165	2.75	673
125	204	3.40	1389
126	205	3.42	1408
127	182	3.03	985
128	197	3.28	1261

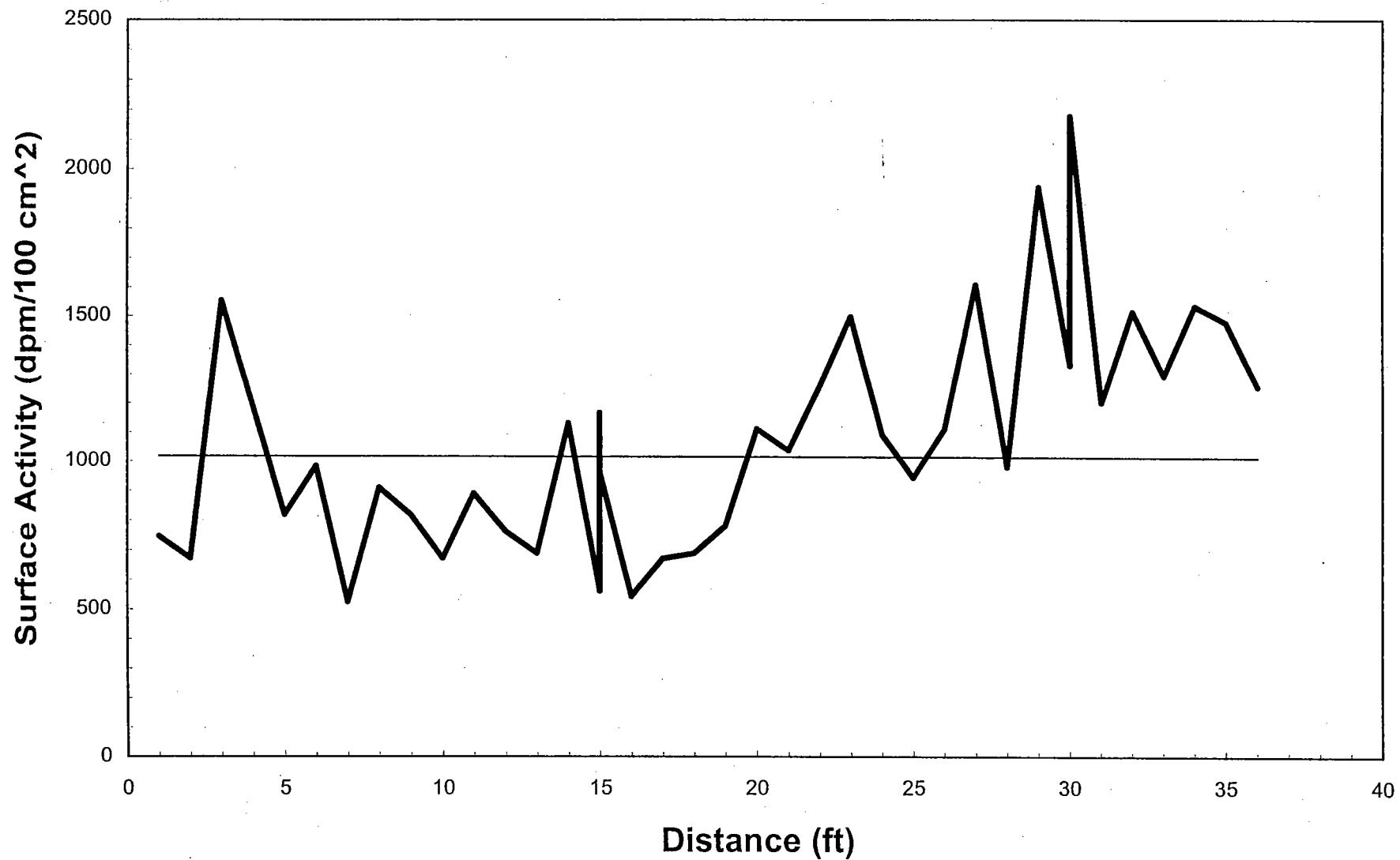
129	197	3.28	1261
130	202	3.37	1352
131	214	3.57	1573
132	147	2.45	342
133	159	2.65	562
134	141	2.35	232
135	200	3.33	1316
136	190	3.17	1132
137	200	3.33	1316
138	196	3.27	1242
139	206	3.43	1426
140	185	3.08	1040
141	216	3.60	1610
142	174	2.90	838
143	201	3.35	1334
144	167	2.78	709
145	172	2.87	801
146	180	3.00	948
147	195	3.25	1224
148	177	2.95	893
149	143	2.38	268
150	187	3.12	1077
151	175	2.92	856
152	181	3.02	967
153	176	2.93	875
154	166	2.77	691
155	154	2.57	470
156	185	3.08	1040
157	173	2.88	820
158	180	3.00	948
159	185	3.08	1040
160	173	2.88	820
161	197	3.28	1261
162	196	3.27	1242
162	169	2.82	746
163	155	2.58	489
164	190	3.17	1132
165	190	3.17	1132
166	157	2.62	526
167	183	3.05	1003
168	159	2.65	562
169	184	3.07	1022
170	202	3.37	1352
171	183	3.05	1003
172	194	3.23	1205
173	164	2.73	654
174	191	3.18	1150
175	201	3.35	1334
176	202	3.37	1352

177	200	3.33	1316
178	159	2.65	562
179	177	2.95	893
180	193	3.22	1187
180	179	2.98	930
181	179	2.98	930
182	169	2.82	746
183	183	3.05	1003
184	176	2.93	875
185	191	3.18	1150
186	164	2.73	654
187	192	3.20	1169
188	164	2.73	654
189	200	3.33	1316
190	181	3.02	967
191	175	2.92	856
192	182	3.03	985
193	179	2.98	930
194	162	2.70	617
195	186	3.10	1058
196	145	2.42	305
197	156	2.60	507
198	171	2.85	783
199	148	2.47	360
200	169	2.82	746
200	136	2.27	140
201	133	2.22	85
202	148	2.47	360
203	149	2.48	379
204	160	2.67	581
205	141	2.35	232
206	134	2.23	103
207	149	2.48	379
208	166	2.77	691
209	180	3.00	948
210	143	2.38	268
211	146	2.43	323
212	148	2.47	360
213	177	2.95	893
214	157	2.62	526
215	183	3.05	1003
216	183	3.05	1003
217	176	2.93	875
218	191	3.18	1150
219	173	2.88	820
220	208	3.47	1463
221	181	3.02	967
222	190	3.17	1132
223	169	2.82	746

224	172	2.87	801
225	187	3.12	1077
226	178	2.97	911
227	239	3.98	2032
228	222	3.70	1720
229	202	3.37	1352
230	174	2.90	838
231	186	3.10	1058
232	193	3.22	1187
233	172	2.87	801
234	154	2.57	470
235	152	2.53	434
236	152	2.53	434
237	128	2.13	-7
238	168	2.80	728
239	161	2.68	599
240	187	3.12	1077
240	187	3.12	1077
241	167	2.78	709
242	167	2.78	709
243	185	3.08	1040
244	156	2.60	507
245	181	3.02	967
246	206	3.43	1426
247	156	2.60	507
248	178	2.97	911
249	184	3.07	1022
250	161	2.68	599

West Jefferson R #JN3-SSD4-A60-23

4" VCP to grade west of JN3



Pipe Explorer™

03/14/2000

Building: JN-3

Run Description: 75' West of JN3

Run ID: JN3-SSD4-A60-23

Pipe Type: 4" VCP to grade

Detector: LND 4-element GM S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

Count Time (s): 60.0

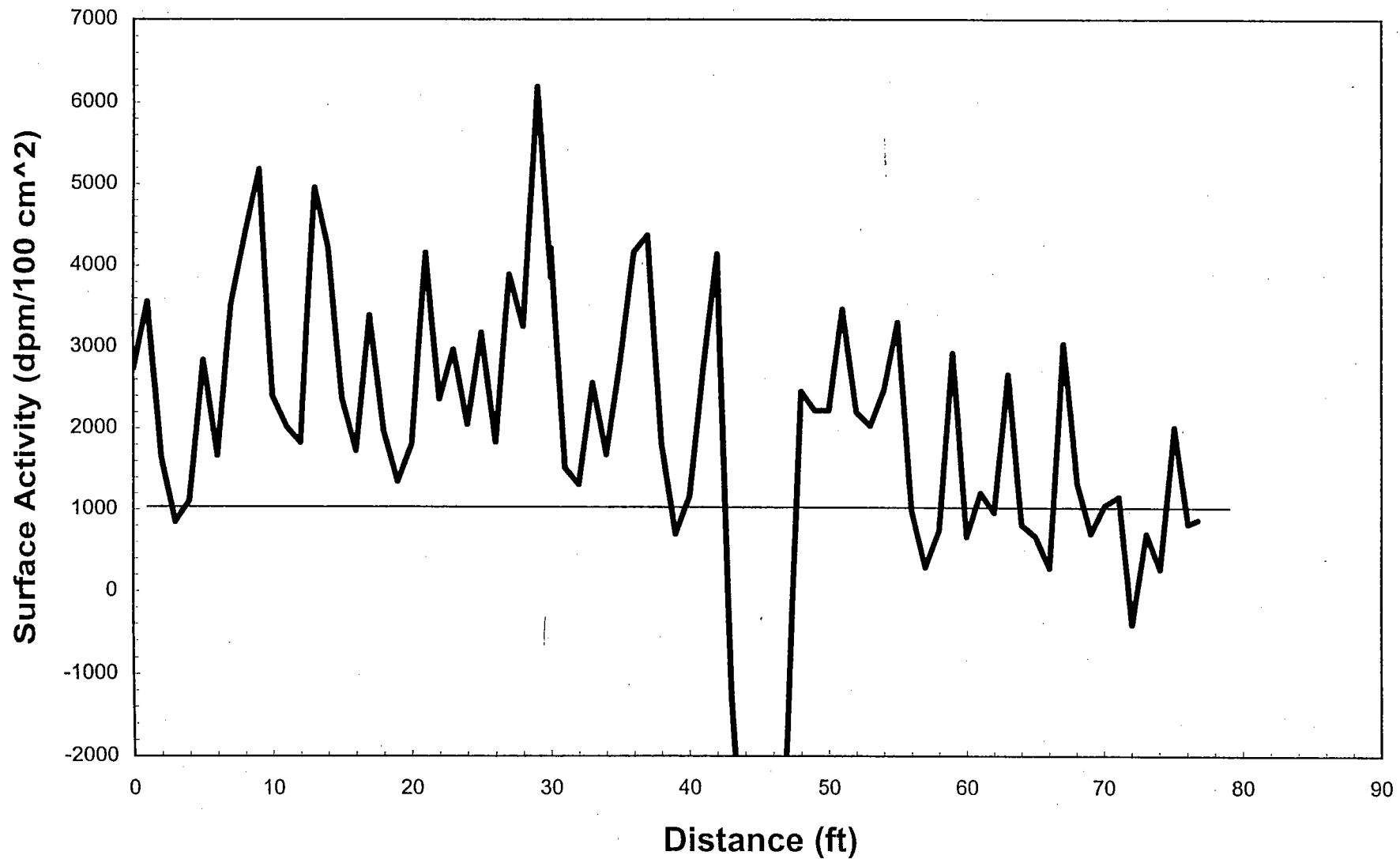
Background (cps): 2.1

MDA (dpm/100cm²): 1018

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
1	169	2.82	746
2	165	2.75	673
3	213	3.55	1555
4	193	3.22	1187
5	173	2.88	820
6	182	3.03	985
7	157	2.62	526
8	178	2.97	911
9	173	2.88	820
10	165	2.75	673
11	177	2.95	893
12	170	2.83	764
13	166	2.77	691
14	190	3.17	1132
15	159	2.65	562
15	192	3.20	1169
15	181	3.02	967
16	158	2.63	544
17	165	2.75	673
18	166	2.77	691
19	171	2.85	783
20	189	3.15	1114
21	185	3.08	1040
22	197	3.28	1261
23	210	3.50	1499
24	188	3.13	1095
25	180	3.00	948
26	189	3.15	1114
27	216	3.60	1610
28	182	3.03	985
29	234	3.90	1940
30	201	3.35	1334

30	247	4.12	2179
31	194	3.23	1205
32	211	3.52	1518
33	199	3.32	1297
34	212	3.53	1536
35	209	3.48	1481
36	197	3.28	1261

West Jefferson Run #NSF-PSD6-A250-24
Manhole 13 by North Filter Site



Pipe Explorer™

03/14/2000

Building: North Site Filter

Run Description: Manhole #13

Run ID: NSF-PSD6-A250-24

Pipe Type: 6" VCP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Court Time (s): 60.0

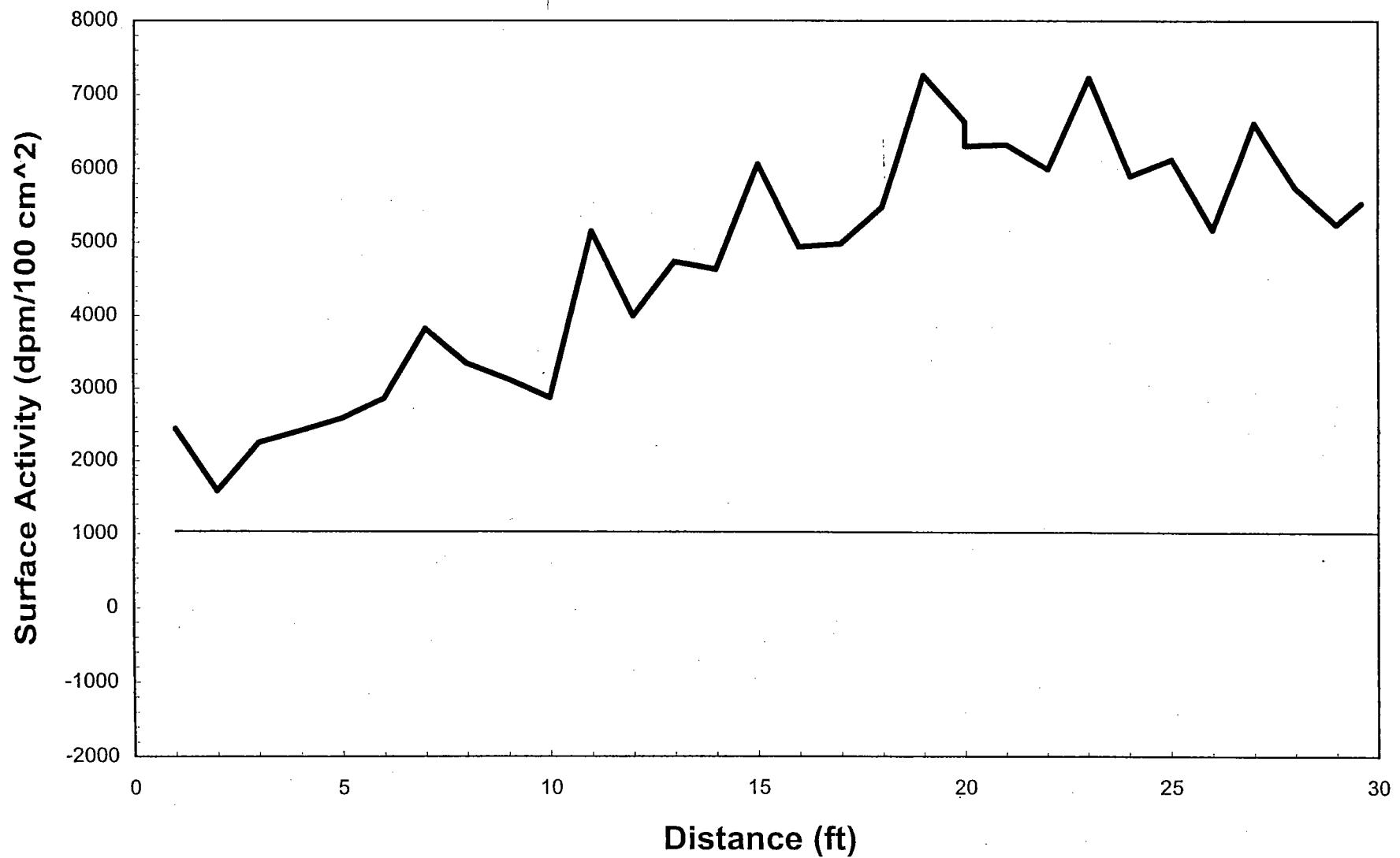
Background (cps): 86.8

MDA (dpm/100cm²): 1035

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	6103	101.72	2737
1	6373	106.22	3563
2	5745	95.75	1642
3	5486	91.43	850
4	5571	92.85	1110
5	6137	102.28	2841
6	5753	95.88	1667
7	6361	106.02	3526
8	6645	110.75	4394
9	6904	115.07	5187
10	5992	99.87	2398
11	5869	97.82	2021
12	5805	96.75	1826
13	6829	113.82	4957
14	6590	109.83	4226
15	5984	99.73	2373
16	5773	96.22	1728
17	6318	105.30	3394
18	5850	97.50	1963
19	5650	94.17	1352
20	5798	96.63	1804
21	6568	109.47	4159
22	5982	99.70	2367
23	6180	103.00	2972
24	5879	97.98	2052
25	6249	104.15	3183
26	5808	96.80	1835
27	6480	108.00	3890
28	6275	104.58	3263
29	7232	120.53	6190
30	6468	107.80	3853
30	6587	109.78	4217

31	5706	95.10	1523
32	5639	93.98	1318
33	6046	100.77	2563
34	5758	95.97	1682
35	6130	102.17	2820
36	6570	109.50	4165
37	6638	110.63	4373
38	5802	96.70	1817
39	5439	90.65	706
40	5591	93.18	1171
41	6107	101.78	2749
42	6562	109.37	4141
43	4784	79.73	-1297
44	3889	64.82	-4034
45	3706	61.77	-4593
46	3712	61.87	-4575
47	4654	77.57	-1694
48	6013	100.22	2462
49	5937	98.95	2229
50	5937	98.95	2229
51	6344	105.73	3474
52	5931	98.85	2211
53	5876	97.93	2043
54	6018	100.30	2477
55	6292	104.87	3315
56	5534	92.23	997
57	5305	88.42	297
58	5455	90.92	755
59	6168	102.80	2936
60	5429	90.48	676
61	5607	93.45	1220
62	5527	92.12	976
63	6082	101.37	2673
64	5478	91.30	826
65	5431	90.52	682
66	5302	88.37	287
67	6205	103.42	3049
68	5646	94.10	1339
69	5443	90.72	719
70	5557	92.62	1067
71	5593	93.22	1177
72	5076	84.60	-404
73	5442	90.70	716
74	5298	88.30	275
75	5871	97.85	2028
76	5481	91.35	835
76.7	5497	91.62	884

West Jefferson Run #MSF-PSD6-A140-25
Manhole #13 Next to Middle Site Filter



Pipe Explorer™

03/15/2000

Building: Middle Site Filter

Run Description: Manhole #13

Run ID: MSF-PSD6-A140-25

Pipe Type: 6" VCP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

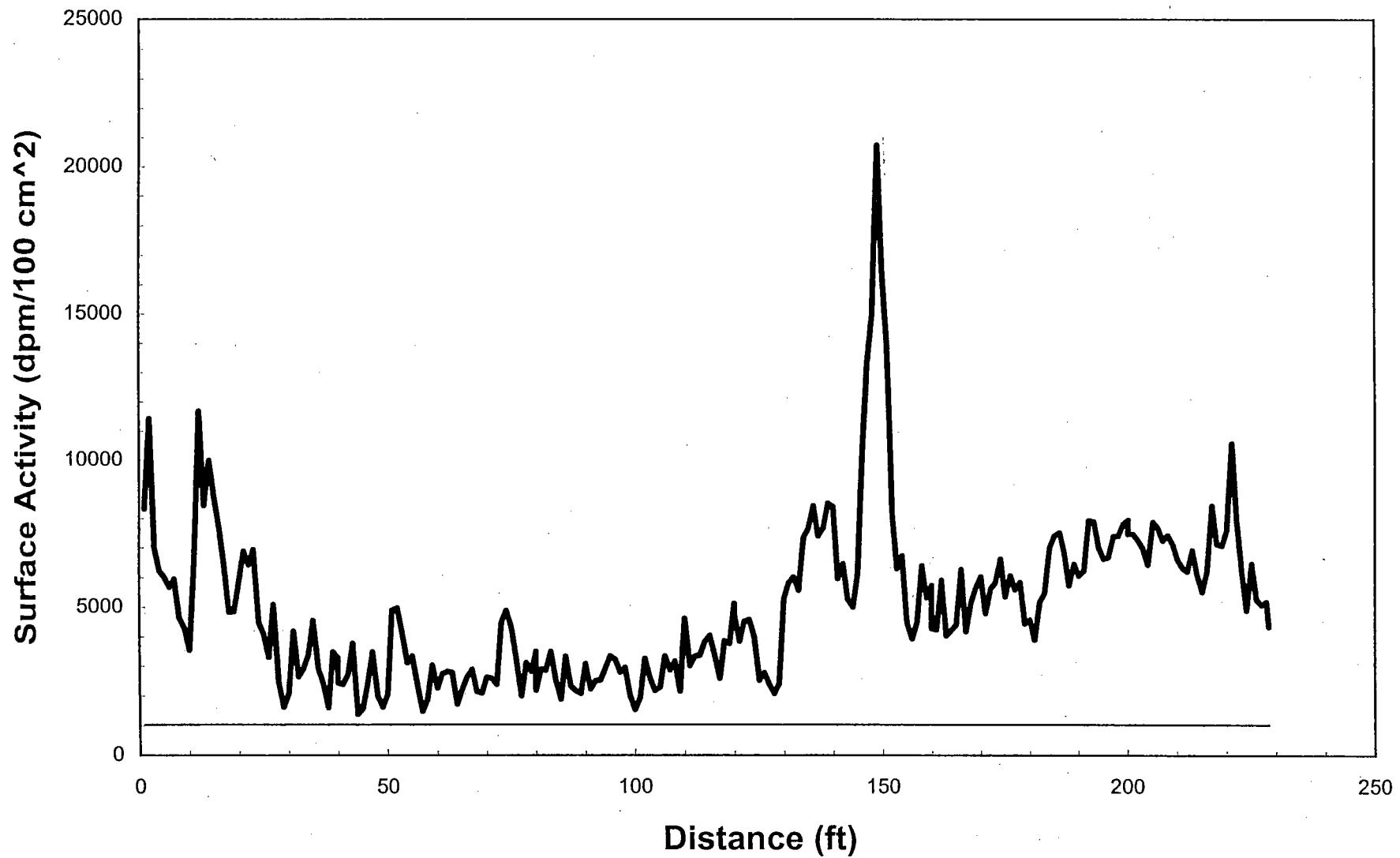
Count Time (s): 60.0

Background (cps): 86.8

MDA (dpm/100cm²): 1035

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
1	6006	100.10	2440
2	5727	95.45	1587
3	5944	99.07	2251
4	5998	99.97	2416
5	6055	100.92	2590
6	6145	102.42	2865
7	6459	107.65	3826
8	6304	105.07	3352
9	6231	103.85	3128
10	6148	102.47	2875
11	6894	114.90	5156
12	6516	108.60	4000
13	6757	112.62	4737
14	6724	112.07	4636
15	7193	119.88	6070
16	6824	113.73	4942
17	6838	113.97	4985
18	7001	116.68	5483
19	7583	126.38	7263
20	7377	122.95	6633
20	7272	121.20	6312
21	7279	121.32	6333
22	7170	119.50	6000
23	7572	126.20	7229
24	7140	119.00	5908
25	7214	120.23	6135
26	6900	115.00	5174
27	7372	122.87	6618
28	7089	118.15	5752
29	6924	115.40	5248
29.6	7018	116.97	5535

