APPENDIX F

SPECIAL MONITORING

1.0 Airborne Radioactivity from the Chernobyl Incident

Local special monitoring for airborne radioactivity from the nuclear reactor incident near Chernobyl, Ukraine, USSR, was initiated after the news media reports from Scandinavian monitoring programs in late April 1986. In order to assess the effect of the occurrence on our environmental monitoring parameters in Western New York State, routine sampling frequencies for some media were increased, and several special analyses and sampling locations were added. This special program was initiated the day following the media announcement in order to obtain background data and trend indication for any unusual radiological parameters. In addition, routinely collected samples of meat, deer, fish, vegetation, and milk were screened for the presence of isotopes from the Chernobyl fallout taken up during the 1986 growing season.

Routine on-going monitoring provided relevant data from fallout pots (open top collectors), particulate air samples both at near-site and remote locations, and a recording rain gauge. Additionally, a recording high pressure ion chamber (HPIC) was set up, and an additional air sampler with a triethylene di-amine (TEDA) - impregnated charcoal cartridge was placed near the HPIC location. It was not expected that any change in external dose rate high enough to be significant during the normal three month period of TLD exposure would be noted. Routine biological monitoring was maintained on the normal schedule.

The charcoal cartridge was analyzed daily for gamma isotopes, specifically I-131. Particulate air filters were counted daily for gross alpha and beta activity, and rain water samples were analyzed for the presence of gamma-emitting isotopes. Direct high pressure ion chamber radiation measurements were recorded continuously and correlated with rainfall events from the recording rain gauge.

Meat samples including beef, venison, and large predator fish showed positive uptake of isotopes such as Cs-134 and Cs-137 (Appendix C-3). These occurred in ratios indicative of fresh fission products, such as those released in the Chernobyl incident rather than the aged mixture present in Tank 8D-2. Both the control and near site samples had statistically similar radionuclide concentrations, indicating uptake from wide spread uniform deposition.

In order to track the appearance of any unusual airborne radioactivity on a daily basis without compromising the sensitivity and schedule of routine air sampling, additional sampling and monitoring equipment was deployed as noted above. The special air sampler consisted of a 47 mm diameter type AE glass fiber filter backed by a 40 mesh TEDA-impregnated 2¼" diameter by 1" thick charcoal cartridge operated at a flowrate of 64 standard litres per minute (SLPM). The sampler head was placed 1.5 m above the ground on the corner of a low shed. The charcoal was removed daily and counted for 600 seconds on a reverse electrode high purity germanium detector, then replaced in the sampler with a new glass fiber prefilter. The total time for this change-out process averaged about 18 minutes daily. The cumulative I-131 activity for the previous period was decay-corrected and subtracted to determine the daily increment of I-131 which was collected (Figure F-1.1). This method provided positive detection and more accurate daily tracking than would be possible if a new cartridge had been used daily with accumulated activity at or below the lower detection limit. The charcoal was changed weekly to preclude breakthrough.

The glass fiber filter was changed daily and gross alpha and beta activity counted one hour after removal (Figure F-1.2). A composite of these filters was also analyzed for identification of gamma-emitting isotopes over a 60,000 second counting period but, because of the low total volume, these results were less sensitive than gamma analysis of composites from all the routine perimeter samplers for a given weekly period.

An argon-filled high pressure ion chamber with an LCD readout and chart recorder was set up at 1 metre from the ground surface in the same vicinity as the special air sampler. The exposure rate was recorded in micro-roentgen per hour, with a relatively flat gamma energy response from 0.1 to 8 Mev. These data were plotted in correlation with rainfall events recorded by an on-site rain gauge (Figures F-1.3 and F-1.4).

The routine air particulate samples collected weekly were processed normally for gross alpha and beta activity, then composited by week for gamma counting. The seven filters included all perimeter and background air sampling stations in operation at that time. Each station draws air through a type AE 47 mm diameter glass fiber filter at 40 SLPM, with four sampler heads placed at 1.7 m and 3 sampler heads at 4 m above the ground. (Normal procedure includes a quarterly gamma scan and Sr-90 analysis on the 13 filters from each station.) Compositing the seven weekly filters provided a large volume (2,800 m^3) sample for increased analytical sensitivity.

Fallout pots which collect deposition (both wet and dry) normally are changed on the first of the month, but were collected one day early (April 30, 1986), and then collected again in two weeks. Any water present was analyzed for tritium, collected separately, then the pot was washed down with distilled water, which was added to the rain water sample, and analyses for gross alpha and beta activity were performed on the evaporated sample.

In addition to the routine collection of particulate samples, the main plant intake air was being sampled weekly as part of another on-site study. The intake is approximately 15 m above the ground, and the sampler flow rate was 70 SLPM. The particulate filter media is the same as for the previously described air particulate samplers (Table F-1.1).

A recently initiated tritium-in-air sampling program also provided indication of tritium as HTO in ambient moisture at one perimeter point and one remote location (Table F-1.3).

Collection of gamma exposure rate and charcoal media samples started on Tuesday April 29, 1986, the same day of the week that routine site air filter media were changed. Using the presence of I-131 on charcoal as an indicator, the first effects of the Chernobyl incident were detected on May 10, 1986. The gross activity on the relatively low volume daily air samples, however, was not sufficiently elevated to be detected above natural airborne particulate background following a one hour decay.

Gamma exposure measured by the HPIC followed the expected pattern, with upward variations during rainfall events. No correlation was seen with the appearance of I-131 or other fission products on filter media, since similar variations were noted before and after the I-131 first was detected. The overall rate did not rise to any statistically measurable level above the normal background gamma dose rate due to the Chernobyl fallout, notwithstanding the distinct presence of unusual isotopes in many routine samples.

A composite of the air filters located upstream of the charcoal cartridge for over 15 days including May 10 was gamma counted. The gamma emitting isotopes which are normally found in particulate air samples near the Project do not include any fission products, but are limited to naturally occurring gamma emitters such as Be-7, Pb-210, and Bi-214. Fission products positively identified in this composite included Cs-137 and I-131, but a composite of filters from the routine perimeter samplers which represented a higher volume provided a more accurate measurement of environmental contamination from Chernobyl (Table F-1.2).

A composite of the seven perimeter air filters removed on May 13 was counted immediately after the routine weekly change. Presence of the fission products found in the special filters was confirmed by this off-site sample of a larger volume.

Neither the gross activity nor the gamma scan of rainwater collected from the four fallout pots on May 12, 1986, indicated any detectable increase in activity or specific fission products for the two week period preceding and including initial detection of I-131.

Due to the recent initiation of this type of collection, tritium activity in air could not be compared with historical data, but did not indicate a concentration above what would normally be expected, based on previous short-term tritium measurements.

2.0 Cattaraugus Creek Gamma Survey

During the summer and fall of 1984, a comprehensive aerial survey of the Western New York Nuclear Service Center (WNYNSC) including the West Valley Demonstration Project site was performed by EG&G under DOE sponsorship. Measurements utilized not only state-of-the-art gamma radiation instruments but also high resolution photography and multi-spectral scanning techniques. The final report is in preparation by EG&G and careful attention is being given to comparisons with previously acquired data from the same area.

In the course of previous reprocessing plant operation and the period of shut down maintenance operations which followed, low levels of treated radioactive liquids were discharged to the local stream within permitted concentrations. The amount of radioactivity released since the DOE Project commenced has been somewhat reduced due to a conscious effort to bring all discharges as low as reasonably achievable. Sediment analyses have shown, however, that the residual effects of the last 20 years are measurable above natural background in the drainage downstream of the site.

In 1969, a team of EG&G scientists sponsored by the U. S. Government performed an aerial measurement of gamma radiation at the WNYNSC. At that time it was noted, as expected, that residual radioisotopes were detectable along the stream (Franks Creek) from the plant site to Buttermilk Creek and down to Cattaraugus Creek. A resurvey of the same area in 1979 showed a reduction in the overall amount of detectable radioactivity, and using computerized processing, cesium-137 was specifically identified in several areas as the major man-made gamma-emitting isotope present.

The present environmental monitoring program for the West Valley Demonstration Project includes measurement of water, air, soil, direct radiation, and edible plant and animal tissue. Cattaraugus Creek water, fish, and sediments are sampled throughout the year, and results are examined for evidence of radionuclide concentration above background levels. Although there are traces of certain isotopes in some media, such as fish taken upstream of the Springville power dam in Cattaraugus Creek, these levels have trended slightly downward over the last five years since the Project has been collecting these data (Figure C-3.2).

Although at no time has there been indication of any radioactivity levels which might adversely affect animals or humans, there still remained the need to quantify the existing levels as accurately as possible. In order to provide a baseline for "before and after" comparisons, it was necessary to establish the concentrations of radionuclides such as cesium-137 which now exist not only near the Project, but in surrounding areas including Cattaraugus Creek.

