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OU-4 Miami-Erie Canal

REMOVAL ACTION

MOUND PLANT
MIAMISBURG, OHIO

June 1999

Final

(Revision 0)

Department of Energy

Babcock & Wilcox of Ohio

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- Summarizes results of verification samples and documents that removal action has been successful.

EXECUTIVE SUMMARY

The Operable Unit (OU4) Miami-Erie Canal Removal Action was located in a segment of the Miami-Erie Canal immediately west of Mound Plant in the City of Miamisburg, Ohio. This Removal action resulted in the excavation and disposal of approximately 38,000 cubic yards of contaminated soil. The contaminated soil was transported by rail for disposal at Envirocare in Clive, Utah. The cleanup goal for 238-Plutonium was 75 pCi/g, at the 95% upper confidence level (UCL) of the mean. Verification sampling results confirmed the 95% UCL of the mean was 24.0 pCi/g and the cleanup goal was achieved.

Arthur Kleinrath, OSC
U.S. Department of Energy
Miamisburg, Ohio

Tim Fischer
U.S. EPA
Chicago, Illinois

Brian Nickel
Ohio EPA
Dayton, Ohio

1.0 SUMMARY OF EVENTS

1.1 Site Conditions And Background

In July 1995, DOE proposed the removal of contaminated soil and sediment from an abandoned segment of the Miami-Erie Canal. The planning phase of the project was completed in 1996. Over a period of about 18 months, the project resulted in the removal and disposal of approximately 38,000 cubic yards of material. This report describes the removal action field work and documents successful completion of the project. This section of the report briefly describes conditions leading up to the removal action.

The Mound Plant is located within the city limits of Miamisburg, Ohio, approximately 10 miles southwest of Dayton and 45 miles north of Cincinnati (see Figure 1). The 1990 census reported 17,834 residents of Miamisburg. The plant site overlooks Miamisburg. The Great Miami River and the river floodplain are to the west. Also to the west is a segment of the abandoned Miami-Erie Canal.

The Mound Plant was added to the National Priorities List (NPL) in 1989. Remedial activities for the site were originally organized into nine Operable Units (OU). OU4 (see Figure 2) was defined as: 1) the abandoned Miami-Erie Canal; 2) the Overflow Creek, which connects the canal to the river; 3) the Drainage Ditch from the site boundary to the canal; 4) the Runoff Hollow between the Conrail tracks and Mound Plant; and 5) the South Pond in the Miamisburg City Park. Within OU4, land use is a combination of a city park, conservancy district, and the railroad right-of-way. The City of Miamisburg is immediately north and west of OU4, and includes the north portion of the canal.

The primary feature of OU4 is a portion of the abandoned Miami-Erie Canal. The north-south trending canal area lies between the Conrail Railroad right-of-way to the east and the Dayton-Cincinnati Road to the west. The Miami-Erie Canal was constructed during the 1800s as a north-south transportation route, and abandoned in 1915. The segment of the canal within OU4, with the exception of the Miamisburg City Park, appears to have gone unmaintained since its abandonment. All of the South Canal and a portion of the North Canal are considered a flood plain.

The Miamisburg City Park, located immediately northeast of OU4, is used year-round, with a peak usage in the summer (basketball area and tennis courts). Houses, a mobile park, and light commercial businesses are located near the Overflow Creek and the west side of the northern portion of the canal.

The Drainage Ditch from the Mound Plant to the canal was utilized for surface water runoff from the elevated plant site. This Drainage Ditch is the separation point between the North and South Canal. Originally, the runoff flowed both north and south

along the canal. In 1976, a flapper valve was installed, eliminating discharges to the North Canal, but allowing flow from the North Canal to the South Canal. The South Canal flows into the Overflow Creek, which empties into the Great Miami River. The Great Miami River is approximately 2,000 feet from the plant's west fence line.

The City of Miamisburg has a sanitary sewer line buried within the North Canal. The sanitary sewer line runs approximately the entire length of the North Canal. At the northern end, it connects to a pump station in the City Park. At the south end, it connects to a line running under Cincinnati-Dayton Road, via another pumping station located immediately north of the Canal/Drainage Ditch intersection. Several manholes access risers protrude from the sanitary sewer line several feet above the canal bed.

The South Canal was overgrown and not as easily accessible as the North Canal. The South Canal supported a continual flow of water and was used to drain surface water runoff from the plant. Water flowing from the Plant into the canal was monitored under an Ohio Environmental Protection Agency (OEPA) National Pollutant Discharge Elimination System (NPDES) permit.

Historic operations and accidental releases from the Mound Plant resulted in the discharge of contamination into the Miami-Erie Canal. This contamination consisted primarily of plutonium and tritium. Although the potential for releases of non-radiological chemicals into the Drainage Ditch may have existed at one time, results of past investigations did not indicate that there was significant non-radiological contamination in the canal.

Plutonium-contaminated soil was conveyed by stormwater into the canal and, to a lesser extent, the Overflow Creek and the Great Miami River, as the result of a pipeline rupture at Mound Plant in 1969. The contaminated soils were deposited as sediments in the canal. Field investigations (Rogers 1975 and DOE 1993b) determined that the maximum plutonium contamination was less than 5,000 pCi/g, with an average concentration of less than 600 pCi/g.

The tritium contamination of OU4 primarily resulted from the pre-1970 disposal of tritiated process liquids. The depth distribution profiles for the tritium contamination were found to resemble those of the plutonium contamination. The highest concentrations of tritium in canal soil samples decreased over time from 7.0×10^5 pCi/g in 1974 and 1.1×10^5 pCi/g in 1976 (Kershner and Rhinehammer 1978) to 180 pCi/g in 1993 (DOE 1993b).

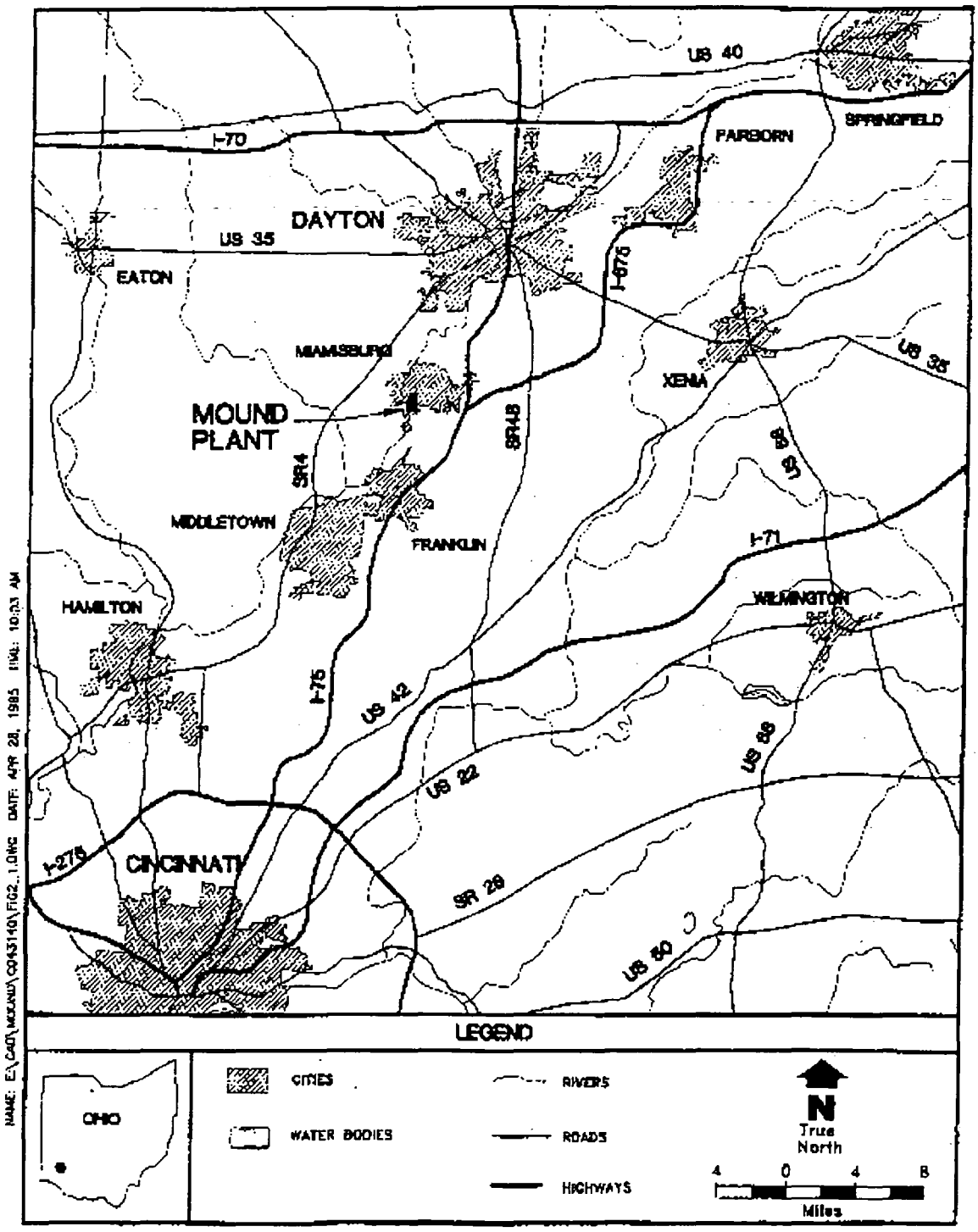
A fraction of the tritiated water that entered the canal percolated into the substrata where it could potentially migrate into the Buried Valley Aquifer (BVA). The results from groundwater samples collected from monitoring wells in the BVA during 1991 and 1992 indicated that the annual average tritium concentrations were below the Safe Drinking Water Act (SDWA) standard (EG&G 1992). Tritium concentrations in all

drinking water wells were also below the SDWA standards.

The 1993 Special Canal Sampling Study (DOE 1993b) determined that little non-radiological contamination existed in the canal. The maximum concentrations of polychlorinated biphenyls PCBs) (19 ppm) and polynuclear aromatic hydrocarbons (PAHs) (53 ppm) occurred at the northern end of the canal. The maximum concentration of lead (579 ppm) occurred along the west bank of the North Canal. These concentrations were within the normal range for a suburban setting, and none were suspected to be the result of emissions or releases from Mound Plant.

Further details of historic releases into the canal can be found in the Removal Site Evaluation (DOE 1993a), the Engineering Evaluation/Cost Analysis (DOE 1995a), the Action Memo (DOE 1995b), the Removal Action Design Document (DOE 1997), and the collection of fact sheets in Appendix A.

Figure 1.1 Location of Mound Site



1.2 Organization Of The Response

Table 1 lists the groups responding to the Action, and their responsibilities.

Table 1.1 Organization of the Response

US EPA SFR-5J 77 W. Jackson Chicago, IL 60604 312-353-2000	Tim Fischer	Federal agency responsible for oversight.
Ohio EPA 401 E. Fifth St. Dayton, OH 45402-2911 937-285-6357	Brian Nickel	State agency responsible for response oversight.
DOE-MEMP P.O. Box 66 1 Mound Road Miamisburg, OH 45343-0066 937-865-4020	Art Kleinrath	Federal OSC responsible for response oversight and success.
EG&G Mound ER Program P.O. Box 3000 Mound Rd. Miamisburg, OH 45343-3000 937-865-4020	Monte Williams	Provided the OSC with technical assistance, administrative support, sampling, photo and site documentation, site safety and report preparation.
BWO Soils Project 1 Mound Road Miamisburg, OH 45343-3030 937-865-4020	John Price	Provided the OSC with technical assistance, administrative support, photo and site documentation, and preparation of OSC report.
Roy F. Weston 2566 Kohnle Dr. Miamisburg, OH 45342 937-384-4200	Gordon Horn	Provided services for verification sampling and managed sample analysis and data validation.
Envirocare of Utah, Inc. 46 W. Broadway, Suite 240 Salt Lake City, Utah 84101 801-532-1330	Sue Rice	Responsible for disposal of the contaminated soils.

1.3 Objectives

DOE as the lead agency, with stakeholder input from the OU4 Focus Group and Mound Action Committee, established the cleanup objective for this removal action (DOE 1995b, included in Appendix A). This objective is summarized as follows:

Objective	238-Pu Concentration
As Low As Reasonably Achievable (ALARA)	25 pCi/g
95% Confidence Limit	75 pCi/g
Maximum Residual	150 pCi/g

The ALARA goal (25 pCi/g) was used to guide decisions on where and how much to excavate. The 95% confidence limit from the verification sampling must be less than 75 pCi/g with no sample values greater than 150 pCi/g.

1.4 Chronological Narrative Of Response Actions

The following is a chronological narrative of events for the OU4 Miami-Erie Canal Removal Action.

1969 A Mound Plant underground pipeline carrying plutonium-238 in a nitric acid solution ruptured, releasing the plutonium to the surrounding soils. During the pipeline remediation, a rainstorm washed some of the contaminated soils and sediments through natural drainage pathways into the Miami-Erie Canal.

1974 Mound Plant performed a comprehensive study (Rogers 1975) to determine the impact of plutonium contamination on the Canal and surrounding waterways.

1989 Mound Plant was placed on the Comprehensive Environmental Response Compensation and Liability Act (CERCLA, i.e. Superfund) National Priorities List and, subsequently, a Federal Facilities Agreement (FFA) was established between the DOE, the U.S. Environmental Protection Agency (EPA) and the Ohio Environmental Protection Agency (OEPA).

1993 Subsequent environmental monitoring and studies, including the 1992-93 study by the Agency for Toxic Substances and Disease

Registry (ATSDR 1993), supported the findings of the 1974 study that the Canal contamination did not pose a public health hazard under the current land use and ownership. DOE determined that a removal action was warranted due to the change in mission for the Mound Plant and the potential for future change in the Canal land use and ownership. DOE performed a Special Canal Sampling Study (DOE 1993b) to determine whether chemical contamination exists in the Canal soils that would require the excavated soils to be classified as mixed hazardous waste. Results of the study indicated that although some chemical contamination exists, it occurred at low levels and was probably from sources other than Mound Plant. DOE prepared an RSE (DOE 1993a) to determine the need for a removal in the Miami-Erie Canal. The report concluded that there was no current threat to human health or the environment, and, on this basis, a removal action was not warranted. However, the DOE decision to change the mission of the Mound Plant could result in a future change in land use and ownership of the Canal, which could alter the human health risk evaluation. On this basis, DOE recommended performing a removal action in the Miami-Erie Canal.

1995

DOE completed an EE/CA (DOE 1995a) which evaluated five removal action alternatives on the basis of effectiveness, implementability and cost. For the OU4 Removal Action, a plutonium cleanup goal was developed by DOE as the lead agency, with input and concurrence from the Stakeholders through the OU4 Focus Group and Mound Action Committee (DOE 1995b). The plutonium-238 cleanup goal included development of a field excavation plan to remove areas of soil and sediments in the Canal known to have plutonium contamination levels greater than 75 pCi/g, which was achievable with state-of-the-art field sampling and analysis techniques. Plutonium concentrations less than 75 pCi/g would not require excavation from the Canal. The excavation plan was developed to remove soils and sediments having plutonium contamination greater than 25 pCi/g in the vicinity of areas that originally exceeded 75 pCi/g.

February 1996

The Project Team partnered with DOE, Stakeholders, and various support groups to hold Open House at the Miamisburg High School on February 21, 1996.

April 1996

Procurements for the site drainage diversion construction, site fencing, articulating haulers, relocation of monitoring wells, DP&L electrical reroute, verification sampling services, mobile lab and equipment and access road materials were all underway. The bid

	opening for the canal site clearing and grubbing work was held. Five bids were received and Cumbo Excavating of Columbus, Ohio was the successful low bidder. Conrail access was approved. Modifications to the Rail Spur Upgrade were completed.
May 1996	Cumbo Excavating started construction fieldwork for site clearing and grubbing. The mobile lab, instrumentation, and the site trailer were delivered to Mound.
June 1996	The site drainage reroute contract was awarded to Glover Excavating. The articulating haulers were delivered.
July 1996	Glover Excavating began construction fieldwork for the site drainage reroute. Terran Corporation was awarded the contract for monitoring well abandonment.
August 1996	Advanced Sewer Technologies performed videotaping of the sanitary sewer in the North Canal. The construction fieldwork for the site clearing and grubbing work and the access roads were completed. The vegetation slash, that had been sampled, analyzed and found contaminant free, was chipped and spread.
September 1996	During excavation of the underground site drainage reroute piping, a concrete slab with stained and oil-smelling soil was discovered. Excavation was stopped and field sampling/analysis indicated contamination from Stoddard Solvent. Approximately 200 yards of soil was removed and staged at the bioremediation facility for treatment. Fieldwork for the monitoring well abandonment was completed. Preparation of the well dossiers and field reports were completed and submitted to DOE and the regulators.
October 1996	Completed fieldwork for site perimeter fencing in the South canal. Completed construction of the on-site soil staging area (at the rail spur). Verification sampling at the South Pond, Runoff Hollow, Overflow Creek and miscellaneous stakeholder areas (off-site areas) was initiated. Access Road extensions were completed.
November 1996	Site Drainage Reroute pipe installation and headwall fabrication were completed. The site perimeter fencing (both North and South Canals) was completed. Completed final preparations of the Soil Staging Area (installation of asphalt, jersey barriers, and perimeter fencing). Verification Sampling was completed in the stakeholder areas. Excavation of the OU4 Miami-Erie Canal soils began on November 11, 1996, at the area south of the weir and the soils were

	transported to the soil staging area. During excavation, an oily substance was encountered, which later was determined to be the result of the natural decay of vegetation. Weston proceeded with formal verification sampling.
December 1996	Results from the October Verification Sampling of the Stakeholder Areas (Rice Field, tennis courts, and overflow creek) have been received and there is no indication of contamination.
February 1997	Excavated South Canal, east side dredging piles. First filled railroad car was picked up by Conrail and transported to Envirocare in Clive, Utah for disposal. Soil screening and formal verification sampling continued in the South Canal.
March 1997	Completed excavation of the South Canal, east side dredging piles. Additional tree removal was required on the west bank in the North Canal. Excavation in the North Canal began March 11, 1997. Sixty railcars were shipped in March to meet a DOE challenge. To date approximately 7,100 cubic yards of contaminated soil was removed, and 76 railcars have been shipped. Cumbo Excavating completed the installation of the North Canal Interceptor Ditch. INEL conducted a calcium fluoride detector technology demonstration (Warthog) on the South Canal, east side dredging piles.
April 1997	To date, 11,535 cubic yards of soil have been excavated. Soil screening and formal verification sampling continued in the North Canal.
May 1997	On May 19, 1997, three buried water collection tanks that belonged to the City were excavated and removed. The 12' long x 6' diameter steel tanks were crushed and disposed as debris with the contaminated soil. To date, 15,889 cubic yards of contaminated soil have been removed.
June 1997	Completed excavation of the North Canal on June 12, 1997. Began excavation in South Canal (Flapper Valve and spillway). To date, approximately 19,411 cubic yards of soil has been excavated, and 192 railcars have been shipped to Envirocare.
August 1997	INEL completed additional Warthog studies. Additional tree removal (approximately 12 trees) was completed on the west bank of the South Canal. Tree roots were shipped as waste because of contaminated soil clinging to them. The large diameter trunks were surveyed and released, and were given away as firewood. To date,

	approximately 24,100 cubic yards of soil had been removed, and 299 railcars had been shipped.
October 1997	Excavated soil under the Conrail Trestle. To date, approximately 32,085 cubic yards of soil have been removed, and 402 railcars have been shipped. Soil screening and formal verification sampling continued in the South Canal.
November 1997	Planned for the remediation of five secondary features: cleaning around the 1895 bridge, decontaminating or demolishing a concrete abutment in the South Canal, cleaning around pipe at the flapper valve, decontaminating the subgrade trestle wall, and "shaving" soil from the west bank of the South Canal.
December 1997	Backfilled the Interceptor Ditch in the North Canal.
January 1998	Removed additional trees from the west bank of the South Canal. Soil screening and formal verification sampling continued in the South Canal.
February 1998	To date, 37,000 cubic yards of soil was removed, and 490 railcars were shipped.
March 1998	Completed the demolition and removal of two concrete structures in the South Canal. Dismantled the 1895 Historical Bridge and excavated contaminated soil. Re-excavated hot spots in the South Canal (north end of the South Canal, on the west bank). Cumbo Excavating began restoration activities in the North Canal. Discussion continues with OEPA and ODH on leaving surface contamination on the Conrail railroad trestle concrete.
April 1998	Due to surface contamination levels, most of the sandstone blocks from the 1895 Historical Bridge were designated for disposal. Re-excavated additional hot spots. Soil screening and formal verification sampling continued in the South Canal. Cumbo Excavating began partial restoration activities in the South Canal. The Conrail railroad trestle concrete wall was sampled. The results of this sampling were used in a risk evaluation that concluded the contamination of the bulk concrete is within acceptable risk levels under CERCLA.
May 1998	Completed monitoring and additional soil sampling of the twin sixties. Completed Canal soil excavation, with soil verification sampling indicating no further excavation required. The entire Canal

project was turned over to Cumbo Excavating for site restoration. To date, approximately 38,000 cubic yards of soil were excavated. Cumbo Excavating completed restoration activities in the North Canal including the re-build of the 1895 Historical Bridge, landscaping, restoration of the pumphouse, re-asphalting of the bike path, and hydroseeding. DOE partnered with the City of Miamisburg in holding the Canal Ribbon Cutting Ceremonies.

July 1998 Restoration activities continued. Foliage was installed along the Conrail railroad trestle concrete wall.

1.5 Resources Committed

Table 1.2 Materials and Disposition

Materials	Quantity	Disposal Method	Disposal Location
Contaminated Soil	38,000 cubic yards	Burial	Clive, Utah

Table 1.3 Removal Project Estimated Total Cost Summary

Extramural Costs:	Costs ($)
Field Work	$15,829,165
Transportation of Contaminated Soil	$ 2,950,000
Disposal of Contaminated Soil	$ 4,625,000
Verification Sampling & Analysis	$ 500,000
Restoration	$ 1,095,835
Estimated Total Project Cost	$25,000,000

2.0 EFFECTIVENESS OF THE REMOVAL ACTION

The verification report (see Appendix C) provides details of the verification measurement results, the statistical analysis of these results, and the steps taken to assure the data are of adequate quality. The clean-up goal was to leave residual radioactivity with a 95% UCL of the mean less than 75 pCi/g, and to remove all known spots greater than 150 pCi/g. The focus group of stakeholders set this goal, which is consistent with risk-based guideline values and a recreational use scenario.

This was achieved; the calculated 95% UCL of the mean is 24.0 pCi/g. Also, all sampled spots with activity greater than 150 pCi/g were removed (As described in Section 2.1 below); the clean-up actually was more stringent and removed almost all known spots with activity greater than 75 pCi/g. By meeting the agreed to plutonium clean-up standard, the canal area is suitable for recreational use.

DOE took one other additional cleanup action. For each of the verification sample results that were greater than 75 pCi/g, the sample location was excavated to a greater depth. The location was then sampled again to confirm that the plutonium-238 activity at that point was less than 75 pCi/g after the re-excavation.

2.1 Actions Taken By Mound Personnel

Mound ER personnel planned and performed the site excavation, monitoring, sampling and analysis, and transportation of contaminated soil through the staging area.

Excavation and sampling were done sequentially:

- soil was excavated to a target depth planned from previous sampling data
- a typical 25 samples were collected from each grid (50 ft long by 50 ft or wider) and were analyzed in Mound's mobile laboratory for rapid results
- the results were evaluated and a decision was made to excavate more or to collect verification samples
- if the decision was to excavate further, the excavation would be made approximately 1 ft deeper and could be expanded laterally as well (depending on mobile lab results for samples on the edge of the grid)
- after additional excavation, the grid would be re-sampled for mobile laboratory analysis
- re-excavation and resampling would continue until it was decided that verification samples could be collected
- verification samples would be collected and shipped to an off-site commercial laboratory
- verification sample results would be reviewed, and each result greater than 75 pCi/g would drive re-excavation at the respective sample location (to ensure meeting a clean-up goal so as not to leave spots known to be greater than 150 pCi/g).

2.2 Actions Taken By Local, State, And Federal Agencies

DOE/MEMP, US EPA, and OEPA had oversight responsibility for the removal action. In FY96-98, DOE/MEMP administered the disposal contract with Envirocare.

2.3 Actions Taken By Subcontractors

Four subcontractors were involved in the project; Glover Excavating performed the reroute installation for the plant site drainage. Roy F. Weston performed the verification sampling and managed the analysis of these samples and the validation of the data. Willard H. Cumbo Excavating performed clearing and grubbing, and site restoration (backfilling, grading, hydro seeding, and planting of trees and shrubs). The contaminated soil was sent to Envirocare in Clive, Utah for disposal.

3.0 DIFFICULTIES ENCOUNTERED

3.1 Items That Affect The Response

The amount of contaminated soil was greater than originally anticipated. As a result, additional tree removal was necessary. Inclement weather extended the length of the project. Concrete and sandstone structures were found to have surface contamination. Only soil contamination was anticipated.

3.2 Issues Of Intergovernmental Coordination

The establishment of 75 pCi/g of plutonium, with a 95% confidence level as a site cleanup goal was a cooperative decision of DOE, US EPA, OEPA and the stakeholders.

4.0 RECOMMENDATIONS

4.1 Means To Prevent A Recurrence Of The Discharge Or Release

The source of the release has been removed therefore, future releases will not occur.

5.0 REFERENCES

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DOE 1993a "Removal Site Evaluation., Operable Unit 4, Miami-Erie Canal, OU4," Final Revision 3. Prepared for US Department of Energy under Contract No. DE-AC04-88DP43495, May, 1993.

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Kershner and Rhinehammer 1978, "Mound Laboratory Tritium Study: 1976-1977, " Monsanto Research Corporation Report Number MLM-2495. Prepared for US Department of Energy.

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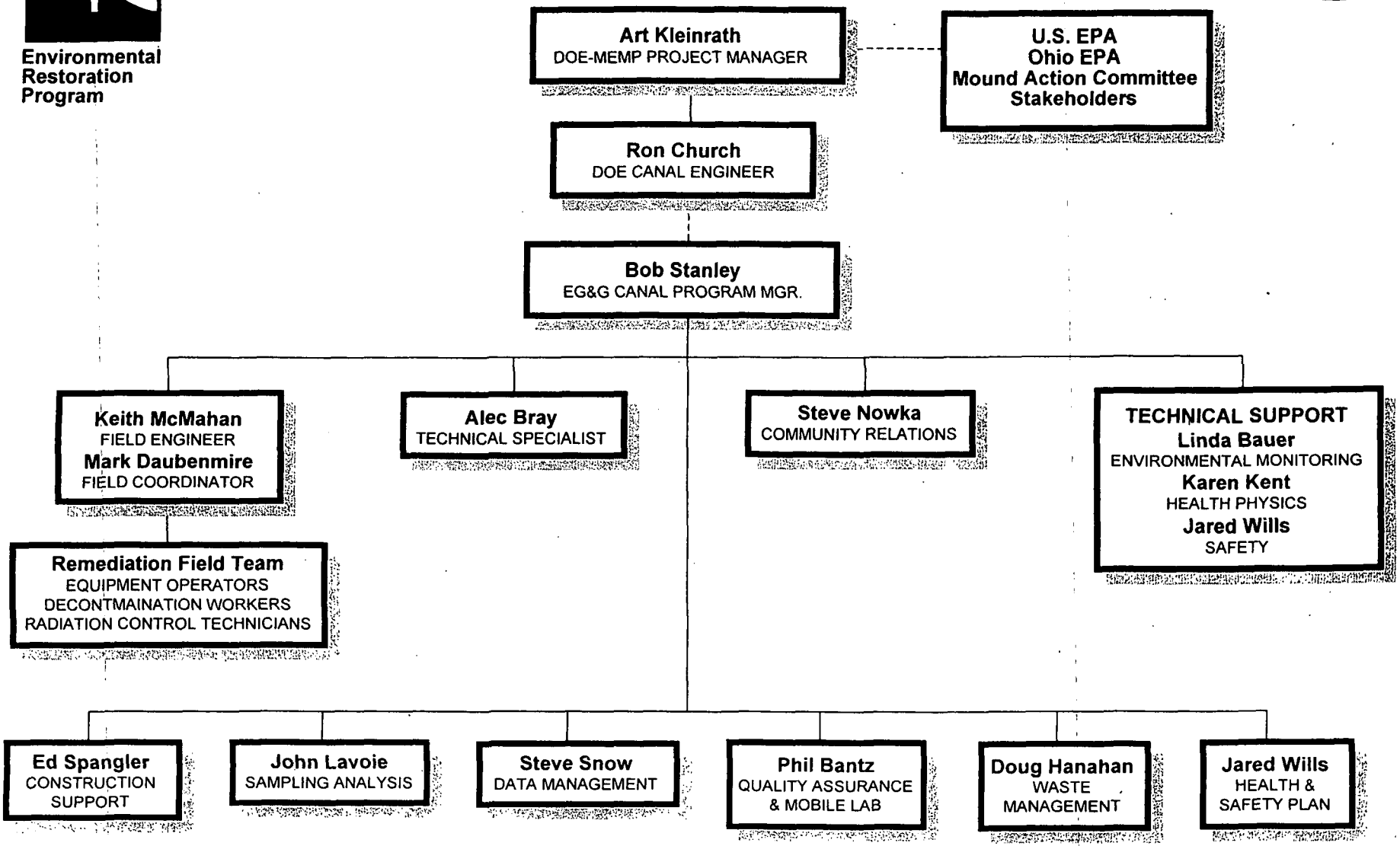
APPENDIX A

General Media Information

MOUND

Environmental Restoration Program

MIAMI/ERIE CANAL CLEANUP PROJECT TEAM



MOUND

Environmental Restoration Program

CANAL UPDATE

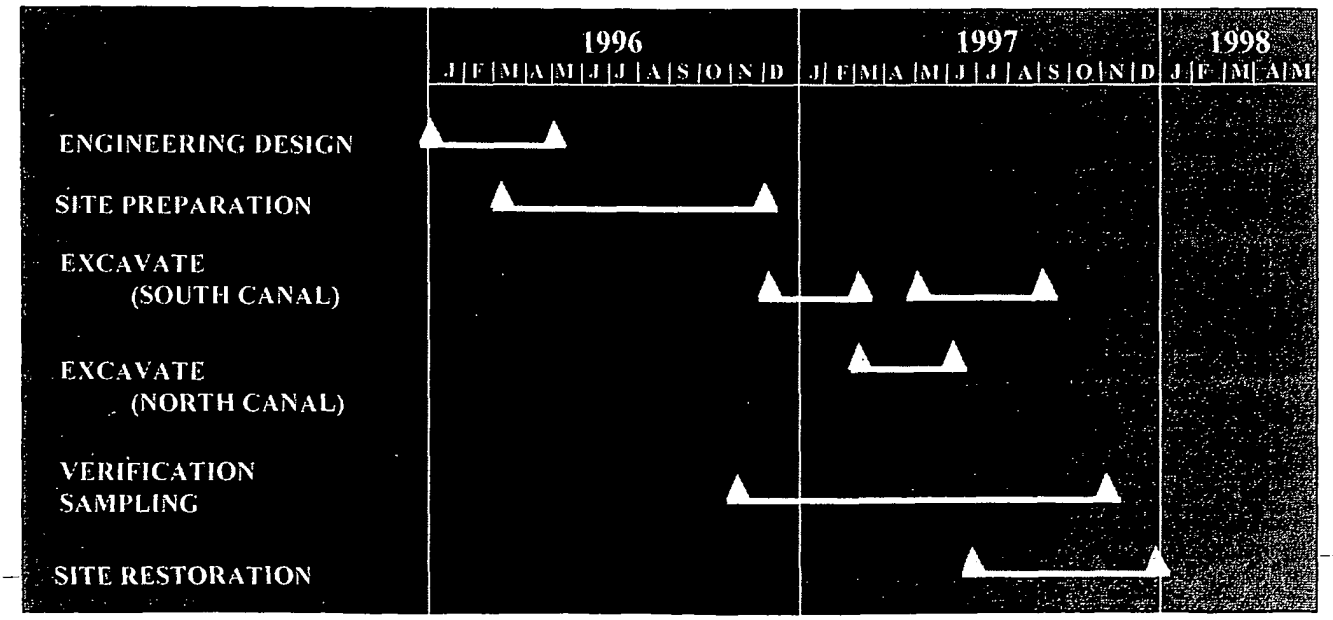
The Department of Energy at Mound in Miamisburg, Ohio, says the cleanup of the Miami-Erie Canal is proceeding more quickly than anticipated. This is due in part to an EG&G Project Team that has worked safely and efficiently since the beginning of the remediation.

At a Canal Open House in February 1996, a full house of Mound Stakeholders heard about the plans for the cleanup. Through the summer, crews cleared and fenced the canal and rerouted rainwater runoff away from the canal beds. The excavation got underway in the South Canal last November and the first railcar of soil left the Mound Plant site on February 11, 1997. In March the loading team shipped sixty carloads of soil. To date 116 cars have been shipped out of an estimated total of 316 to completion. It is expected that the total of 316 to completion will be much less since cleanup has already reached the half-way mark.

As excavation of each area, or grid, is completed, soil sampling confirms that the contamination is entirely removed. Continuous air sampling in the work area has shown no increase in airborne contaminants resulting from the work. A concern voiced by neighbors of the canal about an increase in dust around the project was addressed by using a large water truck to keep dust from the gravel roads to an absolute minimum.

As work continues the Project Team will make every effort to work as safety and efficiently as they have shown they can. For continuing updates on the Canal Cleanup, look to future issues of Mound's ***New Directions*** newsletter or visit the Web Site at ***www.doe-md.gov.***

MIAMI-ERIE CANAL PROJECT SCHEDULE



DOE NEWS

NEWS MEDIA CONTACT:

Jane Greenwalt,
Public Affairs Officer
Miamisburg Environmental Management Project
(937) 865-3116

MEDIA ADVISORY

WHAT: ***Ceremony To Celebrate Completion of the Miami-Erie Canal Restoration Project***

WHEN: ***10:00 a.m., Friday, May 29, 1998***

WHERE: ***Community Park***
550 First Street
Miamisburg, Ohio

You are invited to attend a significant event in the history of the U.S. Department of Energy and the future of the Miamisburg community. The Department of Energy and the City of Miamisburg will be holding a special ceremony to celebrate completion of the Miami-Erie Canal Restoration Project. Several local, regional, and national dignitaries are expected to participate in the ceremony. The Canal restoration has been a major component of the environmental cleanup project by the DOE in and around the Mound site. The Canal property will officially be returned to the City, with a portion of the site to be used as a public park.

"B" roles of the Canal work in progress will be available to the TV news media.

Immediately following the Canal Ceremony, to commemorate Mound's 50th Anniversary as a U.S. Government facility, bus tours of the site will be made available. The tours will start at Community Park every hour until 2 p.m. Please R.S.V.P. by May 27, for a tour by calling 865-5171 and leaving a message with your name and number in your party.

MOUND

Environmental Restoration Program

ENVIRONMENTAL & HEALTH ACTIVITIES FOR THE MIAMI-ERIE CANAL CLEANUP

May 1997

This Fact Sheet was developed to give you information about environmental and public health issues related to the Miami-Erie Canal cleanup. If you have questions the Fact Sheet doesn't answer or need more information, contacts are listed.

Background

In 1969, an underground waste line at the Mound Facility ruptured and released plutonium-238, a radioactive material, to the surrounding soils. During cleanup of this spill, a severe rainstorm washed away some of the contaminated soil. Fine-grained clay particles, contaminated with plutonium, were carried away through the natural drainage courses off plant site to the remnants of the Miami-Erie Canal adjacent to Miamisburg's Community Park and the Mound Facility, and then into the Great Miami River.

Through a series of meetings held with local citizens, including representatives from the City of Miamisburg, U.S. and Ohio EPA's, Ohio Department of Health, and the Agency for Toxic Substance and Disease Registry, it was decided that the most responsible action for the Department of Energy would be to cleanup the Canal.

Questions

1. What is plutonium-238?

Plutonium is a radioactive element. Plutonium-238 is the isotopes that was used at Mound for making satellite power supplies. The most common form used for these power supplies was the oxide form, which binds very strongly to soil. Most plutonium in the environment comes from nuclear weapons testing. Plutonium-238 decays and emits radiation, called alpha and gamma. Plutonium-238 is long lived; taking roughly 90 years for one-half of a given amount to decay. If ingested or inhaled, some of the plutonium-238 will remain in the body for many years.

2. Will exposure to plutonium-238 cause illness or disease?

Health studies on humans exposed to low levels of plutonium are inconclusive. The only evidence linking plutonium to cancer is from animal studies using high doses of plutonium.

All radionuclides are regulated as human carcinogens because all radionuclides produce radiation, and radiation from some radionuclides has caused increased incidences of cancer in humans. Approximately 300 of every 1000 people nationwide will contract cancer in their lifetime. It is estimated that 6 of these 300 people will have contracted cancer from naturally occurring radiation, such as radon.

Little scientific information is available on the health affects of low-level radiation. If you are exposed to plutonium-238, several factors determine whether harmful health effects will occur and the type and severity of those health effects. You may be exposed when you come into contact with the material. Your exposure would occur by breathing the plutonium-238 in the air, eating the dirt containing the substance or from contacting broken skin with the plutonium-238. The dose (how much), the duration (how long), the route of exposure (breathing, eating, or skin contact), the other substances to which you are exposed, and your individual characteristics (age, sex, nutritional status, family traits, life-style and state of health) determine whether a harmful health effect is likely to occur from exposure.

3. What are the current health hazards in the Canal?

The opinion of scientists from the Department of Health and Human Services, Agency for Toxic Substance and Disease Registry (ATSDR) is that the plutonium in the Miami-Erie Canal does not pose a health hazard. There is not enough plutonium-238 in the Canal to cause anyone health problems. This conclusion was based on dose estimates and a review of extensive medical literature by ATSDR on the effects of radiation and metal toxicity.

4. Why is DOE now deciding to clean up the Canal if there's not a health hazard?

DOE's decision is based on three factors:

1. DOE's responsibility for the contamination in the Canal;
2. DOE's effort at reducing the costs associated with the over sight of the Canal and the mandated studies under the CERCLA program; and
3. DOE's responsibility to leave the legacy of Mound in a condition like it was found when they came to Miamisburg in the 1940's.