West Jefferson Run #MSF-PSD6-A140-26
Manhole #11 Next to Middle Site Filter



Pipe Explorer™

03/15/2000

Building: Middle Site Filter

Run Description: Manhole 11 to Manhole 12

Run ID: MSF-PSD6-A140-26

Pipe Type: 6" VCP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

Background (cps): 86.8

MDA (dpm/100cm²): 1035

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
1	7932	132.20	8330
2	8944	149.07	11425
3	7507	125.12	7031
4	7243	120.72	6223
5	7175	119.58	6015
6	7065	117.75	5679
7	7153	119.22	5948
8	6721	112.02	4627
9	6615	110.25	4303
10	6373	106.22	3563
11	7320	122.00	6459
12	9029	150.48	11685
13	7974	132.90	8459
14	8476	141.27	9994
15	8084	134.73	8795
16	7729	128.82	7709
17	7323	122.05	6468
18	6788	113.13	4832
19	6795	113.25	4853
20	7129	118.82	5875
21	7458	124.30	6881
22	7314	121.90	6440
23	7477	124.62	6939
24	6675	111.25	4486
25	6545	109.08	4089
26	6294	104.90	3321
27	6874	114.57	5095
28	6015	100.25	2468
29	5742	95.70	1633
30	5892	98.20	2092
31	6574	109.57	4177
32	6077	101.28	2657

33	6165	102.75	2927
34	6318	105.30	3394
35	6693	111.55	4541
36	6166	102.77	2930
37	6005	100.08	2437
38	5736	95.60	1615
39	6347	105.78	3483
40	6279	104.65	3275
40	6009	100.15	2450
41	5992	99.87	2398
42	6100	101.67	2728
43	6441	107.35	3771
44	5661	94.35	1385
45	5727	95.45	1587
46	6011	100.18	2456
47	6351	105.85	3495
48	5863	97.72	2003
49	5742	95.70	1633
50	5886	98.10	2073
51	6812	113.53	4905
52	6838	113.97	4985
53	6548	109.13	4098
54	6229	103.82	3122
55	6301	105.02	3343
56	5983	99.72	2370
57	5696	94.93	1492
58	5826	97.10	1890
59	6202	103.37	3040
60	5953	99.22	2278
61	6108	101.80	2752
62	6134	102.23	2832
63	6121	102.02	2792
64	5777	96.28	1740
65	5935	98.92	2223
66	6071	101.18	2639
67	6154	102.57	2893
68	5913	98.55	2156
69	5896	98.27	2104
70	6071	101.18	2639
71	6059	100.98	2602
72	5994	99.90	2404
73	6676	111.27	4489
74	6810	113.50	4899
75	6621	110.35	4321
76	6277	104.62	3269
77	5867	97.78	2015
78	6229	103.82	3122
79	6136	102.27	2838
80	6354	105.90	3505

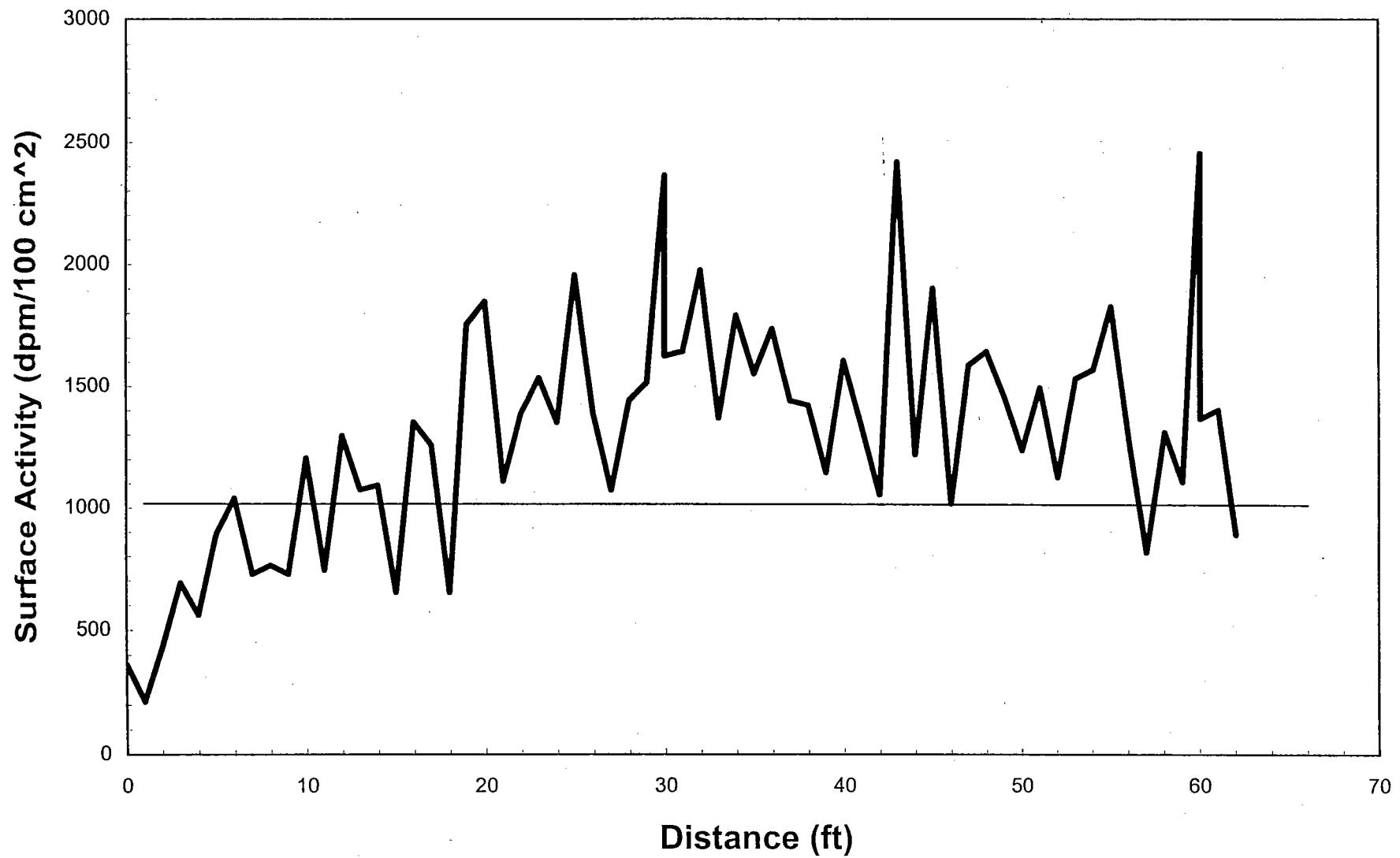
80	5927	98.78	2199
81	6159	102.65	2908
82	6152	102.53	2887
83	6352	105.87	3498
84	6042	100.70	2550
85	5828	97.13	1896
86	6300	105.00	3339
87	5972	99.53	2336
88	5921	98.68	2180
89	5893	98.22	2095
90	6219	103.65	3092
91	5942	99.03	2245
92	6032	100.53	2520
93	6043	100.72	2554
94	6171	102.85	2945
95	6306	105.10	3358
96	6265	104.42	3232
97	6130	102.17	2820
98	6177	102.95	2963
99	5867	97.78	2015
100	5714	95.23	1547
101	5847	97.45	1954
102	6278	104.63	3272
103	6062	101.03	2612
104	5925	98.75	2193
105	5965	99.42	2315
106	6302	105.03	3346
107	6155	102.58	2896
108	6248	104.13	3180
109	5920	98.67	2177
110	6718	111.97	4618
111	6202	103.37	3040
112	6301	105.02	3343
113	6317	105.28	3391
114	6459	107.65	3826
115	6529	108.82	4040
116	6324	105.40	3413
117	6061	101.02	2609
118	6472	107.87	3865
119	6445	107.42	3783
120	6891	114.85	5147
120	6769	112.82	4774
121	6469	107.82	3856
122	6689	111.48	4529
123	6709	111.82	4590
124	6516	108.60	4000
125	6042	100.70	2550
126	6123	102.05	2798
127	5999	99.98	2419

128	5894	98.23	2098
129	6002	100.03	2428
130	6946	115.77	5315
131	7117	118.62	5838
132	7185	119.75	6046
133	7040	117.33	5602
134	7622	127.03	7382
135	7728	128.80	7706
136	7978	132.97	8471
137	7641	127.35	7440
138	7733	128.88	7722
139	8008	133.47	8563
140	7971	132.85	8450
141	7170	119.50	6000
142	7330	122.17	6489
143	6940	115.67	5297
144	6855	114.25	5037
145	7229	120.48	6180
146	8684	144.73	10630
147	9583	159.72	13379
148	10113	168.55	15000
149	11991	199.85	20743
150	10595	176.58	16474
151	9781	163.02	13985
152	7897	131.62	8223
153	7281	121.35	6339
154	7421	123.68	6768
155	6678	111.30	4495
156	6501	108.35	3954
157	6682	111.37	4508
158	7309	121.82	6425
159	6961	116.02	5361
160	7094	118.23	5768
160	6613	110.22	4297
161	6599	109.98	4254
162	7150	119.17	5939
163	6534	108.90	4055
164	6597	109.95	4248
165	6655	110.92	4425
166	7271	121.18	6309
167	6583	109.72	4205
168	6904	115.07	5187
169	7065	117.75	5679
170	7190	119.83	6061
171	6784	113.07	4820
172	7057	117.62	5654
173	7127	118.78	5869
174	7385	123.08	6657
175	6975	116.25	5404

176	7203	120.05	6101
177	7050	117.50	5633
178	7128	118.80	5872
179	6670	111.17	4471
180	6711	111.85	4596
181	6490	108.17	3920
182	6910	115.17	5205
183	7012	116.87	5517
184	7510	125.17	7040
185	7646	127.43	7456
186	7686	128.10	7578
187	7450	124.17	6856
188	7097	118.28	5777
189	7330	122.17	6489
190	7204	120.07	6104
191	7261	121.02	6278
192	7823	130.38	7997
193	7808	130.13	7951
194	7519	125.32	7067
195	7391	123.18	6676
196	7407	123.45	6725
197	7644	127.40	7450
198	7646	127.43	7456
199	7783	129.72	7875
200	7827	130.45	8009
200	7668	127.80	7523
201	7667	127.78	7520
202	7597	126.62	7306
203	7504	125.07	7021
204	7329	122.15	6486
205	7806	130.10	7945
206	7741	129.02	7746
207	7595	126.58	7300
208	7657	127.62	7489
209	7554	125.90	7174
210	7385	123.08	6657
211	7293	121.55	6376
212	7255	120.92	6260
213	7482	124.70	6954
214	7217	120.28	6144
215	7029	117.15	5569
216	7257	120.95	6266
217	7990	133.17	8508
218	7556	125.93	7180
219	7538	125.63	7125
220	7716	128.60	7670
221	8690	144.83	10648
222	7818	130.30	7982
223	7262	121.03	6281

224	6819	113.65	4927
225	7337	122.28	6511
226	6943	115.72	5306
227	6883	114.72	5122
228	6918	115.30	5229
228.5	6637	110.62	4370

West Jefferson Run #AOL-SSD6-A70-27
Abandoned Outfall Line



Pipe Explorer™

03/16/2000

Building: N/A

Run Description: Abandoned outfall line

Run ID: AOL-SSD6-A70-27

Pipe Type: 6" VCP

Detector: LND 4-element GM S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

Count Time (s): 60.0

Background (cps): 2.1

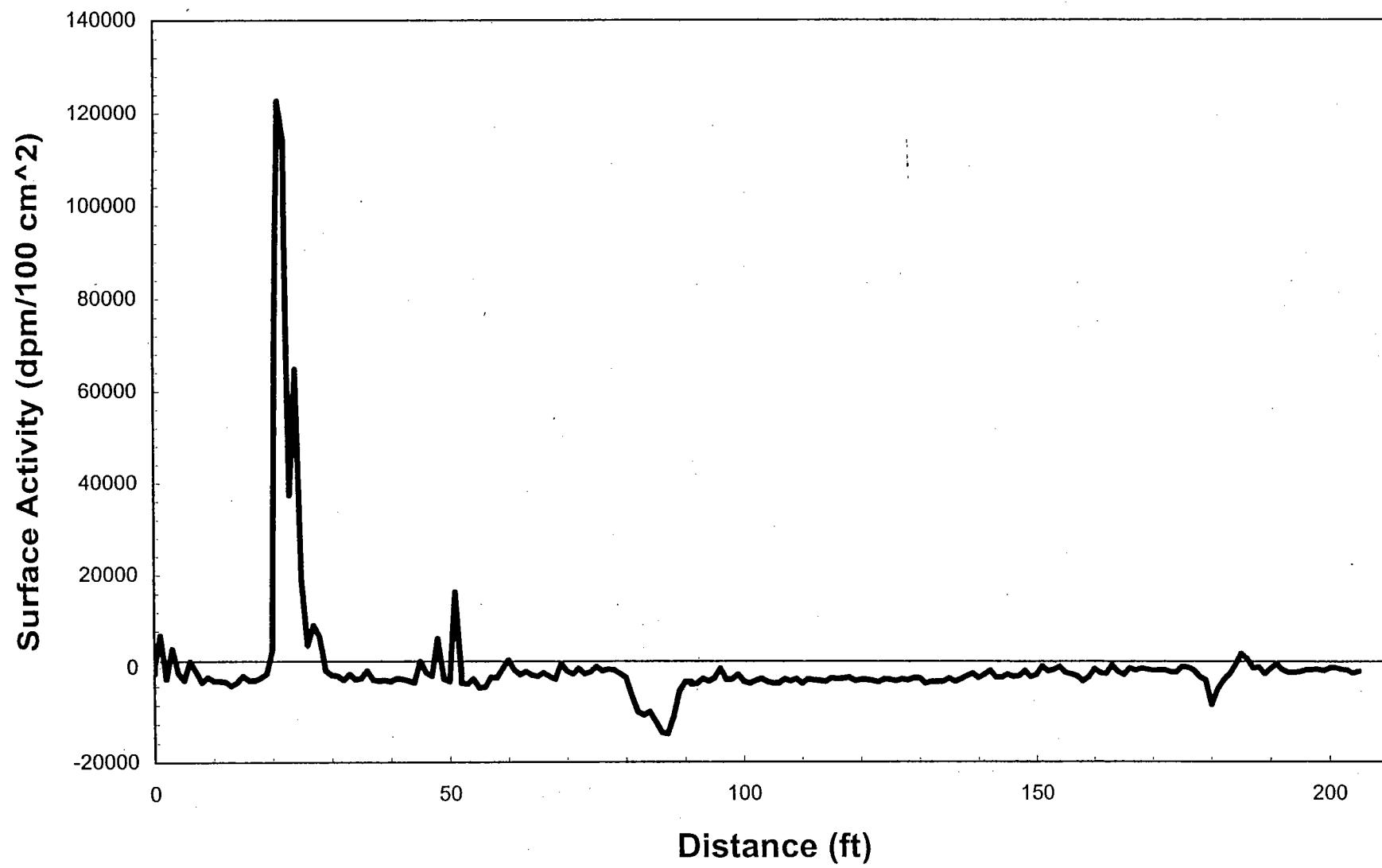
MDA (dpm/100cm²): 1018

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	148	2.47	360
1	140	2.33	213
2	152	2.53	434
3	166	2.77	691
4	159	2.65	562
5	177	2.95	893
6	185	3.08	1040
7	168	2.80	728
8	170	2.83	764
9	168	2.80	728
10	194	3.23	1205
11	169	2.82	746
12	199	3.32	1297
13	187	3.12	1077
14	188	3.13	1095
15	164	2.73	654
16	202	3.37	1352
17	197	3.28	1261
18	164	2.73	654
19	224	3.73	1757
20	229	3.82	1849
21	189	3.15	1114
22	204	3.40	1389
23	212	3.53	1536
24	202	3.37	1352
25	235	3.92	1959
26	204	3.40	1389
27	187	3.12	1077
28	207	3.45	1444
29	211	3.52	1518
30	257	4.28	2363

30	217	3.62	1628
31	218	3.63	1646
32	236	3.93	1977
33	203	3.38	1371
34	226	3.77	1793
35	213	3.55	1555
36	223	3.72	1738
37	207	3.45	1444
38	206	3.43	1426
39	191	3.18	1150
40	216	3.60	1610
41	201	3.35	1334
42	186	3.10	1058
43	260	4.33	2418
44	195	3.25	1224
45	232	3.87	1904
46	184	3.07	1022
47	215	3.58	1591
48	218	3.63	1646
49	208	3.47	1463
50	196	3.27	1242
51	210	3.50	1499
52	190	3.17	1132
53	212	3.53	1536
54	214	3.57	1573
55	228	3.80	1830
56	198	3.30	1279
57	173	2.88	820
58	200	3.33	1316
59	189	3.15	1114
60	262	4.37	2455
60	203	3.38	1371
61	205	3.42	1408
62	177	2.95	893
63	208	3.47	1463
64	215	3.58	1591
65	222	3.70	1720
66	242	4.03	2087
67	211	3.52	1518
68	228	3.80	1830
69	201	3.35	1334
70	183	3.05	1003
71	170	2.83	764
72	179	2.98	930
73	198	3.30	1279
74	177	2.95	893
75	194	3.23	1205
76	205	3.42	1408
77	192	3.20	1169

78	213	3.55	1555
79	188	3.13	1095
80	213	3.55	1555
81	217	3.62	1628
82	192	3.20	1169
83	223	3.72	1738
84	185	3.08	1040
85	168	2.80	728
86	180	3.00	948
87	181	3.02	967
88	211	3.52	1518
89	235	3.92	1959
89	204	3.40	1389
90	198	3.30	1279
91	225	3.75	1775
92	225	3.75	1775

West Jefferson Run #JN1-SSD8-A60-28
Manhole #16



Pipe Explorer™

03/17/2000

Building: JN-1

Run Description: From manhole 16 to manhole 4

Run ID: JN1-SSD8-A60-28

Pipe Type: 8" VCP

Detector: Ludlum 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

Background (cps): 154.00

MDA (dpm/100cm²): 1375

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	8852	147.53	-1187
0	9331	155.52	278
1	11543	192.38	7043
2	8469	141.15	-2358
3	10573	176.22	4076
4	8857	147.62	-1171
5	8381	139.68	-2627
6	9691	161.52	1379
7	8948	149.13	-893
8	8236	137.27	-3070
9	8579	142.98	-2021
10	8326	138.77	-2795
11	8309	138.48	-2847
12	8248	137.47	-3034
13	7988	133.13	-3829
14	8214	136.90	-3138
15	8665	144.42	-1758
16	8369	139.48	-2664
17	8338	138.97	-2758
18	8535	142.25	-2156
19	8827	147.12	-1263
20	10522	175.37	3920
21	49370	822.83	122722
22	46636	777.27	114361
23	21483	358.05	37440
24	30299	504.98	64401
24	30450	507.50	64862
25	15492	258.20	19119
26	10873	181.22	4994
27	12267	204.45	9257
28	11474	191.23	6832
29	9038	150.63	-618

