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REMEDIAL ACTION AND
DECOMMISSIONING PROGRAMS
UC-70A

RMDF LEACH FIELD DECONTAMINATION FINAL REPORT

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1.0 PROJECT OBJECTIVE

The objective of the decontamination effort was to place the Radioactive Materials Disposal Facility (RMDF) leach field in a condition suitable for release for unrestricted use.

The RMDF at the Santa Susana Field Laboratory (SSFL) of the Energy Systems Group (ESG) of Rockwell International is used to support the decommissioning activities of other government facilities at the SSFL. Certain features of the RMDF are no longer required for the decommissioning support operation. These are decommissioned as time and money permit. One of these features, the leach field, served as an onsite sanitary sewer disposal area before the central sewage disposal system accepted the sanitary wastes.

Radioactively contaminated soil was excavated from the leach field to produce a condition of contamination as low as reasonably achievable (ALARA). The contaminated soil was boxed and shipped to an NRC-licensed burial site at Beatty, Nevada, and to the DOE burial site at Hanford, Washington.

The soil excavation project successfully reduced the contamination level in the leach field to background levels, except for less than 0.6 mCi of Sr-90 and trace amounts of Cs-137 that are isolated in cracks in the bedrock. The cracks are greater than 10 ft below the surface and have been sealed with a bituminous asphalt mastic. A pathways analysis for radiation exposure to humans from the remaining radionuclides was performed, assuming intensive home gradening, and the results show that the total first year whole body dose equivalent would be about 0.1 mrem/year. This dose equivalent is a projection for the hypothetical ingestion of vegetables grown on the site. Assuming that an average adult consumes 64 kg of green leafy vegetables per year and that the entire yearly supply could be grown on the site, the amount of ingested Sr-90 and Cs-137 is calculated to be 1100 pCi/year and 200 pCi/year. This ingested quantity would produce a total first year whole body dose equivalent of 0.10 mrem, using the accepted soil-to-plant transfer factors* of 0.0172 and 0.010 for Sr-90 and Cs-137, respectively. Details of this analysis are found in "Radioactive Materials Disposal Facility Leach Field Environmental Evaluation Report," DOE-SF-3 (ESG-DOE-13365), February 23, 1982. The whole body dose equivalent exposure value of 0.1 mrem/year is far below the tentative limit established by NRC of 5 mrem/year for areas released for unrestricted use.

*"Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," NRC Regulatory Guide 1.109, Revision 1, October 1977.

2.0 DESCRIPTION

2.1 PHYSICAL DESCRIPTION

The complete RMDF is shown in Figure 1. It is a fenced area and consists of four main buildings: Building 021, radioactive waste, decontamination, and packaging; Building 022, radioactive waste storage vault; Building 034, offices; and Building 044, health physics services. In addition, there are several minor structures, i.e., Building 075, equipment storage; Building 621, radioactive accountable waste storage; Building 664, low-level radioactive waste processing (inactive); Building 655, oxidation unit (inactive); Building 688, portable building for temporary storage; a storage shelter; and a storage yard. An underground sanitary sewage leach field located outside the fence was connected to Building 021.

The facility improvements are owned by the U.S. Government and are under the responsibility of the Department of Energy, Office of Nuclear Waste Management (ONWM). The land is owned by Rockwell International and is on long-term lease/option to purchase, to the U.S. Government.

The RMDF site is located at the ESG Santa Susana Field Laboratory, which is about 32 miles northwest of the Los Angeles Civic Center (shown on Figure 2).

The RMDF was a support facility to the Systems for Nuclear Auxiliary Power (SNAP) research and development program, the Sodium Reactor Experiment (SRE), and the Hallam Nuclear Power Facility. It was specifically designed to handle the storage, volume reduction, packaging, and shipping of the SNAP and SRE radioactive waste.

The site is about 3 acres including the leach field area outside the fence. All of the open area within the fence is paved with asphalt. Figure 3 is an aerial photo taken in 1976 of the complete, active site including the abandoned leach field site, with ground cover removed.