5. Can you assure me that the plutonium-238 contamination will not be spread during the cleanup of the Canal?

During the cleanup of the Canal, DOE will implement a design that ensures public, worker, and environmental safety. A water mist will be sprayed on all freshly exposed soil and sediments as necessary to eliminate dust, and the potential for airborne exposure. As another precaution, dust and contaminant sampling will be done around the entire site:

1. boundary air monitoring stations will collect air data at the edge of the site;
2. mobile air monitoring stations will be moved to where the actual cleanup is taking place.
3. the 10 fixed monitoring stations, currently located in the Miamisburg area, will continue to provide monitoring.

This sampling will be done to ensure that activities at the cleanup site are not generating dust and contaminants above the U.S. EPA approved levels. U.S. and Ohio EPA will also monitor and oversee the site to ensure that the cleanup complies with regulatory standards.

6. Will there be any plutonium left in the Canal after the cleanup?

Yes. Recognizing that it is impossible to remove every trace of plutonium from the Canal, a focus group consisting of representatives from the U.S. and Ohio Environmental Protection Agencies, the Department of Energy, the City of Miamisburg, the Agency for Toxic Substance and Disease Registry, the Ohio Department of Health and local citizens worked to develop an acceptable level of cleanup. After months of public discussion a risk-based cleanup standard of 75 picocuries per gram of soil was established. Soil cleaned to this level meets all regulatory cleanup requirements.

7. What documents are available for me to read about the Canal contamination, and where can I find them?

There are many documents available in the CERCLA Public Reading Room for your review on this subject. The Public Reading Room is located in the Miamisburg Senior Adult Center, 305 Central Avenue, Miamisburg, Ohio. The Reading Room hours are as follows:

Monday -	**12:00-8:00 pm**
Tuesday -	**8:30 am-1:00 pm**
	4:00-8:00 pm
Wednesday -	**12:00-8:00 pm**
Thursday -	**8:30 am-1:00 pm**
Friday -	**10:30 am-4:30 pm**

All citizens are encouraged to visit the CERCLA Reading Room, and review the documents that will address any questions or comments you may have. Suggested documents to be reviewed on this subject include:

1. *Toxicological Profile for Plutonium by the Agency for Toxic Substances and Disease Registry (ATSDR).* U.S. Public Health Service.
2. *Miami-Erie Canal Remedial Site Evaluation*
3. *Miami-Erie Canal Engineering Evaluation/Cost Analysis*
4. *Miami-Erie Canal Action Memorandum*
5. *Miami-Erie Canal Removal Action Work Plan*
6. *Special Canal Sampling Report*
7. *Radiation (A Fact of Life)*
8. *Facts About Low-Level Radiation*
9. *ATSDR Health Consultation of the Miami-Erie Canal*
10. *The Mound Action Committee Notebook* (containing minutes from all Canal Focus Group Public Meetings)

8. If I have concerns, who can I talk to?

If you have any additional questions or would like assistance in understanding any information, the following individuals can be contacted:

Public Health Agencies:

Ohio Dept. of Health -	*Jim Webb*, (614) 644-2727
ATSDR -	*Dr. Bill Taylor*, (404) 639-6035

Federal & State Environmental Protection Agencies:

U.S. EPA -	*Tim Fischer*, (312) 886-5787
Ohio EPA -	*Brian Nickel*, (513) 285-6468

City of Miamisburg:

Parks & Recreation Information - *Becky Benna*, (937) 866-4532

Mound: *Steve Nowka*, (937) 866-4140

MOUND

Environmental Restoration Program

MIAMI-ERIE CANAL FACT SHEET

May 1998

This fact sheet provides information about the Miami-Erie Canal cleanup, restoration, and its return to the Miamisburg community.

Background

A rupture in 1969 of an underground wasteline at the Mound Facility released plutonium-238 to the surrounding soils. Plutonium-238 is a radioactive material that was used at the site. During the cleanup of the spill a severe rainstorm washed away some of the contaminated soil. Fine grained clay particles contaminated with plutonium were carried away through the natural drainage routes off the plant site. Some of these clay particles were washed into the remnants of the historic Miami-Erie Canal and then into the Great Miami River. The Canal is adjacent to the Miamisburg Community Park and the Mound Facility.

Early studies indicated that plutonium-238, which amounted to 1.6 grams spread out over approximately one mile in length of the canal, did not pose a health hazard as long as it remained undisturbed in the canal soils.

Why cleanup the canal?

Through a series of meetings held with local citizens, and representatives from the City of Miamisburg, U.S. and Ohio EPAs, Ohio Department of Health, and the Agency for Toxic Substances and Disease Registry, it was decided that the most responsible action for the Department of Energy would be to cleanup the canal. Three additional factors also led to this decision by DOE:

- DOE's responsibility for the contamination in the canal;
- DOE's efforts to reduce the cost associated with the oversight of the canal and mandated studies under the CERCLA program; and
- DOE's responsibility to leave the legacy of Mound in a condition like it was found when it came to Miamisburg in the 1940s.

The cleanup and safety to the community

During the cleanup of the Canal, DOE took precautions to ensure public, worker, and environmental safety. A water mist was sprayed on all freshly exposed soil and sediments as necessary to eliminate dust, and the potential for airborne exposure. Dust and contaminant sampling was done around the entire site:

1. Boundary air monitoring stations have collected air data at the edge of the site.
2. Mobile air monitoring stations were moved to where the actual cleanup was taking place.
3. The 10 fixed monitoring stations, currently located in the Miamisburg area, provided monitoring.

This sampling was done to ensure that activities at the cleanup site have not generated dust and contaminants above the U.S. EPA approved levels. U.S. and Ohio EPA also provided monitoring and oversight of the site to ensure that the cleanup complied with regulatory standards.

What has happened to the contaminated materials?

Low-level waste, principally soil amounting to roughly 38,000 cubic yds., were removed from the canal and its banks since the excavation began in November 1996. As the material was removed it was brought to the Mound site to a staging area, placed into rail cars, and transported to a licensed waste containment site in Utah.

Will there still be plutonium in the canal?

Yes. Recognizing that it is impossible to remove every trace of plutonium from the Canal, a focus group of citizens worked to develop an acceptable level of cleanup. This focus group consisted of representatives from the U.S. and Ohio Environmental Protection Agencies, the Department of Energy, the City of Miamisburg, the Agency for Toxic Substances and Disease Registry, the Ohio Department of Health, and local stakeholders. After months of public discussion a risk-based cleanup standard of 75 picocuries per gram of soil was established. Soil cleaned to this level meets all regulatory cleanup requirements. By completion of the cleanup the established cleanup levels were achieved.

What happens to the Canal next?

Environmental cleanup of the canal was completed in May. The next step is the restoration of the site. Restoration includes replacing contaminated soils with clean soils, grading, replanting trees, reseeding the grass, and constructing a bike path. DOE and the City of Miamisburg have worked closely on developing the restoration of the canal and adjoining park. The City of Miamisburg developed a master plan for Community Park with various amenities for the use by the citizens of the community.

If I have questions about the Canal restoration work, who can I contact?

During the course of this project many organizations were involved in the remediation work and oversight. If you have any questions, the following individuals can be contacted:

Public Health Agencies

- Ohio Dept. of Health — *Jim Webb* (614) 644-2727
- ATSDR — *Dr. Wm. Taylor* (404) 639-6035

Federal and State Environmental Protection Agencies

- U.S. EPA — *Tim Fischer* (312) 866-5787
- Ohio EPA — *Brian Nickel* (937) 285-6468

City of Miamisburg

- Public Information Officer — *Gary Giles* (937) 866-3303

Mound

- U.S. Department of Energy — *Jane Greenwalt* (937) 865-3116
- Babcock & Wilcox — *Mark Becker* (937) 865-4450

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OU-4 Canal Clean-up Criteria 12/21/94

Issues: Clean-up criteria for the Miami - Erie Canal area (OU-4).

Background:

DOE's interest in developing the clean-up criteria requires that stakeholders concerns be addressed. This includes taking into consideration extremes from "do nothing" to "clean-up to background". DOE is charged with cleaning up environmental releases to levels that are protective both to human health and the environment. This is to be done as quickly and economically as possible. DOE's obligation is to mitigate the effects of plutonium contamination based on an acceptable land use. This is being done on Mound property which has an Industrial land use classification.

Several citizens groups have expressed concern regarding the clean-up of the canal area. A Focus Group on the canal issue was formed in July 1994. Opinions expressed by the stakeholders over the period from July, 1994 to present, have ranged from do nothing, as there is no justification to clean-up the canal, to clean-up the area to background levels. The most recent Focus Group meeting was held on November 29, 1994.

The city of Miamisburg wishes to maintain the existing land use classification as Recreational, but wishes to retain multiple land use options for the future. Based upon a risk assessment calculation by a consultant from one of the citizens groups, utilizing a Recreational scenario with a 24 hour/day exposure duration and a risk level of 10^{-6}, this produced a clean-up level of 25 pCi/g for plutonium. DOE calculations for the risk assessment level, are based upon an EPA default assumption of 4 hour/day exposure duration for Recreational land use. That exposure produced a clean-up level of 150 pCi/g based upon the same risk level (10^{-6}).

Recommendations:

A.) Based upon input from the OU-4 Focus Group, the DOE is presenting the proposal below. This proposal is based on a clean-up goal which has been successfully implemented at Mound. The results of the process historically fall within the acceptable risk range and have been supported by DOE

headquarters. This proposal has been reviewed by U.S. EPA and Ohio EPA and has their concurrence.

This proposal is based on a lower clean-up standard than was originally proposed for the OU-4 Removal Action, which allows an average less than 100 pCi/g and a maximum of less than 300 pCi/g.

1. Develop an excavation plan to remove areas known to have contamination levels greater than 25 pCi/g. This establishes the ALARA goal of 25 pCi/g, and will be consistent with the stakeholder consensus, provided to DOE on November 29, 1994.

2. The residual contamination must represent no worse than a 10^{-5} risk in a Recreational scenario, for an 8 hour/day exposure. That value is calculated to be 75 pCi/g. Achievement of clean-up will be demonstrated by the 95% confidence interval of the verification sampling data. This means that the canal must be cleaned to a level where the probability is, that out of 100 samples taken from the canal area, 95 would show plutonium concentrations below 75 pCi/g.

3. The maximum residual contamination must represent no worse than a 10^{-5} risk for a 4 hour/day exposure. This maximum value is calculated to be 150 pCi/g. The verification sampling plan and final report will be subject to review/approval by both the US and OH EPA's. The verification sampling plan and final report will also be the subject of future stakeholder's (Mound Action Committees) meetings, where additional input from stakeholders will be collected.

While only plutonium is addressed, it is expected that all other contaminants will be removed. After removal operations are complete, a risk assessment using all the contaminants detected in the verification sampling plan, will be performed.

B.) Following excavation, sampling, and analysis, clean (off-site) material will be hauled to fill in excavated areas in the canal. DOE will remove temporary utility services and restore underground utilities, if required. Once the excavation void is filled and compacted to appropriate grades, a one-foot thick layer of topsoil will be placed over all disturbed areas and then hydroseeded. A vegetative cover will be established representing the local species of flora found within the canal area.

C.) A verification sampling plan will be developed which is consistent with EPA guidance and meets data needs to complete a baseline risk assessment on any residual contaminants that remain. This takes into account the stakeholders concerns about the removal actions effectiveness for other contaminants.

D.) Concerns were expressed that the verification sampling plan would show "peaks" on individual samples which exceeded the clean-up limits for recreational usage. DOE agrees to remove any "peak" area above the 150 pCi/g level.

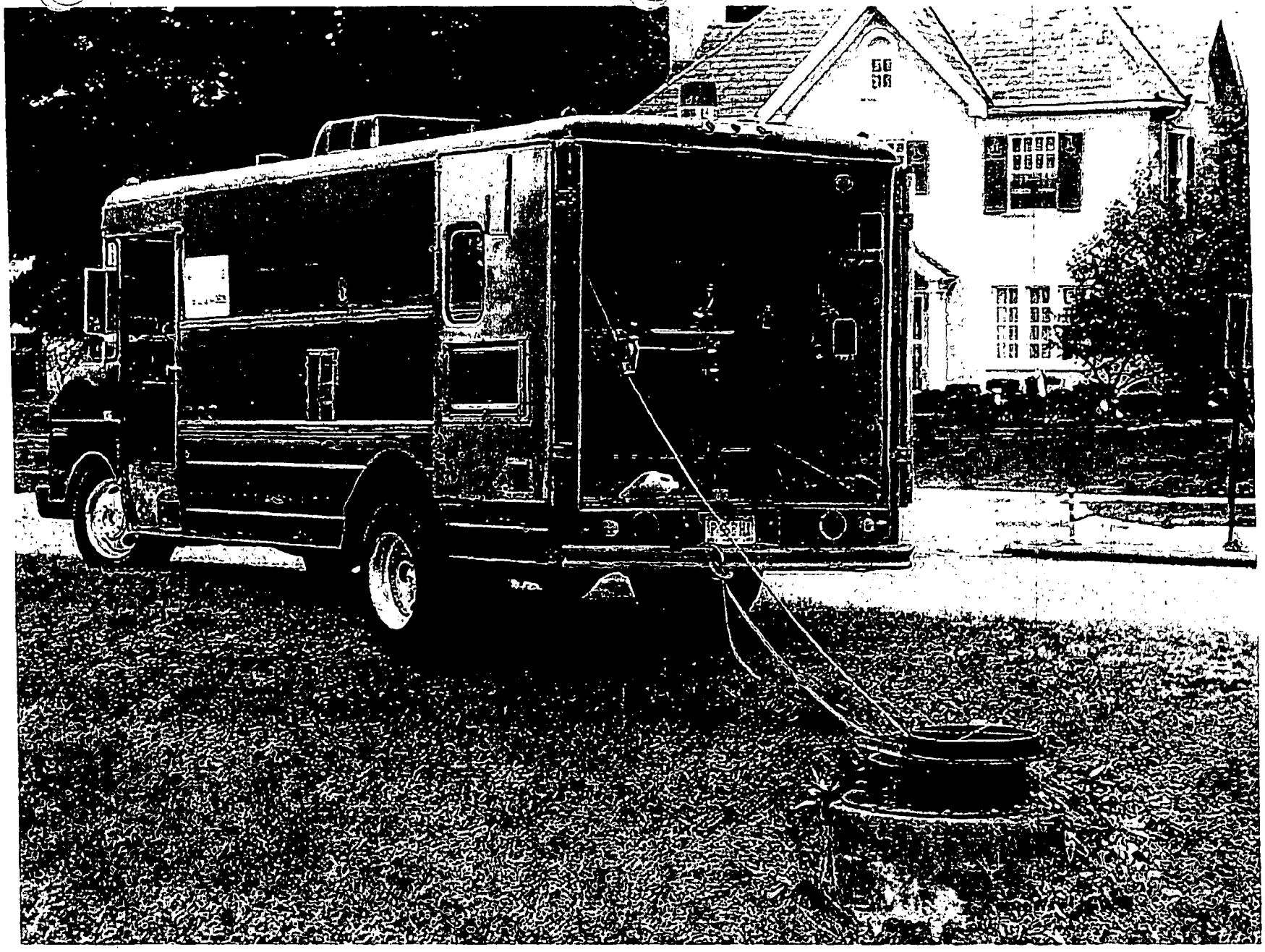
E.) Other areas of concern include the possible contamination of residential areas due to flooding of the canal. Stakeholder input will be sought to identify the areas of concern. Some sampling of the residential areas have previously been conducted. DOE will reevaluate this data and schedule additional studies in areas that have not been addressed.

Summary:

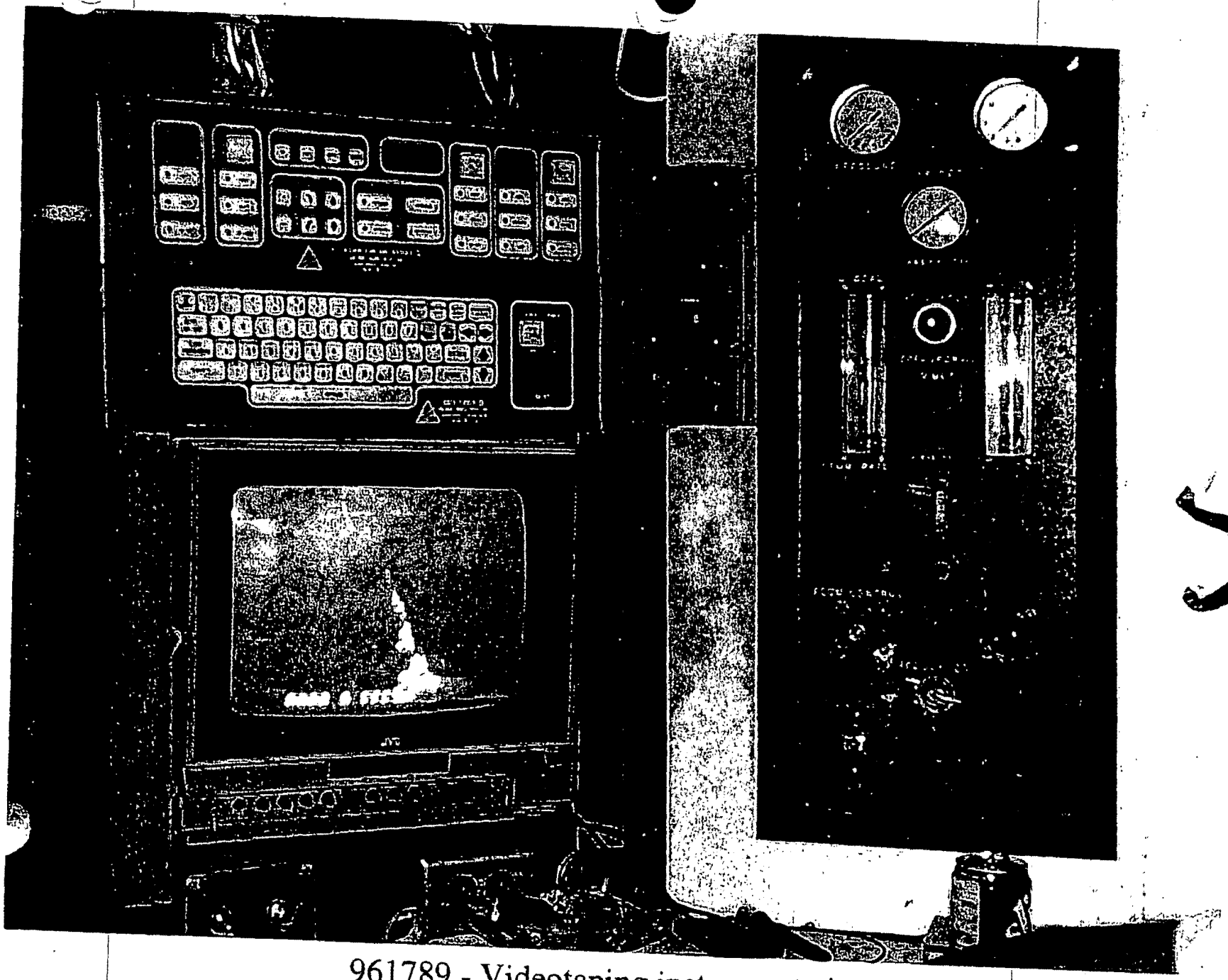
The ALARA goal (25 pCi/g) will be used as a basis for pre-excavation sampling to guide the removal action decisions on where and how much to excavate. The clean-up criteria for OU-4 (Miami-Erie Canal Area) will be:

1.	Maximum residual concentration	150 pCi/g
2.	Clean-up guidelines	75 pCi/g

The 95% confidence level from the verification sampling must be less than 75 pCi/g with no sample values greater than 150 pCi/g. Additional soil areas will be addressed (excavated if warranted) until these criteria are met.



961787 - Videotaping of underground sanitary sewer lines

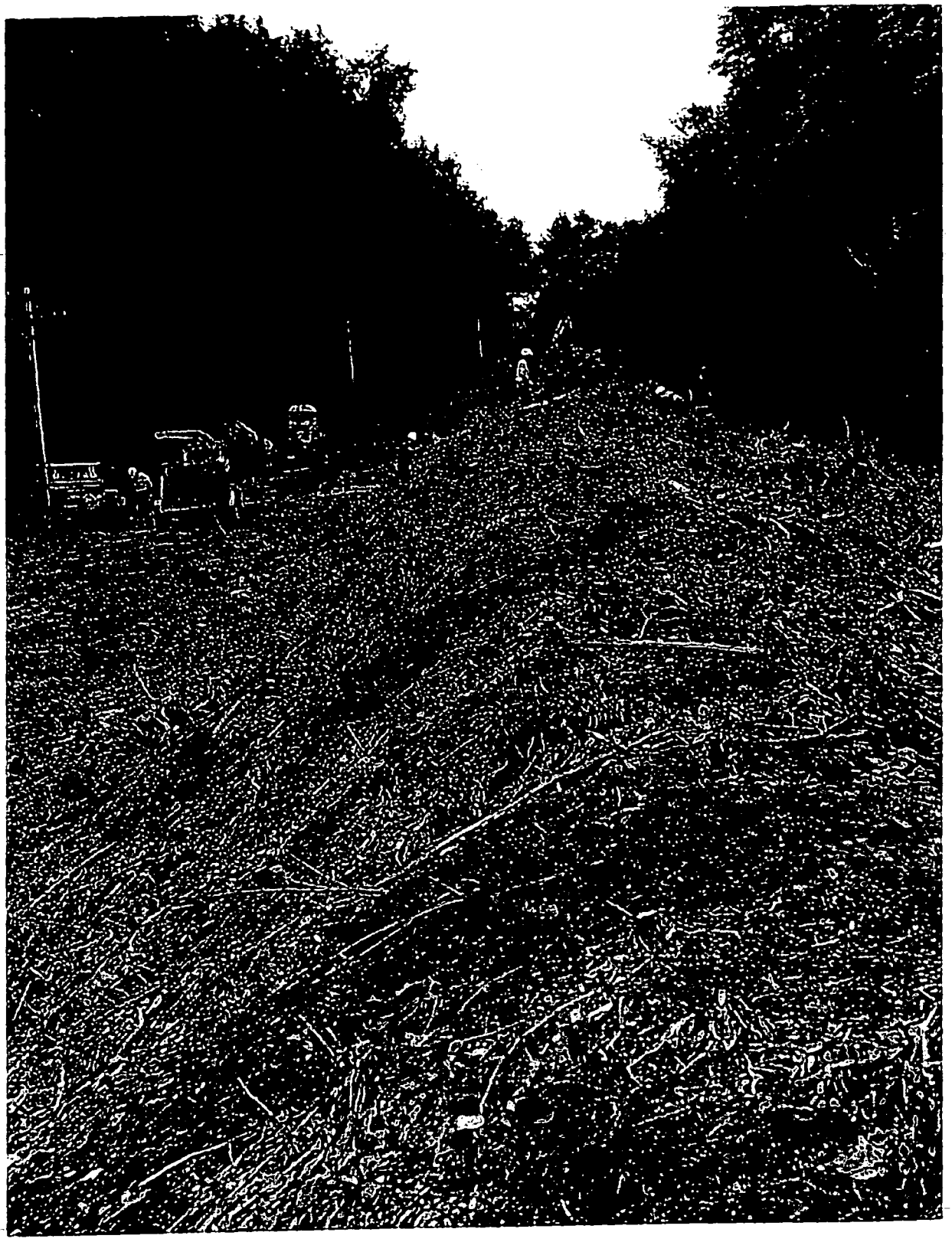


961789 - Videotaping instrumentation

961321 - Cumbo Excavating, clearing and grubbing, north canal

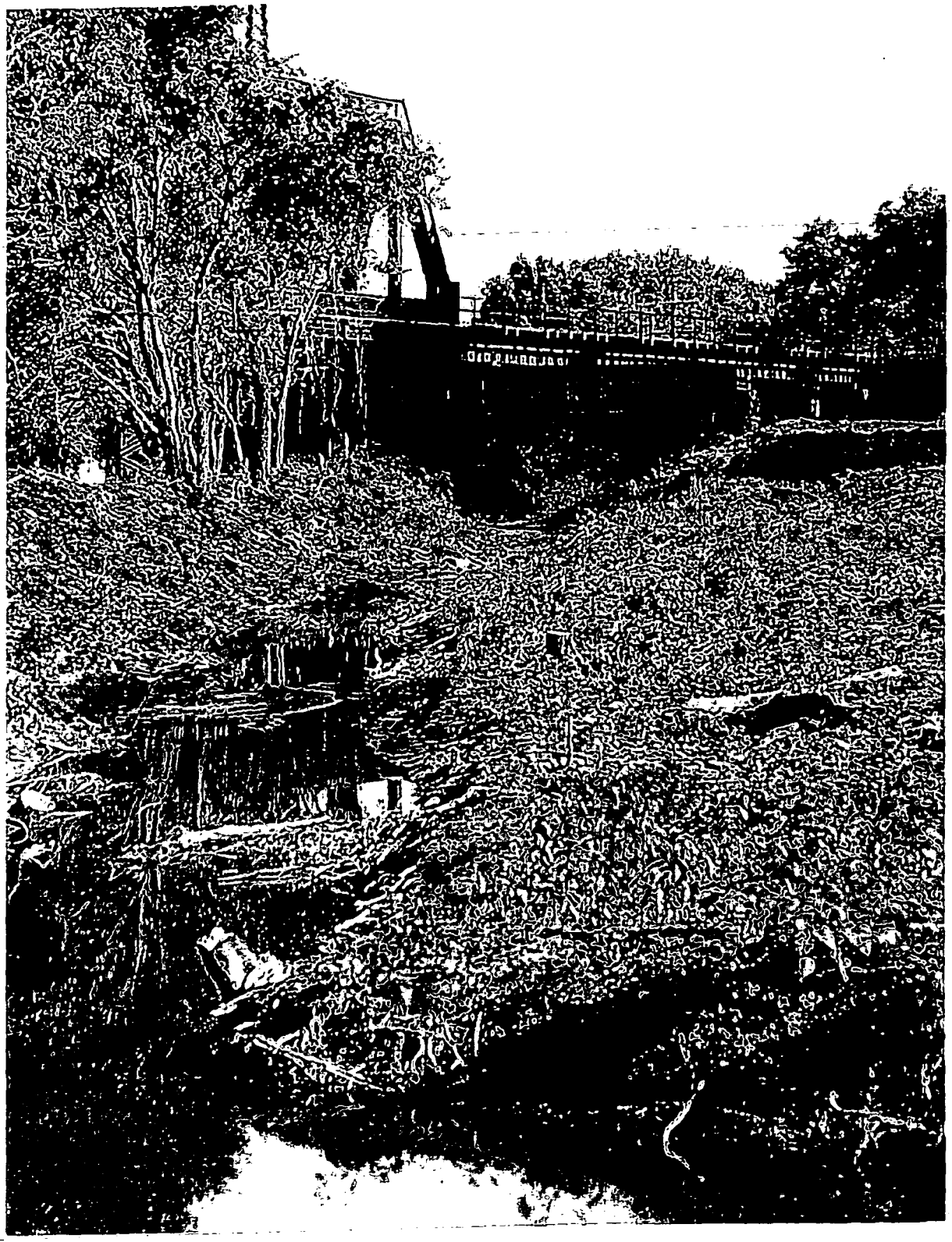
961365 - Cumbo Excavating, north canal, after clearing and grubbing

961324 - Cumbo Excavating, clearing and grubbing, south canal

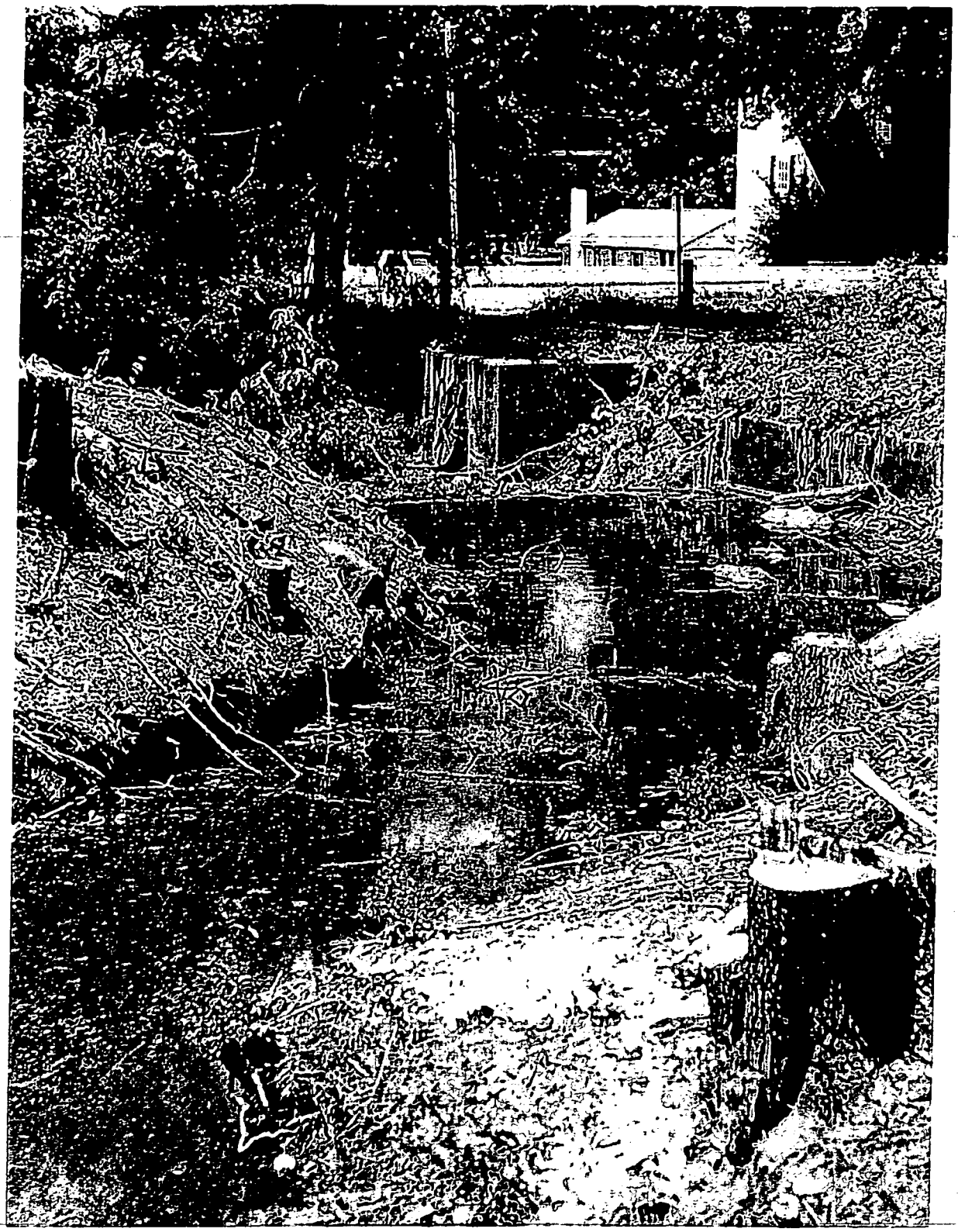


961792 - Cumbo Excavating, south canal, dredging piles, clearing and grubbing in process

961635 - Cumbo Excavating, south canal, weir, after clearing and grubbing

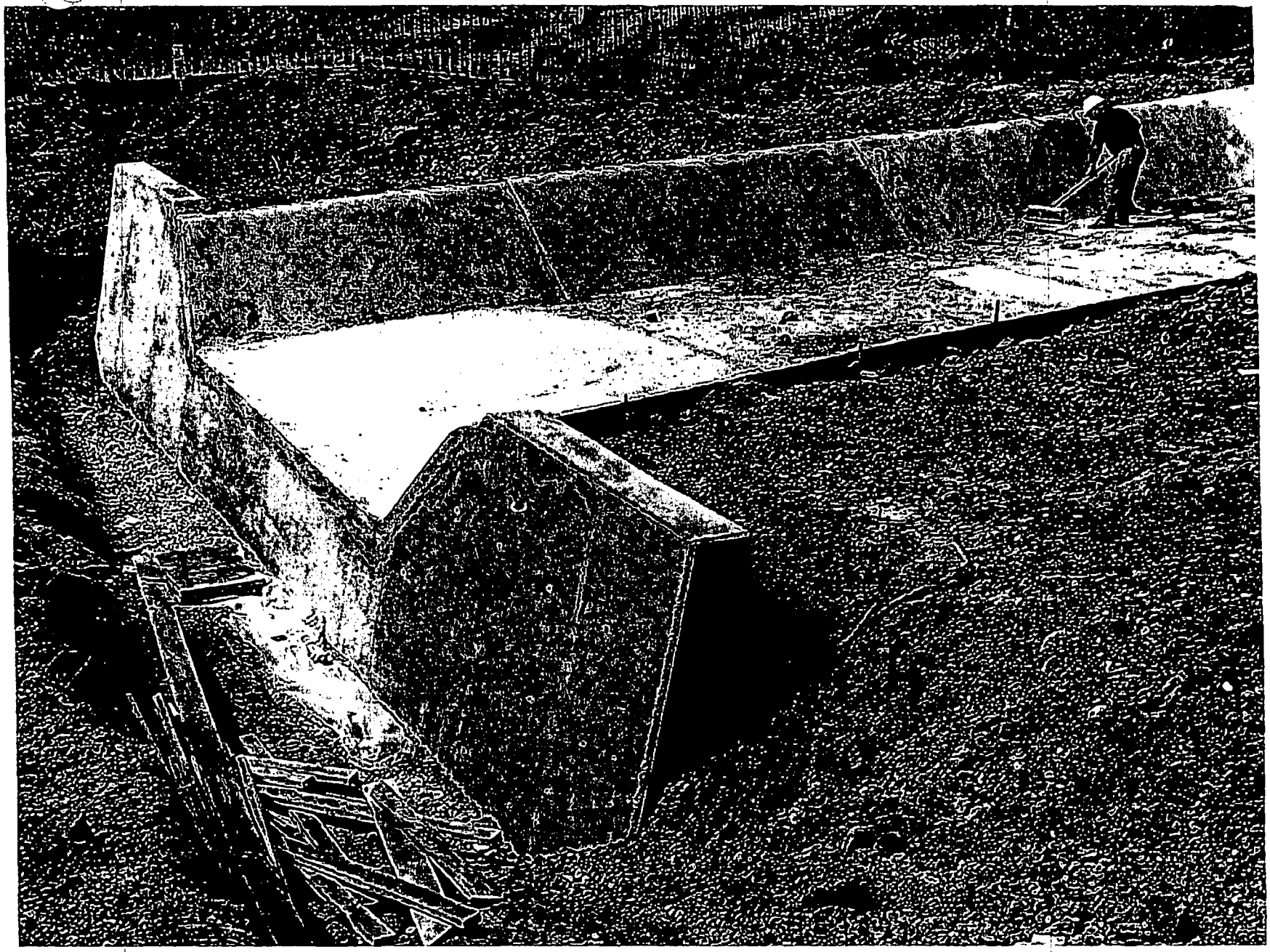


961634 - Cumbo Excavating, clearing and grubbing, south canal, Conrail trestle

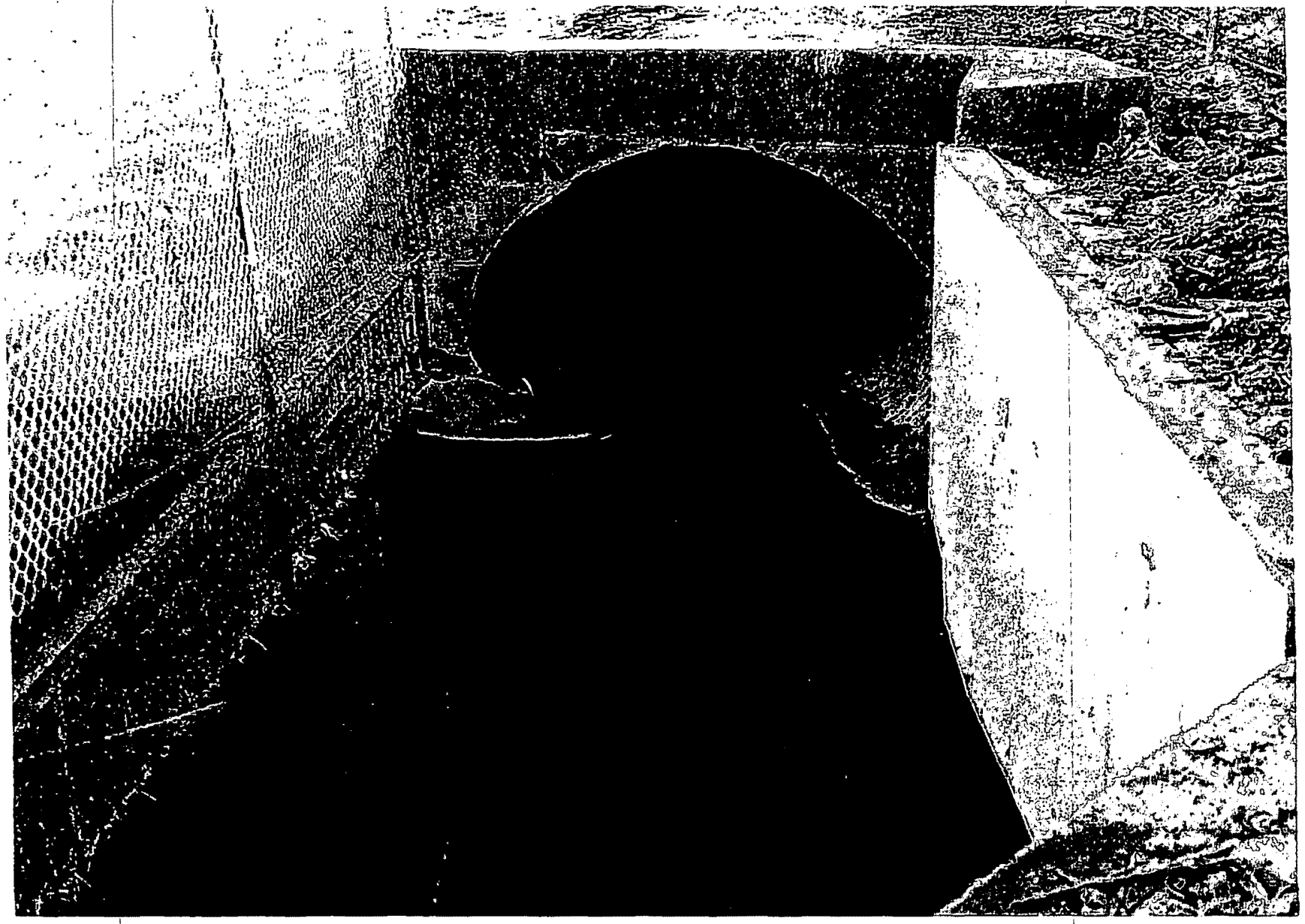


961678 - Cumbo Excavating, clearing and grubbing, south canal, flapper valve

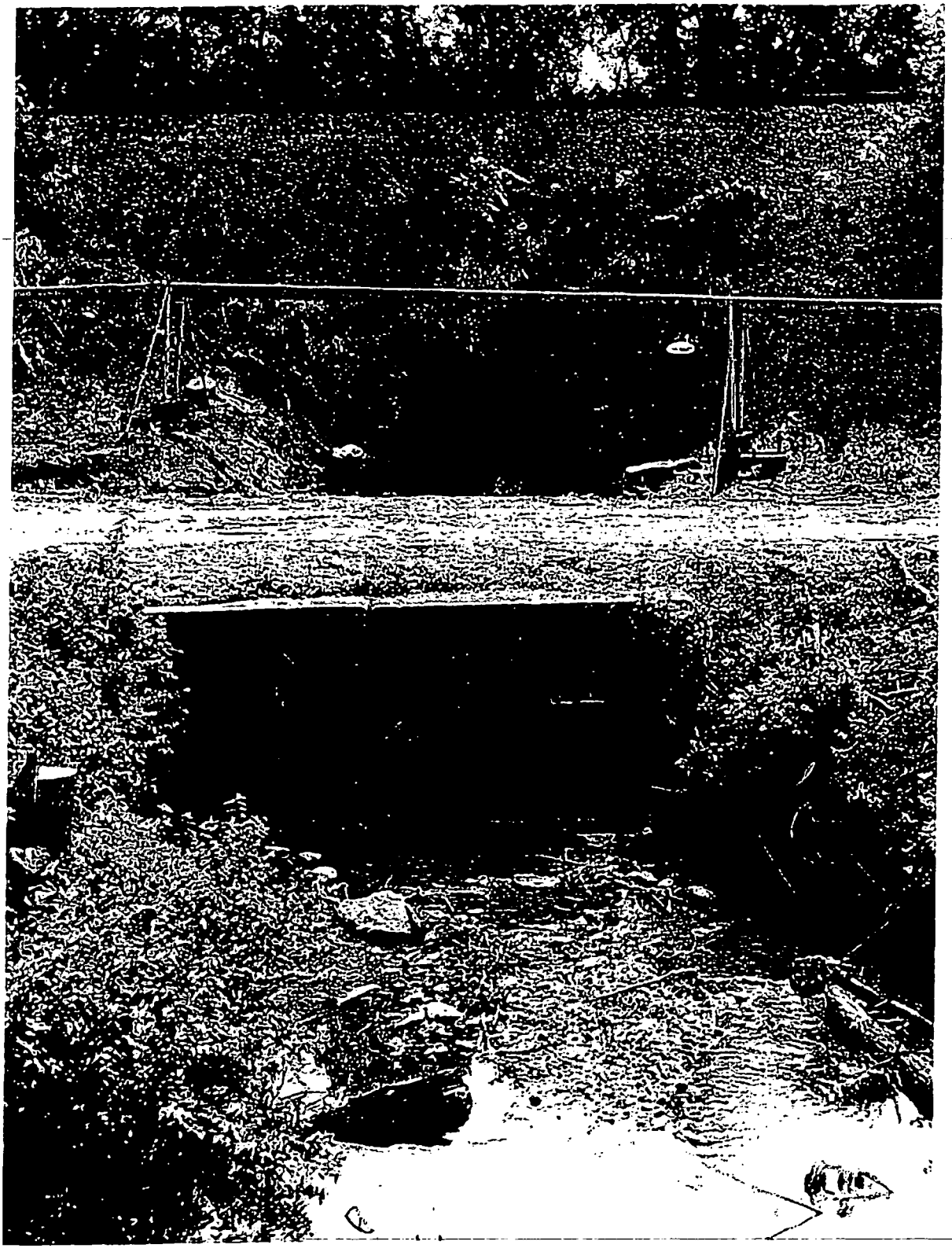
962218 - Glover Contractor, installation of the drainage reroute, concrete culvert