In 1984, flyover gamma radiation measurements by the same EG&G specialists, coordinated by the U.S. Department of Energy and WVNS Environmental Monitoring personnel, included not only the previously measured site areas, but also the Cattaraugus Creek stream bed from upstream of the Buttermilk Creek confluence to Lake Erie. The aerial survey results verified that no major concentrations of radioactive contaminants exist in Cattaraugus Creek, but because of the difficulties in flying close to the stream in the Zoar Valley, and interference from natural radiation from exposed rock formations, an accurate measurement of near-background radioactivity concentrations from man-made radionuclides was not possible using the standard aerial survey data reduction techniques. A sediment sampling program and suitable equipment for measurement of stream sediments both in the field and the laboratory already existed at the West Valley Demonstration Project, and a special survey program was launched in 1986 to verify the findings of the aerial survey by "ground truthing".

Three measurement techniques were used for the ground truthing survey. First was the continuous gamma radiation measurement of the Cattaraugus Creek stream bed from the Rt. 240 bridge to the mouth of the creek at Lake Erie (Figure 2.4). This was done using a digital gamma rate meter with a remote sodium iodide gamma scintillation probe suspended eight feet from the side of the transport craft. The second method utilized a portable multi-channel analyzer and a large (4 x 5 inch) sodium iodide crystal to identify not only man-made and fission product radionuclides such as cesium-137, but also naturally-occurring isotopes such as potassium-40. In situ measurement with the multi-channel analyzer of areas of a sandbar, for example, which indicated a higher than average gamma radiation rate determined the specific isotopes responsible for the increase. Last, but most important, was laboratory analysis of samples of sediment collected from specific points along the creek (See Figures F-2.1 through F-2.3 for sample locations and Table F-2.1 for the radiological data). Accurate determination of a number of samples along with corresponding in situ readings is the basis for interpretation of the continuous stream bed gamma ratemeter log as well as the aerial survey data. This information tied all the data together such that an evaluation of the entire creek bed could be made based on these accurate reference measurements.

To perform the survey, a plan was devised and tested which provided consistent data in as safe and efficient a manner as practicable. Coordination with the Seneca Nation of Indians (SNI), through whose land Cattaraugus Creek flows for about 18 miles, was achieved by several meetings, and retaining an experienced SNI boatman to man the oars and handle logistics of white water boating. The "working platform" was a three-man flat-bottomed aluminum rowboat crewed by two persons. The oarsman directed the boat near the shore having the widest bank to allow the detector to "see" the deposited sediment. His responsibility also included water safety, prelaunch checks of instruments and support materials, and in situ instrument setup. The instrument technician, an environmental monitoring group person familiar with the equipment,

recorded the readings and stream position, determined in situ measurement points and soil sample locations, and was responsible for all measurements, map location references, and communications. He also was the designated driver for vehicles used to transport personnel and equipment. A typical survey segment covered three to five stream miles and was completed in five hours of survey time, not including the launching, takeout, and travel time to and from the site Environmental Laboratory.

Prelaunch checkout at the Project Environmental Lab included instrument operational checks, supplies for sample collection, communications and safety equipment check, and vehicle readiness. The boat crew plus a support crew traveled to the launch site in two vehicles and launched the boat. The oarsman remained with the equipment while both vehicles traveled to the take-out location. The boat trailer and one vehicle were secured at that location downstream, and the remaining crew member and support personnel returned to the launch site to start the survey trip segment. When the crew reached the take-out point, the boat and equipment were portaged to the vehicle, and the crew returned to the Project site. Sediment samples collected that day were logged in for processing, and the equipment and data sheets prepared for the next trip. Depending on the location and personnel available, a midday radio communications check was used to relay crew progress to the site laboratory.

Several areas were identified from the aerial survey as requiring additional ground-level survey. These areas, mostly at or near the Springville dam, were re-surveyed although they had also been on the routine sediment sample collection schedule for several years. The remainder of the areas which indicated higher than background levels of gross gamma or Cs-137 radiation were associated with major stream bends where a silt and sand deposit existed, or with high side banks of 50 to 70 metres above the water.

The survey was performed during the month of October 1986, and required almost 90 man-days of effort to plan, test, execute, and prepare a report of findings. Results of this major ground truthing effort on Cattaraugus Creek were consistent with the preliminary data obtained from the aerial survey.

A plot of the continuous gamma count, which was recorded every 5 to 10 minutes of survey time and more frequently near sand bars, reflects the general shape of the gross gamma count plot recorded by the aerial survey team (Figures F-2.4 and F-2.5). It was noted, however, that since the gamma detection window was set for the 662 keV cesium-137 peak, a proportionally higher countrate was received when a larger percentage of the gross gamma exposure rate was due to Cs-137 than natural gamma emitters. The exception to this was in gorge areas with exposed shale sides and shale rock bottom, where very little gravel or sand was evident. In these cases the count rate was proportionally higher than would be expected compared to the aerial survey gross gamma counts, probably due to the radical change in geometry from above the gorge in an aircraft to inside the winding gorge with four sides presenting a natural radioactive source (e.g, Figure F-2.4, sheet 2 of 3, section 31-38).

The in situ gamma spectral measurements were not of sufficient resolution to detect any but the highest concentrations of Cs-137. The only detectable in situ Cs-137 was about 4 picocuries per gram (148 Bq/kg) in fine sediment (less than 35 mesh). The soil samples analyzed in the laboratory by gamma counting with a high purity, high efficiency germanium detector showed measurable cesium-137 in all the downstream fine sediments. The concentrations of Cs-137 downstream of the Springville dam to Lake Erie ranged from 0.74 to 0.13 pCi/g (27 to 5 Bq/kg). Several background sediment samples from feeder streams along Cattaraugus Creek contained 0.03 to 0.01 pCi/g (1.1 to 0.4 Bq/kg), a factor of 10 lower than the downstream sediments in Cattaraugus Creek.

Although there is positive identification of Cs-137 in Cattaraugus Creek, these preliminary survey data, together with analyses of fish in the creek downstream of the Project effluents, indicate that the radioactivity present could not cause exposure to any member of the general public which approached current Federal guidelines. It was noted that, as expected, no areas of concentrated radioactivity were found, and that the Cs-137 was associated with the fine sediments such as silt and clay. These data will be used and augmented with other information in any future assessments of radionuclides in the Cattaraugus Creek.

TABLE F-1.1

LONG-LIVED GROSS BETA ACTIVITY IN AIR (μCi/ml)*

Location of Sampler	Collection Date 4/29 to 5/6	5/6 to 5/13	5/13 to 5/20
1.5 Km NW of facility	1.8 ± 0.4 E-14	2.5 ± 0.1 E-13	9.5 ± 0.7 E-14
29 Km S of facility	1.6 ± 0.3 E-14	2.5 ± 0.1 E-13	9.8 ± 0.7 E-14
Main facility intake air	4.3 ± 0.3 E-14	2.8 ± 0.1 E-13	1.0 ± 0.1 E-13

*1985 Gross beta activity averaged 2E-14 μCi/ml

TABLE F-1.2

GAMMA-EMITTING ISOTOPES IDENTIFIED IN AIR PARTICULATE FILTER COMPOSITES (μCi/ml)**

Collection Date:	4/29 to 5/6	5/6 to 5/13	5/13 to 5/20
Sample Volume:	2.6 E+09 ml	2.6 E+09 ml	2.5 E+09 ml
Isotope			
Be-7	2.0 E-13	1.6 E-13	1.1 E-13
Ru-103	<1.4 E-15	2.8 E-14	2.3 E-14
I-131	<1.3 E-15	1.8 E-13	1.5 E-14
Cs-134	<1.3 E-15	6.5 E-14	2.6 E-14
Cs-136	<1.9 E-15	1.6 E-14	2.8 E-15
Cs-137	<1.6 E-15	1.6 E-13	6.2 E-14
La-140	<2.2 E-15	1.9 E-13	8.9 E-14

** Estimated systematic plus random uncertainty is ±50% (at 2σ) for positive indications. A "<" indicates the minimum detectable concentration value.