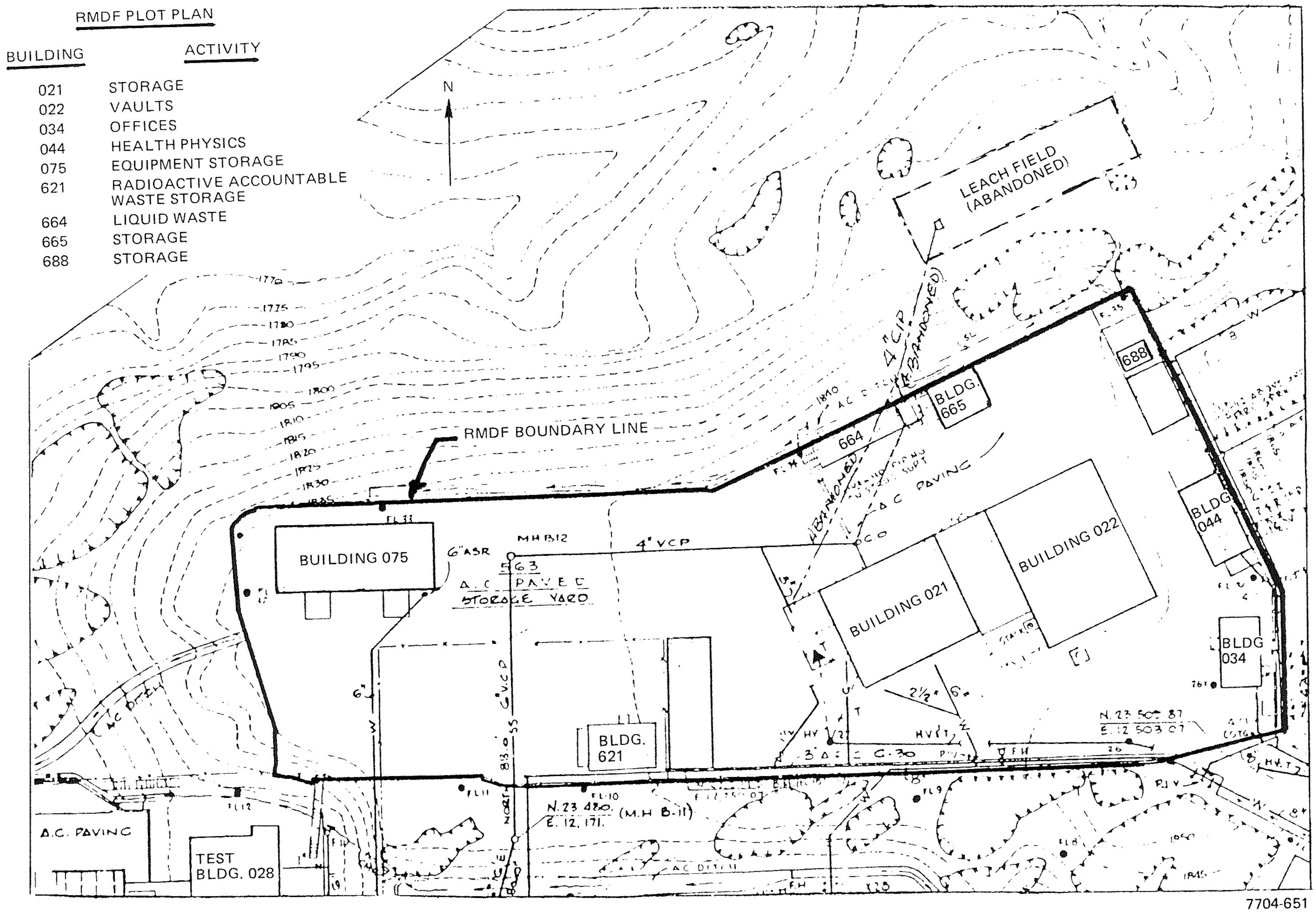

Figure 1. Radioactive Materials Disposal Facility Plot Plan