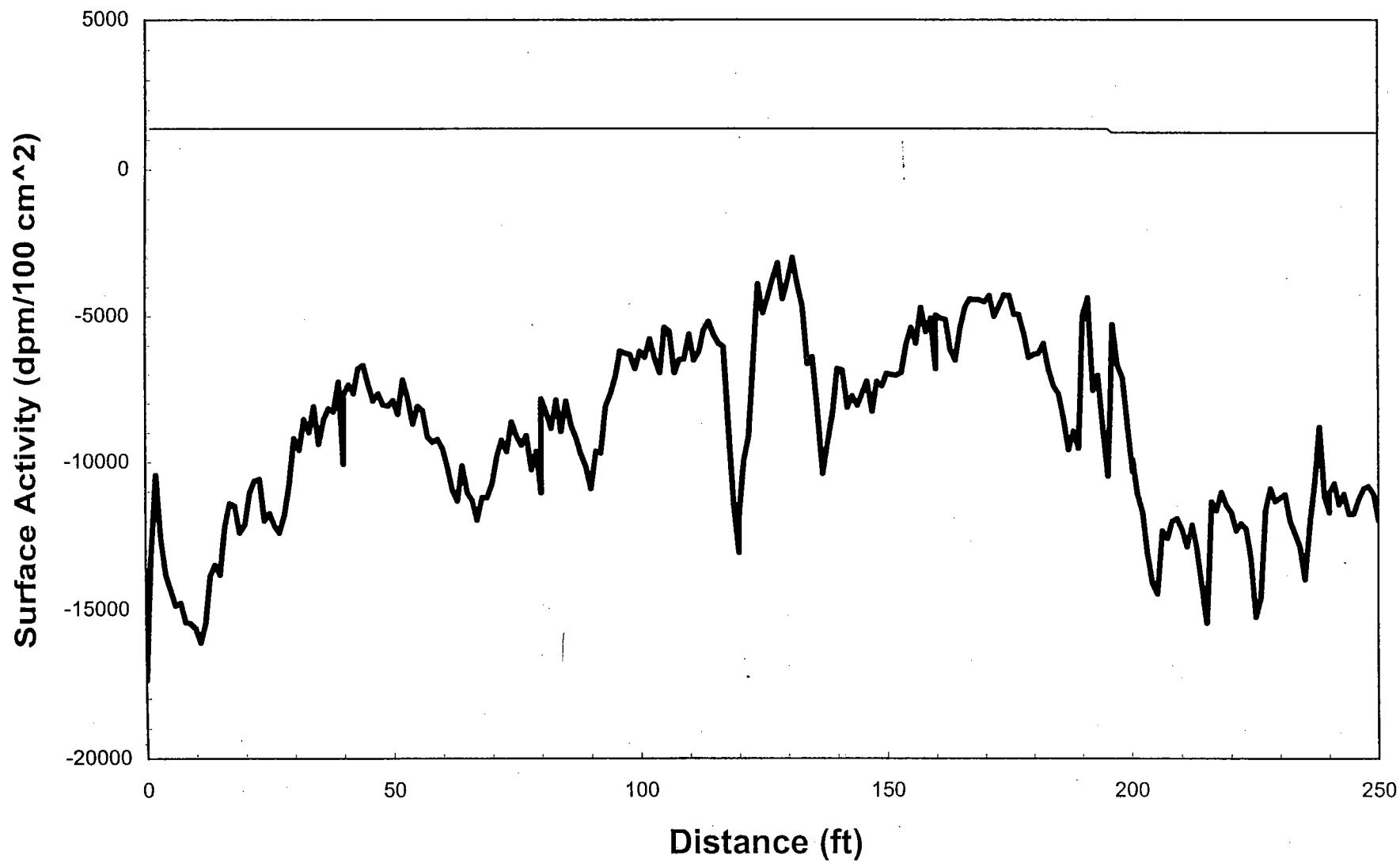
30	8710	145.17	-1621
31	8661	144.35	-1771
32	8383	139.72	-2621
33	8777	146.28	-1416
34	8409	140.15	-2541
35	8512	141.87	-2226
36	9031	150.52	-639
37	8401	140.02	-2566
38	8333	138.88	-2774
39	8358	139.30	-2697
40	8296	138.27	-2887
41	8482	141.37	-2318
42	8432	140.53	-2471
43	8320	138.67	-2813
44	8190	136.50	-3211
45	9688	161.47	1370
46	8897	148.28	-1049
47	8662	144.37	-1768
48	11329	188.82	6388
49	8456	140.93	-2398
50	8296	138.27	-2887
51	14585	243.08	16346
52	8623	143.72	-1887
52	8189	136.48	-3214
53	8103	135.05	-3477
54	8451	140.85	-2413
55	7841	130.68	-4278
56	7903	131.72	-4089
57	8554	142.57	-2098
58	8536	142.27	-2153
59	9177	152.95	-193
60	9800	163.33	1713
61	9102	151.70	-422
62	8760	146.00	-1468
63	8965	149.42	-841
64	8711	145.18	-1618
65	8633	143.88	-1856
66	8882	148.03	-1095
67	8625	143.75	-1881
68	8427	140.45	-2486
69	9516	158.60	844
70	9001	150.02	-731
71	8797	146.62	-1355
72	9192	153.20	-147
73	8809	146.82	-1318
74	8943	149.05	-908
75	9331	155.52	278
76	9031	150.52	-639
77	9123	152.05	-358

78	9072	151.20	-514
79	8819	146.98	-1287
80	8535	142.25	-2156
81	7261	121.02	-6052
82	6158	102.63	-9425
83	5943	99.05	-10083
84	6160	102.67	-9419
85	5475	91.25	-11514
86	4767	79.45	-13679
87	4662	77.70	-14000
88	5825	97.08	-10443
89	7596	126.60	-5028
90	8238	137.30	-3064
91	8261	137.68	-2994
91	8090	134.83	-3517
92	8126	135.43	-3407
93	8449	140.82	-2419
94	8288	138.13	-2911
95	8503	141.72	-2254
96	9186	153.10	-165
97	8400	140.00	-2569
98	8431	140.52	-2474
99	8758	145.97	-1474
100	8287	138.12	-2914
100	8276	137.93	-2948
101	8142	135.70	-3358
102	8328	138.80	-2789
103	8459	140.98	-2388
104	8254	137.57	-3015
105	8140	135.67	-3364
106	8140	135.67	-3364
107	8426	140.43	-2489
108	8290	138.17	-2905
109	8448	140.80	-2422
110	8133	135.55	-3385
111	8431	140.52	-2474
112	8357	139.28	-2700
113	8331	138.85	-2780
114	8272	137.87	-2960
115	8499	141.65	-2266
116	8454	140.90	-2404
117	8486	141.43	-2306
118	8564	142.73	-2067
119	8329	138.82	-2786
120	8393	139.88	-2590
121	8401	140.02	-2566
122	8316	138.60	-2826
123	8240	137.33	-3058
124	8430	140.50	-2477

125	8401	140.02	-2566
126	8307	138.45	-2853
127	8429	140.48	-2480
128	8354	139.23	-2709
129	8502	141.70	-2257
130	8502	141.70	-2257
131	8150	135.83	-3333
132	8268	137.80	-2972
133	8249	137.48	-3031
134	8274	137.90	-2954
135	8481	141.35	-2321
136	8264	137.73	-2985
137	8424	140.40	-2495
138	8639	143.98	-1838
139	8850	147.50	-1193
140	8518	141.97	-2208
141	8751	145.85	-1495
142	9040	150.67	-612
143	8562	142.70	-2073
144	8561	142.68	-2076
145	8780	146.33	-1407
146	8604	143.40	-1945
147	8673	144.55	-1734
148	9022	150.37	-667
149	8608	143.47	-1933
150	8750	145.83	-1498
150	8789	146.48	-1379
151	9350	155.83	336
152	9007	150.12	-713
153	9112	151.87	-391
154	9302	155.03	190
155	8900	148.33	-1040
156	8790	146.50	-1376
157	8654	144.23	-1792
158	8300	138.33	-2875
159	8579	142.98	-2021
160	9172	152.87	-208
161	8879	147.98	-1104
162	8829	147.15	-1257
163	9408	156.80	514
164	8965	149.42	-841
165	8756	145.93	-1480
166	9211	153.52	-89
167	9062	151.03	-544
168	9199	153.32	-125
169	9157	152.62	-254
170	9054	150.90	-569
171	9073	151.22	-511
172	9102	151.70	-422

173	8945	149.08	-902
174	8925	148.75	-963
175	9327	155.45	266
176	9272	154.53	98
177	9050	150.83	-581
178	8591	143.18	-1985
179	8384	139.73	-2618
180	6655	110.92	-7905
181	7719	128.65	-4651
182	8342	139.03	-2746
183	8749	145.82	-1502
184	9421	157.02	554
185	10263	171.05	3128
186	9892	164.87	1994
187	9236	153.93	-12
188	9293	154.88	162
189	8807	146.78	-1324
190	9209	153.48	-95
191	9505	158.42	810
192	9100	151.67	-428
193	8924	148.73	-966
194	8900	148.33	-1040
195	8974	149.57	-813
196	9103	151.72	-419
197	9118	151.97	-373
198	9135	152.25	-321
199	9032	150.53	-636
200	9228	153.80	-37
200	9245	154.08	15
201	9256	154.27	49
202	9128	152.13	-343
203	9068	151.13	-526
204	8858	147.63	-1168
205	8994	149.90	-752

West Jefferson Run #JN1-SSD-A160-29
SE from drain in grate by JN1 high bay door



Pipe Explorer™

03/18/2000

Building: JN1

Run Description: SE from drain in grate by JN1 high

Run ID: JN1-SSD-A160-29

Pipe Type: 6" mixed construction

Detector: Ludlum 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

Background (cps): 154.00

After 190' PVC

MDA (dpm/100cm²): 1375

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	3561	59.35	-17367
1	4877	81.28	-13343
2	5829	97.15	-10431
3	5144	85.73	-12526
4	4724	78.73	-13810
5	4552	75.87	-14336
6	4381	73.02	-14859
7	4414	73.57	-14758
8	4201	70.02	-15410
9	4187	69.78	-15453
10	4129	68.82	-15630
11	3974	66.23	-16104
12	4193	69.88	-15434
13	4710	78.50	-13853
14	4836	80.60	-13468
15	4727	78.78	-13801
16	5259	87.65	-12174
17	5511	91.85	-11404
18	5484	91.40	-11486
19	5192	86.53	-12379
20	5281	88.02	-12107
21	5627	93.78	-11049
22	5763	96.05	-10633
23	5784	96.40	-10569
24	5325	88.75	-11972
25	5403	90.05	-11734
26	5270	87.83	-12141
27	5191	86.52	-12382
28	5390	89.83	-11774
29	5726	95.43	-10746
30	6237	103.95	-9183
31	6109	101.82	-9575

32	6448	107.47	-8538
33	6305	105.08	-8976
34	6589	109.82	-8107
35	6176	102.93	-9370
36	6449	107.48	-8535
37	6567	109.45	-8174
38	6537	108.95	-8266
39	6871	114.52	-7245
40	5955	99.25	-10046
40	6719	111.98	-7709
41	6838	113.97	-7346
42	6741	112.35	-7642
43	7023	117.05	-6780
44	7060	117.67	-6667
45	6846	114.10	-7321
46	6658	110.97	-7896
47	6739	112.32	-7648
48	6616	110.27	-8024
49	6600	110.00	-8073
50	6662	111.03	-7884
51	6510	108.50	-8349
52	6896	114.93	-7168
53	6692	111.53	-7792
54	6400	106.67	-8685
55	6595	109.92	-8089
56	6552	109.20	-8220
57	6257	104.28	-9122
58	6197	103.28	-9306
59	6230	103.83	-9205
60	6128	102.13	-9517
61	5921	98.68	-10150
62	5663	94.38	-10939
63	5544	92.40	-11303
64	5933	98.88	-10113
65	5632	93.87	-11034
66	5550	92.50	-11284
67	5333	88.88	-11948
68	5579	92.98	-11196
69	5577	92.95	-11202
70	5731	95.52	-10731
71	6030	100.50	-9817
72	6222	103.70	-9229
73	6095	101.58	-9618
74	6423	107.05	-8615
75	6264	104.40	-9101
76	6164	102.73	-9407
77	6270	104.50	-9083
78	5893	98.22	-10235
79	6098	101.63	-9609

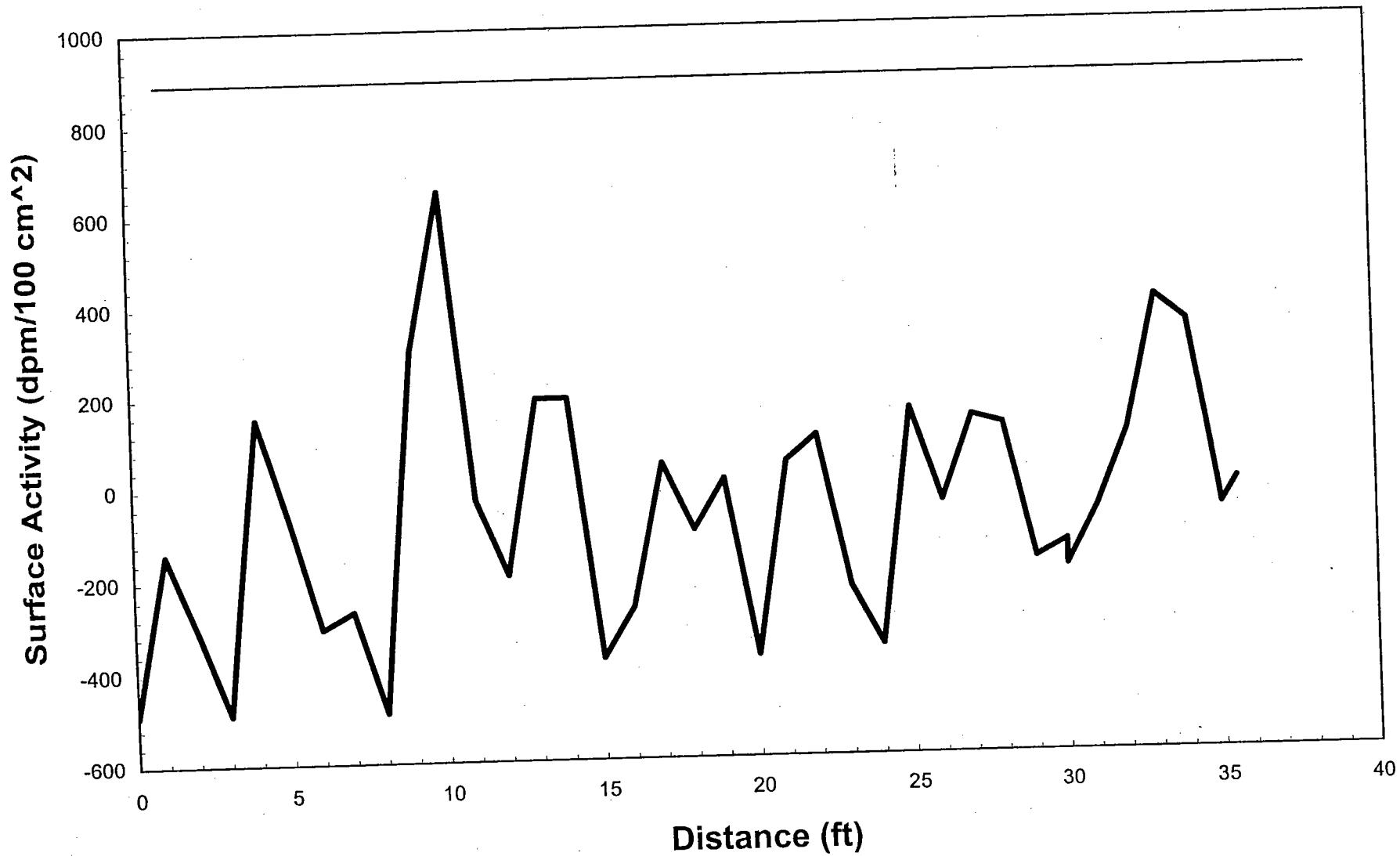
80	5636	93.93	-11021
80	6681	111.35	-7826
81	6532	108.87	-8281
82	6355	105.92	-8823
83	6669	111.15	-7862
84	6320	105.33	-8930
85	6654	110.90	-7908
86	6385	106.42	-8731
87	6251	104.18	-9141
88	6070	101.17	-9694
89	5923	98.72	-10144
90	5684	94.73	-10875
91	6099	101.65	-9606
92	6079	101.32	-9667
93	6594	109.90	-8092
94	6742	112.37	-7639
95	6925	115.42	-7080
96	7218	120.30	-6183
97	7195	119.92	-6254
98	7182	119.70	-6294
99	7026	117.10	-6771
100	7214	120.23	-6196
101	7153	119.22	-6382
102	7351	122.52	-5777
103	7141	119.02	-6419
104	6978	116.30	-6917
105	7480	124.67	-5382
106	7437	123.95	-5514
107	6979	116.32	-6914
108	7124	118.73	-6471
109	7133	118.88	-6443
110	7405	123.42	-5612
111	7121	118.68	-6480
112	7215	120.25	-6193
113	7452	124.20	-5468
114	7546	125.77	-5180
115	7402	123.37	-5621
116	7308	121.80	-5908
117	7268	121.13	-6031
118	6293	104.88	-9012
119	5500	91.67	-11437
120	4976	82.93	-13040
120	5369	89.48	-11838
121	5991	99.85	-9936
122	6260	104.33	-9113
123	7121	118.68	-6480
124	7969	132.82	-3887
125	7649	127.48	-4865
126	7834	130.57	-4300

127	8023	133.72	-3722
128	8206	136.77	-3162
129	7808	130.13	-4379
130	8004	133.40	-3780
131	8267	137.78	-2976
132	7971	132.85	-3881
133	7716	128.60	-4661
134	7083	118.05	-6596
135	7158	119.30	-6367
136	6512	108.53	-8343
137	5853	97.55	-10358
138	6193	103.22	-9318
139	6530	108.83	-8287
140	7026	117.10	-6771
141	7009	116.82	-6823
142	6589	109.82	-8107
143	6718	111.97	-7713
144	6613	110.22	-8034
145	6743	112.38	-7636
146	6883	114.72	-7208
147	6549	109.15	-8229
148	6882	114.70	-7211
149	6830	113.83	-7370
150	6975	116.25	-6927
151	6960	116.00	-6972
152	6955	115.92	-6988
153	6985	116.42	-6896
154	7298	121.63	-5939
155	7484	124.73	-5370
156	7313	121.88	-5893
157	7710	128.50	-4679
158	7437	123.95	-5514
159	7590	126.50	-5046
160	7030	117.17	-6758
160	7623	127.05	-4945
161	7589	126.48	-5049
162	7572	126.20	-5101
163	7240	120.67	-6116
164	7127	118.78	-6462
165	7480	124.67	-5382
166	7709	128.48	-4682
167	7804	130.07	-4391
168	7799	129.98	-4407
169	7796	129.93	-4416
170	7773	129.55	-4486
171	7845	130.75	-4266
172	7612	126.87	-4979
173	7733	128.88	-4609
174	7849	130.82	-4254

175	7848	130.80	-4257
176	7635	127.25	-4908
177	7632	127.20	-4917
178	7419	123.65	-5569
179	7156	119.27	-6373
180	7187	119.78	-6278
181	7199	119.98	-6242
182	7306	121.77	-5914
183	7019	116.98	-6792
184	6835	113.92	-7355
185	6751	112.52	-7612
186	6463	107.72	-8492
187	6127	102.12	-9520
188	6331	105.52	-8896
189	6142	102.37	-9474
190	5899	98.32	-4933
191	6094	101.57	-4336
192	5059	84.32	-7502
193	5230	87.17	-6979
194	4610	76.83	-8875
195	4107	68.45	-10413
196	5790	96.50	-5266
197	5337	88.95	-6651
198	5199	86.65	-7073
199	4639	77.32	-8786
200	4155	69.25	-10266
200	4288	71.47	-9859
201	3904	65.07	-11034
202	3701	61.68	-11654
203	3241	54.02	-13061
204	2909	48.48	-14076
205	2796	46.60	-14422
206	3495	58.25	-12284
207	3411	56.85	-12541
208	3600	60.00	-11963
209	3629	60.48	-11875
210	3508	58.47	-12245
211	3317	55.28	-12829
212	3559	59.32	-12089
213	3295	54.92	-12896
214	2897	48.28	-14113
215	2471	41.18	-15416
216	3819	63.65	-11294
217	3721	62.02	-11593
218	3922	65.37	-10979
219	3782	63.03	-11407
220	3698	61.63	-11664
221	3497	58.28	-12278
222	3574	59.57	-12043

223	3512	58.53	-12232
224	3192	53.20	-13211
225	2539	42.32	-15208
226	2747	45.78	-14572
227	3721	62.02	-11593
228	3965	66.08	-10847
229	3823	63.72	-11281
230	3861	64.35	-11165
231	3899	64.98	-11049
232	3608	60.13	-11939
233	3458	57.63	-12398
234	3313	55.22	-12841
235	2957	49.28	-13930
236	3566	59.43	-12067
237	4013	66.88	-10700
238	4647	77.45	-8761
239	3884	64.73	-11095
240	3702	61.70	-11651
240	3919	65.32	-10988
241	4022	67.03	-10673
242	3791	63.18	-11379
243	3906	65.10	-11028
244	3684	61.40	-11706
245	3688	61.47	-11694
246	3843	64.05	-11220
247	3968	66.13	-10838
248	3991	66.52	-10768
249	3907	65.12	-11024
250	3614	60.23	-11920