962223 - Glover Contractor, installation of the drainage reroute, concrete culvert



970368 - Entrance to the drainage reroute

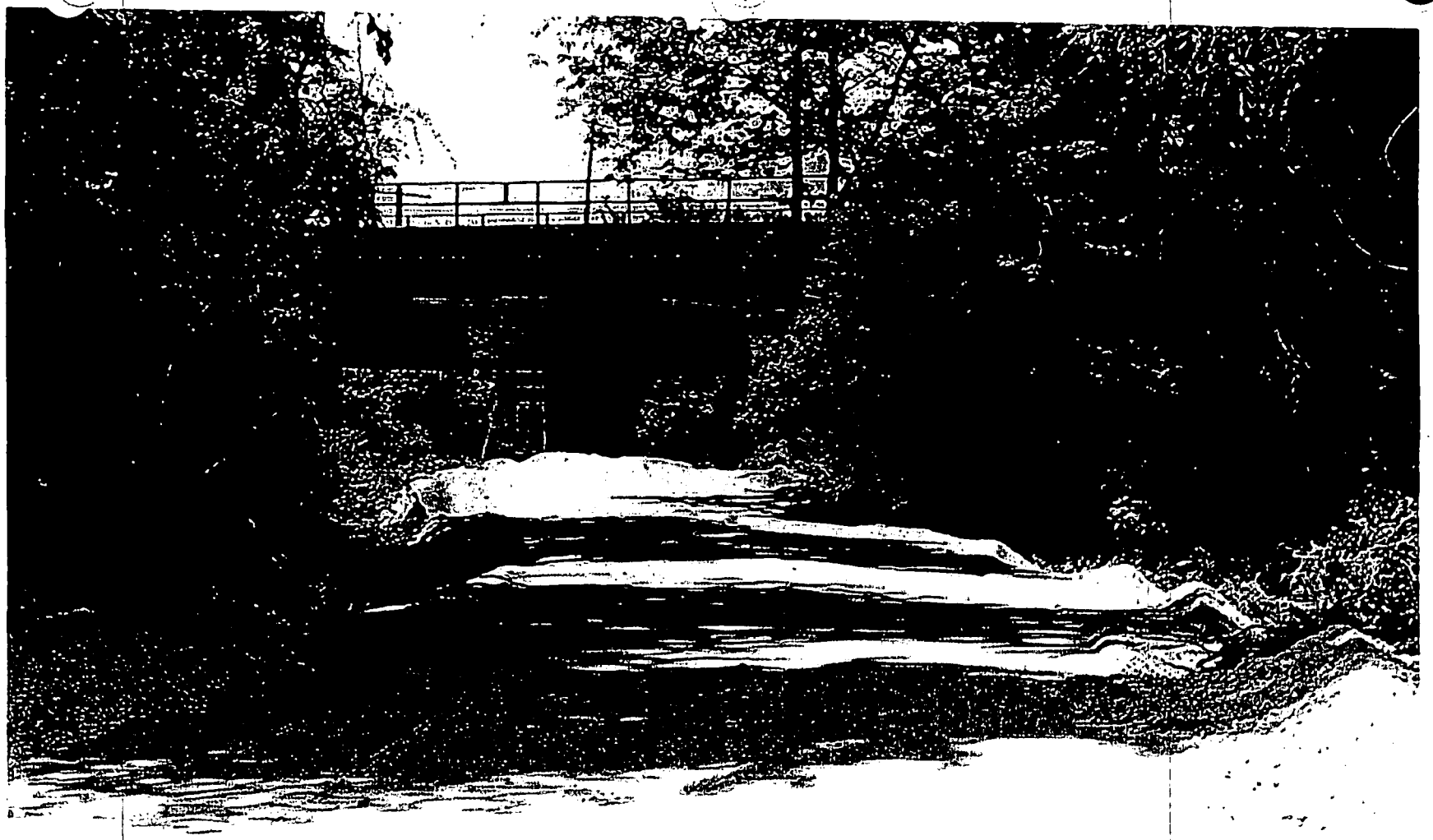


962076 - 1895 Historical Bridge and Twin 60's drainage culvert

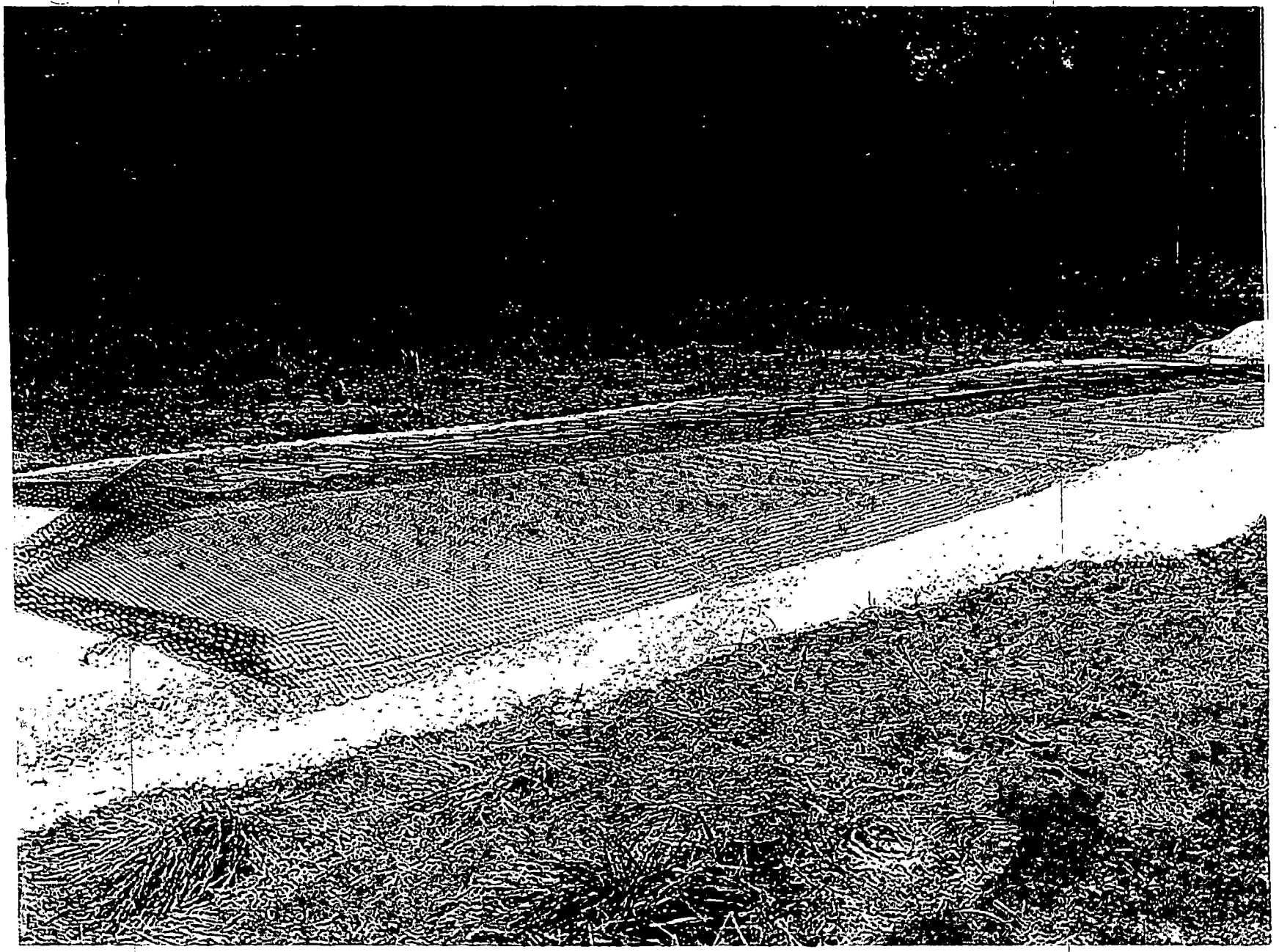
962081 - Twin 60's drainage culvert

960971 - Receiving of heavy duty equipment

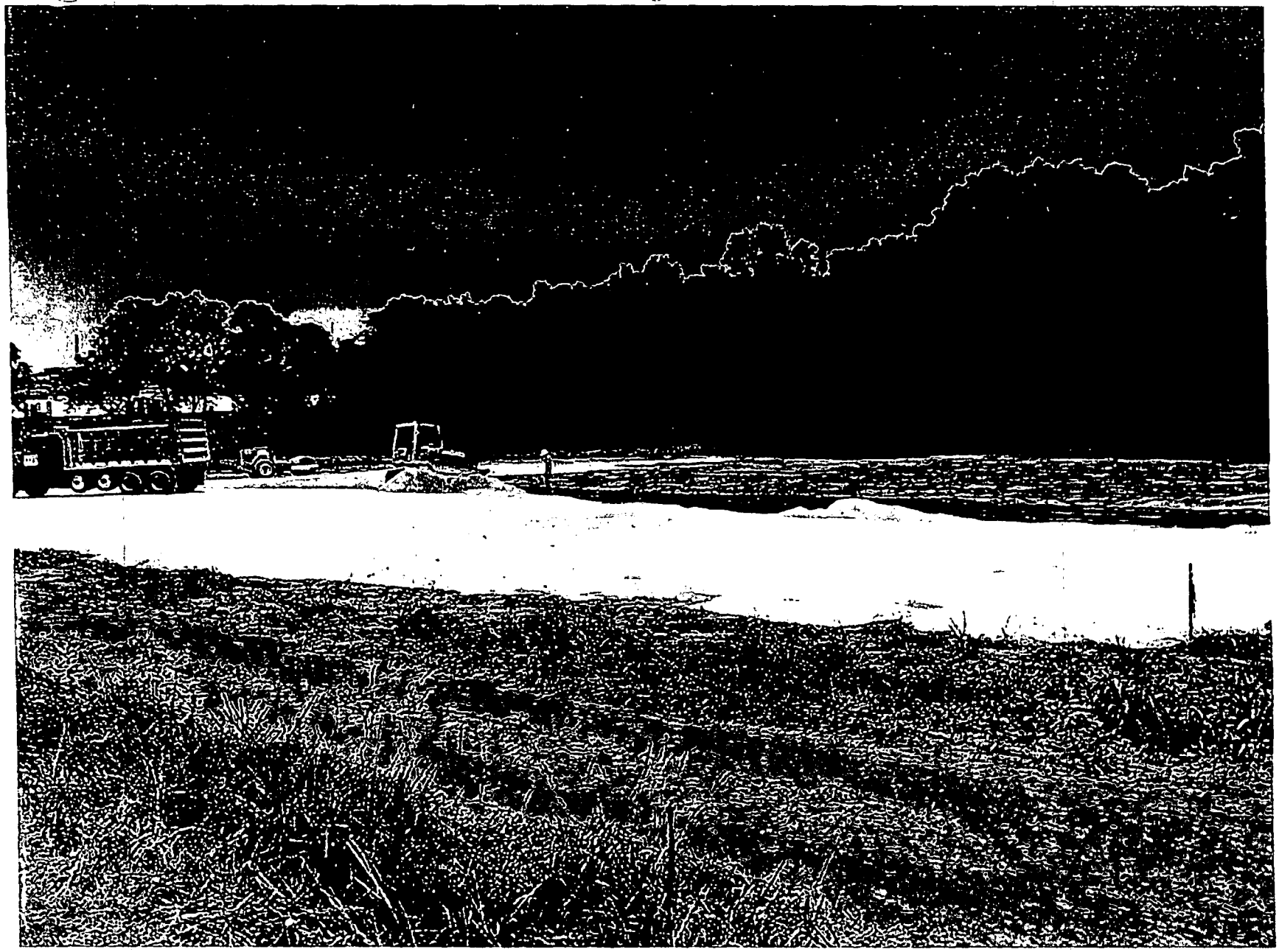
961572 - Volvo Articulating Hauler



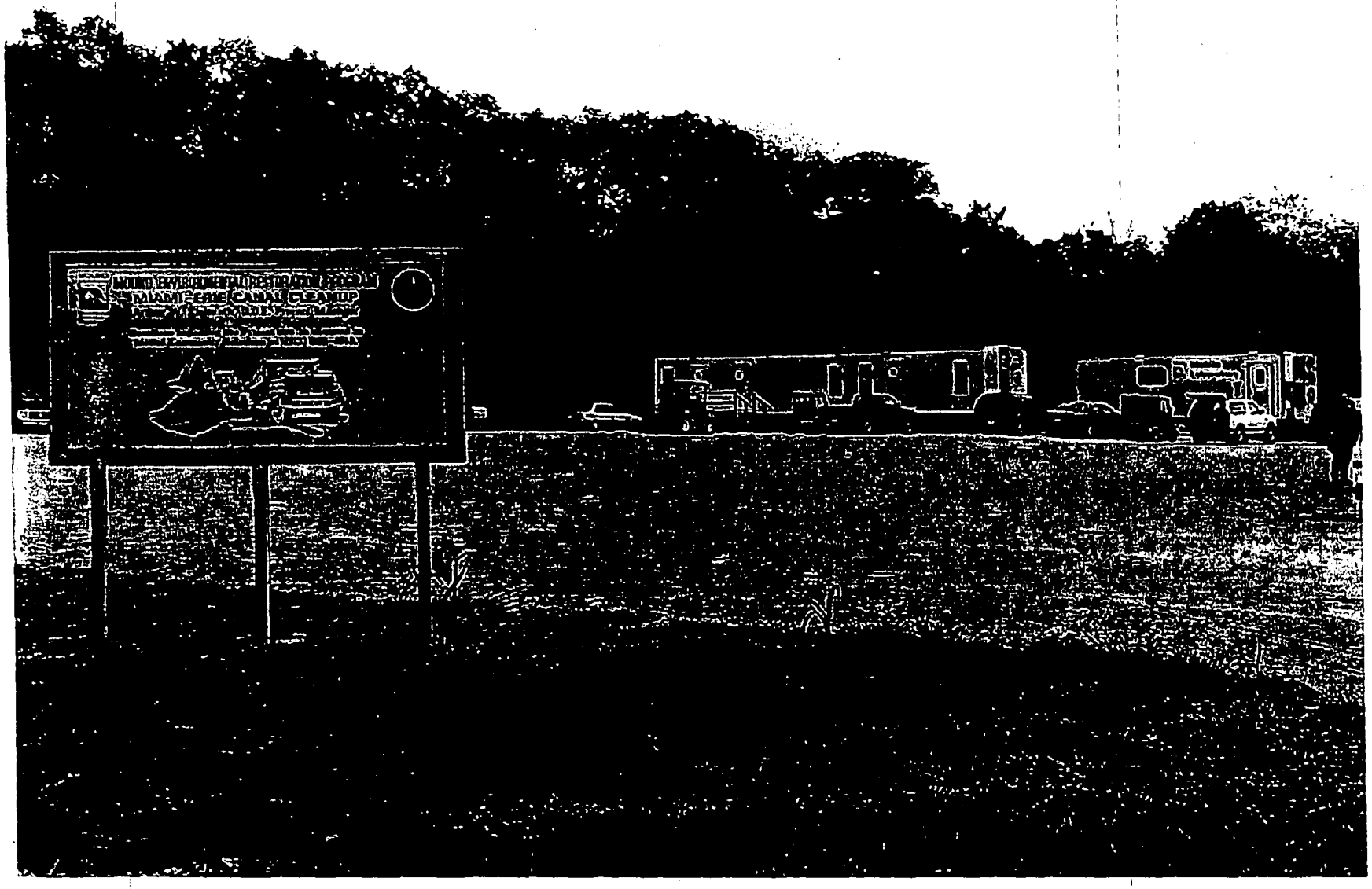
961692 - Installation of project haul road



961690 - Installation of project lay-down area



961682 - Installation of project lay-down area



961905 - Completion of project lay-down area

962707 - Installation of project fence

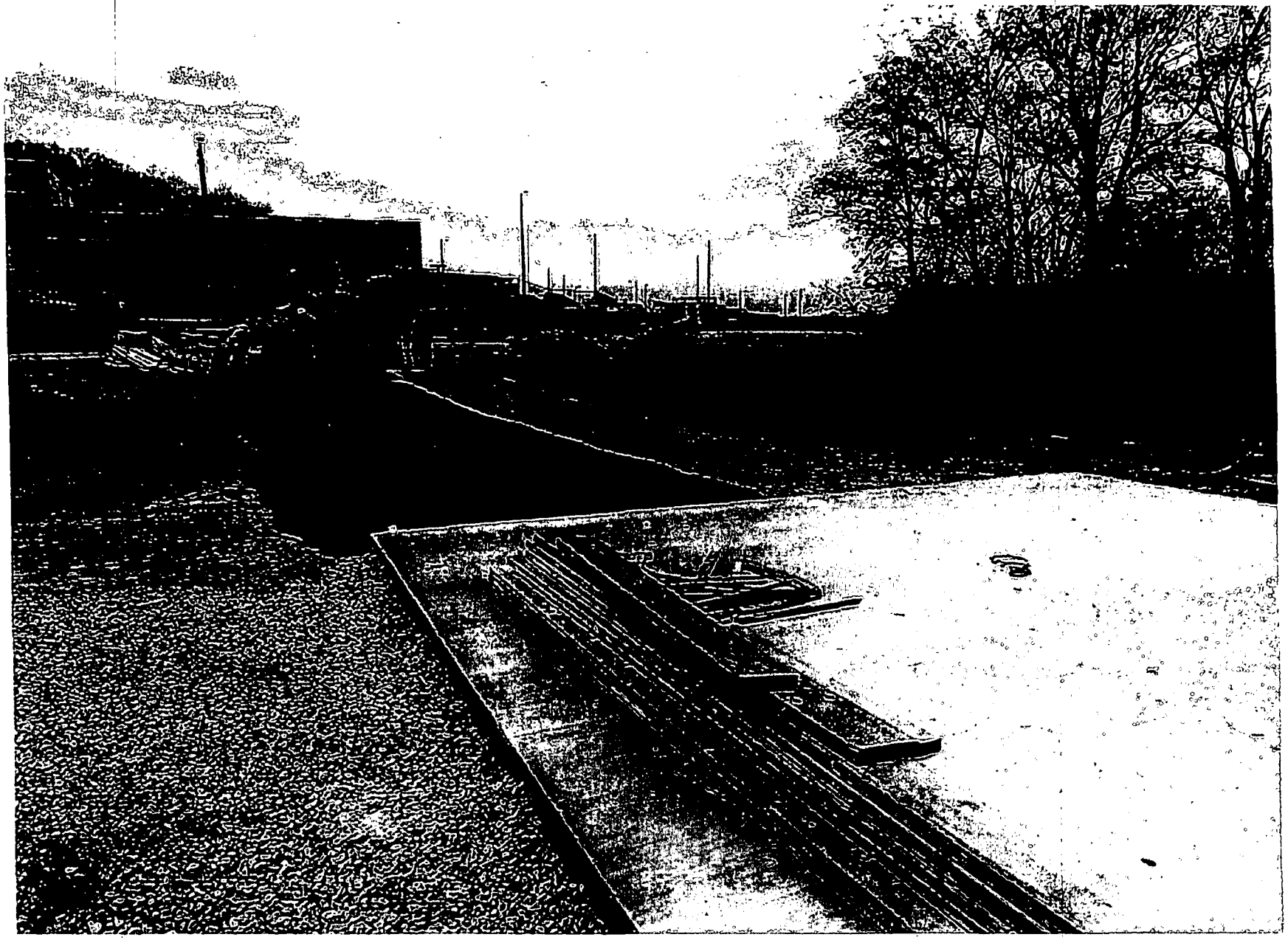
962704 - Installation of project fence

962893 - Soil Staging Area, installation of driveway and apron

962866 - Soil Staging Area, installation of driveway

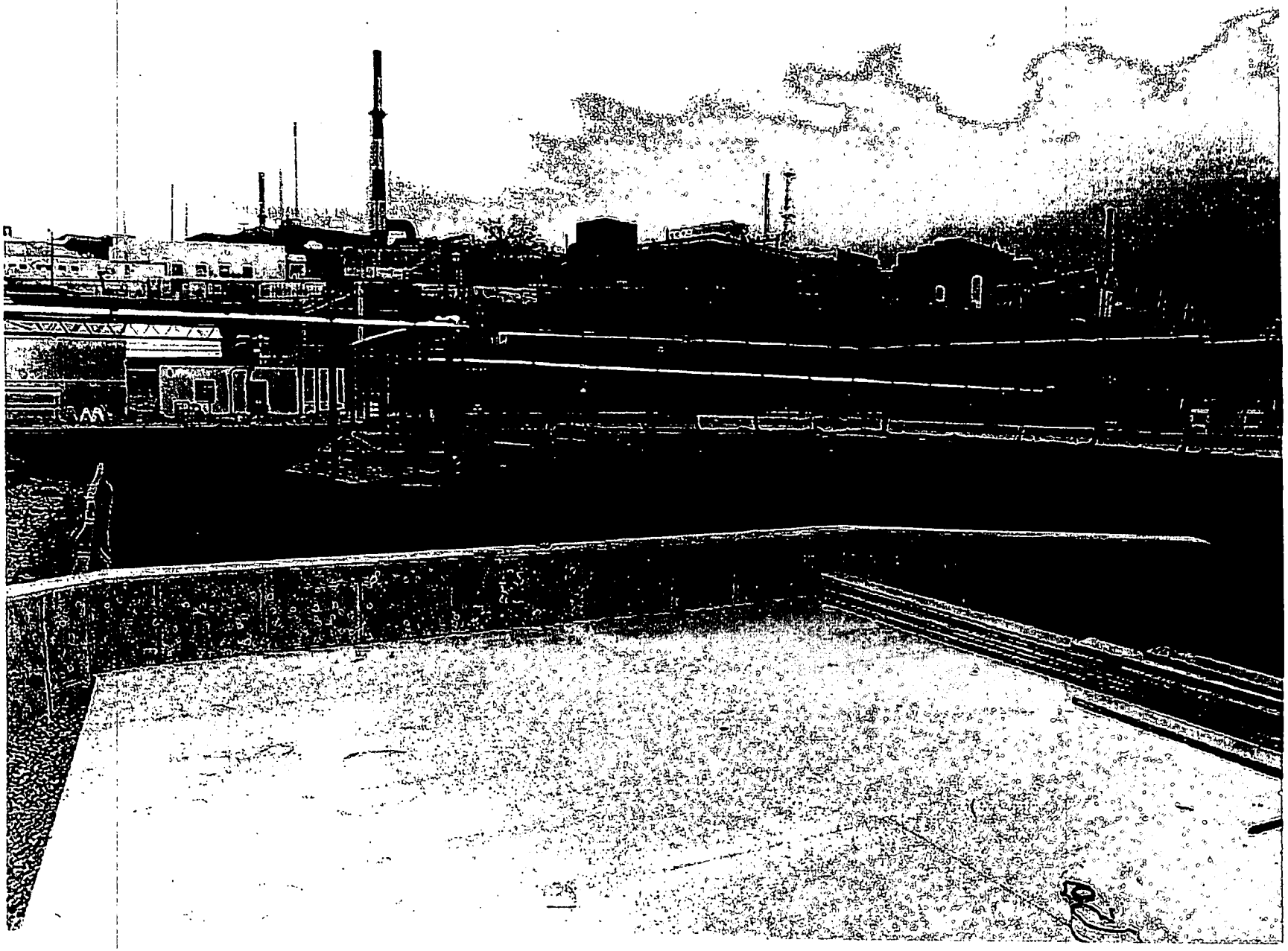
962895 - Soil Staging Area, completion of pit blacktopping

962704 - Installation of project fence



962893 - Soil Staging Area, installation of driveway and apron

962866 - Soil Staging Area, installation of driveway



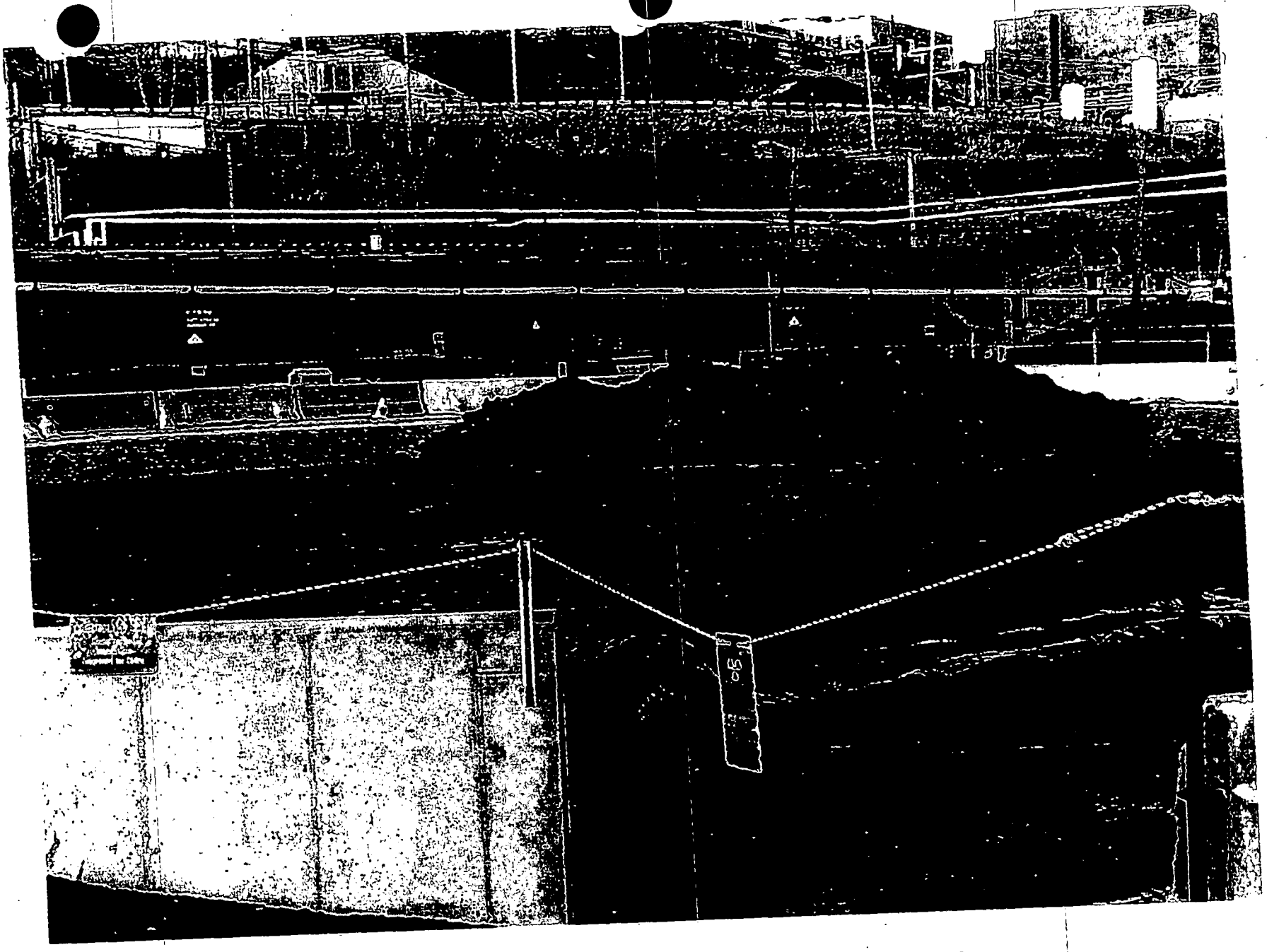
962895 - Soil Staging Area, completion of pit blacktopping

962951 - Beginning project excavation, south of weir

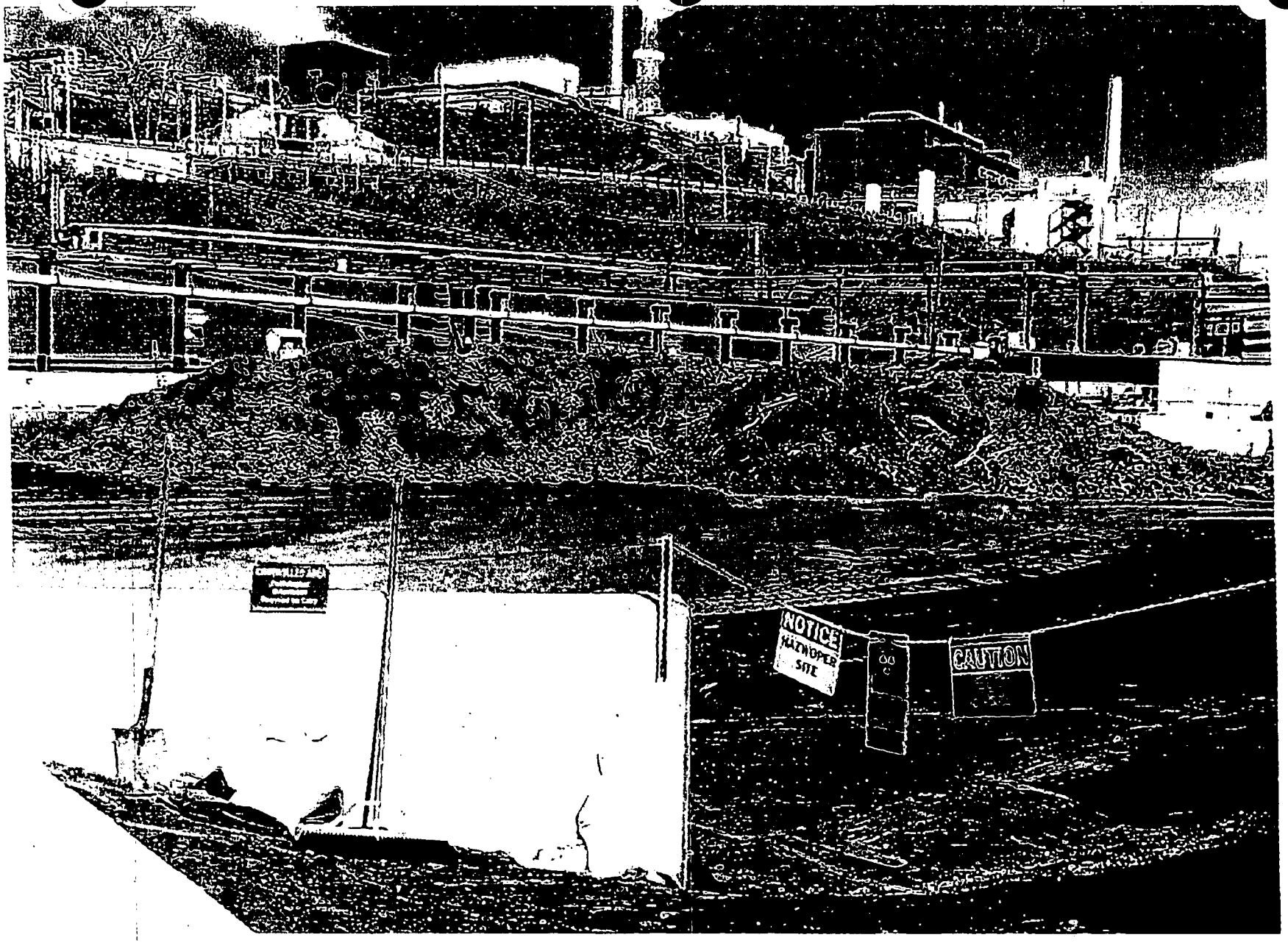
962946 - Loaded Volvo Articulating Hauler