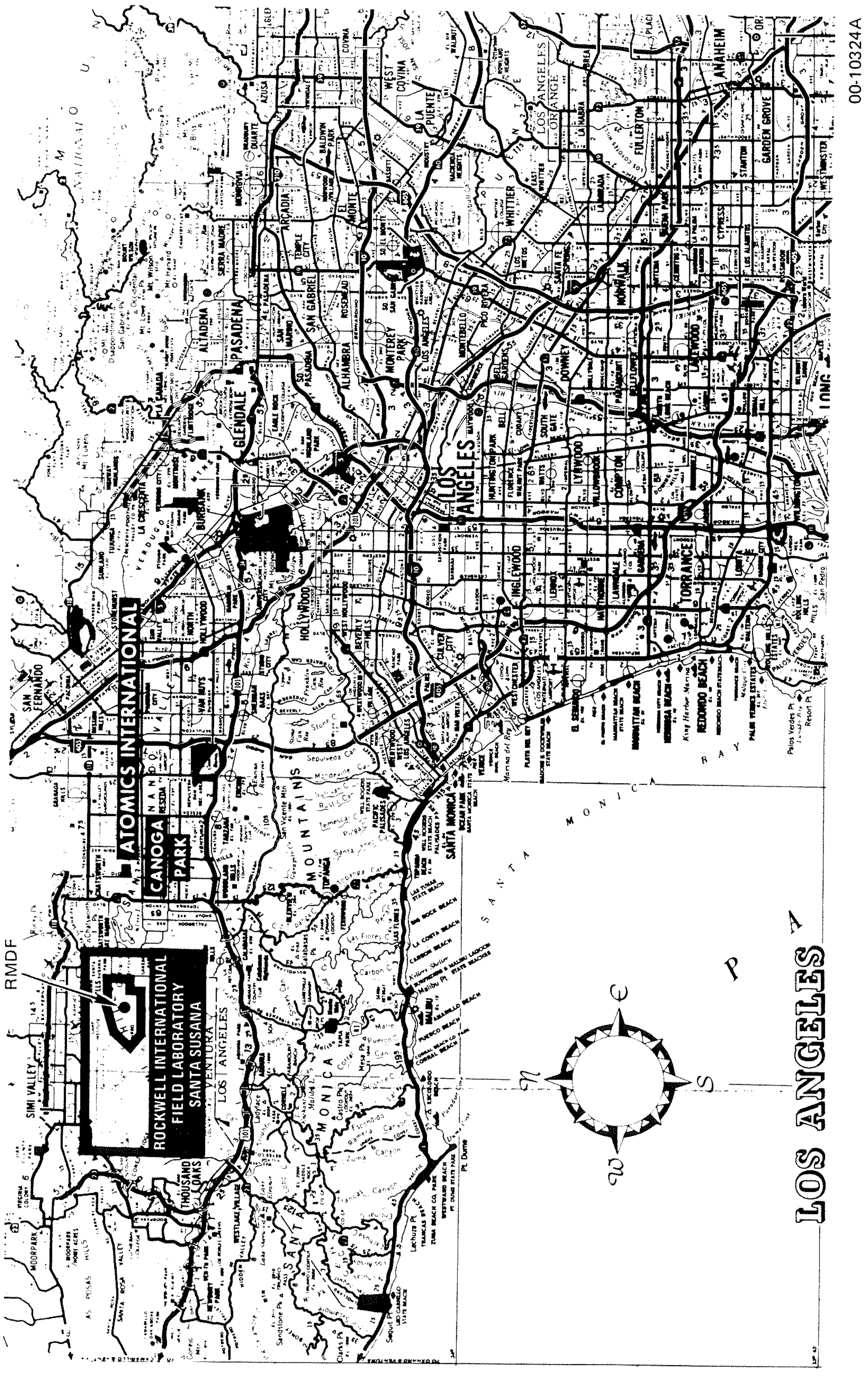

Figure 2. Vicinity Map (printed with permission of Auto Club)