West Jefferson Run #JN1-SSD4-A80-30
PVC Pipe Protruding from Grade next to Lake



Pipe Explorer™

03/20/2000

Building: JN-1

Run Description: PVC pipe protruding from grade by

Run ID: JN1-SSD4-A80-30

Pipe Type: 4" PVC

Detector: LND 4 element S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

Count Time (s): 60.0

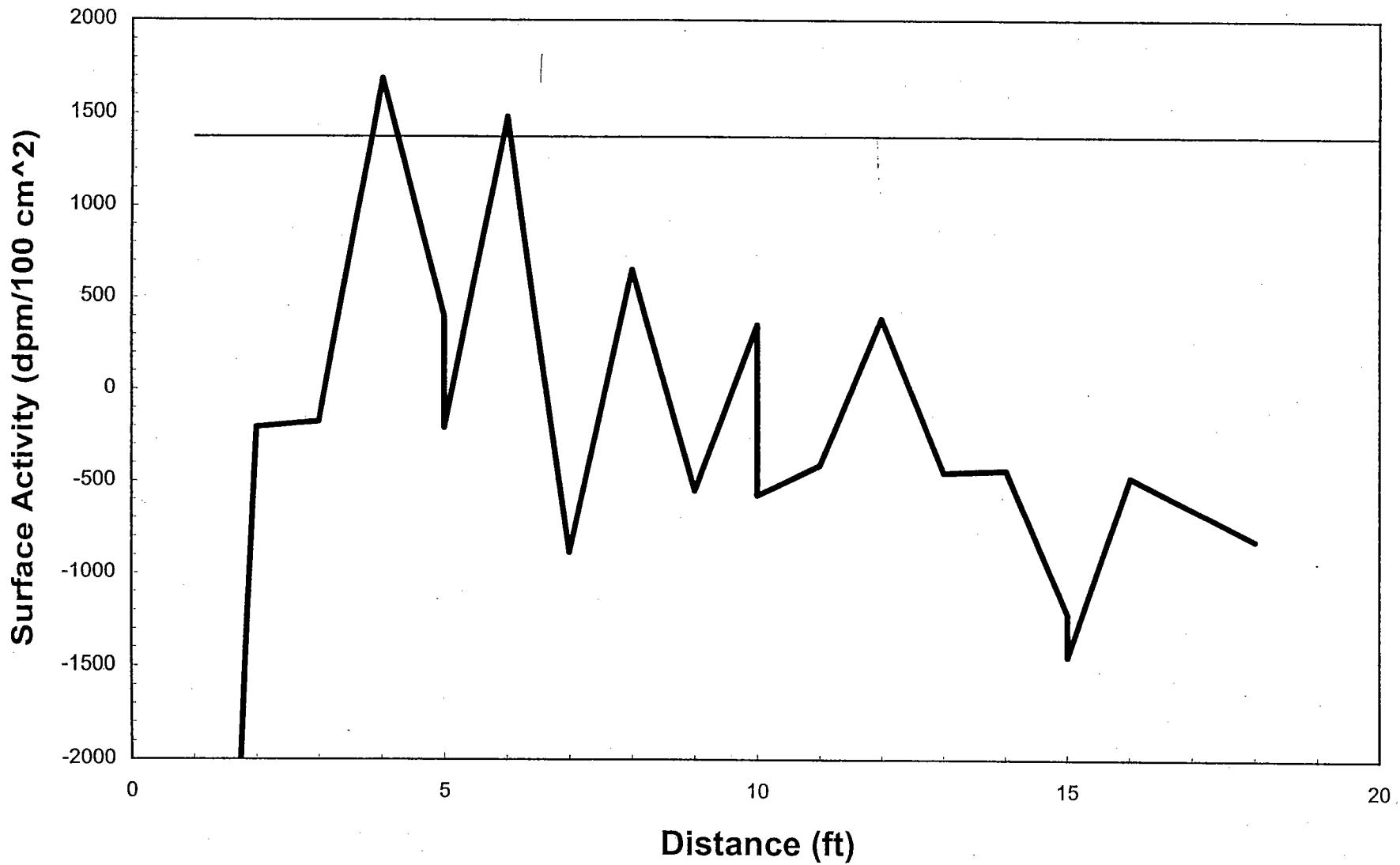
Background (cps): 1.61

MDA (dpm/100cm²): 890

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	70	1.17	-489
1	89	1.48	-140
2	80	1.33	-305
3	70	1.17	-489
4	105	1.75	154
5	93	1.55	-66
6	80	1.33	-305
7	82	1.37	-268
8	70	1.17	-489
9	113	1.88	301
10	132	2.20	650
11	95	1.58	-29
12	86	1.43	-195
13	107	1.78	191
14	107	1.78	191
15	76	1.27	-379
16	82	1.37	-268
17	99	1.65	44
18	91	1.52	-103
19	97	1.62	7
20	76	1.27	-379
21	99	1.65	44
22	102	1.70	99
23	84	1.40	-232
24	77	1.28	-360
25	105	1.75	154
26	94	1.57	-48
27	104	1.73	136
28	103	1.72	118
29	87	1.45	-176
30	89	1.48	-140
30	86	1.43	-195

31	93	1.55	-66
32	102	1.70	99
33	118	1.97	393
34	115	1.92	338
35	93	1.55	-66
35.5	96	1.60	-11

West Jefferson Run #JN1-SSD6-A280-31
6" VCP Protruding from Concrete Barrier Next to Lake



Pipe Explorer™

03/21/2000

Building: JN1

Run Description: Pipe protruding from concrete next to lake

Run ID: JN1-SSD6-A280-31

Pipe Type: 6" VCP

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

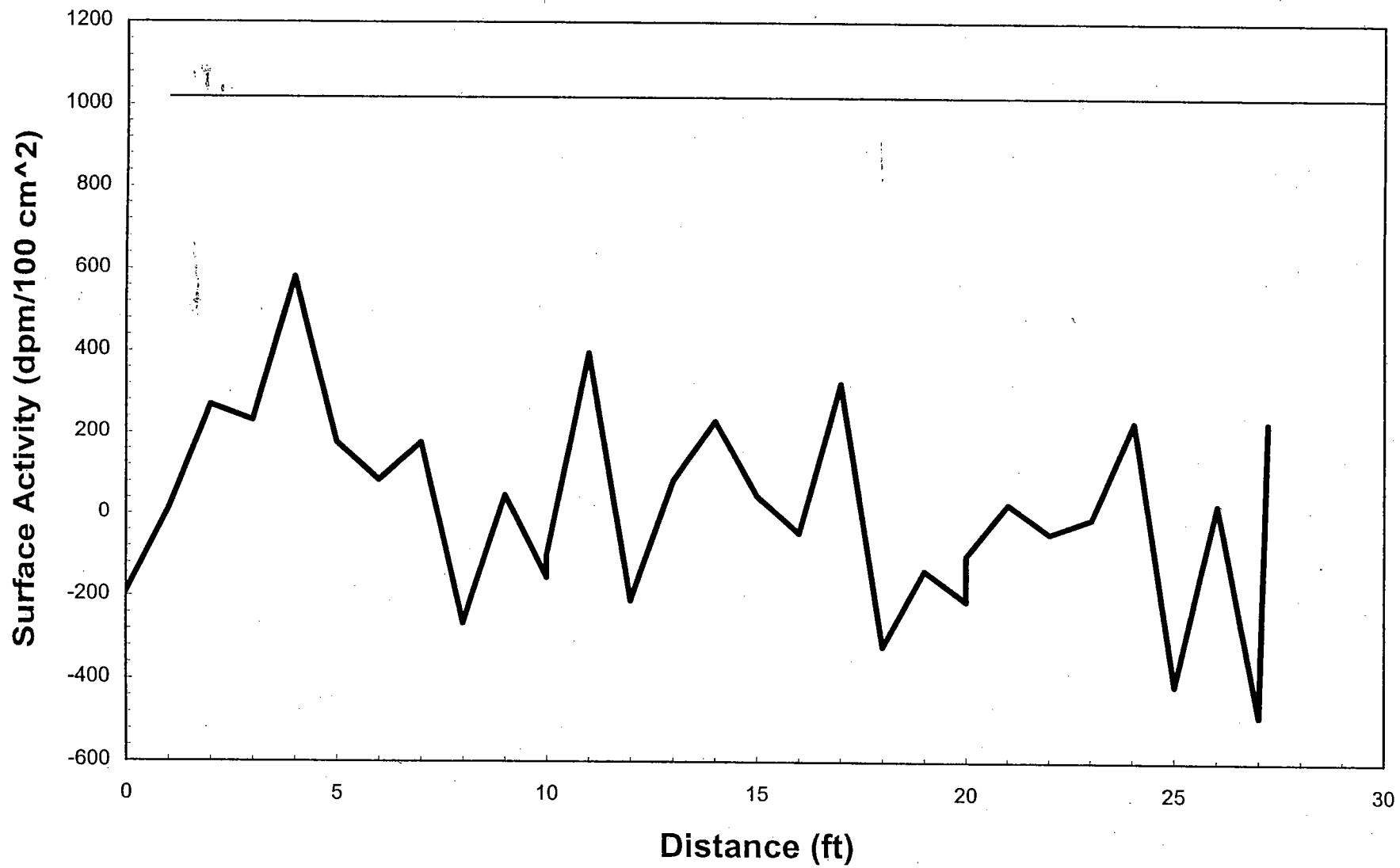
Background (cps): 154.0

MDA (dpm/100cm²): 1375

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	4162	69.37	-15529
1	6909	115.15	-7128
2	9173	152.88	-205
3	9183	153.05	-174
4	9792	163.20	1688
5	9370	156.17	398
5	9172	152.87	-208
6	9725	162.08	1483
7	8951	149.18	-884
8	9454	157.57	654
9	9061	151.02	-547
10	9357	155.95	358
10	9053	150.88	-572
11	9106	151.77	-410
12	9368	156.13	391
13	9094	151.57	-446
14	9098	151.63	-434
15	8842	147.37	-1217
15	8767	146.12	-1446
16	9086	151.43	-471
17	9030	150.50	-642
18	8974	149.57	-813

West Jefferson Run #JN1-SSD6-A300-32

North from Sump #1



Pipe Explorer™

03/21/2000

Building: JN-3

Run Description: North from Sump #1

Run ID: JN1-SSD6-A300-32

Pipe Type: 6" VCP

Detector: LND 4-element GM

Yield Factor (cps/dpm/100cm²): 9.07E-04

Count Time (s): 60.0

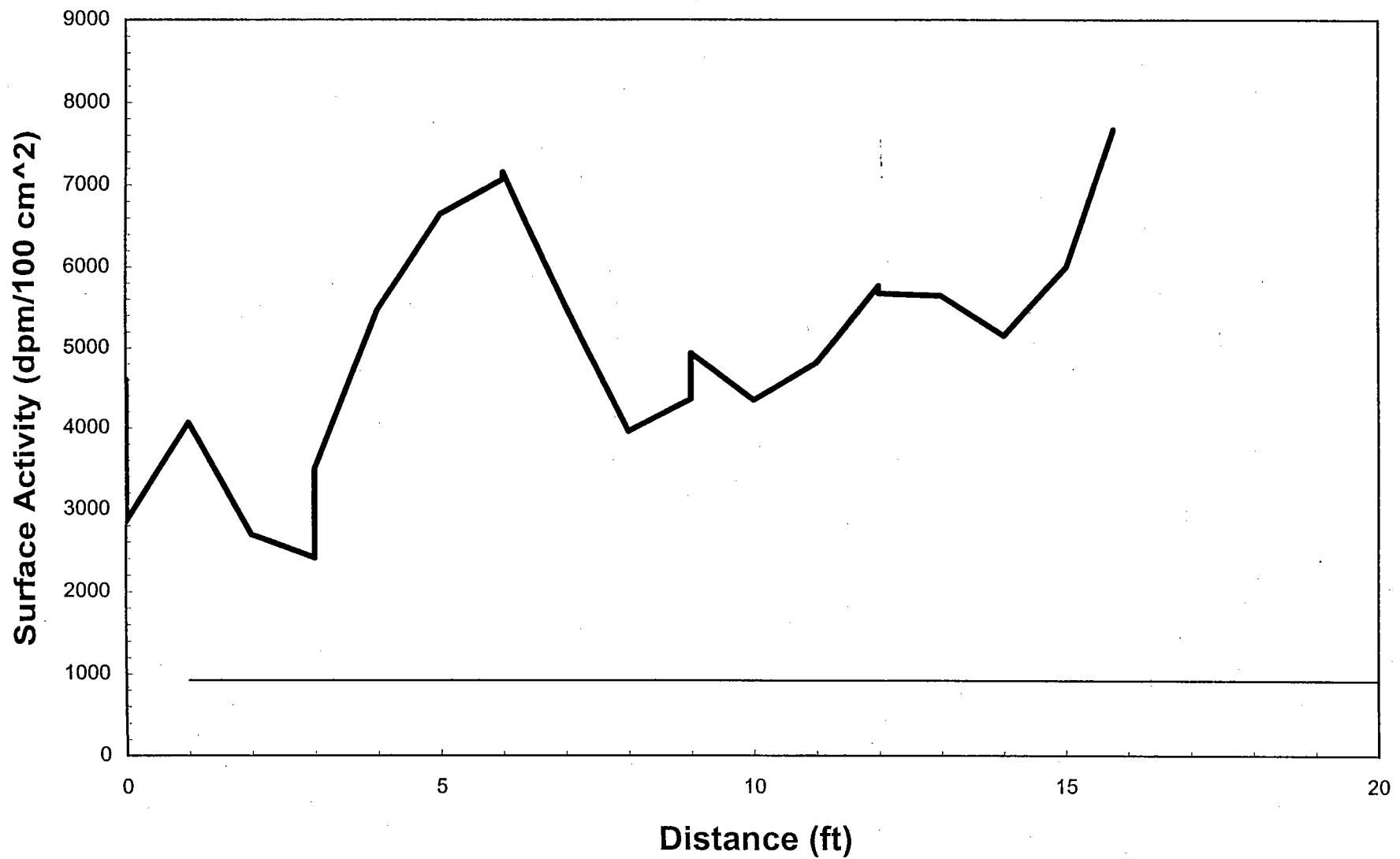
Background (cps): 2.1

MDA (dpm/100cm²): 1018

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	118	1.97	-191
1	129	2.15	11
2	143	2.38	268
3	141	2.35	232
4	160	2.67	581
5	138	2.30	176
6	133	2.22	85
7	138	2.30	176
8	114	1.90	-265
9	131	2.18	48
10	120	2.00	-154
10	123	2.05	-99
11	150	2.50	397
12	117	1.95	-209
13	133	2.22	85
14	141	2.35	232
15	131	2.18	48
16	126	2.10	-44
17	146	2.43	323
18	111	1.85	-320
19	121	2.02	-136
20	117	1.95	-209
20	123	2.05	-99
21	130	2.17	29
22	126	2.10	-44
23	128	2.13	-7
24	141	2.35	232
25	106	1.77	-412
26	130	2.17	29
27	102	1.70	-485
27.2	141	2.35	232

West Jefferson Run #JN1-SSD12-A275-33

12" concrete pipe to grade by dam



Pipe Explorer™

03/22/2000

Building: JN1

Run Description: 12" concrete pipe to grade by dam

Run ID: JN1-SSD12-A275-33

Pipe Type: 12" concrete

Detector: 44-10 S/N PR165908

Yield Factor (cps/dpm/100cm²): 5.45E-03

Count Time (s): 60.0

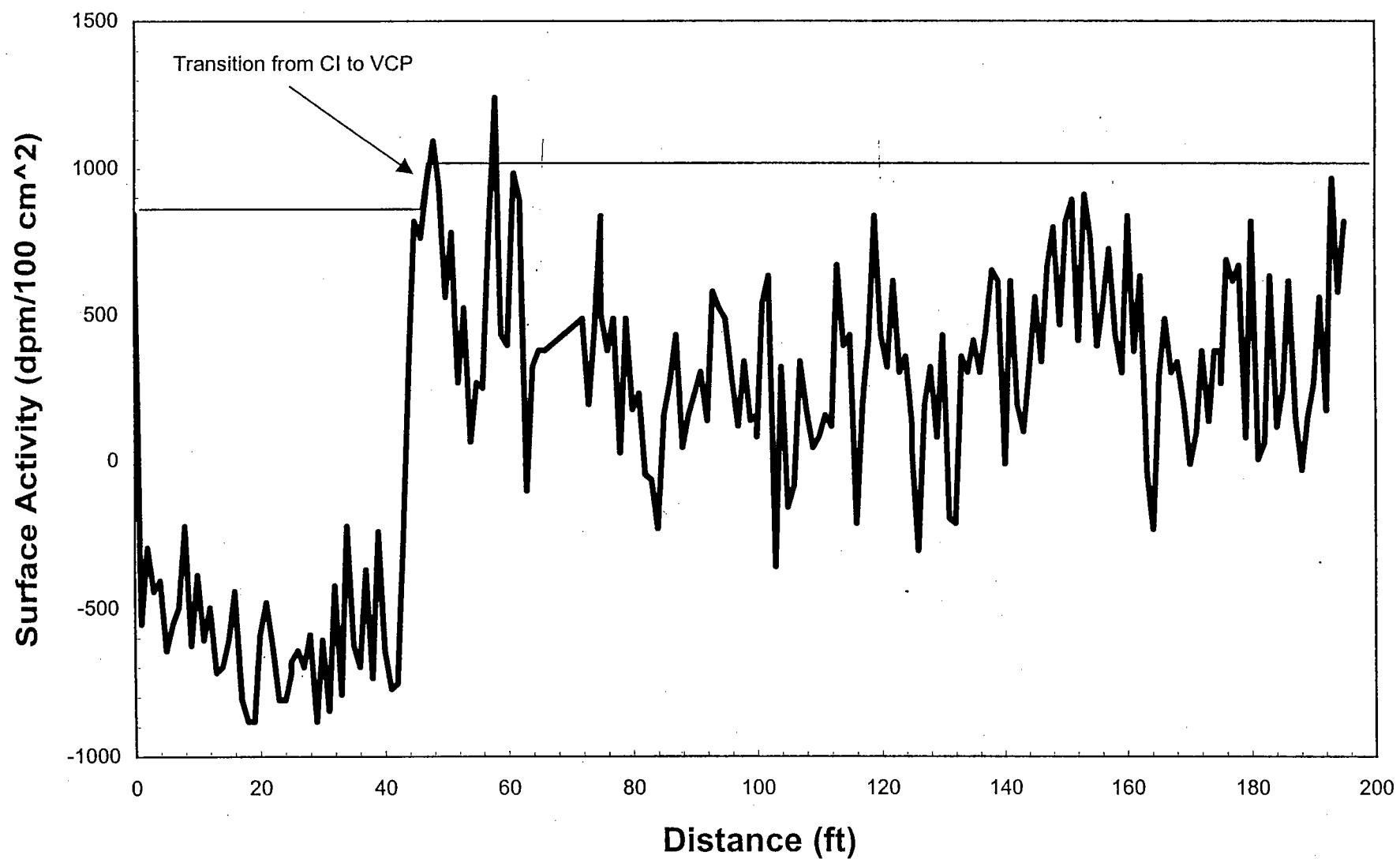
Background (cps): 68.7

MDA (dpm/100cm²): 921

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	5628	93.80	4606
0	5056	84.27	2856
1	5452	90.87	4067
2	5003	83.38	2694
3	4911	81.85	2413
3	5267	87.78	3502
4	5911	98.52	5471
5	6296	104.93	6648
6	6433	107.22	7067
6	6461	107.68	7153
7	5928	98.80	5523
8	5419	90.32	3966
9	5550	92.50	4367
9	5737	95.62	4939
10	5546	92.43	4355
11	5698	94.97	4820
12	6009	100.15	5771
12	5979	99.65	5679
13	5970	99.50	5651
14	5811	96.85	5165
15	6088	101.47	6012
15.75	6630	110.50	7670

West Jefferson Run #JN4-SSD6-A130-34

Cleanout next to JN4 to manhole #4



Pipe Explorer™

03/24/2000

Building: JN4

Run Description: Cleanout next to JN4 to manhole #

Run ID: JN4-SSD6-A130-34

Pipe Type: 6" VCP and CI

Detector: LND 4-element GM S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

Count Time (s): 60.0

Background (cps): 1.50

After 43' VCP

MDA (dpm/100cm²): 860

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	124	2.07	625
0	136	2.27	845
1	60	1.00	-551
2	74	1.23	-294
3	66	1.10	-441
4	68	1.13	-404
5	55	0.92	-643
6	60	1.00	-551
7	63	1.05	-496
8	78	1.30	-221
9	56	0.93	-625
10	69	1.15	-386
11	57	0.95	-606
12	63	1.05	-496
13	51	0.85	-717
14	52	0.87	-698
15	57	0.95	-606
16	66	1.10	-441
17	46	0.77	-809
18	42	0.70	-882
19	42	0.70	-882
20	58	0.97	-588
21	64	1.07	-478
22	56	0.93	-625
23	46	0.77	-809
24	46	0.77	-809
25	51	0.85	-717
25	53	0.88	-680
26	55	0.92	-643
27	52	0.87	-698
28	58	0.97	-588
29	42	0.70	-882