962935 - Soil Staging Area, dumping of canal soil into the pit

962938 - Soil Staging Area, dumping of canal soil into the pit



962939 - Soil Staging Area, staging of canal soil

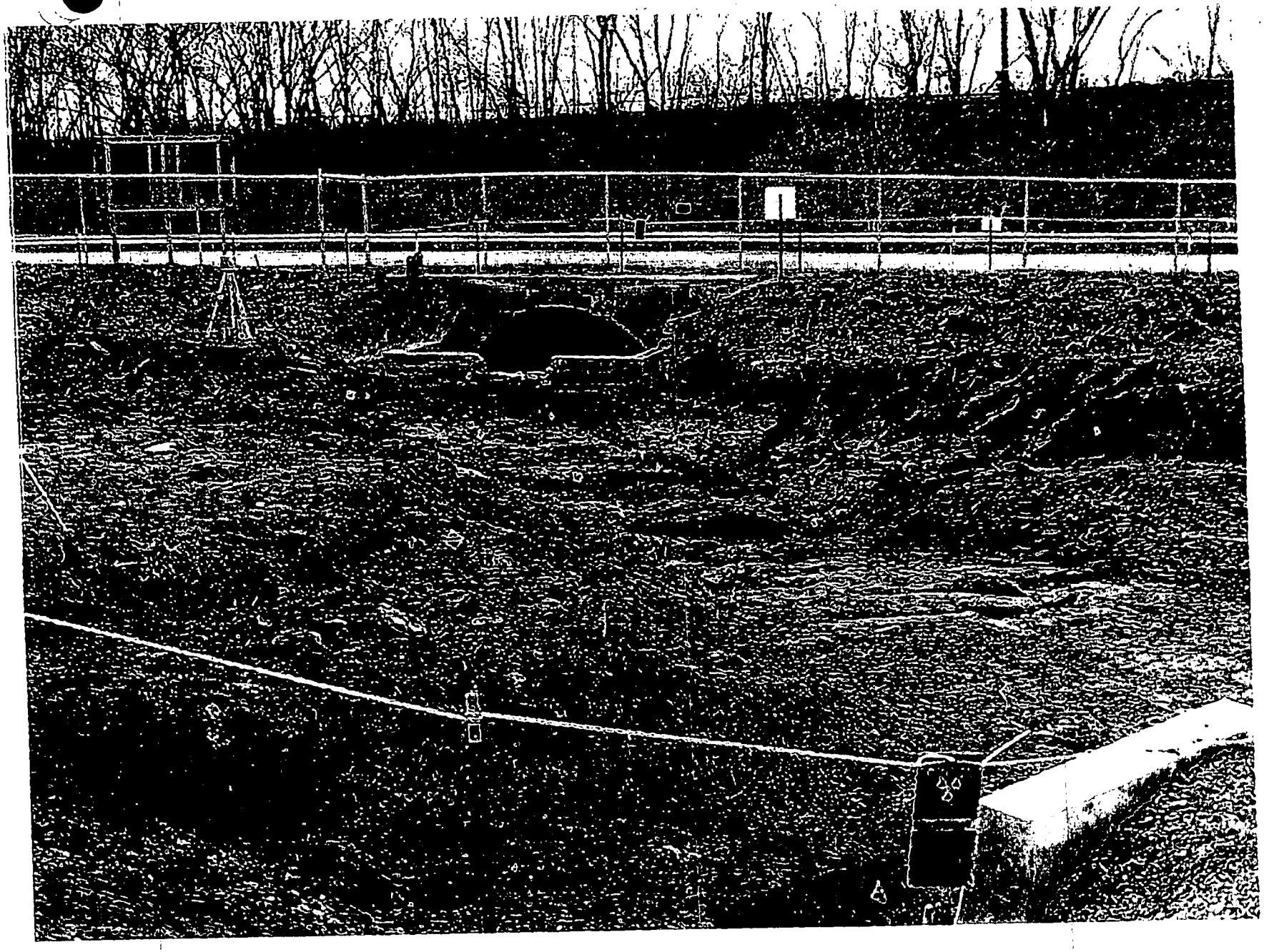


962942 - Soil Staging Area, staging of canal soil

963048 - Soil Staging Area, Railroad Spur, receiving of railcars

962948 - Completed excavation, south of weir

962962 - RCT soil sampling markers, south of weir

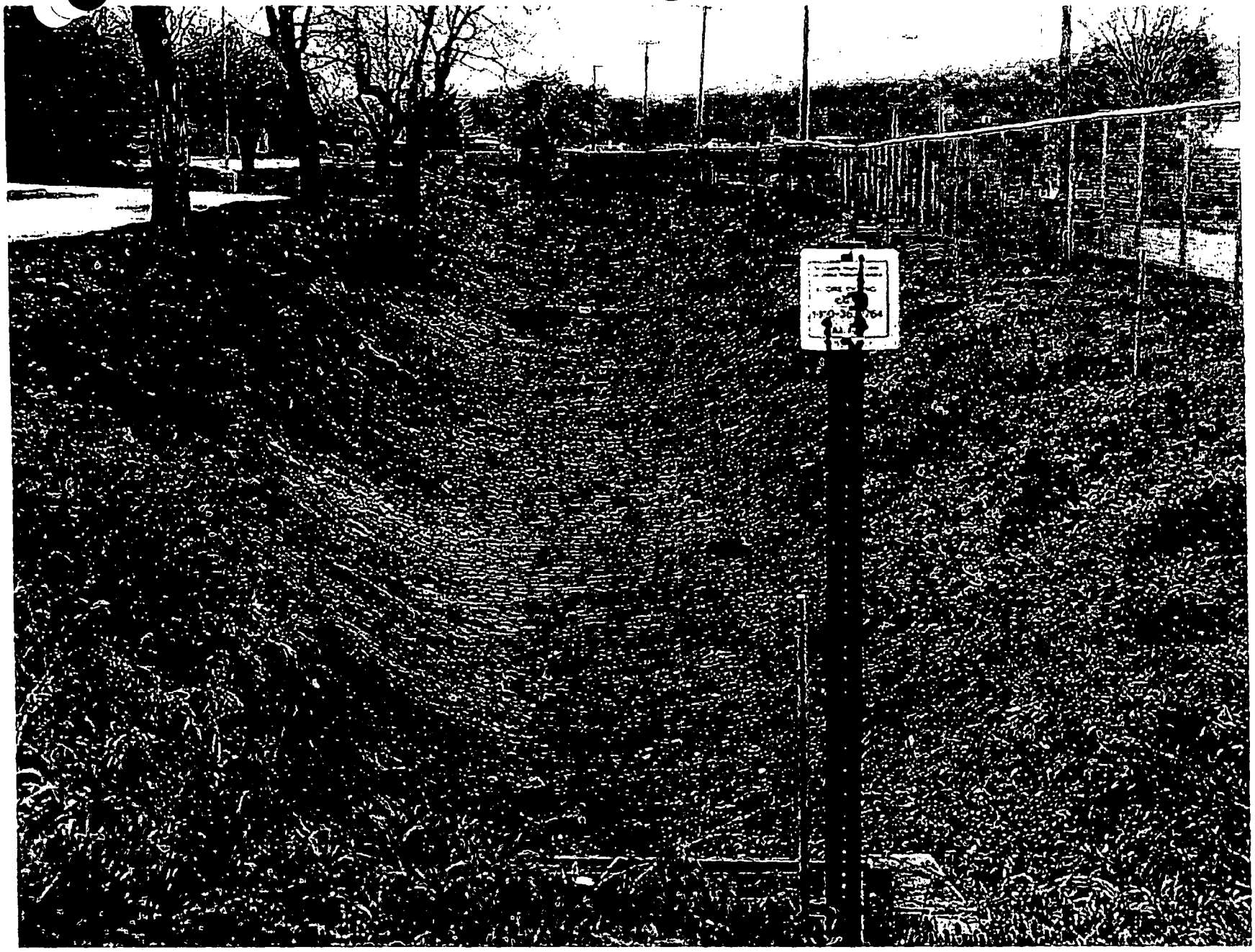


962958 - RCT soil sampling markers, weir area

970664 - Rain water run-off reroute, north canal

970665 - Rain water run-off reroute, north canal

963071 - Drainage reroute flowing into weir

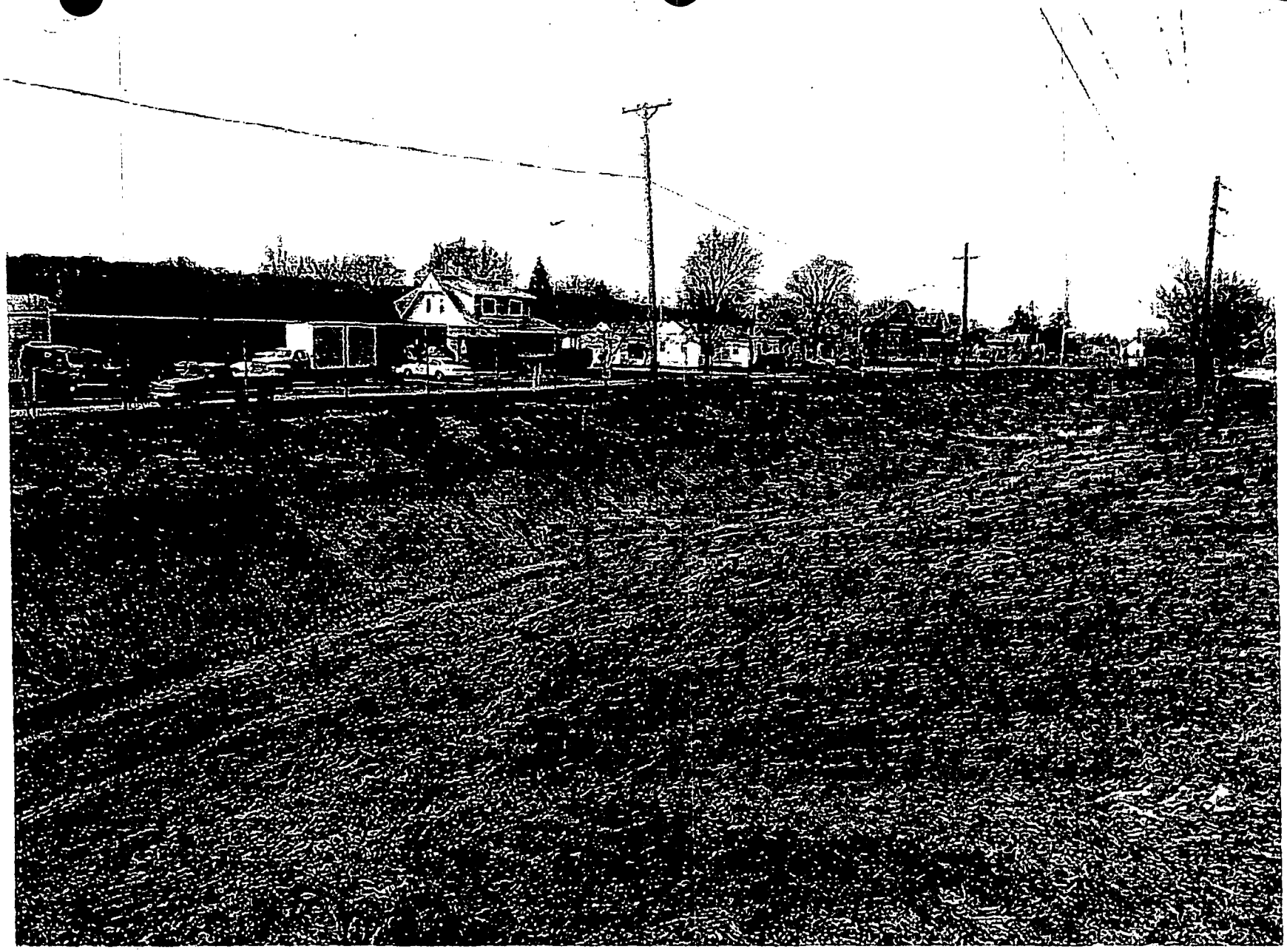


970662 - North canal, excavation

970474 - North canal, excavation

970473 - Transporting contaminated soil

970722 - Utilization of water truck on haul roads



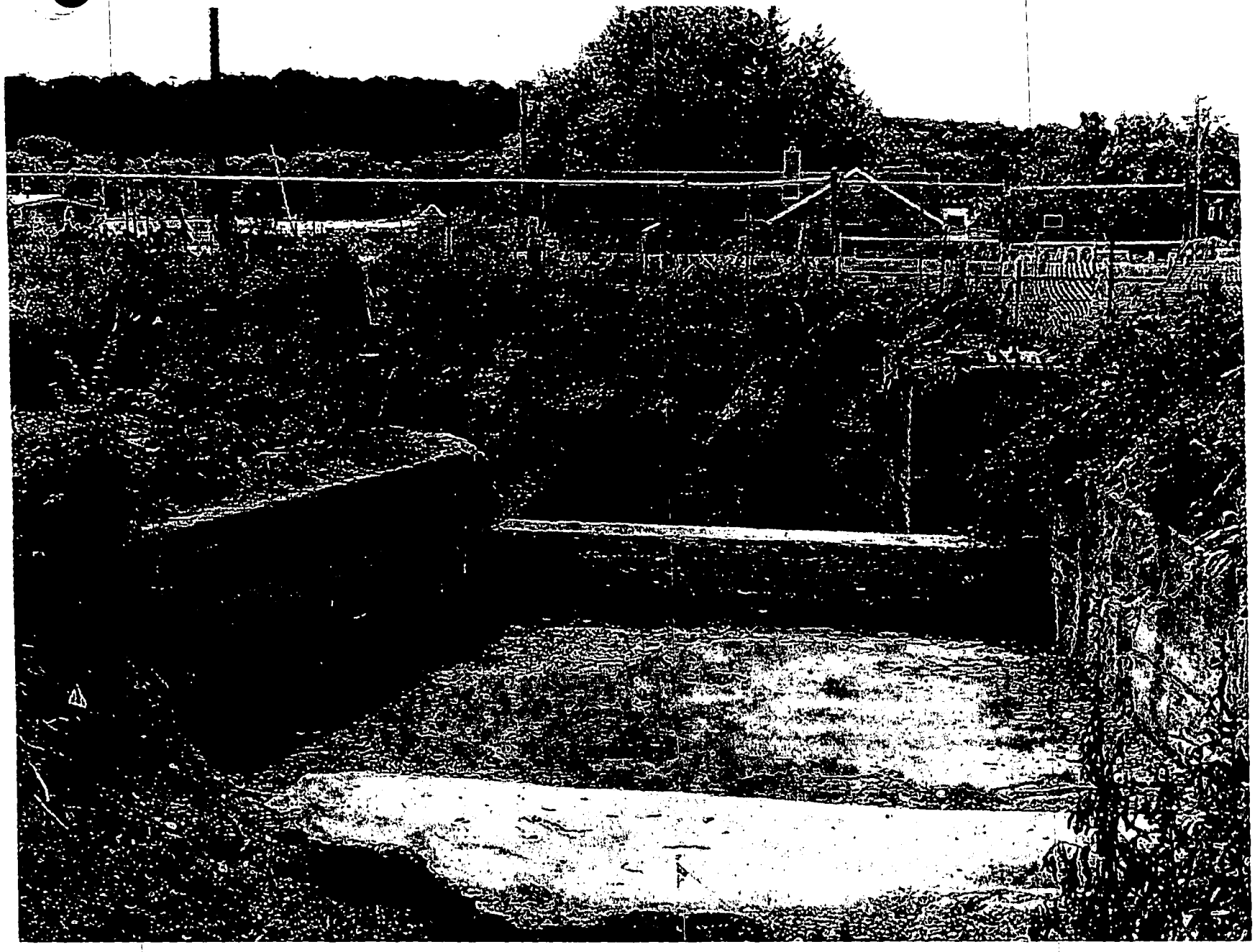
970478 - North canal, excavation

970666 - North canal, excavation, air sampling station

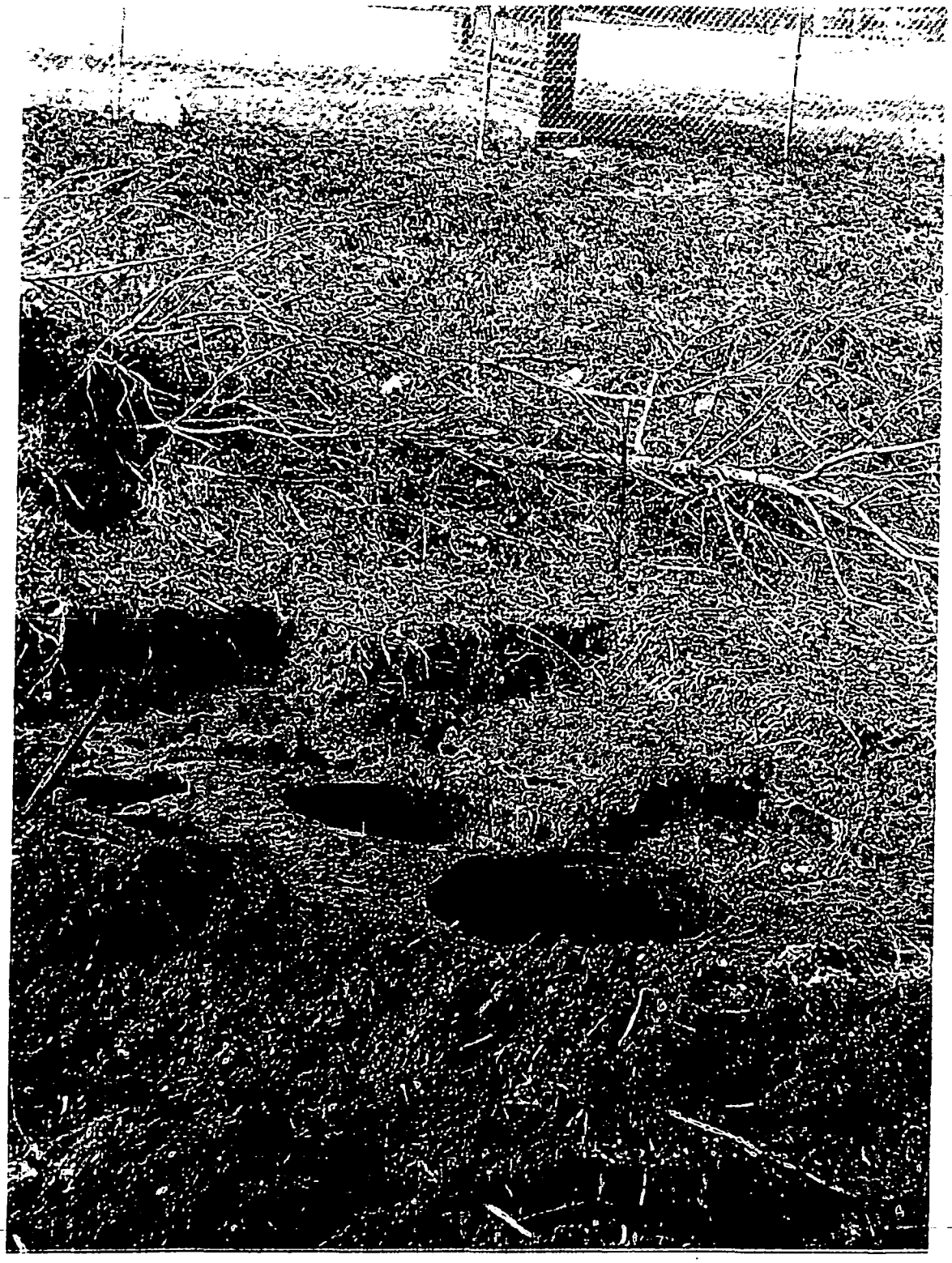
970044 - Twin 60's, excavation

970045 - 1895 Historical Bridge, excavation

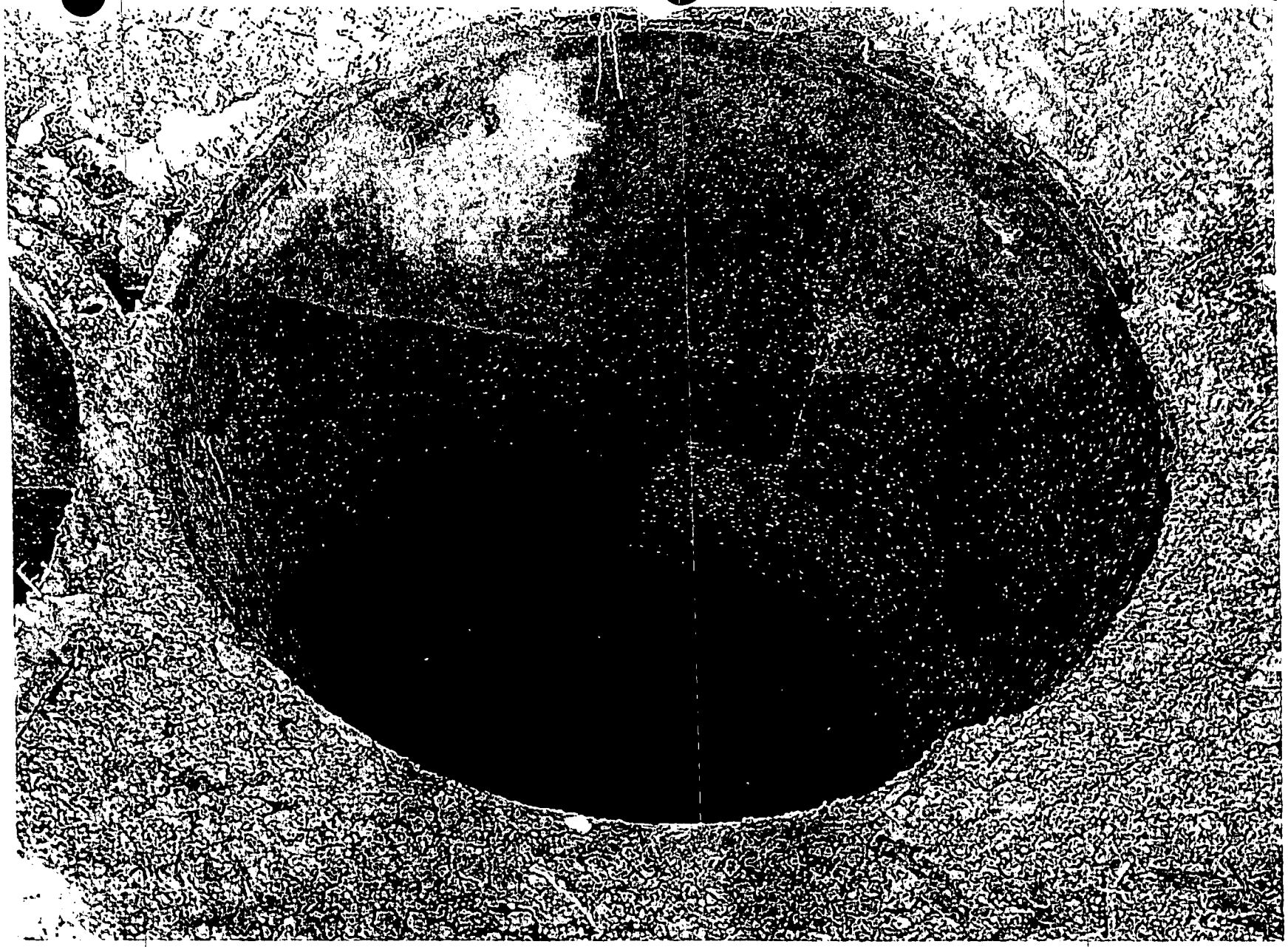
962960 - RCT soil sampling, south of weir



971196 - Spillway and flapper valve, excavation



970183 - Buried sediment tanks



970186 - Buried sediment tanks

970906 - Excavation of sediment tanks

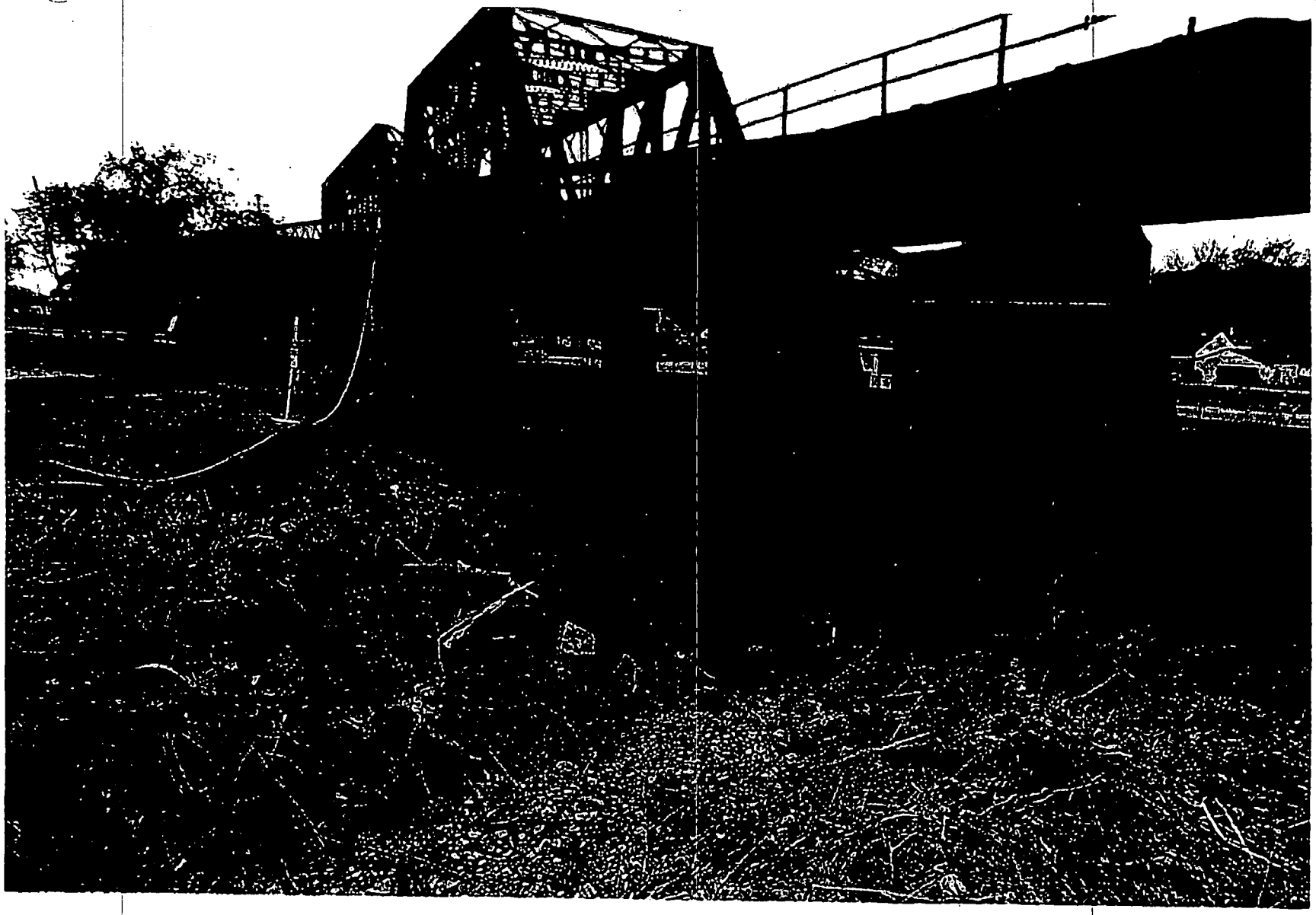
970286 - Ohio EPA monitoring equipment

971036 - North canal, dredging piles, excavation

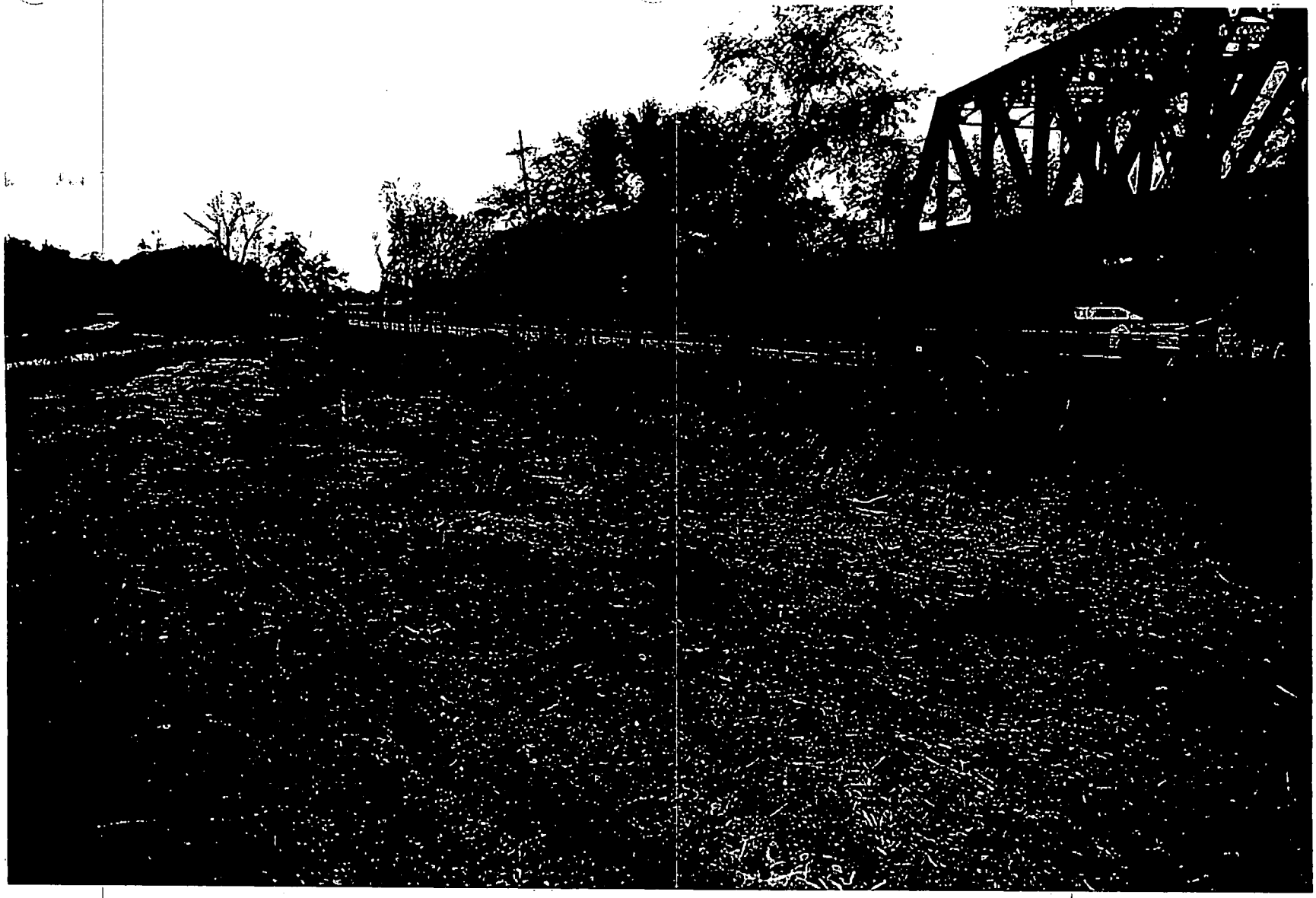
971191 - Re-grading of haul roads

970909 - Surveying of sediment tanks

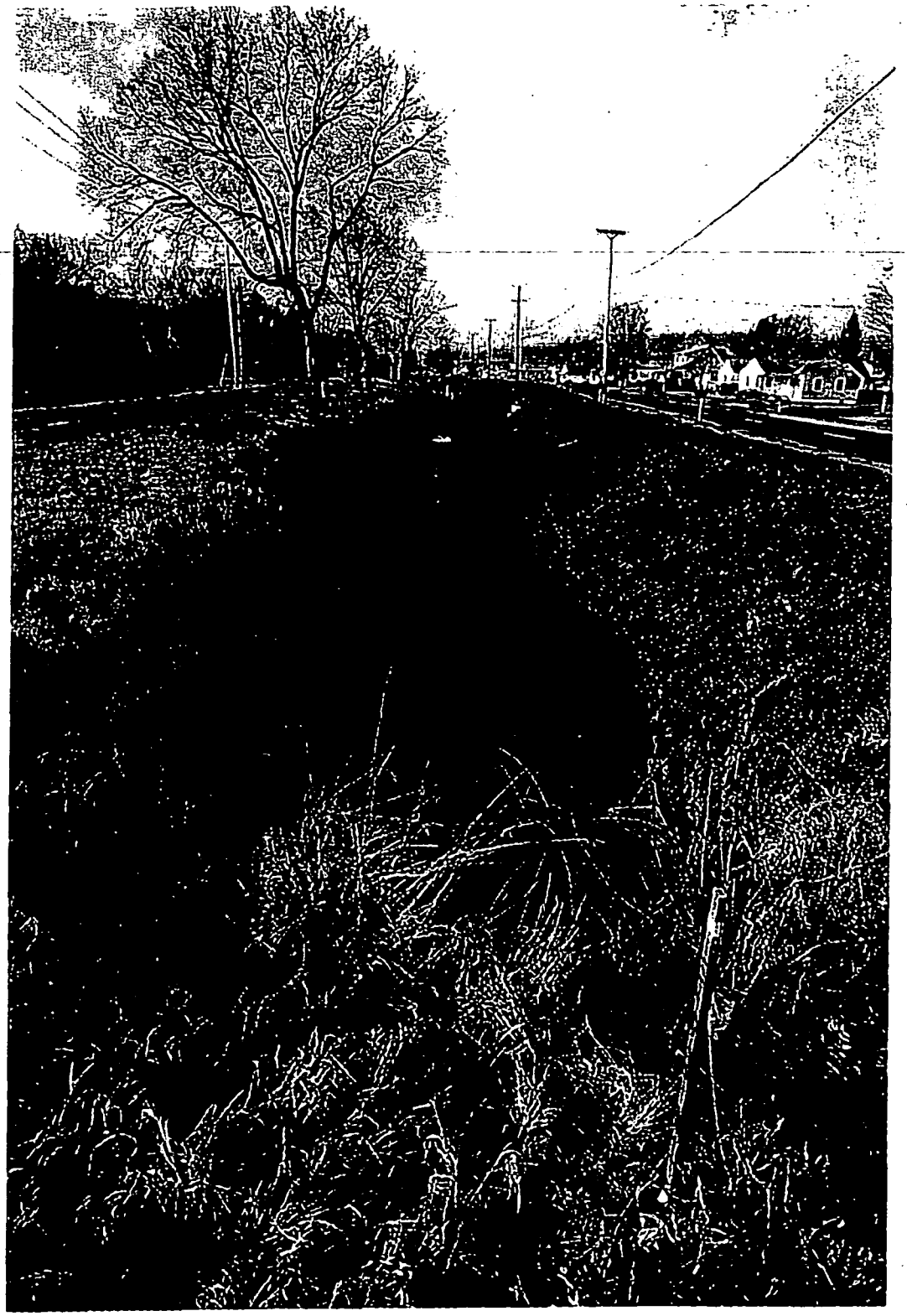
971628 - Conrail railroad trestle, excavation



971626 - Conrail railroad trestle, excavation



971632 - Conrail railroad trestle, south excavation



980634 - North canal restoration, grading

980700 - North canal restoration, grading

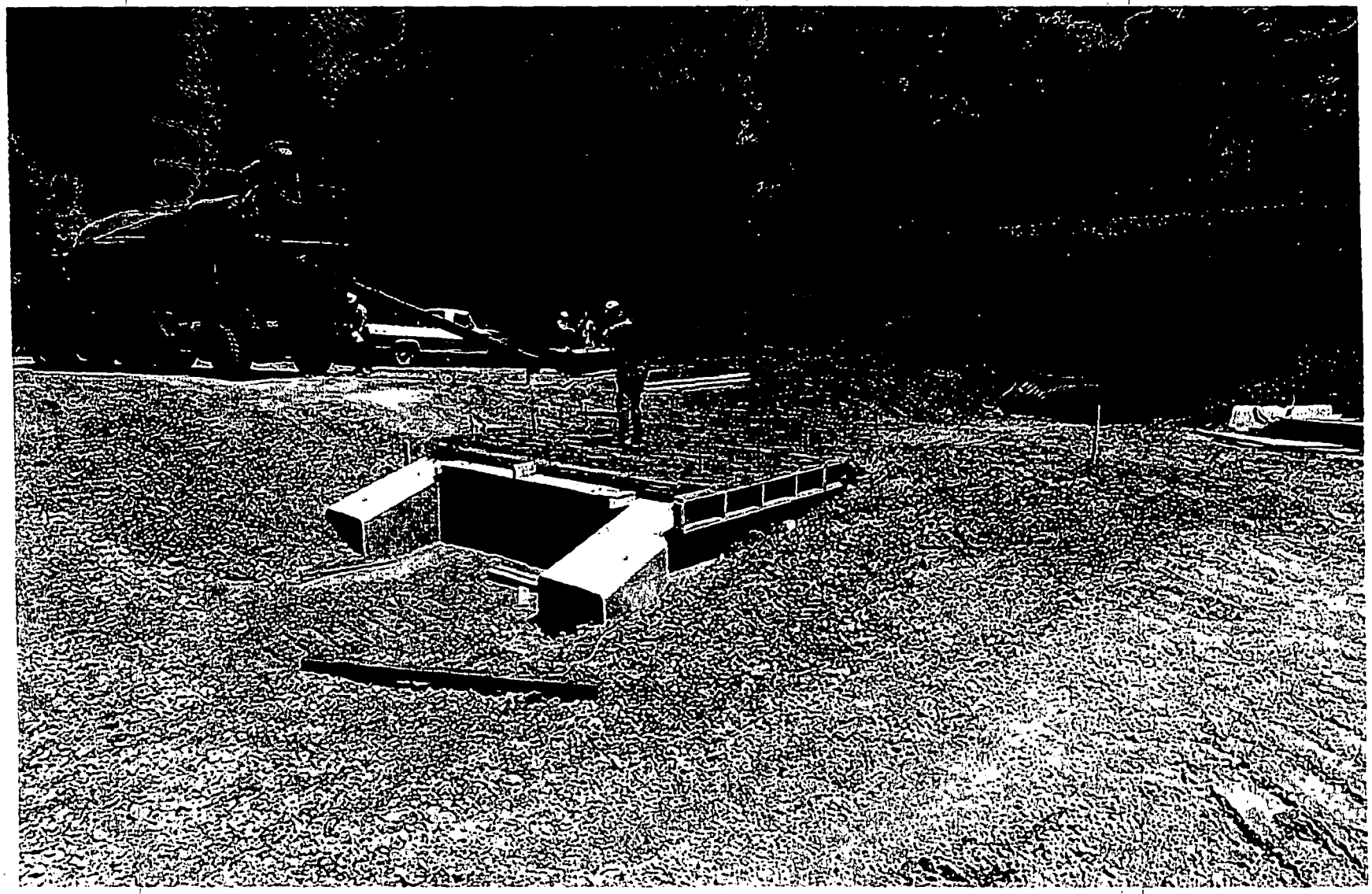
980704 - North canal restoration, grading