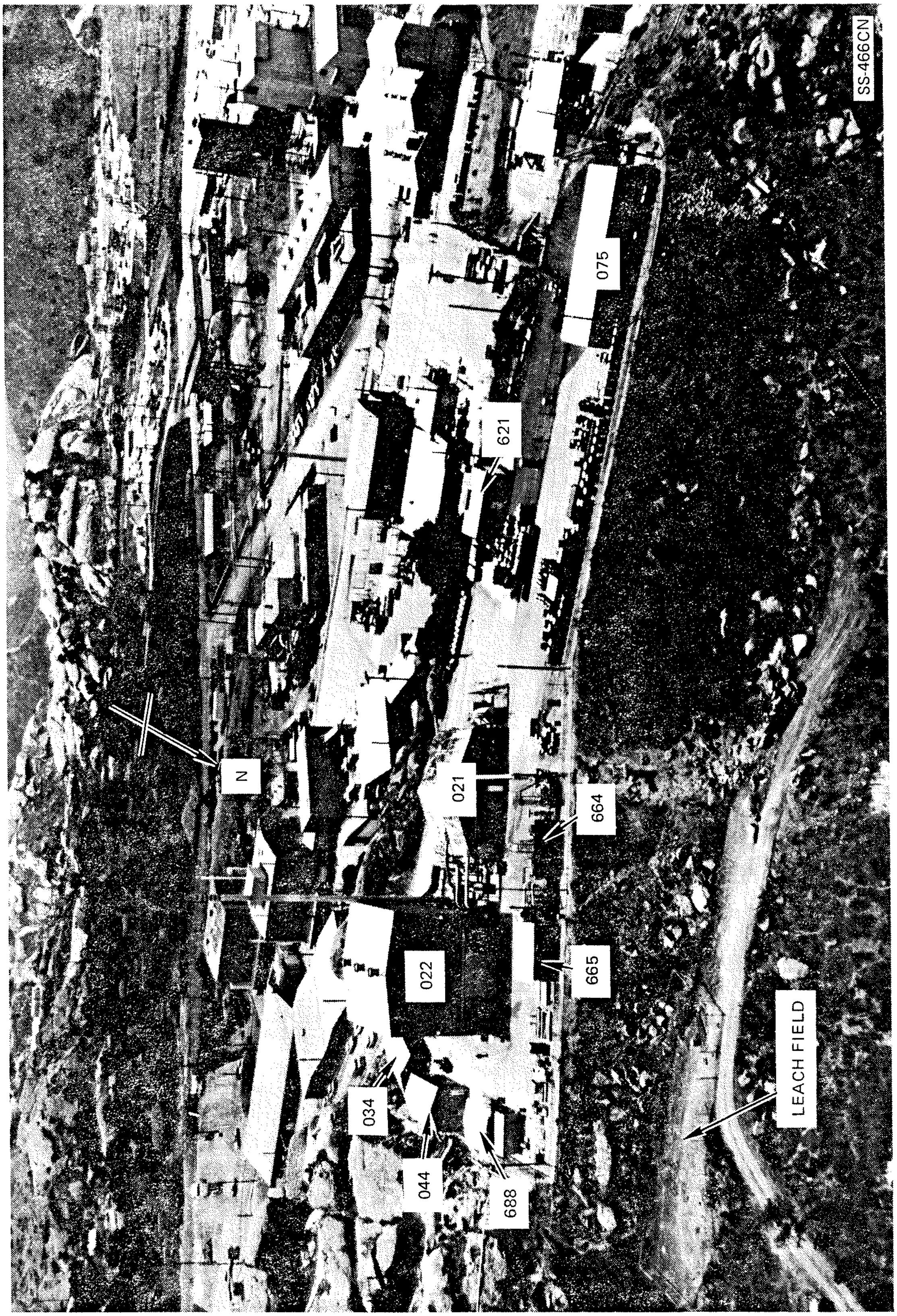

Figure 3. General RMDF View before Decommissioning

The leach field was constructed as an irregular-shaped excavation approximately 35 ft wide by 110 ft long by 6 ft deep. This was backfilled with about 4 ft of gravel, which was covered with a paper barrier and then with native soil to the original grade. The excavation was made to the fractured sandstone rock common in the area or in the soil overburden where underlying rock was deeper than the excavation.

The RMDF leach field was the liquid effluent disposal point for a gravity septic tank sanitary waste system that accepted the sanitary wastes from the Building 021 lavatories, shower, and toilets. A second connection to the leach field, bypassing the septic tank, was made from the radioactive water processing system at the waste holding tank on the west side of Building 021. Liquid from the radioactive holdup tank would be discharged to the leach field only after sample analysis indicated no radioactive contamination above acceptable limits.

The field was equipped with two parallel perforated pipe leach lines which extended 100 ft from a concrete distribution box. The distribution box was at the west end of the field and was connected to the outlet of the septic tank, buried at the top of the embankment forming the north side of the RMDF site, by a 4-in.-diameter cast iron sanitary sewer pipe (CIP). A sanitary wye continued the CIP to the radioactive waste processing holding tank. The septic tank inlet was connected to the Building 021 outfall by 4-in. CIP. There was about 300 ft of CIP buried with 2 to 3 ft of soil cover.

The RMDF leach field was constructed in early 1959 as part of the original improvement of the site consisting of Buildings 021 and 022. In late 1961, a central sanitary sewage system was constructed to service the SSFL and Building 021 was connected to it. The RMDF septic system was then abandoned in place. Buildings 665 and 664 were erected in 1964 on the site of the septic tank. A portion of the connecting CIP was removed at that time as it interfered with the new construction.

After removal of the contaminated soil, the whole field was backfilled with compacted earth and finished to a grade several feet lower than the original surface at the conclusion of the project in 1978. This protected the area from wind and water erosion. It was graded and contoured to pass surface water to the west, and erosion control was provided by seeding rye grass on all of the disturbed soil areas. Figure 4 is a photograph of the leach field as it exists today.

2.2 RADIOLOGICAL DESCRIPTION

There have never been any significant sources of neutron flux at RMDF; therefore, there are no activation products induced in the RMDF structures. However, activated materials are processed through the RMDF buildings from other sites, and their residuals appear principally as surface contamination on the concentration and wash equipment.

In July 1975, while making a site survey, slightly radioactively contaminated vegetation was discovered at the leach field site. Further discovery of radioactive contamination in the leach field distribution box identified the source of vegetation contamination as root uptake from the underlying leach field.

Based on this evidence, it was concluded that prior to the connection of the central sanitary sewer to RMDF, a valve to the emergency overflow of the radioactive water processing system was inadvertently left partially open and allowed an unknown amount of contaminated water to enter the leach field system.

The site was surveyed to learn the extent of contamination by drilling 30 test holes about 6 ft deep with a tractor-mounted auger bottomed bucket.

The RMDF leach field probably contained some activated material as well as fission products. The only significant isotopes identified in the various surveys were Sr-90 + Y-90 and traces of Cs-137. No estimates of the radioactive inventory were available due to the lack of precise data on the nature and quantity of the dissolved material introduced into the leach field. The exploration with test holes was designed to identify only the limits of the migration of the radioactive materials in the leach field.