TABLE F-1.3

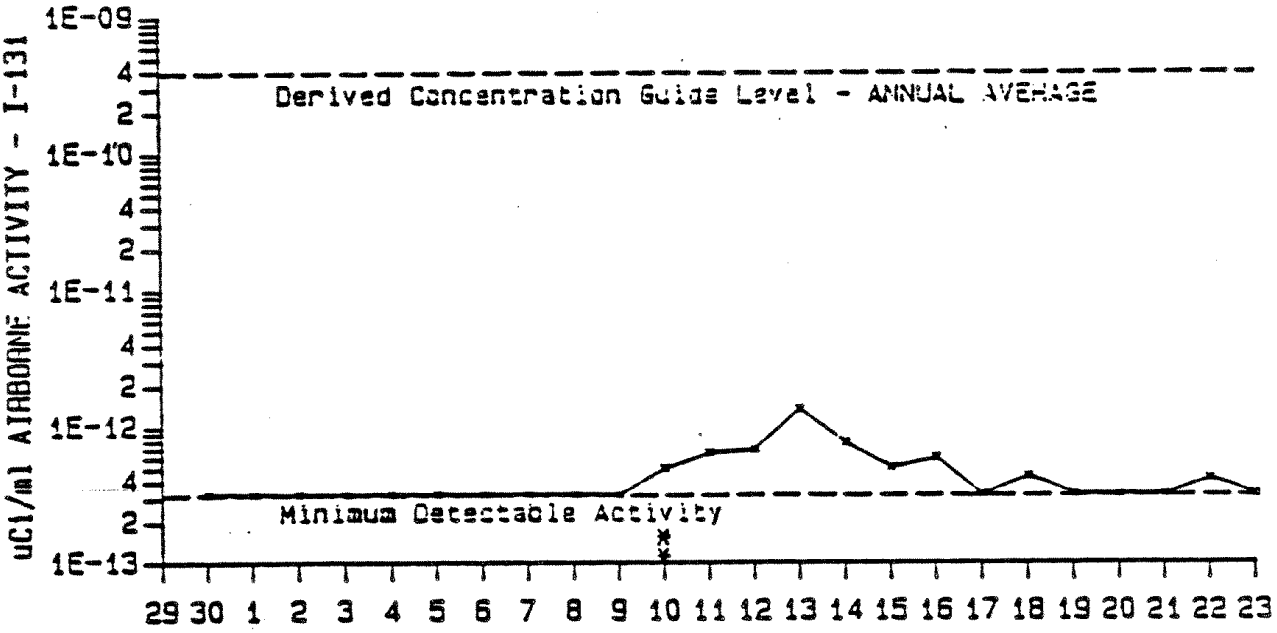
TRITIUM AS HTO IN AIR (μCi/ml)*

Location of Sampler	Collection Date			
	4/21 to 4/29	4/29 to 5/6	5/6 to 5/13	5/13 to 5/20
1.5 Km NW of facility	<5.1 E-13	1.0 E-12	<6.1 E-13	<9.5 E-13
29 Km S of facility	<6.1 E-13	9.0 E-13	1.3 E-12	<1.0 E-12

* Estimated systematic plus random uncertainty is ±60% (at 2 σ) for positive indications.