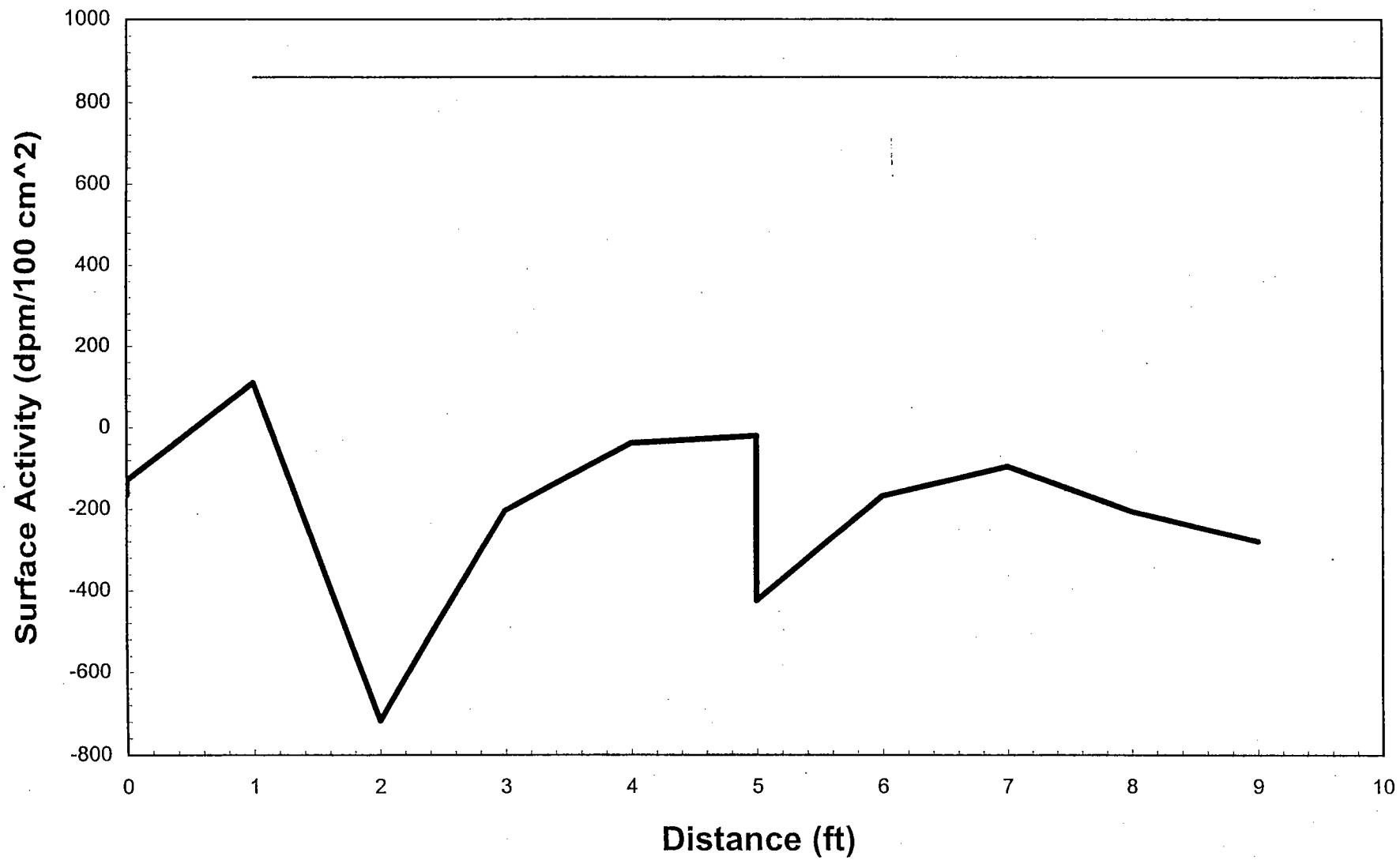
30	57	0.95	-606
31	44	0.73	-845
32	67	1.12	-423
33	47	0.78	-790
34	78	1.30	-221
35	56	0.93	-625
36	52	0.87	-698
37	70	1.17	-368
38	50	0.83	-735
39	77	1.28	-239
40	55	0.92	-643
41	48	0.80	-772
42	49	0.82	-753
43	75	1.25	-276
44	145	2.42	305
45	173	2.88	820
46	170	2.83	764
47	180	3.00	948
48	188	3.13	1095
49	179	2.98	930
50	159	2.65	562
50	159	2.65	562
51	171	2.85	783
52	143	2.38	268
53	157	2.62	526
54	132	2.20	66
55	143	2.38	268
56	142	2.37	250
57	170	2.83	764
58	196	3.27	1242
59	152	2.53	— 434
60	150	2.50	397
61	182	3.03	985
62	177	2.95	893
63	123	2.05	-99
64	146	2.43	323
65	149	2.48	379
66	149	2.48	379
72	155	2.58	489
73	139	2.32	195
74	154	2.57	470
75	174	2.90	838
75	156	2.60	507
76	149	2.48	379
77	155	2.58	489
78	130	2.17	29
79	155	2.58	489
80	138	2.30	176
81	141	2.35	232

82	126	2.10	-44
83	125	2.08	-62
84	116	1.93	-228
85	137	2.28	158
86	143	2.38	268
87	152	2.53	434
88	131	2.18	48
89	137	2.28	158
90	141	2.35	232
91	145	2.42	305
92	136	2.27	140
93	160	2.67	581
94	157	2.62	526
95	155	2.58	489
96	144	2.40	287
97	135	2.25	121
98	147	2.45	342
99	136	2.27	140
100	137	2.28	158
100	133	2.22	85
101	158	2.63	544
102	163	2.72	636
103	109	1.82	-356
104	146	2.43	323
105	120	2.00	-154
106	124	2.07	-81
107	147	2.45	342
108	138	2.30	176
109	131	2.18	48
110	133	2.22	85
111	137	2.28	158
112	135	2.25	121
113	165	2.75	673
114	150	2.50	397
115	152	2.53	434
116	117	1.95	-209
117	139	2.32	195
118	151	2.52	415
119	174	2.90	838
120	152	2.53	434
121	146	2.43	323
122	162	2.70	617
123	145	2.42	305
124	148	2.47	360
125	135	2.25	121
125	130	2.17	29
126	112	1.87	-301
127	139	2.32	195
128	146	2.43	323

129	133	2.22	85
130	152	2.53	434
131	118	1.97	-191
132	117	1.95	-209
133	148	2.47	360
134	145	2.42	305
135	151	2.52	415
136	145	2.42	305
137	153	2.55	452
138	164	2.73	654
139	162	2.70	617
140	128	2.13	-7
141	162	2.70	617
142	139	2.32	195
143	134	2.23	103
144	146	2.43	323
145	159	2.65	562
146	147	2.45	342
147	165	2.75	673
148	172	2.87	801
149	154	2.57	470
150	172	2.87	801
150	173	2.88	820
151	177	2.95	893
152	151	2.52	415
153	178	2.97	911
154	170	2.83	764
155	150	2.50	397
156	158	2.63	544
157	168	2.80	728
158	152	2.53	434
159	145	2.42	305
160	174	2.90	838
161	149	2.48	379
162	163	2.72	636
163	127	2.12	-26
164	116	1.93	-228
165	144	2.40	287
166	155	2.58	489
167	145	2.42	305
168	147	2.45	342
169	139	2.32	195
170	128	2.13	-7
171	134	2.23	103
172	149	2.48	379
173	136	2.27	140
174	149	2.48	379
175	149	2.48	379
175	143	2.38	268

176	166	2.77	691
177	162	2.70	617
178	165	2.75	673
179	133	2.22	85
180	173	2.88	820
181	129	2.15	11
182	132	2.20	66
183	163	2.72	636
184	135	2.25	121
185	142	2.37	250
186	162	2.70	617
187	137	2.28	158
188	127	2.12	-26
189	137	2.28	158
190	143	2.38	268
191	159	2.65	562
192	138	2.30	176
193	181	3.02	967
194	160	2.67	581
195	173	2.88	820

West Jefferson Run #JN1-SSD6-A80-35
Corrugated Pipe from Shallow Manhole Found Next to JN-1



Pipe Explorer™

03/27/2000

Building: JN-1

Run Description: Corrugated pipe from manhole found next to JN-1

Run ID: JN1-SSD6-A80-35

Pipe Type: 6" Corrugated steel

Detector: LND 4 Element S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

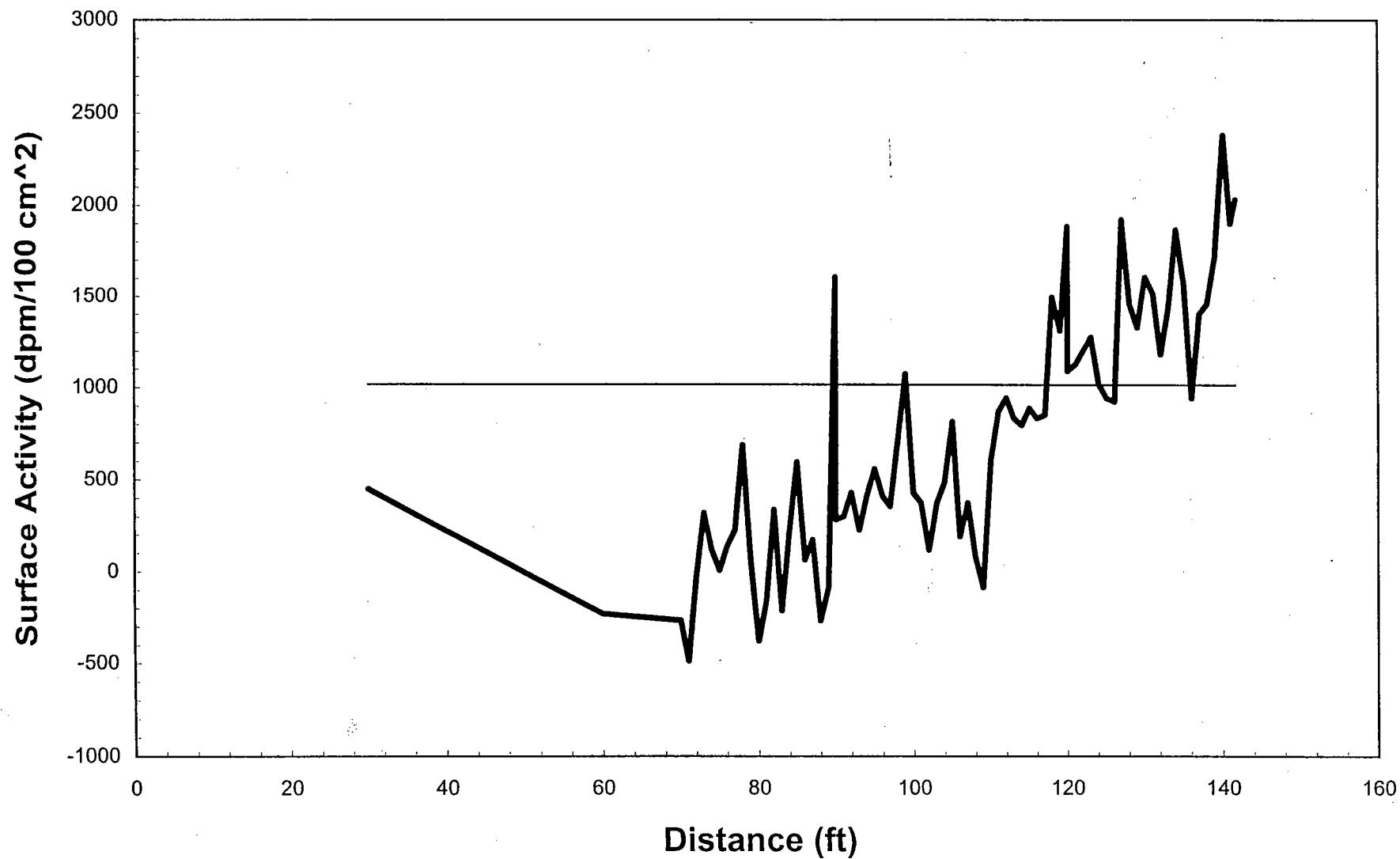
Count Time (s): 60.0

Background (cps): 1.50

MDA (dpm/100cm²): 860

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
0	81	1.35	-165
0	83	1.38	-129
1	96	1.60	110
2	51	0.85	-717
3	79	1.32	-202
4	88	1.47	-37
5	89	1.48	-18
5	67	1.12	-423
6	81	1.35	-165
7	85	1.42	-92
8	79	1.32	-202
9	75	1.25	-276

West Jefferson Run #JN3-SSD6-A120-37
Inside JN-3, South Side Roof Drain



Pipe Explorer™

03/28/2000

Building: JN-3

Run Description: Inside JN-3, south side roof drain

Run ID: JN3-SSD6-A120-37

Pipe Type: 6" VCP

Detector: LND 4-element GM S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

Count Time (s): 60.0

Background (cps): 2.14

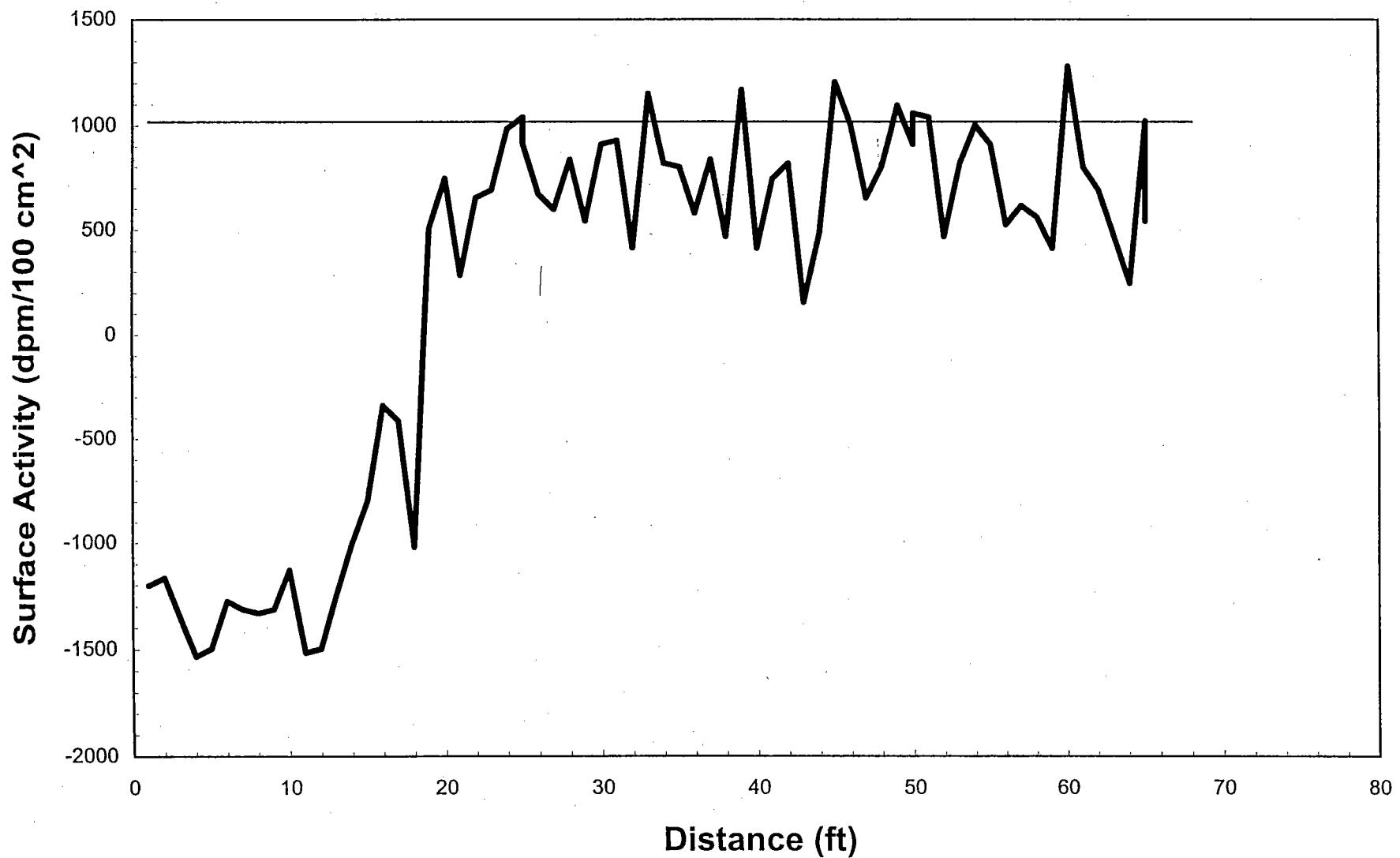
MDA (dpm/100cm²): 1018

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
30	153	2.55	452
60	116	1.93	-228
70	114	1.90	-265
71	102	1.70	-485
72	127	2.12	-26
73	146	2.43	323
74	135	2.25	121
75	129	2.15	11
76	136	2.27	140
77	141	2.35	232
78	166	2.77	691
79	132	2.20	66
80	108	1.80	-375
81	120	2.00	-154
82	147	2.45	342
83	117	1.95	-209
84	141	2.35	232
85	161	2.68	599
86	132	2.20	66
87	138	2.30	176
88	114	1.90	-265
89	124	2.07	-81
90	216	3.60	1610
90	144	2.40	287
91	145	2.42	305
92	152	2.53	434
93	141	2.35	232
94	151	2.52	415
95	159	2.65	562
96	151	2.52	415
97	148	2.47	360

98	168	2.80	728
99	187	3.12	1077
100	152	2.53	434
101	149	2.48	379
102	135	2.25	121
103	149	2.48	379
104	155	2.58	489
105	173	2.88	820
106	139	2.32	195
107	149	2.48	379
108	133	2.22	85
109	124	2.07	-81
110	162	2.70	617
111	176	2.93	875
112	180	3.00	948
113	174	2.90	838
114	172	2.87	801
115	177	2.95	893
116	174	2.90	838
117	175	2.92	856
118	210	3.50	1499
119	200	3.33	1316
120	231	3.85	1885
120	188	3.13	1095
121	190	3.17	1132
122	194	3.23	1205
123	198	3.30	1279
124	184	3.07	1022
125	180	3.00	948
126	179	2.98	930
127	233	3.88	1922
128	208	3.47	1463
129	201	3.35	1334
130	216	3.60	1610
131	211	3.52	1518
132	193	3.22	1187
133	207	3.45	1444
134	230	3.83	1867
135	214	3.57	1573
136	180	3.00	948
137	205	3.42	1408
138	208	3.47	1463
139	222	3.70	1720
140	258	4.30	2381
141	232	3.87	1904
141.6	239	3.98	2032

West Jefferson Run #JN3-SSD5-A325-38

Inside JN-3, North Side Roof Drain



Pipe Explorer™

03/29/2000

Building: JN-3

Run Description: Inside JN-3, north side roof drain

Run ID: JN3-SSD5-A325-38

Pipe Type: 5" VCP

Detector: LND 4-element GM S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

Count Time (s): 60.0

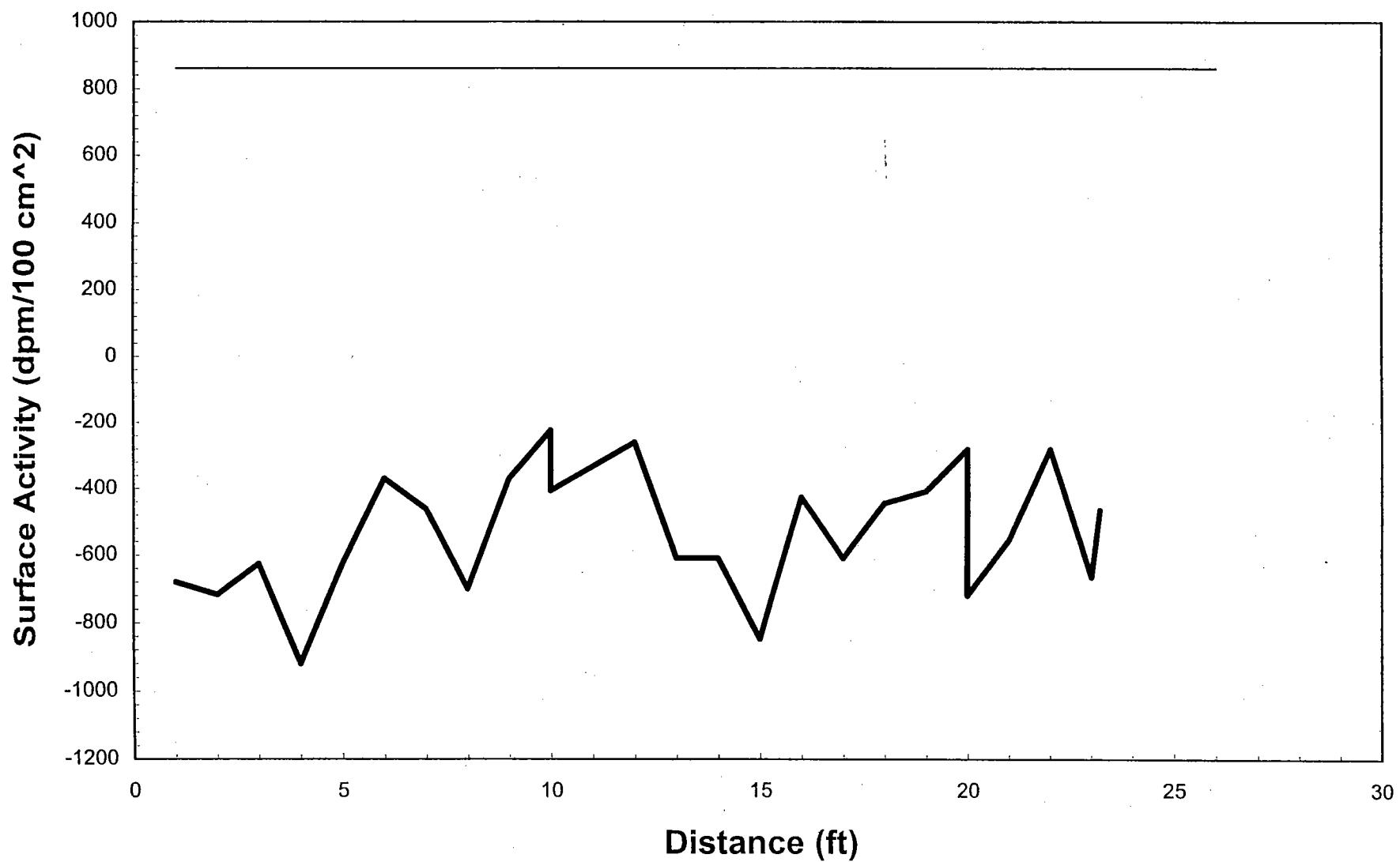
Background (cps): 2.14

MDA (dpm/100cm²): 1018

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
1	63	1.05	-1202
2	65	1.08	-1165
3	55	0.92	-1349
4	45	0.75	-1533
5	47	0.78	-1496
6	59	0.98	-1275
7	57	0.95	-1312
8	56	0.93	-1330
9	57	0.95	-1312
10	67	1.12	-1128
11	46	0.77	-1514
12	47	0.78	-1496
13	61	1.02	-1239
14	74	1.23	-1000
15	85	1.42	-798
16	110	1.83	-338
17	106	1.77	-412
18	73	1.22	-1018
19	156	2.60	507
20	169	2.82	746
21	144	2.40	287
22	164	2.73	654
23	166	2.77	691
24	182	3.03	985
25	185	3.08	1040
25	178	2.97	911
26	165	2.75	673
27	161	2.68	599
28	174	2.90	838
29	158	2.63	544
30	178	2.97	911
31	179	2.98	930

32	151	2.52	415
33	191	3.18	1150
34	173	2.88	820
35	172	2.87	801
36	160	2.67	581
37	174	2.90	838
38	154	2.57	470
39	192	3.20	1169
40	151	2.52	415
41	169	2.82	746
42	173	2.88	820
43	137	2.28	158
44	155	2.58	489
45	194	3.23	1205
46	183	3.05	1003
47	164	2.73	654
48	172	2.87	801
49	188	3.13	1095
50	178	2.97	911
50	186	3.10	1058
51	185	3.08	1040
52	154	2.57	470
53	173	2.88	820
54	183	3.05	1003
55	178	2.97	911
56	157	2.62	526
57	162	2.70	617
58	159	2.65	562
59	151	2.52	415
60	198	3.30	1279
61	172	2.87	801
62	166	2.77	691
63	154	2.57	470
64	142	2.37	250
65	184	3.07	1022
65	158	2.63	544
66	171	2.85	783
67	177	2.95	893
68	161	2.68	599
69	133	2.22	85