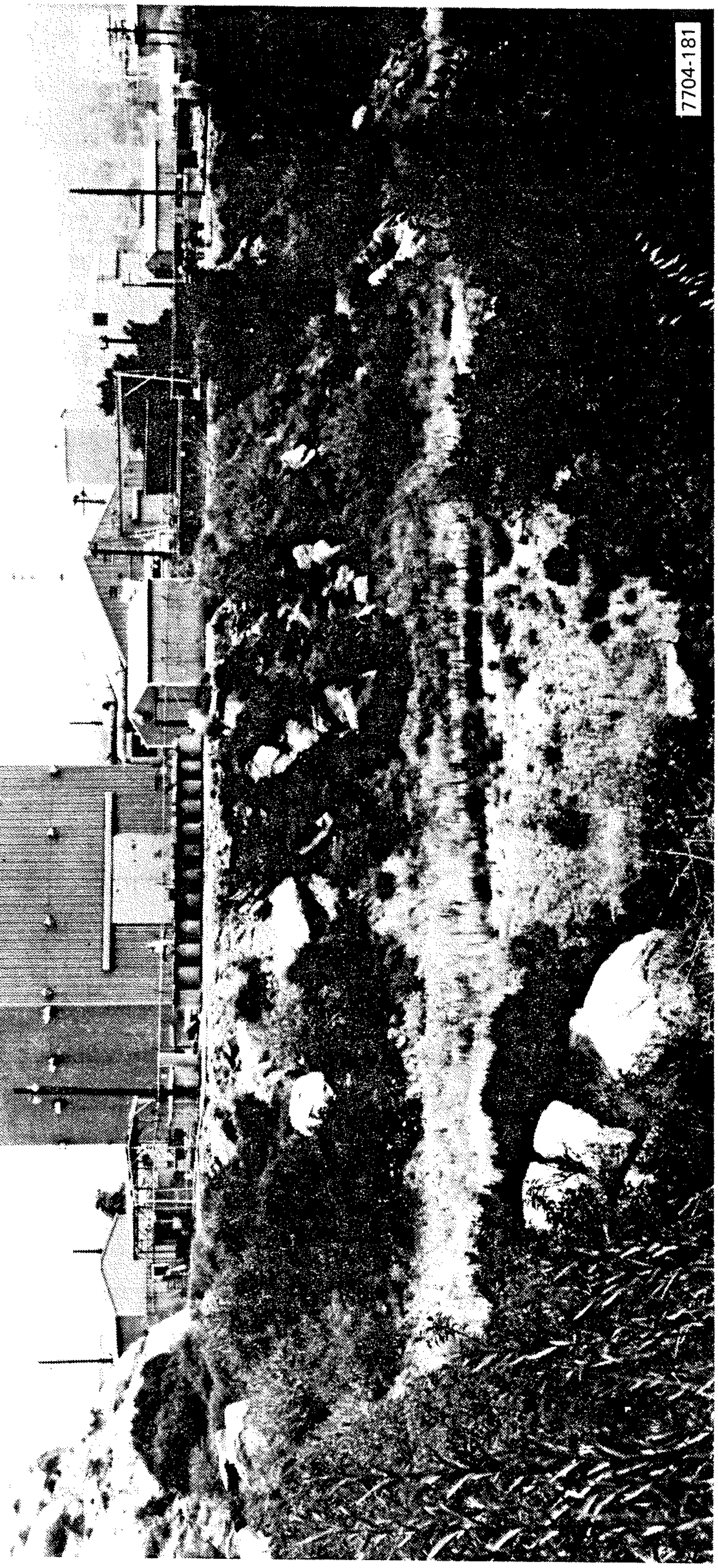

Figure 4. RMDF Leach Field Looking South

The relative locations of the test holes are shown in Figure 5 with the maximum radioactivity, in pCi per gram, found in each hole. Five holes penetrated through the overburden and leach field gravel. The remainder were drilled around the periphery in undisturbed rock and soil. Small test samples of soil were removed at 1-ft-depth intervals from the sides of each hole as it was drilled. This was to minimize cross contamination of the sample locations by the action of moving the bucket in and out for unloading the soil. A light water spray was applied at each bore site operation to reduce dust dispersal into the air. High-volume air samples located about 4 ft from the bore site were monitored for airborne activity. The immediate count indicated no more than 3.8×10^{-11} μCi/ml β-γ. One hundred seventy of these samples were analyzed for gross β-γ radiation with a thin window GM-type survey meter to provide on-the-spot guidance for depth control and for predicting the location of the next hole. Laboratory analysis followed on a Nuclear Chicago automatic gas-flow proportional counter. These laboratory results were used to develop the isopleths shown in Figures 6 through 10. An interpretive horizontal plot of the readings is shown in Figure 5 superimposed on a plot map of the site. The isopleth represents a possible horizontal distribution limit of the radioactive materials without any consideration of the vertical elevation of the readings. Selected portions of the basic data are shown as isopleths of vertical cross sections in Figures 6, 7, 8, 9, and 10 to provide visualization of a possible vertical distribution of radioactive materials.

From the combination of the horizontal and vertical data, it was assumed that the distribution box must have flooded and leaked near its upper surface when the dissolved radioactive materials were introduced and that these materials percolated northeasterly as well as flowing down the north leach line and down into the gravel bed. The isopleths are drawn within the constraints of the data available to support this assumption. Several additional holes would have been required to conclusively support this, but the additional data would not have altered the approach, safety, or magnitude of the removal task. Therefore, additional drilling was not done.