SPECIAL AIR SAMPLING FOR I-131 FISSION PRODUCT MAY 1986

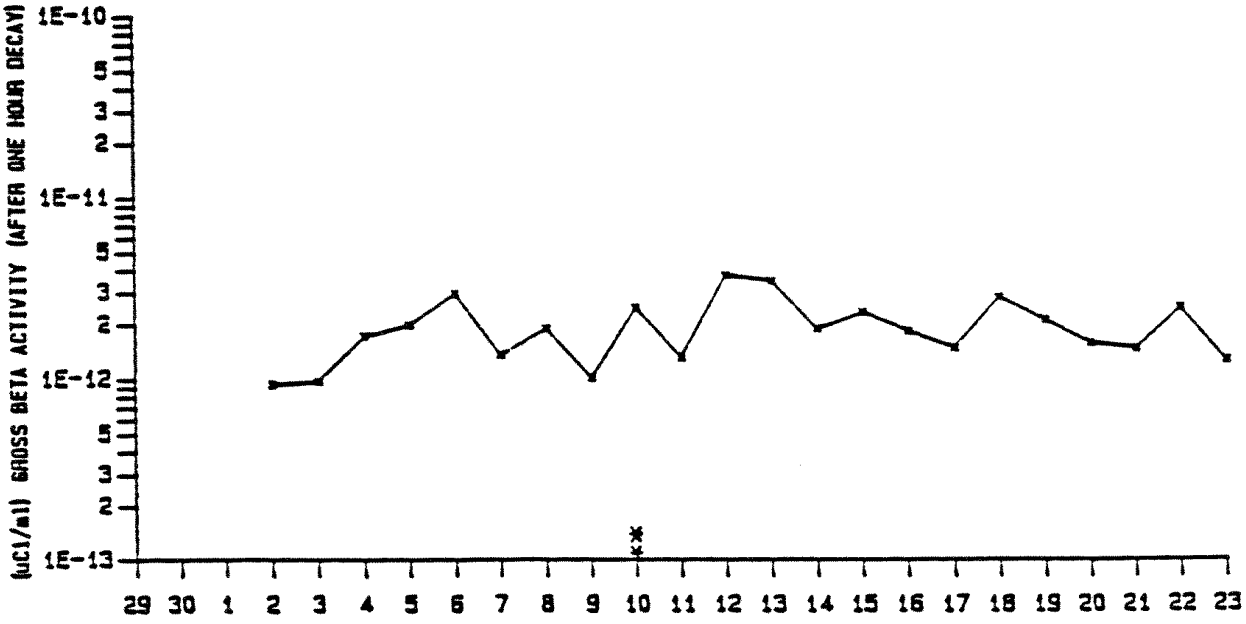
FIGURE F-1.1



Daily Collection from April 30 thru May 23

SPECIAL AIR SAMPLING FOR GROSS BETA RADIOACTIVITY MAY 1986

FIGURE F-1.2

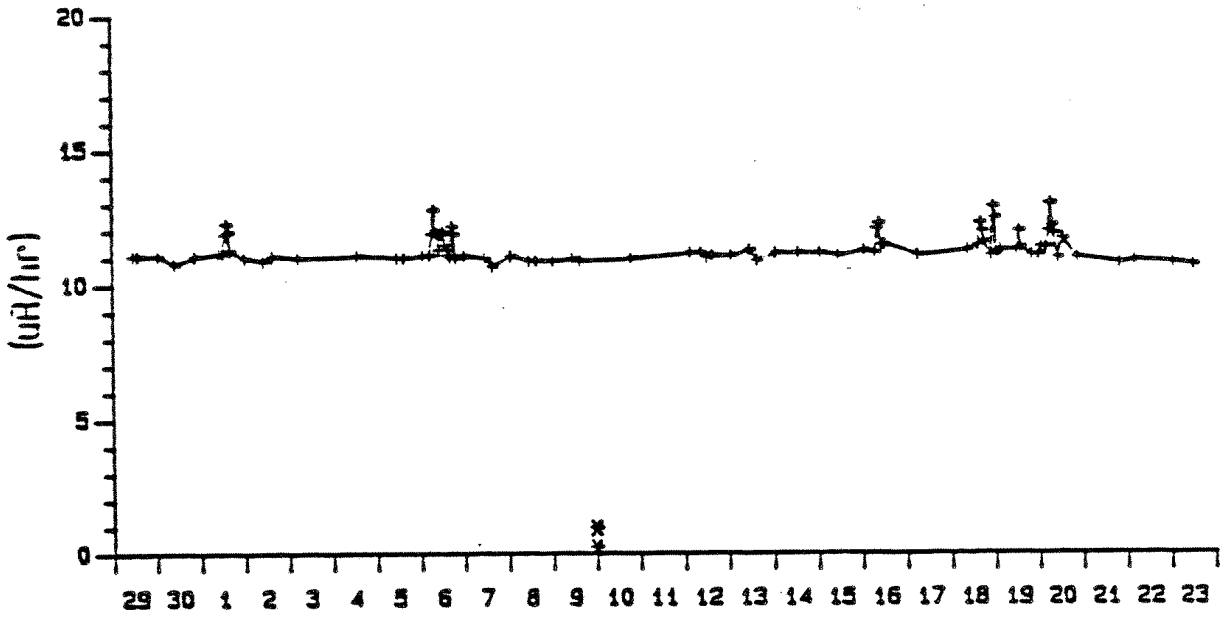


Daily Collection from May 2 thru May 23

** First incidence of detectable fission products

SPECIAL HPIC MONITORING
MAY 1986

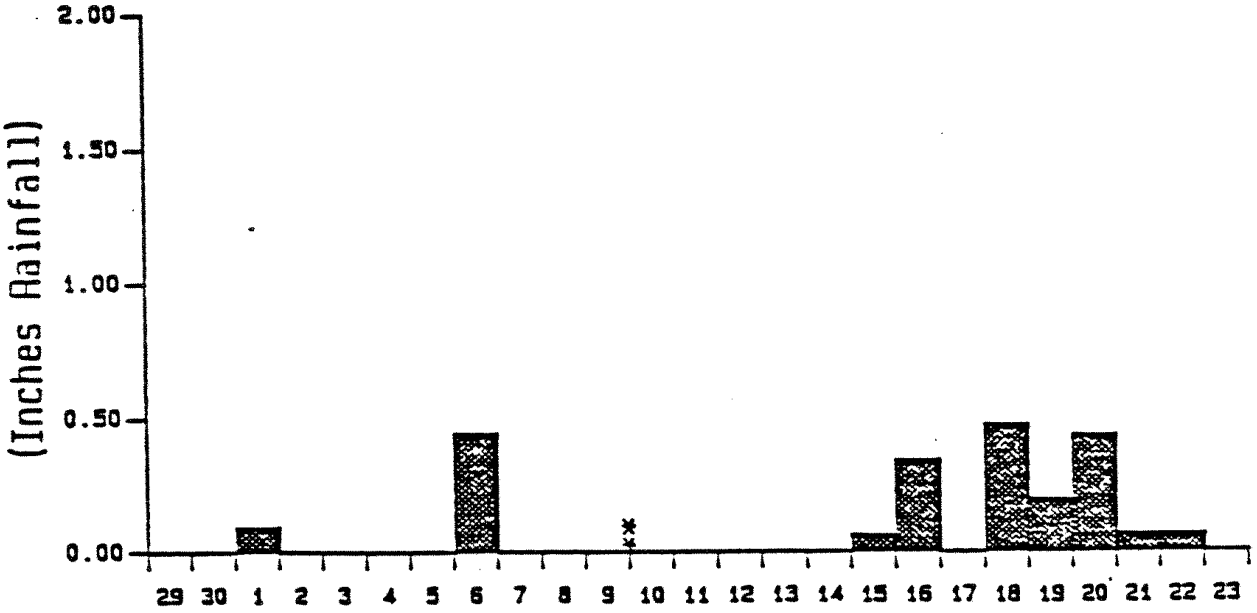
FIGURE F-1.3



Daily Monitoring from April 29 thru May 23

RAINFALL MONITORING
MAY 1986

FIGURE F-1.4



Daily Rainfall from April 29 thru May 23

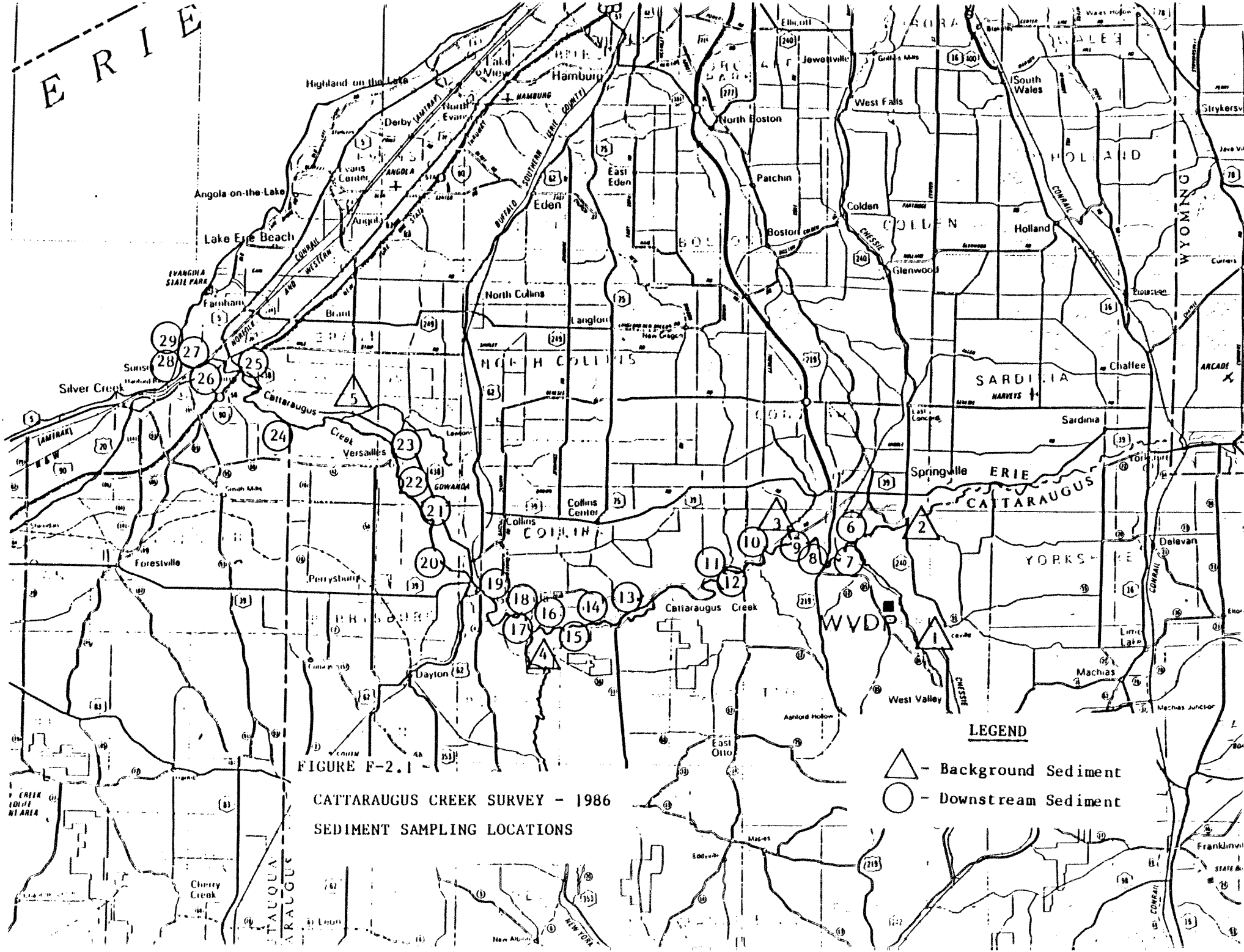
** First incidence of detectable fission products

TABLE F-2.1

CATTARAUGUS CREEK SURVEY - 1986

LOCATION NUMBER (FIG F-2.1)	LOCATION CODE	SAMPLE DATE	Cs-137	K-40	Pb-214	Bi-214	LOCATION EXPOSURE RATE (uR/hr)
			<----------uCi/g Dry Sediment---------->				
		A - BACKGROUND CREEK SEDIMENT					
1	SFBCSED	12MAY86	6.32 ± 2.9 E-08	1.24 ± 0.1 E-05	4.91 ± 0.5 E-07	5.57 ± 0.6 E-07	
1	SFBCSED	16DEC86	3.33 ± 2.9 E-08	9.58 ± 0.4 E-06	4.71 ± 0.5 E-07	5.20 ± 0.6 E-07	
2	SFBISED	12MAY86	5.89 ± 3.5 E-08	1.10 ± 0.1 E-05	4.25 ± 0.6 E-07	5.11 ± 0.7 E-07	
2	SFBISED	16DEC86	<3.21 E-08	9.57 ± 0.5 E-06	4.27 ± 0.5 E-07	5.07 ± 0.6 E-07	
3	SFSPONRS.CR	4NOV86	<3.21 E-08	1.24 ± 0.1 E-05	3.84 ± 0.5 E-07	4.59 ± 0.6 E-07	10
4	SFSBRANCHCC	4NOV86	<3.21 E-08	1.12 ± 0.1 E-05	3.16 ± 0.5 E-07	3.55 ± 0.5 E-07	12
5	SFCLEAR.CR	4NOV86	6.68 ± 3.3 E-08	1.21 ± 0.1 E-05	4.04 ± 0.5 E-07	4.85 ± 0.6 E-07	9
		B - CATTARAUGUS CREEK SEDIMENT - DOWNSTREAM OF WVDP					
6	SF05N-SCC	13AUG86	3.95 ± 0.1 E-06	1.11 ± 0.1 E-05	3.24 ± 0.6 E-07	4.10 ± 0.6 E-07	14
7	SFCCSED	12MAY86	7.56 ± 0.3 E-06	1.03 ± 0.2 E-05	4.85 ± 2.8 E-07	7.77 ± 2.2 E-07	
7	SFCCSED	12DEC86	1.97 ± 0.1 E-06	8.70 ± 0.5 E-06	4.64 ± 0.6 E-07	5.80 ± 0.6 E-07	
8	SFSDSED	30JUN86	1.06 ± 0.2 E-06	1.18 ± 0.2 E-05	4.88 ± 1.9 E-07	5.34 ± 2.1 E-07	
8	SFSDSED	16DEC86	4.86 ± 0.4 E-07	9.88 ± 0.5 E-06	4.35 ± 0.5 E-07	5.02 ± 0.6 E-07	
9	SF14N-SCC	7OCT86	7.42 ± 0.4 E-07	9.98 ± 0.5 E-06	3.54 ± 0.5 E-07	4.06 ± 0.6 E-07	12
10	SF16N-NCC	7OCT86	4.74 ± 0.4 E-07	1.08 ± 0.1 E-05	2.65 ± 0.5 E-07	3.51 ± 0.5 E-07	10
11	SF22.5N-SCC	10OCT86	3.31 ± 0.4 E-07	1.08 ± 0.1 E-05	3.05 ± 0.5 E-07	3.13 ± 0.5 E-07	11
12	SF21S-NCC	10OCT86	3.87 ± 0.4 E-07	1.15 ± 0.1 E-05	3.97 ± 0.5 E-07	5.39 ± 0.6 E-07	15
13	SF31N-SCC	20OCT86	3.41 ± 0.4 E-07	9.24 ± 0.5 E-06	3.07 ± 0.5 E-07	4.12 ± 0.6 E-07	12
14	SF30S-NCC	20OCT86	2.84 ± 0.4 E-07	1.08 ± 0.1 E-05	3.56 ± 0.5 E-07	4.22 ± 0.6 E-07	15
15	SF31.5S-SCC	20OCT86	2.58 ± 0.3 E-07	1.06 ± 0.1 E-05	3.48 ± 0.5 E-07	3.76 ± 0.6 E-07	14
16	SF33S-NCC	20OCT86	2,49 ± 0.4 E-07	1.31 ± 0.1 E-05	4.49 ± 0.5 E-07	4.78 ± 0.6 E-07	19
17	SF35S-SCC	21OCT86	1.39 ± 0.3 E-07	1.03 ± 0.1 E-05	3.98 ± 0.5 E-07	4.57 ± 0.6 E-07	17
18	SF37S-NCC	21OCT86	1.65 ± 0.3 E-07	1.01 ± 0.1 E-05	3.35 ± 0.5 E-07	3.86 ± 0.6 E-07	12
19	SF42N-ROCK	4NOV86	<3.21 E-08	1.62 ± 0.1 E-05	5.84 ± 0.6 E-07	7.05 ± 0.6 E-07	19
10	SF45N-NCC	22OCT86	2.19 ± 0.4 E-07	1.12 ± 0.1 E-05	3.42 ± 0.5 E-07	4.34 ± 0.6 E-07	11
21	SF47N-SCC	22OCT86	3.15 ± 0.4 E-07	1.18 ± 0.1 E-05	5.45 ± 0.5 E-07	5.56 ± 0.6 E-07	9
22	SF51N-SCC	22OCT86	1.51 ± 0.3 E-07	1.01 ± 0.1 E-05	3.06 ± 0.5 E-07	3.29 ± 0.5 E-07	14
23	SF52N-NCC	24OCT86	1.43 ± 0.3 E-07	1.10 ± 0.1 E-05	3.27 ± 0.5 E-07	3.99 ± 0.6 E-07	13
24	SF59S-NCC	24OCT86	1.34 ± 0.3 E-07	1.08 ± 0.1 E-05	3.90 ± 0.5 E-07	4.56 ± 0.5 E-07	8
25	SF58N-SCC	27OCT86	6.09 ± 0.4 E-07	1.22 ± 0.1 E-05	4.48 ± 0.5 E-07	5.86 ± 0.6 E-07	11
26	SF61N-NCC	31OCT86	3.42 ± 0.4 E-07	1.13 ± 0.1 E-05	5.07 ± 0.5 E-07	6.13 ± 0.6 E-07	9
27	SF63N-MCC	31OCT86	1.41 ± 0.4 E-07	1.18 ± 0.1 E-05	3.84 ± 0.5 E-07	4.45 ± 0.6 E-07	
28	SFCCB.W.END	31OCT86	1.88 ± 0.3 E-07	1.14 ± 0.1 E-05	3.58 ± 0.5 E-07	3.79 ± 0.6 E-07	
29	SF69N-BCH	31OCT86	1.58 ± 0.3 E-07	1.09 ± 0.1 E-05	2.07 ± 0.5 E-07	2.87 ± 0.5 E-07	6