West Jefferson Run #JN4-SSD4-A-39
Floor Drain Inside JN-4



Pipe Explorer™

03/29/2000

Building: JN-4

Run Description: Floor drain inside JN-4

Run ID: JN4-SSD4-A-39

Pipe Type: 4" CI

Detector: LND 4-element GM S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

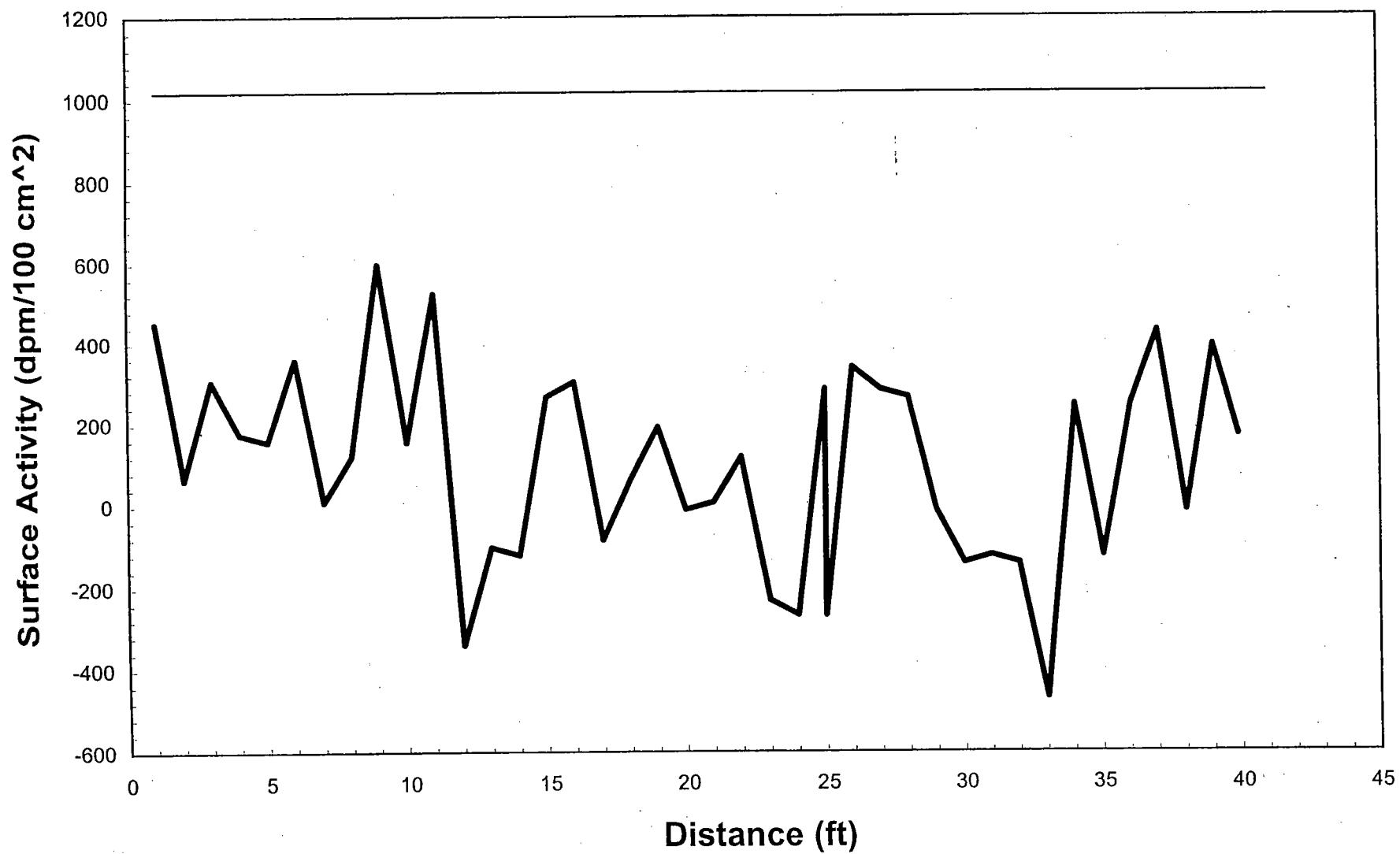
Count Time (s): 60.0

Background (cps): 1.50

MDA (dpm/100cm²): 860

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
1	53	0.88	-680
2	51	0.85	-717
3	56	0.93	-625
4	40	0.67	-919
5	56	0.93	-625
6	70	1.17	-368
7	65	1.08	-459
8	52	0.87	-698
9	70	1.17	-368
10	78	1.30	-221
10	68	1.13	-404
11	72	1.20	-331
12	76	1.27	-257
13	57	0.95	-606
14	57	0.95	-606
15	44	0.73	-845
16	67	1.12	-423
17	57	0.95	-606
18	66	1.10	-441
19	68	1.13	-404
20	75	1.25	-276
20	51	0.85	-717
21	60	1.00	-551
22	75	1.25	-276
23	54	0.90	-662
23.2	65	1.08	-459

West Jefferson Run #JN3-RWC4-A330-40
East in rain water conduit dug up in field



Pipe Explorer™

03/31/2000

Building: JN-3

Run Description: East in rain water conduit dug up in field

Run ID: JN3-RWC4-A330-40

Pipe Type: 4" VCP

Detector: LND 4-element GM S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

Count Time (s): 60.0

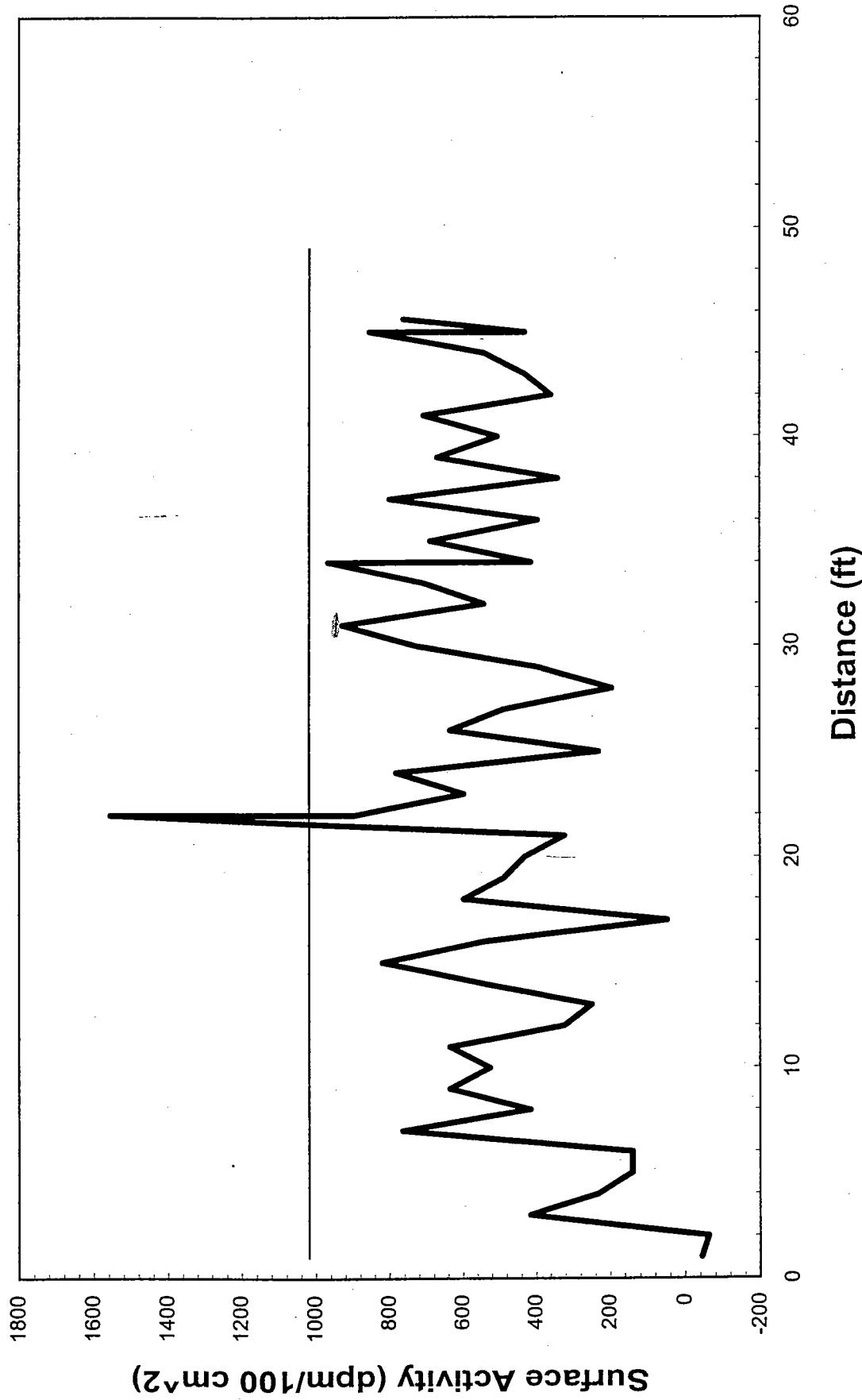
Background (cps): 2.14

MDA (dpm/100cm²): 1018

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
1	153	2.55	452
2	132	2.20	66
3	145	2.42	305
4	138	2.30	176
5	137	2.28	158
6	148	2.47	360
7	129	2.15	11
8	135	2.25	121
9	161	2.68	599
10	137	2.28	158
11	157	2.62	526
12	110	1.83	-338
13	123	2.05	-99
14	122	2.03	-118
15	143	2.38	268
16	145	2.42	305
17	124	2.07	-81
18	132	2.20	66
19	139	2.32	195
20	128	2.13	-7
21	129	2.15	11
22	135	2.25	121
23	116	1.93	-228
24	114	1.90	-265
25	144	2.40	287
25	114	1.90	-265
26	147	2.45	342
27	144	2.40	287
28	143	2.38	268
29	128	2.13	-7
30	121	2.02	-136
31	122	2.03	-118

32	121	2.02	-136
33	103	1.72	-467
34	142	2.37	250
35	122	2.03	-118
36	142	2.37	250
37	152	2.53	434
38	128	2.13	-7
39	150	2.50	397
39.9	138	2.30	176

West Jefferson Run #JN3-RWC4-A150-41
South in rain water conduit dug up in field



Pipe Explorer™

03/31/2000

Building: JN-3

Run Description: South in rain water conduit dug up in field

Run ID: JN3-RWC4-A150-41

Pipe Type: 4" VCP

Detector: LND 4-element GM S/N 1

Yield Factor (cps/dpm/100cm²): 9.07E-04

Count Time (s): 60.0

Background (cps): 2.14

MDA (dpm/100cm²): 1018

Distance Into Pipe (ft.)	Counts	Gross Count Rate (cps)	Measured Beta Activity (dpm/100 cm ²)
1	126	2.10	-44
2	125	2.08	-62
3	151	2.52	415
4	141	2.35	232
5	136	2.27	140
6	136	2.27	140
7	170	2.83	764
8	151	2.52	415
9	163	2.72	636
10	157	2.62	526
11	163	2.72	636
12	146	2.43	323
13	142	2.37	250
14	158	2.63	544
15	173	2.88	820
16	158	2.63	544
17	131	2.18	48
18	161	2.68	599
19	155	2.58	489
20	152	2.53	434
21	146	2.43	323
22	213	3.55	1555
22	177	2.95	893
23	161	2.68	599
24	171	2.85	783
25	141	2.35	232
26	163	2.72	636
27	155	2.58	489
28	139	2.32	195
29	150	2.50	397
30	168	2.80	728
31	179	2.98	930

32	158	2.63	544
33	167	2.78	709
34	181	3.02	967
34	151	2.52	415
35	166	2.77	691
36	150	2.50	397
37	172	2.87	801
38	147	2.45	342
39	165	2.75	673
40	156	2.60	507
41	167	2.78	709
42	148	2.47	360
43	152	2.53	434
44	158	2.63	544
45	175	2.92	856
45	152	2.53	434
45.6	170	2.83	764



Manhole #1



Manhole #2



Manhole #3



Manhole #4



Manhole #5



142

Manhole #6



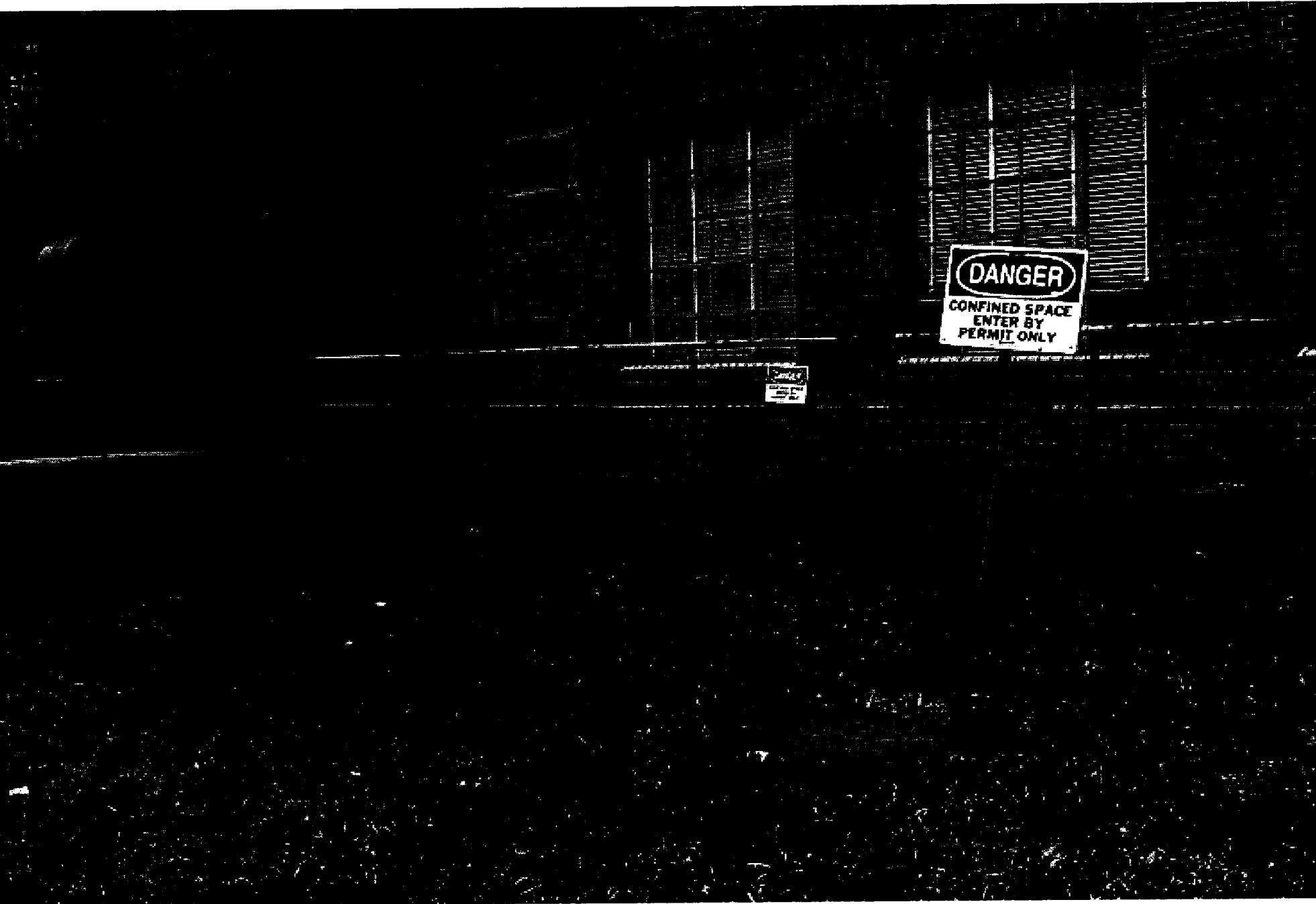
Manhole #7



Manhole #8
(No Surveys)