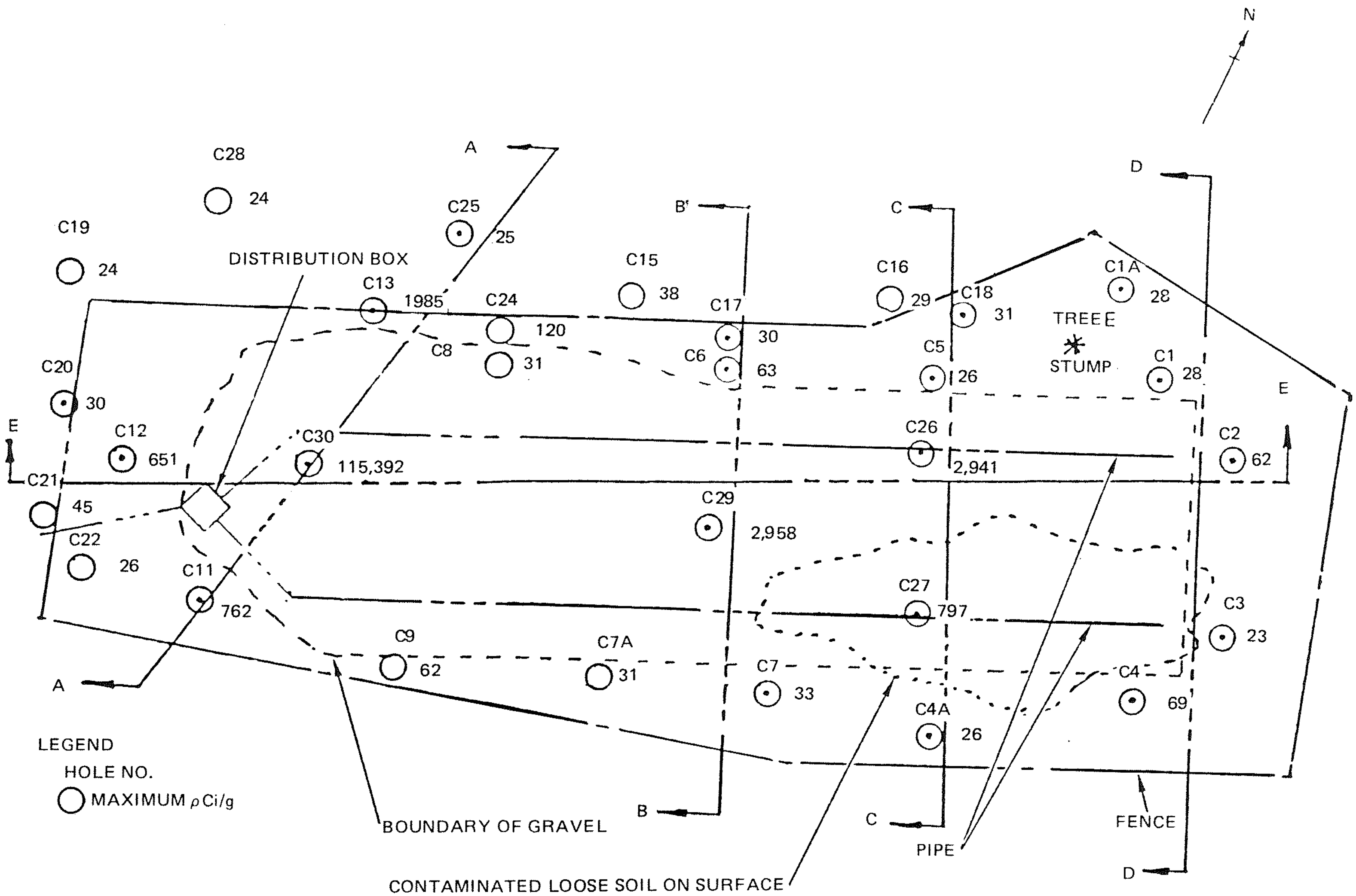

Figure 5. Plot RMDF Leach Field Soil Survey Holes