Location Code Key: Codes ending in SED refer to routine sampling locations (See Appendix A-1);
SFPONRS.CR = Spooners Creek; SFSBRANCHCC = South Branch Cattaraugus Creek; SFCLEAR.CR = Clear Creek
SF35S-SCC: 35S = South Bank Survey map location (See Fig F-2.3); SCC = South Bank sample
SF45N-NCC: 45N = North Bank Survey map location (See Fig F-2.2); NCC = North Bank sample



LEGEND

△ - Background Sediment

○ - Downstream Sediment

FIGURE F-2.1

CATTARAUGUS CREEK SURVEY - 1986

SEDIMENT SAMPLING LOCATIONS

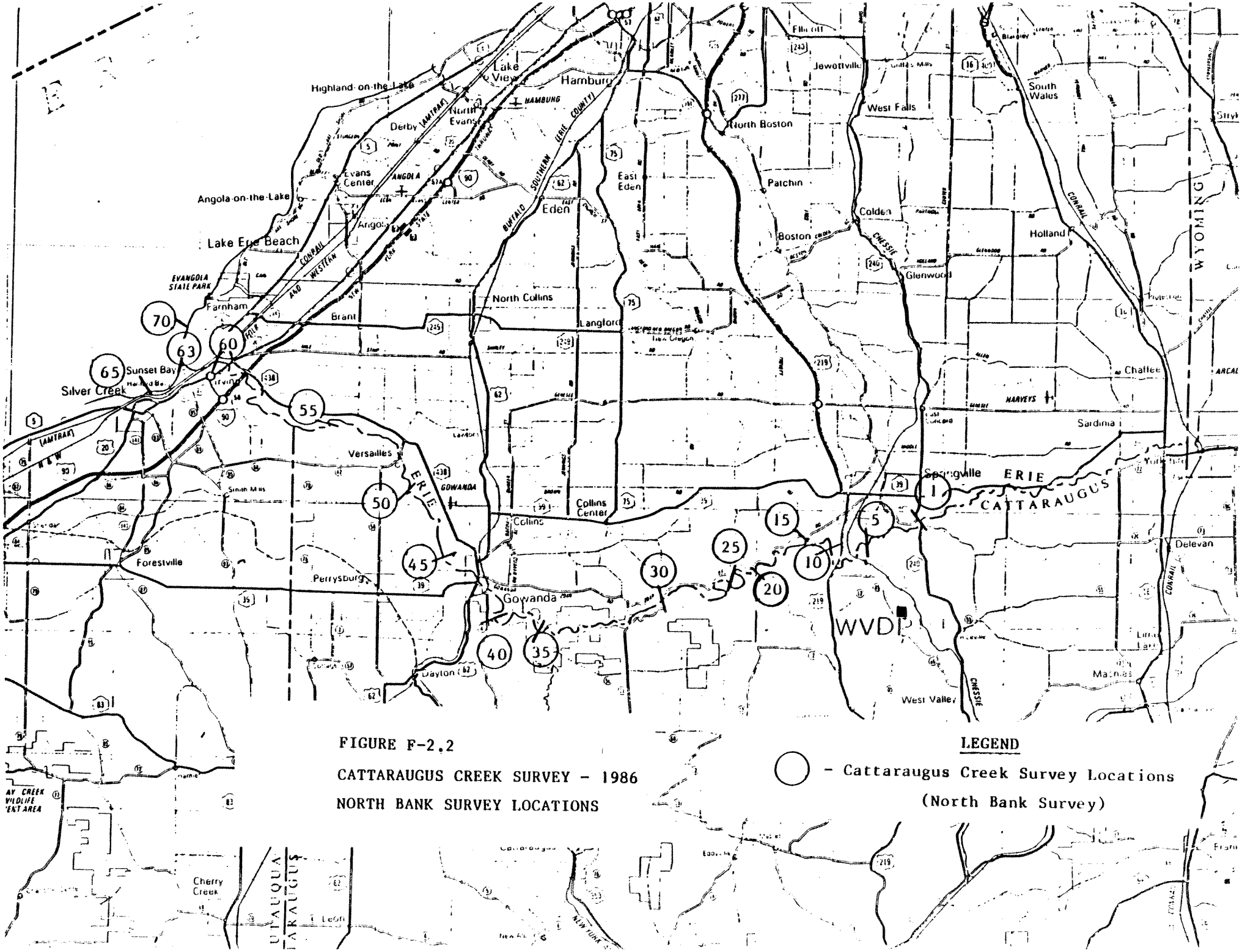


FIGURE F-2.2

CATTARAUGUS CREEK SURVEY - 1986

NORTH BANK SURVEY LOCATIONS

LEGEND

○ - Cattaraugus Creek Survey Locations (North Bank Survey)