981034 - North canal restoration, planting trees

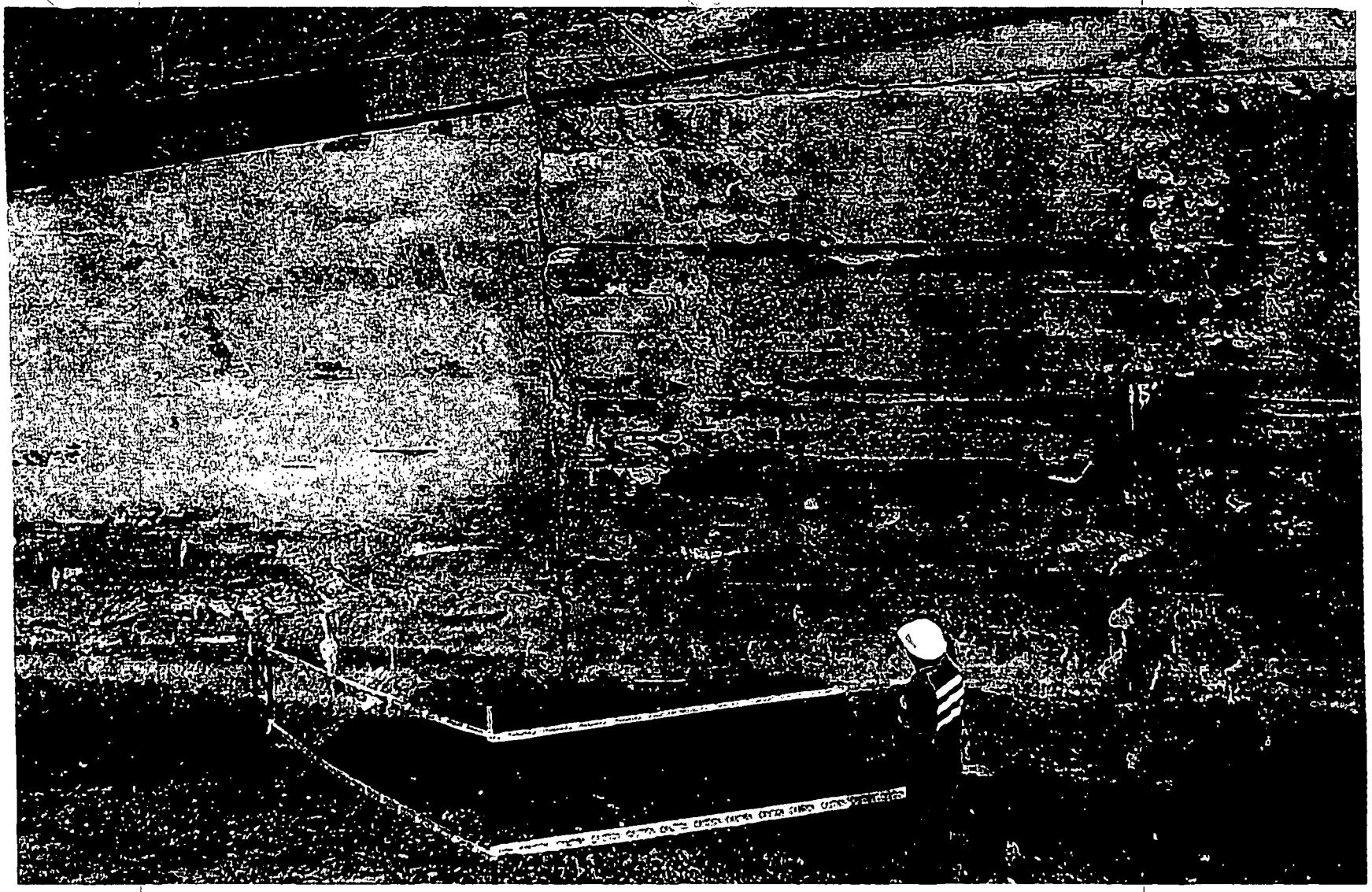
980954 - North canal French Drain

980876 - South canal restoration, grading

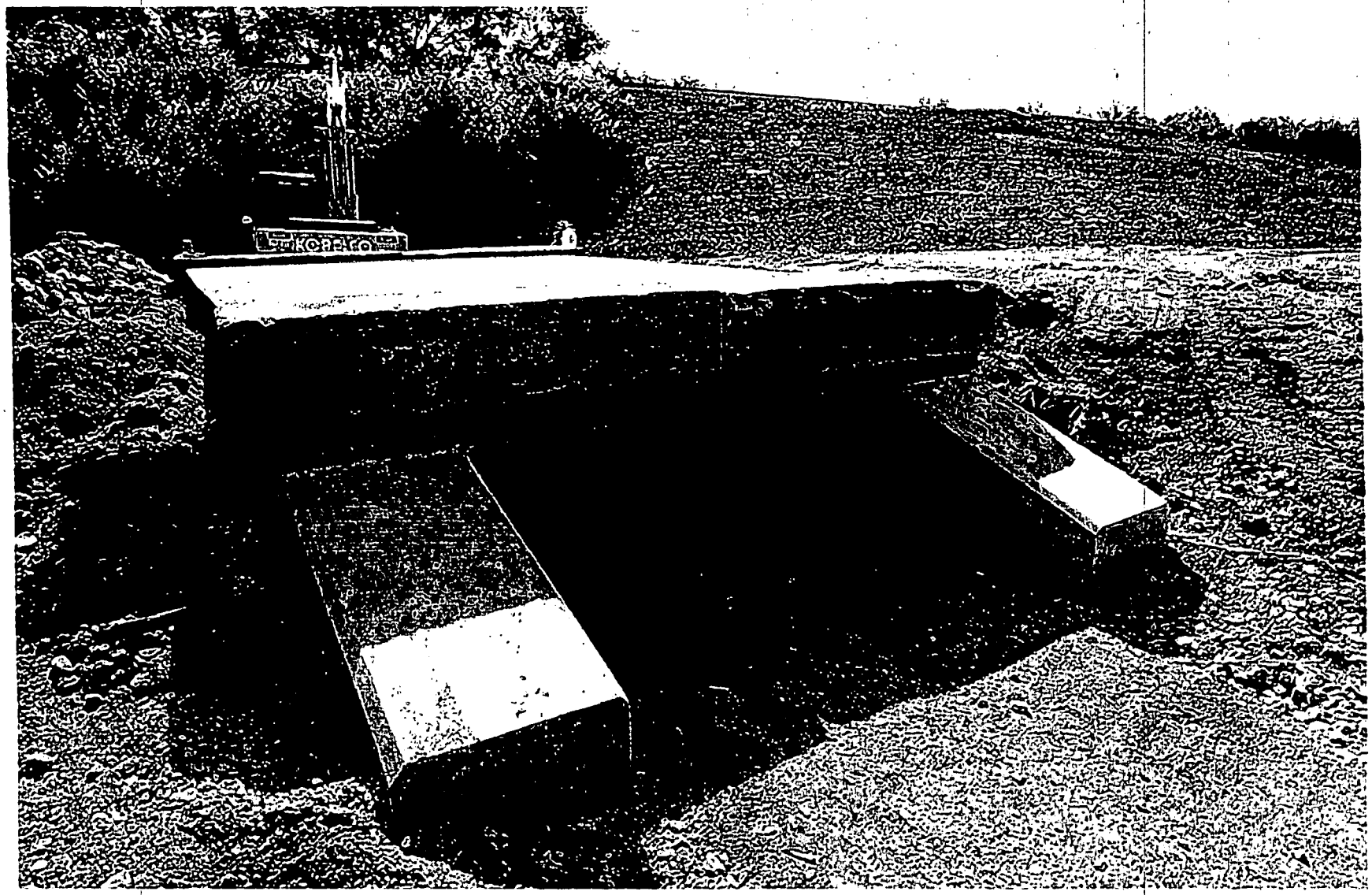
980956 - 1895 Historical Bridge, forming of retaining walls



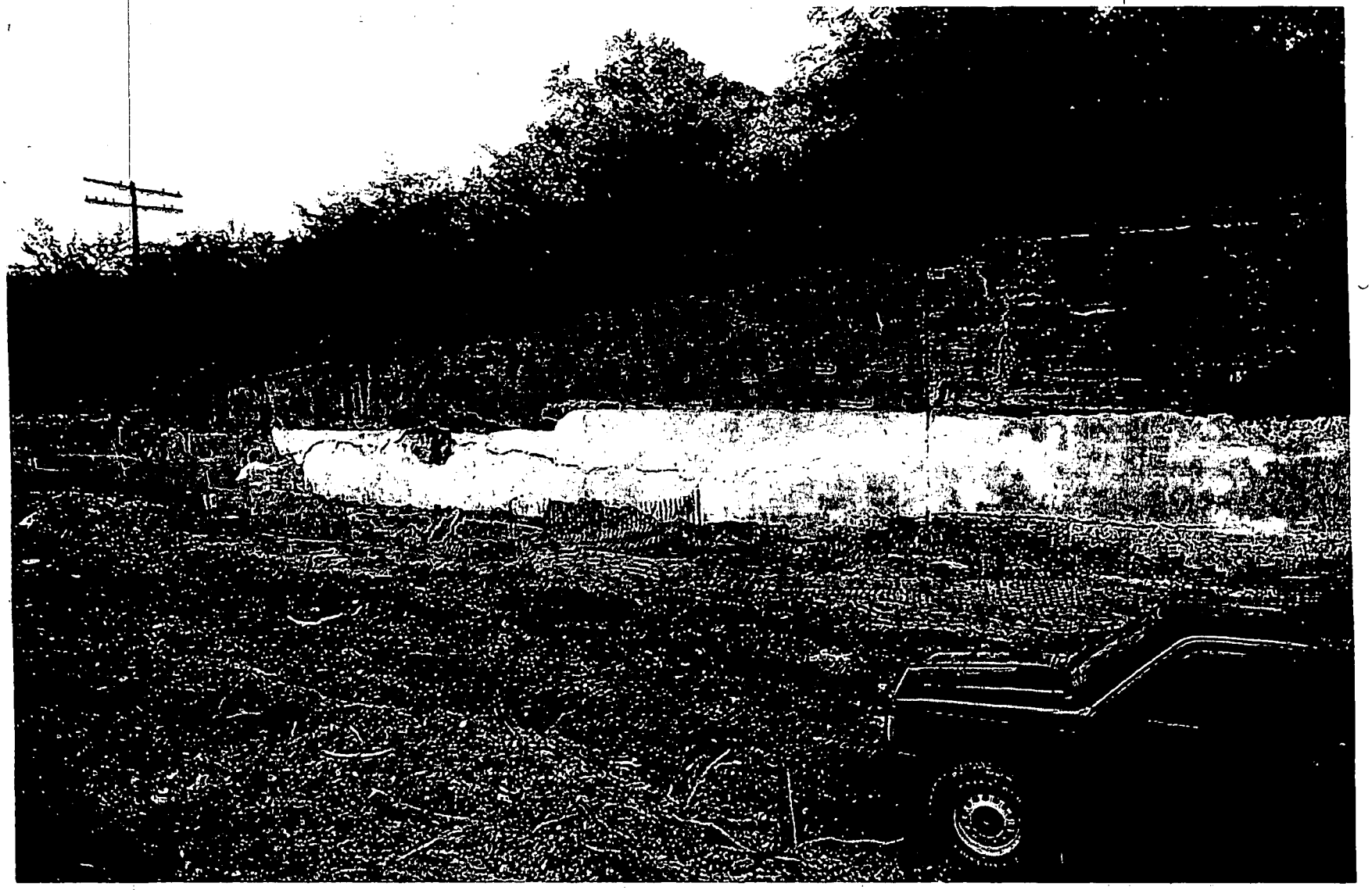
981078 - 1895 Historical Bridge, bridge pad installation



971790 - Conrail railroad retaining wall

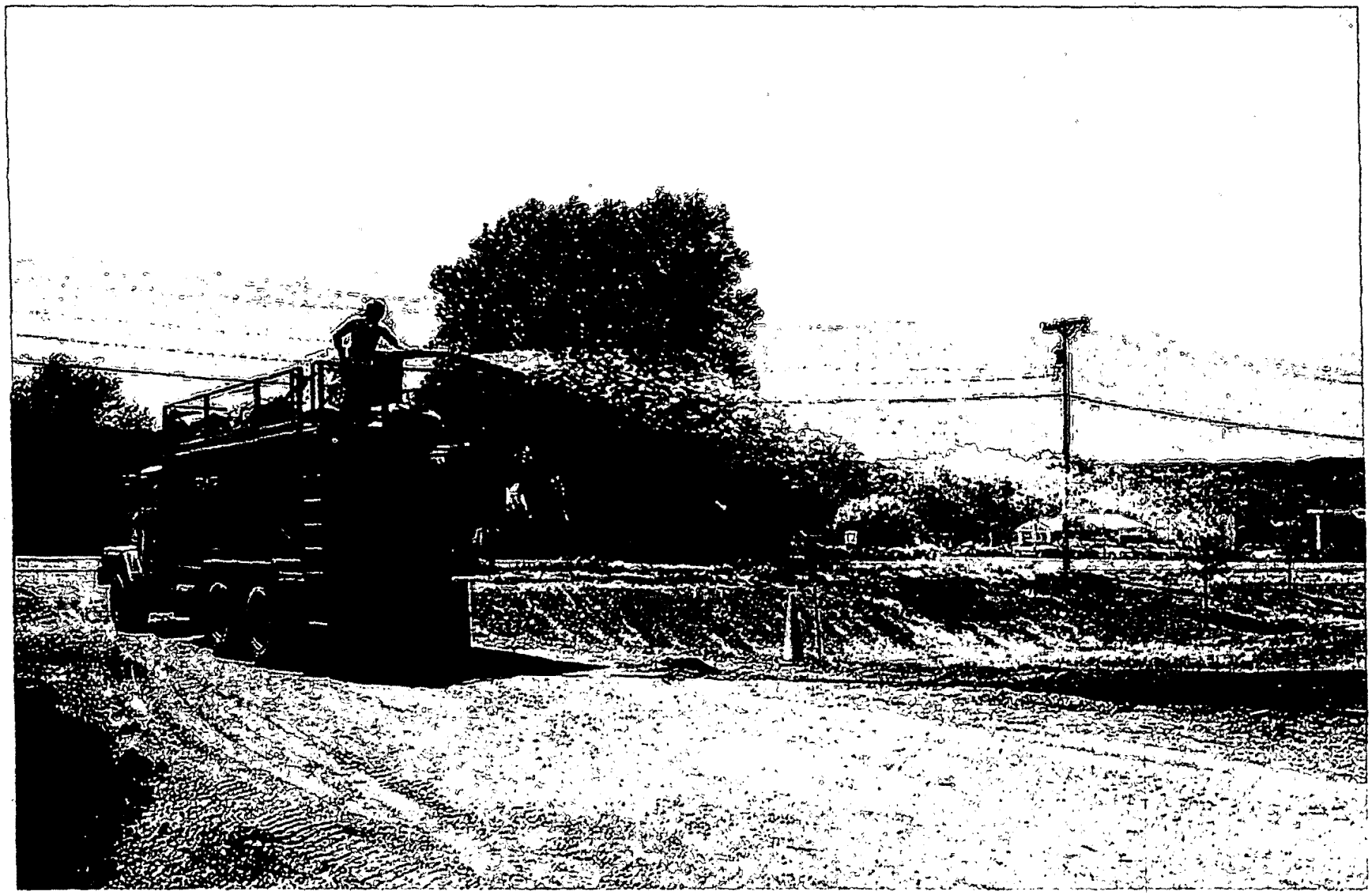


981173 - 1895 Historical Bridge, completion



980959 - Conrail retaining wall, sealing

981180 - Conrail retaining wall, shrub installation



981084 - Canal restoration, hydro-seeding

981201 - Canal restoration, asphalt bike-path installation

981204 - Canal restoration, north completion

981466 - Canal restoration, north completion

981469 - Canal restoration, 1895 Historical Bridge completion

981473 - Canal restoration, Conrail trestle completion

APPENDIX C

Miami-Erie Canal Verification Sampling Data Assessment Report

Describes the conformance to the administrative and quality. Assurance programs, the quality control results, and the interpretation of the data associated with the verification samples.

Miami Erie Canal Verification Sampling Data Assessment Report

MOUND PLANT
MIAMISBURG, OHIO

U.S. DEPARTMENT OF ENERGY
OHIO FIELD OFFICE

Babcock & Wilcox of Ohio

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1 INTRODUCTION

The administrative and quality assurance programs that were utilized during the Miami-Erie Canal Removal Action are described in the Field Sampling Plan (April 1996). The Field Sampling Plan (FSP) defined the procedures that were to be followed to achieve the following objectives:

1. "Soil screening analyses were performed to provide scientific evidence, through laboratory analysis, that Pu-238 removal action meets the established cleanup standard for plutonium." (FSP. 1996)
2. "Verification analyses will be performed to characterize the soil in the excavated area to determine the presence of plutonium contaminants, and to analyze for other selected chemicals and radiological contaminants. The verification sampling will test for both radiological and chemical contaminants to determine if there are other chemicals of concern that have action levels above acceptable standards." (FSP.1996)

This document describes the conformance to the administrative and quality assurance programs, the quality control results, and the interpretation of the data associated with the verification samples.

The FSP specifies that the requirements for the field methods, sampling procedures, and sample custody were obtained from the Mound Plant Quality Assurance Project Plan (QAPP) for Operable Unit (OU) 4. The requirements specified in the OU4 QAPP in turn reference the Mound Plant ER Program Standard Operating Procedures contained in the OU9 Site-Wide QAPP (DOE 1993). During the Miami Erie Canal project, Mound made a transition away from the OU9 QAPP, and the methods and requirements were incorporated into the Mound Plant Methods Compendium. No significant technical changes were made to the OU9 specifications as a result of the conversion to the Methods Compendium.

There are two aspects to the Quality Assurance Program implemented for the sampling and analysis of the Miami-Erie Canal during the Removal Action: Quality Control and Quality Assessment. Quality control is the system of procedures performed to control the quality of the product, usually with defined standards of performance for those procedures. Quality control procedures for this program includes activities such as control checks for field and laboratory measurements with specified acceptance criteria and the corrective actions applied for non-compliance to these checks. Section 2 describes and evaluates the impacts from various changes or deviations from the FSP that occurred during the removal action. Because the FSP references many of the OU9 Site-Wide QAPP quality assurance requirements, Section 2 has been organized to discuss compliance relative to the OU9 QAPP.

Quality Assessment is a program of activities used to evaluate the performance of implemented quality control procedures and the quality of the product against established quality objectives. If the quality objectives are not met and the program has been followed, then the program may require modification. When variations from the program occur, the impact of the variations must be assessed. For example, if the QAPP required the laboratory to add 2-benzyl-4-chlorophenol to the semi-volatile matrix spike solution and the laboratory failed to implement this requirement, the impact of the non-compliance on the usability of the data must be evaluated before comparing the data to an action limit. Laboratory data affected by quality control deficiencies are qualified during data validation. For this program, ten percent of the sample results were submitted for data validation and the results of the data validation were used to characterize the data set. Section 3 summarizes the data qualifications and impacts to data usability for laboratory data generated from the verification samples.

2 QUALITY ASSURANCE PROGRAM

The following subsections discuss any deviations to applicable sections of FSP or the OU9 QAPP. Because the majority of the quality assurance and quality control specifications were specified in the OU9 QAPP, the subsections are presented in the same order as the QAPP.

2.1 Introduction

There were no reportable events related to this section of the QAPP.

2.2 Project Organization and Responsibility

Three programmatic changes occurred during the project.

- B&W Ohio became the site prime contractor effective October 1, 1997 replacing EG&G. The canal verification sampling and analysis contracts were novated from EG&G to B&W Ohio.
- In May 1998, the B&W Ohio Miami Erie Canal Program Manager, Mr. Robert Stanley, was replaced by Mr. Keith McMahan.
- WESTON Analytics, a division of Roy F. Weston, Inc., was sold to RECRA. WESTON Analytics had been contracted to perform chemical analyses on the canal verification samples. Work continued to be performed by RECRA after the acquisition of WESTON Analytics.

These three program changes did not impact the quality of the soil verification project.

2.3 Quality Assurance Objectives in Terms of Accuracy, Precision, Completeness, Representativeness, and Comparability.

2.3.1 Accuracy

Accuracy of measurement data is defined as the degree of comparability of a measure, x, with an accepted reference or true value, T. For the Canal Verification samples, accuracy was measured through the evaluation of Performance Evaluation (PE) samples, laboratory control samples (blank spikes), surrogates, calibration checks, and matrix spike samples.

2.3.1.1 Performance Evaluations Samples

No project specific performance evaluation (PE) samples were submitted to the laboratories. However, USEPA and DOE PE samples submitted to the laboratories were reviewed. The results for the external PE results provided by the laboratories during the project are summarized in Table 2.1 and the results are discussed by laboratory in this section. The discussion assumes that acceptable performance is defined as 80 percent of the analytes being properly reported and quantitated.

Table 2.1 – Summary of PE Results

Organization	Study	Date	Analyte	Result (% Correct)
Quanterra - Richland	QAP 43 (EML 576)	Feb-96	Plutonium	100%
	QAP 44 (EML 581)	Jul-96	Plutonium	100%
	QAP 45 (EML 587)	Jan-97	Plutonium	100%
	QAP 46 (EML 591)	Jul-97	Plutonium	100%
	QAP Summary Listing	1-Dec-97	Plutonium	100%
	QAP 9803.REP	1-Jun-98	Plutonium	100%
	DOE MAPEP (Quan03)	1996	Plutonium	100%
	DOE ORO SMO Ref. 0039	Jul-97	Thorium	Anomaly
	DOE ORO SMO Ref. 0040	Jul-97	Thorium	Anomaly
	QAP 43 (EML 576)	Feb-96	Tritium	100%
	EPA intercomparison Study	8-Mar-96	Tritium	80.0%
	QAP 44 (EML 581)	Jul-96	Tritium	100%
	QAP 45 (EML 587)	Jan-97	Tritium	100%
	QAP 46 (EML 591)	Jul-97	Tritium	100%
	QAP Summary Listing	1-Dec-97	Tritium	100%
	QAP 9803.REP	1-Jun-98	Tritium	100%
	DOE MAPEP (Quan03)	1996	Uranium	75.0%
	EPA intercomparison Study	16-Apr-96	Uranium	81.8%
	QAP 45 (EML 587)	Jan-97	Uranium	100%
	DOE ORO SMO Ref. 0039	Jul-97	Uranium	100%
	DOE ORO SMO Ref. 0040	Jul-97	Uranium	100%
	QAP 46 (EML 591)	Jul-97	Uranium	100%
	DOE ORO SMO Ref. 0061	Oct-97	Uranium	100%
	DOE ORO SMO Ref. 0068	Oct-97	Uranium	100%
	QAP Summary Listing	1-Dec-97	Uranium	100%
	QAP 9803.REP	1-Jun-98	Uranium	100%
WESTON/RCRA	WP035 PE study	May-96	Metals	100%
	MAPEP-95-W3	May-96	Metals	100%
	WS037 PE study	Oct-96	Metals	94%
	WP036 PE study	Dec-96	Metals	100%
	WS038 PE study	Apr-97	Metals	94%
	MAPEP-96-W4	Apr-97	Metals	0%
	WP037 PE study	Jun-97	Metals	96%
	WS039 PE study	Oct-97	Metals	94%
	MAPEP-97-S4	Oct-97	Metals	100%
	WP038 PE study	Jan-98	Metals	100%
	WS040 PE study	Apr-98	Metals	100%
	MAPEP-97-W5	Apr-98	Metals	100%
	WP039 PE study	May-98	Metals	100%
	WS037 PE study	Oct-96	Semivolatiles	100%
	WS038 PE study	Apr-97	Semivolatiles	100%
	MAPEP-96-W4	Apr-97	Semivolatiles	90%
	WS039 PE study	Oct-97	Semivolatiles	100%
	MAPEP-97-S4	Oct-97	Semivolatiles	100%
	WS040 PE study	Apr-98	Semivolatiles	100%
	WP035 PE study	May-96	Wet Chemistry	100%
	WS037 PE study	Oct-96	Wet Chemistry	75%

Table 2.1 – Summary of PE Results

Organization	Study	Date	Analyte	Result (% Correct)
	WP036 PE study	Dec-96	Wet Chemistry	100%
	WS038 PE study	Apr-97	Wet Chemistry	66%
	WP037 PE study	Jun-97	Wet Chemistry	91%
	WS039 PE study	Oct-97	Wet Chemistry	62%
	WP038 PE study	Jan-98	Wet Chemistry	87.50%
	WS040 PE study	Apr-98	Wet Chemistry	100%
	WP039 PE study	May-98	Wet Chemistry	100%

The external PE results submitted by Quanterra between 1996 and 1998 were generally acceptable. While Quanterra experienced minor problems with uranium and thorium, the problems do not appear to be systematic and the over-all PE performance between 1996 and 1998 is judged acceptable.

The external PE results submitted by WESTON Analytics/RECRA between 1996 and 1998 were generally acceptable. The 0 percent correct for metals in MAPEP-96-W4 was attributable to an error in the units reported by the laboratory. If the units error is corrected, all of the results were within the acceptance criteria. After accounting for the 0% percent performance for the one PE sample, the metals PE sample results were acceptable. The semi-volatile results were all acceptable. The anions results for the PE samples may indicate a performance problem. In three of the PE samples, the laboratory experienced difficulty properly reporting cyanide. In one instance the cyanide results were reported with incorrect units and in the other instances the results were simply incorrect. While the cyanide PE results were incorrect, the routine quality control checks associated with cyanide results reported for the canal samples did not indicate any problems and no data qualifications were applied to the project cyanide data.

In the April 1997, RECRA experienced problems determining fluoride in PE sample WS038. Based on the matrix spike data for this project for fluoride, the PE results may substantiate a laboratory problem and the fluoride results reported for the project should be treated as estimated (J,UJ).

2.3.1.2 Matrix Spike Trends

The matrix spike data are used to evaluate whether a sample matrix may interfere with the accurate and precise quantitation of selected target analytes. If the matrix spike is determined to have poor accuracy, evaluated as a percent recovery, the sample results are qualified. If the selected sample's matrix is considered similar to other samples, then the other samples are often qualified similarly. In the case of the Mound Canal Investigation, the soil samples were all collected within a mile radius and are assumed to have similar sample matrices.

A subset (5% percent) of the samples collected for analysis was submitted with an additional request to the laboratory to perform a matrix spike. The matrix spike data was evaluated to determine whether trends could be identified that might indicate biases in the reported data. Both the matrix spike recovery and the relative standard deviation of the matrix spike recoveries were evaluated. The average recoveries and relative standard deviations for the matrix spike analytes are listed in Table 2.2. In the tables summarizing the standard deviation, some points were selectively eliminated as indicted by the footnotes. The eliminated data points represent isolated performance outliers and are not representative of the over-all program. The elimination of the data points enables the average recovery and standard deviations for the majority of the spiked samples to be evaluated and used to evaluate the program performance.

The following observations were made regarding the data set presented in Table 2.2 and the associated sample data, i.e. raw data and/or data validation reports.

- The QAPP specifies that fluoride recoveries must be 80%--120%. The average recovery for fluoride was 78%. The average was negatively impacted by the matrix spike recoveries reported for laboratory batches 9610L831, 9712L769 and 9712L907. These low percent recoveries could be attributed to matrix interference or perhaps to

a laboratory performance problem. Because the laboratory control sample recoveries associated with the low matrix spike recoveries were acceptable, the deficiency may be attributed to matrix interference. However, the PE results for fluoride as presented in Section 2.3.1.1 of this report also were reported with low recoveries. Since the cause of the low recoveries are uncertain and there is evidence of a pattern of low recoveries, the fluoride results for the project should be treated as estimated (J,UJ).

- The average percent recovery for antimony is outside quality control standards, although data points are generally evenly distributed around this average. Antimony matrix spike recoveries have been historically low for the Mound site, i.e. the soils from the Surface Water and Sediment investigation had reported average recoveries of 47.8% for the Fall of 1994 and 66.9% for the Spring of 1995.
- The average recovery and relative standard deviation for manganese were judged unusable for trend analysis. The concentration of manganese in the soil was equal to or greater than the spike concentration added to the soil and resulted in unreliable matrix spike information. The recovery and standard deviation data is included in the table, but should not be used for assessing data quality.
- Tritium had two points eliminated from its data set, as noted in Table 2.2. The average recovery and standard deviation after the deletion of these two points were based upon six (6) results instead of eight (8) results. It should be noted that the small matrix spike results may not be indicative of the sample matrix. No corrective measures were possible to improve the matrix evaluation based on this data.

2.3.1.3 Laboratory Control Samples

Laboratory control samples (LCS) are introduced by the laboratory at a frequency of 1 per laboratory batch. An LCS is a pure sample (type II water, "clean" sand, etc.) that is spiked with target analytes (matrix spike solution), prepared with the other samples, and then analyzed with the other samples. The data from an LCS can provide the following information:

- The LCS can provide an indication of whether the laboratory methodology and analysis was performed properly. If the LCS results are outside acceptance ranges, the results may indicate a handling error by the laboratory.
- The LCS can be used in conjunction with a matrix spike to substantiate a matrix interference. If a matrix spike recovery is outside acceptance limits and the LCS is within acceptance limits, then the deficient matrix spike recovery can be attributed to the sample matrix. If the laboratory control sample is similarly biased and outside acceptance limits like the matrix spike sample, then there is evidence that the laboratory may have mis-handled the sample.

The LCS data average recoveries and standard deviations are listed in Table 2.3. There was no evidence of systematic laboratory problems in the LCS data.

Table 2.2 - Summary of Soil Matrix Spike Performance

Analyte	Average Recovery (%)	Standard Deviation (%)	Analyte	Average Recovery (%)	Standard Deviation (%)
Metals - CLP ILM3.0					
Antimony	61.8	14.0	Lead	91.8	5.7
Arsenic	94.9	3.8	Manganese[3]	114.2	33.4
Barium	93.8	4.4	Mercury	95.1	19.2
Beryllium	93.6	3.8	Nickel	91.9	6.3
Bismuth	95.6	3.5	Selenium	95.2	3.9
Cadmium	90.2	4.2	Silver	97.7	4.8
Chromium	95.7	8.8	Thallium	93.0	4.1
Cobalt	93.4	3.2	Vanadium	95.1	4.9
Copper	94.3	6.4	Zinc	94.3	12.1
Semi-volatiles - CLP 3/90					
1,2,4 - Trichlorobenzene	67.6	12.1	1,4 - Dichlorobenzene	60.6	11.5
2 - Chlorophenol	65.1	14.6	4 -Chloro-3-methylphenol	68.4	16.4
4 – Nitrophenol	75.1	20.6	Acenaphthene	72.0	11.7
N - Nitroso-di-n-propylamine	75.4	16.3	Pentachlorophenol	69.9	19.8
Phenol	67.9	14.5	Pyrene[2]	78.5	18.9
2,4 - Dinitrotoluene	72.8	14.6			
Anions					
Chloride	101.5	6.4	Nitrate-Nitrite	103.5	6.4
Fluoride	78.0	30.2	Sulfate	99.8	17.4
Cyanide	93.5	11.4			
Radiological					
Thorium-230[4]	109.9	61.0	Uranium-238	104.3	24.1
Uranium-234	112.0	18.8	Plutonium-239/240	105.0	18.4
			Tritium[5]	77.7	21.8

1 2 points eliminated from each semi-volatile analysis. In these samples the laboratory identified a problem and reanalyzed. The reanalysis is used and the original matrix spikes were eliminated.

2 Pyrene: 1 point was eliminated due to an outlying percent recovery of 0%. Because 2 matrix spikes were performed on this sample and the first yielded a 101% recovery, the problem was attributed to laboratory handling not matrix interference.

3 Manganese: 5 points were eliminated due to high sample concentration in relation to concentration of spike added.

4 Thorium-230: 1 data point eliminated with a recovery of 279%

5 Tritium: 2 points were eliminated: 0% and 2949% recoveries.

Table 2.3 - Summary of Laboratory Control Sample Performance

Analyte	Average Recovery (%)	Standard Deviation (%)	Analyte	Average Recovery (%)	Standard Deviation (%)
Semi-volatiles (Water)					
Phenol	77.0	10.3	Acenaphthene	70.8	9.6
2-Chlorophenol	76.0	8.6	4-Nitrophenol	80.1	18.1
1,4-Dichlorobenzene	54.7	11.6	2,4-Dinitrotoluene	79.4	11.9
N-Nitroso-di-n-propylamine	80.1	18.1	Pentachlorophenol	79.0	14.5
1,2,4-Trichlorobenzene	58.5	11.3	Pyrene	87.4	16.3
4-Chloro-3-methylphenol	77.6	10.8			
Semi-volatiles - CLP 3/90 (Soil)					
Phenol	73.7	16.9	Acenaphthene	74.3	15.6
2-Chlorophenol	71.6	15.8	4-Nitrophenol	80.3	23.7
1,4-Dichlorobenzene	67.4	14.5	2,4-Dinitrotoluene	74.4	18.5
N-Nitroso-di-n-propylamine	76.8	20.2	Pentachlorophenol	79.9	23.9
1,2,4-Trichlorobenzene	72.6	16.7	Pyrene	82.1	17.7
4-Chloro-3-methylphenol	75.1	18.6			
Anions (Soil)					
Chloride	103.1	3.2	Fluoride	100.6	2.9
Cyanide	96.8	5.6	Nitrate/Nitrite	100.0	2.6
Sulfate	98.9	4.0			
Anions (Water)					
Chloride	103.6	2.8	Fluoride	102.1	2.9
Cyanide	94.0	5.67	Nitrate/Nitrite	100.9	3.4
Sulfate	99.2	3.8			

Table 2.3 - Summary of Laboratory Control Sample Performance

Metals - CLP ILM3.0 (Soil)					
Analyte	**Average Recovery (%)**	**Standard Deviation (%)**	**Analyte**	**Average Recovery (%)**	**Standard Deviation (%)**
Aluminum	99.2	1.4	Magnesium	99.5	2.3
Antimony	97.5	2.1	Manganese	101.7	2.0
Arsenic	98.1	2.3	Mercury	102.6	7.6
Barium	97.9	2.5	Nickel	97.8	3.3
Beryllium	97.7	3.2	Potassium	104.3	1.7
Cadmium	98.2	3.3	Selenium	98.2	2.3
Calcium	99.9	2.4	Silver	96.8	5.4
Chromium	99.7	2.5	Sodium	97.9	2.1
Cobalt	100.2	2.4	Thallium	98.7	2.4
Copper	98.8	2.3	Vanadium	99.8	1.9
Iron	98.3	2.1	Zinc	99.5	2.8
Lead	99.5	2.4	Bismuth	98.6	2.4
Metals - CLP ILM3.0 (Water)					
Analyte	**Average Recovery (%)**	**Standard Deviation (%)**	**Analyte**	**Average Recovery (%)**	**Standard Deviation (%)**
Aluminum	100.2	1.8	Magnesium	100.7	2.3
Antimony	98.5	2.0	Manganese	101.7	1.9
Arsenic	99.8	1.6	Mercury	102.6	6.6
Barium	99.2	2.7	Nickel	99.2	3.2
Beryllium	99.6	3.0	Potassium	104.4	2.1
Cadmium	98.7	3.6	Selenium	101.5	2.3
Calcium	100.5	2.1	Silver	100.9	1.5
Chromium	100.1	1.7	Sodium	99.9	2.4
Cobalt	100.4	1.8	Thallium	100.3	2.1
Copper	99.4	2.1	Vanadium	100.0	1.6
Iron	99.6	1.8	Zinc	101.2	2.4
Lead	100.4	2.5	Bismuth	97.9	3.7

Table 2.3 - Summary of Laboratory Control Sample Performance

Radiological					
Analyte (Soil)	Average Recovery (%)	Standard Deviation (%)	Analyte (Water)	Average Recovery (%)	Standard Deviation (%)
Uranium-234	103.4	9.4	Uranium-234	103.6	9.9
Uranium-238	100.9	12.1	Uranium-238	102.9	11.6
Plutonium-239/240	104.3	9.4	Plutonium-239/240	102.4	13.5
Thorium-230	98.7	9.9	Thorium-230	97.2	13.1
Tritium	102.3	13.3	Tritium	98.1	7.3

2.3.2 Precision

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is expressed as the standard deviation among a group of measurements or as a relative percent difference between two measurements. For the Canal Verification Task, precision was evaluated based on laboratory duplicates, field duplicates, matrix spike pairs, and the relative standard deviations from calibration curves. The precision results for this investigation are summarized in Table 2.4. The specified frequency of field duplicates and matrix spike pairs was performed for the Canal Verification Task as described in Table 2.5.

The field duplicate data indicated acceptable precision between measurements. The data extracted into Table 2.4 was calculated using results for which both the original and duplicate sample results were greater than the reporting limit. There was insufficient data to calculate meaningful average relative percent differences and standard deviations for semi-volatiles, sulfate, antimony, cadmium, cobalt, cyanide, selenium, silver, sodium, and thallium. During data assessment, the duplicate results, where one result was at or below the reporting limit and the other result was above the reporting limit, were subjectively judged to have similar results given the proximity of the reporting limit and eliminated from the calculation to avoid negatively biasing the evaluation of duplicate precision.

Table 2.4 – Field Duplicate Precision (Soil)

Analyte	Average RPD (%)	Guideline Limit (%)	Std. Dev. (%)
Anions			
Chloride	22	50	16.6
Fluoride	8.9	50	11.0
Nitrate/Nitrite	31	50	21.7
Sulfate	-	50	-
Percent Solids	0.7	NA	1.1
Metals and Cyanide			
Aluminum	7.8	50	5.8
Antimony	-	50	-
Arsenic	5.9	50	5.1
Barium	5.1	50	3.9
Beryllium	5.4	50	4.3
Cadmium	-	50	-
Calcium	23.1	50	29.6
Chromium	10.4.	50	7.1
Cobalt	-	50	-
Copper	14.0	50	15.8
Cyanide	-	50	-
Iron	5.0	50	4.6
Lead	16.4	50	26.1
Magnesium	13.3	50	11.8
Manganese	8.9	50	9.5
Mercury	22.5	50	16.4
Nickel	5.2	50	4.3
Potassium	7.0	50	6.0
Selenium	-	50	-
Silver	-	50	-
Sodium	-	50	-
Thallium	-	50	-
Vanadium	6.0	50	5.6
Zinc	7.3	50	5.6

Table 2.4 – Field Duplicate Precision (Soil)

Analyte	Average RPD (%)	Guideline Limit (%)	Std. Dev. (%)
Radiological Parameters			
Plutonium-238	21.4	NA	23.6
Plutonium-239/240	39.4	NA	29.7
Thorium-228	9.5	NA	7.3
Thorium-230	12.6	NA	10.0
Thorium-232	13.3	NA	13.5
Tritium	42.9	NA	49.7
Uranium-234	12.2	NA	10.5
Uranium-235	30.1	NA	24.3
Uranium-238	12.8	NA	8.6

2.3.3 Completeness

Completeness is a measure of the amount of data obtained from a measurement system that achieves the project goals, compared to the amount expected under normal conditions. Completeness is affected by unexpected conditions that may occur during the data collection process. For example, occurrences that reduce the amount of data collected include: a dry monitoring well, an instrument breakdown, or a loss of a sample extract. For the Canal Verification task, completeness has been calculated for sample collection and laboratory analysis according to the procedure outlined in Table III.4 in the OU9 QAPP.

Table 2.5 – Field Completeness Summary

Analysis	Planned Samples[1]	Collected Samples[1]	Percent Completeness	Field Blanks	Field Duplicates	Matrix Spike
Anions	125	125	100	13	13	7
Metals	125	125	100	13	13	7
Semi-volatiles[2]	125	131	100[3]	14	13	7
Uranium	125	125	100	13	13	7
Thorium	125	125	100	13	13	7
Tritium	125	125	100	13	13	7
Plutonium	679	679	100	69	73	35

[1] The planned and collected samples are investigative samples and exclude quality control samples.
[2] Six SVOC samples were re-collected on 5/19/98 (and one field blank)
[3] Six re-collected SVOC samples were not included in the completeness calculation.

Based on the sampling plan, the correct number of grids were generated and sampled and the sampling completeness objective was met.

The FSP required that for every 10 investigative samples collected, a field duplicate and field blank be collected and submitted. Based on the number of samples collected, the field team collected and submitted the proper number of field blanks and field duplicates. The FSP also required that a matrix spike be specified for every 20 samples. Based on the number of samples collected, the field team also met this completeness requirement.

Table 2.6 – Laboratory Completeness

Analysis	Submitted Samples	Usable Samples	Percent Completeness
Anions	140	140	100%
Metals	140	140	100%
Semi-volatiles	146	146	100%
Uranium	140	140	100%
Thorium	140	140	100%
Tritium	140	138	98%
Plutonium	823	823	100%

All of the sample data was determined to be usable and the project completeness goal was met. However, the benzyl-2-chlorophenol results were not reported for three (3) semi-volatiles analyses.

2.3.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent characteristics of a population, parameter, variation, sampling point, process condition, or environmental condition. Data representativeness for this project is accomplished through implementing approved sampling procedures and analytical methods that will generate data representative of site conditions. Sampling and analysis was performed by the procedures described in the FSP and the OU9 QAPP with only minor deviations as noted in Table 2.7– Corrective Action Reports. The impacts from the program deviations are summarized in the table.

2.3.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another. Comparability of data sets generated from this investigation are obtained through implementation of specific protocols for sampling and analysis, by the use of traceable reference materials for laboratory standards, by expressing results in comparable concentration units, and by participation of the laboratories in external PE programs. These protocols are defined in the OU9 QAPP.