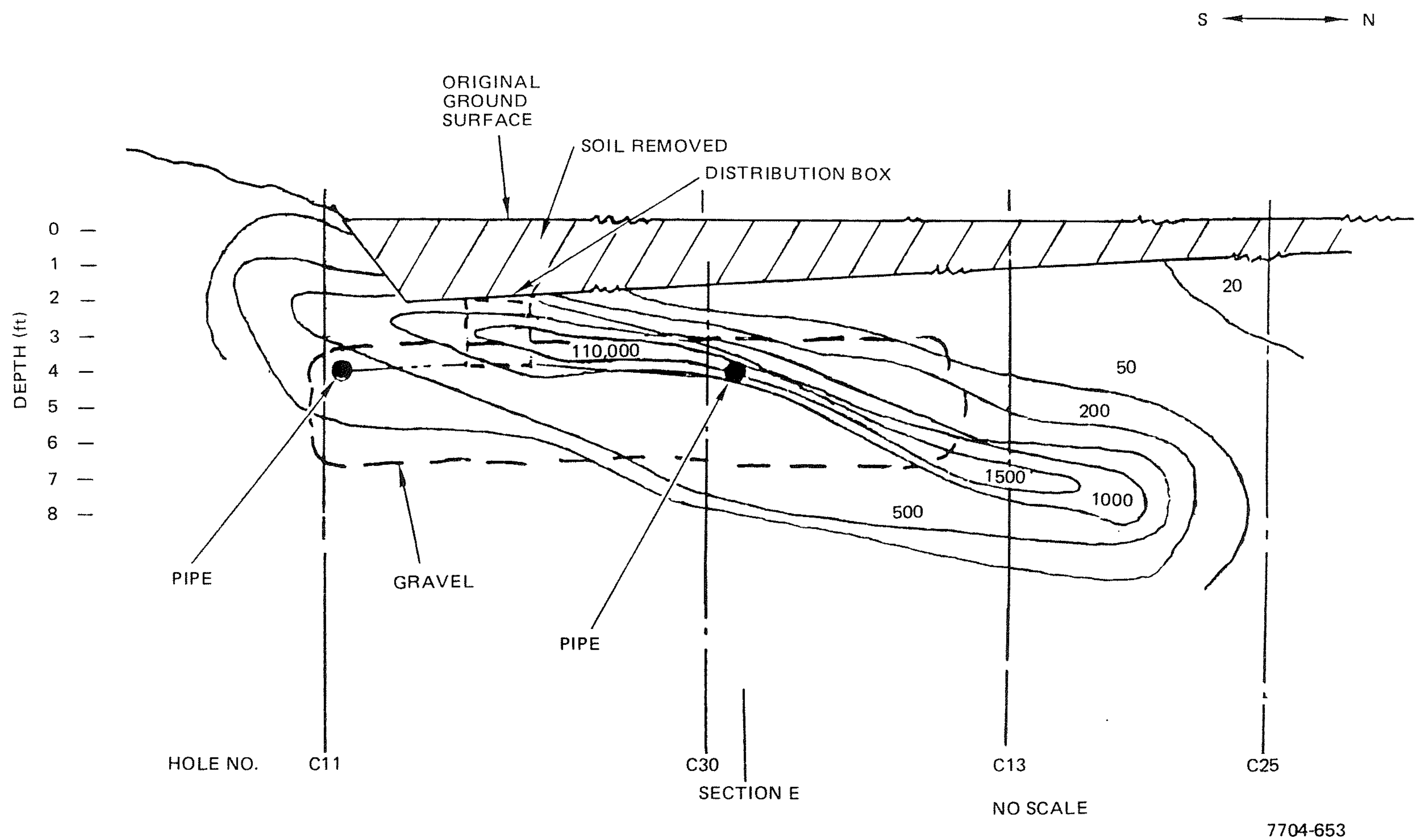

Figure 6. RMDF Leach Field Section A-A

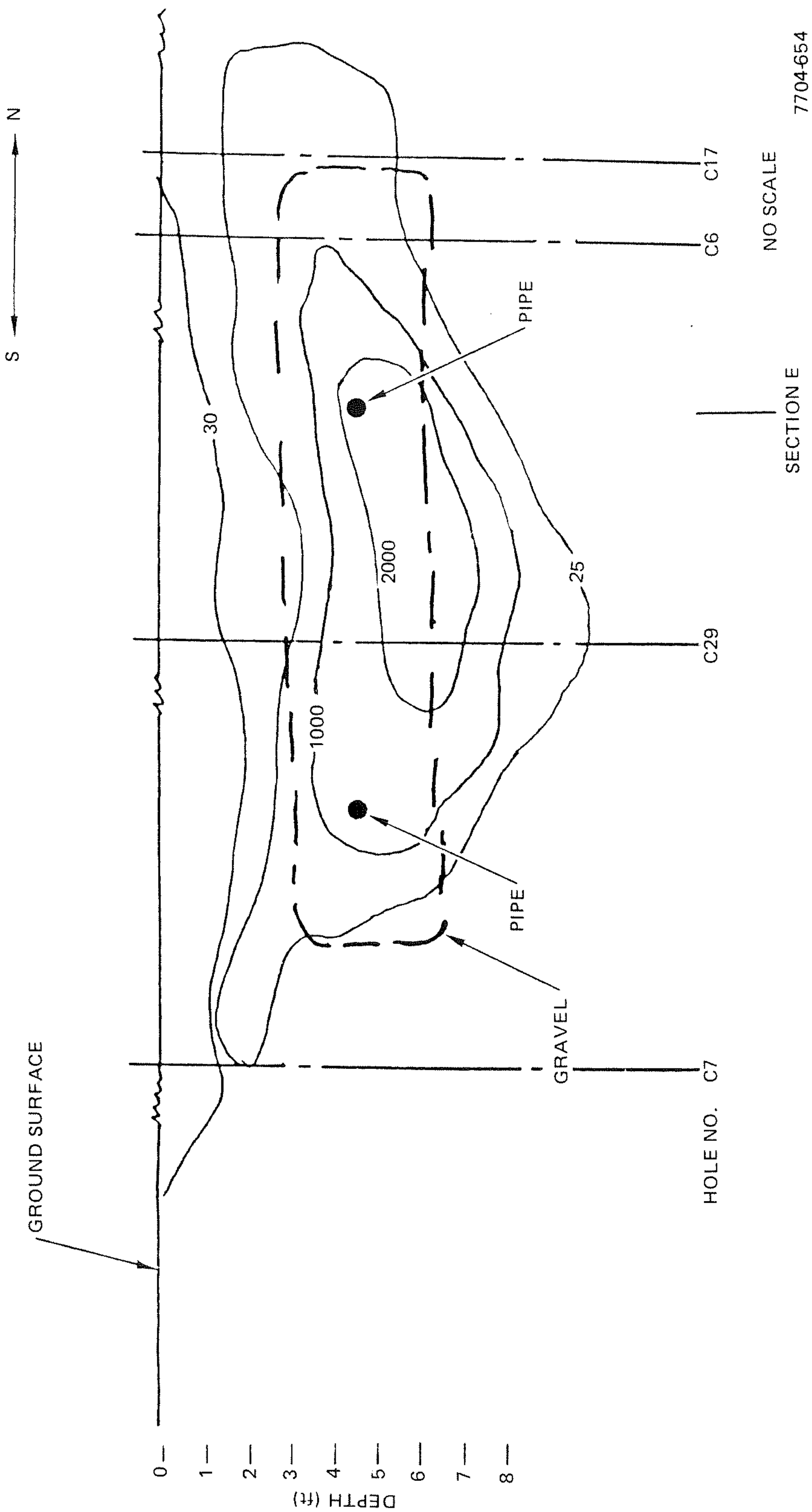