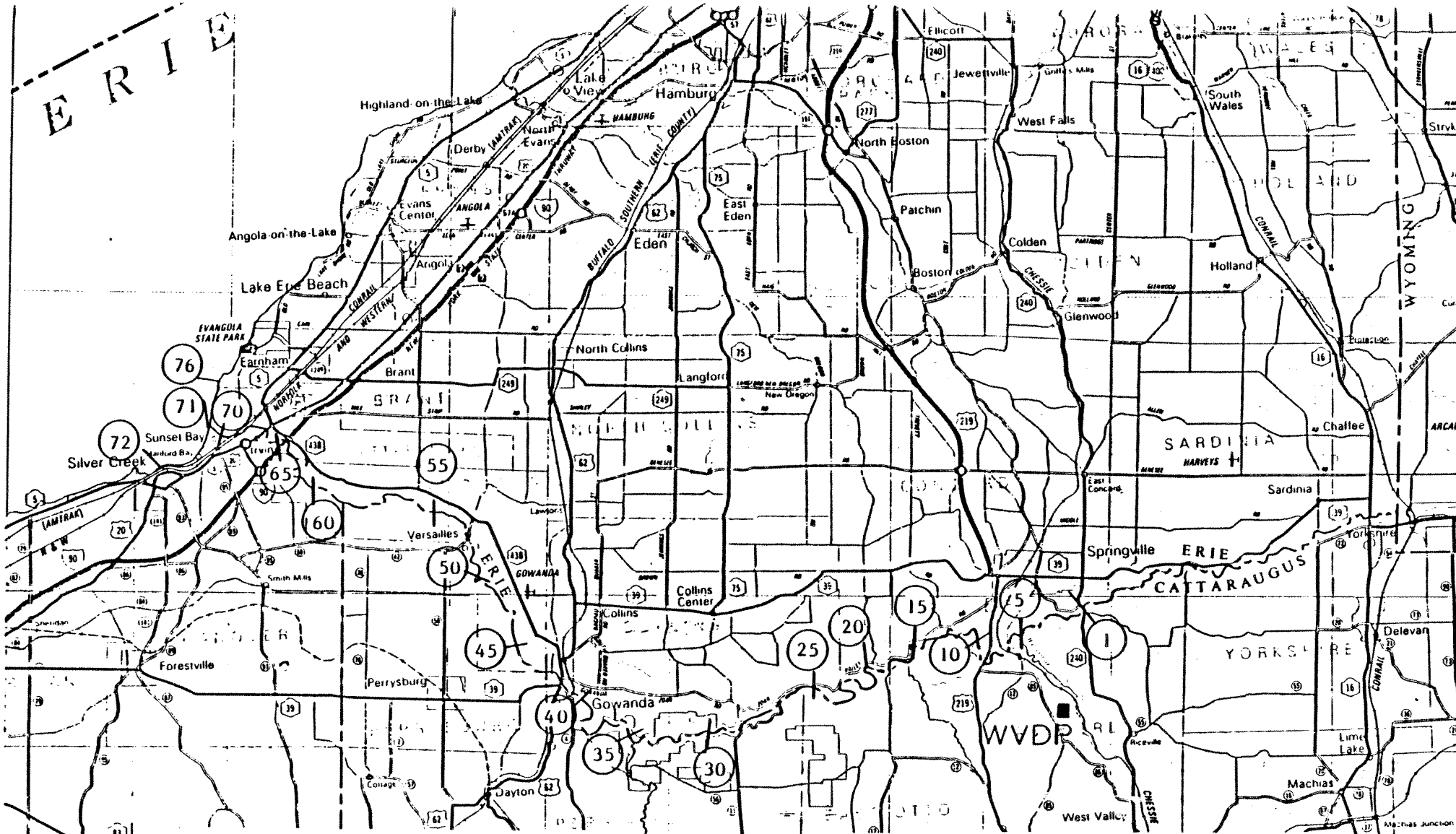


FIGURE F-2.3

CATTARAUGUS CREEK SURVEY - 1986

SOUTH BANK SURVEY LOCATIONS

LEGEND

○ - Cattaraugus Creek Survey Locations

(South Bank Survey)

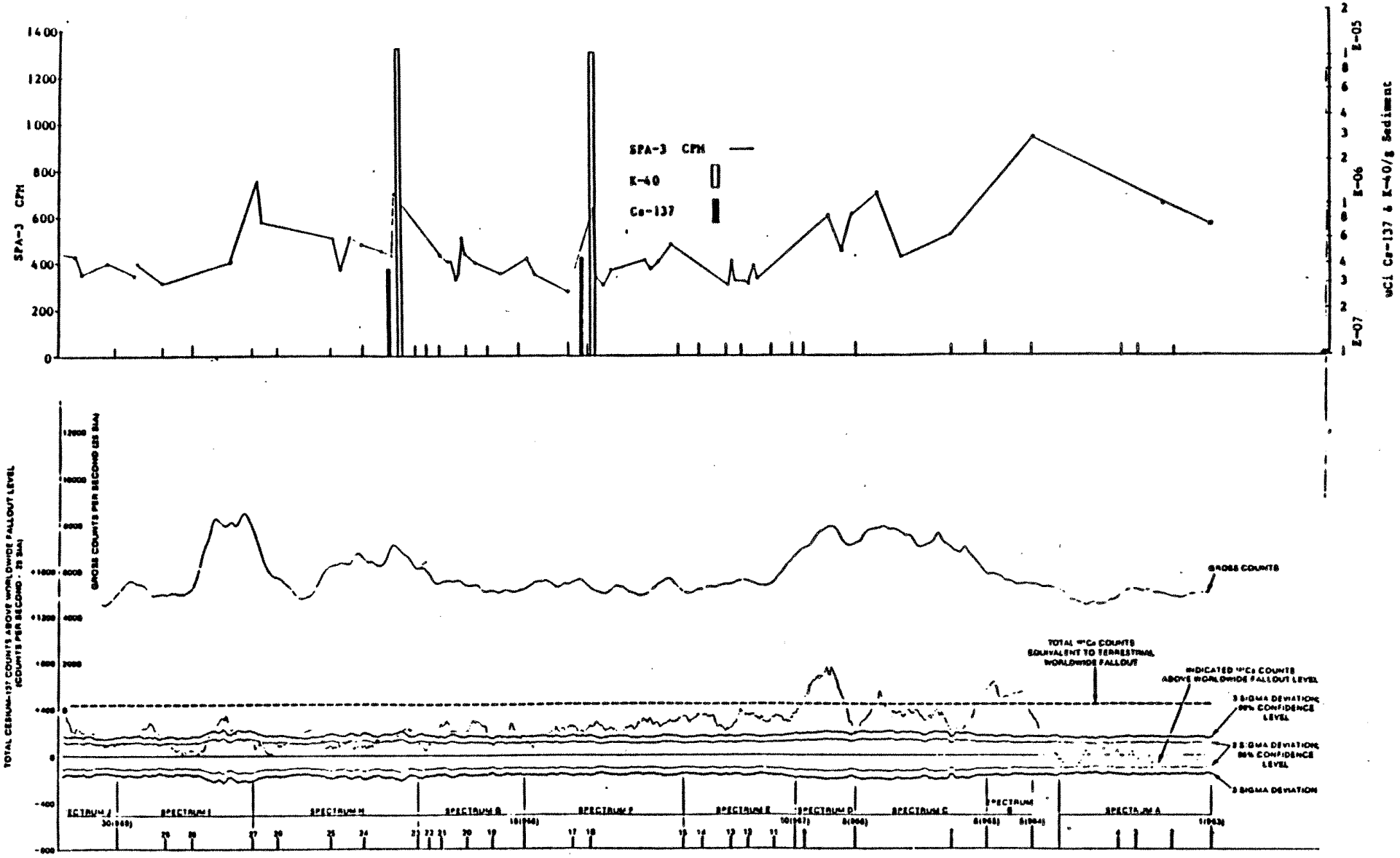


FIGURE F-2.4 CATTARAUGUS CREEK SURVEY - 1986
Aerial Survey (Bottom) Compared to Ground Level Survey (Top)
North Bank Data - Sheet 1 of 3