Several deviations to the OU9 QAPP occurred during the analysis of the samples and were recorded on Corrective Action Reports. None of the deviations are considered to have impacted the usability or future compatibility of the data. The deviations and any potential impacts are summarized in Table 2.7 – Corrective Action Reports.

2.4 Sampling Procedures

Sampling procedures include the mechanisms used for selecting sample points, the sample collection procedures, the sample handling procedures, and the shipping procedures. Several corrective action reports were generated as a result of the field sampling program. These corrective actions are listed in Section 2.13. In most instances, the corrective measure implemented for the identified deficiencies resulted in no data loss. The majority of the deficiencies, 14 of 43, were the result of entry errors on the chain-of-custody forms. The corrective action reports relating to chain-of-custody errors or sample identification errors are listed in the Table 2-7. These problems were usually corrected shortly after the lab received the samples and did not impact the sampling program.

Table 2.7 – Chain-of-Custody Corrective Action Reports

CAR No.	Date	Description
001	10/25/96	Wrong sample identification scheme used on COC

004	11/22/96	Incorrect Sample Identification
007	12/3/96	Bismuth not reported by laboratory
012	4/7/97	Sample 065042 should not be a analyzed.
017	6/11/97	The collection date was not included on two radiological COCs for select samples on the COC.
018	8/13/97	Collection date omitted from the COC for 6 samples submitted for radiological analysis.
019	8/13/97	Radiological analyses not specified for several samples on a COC.
020	9/3/97	The chemical COC did not properly specify the collection date for three samples.
022	2/25/98	Sample 180041 correction on COC unclear
023	2/25/98	Sample 050011 was collected on July 18 and December 3 of 1997.
027	3/5/98	Shipping and COC error
033	3/30/98	COC not properly filled out.
035	4/27/98	Additional sample fractions needed to meet client request.
040	5/7/98	Sample 315011 mis-identified as 315021.

Seven (7) corrective action reports were initiated to document deviations from the FSP requirements. These changes were required to accommodate unanticipated field conditions, such as plastic bottles not being available from the laboratory for the inorganic fraction within the required time frame or the lack of a numbering system for field blanks. These deviations were documented as corrective actions and are listed in Table 2.8.

Table 2.8 – Plan Change Corrective Action Reports

CAR No.	Date	Description
002	10/28/96	No identification scheme for field blanks.
005	11/27/96	Eliminate requirement from logbook to record the level of protection worn at the site.
006	11/27/96	Eliminate decontamination step from SOP 1.6
014	5/5/97	Glass bottles used instead of plastic bottles for metal fraction
021	9/11/97	Re-sample locations at Mound's request to verify analyte levels
036	5/7/98	Grid S1 sub-divided
037	5/7/94	Grid N53 sub-divided
043	9/10/98	Sample verification gridding change requested by Mound.

Five (5) corrective action reports were initiated to document the incorrect identification of sample containers. In all cases, a corrective action was possible and there was no impact to the data quality. The associated corrective action reports are identified in Table 2.9.

Table 2.9 – Sample Identification Corrective Action Reports

CAR No.	Date	Description
003	11/11/96	Identification scheme in CAR#1 also impacted MEIMS
011	3/27/97	Sample bottle label incorrect

Table 2.9 – Sample Identification Corrective Action Reports

CAR No.	Date	Description
016	5/22/97	Sample fraction labeled incorrectly.
028	3/5/98	Incorrect label on a Field Blank bottle 440053.
029	3/5/98	Incorrect sample id on three samples: 445031, 440031, and 440041.

Seven (7) corrective action reports were initiated to document field deviations, such as samples received outside the laboratories temperature acceptance range. These deviations are listed in Table 2.10. The impact of these deviations are described in the complete corrective action report and summarized in Section 2.13 of this report. While some of the documented problems did impact the data quality, the associated data was still determined to be usable for the purpose of providing verification of the field screening results. For instance, corrective action report #038 documents that the SW coordinate for three grids may be inaccurate. Because the data points were still collected with the grid of interest and the verification sample points are being assigned randomly within the grid, the lack of accuracy does not invalidate the use of the data to confirm the screening sample result.

Table 2.10 – Miscellaneous Field-Related Corrective Action Reports

CAR No.	Date	Description
026	3/2/98	Minor procedural variance in sample specification in the field.
030	3/10/98	Location identification verification.
031	3/11/98	Laboratory temperature violation at sample receipt.
034	4/10/98	Tritium fraction sent to the wrong laboratory.
038	5/7/98	SW coordinate for S1A, S1B, and S1C estimated.
039	5/7/98	NW coordinate for S26, 27, and S31 estimated due to temporary access road.

Lastly, three (3) corrective action were initiated to document problems with the spatial coordinates assigned to the data points. The corrective actions are listed in Table 2.11. In all cases, the accuracy of the coordinate data was impacted and is discussed in greater detail in the actual corrective action report. Essentially, all three reports document instances where the corner point had to be estimated due to either an oversight, a data entry error, or a site condition. Since the data points were collected within the specified grid and were still randomly dispersed through the grid, the inaccuracy in the exact location should not impact usage of the data for verification of the field screening data.

Table 2.11 – Coordinate Corrective Action Reports

CAR No.	Date	Description
032	3/17/98	Coordinates collected during initial survey incorrect
038	5/7/98	SW coordinate for S1A, S1B, and S1C estimated.
039	5/7/98	NW coordinate for S26, 27, and S31 estimated due to temporary access road.

No other significant field deviations or variations were recorded during the Miami Erie Canal project.

2.5 Sample Chain-of-Custody Procedures

A few deviations from the sample field custody procedures occurred during the program, for example, entry errors on the chain-of-custody. However, these deviations were identified, documented, and corrected, and did not impact on sample custody, Table 2.7 – Corrective Action Reports.

2.6 Analytical Procedures

In general, the laboratory conformed systematically to the analytical procedures as prescribed in the OU9 QAPP. Four (4) corrective action reports were initiated to document laboratory related problems and are listed in Table 2.12. Three (3) of the reports were initiated to document laboratory problems at RECRA, *formerly WESTON Analytics Division, and one (1) report was initiated to document a problem at Quanterra – Richland.*. Corrective action report #015 documents a Gel Permeation Chromatography (GPC) problem that affected six samples. The affected samples were re-collected and re-analyzed. Corrective action report #024 documents the receipt of an EDD with the incorrect sample identification for the metals fraction and corrective action report #44 documents the receipt of EDD that would not load properly in the database. The data in both cases were loaded manually by WESTON. Corrective action report #042 was initiated to document that Quanterra – Richland did not analyze the tritium fraction for sample 335041. No corrective action was possible for this deficiency.

Table 2.12 – Laboratory Corrective Action Reports

CAR No.	Date	Description
015	5/5/97	SVOC analysis problem affecting 8 soil samples.
024	2/25/98	Sample data incorrectly loaded in database for sample 095037.
042	5/26/98	Tritium fraction for sample 335041 lost
044	9/10/98	Laboratory electronic deliverables would not load properly into MEIMS.
045	11/39/98	Tritium fraction for sample 345031 was lost

2.7 Calibration Procedures

Laboratory calibration procedures were performed as required by the OU9 QAPP based on the 10% data validation performed for the project.

2.8 Internal Quality Control Checks

There were no changes made to, or deviations from, this section of the OU9 QAPP.

2.9 Data Reduction, Validation, and Reporting

The laboratory correctly calculated results and organized the hard copy data reports. The laboratories failed on numerous occasions to provide a usable electronic deliverable. The radiological laboratory ultimately succeeded in meeting the deliverable requirement at the end of the project. The chemical laboratory was not able to produce an electronic media in the non-CLP format that would load on to the Mound Environmental Information Management System (MEIMS) data system. The authors of the MEIMS examined the deficient media and the error was not isolated. The deficiency is discussed as corrective action report #044.

All of the plutonium results were validated in accordance with the OU9 QAPP procedures. In addition to the validation of the plutonium results, ten percent of the chemical (SVOC, metals and anions) and the additional radiological results (uranium, thorium, and tritium) were also validated.

2.10 Performance and System Audits

No audits were performed for this project.

2.11 Preventive Maintenance

During the pre-qualification assessment of the laboratories and subsequent project assessments, the preventive maintenance programs were determined to be acceptable. No project assessments of the laboratories were performed during this project.

2.12 Routine Procedures for Assessing Data Quality

Data quality was assessed based on the guidelines provided in Section 9.2 of the OU9 QAPP. The conclusions of the data assessment are summarized in **Section 3.**

2.13 Corrective Actions

Corrective actions required as a result of non-compliance to the FSP or the OU9 QAPP are summarized in Table 2.13. These deficiencies have been evaluated and found to have minimal impact on the data quality for the Miami Erie Canal task. The problems related to field sampling are discussed in Section 2.4 and the problems related to the laboratory procedures are discussed in Section 2.6. Copies of the completed corrective action procedures are attached to this summary report.

Table 2.13 – Corrective Action Reports

CAR No.	Date	Description	Impact on Data
001	10/25/96	Wrong sample identification scheme used on COC	No impact on data quality.
002	10/28/96	No identification scheme for field blanks.	Initiated identification scheme. No impact.
003	11/11/96	Identification scheme in CAR#1 also impacted MEIMS	Corrected Problem. No impact
004	11/22/96	Incorrect Sample Identification	Corrected Problem. No impact
005	11/27/96	Eliminate requirement from logbook to record the level of protection worn at the site.	No impact.
006	11/27/96	Eliminate decontamination step from SOP 1.6	Requested by Mound. Minimal impact.
007	12/3/96	Bismuth not reported by laboratory	Corrected by laboratory. Minimal impact.
008	12/12/96	Using distilled water for equipment rinsate samples.	No impact.
009	12/12/96	Re-calculating sample locations for the South Pond.	Requested by Mound. No impact.

Table 2.13 – Corrective Action Reports

CAR No.	Date	Description	Impact on Data
010	12/12/96	Additional sample location areas are added outside the SAP and SOW.	Requested by Mound. No impact
011	3/27/97	Sample bottle label incorrect	No impact.
012	4/7/97	Sample 065042 should not be a analyzed.	No impact.
013	4/7/97	Void	Void
014	5/5/97	Glass bottles used instead of plastic bottles for metal fraction	No impact
015	5/5/97	SVOC analysis problem affecting 8 soil samples.	Re-collected SVOC fraction
016	5/22/97	Sample fraction labeled incorrectly.	Laboratory notified and corrective action taken. No impact.
017	6/11/97	The collection date was not included on two radiological COCs for select samples on the COC.	No impact.
018	8/13/97	Collection date omitted from the COC for 6 samples submitted for radiological analysis.	No impact.
019	8/13/97	Radiological analyses not specified for several samples on a COC.	The laboratory was notified of correct analyses. No impact.
020	9/3/97	The chemical COC did not properly specify the collection date for three samples.	The laboratory was notified of the error. No impact.
021	9/11/97	Re-sample locations at Mound's request to verify analyte levels	NA
022	2/25/98	Sample 180041 correction on COC unclear	Error noted. No impact.
023	2/25/98	Sample 050011 was collected on July 18 and December 3 of 1997.	July sample should not have been collected.
024	2/25/98	Sample data incorrectly loaded in database for sample 095037.	Error corrected. No impact.
025	3/2/98	WESTON location data entered into the database was incorrect.	Data was corrected
026	3/2/98	Minor procedural variance in sample specification in the field.	No impact.
027	3/5/98	Shipping and COC error	No impact.
028	3/5/98	Incorrect label on a Field Blank bottle 440053.	No impact
029	3/5/98	Incorrect sample id on three samples: 445031, 440031, and 440041.	No impact
030	3/10/98	Location identification verification.	No impact
031	3/11/98	Laboratory temperature violation at sample receipt.	Within the OU9 QAPP acceptance limits. No impact.
032	3/17/98	Coordinates collected during initial survey incorrect	Minimal
033	3/30/98	COC not properly filled out.	Corrected at Lab
034	4/10/98	Tritium fraction sent to the wrong laboratory.	NA

Table 2.13 – Corrective Action Reports

CAR No.	Date	Description	Impact on Data
035	4/27/98	Additional sample fractions needed to meet client request.	No impact
036	5/7/98	Grid S1 sub-divided	No impact
037	5/7/94	Grid N53 sub-divided	No impact
038	5/7/98	SW coordinate for S1A, S1B, and S1C estimated.	Inaccuracy in reported spatial coordinate for associated samples.
039	5/7/98	NW coordinate for S26, 27, and S31 estimated due to temporary access road.	Inaccuracy in reported spatial coordinate for associated samples.
040	5/7/98	Sample 315011 mis-identified as 315021.	Error corrected. No impact.
041	5/26/98	Void – Already documented in CAR#034.	NA
042	5/26/98	Tritium fraction for sample 335041 lost	Data lost.
043	9/10/98	Sample verification gridding change requested by Mound.	No impact.
044	9/10/98	Laboratory electronic deliverables would not load properly into MEIMS.	No impact.
045	11/30/989	The tritium fraction for sample 345031 was lost by the laboratory.	Data lost.

2.14 QA Reports to Management

No formal QA reports were required or provided for this project.

3 DATA QUALITY ASSESSMENT

Data validation was performed on all samples collected for plutonium analyses and 10 percent of the samples collected for chemical and extended radiological analyses. This section addresses assessment of data qualifications assigned during data validation and whether the validation results for the radiological and chemical parameters should be extended to the entire data set. The section is organized to address the qualifications by analysis. Table 3.15 at the end of this section lists all of the qualifications assigned during data validation for each of the analyses.

Quality control checks (QCCs) are used to monitor sampling and analysis at a process level. When QCCs are outside specified criteria, a corrective action should be taken in the process. When a corrective action is not possible or is not taken, the QCCs can often be used to evaluate the possible error associated with the reported results. Quality control checks are typically evaluated during data validation and applied to the affected samples. Examples of QCCs include surrogate recoveries, matrix spike recoveries, percent differences for calibration curves, etc. When QCCs were noted outside criteria during validation, the validator applied data qualiifers and sub-qualifiers following the guidelines presented in the OU9 QAPP and Methods Compendium. The qualifiers used are summarized on Table 3.1. Validation sub-qualifiers are not used in this report. The qualified data and the significance of the qualifications are then assessed to determine whether the qualification impacts the use of the data for the intended purpose.

Table 3.1 – Data Qualification Definitions

Qualifier	Description of Data Qualifier
U	The material was analyzed for, but was not detected. The associated numerical result is the sample quantitation limit.
J	The associated numerical result is an estimated quantity.
R	The data are unusable (compound may or may not be present).
UJ	The material was analyzed for, but was not detected. The sample quantitiation limit is an estimated quantity.

The qualifications for each laboratory analysis are presented in separate subsections. Each subsection includes a table listing the qualifications applied during data validation and a written description of the qualifications and their impact on the data set. The data usability assessment presented in this report is limited to use of the data for comparison to the limits listed in the Field Sampling Plan. In this report, the deficient Quality Control Checks were used, as possible, to estimate the potential bias. The estimate typically takes the form of a multiplication factor that is applied to the reported result. The assigned factor has been used to establish a probable upper limit to the sample concentration. If the upper limit was found to exceed an action limit, the result was assessed unusable.

3.1 Semi-Volatiles

Weston collected and submitted 131 samples for Semi-volatile analysis. Of the 131 samples, 6 samples were re-collected by WESTON due to a laboratory handling error. The number of samples selected for data validation was based on 125 samples and not 131 samples. The original results for the re-collected samples were not reported by the laboratory as usable data and were not included in the sample count for data validation purposes. Based on 125 investigative samples, 13 samples (10 percent) were selected for validation. The samples selected for data validation are listed in the table below.

Table 3.2 – Samples Selected for Semi-volatile Data Validation

800031	095011	145011	055011
290041	220011	270021	130018
310017	515041	475031	345031

Table 3.2 – Samples Selected for Semi-volatile Data Validation

315141			

During data validation, the validators identified 3 types of deficiencies. The deficiencies are listed below and then discussed separately in the following subsections of this report.

- Continuing calibration percent differences outside acceptance limits;
- Calibration curve relative standard deviations (RSD) outside acceptance criteria; and
- Blank contamination

3.1.1 Continuing Calibration Percent Differences

Continuing calibration checks are analyzed after every 10 samples and at the end of an analytical sequence to confirm the continued stability of the calibration curve. The percent difference calculated from the continuing calibration check must be equal to or less than 25 percent. During the project, several of the validated samples were qualified due to deficient continuing calibration checks. The table below summarizes the analytes with percent differences outside the acceptance criteria and the number of samples qualified for the analyte.

Table 3.3 – Semi-volatile Percent Difference Deficiencies

Analyte	Percent Differences	Number of Qualified Samples
bis (2-Ethylhexyl)phthalate	27.5%	1
Hexachlorocyclopentadiene	50%, 28%, 28%	3
2,4-dinitrophenol	35%, 33%, 50%	3
4-nitrophenol	25%	1
benzoic acid	39%	1
Carbazole	32%, 146%	2
2,4-dimethylphenol	25%	1
4,6-dinitro-2-methylphenol	28%	1
N-Nitroso-di-n-propylamine	26%	1

The most frequent deficiencies were reported for hexachlorocyclopentadiene and 2,4-dinitrophenol. Based on the number of deficiencies, three samples in 13 validated samples, there is no pattern that warrants extending the qualifications to the entire data set. The affected sample data are usable as qualified.

3.1.2 Calibration Curve Relative Standard Deviation

The relative standard deviation between response factors is calculated each time that a new calibration curve is generated and is used to evaluate the consistency of the response factors. If the RSD is outside an acceptance limit, then the results calculated for the affected analyte may be less accurate. Only one analyte, carbazole, in one sample was qualified due to a deficient RSD. Because only one analyte in one sample was qualified for a deficient RSD, the qualification was not extended to the entire data set.

3.1.3 Blank Contamination

The field teams and laboratories introduce blanks to assess whether the processes being employed to collect, ship, store, prepare, or analyze a sample may be contaminating samples and positively biasing the data. When blank contamination is associated with sample results, the associated sample results may be qualified non-detect by the data validator. The decisions to qualify the results are dependent on the associated blank contamination level and the analyte concentration in the sample. Table 3.4 lists the analytes detected in the blanks associated with the validated samples and the frequency of their detection.

Table 3.4 – Semi-volatile Blank Contamination Summary

Analyte	Max. Detected Concentration	Number of Qualified Samples
Carbazole	17 ug/kg	1
benzoic acid	53 ug/kg	2
di-n-butylphthalate	1100 ug/kg	1
bis(2-ethylhexyl)phthalate	22 ug/kg	2

Since blank contamination was associated with not more than 2 of the 13 samples validated, there is no apparent pattern of contamination based on the data validation results.

3.1.4 Table of All Semi-volatile Qualifications

Table 3.5 presents all of the data validation qualifications applied to the semi-volatile results and a description of the potential impact on the associated sample results.

Table 3.5 – List of Semi-volatile Qualifications

Batch	Sample	Analyte	Qualification	Impact
9610L831	800031	bis (2-Ethylhexyl)phthalate	J-CC (%D-27.5)	Inaccuracy
9710L852	130018	Hexachlorocyclopentadiene	UJ-C (%D=49.8%)	Inaccuracy
9710L852	130018	2,4-dinitrophenol	UJ-C (%D=50.5%)	Inaccuracy
9710L852	130018	4-nitrophenol	UJ-C (%D=25.2%)	Inaccuracy
9710L852	130018	benzoic acid	UJ-C (%D=39%)	Inaccuracy
9706L204	270021	Carbazole	UJ-RSD (30%)	Inaccuracy
9704L237	145011	Carbazole	UJ-CC (%D=31.9%)	Inaccuracy
9704L237	145011	Carbazole	U-B (17ug/kg)	Raised reporting limit
9712L907	345031	2,4-dimethylphenol	UJ (%D=25%)	Inaccuracy
9712L907	345031	2,4-dinitrophenol	UJ (%D=35%)	Inaccuracy
9712L907	345031	4,6-dinitro-2-methylphenol	UJ (%D=28.1%)	Inaccuracy
9710L977	310017	2,4-dinitrophenol	UJ (%D=33%)	Inaccuracy
9710L977	310017	Carbazole	J (%D=146%)	Inaccuracy
9704L004	95011	Hexachlorocyclopentadiene	UJ (%D=28.3%)	Inaccuracy
9704L914	55011	N-Nitroso-di-n-propylamine	UJ (%D=26.3%)	Inaccuracy
9705L571	290041	benzoic acid	U-B (53ug/kg)	Raised reporting limit
9705L571	290041	di-n-butylphthalate	U-B(1100 ug/kg)	Raised reporting limit
9705L571	290041	bis(2-ethylhexyl)phthalate	U-B (18 ug/kg)	Raised reporting limit
9711L253	515041	Hexachorocyclopentadiene	UJ-(%D=28.3%)	Inaccuracy
9711L253	515041	bis (2-Ethylhexyl)phthalate	U-B (22ug/kg)	Raised reporting limit

Table 3.5 – List of Semi-volatile Qualifications

Batch	Sample	Analyte	Qualification	Impact
9705L666	220011	benzoic acid	U-B (26 ug/kg)	Raised reporting limit

3.2 Inorganic (Metals)

Weston collected and submitted 125 samples for inorganic analysis. Based on 125 investigative samples, 13 samples (10 percent) were selected for validation. The samples selected for data validation are listed in the table below.

Table 3.6 – Samples Selected for Inorganic Data Validation

800031	095011	145011	055011
290041	220011	270021	130018
310017	515041	475031	345031
315141			

During data validation, the validators identified 6 types of deficiencies. The deficiencies are listed below and then discussed separately in the following subsections of this report.

- Continuing calibration verification was outside the acceptance limit;
- Continuing calibration blank was contaminated with a target analyte;
- Serial dilution was outside the acceptance limit;
- Holding time was exceeded;
- Matrix spike recovery was outside acceptance limits;
- Relative percent difference between laboratory duplicates greater than acceptance limits; and

3.2.1 Continuing Calibration Verification

The continuing calibration verification standard is used to ensure that the calibration curve is stable. The continuing verification calibration check standards in one validated batch had outliers for aluminum, beryllium, chromium, cobalt, nickel, selenium, and zinc. All of these metals had percent recoveries greater than 110 percent, but less than 120 percent. The associated sample results may be positively biased based continuing calibration results. The affected results for sample 270021 were qualified estimated (J,UJ) and while positively biased, are usable. Because no other samples were qualified on the basis of the continuing calibration verification sample, the deficiency was not systematic.

3.2.2 Continuing Calibration Blank

Continuing calibration blanks are used to verify the calibration samples, the continuing calibration samples, and other samples are not being cross-contaminated during analysis by the laboratory. Beryllium was qualified non-detect (U) in sample 800031 due to continuing calibration blank contamination. The qualified result is usable as qualified. Because no other samples were qualified on the basis of continuing calibration blank contamination, the deficiency is not systematic and no further action is required.

3.2.3 Serial Dilution

Serial dilutions are used to determine whether high concentrations of target analytes are accurately quantified. Serial dilutions also evaluate the laboratory precision as it applies to diluted samples. The acceptance criterion for a serial dilution is 10 percent. The table below lists the samples, analytes and associated serial dilutions that were

outside of acceptance limits. Since none of these elements had exceedingly high concentrations, these dilution results are considered acceptable.

Table 3.7 – Inorganic Serial Dilutions Outside Acceptance Limits

Sample Id	Analyte	Serial Dilution Result
270021	Copper	12%
270021	Potassium	13%
220011	Potassium	17%
800031	Potassium	15.4%
220011	Sodium	17%
800031	Calcium	104%

3.2.4 Holding Times

The holding time for mercury analysis was exceeded for two of the validated samples by one (1) days and two (2) days. . The associated samples were qualified estimated (J,UJ). Since the holding times for sample 415031 and 345031 were exceeded by no more than two days, the impact of the deficiency on the data was minimal and the data is usable.

3.2.5 Matrix Spike Recoveries

Matrix spike samples are used to evaluate whether the sample matrix interferes with the accurate and precise measurement of contaminants. A matrix spike sample may also indicate whether laboratory analytical practices are contributing to inaccurate or imprecise data. Several samples were qualified for matrix spike results outside the acceptance criteria and the affected samples, analytes, and the deficient matrix spike results are listed in the table below.

Table 3.8 – Summary of Deficient Inorganic Matrix Spike Recoveries

Sample ID	Target Analyte	Matrix Spike Recovery
345031	Manganese	146%
130018	Manganese	-6%
800031	Manganese	64%
345031	Mercury	74%
220011	Mercury	72%
130018	Mercury	47%
270021	Antimony	39%
475031	Antimony	57%
220011	Antimony	22%
290041	Antimony	37%
130018	Antimony	62%
800031	Antimony	70%
315141	Antimony	70%

The affected results were qualified estimated (J) and are usable as qualified. All of the matrix spike data for the project was evaluated. The results are discussed in Section 2 of this report. As indicated by Table 3.8, antimony was determined to be a systematic problem and the results for antimony are probably biased low. Section 2 of the report addresses the systematic antimony problem in detail. The manganese matrix spike recovery was also identified as a problem in Section 2 of the report. The manganese concentrations in the samples were at times equal to and greater than the manganese spike concentration. When the spike concentrations are not significantly (5x) greater than the sample concentrations, the spike recoveries are often very high or even negative. Because of the

problem with the spike concentration, the manganese matrix spike data are unusable for evaluating the data quality of the project.

3.2.6 Laboratory Duplicates

A total of seven metals from the four of the laboratory batches were reported with soil relative percent differences outside the quality control limit of (35%). Relative percent differences ranged from 22% for calcium to 123% for mercury. Based on the data validation criteria specified in the Methods Compendium and in the OU9 QAPP, soil sample 800031 should not have been qualified based on the percent differences reported for magnesium and calcium and are usable without qualification. The samples qualified estimated (J,UJ) on the basis of the percent differences are listed in Table 3.9. The two sample results, which should not have been qualified, are shown in Italics in Table 3.9. The results for mercury in samples 160057 and 220011 were near the reporting limit and the high variance may be attributable to the proximity of the reporting limit to the reported results. The qualified antimony and selenium results in sample 160057 were less than the reporting limit and consequently higher variance is not unexpected. Given the proximity of many of the results to the reporting limit and the small number of deficient relative percent differences, there is no indication of a systematic deficiency and the qualified data are usable as qualified.

Table 3.9 – Summary of Deficient Laboratory Duplicate RPDs

Sample Id	Target Analyte	Percent Differences
220011	Arsenic	82.7%
220011	Mercury	71.2%
160057	Mercury	123%
160057	Antimony	40.9%
160057	Magnesium	52.3%
800031	*Magnesium*	*28.3*
160057	Selenium	42%
800031	*Calcium*	*22%*
800031	Nickel	110%
315141	Calcium	44%

3.2.7 Table of all Inorganic Qualifications

Table 3.5 presents all of the data validation qualifications applied to the inorganic results and a description of the potential impact on the associated sample results

Table 3.10 – Summary of Inorganic Qualifications

Batch	Sample	Analyte	Qualification	Impact
9712L907	345031	Antimony	UJ - MS (34%)	Negative bias
9712L907	345031	Manganese	J - MS (146%)	Positive bias
9712L907	345031	Mercury	J - HT (1 day)	No significant impact
9712L907	345031	Mercury	J - MS (74%)	Negative bias
9796L294	270021	Aluminum	J - CCV (116%)	Slight positive bias
9796L294	270021	Antimony	J - MS(39.2%)	Negative bias
9796L294	270021	Beryllium	J - CCV (120%)	Slight positive bias
9796L294	270021	Chromium	J - CCV (115%)	Slight positive bias
9796L294	270021	Cobalt	J - CCV (111%)	Slight positive bias
9796L294	270021	Copper	J - SD (12%)	Slight inaccuracy

Table 3.10 – Summary of Inorganic Qualifications

Batch	Sample	Analyte	Qualification	Impact
9796L294	270021	Nickel	J - CCV (113%)	Slight positive bias
9796L294	270021	Potassium	J - SD (-13%)	Slight inaccuracy
9796L294	270021	Selenium	J - CCV (118%)	Slight positive bias
9796L294	270021	Zinc	J - CCV (115%)	Slight positive bias
9712L769	475031	Antimony	UJ - MS (57%)	Negative bias
9712L769	475031	Mercury	J - HT (2 days)	No significant impact
9705L666	220011	Antimony	J - MS (51%)	Negative bias
9705L666	220011	Arsenic	J - D (82.7)	Inaccuracy
9705L666	220011	Mercury	J - D (71.2)	Inaccuracy
9705L666	220011	Mercury	J - MS (72%)	Slight negative bias
9705L666	220011	Potassium	J - SD (17%)	Inaccuracy
9705L666	220011	Sodium	J - SD (17%)	Inaccuracy
9707L571	290041	Antimony	UJ-MS (37%)	Negative bias
9710L852	130018	Antimony	UJ-MS (62%)	Negative bias
9710L852	130018	Manganese	UJ-MS (-6%)	Negative bias
9710L852	130018	Mercury	UJ-MS (47%)	Negative bias
9610L831	800031	Antimony	UJ-S (MSR-70)	Slight negative bias
9610L831	800031	Beryllium	U-B (CCB-0.73 mg/kg)	Raised reporting limit
9610L831	800031	Calcium	J-I (SD-104%) J- D (RPD-22.1)	Inaccuracy Inaccuracy
9610L831	800031	Magnesium	J-D (RPD-28.6)	Inaccuracy
9610L831	800031	Manganese	J-S (MSR-64)	Negative bias
9610L831	800031	Nickel	J-D (RPD-110)	Inaccuracy
9610L831	800031	Potassium	J-I (SD-15.4%)	Inaccuracy
9703L761	315141	Calcium	J-RPD (44.1%)	Inaccuracy
9703L761	315141	Antimony	J-MSR (70.7)	Slight negative bias

3.3 Anions

Weston collected and submitted 125 samples for anion analysis. Based on 125 investigative samples, 13 samples (10 percent) were selected for validation. The samples selected for data validation are listed in the table below.

Table 3.11 – Samples Selected for Anion Data Validation

800031	095011	145011	055011
290041	220011	270021	130018
310017	515041	475031	345031
315141			

During data validation, the validators identified 3 types of deficiencies. The deficiencies are listed below and then discussed separately in the following subsections of this report.

- Holding times exceeded;
- Matrix spike recovery outside acceptance limits; and

- Sample was not reported on a dry weight basis.

3.3.1 Holding Times

The QAPP holding time was exceeded for fluoride, chloride, sulfate and nitrate/nitrite analyses. While anions are not typically subject to significant degradation over time, it is possible that the exceeded holding times may result in some of the values being biased low. The degree of possible bias is expected to be proportional to the number days past the regulatory holding time. During data validation, the sample results were qualified estimated (J,UJ). Based on the low likelihood of anion degradation, the data are considered usable for the purposes of this investigation.

3.3.2 Matrix Spike Recovery

The matrix spike recovery limits were exceeded for fluoride in 3 validated samples and sulfate in 2 validated sample. The sulfate recovery exceeded the acceptance limit by 10% in one sample and may indicate a positive matrix bias. In the other sample, the matrix spike and matrix spike duplicate recoveries are extremely different and are indicative of a spiking problem in the laboratory or an extremely heterogeneous soil. Because only two sulfate matrix spike samples were outside acceptance limit, the deficiency was not considered to be systematic and the qualification was not applied to the entire data set.

The fluoride matrix spike recoveries were below the acceptance limit. The low recoveries are indicative of a possible low bias in the data set. In Section 2 of the report, the systematic matrix spike recovery evaluation was discussed and the low fluoride matrix spike recoveries were identified as a potential problem. Based on the available data, there is an indication that the fluoride results are biased low by a factor as large as 5x and as noted in Section 2, all fluoride results should be treated as estimated (J,UJ)..

3.3.3 Table of all Anion Qualifications

Table 3.5 presents all of the data validation qualifications applied to the anion results and a description of the potential impact on the associated sample results

Table 3.12 – List of Anion Qualifications

Batch	Sample	Analyte	Qualification	Impact
9707L571	290041	Fluoride	J-H (2 days)	Slight low bias possible
9711L253	515041	Chloride	J-H (1 day)	Slight low bias possible
9703L739	050011	Chloride	J-H (16 days)	Low bias possible
9703L739	050011	Fluoride	J-H (12 days)	Low bias possible
9703L739	050011	Nitrate/Nitrite	J-H (16 days)	Low bias possible
9703L739	050011	Sulfate	J-H (13 days)	Low bias possible
9706L204	270021	Fluoride	J-H (3 days)	Slight low bias possible
9706L204	270021	Sulfate	J-H (2 days)	Slight low bias possible
9704L237	145011	Sulfate	J-S (MS-129.4)	Slight high bias possible
9710L977	310018	Sulfate	J-H (8 days)	Slight low bias possible
9712L907	345031	Fluoride	J-S (MS-14.1%) J-S (MSD-12.2%)	Low bias probable Low bias probable
9712L907	345031	Sulfate	J-H (2 days)	Slight low bias possible
9712L769	475031	Fluoride	UJ-H (1 day)	Slight low bias possible

Table 3.12 – List of Anion Qualifications

Batch	Sample	Analyte	Qualification	Impact
			UJ-S (MS-20.3%) UJ-S (MS=31.4%)	Low bias probable Low bias probable
9610L831	800031	Fluoride	J-S (MS=59.8) J-S (MS=63.3)	Low bias probable Low bias probable
9803L761	315141	Nitrate	J-H (3 days)	Slight low bias possible
9803L761	315141	Sulfate	J-H (13 days)	Slight low bias possible
9803L761	315141	Sulfate	J- MS (139%) #440041 J-MSR (22%)	Inaccuracy

3.4 Radioisotopes

Weston collected and submitted 679 samples for plutonium analysis and 125 samples for thorium, uranium, and tritium analysis. All of the plutonium samples were validated. Based on 125 investigative samples submitted for full radiological target list, 13 samples (10 percent) were selected for validation. The samples selected for radiological data validation are listed in the table below.

Table 3.13 – Samples Selected for Radiological Data Validation

800031	095011	145011	055011
290041	220011	270021	130018
310017	515041	475031	345031
315141			

During data validation, the validators identified 5 types of deficiencies. The deficiencies are listed below and then discussed separately in the following subsections of this report.

- Relative percent difference for a duplicate analysis outside acceptance limits;
- A yield below the expected recovery range;
- Blank contamination;
- Matrix spike recovery outside acceptance limits; and
- The method detection limit above the cited minimum requirement.

3.4.1 Relative Percent Difference

Relative percent difference is calculated on duplicate sample fractions. The duplicate fractions may be initiated as part of the field quality control in which case, the duplicates are called field duplicates. If the duplicate analysis is generated in the laboratory, then the duplicate pair is called laboratory duplicates. Five samples analyzed for plutonium were qualified due to poor relative percent differences: 520041, 560053, 385073, 490031, and 160017. Two of the samples were field blanks and three of the samples were investigative samples. The deficient relative percent differences were all associated with laboratory duplicates.

The field blank results resulting in the higher than normal relative percent differences were near the laboratory reporting limits. Because of the proximity of these results to the reporting limit, the higher than normal relative percent differences were not unusual. Therefore, the results for these blanks are usable and do not indicate a systematic precision problem.

Three investigative samples were qualified due to deficient relative percent differences. Based on the number of duplicate analyses and field duplicates performed, the deficiencies do not indicate a systematic problem with precision. The results are usable as qualified..

3.4.2 Yield

The sample preparation and analysis is assessed by adding a known activity of a non-target isotope to the sample aliquot prior to preparation, counting the activity of the non-target isotope at the time the target isotopes are counted, and determining the percentage activity present. The reported sample concentration is mathematically adjusted based on the determined yield. If the yield is very low, the low yield indicates there was a problem with the sample preparation and analysis. While the yield is supposed to compensate for the deficiency reported target isotopes, very low yields can result in less accurate data.

Two samples were qualified for low yield recoveries: 515031 and 950061. The affected results were qualified estimated to indicate the potential inaccuracy of the results. Because only two samples were qualified, there is no indication of a systematic performance problem. The sample results are usable as qualified

3.4.3 Blank Contamination

The field teams and laboratories introduce blanks to assess whether the processes being employed to collect, ship, store, prepare, or analyze a sample may be contaminating samples and biasing the data high. When blank contamination is associated with sample results, the sample result may be qualified non-detect or rejected by the data validator. Six samples were qualified due to associated blank contamination: 230017, 520041, 520051, 220011, 555041, and 370081. Five of the samples qualified were for plutonium and one sample was qualified for uranium.

The qualified results were assessed relative to the project action limits. Because the sample results were so much less than the associated action limits, it was determined that the blank contamination did not impact the usability of the results. For example, sample 370081 was rejected due to blank contamination. The sample results for 370081 was 0.269 pCi/g with an associate action limit of 75 pCi/g. Because blank contamination results in positive bias and the positively biased result was still far below the action limit, the data are usable.

3.4.4 Matrix Spike

Matrix spikes are used to determine whether a sample matrix is impacting the reported concentration of isotopes of interest. The matrix spike performance for the project was separately evaluated in Section 2 of this report. The qualification applied by the validator was applied only to the original fraction of the sample selected for matrix spike analysis. The sample result is usable as qualified. No systematic deficiencies were identified in the radiological matrix spike data as discussed in Section 2 of the report.

3.4.5 Minimum Detectable Activity above the QAPP requirement

The minimum detectable activity, a sample specific reporting limit, was greater than the QAPP requirement for plutonium in one sample 400081. Because the reported MDA was far below the associated 75 pCi/g action limit, the qualification did not impact the usability of the data.