Manhole #9



DANGER

CONFINED SPACE
ENTER BY
PERMIT ONLY

Manhole #10



Manhole #12



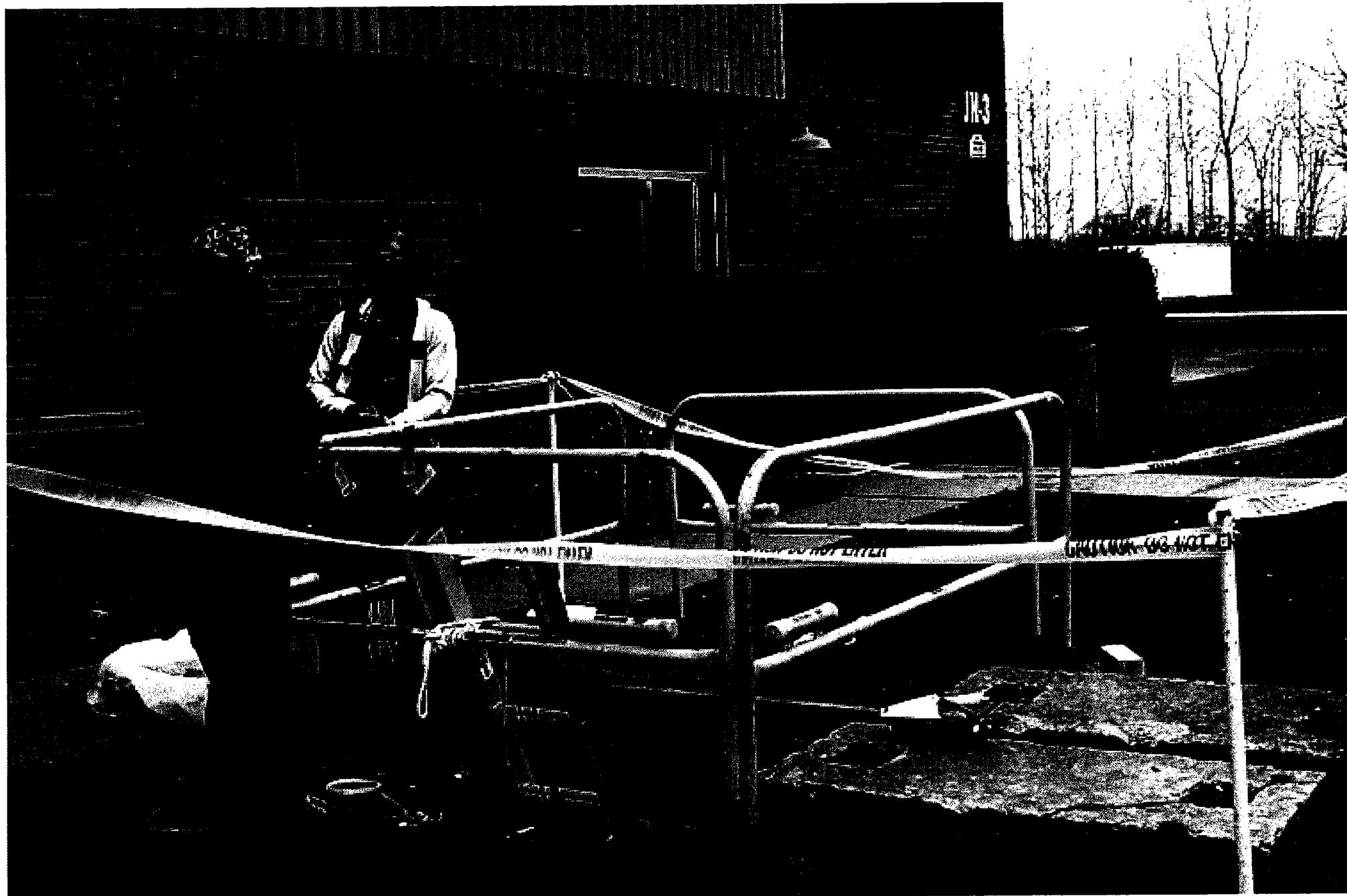
Manhole #13



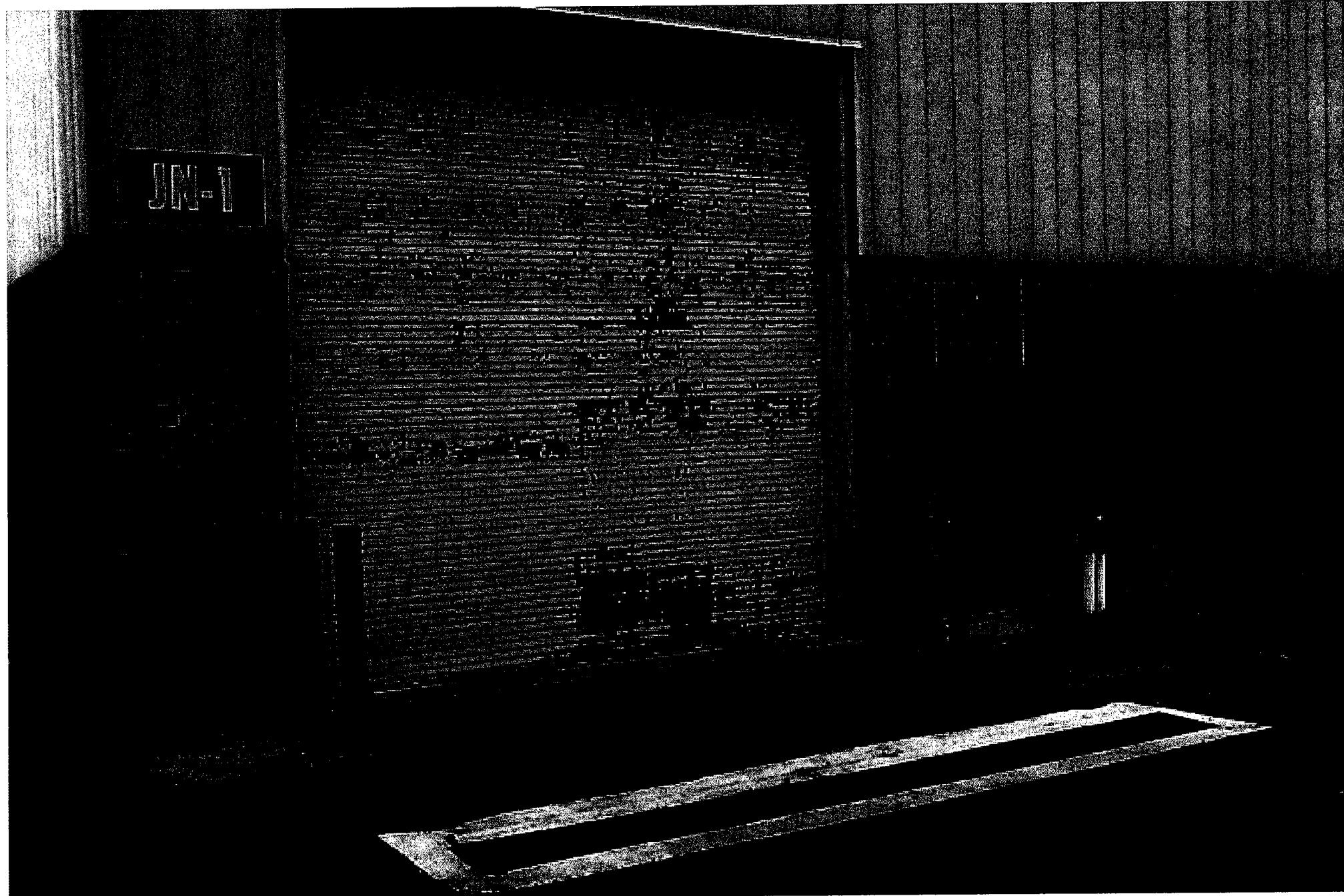
Manhole #15



Manhole #16



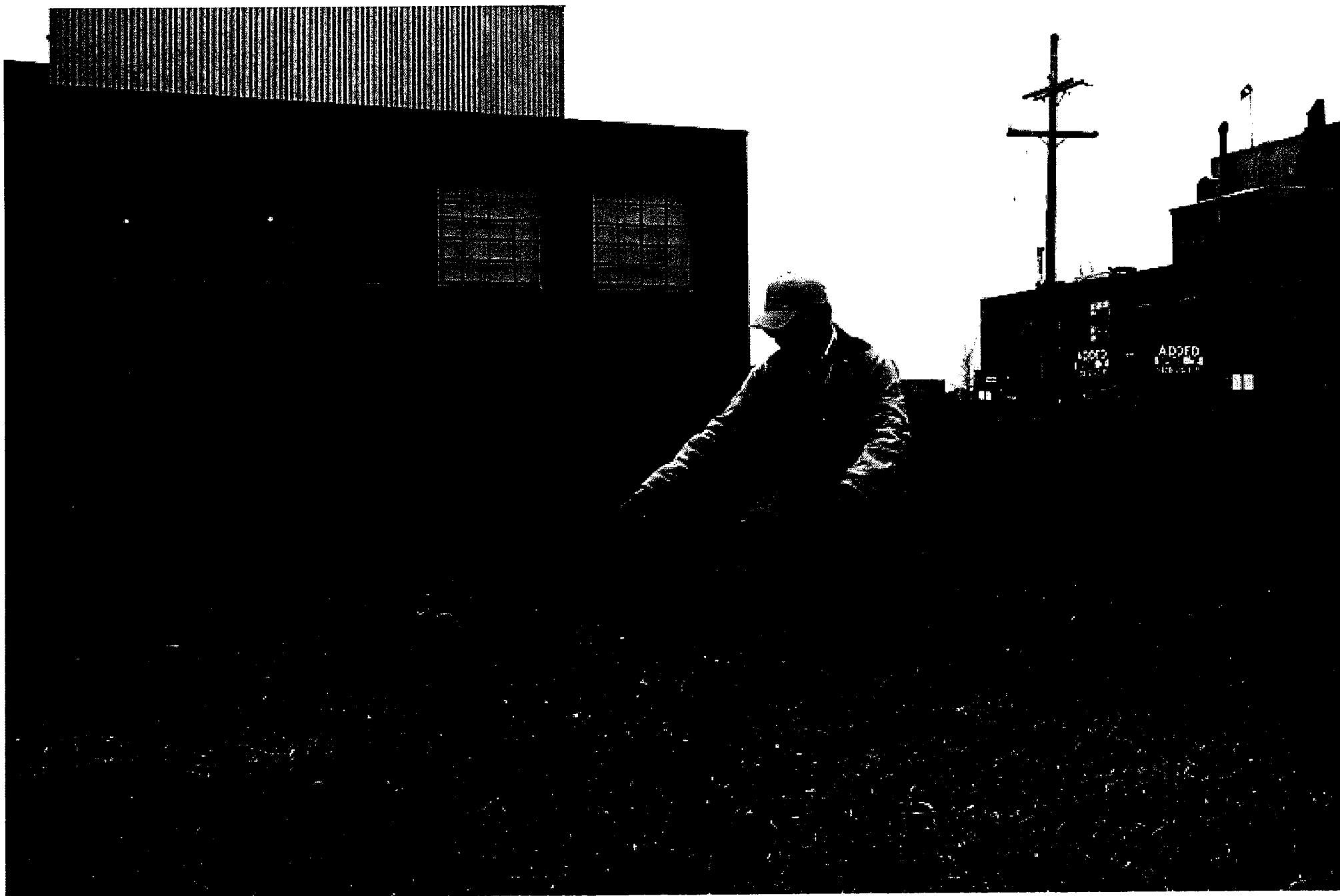
Sump #1



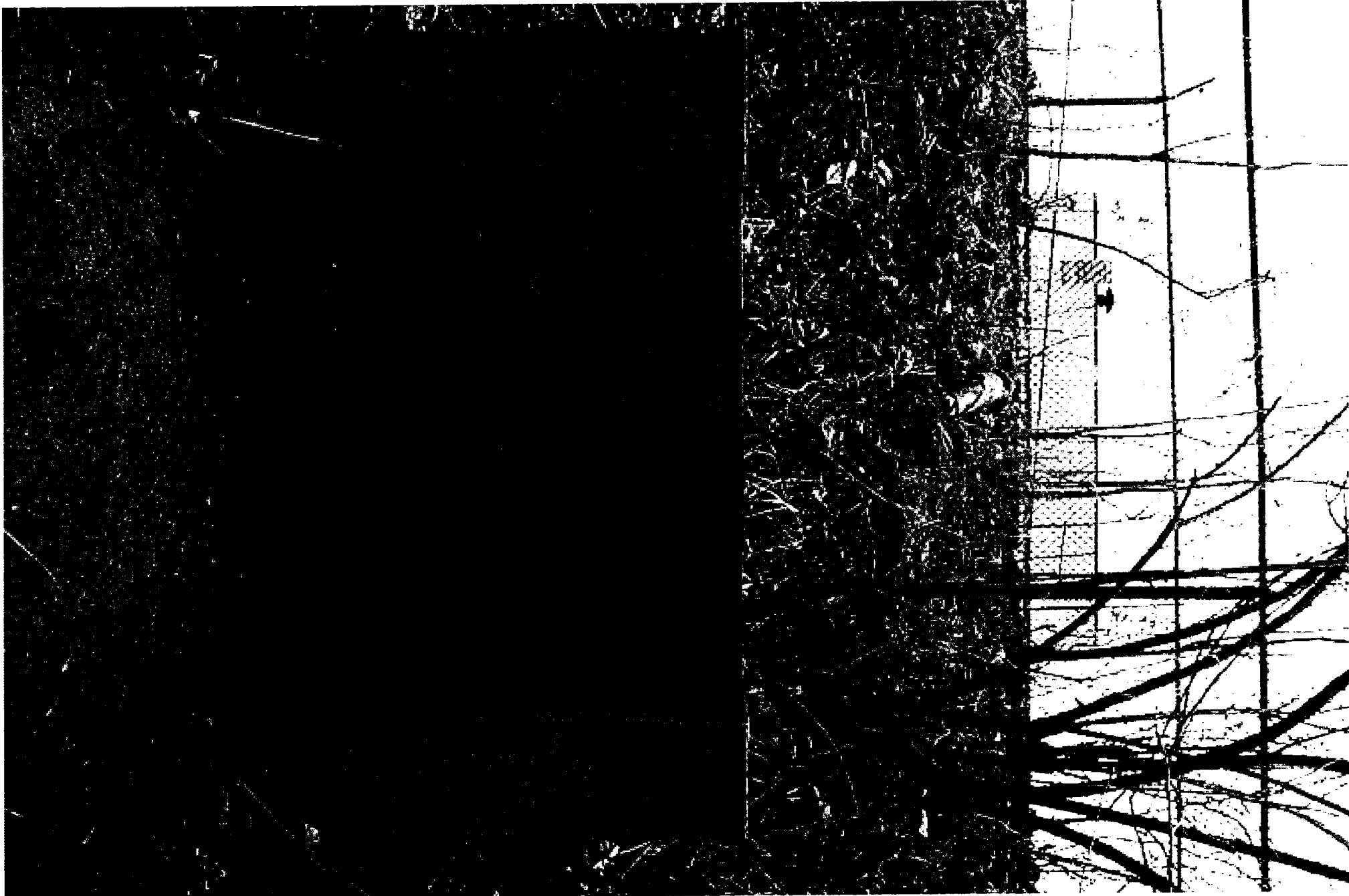
Trench Drain



PVC "to grade" from JN1 located East of JN2



4" VCP "to grade" East of JN3



6" Clay "to grade" South of JN1

12/02/1999
 Calibration Data for LND 4-element GM Detector
 Net Count Rate Matrix
 8-inch PVC Pipe

Pipe Explorer™

Axial Pos. (cm)	-174	-163	-151	-139	-128	-116	-105	-93	-81	-70	-58	-46	-35	-23	-12	0	12	23	35	46	58	70	81	93	105	116	128	139	151	163	174
-12	5.32	4.85	4.85	4.85	5.29	3.45	4.35	3.02	2.55	1.52	1.12	0.82	0.29	0.55	-0.01	-0.08	0.22	0.55	1.89	2.65	2.99	3.75	3.52	4.25	4.65	3.79	5.09	3.59	3.65	2.89	3.82
-10	4.99	6.45	4.69	5.02	5.25	5.82	5.62	4.89	3.29	1.99	1.55	0.69	0.75	0.45	0.02	0.15	0.99	2.39	3.22	3.39	4.82	5.79	6.95	6.29	6.75	4.99	5.89	5.32	5.55	4.55	4.02
-8	5.85	6.25	6.02	6.95	5.95	6.02	6.02	5.49	3.79	2.99	1.79	1.79	0.69	0.62	0.39	1.45	2.85	6.15	7.49	8.85	7.95	7.55	6.95	7.69	7.09	6.92	5.89	6.92	5.49	4.55	5.79
-6	6.62	6.12	5.62	7.62	7.49	6.99	6.19	7.22	4.99	5.02	3.02	2.22	0.79	1.55	1.02	4.75	14.19	19.02	16.22	13.72	12.29	11.39	8.89	9.25	8.49	6.65	6.99	6.95	5.42	6.72	4.89
-4	5.12	6.49	5.92	6.59	7.25	6.72	6.19	7.02	5.42	5.59	4.92	3.45	2.95	2.55	2.15	26.85	59.92	45.49	29.52	22.19	16.12	12.35	12.45	11.95	8.55	9.39	8.29	6.29	6.85	6.02	5.72
-2	5.89	6.05	5.59	5.99	6.89	6.59	8.95	7.99	8.25	7.49	7.49	8.05	7.59	12.82	18.12	69.92	103.79	59.39	38.95	24.55	20.32	14.45	12.99	11.32	8.49	7.99	6.29	6.62	6.95	6.92	5.72
0	3.92	4.32	5.49	6.85	5.55	7.99	8.42	10.12	9.79	10.22	14.95	17.02	29.22	80.19	188.72	132.42	71.52	47.29	32.09	23.65	17.62	13.39	11.12	8.69	7.79	7.82	7.02	6.15	5.52	5.62	5.89
2	4.05	4.69	4.85	6.25	7.05	7.45	7.82	9.72	11.82	16.32	22.42	35.55	57.32	106.02	207.05	150.42	40.09	19.55	18.99	15.19	12.25	9.39	8.75	7.02	7.25	6.09	5.62	6.15	4.32	5.69	4.85
4	3.92	3.35	4.45	5.49	6.35	5.62	7.89	7.99	12.65	16.49	26.09	43.62	78.19	91.75	37.95	23.29	9.85	7.39	8.02	8.82	6.39	7.09	6.12	5.09	5.22	4.39	4.32	4.12	4.52	5.29	3.72
6	3.39	3.42	4.22	5.12	4.62	5.65	6.75	7.75	11.69	15.82	22.42	36.62	59.49	47.65	5.52	1.95	2.09	2.95	4.25	4.12	4.12	4.19	4.85	3.72	4.29	3.72	4.19	4.45	4.35	4.02	4.42
8	3.25	2.79	3.52	3.72	4.79	5.35	5.59	7.39	8.72	10.72	14.72	18.25	21.02	9.32	1.29	1.02	1.22	1.29	1.89	2.52	2.82	3.55	3.22	4.62	3.15	3.52	3.09	3.65	3.65	2.85	2.95
10	1.59	2.19	3.02	3.19	3.25	3.99	4.09	4.95	5.32	7.09	6.79	7.05	5.72	1.62	0.79	0.49	1.29	0.99	1.72	1.42	1.59	2.22	1.72	2.39	2.55	2.79	2.65	3.02	2.85	2.15	1.92
12	1.82	2.12	1.69	1.75	2.49	2.85	3.65	3.65	3.85	5.19	4.45	3.39	1.69	0.79	-0.11	0.65	0.32	0.55	0.65	0.85	0.79	1.72	1.22	2.35	1.82	1.72	2.22	2.79	2.19	2.32	1.99

55.73 59.09 59.93 69.39 72.23 74.49 81.53 87.19 92.13 106.43 131.73 178.53 265.69 355.89 462.89 413.29 308.33 212.99 164.89 131.93 110.06 96.83 88.76 84.63 76.09 69.76 67.53 66.03 61.33 59.59 55.69

Calibration Results for LND 4-element GM Detector
 Conditions: 8-Inch PVC Pipe
 Source I.D. Sr/Y-90 S/N 95SR2202652

Grid Cell Dimensions:
 X= 2.00
 Y= 2.04
 Cell Area 4.08

Total Net Count Rate (ncps)	2494.44
Calibrated Activity (4/26/95)	161,000
Corrected Activity (8/6/99)	144,650 dpm
Backscatter Corr.	1.00
Corr. Activity	144,650 dpm

Ludlum 2200 Instrument Settings:
 High Voltage 500
 HV Dial Setting 2.00
 Threshold 0.5
 Window off

Check Source:
 Isotope : CS-137
 ID: OX-CS137-1
 Activity ~ 1.0 micro Ci
 Average Check Source 1-min Count
 Element 1 Element 2 Element 3 Element 4
 33334 37627 34151 37353

Activity Density	10,283 dpm/cm ²
Activity/100 cm ²	1.03E+06 dpm/100 cm ²
Y = Σ net count rate over the detector response area	
Activity density per 100 cm ²	

Y = 2.43E-03 ncps / [dpm/(100 cm²)]
 Mult = 412 [dpm/(100 cm²)]/ncps

Calibration Data for Ludlum 2x2 NaI Detector S/N PR165908
Raw Count Matrix
8-inch Pipe
12 second count time

Operator: CD Crem

1/8/00

Pipe Explorer™

Axial Pos. (cm)		Circumferential Position (degrees)																									Net Counts per Second																								
-169	-158	-146	-135	-124	-113	-101	-90	-79	-68	-56	-45	-34	-23	-11	0	11	23	34	45	56	68	79	90	101	113	124	135	146	158	169	180																				
18	61	64	75	74	70	75	80	77	81	80	83	78	98	91	92	97	102	102	87	90	89	94	89	89	80	78	74	72	74	67	70	69																			
16	72	72	77	75	86	90	91	95	107	113	106	102	114	117	120	117	131	130	106	115	146	114	103	97	90	89	91	81	79	71	84	76	70																		
14	88	89	90	88	93	102	113	116	123	124	135	141	154	163	158	172	178	178	158	147	149	138	125	117	117	100	105	98	87	88	87	88	87	88	87																
12	96	96	105	109	117	121	125	136	144	158	172	176	198	221	224	239	239	240	201	196	180	171	157	141	119	121	113	108	96	93	94	95	94	95	94																
10	107	113	120	120	131	140	151	168	179	205	225	253	290	308	332	351	336	318	275	271	233	210	190	169	149	140	129	123	118	114	116	114	116	114																	
8	114	120	122	143	144	155	186	198	218	251	300	342	401	460	511	523	500	443	367	342	290	255	231	189	167	162	144	142	121	123	115	116	114	115	114																
6	126	134	148	157	168	179	217	235	281	318	387	469	570	686	770	823	735	646	500	444	381	321	276	229	193	177	163	157	139	135	135	135	135	135	135																
4	138	147	157	163	184	199	235	260	322	377	481	627	810	1,048	1,240	1,433	1,199	922	683	564	440	365	298	249	203	187	172	157	153	149	145	144	145	144	145																
2	152	149	159	168	195	213	242	295	325	416	550	774	1,028	1,421	1,752	2,089	1,599	1,176	797	660	506	412	324	266	226	196	179	167	155	153	149	145	144	145	144																
0	142	148	158	169	194	214	247	292	347	421	564	787	1,039	1,464	1,912	2,055	1,600	1,164	797	652	508	404	333	273	223	198	185	167	155	151	145	144	144	145	144	144															
-2	147	144	151	166	189	197	241	268	323	382	481	662	863	1,149	1,393	1,390	1,214	939	661	560	433	366	300	260	205	191	177	175	151	153	136	144	144	144	144																
-4	130	139	139	154	166	191	213	243	277	327	402	491	630	706	805	821	740	669	538	439	366	317	265	220	198	178	166	160	143	137	141	139	139	139	139																
-6	122	126	135	146	148	169	178	209	227	265	298	348	407	481	521	503	473	441	385	321	277	244	219	198	175	158	138	128	119	130	128	128	128	128																	
-8	107	109	113	120	134	144	152	162	187	205	225	275	288	318	360	339	316	310	275	234	210	186	185	155	153	140	133	123	119	118	112	111	111	111																	
-10	98	97	99	98	115	125	133	144	155	162	189	203	222	231	244	243	231	227	207	183	162	152	150	145	125	121	113	112	107	106	90	91	90	91	90																
-12	84	90	93	94	94	94	107	107	120	133	149	150	166	179	187	188	184	166	162	144	141	123	116	117	105	104	97	93	91	87	83	80	80	80	80	80															
-14	68	73	74	74	80	90	88	90	104	106	114	124	131	126	141	137	140	140	124	122	115	108	97	99	93	86	83	75	79	71	76	77	76	76	76	76															
-16	58	68	64	62	72	66	75	79	82	87	99	100	103	106	113	112	116	108	105	99	97	89	80	79	76	75	69	71	63	68	66	68	66	68	66	68	66														
-18	56	56	59	59	63	66	66	71	71	78	84	82	86	86	90	91	85	92	78	74	71	73	64	73	66	64	58	57	60	54	54	54	54	54	54	54															

Column Totals	1,965	2,034	2,136	2,238	2,443	2,631	2,940	3,237	3,674	4,201	5,037	6,185	7,594	9,363	10,961	11,721	10,127	8,405	6,520	5,660	4,800	4,141	3,611	3,157	2,769	2,566	2,422	2,274	2,124	2,057	2,020	0,000
---------------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--------	--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Conditions: 8-Inch Pipe
Source ID: Cs-137 S/N C-138-2

	<u>Net Count Rate (cps)</u>	<u>76,534</u>
Grid Cell Dimensions:	Calibrated Activity (4/26/95)	37,400 Bq
X=	Corrected Activity (1/8/00)	32,793 Bq.
Y=	Back scatter Corr.	1.00
Cell Area	Corr. Activity	1,967,564 dpm

Beginning 5-min background 19,0
Ending 5-min background 17,8

Instrument Settings:
Ludlum 2200 S/N 159038
High Voltage (kV)
Threshold
Window

Calibration Data for LND 4-element GM Detector S/N 1

Operator: CD Cremer

1/6/00



Count Rate Matrix

4-inch Pipe

30 second count time

Axial Pos. (cm)	Circumferential Position (degrees)														
	-168	-144	-120	-96	-72	-48	-24	0	24	48	72	96	120	144	168
	Net Counts per Second														
-20	1.01	0.37	0.81	0.04	0.11	0.61	0.21	0.11	0.14	0.17	0.21	0.34	0.04	0.14	0.47
-18	0.61	0.31	0.41	0.37	0.24	0.24	0.14	0.57	0.17	0.16	0.34	0.54	0.54	0.44	0.11
-16	0.44	0.27	0.64	0.34	0.71	0.27	0.14	-0.03	0.34	0.47	0.37	0.71	0.14	0.11	0.07
-14	2.07	1.11	0.31	0.51	0.67	0.54	0.11	0.64	0.74	0.17	0.24	0.37	0.77	0.61	0.61
-12	4.11	1.14	0.81	0.71	0.37	0.14	0.51	0.41	0.07	0.41	0.51	0.17	0.47	0.87	0.91
-10	7.71	1.64	0.97	0.87	1.27	0.31	0.87	-0.19	0.64	0.91	1.74	2.07	2.84	2.94	2.34
-8	11.61	1.97	2.37	1.54	2.21	1.57	0.61	1.51	0.81	7.37	10.34	12.14	11.64	6.04	3.21
-6	13.41	3.21	3.44	3.71	2.47	2.61	3.24	4.14	13.51	6.25	50.11	35.21	22.07	13.54	7.24
-4	11.34	5.21	6.17	6.57	5.77	7.31	23.54	46.24	31.24	84.87	70.27	51.31	34.97	19.71	11.71
-2	10.67	10.04	14.94	20.41	21.74	21.57	109.77	212.91	79.81	39.41	41.94	35.41	27.91	18.41	10.67
0	16.97	20.41	28.71	48.57	66.31	74.07	77.14	133.47	45.01	12.71	13.14	14.57	15.87	13.44	8.77
2	24.54	29.81	38.94	58.07	83.84	104.17	87.61	12.11	5.11	2.94	5.74	5.77	8.84	11.47	10.94
4	25.64	29.91	37.87	43.64	44.47	43.87	18.04	3.14	1.94	1.41	2.67	6.31	12.04	16.91	17.11
6	18.07	23.37	26.11	20.24	11.71	7.34	2.67	1.37	1.01	1.57	2.31	6.67	16.91	24.27	28.87
8	9.47	11.21	11.74	8.01	4.57	1.74	1.51	0.94	0.91	1.01	1.84	5.24	12.91	24.97	25.47
10	4.64	4.81	4.24	2.17	2.14	1.34	1.24	0.34	0.44	0.81	1.44	3.21	7.31	13.24	17.04
12	1.84	2.31	1.41	1.11	0.94	0.64	0.41	0.37	0.44	0.14	1.44	1.11	3.31	5.24	8.11
14	0.57	1.24	0.97	1.34	0.74	0.44	0.41	0.51	0.44	0.21	0.91	0.84	1.41	3.04	3.37
16	0.04	0.61	0.54	0.57	0.24	0.57	0.24	0.24	0.47	0.31	0.24	0.37	1.17	2.11	1.87
18	0.34	0.54	0.67	-0.29	0.31	0.27	0.04	0.01	0.74	0.34	0.31	0.24	0.77	1.17	1.11
20	0.64	0.21	0.44	0.27	-0.09	0.61	0.31	-0.13	0.71	0.37	0.41	0.41	0.47	0.31	0.01