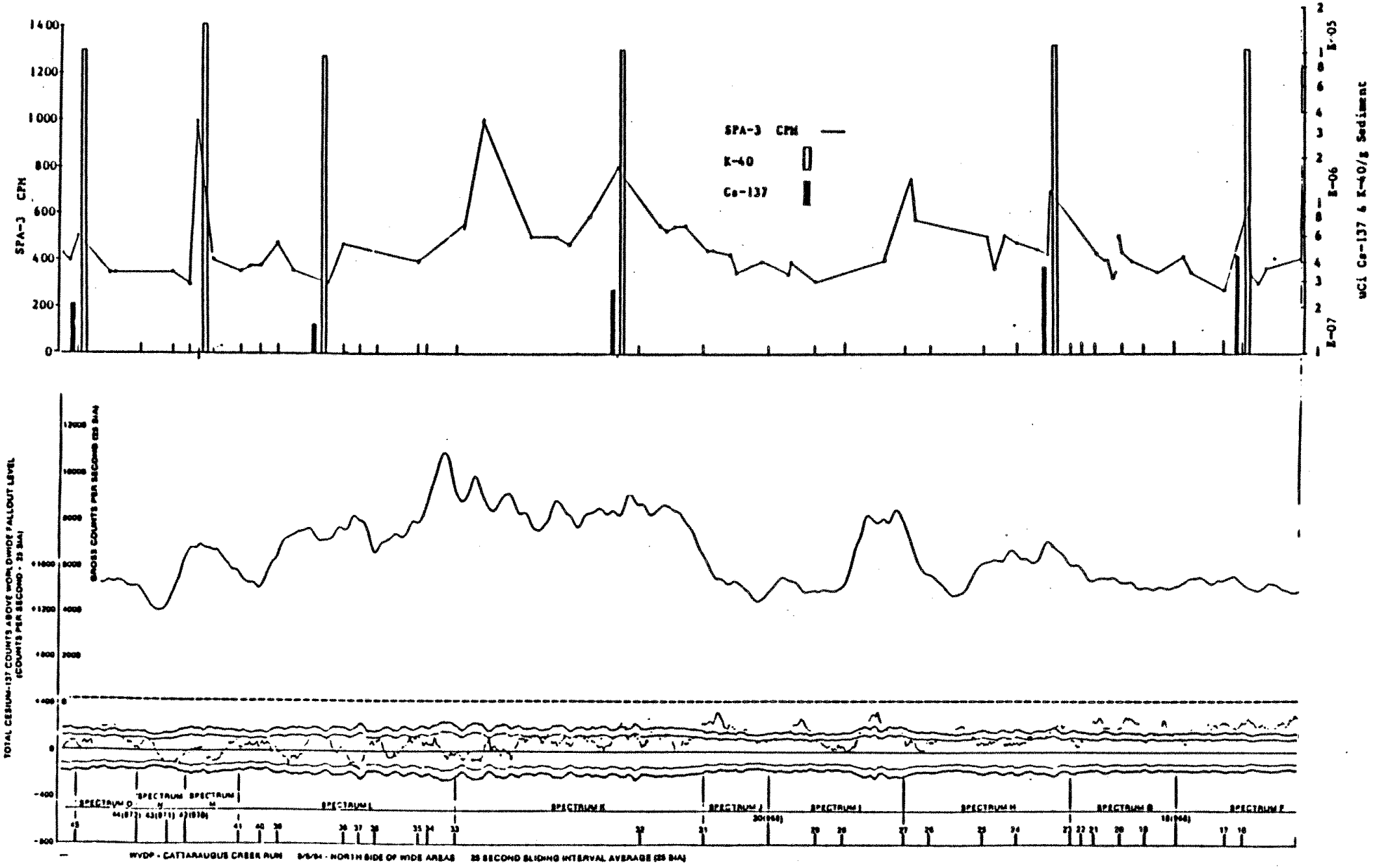


FIGURE F-2.4 CATTARAUGUS CREEK SURVEY - 1986
Aerial Survey (Bottom) Compared to Ground Level Survey (Top)
North Bank Data - Sheet 2 of 3

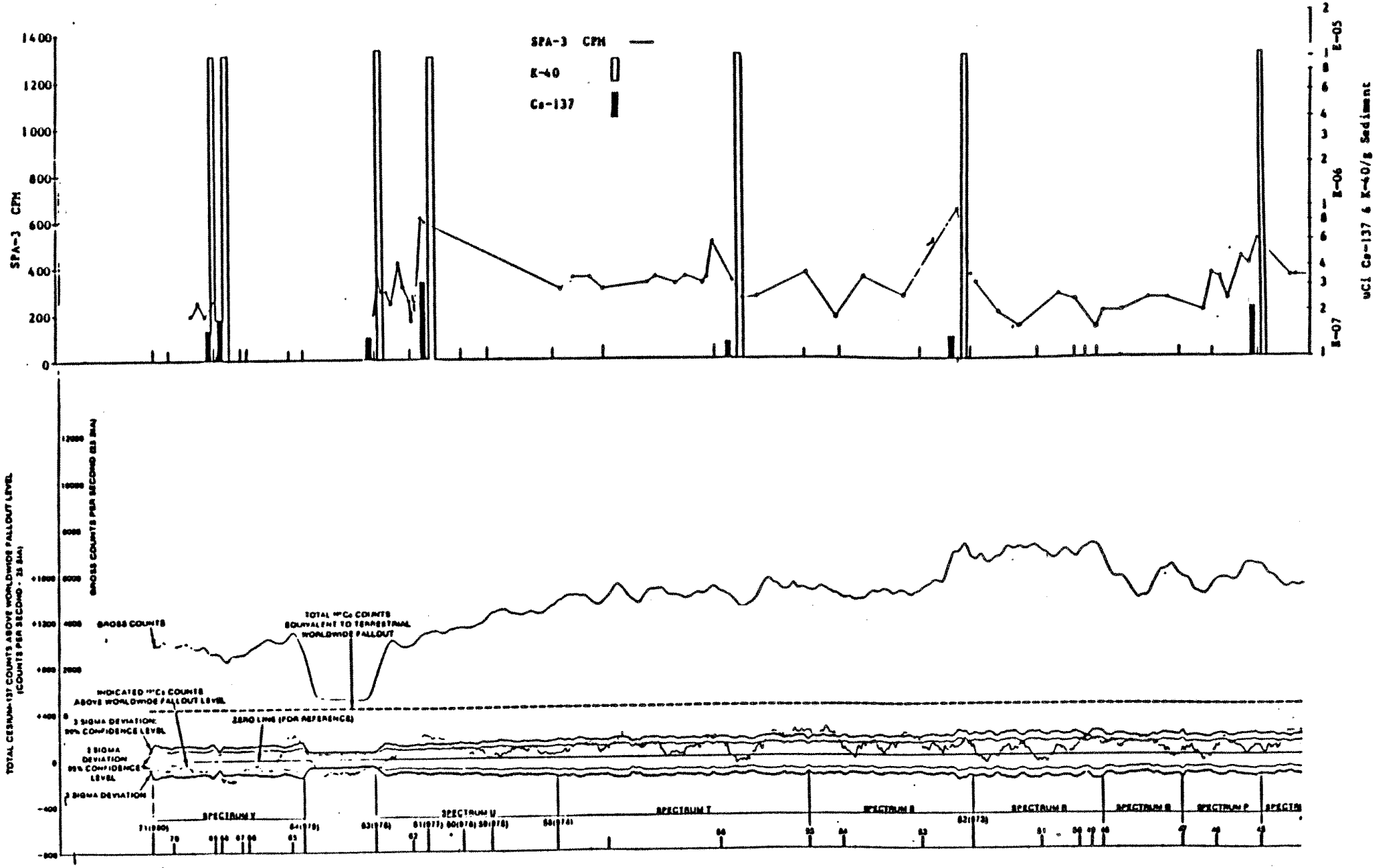


FIGURE F-2.4 CATTARAUGUS CREEK SURVEY - 1986
Aerial Survey (Bottom) Compared to Ground Level Survey (Top)
North Bank Data - Sheet 3 of 3

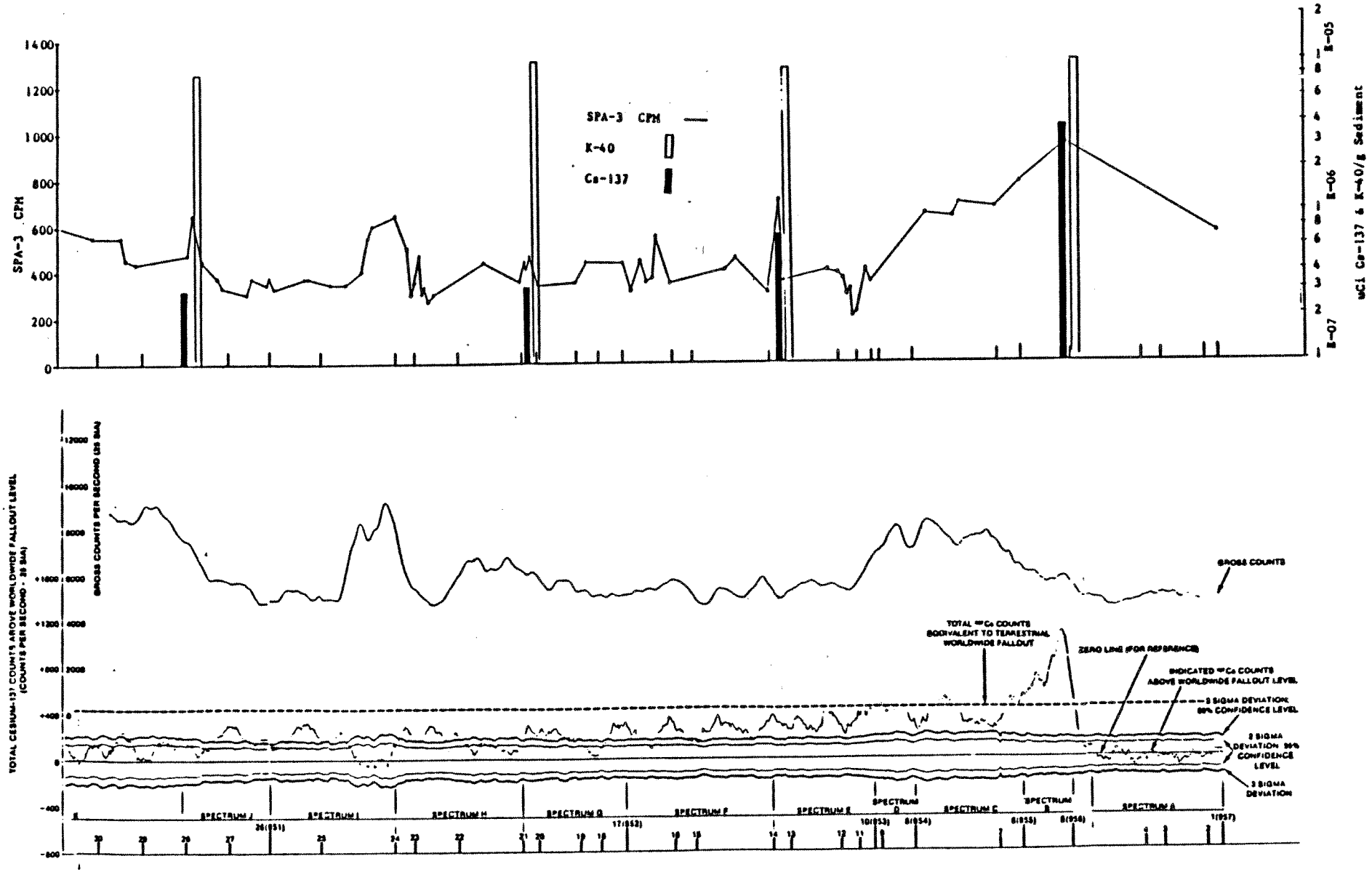


FIGURE F-2.5 CATTARAUGUS CREEK SURVEY - 1986
Aerial Survey (Bottom) Compared to Ground Level Survey (Top)
South Bank Data - Sheet 1 of 3