3.4.6 Table of all Radioisotope Qualifications

Table 3.5 presents all of the data validation qualifications applied to the radiological results and a description of the potential impact on the associated sample results

Table 3.14 – List of Radiological Qualifications

Batch	Sample	Analyte	Qualification	Impact
W711428	395062	PU 239/240	UJ (MDA>RDL) 0.205 pCi/g	<<75 pCi/g. No impact
W711428	400031	PU 239/240	UJ (MDA>RDL) 0.11 pCi/g	<<75 pCi/g. No impact
W710346	230017	PU238	R-B (0.0597 pCi/g)	<<75 pCi/g. No impact
W711990	520041	PU-238	R-B (<<75 pCi/g)	No impact
W711990	520051	PU-238	J-B (<<75 pCi/g)	No impact
W711990	520041	PU-239/240	J-RPD(11.5)	Less precise
W711990	515031	PU239/240	J-yield (9.1%)	Less precise
W711201	560053	PU-238	J-RPD (<<75 pCi/g)	No impact
W711429	385073	PU-238	J-RPD (15)	<<75p Ci/g. No impact
W705329	220011 (Replicate)	U234	J-B (0.211 pCi/g)	No impact
W712280	490031	PU 239/240	J-RPD(4.71)	Less precise
W711200	555041	PU 239/240	R-B (0.0229 pCi/g)	<<75 pCi/g. No impact
W710231	160017	PU 239/240	J-RPD (5.13)	<<75 pCi/g. No impact
W711282	370081	PU238	R-B (0.516 pCi/g)	<<75 pCi/g. No impact
W712042	400081	PU 239/240	UJ-(MDA>RDL) 0.213 pCi/g	<<75 pCi/g. No impact
W712042	400081REP	PU239/240	UJ-(MDA>RDL) 0.217 pCi/g	<<75 pCi/g. No impact
W711200	515041	Tritium	J/UJ-MS	
W704147	95011	Tritium	R (LCS Diff Std. Dev - 3.2)	Less precise
W610405	950061	PU-238	J (yield-7.4%)	Less precise
W610405	950061	PU 239/240	UJ (Yield-7.4%)	Less precise

4 Summary

The data collected for the verification sampling event was found to be usable with only a few exceptions as noted in Section 3.0 of this report. Based on the data review and data validation performed for these samples, only two systematic deficiencies were identified:

1. All of the fluoride results were assessed estimated (J,UJ) due to poor matrix recoveries and performance evaluation samples that were outside the acceptance limits. The assessment did not conclude the data were unusable.
2. The antimony results were assessed to be biased low and used as estimated (J,UJ) based on the matrix spike recoveries. It was noted in Section 2 of the report that there is a history of the antimony matrix spike recoveries being biased low for Mound samples. The low bias appears to be attributable to matrix interferences based on the historic evidence.
3. There is also an indication in the data validation reports that the holding times for some anions and mercury were exceeded for samples not validated. The impact of the missed anion holding time is assumed to be minimal. Without a better understanding of the number of days past holding for the unvalidated mercury samples, it is not possible to evaluate the project impact.

In addition to the systematic deficiencies, the laboratory did not perform a few of the requested sample analyses. In these instances, the data was lost and no corrective action was possible. These instances are documented in the corrective action reports and in Section 2 of the report. The affected analyses and samples were:

1. The laboratory did not report tritium for sample 335041.

The impact on the percent completeness is shown in Table 2.6 in Section 2.0. Because of the large number of samples analyzed, the impact of this missing data was negligible and should not impact site closure.

Finally, while a few of the samples were qualified rejected during data validation, the samples were determined to be usable during data assessment. During data assessment the validation qualifications were evaluated against the site action limits. Based on the evaluation, it was determined that the potential bias would have an insignificant impact on the sample result relative to the site action limit.

Table 3.15 – Data Qualifications List

Batch	Sample	Analyte	Qualification	Impact
Semi-volatile Organic Analyses				
9610L831	800031	bis (2-Ethylhexyl)phthalate	J-CC (%D-27.5)	Inaccuracy
9710L852	130018	Hexachlorocyclopentadiene	UJ-C (%D=49.8%)	Inaccuracy
9710L852	130018	2,4-dinitrophenol	UJ-C (%D=50.5%)	Inaccuracy
9710L852	130018	4-nitrophenol	UJ-C (%D=25.2%)	Inaccuracy
9710L852	130018	benzoic acid	UJ-C (%D=39%)	Inaccuracy
9706L204	270021	Carbazole	UJ-RSD (30%)	Inaccuracy
9704L237	145011	Carbazole	UJ-CC (%D=31.9%)	Inaccuracy
9704L237	145011	Carbazole	U-B (17ug/kg)	Raised reporting limit
9712L907	345031	2,4-dimethylphenol	UJ (%D=25%)	Inaccuracy
9712L907	345031	2,4-dinitrophenol	UJ (%D=35%)	Inaccuracy
9712L907	345031	4,6-dinitro-2-methylphenol	UJ (%D=28.1%)	Inaccuracy
9710L977	310017	2,4-dinitrophenol	UJ (%D=33%)	Inaccuracy
9710L977	310017	Carbazole	J (%D=146%)	Inaccuracy
9704L004	95011	Hexachlorocyclopentadiene	UJ (%D=28.3%)	Inaccuracy
9704L914	55011	N-Nitroso-di-n-propylamine	UJ (%D=26.3%)	Inaccuracy
9705L571	290041	benzoic acid	U-B (53ug/kg)	Raised reporting limit
9705L571	290041	di-n-butylphthalate	U-B(1100 ug/kg)	Raised reporting limit
9705L571	290041	bis(2-ethylhexyl)phthalate	U-B (18 ug/kg)	Raised reporting limit
9711L253	515041	Hexachorocyclopentadiene	UJ-(%D=28.3%)	Inaccuracy
9711L253	515041	bis (2-Ethylhexyl)phthalate	U-B (22ug/kg)	Raised reporting limit
9705L666	220011	benzoic acid	U-B (26 ug/kg)	Raised reporting limit
Inorganic Analyses				
9712L907	345031	Antimony	UJ - MS (34%)	Negative bias
9712L907	345031	Manganese	J - MS (146%)	Positive bias
9712L907	345031	Mercury	J - HT (1 day)	No ,significant impact
9712L907	345031	Mercury	J - MS (74%)	Negative bias
9796L294	270021	Aluminum	J - CCV (116%)	Slight positive bias
9796L294	270021	Antimony	J - MS(39.2%)	Negative bias
9796L294	270021	Beryllium	J - CCV (120%)	Slight positive bias
9796L294	270021	Chromium	J - CCV (115%)	Slight positive bias
9796L294	270021	Cobalt	J - CCV (111%)	Slight positive bias
9796L294	270021	Copper	J - SD (12%)	Slight inaccuracy
9796L294	270021	Nickel	J - CCV (113%)	Slight positive bias
9796L294	270021	Potassium	J - SD (-13%)	Slight inaccuracy
9796L294	270021	Selenium	J - CCV (118%)	Slight positive bias
9796L294	270021	Zinc	J - CCV (115%)	Slight positive bias
9712L769	475031	Antimony	UJ - MS (57%)	Negative bias
9712L769	475031	Mercury	J - HT (2 days)	No significant

Table 3.15 – Data Qualifications List

Batch	Sample	Analyte	Qualification	Impact
				impact
9705L666	220011	Antimony	J - MS (51%)	Negative bias
9705L666	220011	Arsenic	J - D (82.7)	Inaccuracy
9705L666	220011	Mercury	J - D (71.2)	Inaccuracy
9705L666	220011	Mercury	J - MS (72%)	Slight negative bias
9705L666	220011	Potassium	J - SD (17%)	Inaccuracy
9705L666	220011	Sodium	J - SD (17%)	Inaccuracy
9707L571	290041	Antimony	UJ-MS (37%)	Negative bias
9710L852	130018	Antimony	UJ-MS (62%)	Negative bias
9710L852	130018	Manganese	UJ-MS (-6%)	Negative bias
9710L852	130018	Mercury	UJ-MS (47%)	Negative bias
9610L831	800031	Antimony	UJ-S (MSR-70)	Slight negative bias
9610L831	800031	Beryllium	U-B (CCB-0.73 mg/kg)	Raised reporting limit
9610L831	800031	Calcium	J-I (SD-104%) J- D (RPD-22.1)	Inaccuracy Inaccuracy
9610L831	800031	Magnesium	J-D (RPD-28.6)	Inaccuracy
9610L831	800031	Manganese	J-S (MSR-64)	Negative bias
9610L831	800031	Nickel	J-D (RPD-110)	Inaccuracy
9610L831	800031	Potassium	J-I (SD-15.4%)	Inaccuracy
9703L761	315141	Calcium	J-RPD (44.1%)	Inaccuracy
9703L761	315141	Antimony	J-MSR (70.7)	Slight negative bias
Anion Analyses				
9707L571	290041	Fluoride	J-H (2 days)	Slight low bias possible
9711L253	515041	Chloride	J-H (1 day)	Slight low bias possible
9703L739	050011	Chloride	J-H (16 days)	Low bias possible
9703L739	050011	Fluoride	J-H (12 days)	Low bias possible
9703L739	050011	Nitrate/Nitrite	J-H (16 days)	Low bias possible
9703L739	050011	Sulfate	J-H (13 days)	Low bias possible
9706L204	270021	Fluoride	J-H (3 days)	Slight low bias possible
9706L204	270021	Sulfate	J-H (2 days)	Slight low bias possible
9704L237	145011	Sulfate	J-S (MS-129.4)	Slight high bias possible
9710L977	310018	Sulfate	J-H (8 days)	Slight low bias possible
9712L907	345031	Fluoride	J-S (MS-14.1%) J-S (MSD-12.2%)	Low bias probable Low bias probable
9712L907	345031	Sulfate	J-H (2 days)	Slight low bias possible
9712L769	475031	Fluoride	UJ-H (1 day) UJ-S (MS-20.3%) UJ-S (MS=31.4%)	Slight low bias possible Low bias probable Low bias probable

Table 3.15 – Data Qualifications List

Batch	Sample	Analyte	Qualification	Impact
9610L831	800031	Fluoride	J-S (MS=59.8) J-S (MS=63.3)	Low bias probable Low bias probable
9803L761	315141	Nitrate	J-H (3 days)	Slight low bias possible
9803L761	315141	Sulfate	J-H (13 days)	Slight low bias possible
9803L761	315141	Sulfate	J- MS (139%) #440041 J-MSR (22%)	Inaccuracy
		Radiological Analyses		
W711428	395062	PU 239/240	UJ (MDA>RDL) 0.205 pCi/g	<<75 pCi/g. No impact
W711428	400031	PU 239/240	UJ (MDA>RDL) 0.11 pCi/g	<<75 pCi/g. No impact
W710346	230017	PU238	R-B (0.0597 pCi/g)	<<75 pCi/g. No impact
W711990	520041	PU-238	R-B (<<75p Ci/g)	No impact
W711990	520051	PU-238	J-B (<<75 pCi/g)	No impact
W711990	520041	PU-239/240	J-RPD(11.5)	Less precise
W711990	515031	PU239/240	J-yield (9.1%)	Less precise
W711201	560053	PU-238	J-RPD (<<75 pCi/g)	No impact
W711429	385073	PU-238	J-RPD (15)	<<75 pCi/g. No impact
W705329	220011 (Replicate)	U234	J-B (0.211 pCi/g)	No impact
W712280	490031	PU 239/240	J-RPD(4.71)	Less precise
W711200	555041	PU 239/240	R-B (0.0229 pCi/g)	<<75 pCi/g. No impact
W710231	160017	PU 239/240	J-RPD (5.13)	<<75 pCi/g. No impact
W711282	370081	PU238	R-B (0.516 pCi/g)	<<75 pCi/g. No impact
W712042	400081	PU 239/240	UJ-(MDA>RDL) 0.213 pCi/g	<<75 pCi/g. No impact
W712042	400081REP	PU239/240	UJ-(MDA>RDL) 0.217 pCi/g	<<75 pCi/g. No impact
W711200	515041	Tritium	J/UJ-MS	
W704147	95011	Tritium	R (LCS Diff Std. Dev - 3.2)	Less precise
W610405	950061	PU-238	J (yield-7.4%)	Less precise
W610405	950061	PU 239/240	UJ (Yield-7.4%)	Less precise

APPENDIX D

Miami-Erie Canal Verification Report

Summarizes results of verification samples and documents that removal action has been successful.

Miami-Erie Canal Verification Report

Mound Plant

Miamisburg, Ohio

Department of Energy

B&W of Ohio

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Appendix A: Miami-Erie Canal Verification Sampling Data Assessment Report

Plates I - IV: Maps Locating Pu-238 Verification Results

1.0. Introduction

This verification sampling report (VSR) has been prepared for the Miami-Erie Canal site adjacent to the US Department of Energy Mound Plant in Miamisburg, Ohio. This VSR summarizes results of verification samples taken after remediation of the Miami-Erie Canal and is intended to provide substantive evidence that the removal action has been successful.

1.1. Scope

This report describes the results of verification sampling and analysis in the Miami-Erie Canal. The samples were analyzed by radiochemical analysis for isotopes of concern; the principal contaminant of concern was plutonium-238. It also describes the results of chemical analyses for hazardous constituents.

1.2. Site Background and Setting

1.2.1. History

The Miami-Erie Canal was constructed during the 1800's as a north-south transportation route, and abandoned in 1915. The segment of the canal adjacent to Mound, with the exception of the Miamisburg city park, appears to have gone unmaintained since its abandonment. All of the South Canal and a portion of the North Canal are mapped within a floodplain.

Due to the elevated plant site, the Drainage Ditch from the Mound Plant to the canal is utilized for surface water runoff. This Drainage Ditch is the separation point between the North and South Canal. Originally the runoff flowed both north and south along the canal. In 1976, a flapper valve was installed, eliminating discharges to the North Canal, but allowing flow into the South Canal, which flows into the Overflow Creek, that

empties into the Great Miami River. The Great Miami River is approximately 2000 feet from the plant's west fence-line.

Historical operations and accidental releases from the Mound Plant have resulted in the discharge of contamination into the Miami-Erie Canal. The extent of this contamination consists primarily of plutonium and tritium. Although the potential for releases of non-radiological chemicals into the Drainage Ditch may have existed at one time, results of past characterization investigations do not indicate significant non-radiological contamination in the canal.

In July 1995 after considerable study, the DOE issued a Removal Action Memorandum proposing excavation of the Miami-Erie Canal to remove contaminated soils and sediments. The planning phase of the project was completed in 1996 as documented in the Removal Action Design Document (DOE 1996a). The project was executed over a period of about 18 months resulting in the removal of over 40,000 cubic yards of material.

1.2.2 Setting

The Miami-Erie canal includes five parts:

1) the North section of abandoned Miami-Erie Canal west of the Mound Plant;
2) the Runoff Hollow between the Conrail Railroad right-of-way to the east and the Dayton-Cincinnati Road to the west;
3) the abandoned South section of the canal;
4) the Overflow Creek, which connects the canal to the Great Miami River;
5) the Drainage Ditch from the plant boundary to the canal;

The first four are also known as Potential Release Sites (PRS) 3, 4, 5, and 6 (refer to Figure 1 for a map depiction).

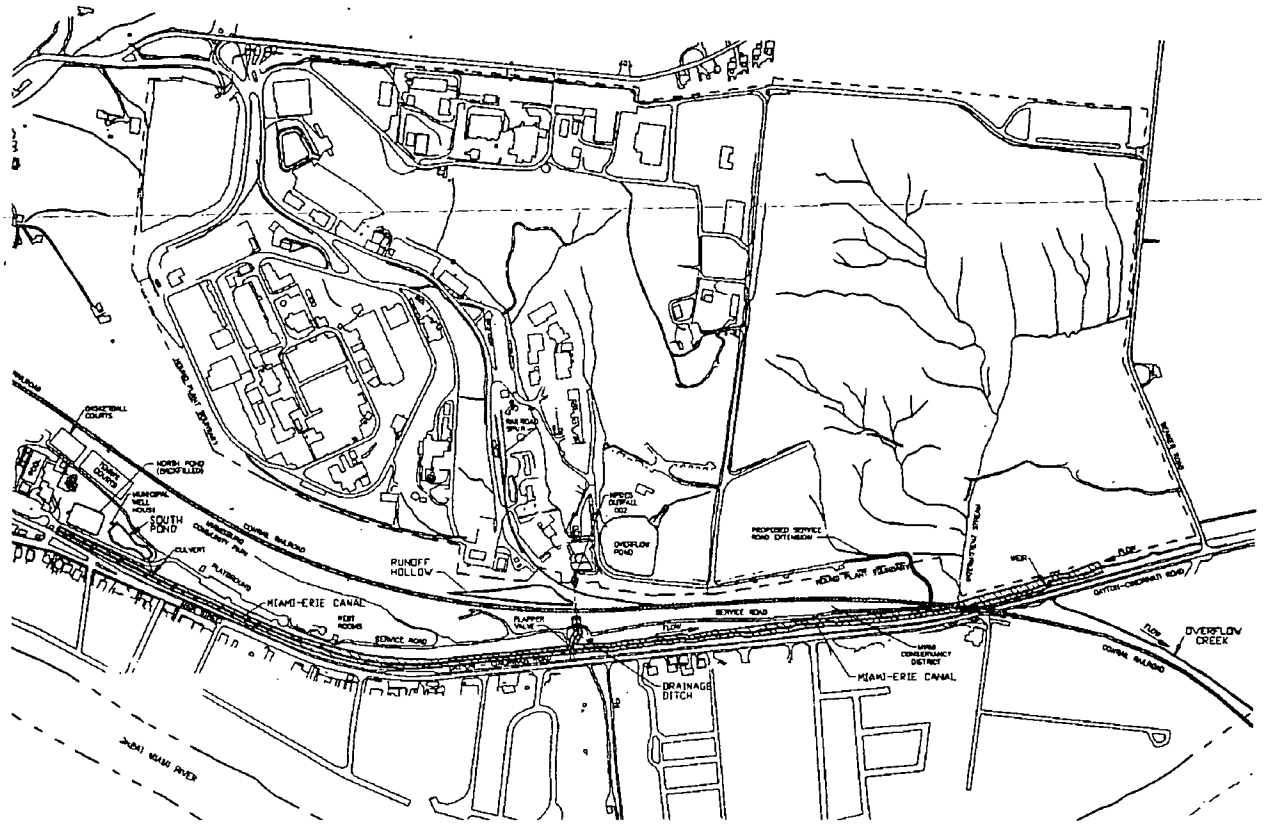

Figure 1: Miami-Erie Canal Areas of Potential Contamination

Site land use is a combination of a city park, conservancy district, and the railroad right-of- way. The City of Miamisburg is immediately north and west of the site and includes the northern portion of the canal. The 1990 census of Miamisburg reported 17,834 residents.

The park, located immediately northeast of the canal is used year-round and includes tennis and basketball courts. Houses, a mobile home park, and light commercial businesses are located near the Overflow Creek and the west side of the northern portion of the canal site. Further details are available in the RSE (DOE 1993) and EE/CA (DOE 1995).

2.0. Verification Sampling Methodology

2.1. Methodology

After excavation, verification samples were collected from the remaining surface contour to confirm that the cleanup goal has been achieved. The verification samples were obtained from a depth of 0-6" and conformed to CERCLA remedial investigation quality specifications for collection, handling, analyses, and evaluation (DOE 1996a). The entire Miami-Erie remedial site was included in the post-removal sampling (i.e., canal, runoff hollow, south pond, overflow creek, and plant drainage ditch).

For removal action design and implementation purposes, the canal area was divided into segments 50-feet long as measured along the centerline of the canal (DOE 1996a). The successive cross-sectional boundaries of these segments are perpendicular to the centerline and, therefore, are not generally parallel. The design for the removal action and the sampling program was based on this 50-foot incremental segmented structure. The sample area for the canal follows the segments of the canal for a total distance of approximately 6,000 feet and extends laterally a variable distance depending on the width of the canal bed, typically 20 to 40 feet in either direction from the canal centerline. Note that the sample area is not the same as the excavation area because the sample area was extended to include the banks of the canal; the excavation area is, in general a subset of the sample area.

To satisfy the objectives of the verification sampling program and to be able to make statistical inferences about the cleanup areas, the following random sampling design was used (DOE 1996a) where any point on the surface within the boundary of the sample area was a candidate location for sampling and each point has an equal chance of being selected. From a random starting point located in each canal segment, a 10-ft. by 10-ft. grid was be laid out for the segment in the fashion outlined below.

Using the survey markers previously established to delineate the corners of each segment, a 10-ft. by 10-ft. rectangular grid was superimposed on the 50-foot segments in the canal as follows:

1. Two random numbers were generated using a standard uniform random number generation computer program, with values x and y between 0 and 10.

2. Distance was measured x feet along the centerline from the beginning of the segment, and then y feet perpendicular to the centerline to locate the random origin of the sampling grid.

3. The remaining nodes were then located by proceeding in 10 foot increments in the x and y directions until the entire 50-foot segment is covered. Each of the nodes that are located within the 50-foot segment could be used for verification sampling.

4. This process is carried out for each 50-ft. segment of the canal.

Sample locations were determined for each 50-foot segment independently. A typical example is shown in Figure 2. Similar rectangular grids were established for each segment and potential sample locations corresponded to the grid nodes (grid line intersections).

For each of these randomly placed grids, every grid node was assigned an integer coordinate. (The coordinate values are equivalent to the number of 10-foot intervals in the sample area). Starting with the grid origin (0) located at the northwest corner of the grid, the sample area nodes can be represented as locations along the canal centerline

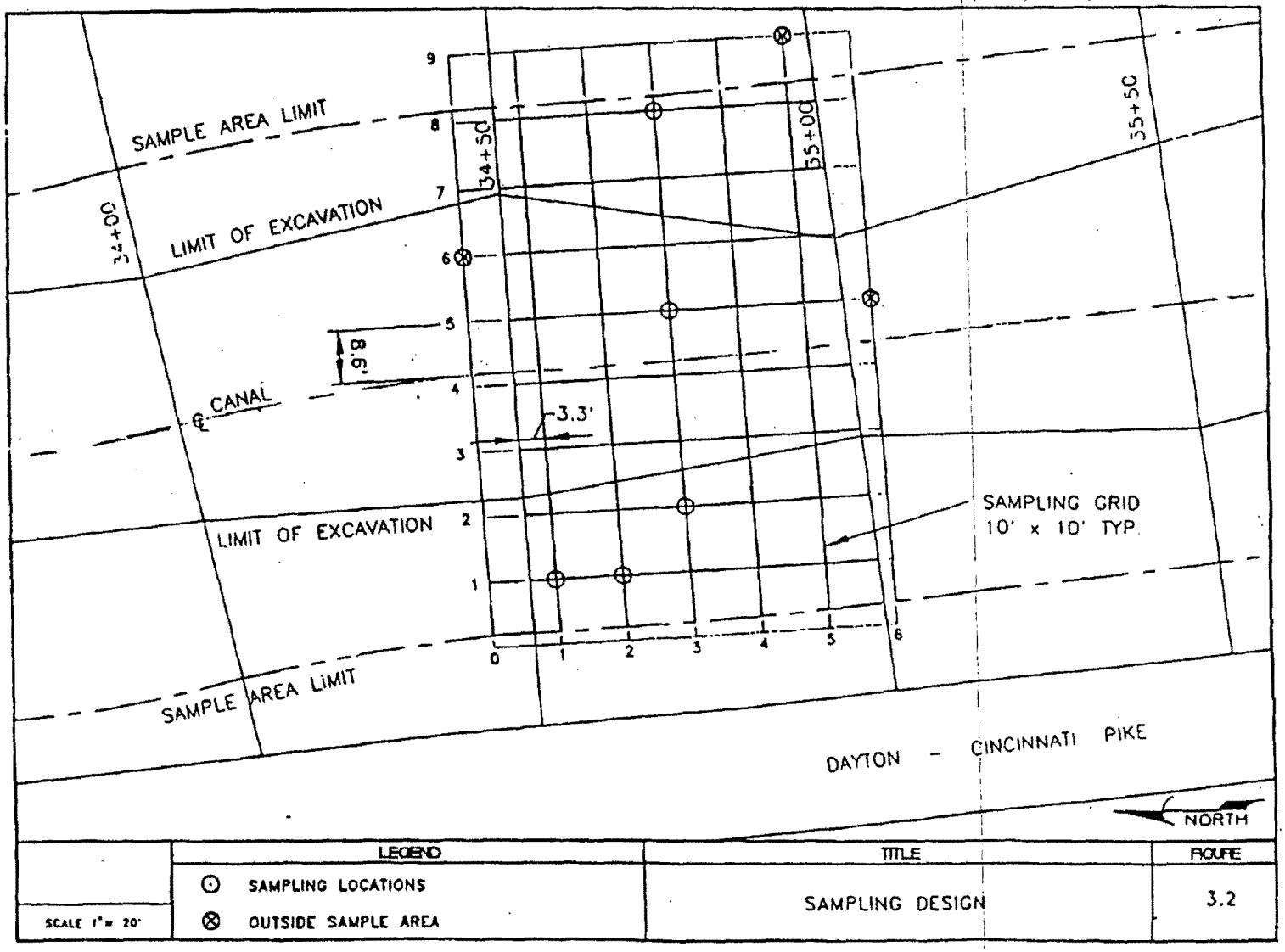

Figure 2. Example Canal Verification Sampling Locations.

("axis") and across the width of the canal ("width"). For a typical canal segment example, "axis" ranges from zero to six, and the "width" from zero to nine. For each grid a random subset of 5 nodes was selected by generating random x,y pairs and selecting the first 5 coordinates that fall within the excavation segment area as illustrated by the example in Table 1. Using this technique, five locations (grid nodes) were randomly selected for the collection of verification samples within each 50-foot segment of the canal. All of these samples were then analyzed for Pu-238 by alpha spectrometry (DOE 1996b), but only the first sample selected from each segment was analyzed for all canal analytes as described in the next section.

Table 1. Canal Segment Random Grid Coordinates (Example)

Axis	Width
3	2 *
1	1 *
3	8 *
2	1 *
5	9
6	5
0	6
3	5 *
2	4
4	3

Notes

* denotes selected coordinates that fall within excavation segment area (Figure 2).

In addition to the 50-foot canal segments that follow the centerline of the canal, the sample area includes four associated areas subject to verification sampling because of the potential for contamination as identified in the Action Memorandum. These are the Runoff Hollow, the South Pond (PRS 2), the Overflow Creek, and the portion of the Plant Drainage Ditch between the plant boundary and the canal. A random sampling strategy similar to the one described above was used for these other areas (DOE 1996a).

2.2. Analytical Rationale

As previously discussed, earlier studies conducted at the site have found only small quantities of radioactive materials other than plutonium and no significant concentration of chemical contaminants. Using these historical sampling results, process knowledge, and factors such as fate and transport mechanisms, the compounds of concern listed in the OU9 Site-Wide QAPP (DOE 1993) were "screened" to develop an appropriate analyte list for the canal verification sampling (DOE 1996a). The associated quantitation limits, preliminary remediation goals (PRGs), and ARARs/To Be Considered (TBCs) for each of the target analytes are reproduced in Table 2. In general, TBCs are not formally promulgated standards but are to be considered when establishing cleanup targets, and are developed using best professional judgement based on the latest available information. Some of these constituents have been previously detected in the canal. Others may be present because of their common use throughout the Mound Plant. Some may also be present because they could have been used at some point in the plutonium processing operations and may have been discharged to the canal area during the WTS line rupture.

Table 2a. List of Quantitation Limits, PRGs, and ARARs/TBCs for the Miami-Erie Canal - Inorganics

INORGANIC ANALYTE	QUANTITATION LIMIT (mg/kg)	PRG[a] (mg/kg)	ARARs/TBCs[b] (mg/kg)
Aluminum	4	Na	Na
Antimony	2	1.1E+02	3E+01
Arsenic	2	3.7E+01	8E+01
Barium	40	1.9E+04	4E+03
Beryllium	0.2	6.0E+00	2E-01
Cadmium	1	1.4E+02	4E+01
Calcium	1,000	Na	Na
Chromium	2	1.4E+03	4E+02
Cobalt	10	Na	Na
Copper	5	Na	2.96E+03
Iron	20	Na	Na
Lead	0.6	Na	400
Magnesium	1,000	Na	Na
Manganese	3	2.7E+04	8E+03
Mercury	0.04	8.1E+01	2E+01
Nickel	8	5.4E+03	2E+03
Potassium	1,000	Na	Na
Selenium	1	1.4E+03	Na
Silver	2	1.4E+03	2E+02
Sodium	1,000	Na	Na
Thallium	2	Na	Na
Vanadium	2	1.9E+03	5.6E+02
Zinc	4	5.4E+04	1.6E+04
Cyanide	2	5.4E+03	2E+03

NOTES: Na = data not available.

[a] Developed using Risk Assessment guidance for Superfund (RAGS), Volume 1, Part B.

[b] EPA published a proposed rule establishing procedures and technical requirements for implementing corrective action for solid waste management units on July 27, 1990 (55 FR 30798) (FR 1990b). These standards were identified from Appendix A: Examples of Concentrations Meeting Criteria For Action Levels.

Table 2b. List of Quantitation Limits, PRGs, and ARARs/TBCs for the Miami-Erie Canal - SVOCs

TCL SVOC Parameters	Quantitation Limit (ug/kg)	PRG (mg/kg)	ARARs/TBCs (mg/kg)
Phenol	330	1.6E+05	5E+04
Bis(2-chloroethyl) ether	330	Na	Na
2-Chlorophenol	330	Na	Na
1,3-Dichlorobenzene	330	Na	Na
1,4-Dichlorobenzene	330	Na	Na
1,2-Dichlorobenzene	330	Na	Na
2-Methylphenol	330	Na	Na
2,2'-oxybis(1-chloropropane)	330	Na	Na
4-Methylphenol	330	Na	Na
N-nitroso-di-n-propylamine	330	Na	Na
Hexachloroethane	330	Na	Na
Nitrobenzene	330	Na	Na
Isophorone	330	Na	Na
2-Nitrophenol	330	Na	Na
2,4-Dimethylphenol	330	Na	Na
Bis(2-Chloroethoxy) methane	330	Na	Na
2,4-Dichlorophenol	330	Na	Na
1,2,4-Trichlorobenzene	330	Na	Na
Naphthalene	330	Na	Na
4-Chloroaniline	330	Na	Na
Hexachlorobutadiene	330	Na	Na
4-Cholor-3-methylphenol	330	Na	Na
2-Methylnaphthalene	330	Na	Na
Hexachlorocyclopentadiene	330	Na	Na
2,4,6-Trichlorophenol	330	Na	Na
2,4,5-Trichlorophenol	800	Na	Na
2-Chloronaphthalene	330	Na	Na
2-Nitroaniline	800	Na	Na
Dimethylphthalate	330	Na	Na
Acenaphthalene	330	Na	Na
2,6-Dinitrotoluene	330	Na	Na
3-Nitroaniline	800	Na	Na
Acenaphthene	330	Na	Na
2,4-Dinitrophenol	800	Na	Na
4-Nitrophenol	800	Na	Na
Dibenzofuran	330	Na	Na

2,4-Dinitrotoluene	330	Na	Na
Diethylphthalate	330	Na	Na
4-Chlorophenyl-phenylether	330	Na	Na
Fluorene	330	Na	Na
4-Nitroaniline	800	Na	Na
4,6-Dinitro-2-methylphenol	800	Na	Na
N-nitrosodiphenylamine	330	Na	Na
4-Bromophenyl-phenylether	330	Na	Na
Hexachlorobenzene	330	Na	Na
Pentachlorophenol	800	8.1E+03	2.1E+02
Phenanthrene	330	Na	Na
Anthracene	330	8.1E+04	Na
Carbazole	330	Na	Na
Di-n-butylphthalate	330	Na	Na
Fluoranthene	330	1.1E+04	Na
Pyrene	330	Na	Na
Butylbenzylphthalate	330	Na	2E+04
3,3'-Dichlorobenzidene	330	Na	Na
Benzo(a)anthracene	330	3.5E+01	Na
Chrysene	330	Na	Na
bis(2-Ethylhexyl)phthalate	330	1.8E+03	5E+01
Di-n-octylphthalate	330	Na	Na
Benzo(b)fluoranthene	330	3.5E+01	Na
Benzo(k)fluoranthene	330	3.5E+02	Na
Benzo(a)pyrene	330	3.5E+00	Na
Ideno(1,2,3-cd)pyrene	330	3.5E+01	Na
Dibenz(a,h)anthracene	330	3.5E+00	Na
Benzo(g,h,i)perylene	330	Na	Na

Notes: Na = data not available.

Table 2c. List of Quantitation Limits, PRGs, and ARARs/TBCs for the Miami-Erie Canal - Radionuclides

Radionuclide	Quantitation Limit (pCi/g)	PRG (pCi/g)	ARARs/TBCs (pCi/g)
Plutonium-238	1	75	Na
Plutonium-239	1	1.0E+02	Na
Plutonium-240	1	1.0E+02	Na
Thorium-228	1	1.7E+00	5[a]/15[b]
Thorium-230	1	8.2E+02	5[a]/15[b]
Thorium-232	1	9.5E+02	5[a]/15[b]
Tritium	50	4.5E+05	Na
Uranium-234	0.6	7.1E+02	Na
Uranium-235	0.6	6.6E+00	Na
Uranium-238	0.6	3.1E+01	Na

Notes: PRGs from Mound *Risk-Based Guidance Values Report,* May 1995.
Na = data not available.
[a] = 5pCi/g averaged over the first 15 cm of soil below the surface (40 CFR 192.12).
[b] = 15pCi/g averaged over 15cm thick layers of soil more than 15cm below the surface (40 CFR 192.12).
These ARARs identified for thorium are discussed by the February 12, 1998 USEPA Directive 9200.4-25. That directive postdates the CERCLA documents specific to the Canal Removal Action, which were submitted to USEPA for review and approval. No EPA comments were received on the use of the 40CFR192.12 ARAR at that time and they became an agreed ARAR under the terms of the Federal Facility Agreement between USDOE and USEPA.

2.3. Data Validation and Data Quality Assessment

Six hundred and seventy-nine verification samples were collected and analyzed for Pu-238. All of these results were subjected to data validation as well as data assessment and the results of these reviews are reported in the Miami-Erie Canal Data Assessment Report (Appendix A). All Pu-238 results were found to be useable. While a few of the samples were qualified as "rejected" during data validation, the samples were determined to be usable during data assessment when the validation qualifications were evaluated against the site action limits. Based on the evaluation, it was determined that the potential bias would have an insignificant impact on the sample result relative to the site action limit of 75 pCi/g.

One hundred and twenty-five of the above samples were also analyzed for the other potential contaminants on the Miami-Erie target analyte list. Ten percent of these results were validated as discussed in the assessment report. All results were found to be usable as qualified with the exception of one lost tritium result for sample 335041. Based on the data assessment, it was determined that none of the qualifications noted would have a significant impact on the sample results relative to the site action limits.

3.0. Results

The objective of this report is to provide substantive evidence that the Miami-Erie Canal removal action has been successful. A number of standard statistical measures have been reported in addition to the stated cleanup goal, the upper 95% UCL of the mean. The goal of 75 pCi/g was exceeded because the upper 95% of the mean was 24.0 pCi/g.

3.1 Data Tabulation

Summary tables of analytical results for all 679 samples are included in the CD-ROM which is attached to this report. The file format is Microsoft Excel version 4. These tables include the unique sample numbers, location coordinates, parameter names, CAS numbers, analytical results, minimum detectable amounts, and any data qualifiers resulting from the analysis, validation and assessment.

3.2. Plutonium-238 Results

3.2.1. Data Review

All 679 Pu-238 results are posted to maps attached to this report in Plates I -IV. Values above and below the action limit appear in red and green respectively. The verification sample coverage as well as the spatial distribution of samples exceeding 75 pCi/g is clearly depicted. The 35 results above the cleanup standard appear to be distributed across the entire length of the canal. No exceedances were observed for the runoff hollow, south pond, or overflow creek. Eight Pu-238 results were from low lying locations outside the planned canal sampling areas. These areas were identified by stakeholders as areas of concern because of historic canal flooding and are referred to as the stakeholder areas. None of these stakeholder results exceeded the cleanup criteria.

A histogram or frequency plot of the Pu-238 results appears in Figure 3. The data do not appear to be symmetric or normally distributed, but are highly skewed to the right. This behavior is typical of environmental data, which often requires transformation by applying the log function to each data point to approximate normality. The histogram of the log transformed Pu data, in Figure 4, indeed demonstrates much more symmetric behavior.

Probability plots are another useful tool for studying the distribution of a variable. Plots of the values of a variable against the corresponding percentage points of a theoretical

distribution, or plots of the expected values of one variable against those of another can help determine whether the two variables are samples from the same distribution. If the variable is a sample from the selected distribution, or if the two variables are samples from the same distribution, the plotted points cluster in a straight line. The lognormal probability plot of the Pu data, shown in Figure 5, demonstrates an approximate fit to the lognormal model.