Column Totals 166 150 182 219 251 270 329 419 185 218 206 183 182 179 160

Conditions: 4-Inch Pipe
Source I.D. Cs-137 S/N 540-56Instrument Settings:
Ludlum 2200 S/N 159038High Voltage (V) 500
Threshold 0.5
Window OffGrid Cell Dimensions:
X= 2.00
Y= 2.13
Cell Area 4.26Total Net Count Rate (cps) 1,420
Calibrated Activity (8/1/96) 3,609 Bq
Corrected Activity (1/5/00) 3,336 Bq
Backscatter Corr. 1.00
Corr. Activity 200,160 dpmBeginning 5-min background 423
Ending 5-min background 433Y = $\frac{I_{net}}{A}$ net count rate over the detector response areaActivity density per 100 cm²Y = $9.07 \times 10^{-4} \text{ cps / (dpm/(100 cm²)})$
Mult = 1102 [dpm/(100 cm²)]/cps

Check Source Readings			
4-element LND detector Cs-137 Calibration			
Element	Average	Range	
1	36,677	33,009	to 40,345
2	35,473	32,826	to 40,120
3	32,161	28,945	to 35,377
4	36,053	32,448	to 39,658

Check Source:
Isotope : Cs-137 S/N OX-CS137-t
Activity ~ 1.0 microCurie

Pipe Explorer

12/01/1999

Calibration Data for LND 4-element GM Detector

Net Count Rate Matrix

6-inch PVC Pipe

Operator: CD Cremer

Axial Pos. (cm)	Circumferential Position Degrees																								
	-173	-158	-144	-130	-115	-101	-86	-72	-58	-43	-29	-14	0	14	29	43	58	72	86	101	115	130	144	158	173
-15	4.12	3.78	3.72	3.45	1.92	1.62	0.95	1.05	0.65	0.28	0.75	0.58	0.58	0.28	0.88	0.68	0.65	1.12	1.72	1.48	1.68	1.92	2.08	2.48	1.48
-13	5.78	4.98	4.92	4.28	3.98	1.65	2.25	0.88	0.62	0.82	0.45	0.65	0.48	0.28	0.72	1.25	0.88	1.52	2.22	2.32	2.05	2.98	3.22	3.08	2.82
-11	6.82	6.52	7.42	7.15	4.32	4.58	2.58	1.75	0.65	0.42	0.65	0.42	0.42	0.58	0.68	1.28	1.55	2.48	3.38	4.02	4.65	4.78	4.92	4.88	4.55
-9	8.25	9.02	9.18	8.62	7.48	6.88	3.78	2.15	2.05	0.55	0.45	0.49	0.35	0.78	1.35	2.48	3.98	4.32	5.72	7.08	7.15	7.02	6.35	6.52	6.92
-7	10.65	11.08	11.58	11.02	9.35	8.78	6.82	4.22	2.35	1.38	1.18	0.65	0.08	1.98	3.75	5.58	8.22	8.08	9.12	9.85	9.85	10.72	9.35	8.72	7.52
-5	10.55	11.98	11.92	11.25	11.42	9.98	8.38	5.12	2.78	2.08	0.72	1.25	1.48	5.15	12.05	13.75	13.55	16.18	14.12	14.28	13.08	12.28	11.38	10.88	10.15
-3	10.52	10.75	11.28	11.85	11.92	9.65	8.62	6.75	3.95	3.05	2.18	2.32	4.02	22.45	47.45	38.12	25.48	20.05	16.48	17.82	14.08	13.72	12.62	11.38	11.95
-1	9.15	10.28	10.75	10.68	11.25	9.68	9.58	6.22	6.35	7.62	13.75	15.88	94.68	97.05	60.22	33.15	23.52	19.45	17.58	16.88	13.95	12.52	10.75	9.85	
1	6.72	8.22	9.38	10.22	9.82	11.98	11.88	13.75	14.65	16.92	34.42	98.12	130.75	97.48	82.15	64.58	33.08	22.78	16.52	16.65	13.32	13.12	10.92	10.78	9.95
3	7.05	7.12	7.82	9.75	9.82	13.45	14.82	18.98	30.28	40.08	68.35	151.62	218.15	125.22	40.98	28.95	19.85	16.95	12.88	11.15	10.55	9.82	9.48	8.88	8.68
5	4.85	6.78	7.32	8.15	11.58	12.72	15.38	22.52	39.55	65.85	96.98	79.62	74.58	41.75	12.88	11.72	9.18	8.32	8.02	8.22	7.68	7.18	7.28	6.58	6.55
7	4.28	4.82	6.75	8.22	10.15	11.42	14.82	20.48	32.72	55.92	78.12	36.45	7.58	4.68	3.98	4.68	4.52	5.78	5.52	5.08	5.85	5.15	5.38	5.65	5.12
9	3.42	4.38	4.75	5.48	8.32	8.85	10.52	14.62	20.32	26.98	24.02	7.48	1.38	1.55	1.95	1.92	3.25	3.35	3.25	3.88	4.35	4.52	4.62	3.82	
11	2.82	3.15	4.58	4.98	4.62	6.72	7.42	8.08	9.45	8.75	5.35	1.55	0.72	0.82	1.35	1.28	1.45	2.02	1.98	2.32	2.48	3.28	3.05	3.02	
13	1.55	2.25	3.18	3.82	4.05	3.92	4.08	4.08	3.88	2.92	2.12	0.72	-0.05	0.36	0.52	0.78	1.52	1.42	1.65	1.18	2.58	2.12	3.02	2.42	2.65
15	1.75	1.52	1.98	1.82	2.58	2.55	2.35	2.12	1.95	1.62	0.32	0.35	0.28	0.08	0.42	0.65	0.68	0.98	1.62	1.48	1.42	1.72	2.32	3.02	
17	1.72	1.15	1.55	1.62	1.42	1.52	1.92	1.75	0.78	0.72	-0.15	0.62	0.35	0.45	0.55	0.38	0.85	0.55	1.18	1.12	1.25	1.35	1.08	0.95	1.55

99.98 107.78 118.08 122.35 123.62 127.52 126.25 137.92 172.85 234.68 323.52 396.62 457.05 398.62 308.72 228.32 161.85 138.48 126.28 125.02 118.72 115.15 108.88 103.92 99.58

Grid Cell Dimensions:
X= 2.00
Y= 1.93
Cell Area 3.65

Total Net Count Rate (ncps)	2347.52
Calibrated Activity (4/26/95)	161,000
Corrected Activity (8/6/99)	144,650 dpm
Backscatter Corr.	1.00
Corr. Activity	144,650 dpm

Activity Density 10,519 dpm/cm²
Activity/100 cm² 1.05E+06 dpm/100 cm²

Y = E net count rate over the detector response area

Activity density per 100 cm²

Y = 2.23E-03 ncps /[dpm/(100 cm²)]
Mult = 448 [dpm/(100 cm²)]/ncps

Column Totals

Calibration Results for LND 4-element GM Detector
Conditions: 6-Inch PVC Pipe
Source I.D. Sr/Y-90 S/N 955R2202652

Ludlum 2200 Instrument Settings:
High Voltage (V) 500
HV Dial Setting 2.00
Threshold 0.5
Window off

9.8 Ensure that all electrical connections between the deployment canister and the NIM rack, and control console are made as for standard field use.

9.9 Ensure that the settings on the NIM electronics, or Ludlum Scalar are correct for the detector being calibrated. Refer to the calibration notebook entries from the last calibration for the correct settings, or the manufacturers recommended operating conditions for detectors not previously calibrated. Power-up the detector support electronics and check for the appropriate background response for the detector used.

10. Procedure

Note: all grid coordinates will be given in the following format A,B where A refers to the X coordinate and B refers to the Y coordinate.

10.1 Prepare the detector calibration notebook for data entry.

10.2 Enter the following items in the detector calibration notebook: date, your name, the detector serial number or other unique detector identifier, the ID of the source to be used, the certified source activity, and the date of the certification.

10.3 Record all electronics instrument settings in the notebook.

10.4 Acquire a 5-minute background count, and record the total counts, and the count rate in cps in the notebook.

10.5 Mount the source in the hole with the active side facing towards the center of the pipe, and such that the active surface is even with the interior surface of the pipe.

10.6 Position the detector at the 0,0 grid position.

10.7 Prepare a table for data entry in the notebook. The table should have one column for the X axis grid locations and a pair of columns (gross counts, and count time) for each Y axis grid location. Table 1 shows an example of a portion of such a table. Alternatively a single column may be used to record the gross count rate for each Y axis grid location.

TABLE 1
Data Collection Format

X (cm)	Y ₁ (0 cm)		Y ₂ (1.99 cm)	
	(0 s)		(22.5 s)	
	Total Counts	Count Time (s)	Total Counts	Count Time (s)
-26				
-24				
...				
-4				
-2				
0				
2				
4				
...				
24				
26				

10.8 Set-up the Scaler for a preset count time of at least 10 seconds.

10.9 Clear the scalar memory and collect the count total for the 0,0 grid position.

10.10 Determine the limits of the detector response region in the negative X direction by moving the source backward until the observed count rate is 5% (or less) of the count rate observed at the 0,0 grid position. Ensure that the Y axis position of the source remains at the 0 grid position.

10.11 Determine the limits of the detector response region in the positive X direction by moving the source forward from the 0,0 grid position until the observed count rate is 5% (or less) of the count rate observed at the 0,0 grid position. Ensure that the Y axis position of the source remains at the 0 grid position.

10.12 Determine the limits of the detector response region in the positive Y direction by moving the source counterclockwise from the 0,0 grid position until the observed count rate is 5% (or less) of the count rate observed at the 0,0 grid position. Ensure that the X axis position of the source remains at the 0 grid position.

10.13 Determine the limits of the detector response region in the negative Y direction by moving the source clockwise from the 0,0 grid position until the observed count rate is 5% (or less) of the count rate observed at the 0,0 grid position. Ensure that the X axis position of the source remains at the 0 grid position.

10.14 Position the source at the negative X limit of the response region, and the negative Y limit of the response region, as determined above, and collect the total counts for the selected count time. Record the total counts in the notebook, alternatively you may record the gross count rate.

10.15 Move the source to the next grid location in the positive X direction and collect the total counts for the selected count time. Record the total counts in the notebook, alternatively you may record the gross count rate.

10.16 Repeat step 10.15, collecting data for each succeeding grid point in the positive X direction until data has been collected for the X grid point corresponding to the limit of the response region in the positive X direction.

10.17 Reposition the source the next Y grid position in the positive Y direction, at the negative X limit of the response region, and collect the total counts for the selected count time. Record the total counts in the notebook, alternatively you may record the gross count rate.

10.18 Move the source to the next grid location in the positive X direction and collect the total counts for the selected count time. Record the total counts in the notebook, alternatively you may record the gross count rate.

10.19 Repeat step 10.18, collecting data for each succeeding grid point in the positive X direction until data has been collected for the X grid point corresponding to the limit of the response region in the positive X direction.

10.20 Repeat steps 10.17 through 10.19 until data have been collected for each Y grid position in the response region.

10.21 Remove the calibration source from the calibration jig, and return it to its proper storage location.

10.22 Collect a 5-minute background count and record the total counts as well as the count rate in cps in the notebook.

10.23 Position the check source fixture on the beta detector and install the check source. The check source does not have to be the same source used as the calibration source.

10.24 Configure the scaler for a preset count time of 1 minute and acquire four separate counts of the check source. Record the results of each count in the notebook.

10.25 Compute the average net count rate for the check source determination and record this in the notebook. Also compute and record the 3σ counting statistics uncertainty for the estimate of the average net count rate.

11. Calculation of the Yield Factor

11.1 Determine the average background count rate (cps) for the data collection period by averaging the two 5-minute background counts.

11.2 Determine the net count rate for each of the grid locations by first determining the gross count rate (total counts divided by the count live time in seconds), then subtract the average background count rate. This and the following step are best accomplished by using a spread sheet program.

11.3 Compute the sum of all of the net count rates within the detector response area. This sum will be referred to as the total net count rate.

11.4 Compute the grid cell area as the product of the X spacing and the Y spacing in cm.

11.5 Compute the simulated activity density by dividing the certified source activity (in dpm) by the area of the grid cell in cm^2 .

11.6 Multiply the simulated activity density (dpm/cm^2) by 100 to get the activity density per 100 cm^2 .

11.7 Compute the yield factor by dividing the total net count rate by the activity density per 100 cm^2 , the units of the yield factor are $\text{ncps}/[\text{dpm}/100 \text{ cm}^2]$.

12. Random and Systematic Uncertainties

12.1 The precision obtainable for execution of this procedure is related to the random error of positioning of the source in the defined grid system, and the random error associated with counting statistics and timing information.

For each grid location (i) the uncertainty due to counting statistics is given by equation 1.

$$\sigma_{nc_i} = \sqrt{\sigma_{G_i}^2 + \sigma_{BK_i}^2} \quad (1)$$

Where: σ_{nc_i} = the 1σ uncertainty in the net counts for the i^{th} grid location.

σ_{G_i} = the 1σ uncertainty in the gross counts for the i^{th} grid location (square root of the total counts).

σ_{BK_i} = the 1σ uncertainty in the background counts for the i^{th} location (square root of the product of the background count rate and the measurement live time).

The relative 1σ uncertainty in the net count rate (ncr) for each grid position i is given by equation 2.

$$\frac{\sigma_{ncr_i}}{ncr_i} = \sqrt{\left(\frac{\sigma_{nc_i}}{nc_i}\right)^2 + \left(\frac{\sigma_{t_i}}{t_i}\right)^2 + \left(\frac{\sigma_{pi}}{nc_i}\right)^2} \quad (2)$$

Where: σ_{ncr_i} = The 1σ uncertainty in the net count rate for the i^{th} grid location

ncr_i = the net count rate for the i^{th} grid location

σ_{nc_i} is defined as in equation 1, above.

nc_i = the net counts for the i^{th} grid location.

σ_{t_i} = the 1σ uncertainty in time measurement (0.003 s) for the i^{th} grid location.

t_i = the count time for the i^{th} grid location.

σ_{pi} = the 1σ uncertainty in grid position

The relative uncertainty of the total net count rate is given by equation 3.

$$\frac{\sigma_{ncr}}{ncr} = \frac{\sqrt{\sum_{i=1}^n (\sigma_{ncri})^2}}{ncr} \quad (3)$$

Where: σ_{ncr} is the 1σ uncertainty for the total net count rate

σ_{ncri} is the 1σ uncertainty for the net count rate for the i^{th} grid location.

ncr is the total net count rate

n is the total number of grid locations at which data were collected

There is no random uncertainty associated with the activity value assigned to the source in the computation of the yield factor. That is to say that the same activity is assigned to the source for each of the grid locations at which measurements are conducted. In this application, the uncertainty assigned to the source activity by the manufacturer is of a systematic nature, rather than a random nature, and therefore can not be reduced in magnitude by combining it with the random uncertainties described above.

Thus the relative-random uncertainty in the yield factor Y , is estimated as the relative-random uncertainty in the total net count rate (ncr), and is given by equation 3. For typical values of the parameters described above, the resulting random uncertainty in the yield factor is less than 1%. The low magnitude of this uncertainty is due to the very large number of measurements acquired during the course of a single calibration.

12.2 The systematic error associated with the yield factor is dominated by two sources. The first is the uncertainty assigned to the certified activity of the source by the manufacturer. This value is typically given as a 3σ value, and is commonly around 5% of the stated activity of the source. The second is the systematic uncertainty in the placement of the source in the calibration fixture. While this is random from calibration to calibration, it becomes a systematic uncertainty for a given calibration. Empirical estimates of this uncertainty place it at approximately 5%. It is the systematic uncertainty that dominates the overall uncertainty of the yield factor produced by this procedure.

13. Records

13.1 Certificates of activity for the various radioactive sources used in this procedure are kept in the division files, located in the SEA-Albuquerque office, sixth floor. All other records associated with execution of this procedure are maintained as entries in the detector calibration notebook, also located in the SEA-Albuquerque office, sixth floor.

CERTIFICATE OF CALIBRATION

BETA STANDARD SOURCE

Radionuclide: Cs-137
Half Life: 30.17 ± 0.16 years
Catalog No.: BF-137
Source No.: 540-56

Customer: SCIENCE & ENGINEERING ASSOCIATES
P.O.No.: AB-97-0309
Reference Date: 1 August 1996 12:00 PST.
Contained Radioactivity: 97.54 nCi
Contained Radioactivity: 3609 Bq

Description of Source

- a. Capsule type: MF-2
- b. Nature of active deposit: Evaporated metallic salts
- c. Active diameter/volume: 3 mm
- d. Backing: 0.9 mg/cm² aluminized mylar
- e. Cover: 0.9 mg/cm² aluminized mylar

Radioimpurities

None detected

Method of Calibration

The source was prepared from a weighed aliquot of solution whose concentration in $\mu\text{Ci/g}$ was determined by gamma spectrometry.

Uncertainty of Measurement

- a. Systematic uncertainty in instrument calibration: $\pm 3.0\%$
- b. Random uncertainty in assay: $\pm 1.2\%$
- c. Random uncertainty in weighing(s): $\pm 0.4\%$
- d. Total uncertainty at the 99% confidence level: $\pm 3.3\%$

NIST Traceability

This calibration is traceable to the National Institute of Standards and Technology.

Leak Test(s)

See reverse side for Leak Test(s) applied to this source

Notes

1. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15)
2. The surface emission rate for this source is 128000 betas/min/2pi on 24 July 1996.

Ann U. Ken

Quality Control

24 Jul 96

Date Signed



ISOTOPE PRODUCTS LABORATORIES

1800 N. KEYSTONE STREET
BURBANK, CALIFORNIA 91504

818•843•7000 FAX 818•843•6168

IPL Ref. No.: 540-56

CERTIFICATE OF CALIBRATION GAMMA RAY STANDARD

Model No. Cs-137-SC-2

This point source standard of Cs-137 has been calibrated with a HPGe detector for which the efficiency has been established using NIST traceable sources. The uncertainty in the absolute activity is estimated to be +/- 5%.

Serial Number: C-138-2 Source Type: 2" disk

Calibration Date: 04/19/94 Julian Day: (244) 9462

Activity: 37.400 Bq 1.01 uCi

Half-Life: 30.2 y

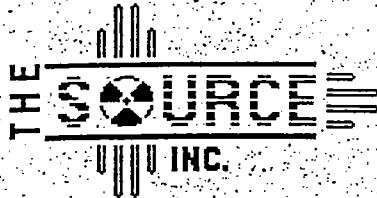
Photon Emission Rates:

Certified By:

Date: 4/21/94

Nuclear Measurements Group
Microanalysis Group

Oxford Instruments Inc
Analytical Systems Division
601 Oak Ridge Turnpike
Oak Ridge, Tennessee 37830, USA
Telephone (615) 242-8405



Radiation standards and check sources
2810 Siler Lane Santa Fe, NM 87501
(505)473-9538 FAX(505)473-5805

Certificate of Calibration (Beta Source)

The Strontium Yttrium 90 beta source was measured in a gas proportional counter using P-10 as counting gas. The beta emissions from the surface of the source were measured at it's plateau voltage to determine it's 2π cpm rate. Corrections were applied for background, coincidence loss and backscatter factors when applicable.

Beta standard 93SR2204195 is our NIST referenced source used in establishing NIST traceability.

REF.PO# 130315

Model S-Sr-22

Active Diameter(or area)	<u>19mm</u>	Mounting Material	<u>Ni</u>
Total Diameter(or area)	<u>22mm</u>	Thickness	<u>0.79mm</u>
112,000	cpm +	5,600	cpm 2π
161,000	dpm +	8,050	dpm 4π
0.0725	microcurie		
04-26-95	date of measurement		
95SR2202652	source serial number		
5.0	overall uncertainty(percent)		
40	backscatter(percent)		

*Michael A. Ortiz
Charles L. Gonzales*

Michael A. Ortiz
Calibration Manager
Charles L. Gonzales
Quality Assurance Manager

less than 2200 leak test results(dpm / $100cm^2$)

The overall uncertainty of the measurement is three times the value found from combining quadratically the sum of the overall uncertainty reported by NIST in the radioactive measurements assurance program; the standard deviation of the mean for the NIST standard as measured in the system used for calibration; and the standard deviation of the mean for the source measurements.

BC007-95