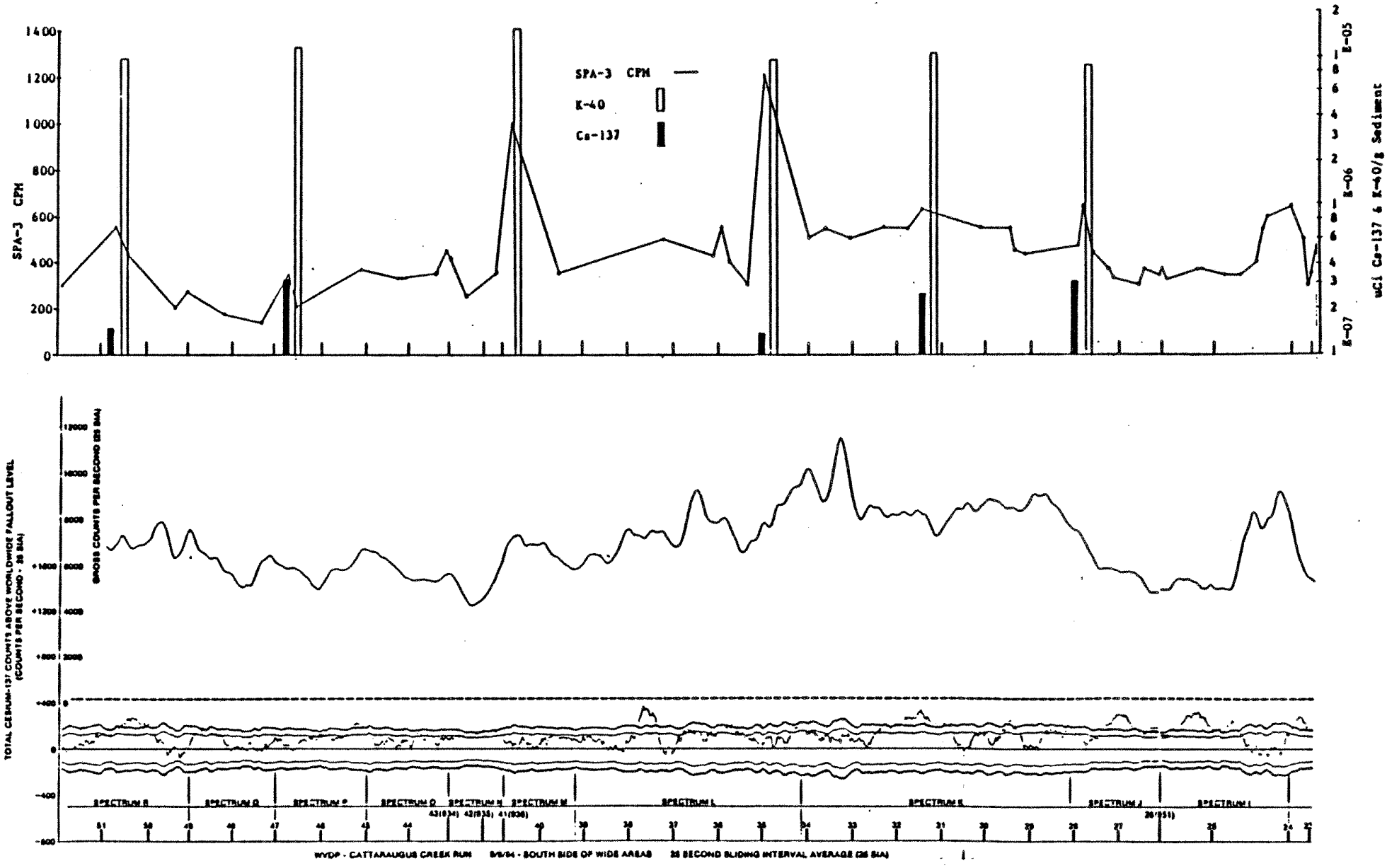


FIGURE F-2.5 CATTARAUGUS CREEK SURVEY - 1986
Aerial Survey (Bottom) Compared to Ground Level Survey (Top)
South Bank Data - Sheet 2 of 3

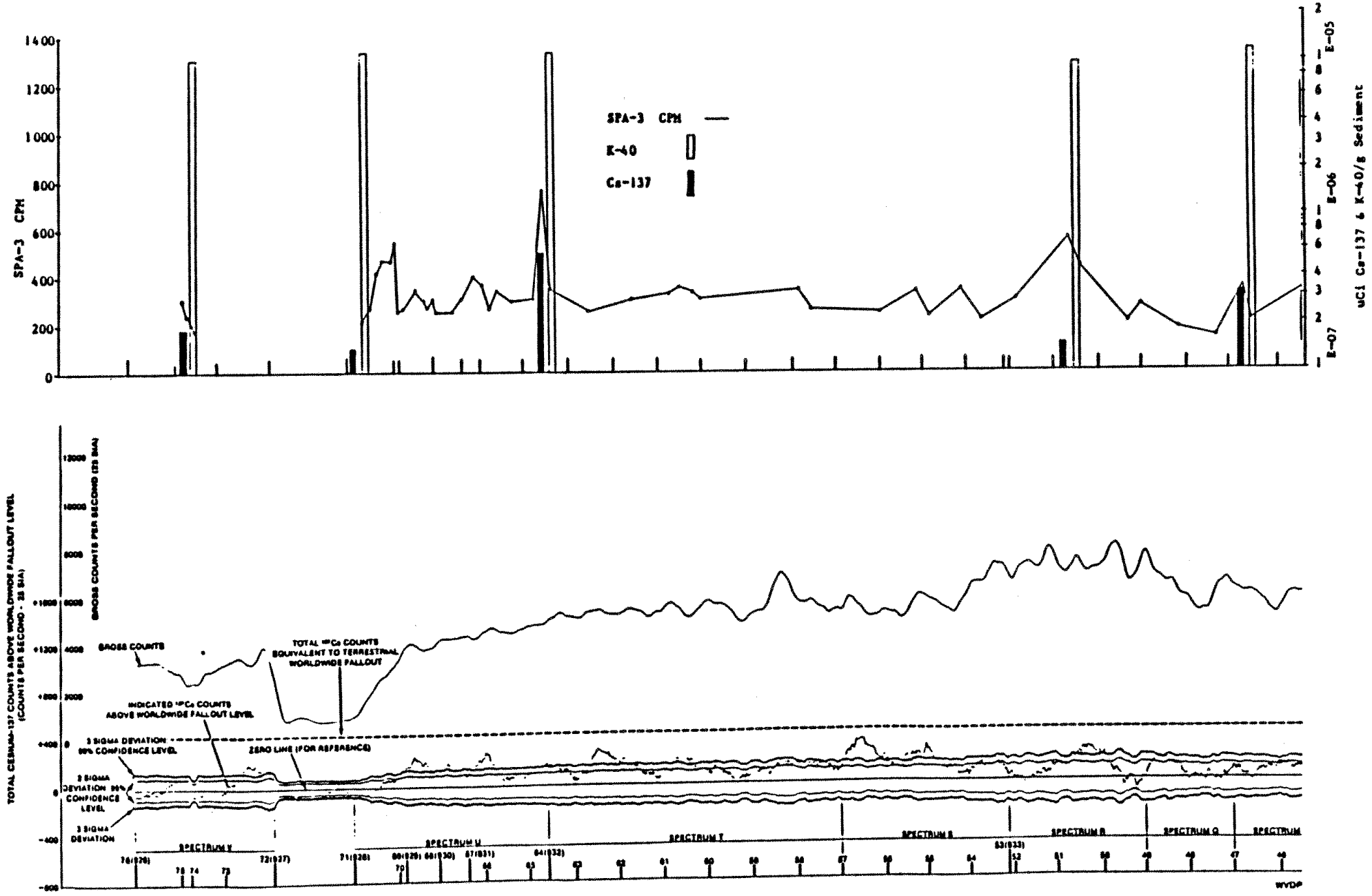


FIGURE F-2.5

CATTARAUGUS CREEK SURVEY - 1986
Aerial Survey (Bottom) Compared to Ground Level Survey (Top)
South Bank Data - Sheet 3 of 3