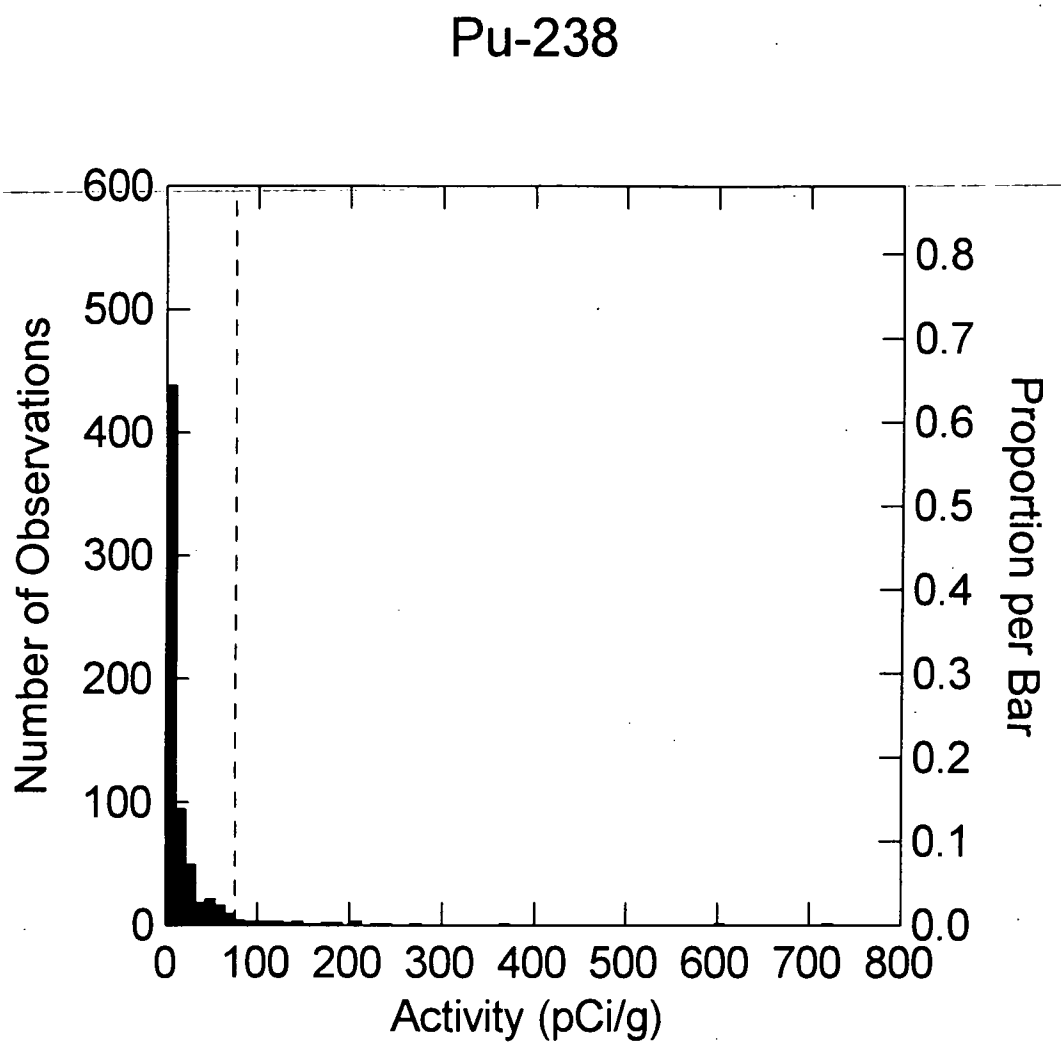

Figure 3. Histogram of Pu-238 Results

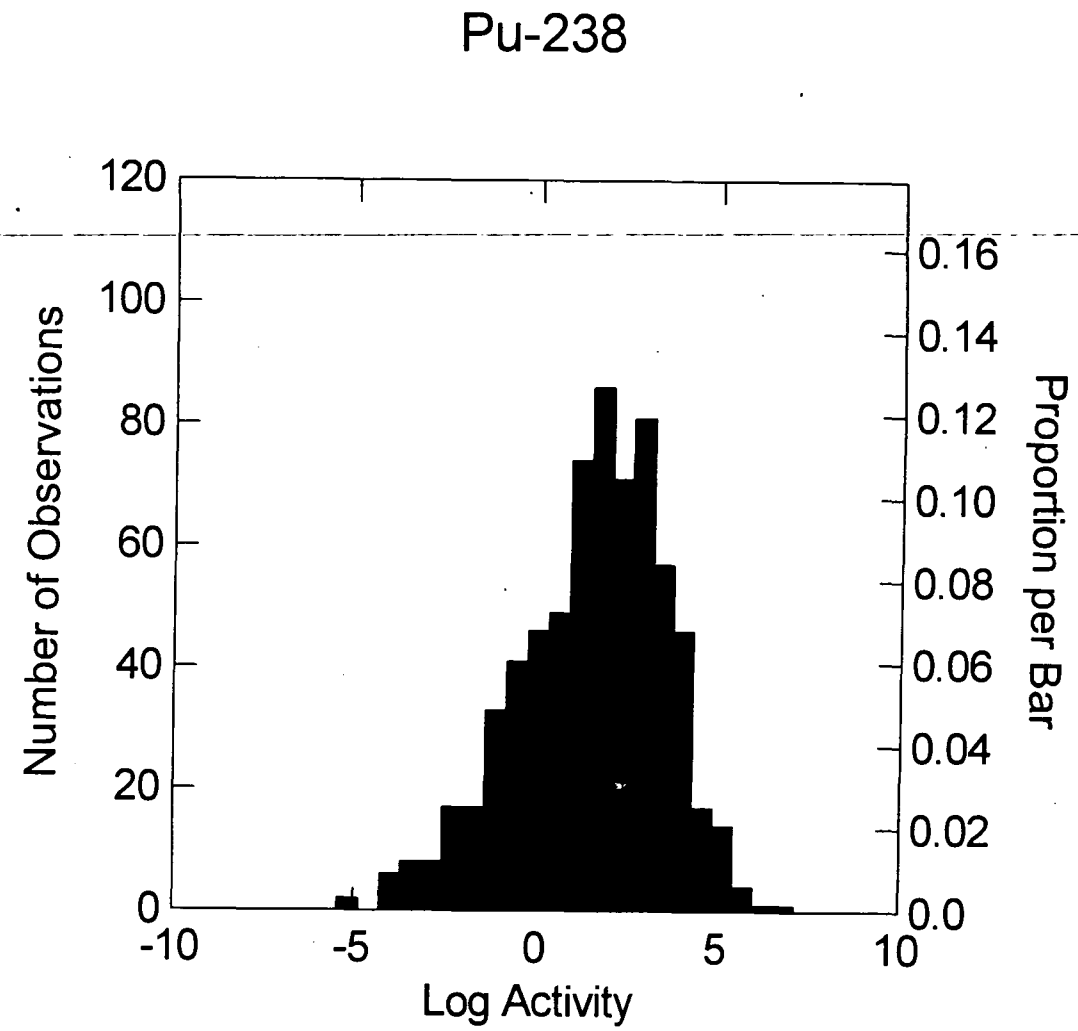

Figure 4. Histogram of Log Transformed Pu-238 Activity

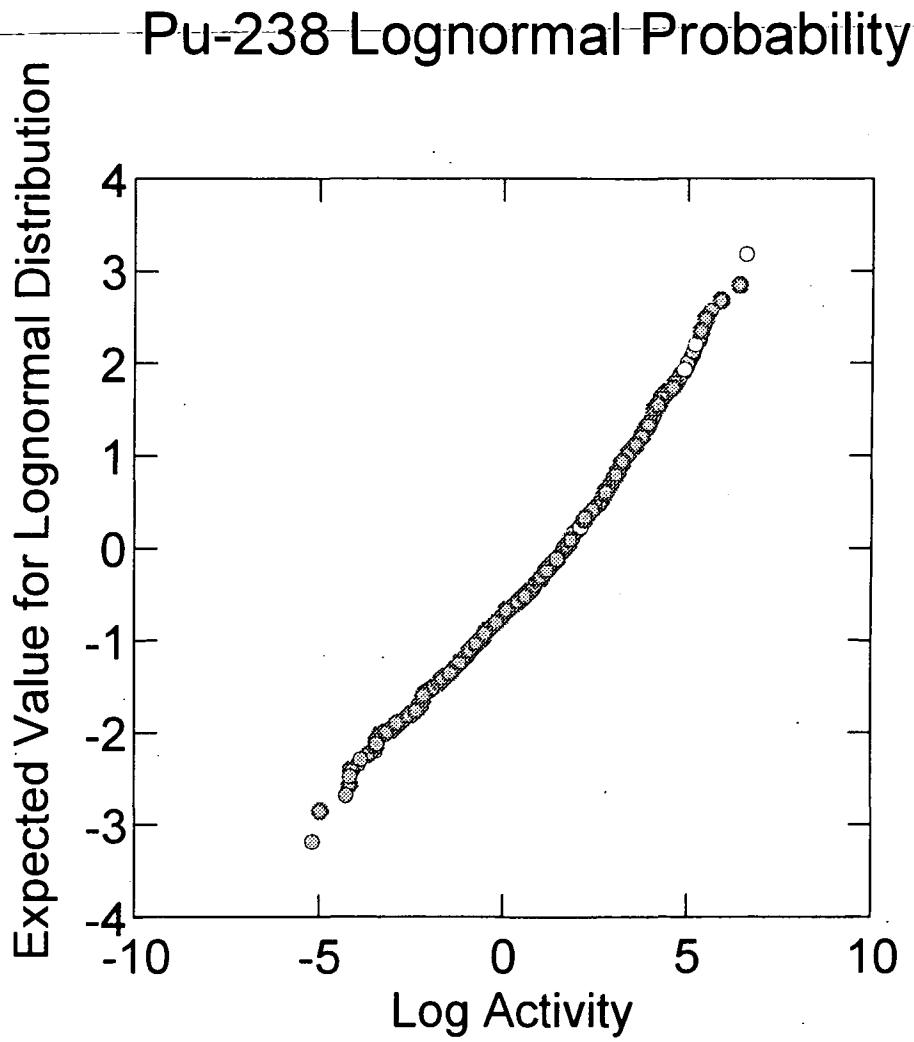

Figure 5. Pu-238 Lognormal Probability Plot

Descriptive statistics for the observed distribution of Pu-238 results appear below in Table 3. The median, geometric mean and arithmetic mean are all below the ALARA goal of 25 pCi/g. Of the 679 sample results, only 35 are above the 75 pCi/g PRG.

Table 3. Summary Statistics for Pu-238

Number of samples	679
Minimum value	0.006
Maximum value	715
Median	5.56
Arithmetic Mean	20.2
Upper 95% UCL of the Arithmetic Mean	24.0
Standard Deviation	50.5
Geometric Mean	4.37
Geometric Std Deviation	7.48
N of samples above 75 pCi/g*	35
N of samples above 150 pCi/g*	15
Skewness	7.7

* These locations were re-excavated based on the sampling results until Pu-238 concentrations were below 75 pCi/g. However, for statistical reasons these original sample results are included in the canal verification calculations.

3.2.2. Proportion Test

During a series of stakeholder meetings, interest focused on controlling extreme values and minimizing the percentage of area where residual concentrations might exceed the cleanup standard. Because of this interest, another statistical test was made using USEPA (1989) guidance, the large sample nonparametric test for proportions based on the binomial distribution. The test for proportions is designed to ensure that no more than a small proportion of the site is above the cleanup standard. This statistical approach is valid for any distribution as long as the data are uncorrelated and drawn by random

sampling. It is not necessary to assume that the radiological contamination in the soil is normally (or lognormally) distributed. The test requires only that the cleanup standard be greater than the analytical method detection limit.

3.2.3. Plutonium-238 Data Evaluation

To estimate P_{75}, the proportion of the site population exceeding 75 pCi/g, compute the proportion of samples (p) above the cleanup standard using the following equation:

$$p = \frac{r}{n} = \frac{35}{679} = .0515$$

where:

$$r = \sum y_i$$

n = total number of samples

y_i = 1 if the sample concentration is greater than the cleanup standard

y_i = 0 otherwise

The quantile plot shown in Figure 6 graphically depicts this realization. The broken line in the figure represents the cleanup standard. Examining the fraction of observations which fall above and below this line, shows that only ~5% of the sample measurements exceed 75 pCi/g.

The uncertainty in this estimate of P_{75} is inversely proportional to the square root of the sample size and the standard error (s_p) of the proportion (p) can easily be calculated:

$$s_p = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{.0515(1-.0515)}{679}} = .00848$$

The upper 95% confidence limit can now be obtained using the large sample approximation:

$$P_u = p + z_{1-\alpha} s_p = .0515 + (1.645).00848 = .0655$$

where:

P_u = 95% upper confidence limit

p = proportion of samples with concentrations > cleanup standard

$z_{1-\alpha}$ = critical value for a normal distribution with probability $1-\alpha$

($z_{1-\alpha}$ = 1.645 for α=0.05) for a 5% false positive error rate

s_p = standard error for proportion p

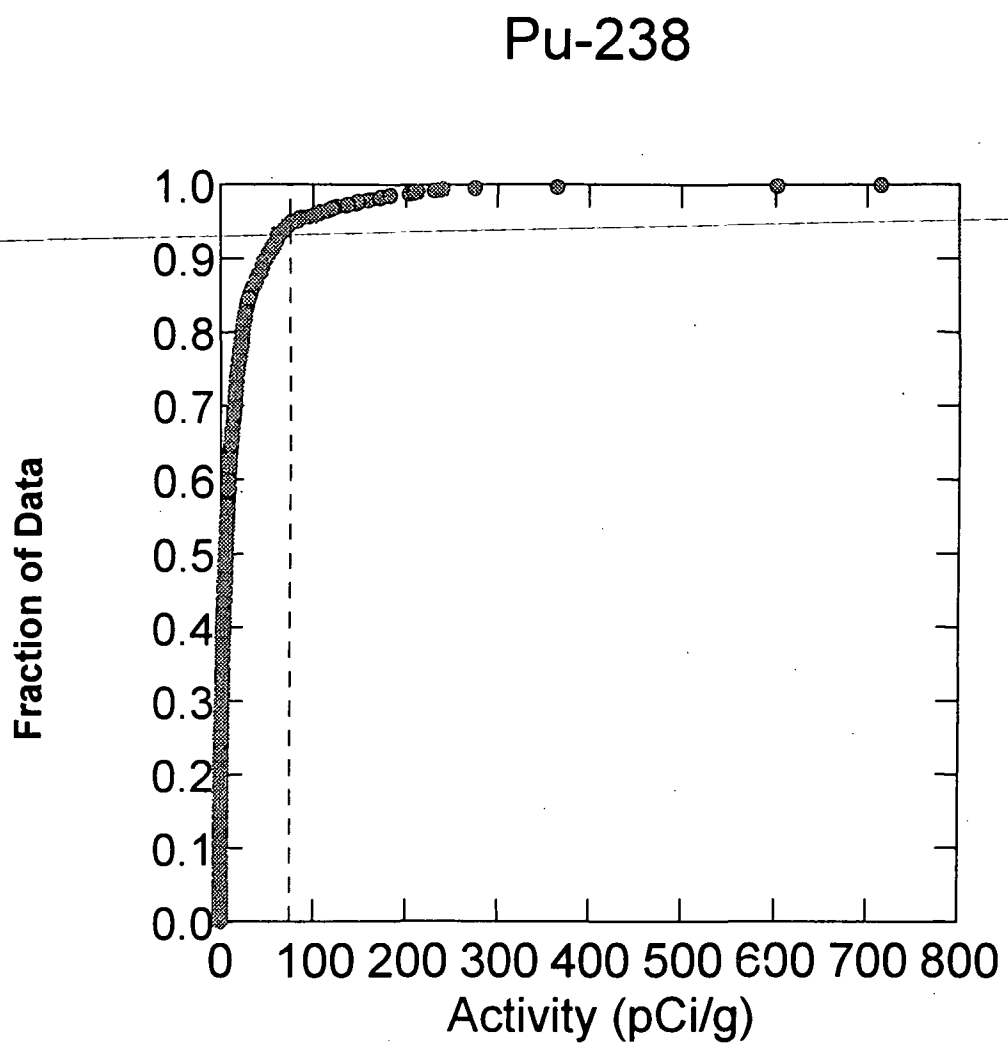

Figure 6. Pu-238 Quantile Plot

3.3. Chemical or Other Radiological Contamination

Previous sampling of the canal site has shown that chemical and radiological contaminants other than plutonium (hereinafter called "chemical") are not present, or are present at very low levels. Therefore, per EPA guidance (EPA 1989) for chemical constituents the null hypothesis is that the site is clean. The alternative hypothesis, that the site is contaminated, has to be proven. This expectation was confirmed by the verification sampling data as described below.

3.3.1. Evaluation Criteria

To determine if areas in the Miami-Erie Canal contain concentrations above the cleanup standards for other radioactive or chemical contaminants normally associated with Mound Plant operations, the following procedure was employed. After the chemical and other radiological data were collected, analyzed, validated, and stored in a centralized database, summary statistics (the overall proportion of exceedances, and the standard error of the proportion) were calculated for concentration values for each proposed analyte over the entire sample area. The chemical verification data were then evaluated by calculating the lower 95 percent confidence limit for the proportion of the site with levels exceeding the standard.

The 95 percent lower confidence limit is expressed in the following equation:

$$P_L = p - Z_{1-a} S_p$$

where P_L is the lower confidence limit and the other quantities are as defined in Section the previous section.

3.3.2. Results

Of the chemical and other radiological analytes, only antimony, benzo(a)pyrene, beryllium, Th-228, and Th-230 had any detects above the PRG's and ARAR's established for the canal. The lower 95% confidence limit of the proportion for each of these cases appears in Table 4. All are less than 0.05 except for the beryllium ARAR. For beryllium, all but one result exceed the ARAR of 0.2 mg/kg, but no results exceed the risk based PRG of 6 mg/kg. *Since none of the values of P_L calculated for the canal PRGs exceed .05, the site is considered clean.*

Table 4. Proportions (P_L) for Results above Cleanup Standards

Analyte	PRG	ARAR
antimony	0	0
benzo(a)pyrene	.01	NA
beryllium	0	.98
lead	NA	.01
Th-228	.02	0
Th-230	0	0

References

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DOE. 1993. "Remedial Investigation/Feasibility Study Operable Unit 9, Site-Wide Quality Assurance Project Plan, [Final Revision 3]", U.S. Department of Energy, Albuquerque Operation Office, Albuquerque, New Mexico, June 1993.

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DOE. 1993b. "Removal Site Evaluation, Operable Unit 4, Miami-Erie Canal." [Final Revision 3], prepared for the U.S. Department of Energy under contract no. DE-AC04-88DP43495. May 1993.

Halford, D. 1990. "Results of South Pond Sampling" (letter to Dwain Farley, Mound ER Program Technical Support Office), Los Alamos National Laboratory, Los Alamos, New Mexico. June 1990.

Kershner, C.J. and Rhinehammer, T.B. 1978. "Mound Laboratory Tritium Environmental Study: 1976-1977", Monsanto Research Corporation report number MLM-2495, prepared for the U.S. Department of Energy, April 1978.

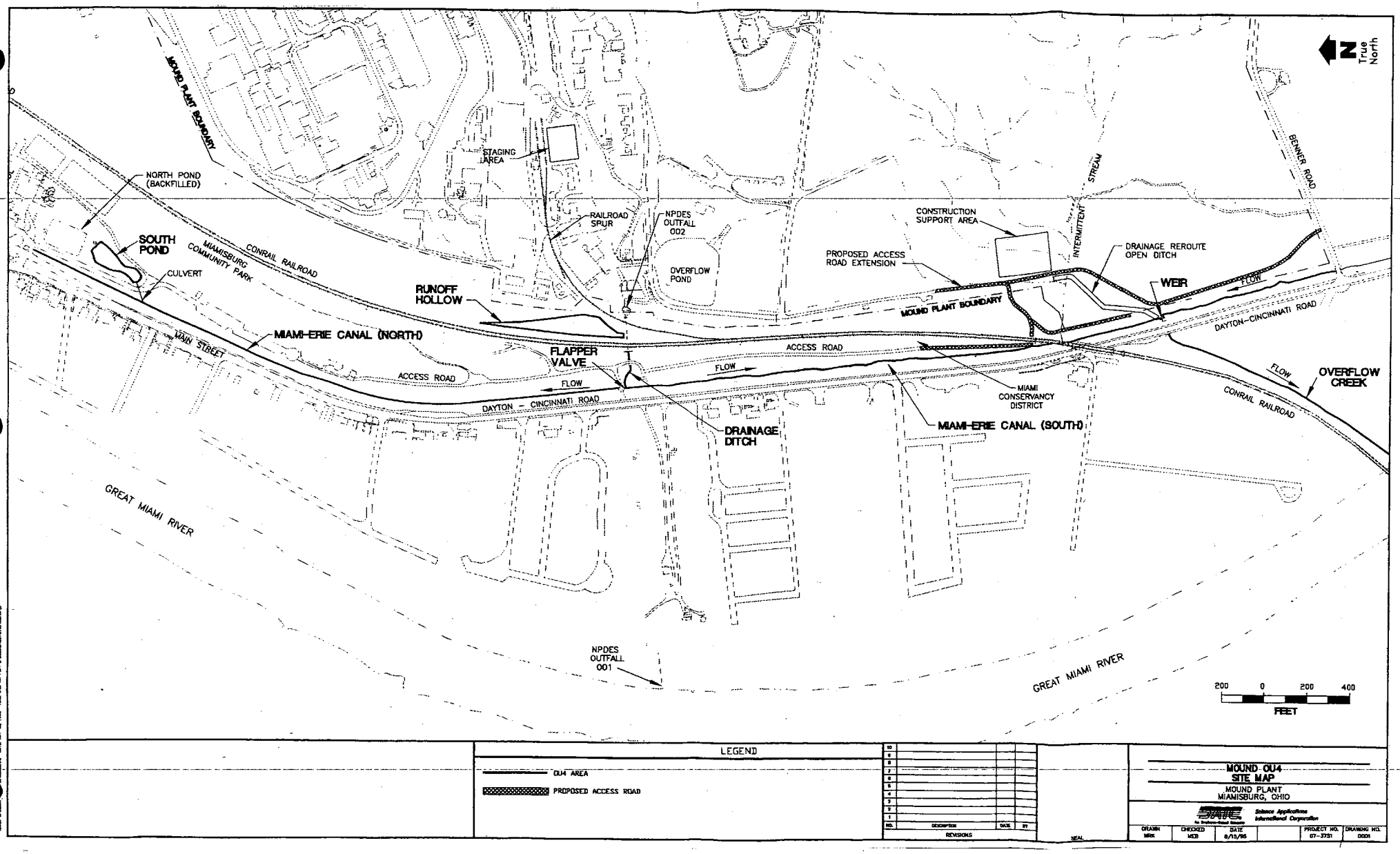
Rogers, D.R. 1975. "Mound Laboratory Environmental Plutonium Study 1974." Monsanto Research Corporation Report Number MLM-2249. Prepared for the U.S. Energy Research and Development Administration. Miamisburg, Ohio. September 1975.

U.S. EPA. 1989. "Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Soil Media", U.S. Environmental Protection Agency 230/02-89-042, Washington, D.C., February 1989.

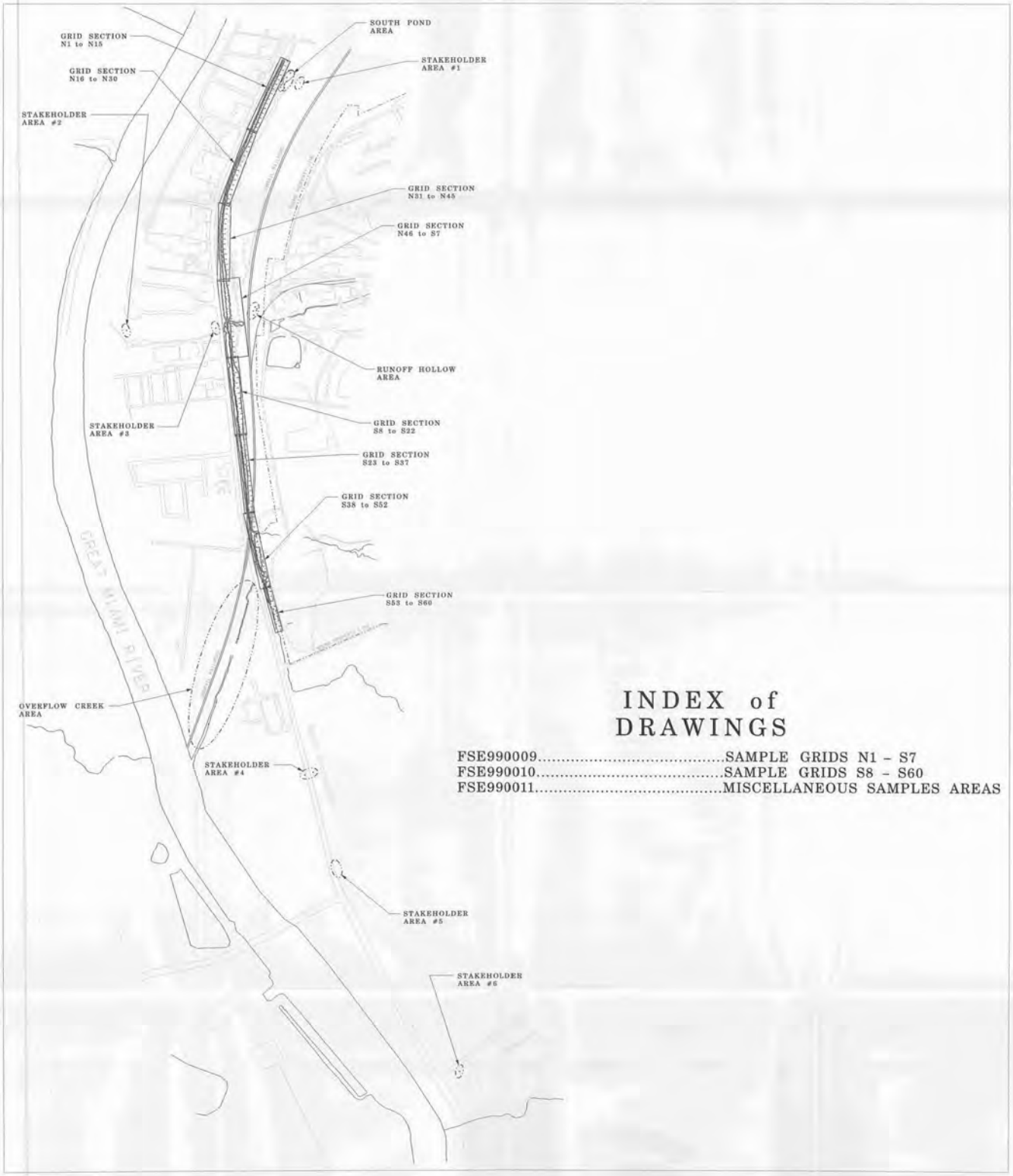
Page Redacted

Contains Proprietary Information

Figure 1.2 Location of Project Site



Miami-Erie Canal Project
Verification Sampling Results for Plutonium-238



INDEX of DRAWINGS

FSE990009.....SAMPLE GRIDS N1 - S7
FSE990010.....SAMPLE GRIDS S8 - S60
FSE990011.....MISCELLANEOUS SAMPLES AREAS

KEY PLAN

Scale in Feet

1. The electronic base map data file was obtained from Woolpert Consultants, Inc., Dayton, Ohio. The data were photogrammetrically compiled from aerial photography dated 04/04/94.

Coordinate Datum is based on the Ohio State Plane Coordinate System, South Zone - Horizontal Ground Control is based on NAD 1983. Vertical Ground Control is based on NAVD 1988.

1981 magnetic north declination of center of plant. Magnetic north is 3 degrees west of true north. Declination between state plane (grid) north is 1.13 degrees west of true north.

TN GN MN

MOUND
Environmental Restoration Geographic Information System

REV	DATE	REVISION	BY	CHKD	ENG	M
0	03/11/99	PRELIMINARY ISSUE	MR			

SHEET 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
ISSUE
SHEET 1 2 3 4 5 6
ISSUE 0
PART CLASSIFICATION

(U) TITLE CLASSIFICATION
Miami-Erie Canal Project
Verification Sampling Results
for Plutonium-238
Plate 1 - Canal Key Plan

DRAWING CLASSIFICATION: UNCLASSIFIED
SIZE: E
DRAWING NUMBER: FSE990008
JOB NUMBER: 12559
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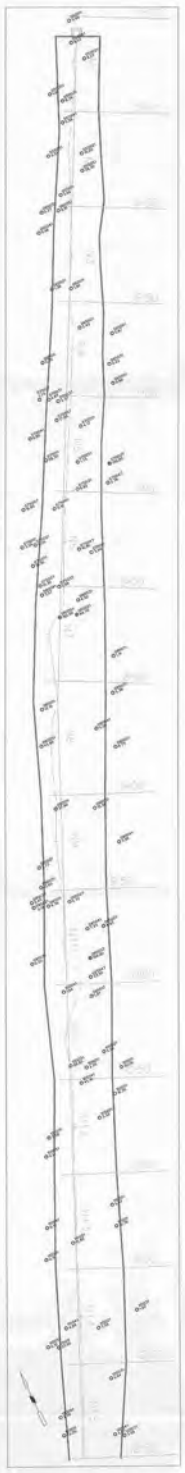
CADD: 14065
SCALE: Graph
SHEET: 1
STATUS: MD-REL-03/11/99
ORIGIN: MSTATION 95

FSE990008



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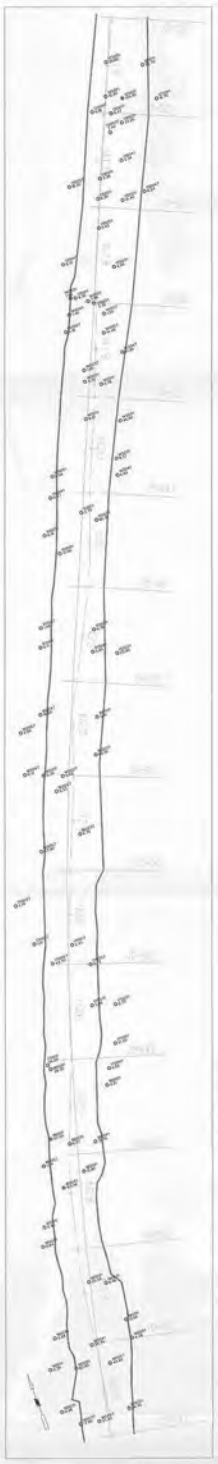

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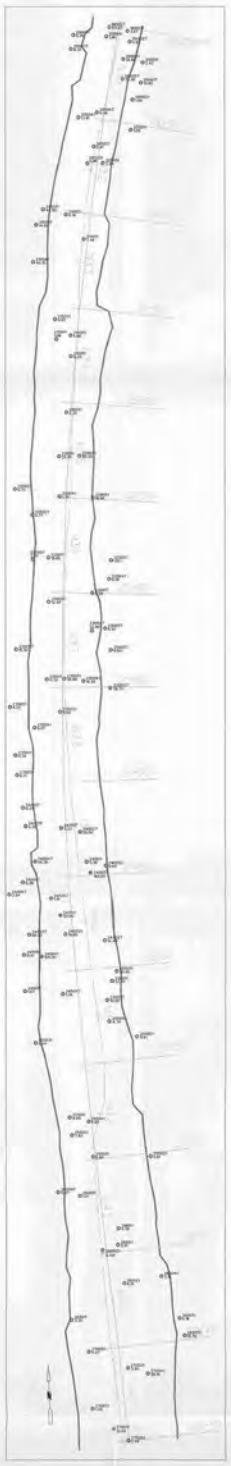

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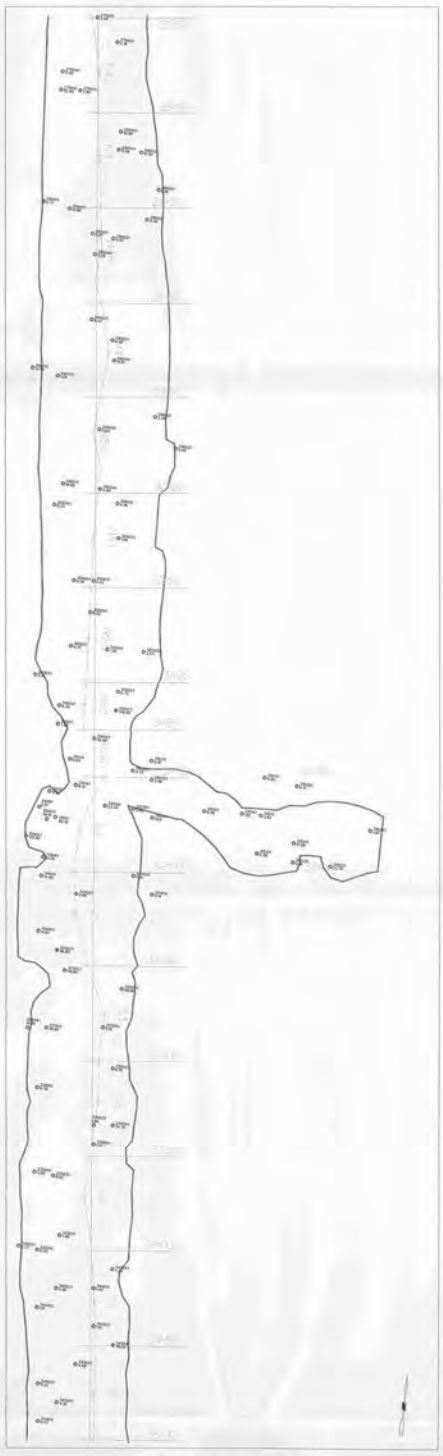

GRID SECTIONS
N46 to S7

Legend

- Excavated area boundary
- Pre-excavated canal centerline
- Grid station number
- Grid designation
- Sample ID 285051 / Result 75.0 — Sample with label less than 75 pCi/g Pu
- 285051 / 75.0 — Sample with label more than 75 pCi/g Pu

0 25 50 100 150
Scale in Feet
1 in. = 25 ft.

Coordinate Datum is based on the Ohio State Plane Coordinate System, South Zone. Horizontal Ground Control is based on NAD 1983. Vertical Ground Control is based on NAVD 1988.

MOUND
Environmental Restoration Geographic Information System

ISS	DATE	REVISION	BY	CHKR	ENG	M
0	03/11/99	PRELIMINARY ISSUE	SSP			

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JOB NUMBER: 12559
DWG TYPE: Site
DWG: CADD: 14065
SCALE: Graph
SHEET 1
STATUS: MD-REL-03/11/99
ORIGIN: MSTATION 95
REV: 0SHQ
D 240805XXXX-0405 M0003 #2

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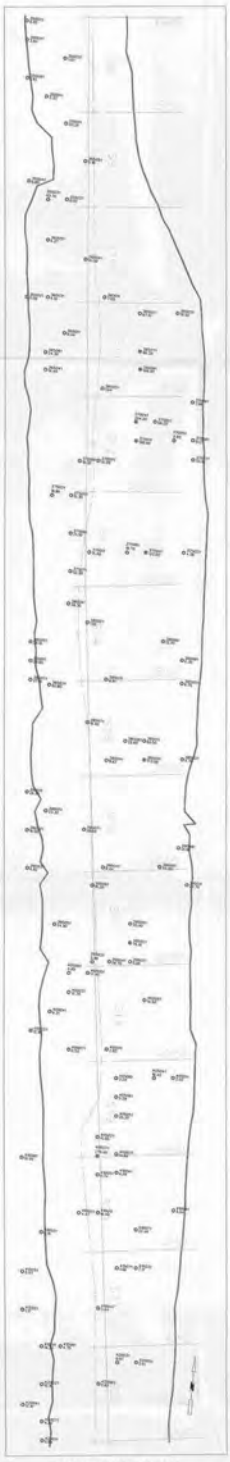
Miami-Erie Canal Project
Verification Sampling Results
for Plutonium-238
Plate II – Grids N1 – S7

FSE990009



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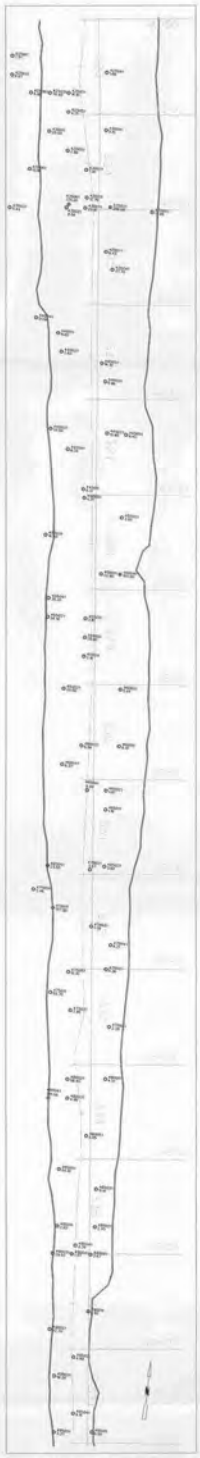
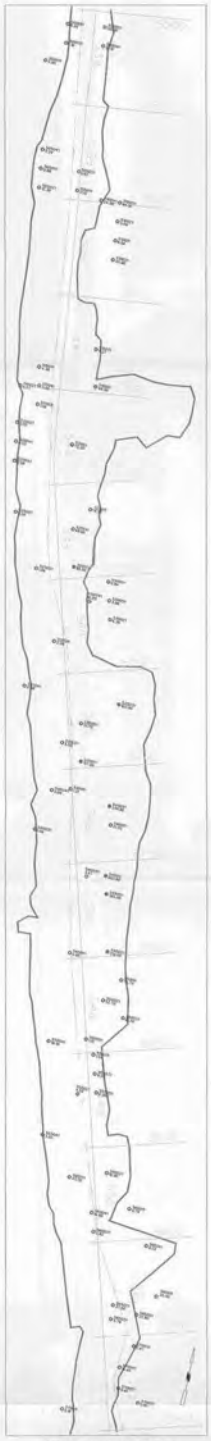
S8 to S22



GRID SECTIONS
S23 to S37



GRID SECTIONS
S38 to S52

GRID SECTIONS
S53 to S60

Legend

- Excavated area boundary
- Pre-excavated canal centerline
- (0+00) Grid station number
- (G1) Grid designation
- Sample ID: 285061 / result: 15.0 — Sample with label less than 75 pCi/g Pu
- Sample ID: 285061 / result: 125.0 — Sample with label more than 75 pCi/g Pu

0 25 50 100 150
Scale In Feet
1 in. = 25 ft.

Coordinate Datum is based on the Ohio State Plane Coordinate System, South Zone - Horizontal Ground Control is based on NAD 1983. Vertical Ground Control is based on NAVD 1988.

MOUND
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SHEET	1	2	3	4	5	6
ISSUE	0					

PART CLASSIFICATION

(U) TITLE CLASSIFICATION
Miami-Erie Canal Project
Verification Sampling Results
for Plutonium-238
Plate III - Grids S8 - S60

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DWG TYPE: Site | PRNG | CADD: MOD | SCALE: Graph | SHEET: 1
STATUS: MD-REL-03/11/99 | ORIGIN: MSTATION 95

REV	DATE	REVISION	BY	CHKR	ENG	M
0	03/11/99	PRELIMINARY ISSUE	SSP			

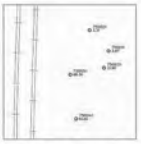
FSE990010

BOX 28142

D 2H0305XXXX-0406 19 0003 #3

Overflow Creek Area

South Pond Area



Runoff Hollow Area

Stakeholder Area #1

Stakeholder Area #2

Stakeholder Area #3

Stakeholder Area #4

Stakeholder Area #5

Stakeholder Area #6

Legend

- Structures
- Paved roadway
- Railroad
- Water course

Sample ID — 285051 Pu-0 — result — Sample with label less than 75 pCi/g Pu

285051 Pu-6 — Sample with label more than 75 pCi/g Pu

0 25 50 100 150
Scale in Feet
1in. = 40 ft.

Coordinate Datum is based on the Ohio State Plane Coordinate System, South Zone, Horizontal Ground Control is based on NAD 1983. Vertical Ground Control is based on NAVD 1988.

1. The electronic base map data file was obtained from Woolpert Consultants, Inc., Dayton, Ohio. The data were photogrammetrically compiled from aerial photography dated 04/04/94.

1981 magnetic north declination at center of plant. Magnetic north is 3 degrees west of true north. Declination between state plane (grid) north is 1.13 degrees west of true north.

TN
GN
MN

MOUND
Environmental Restoration Geographic Information System

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ISSUE																					

SHEET	1	2	3	4	5	6
ISSUE	0					

PART CLASSIFICATION

(U) TITLE CLASSIFICATION

Miami-Erie Canal Project
Verification Sampling Results
for Plutonium-238
Plate IV – Miscellaneous Samples Areas

DRAWING CLASSIFICATION: UNCLASSIFIED

SIZE: E | DRAWING NUMBER: FSE990011 | JOB NUMBER: 12559

DWG TYPE: Site | PRNG | CADD: 14065 | SCALE: Graph | SHEET 1 OF

STATUS: MD-REL-03/11/99 | ORIGIN: MSTATION 95

ISS	DATE	REVISION	BY	CHKR	ENG	M
0	03/11/99	Preliminary Issue	SSP			

DRAWING NUMBER FSE990011

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