Figure 7. RMDF Leach Field Section B-B

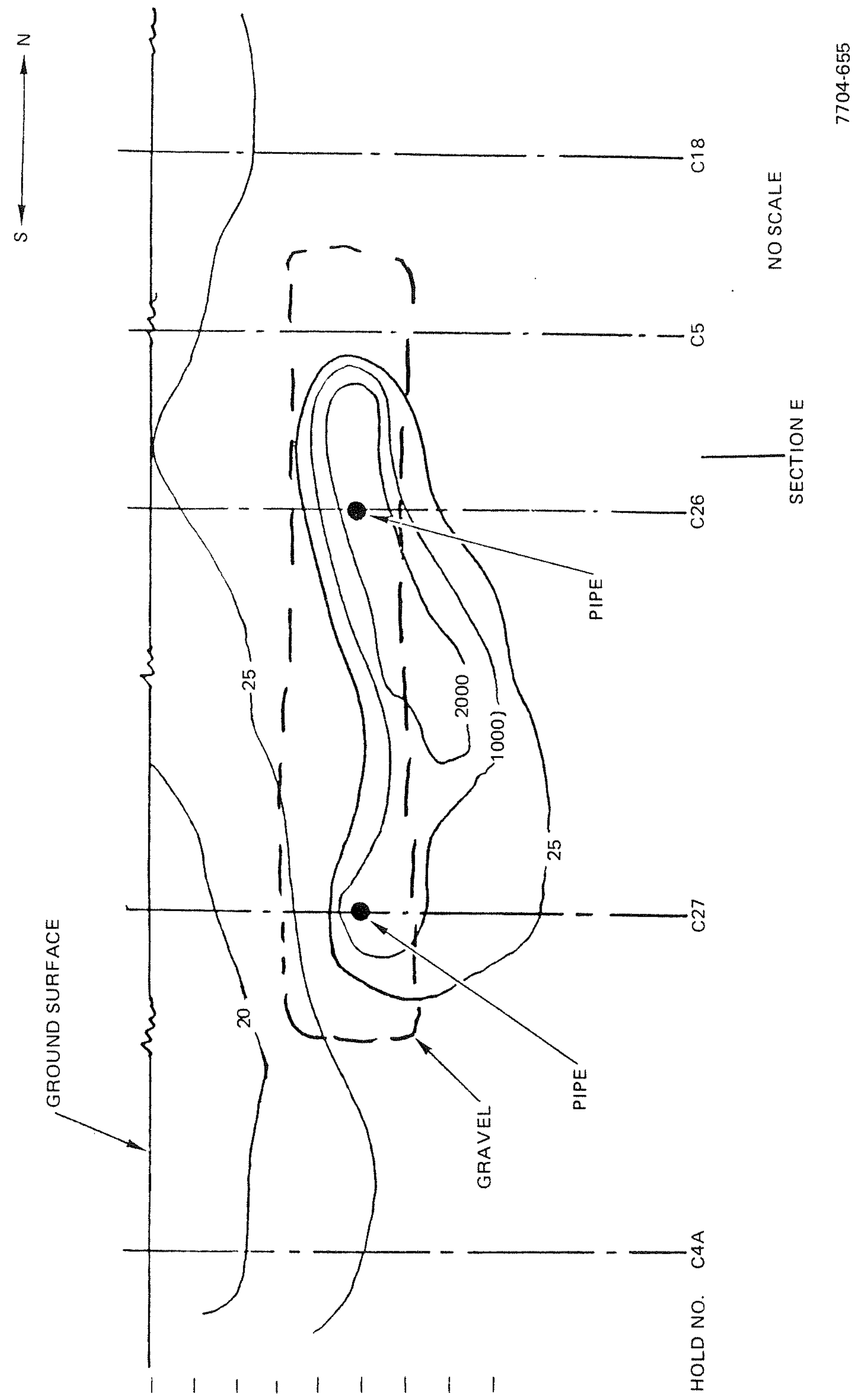

Figure 8. RMDF Leach Field Section C-C

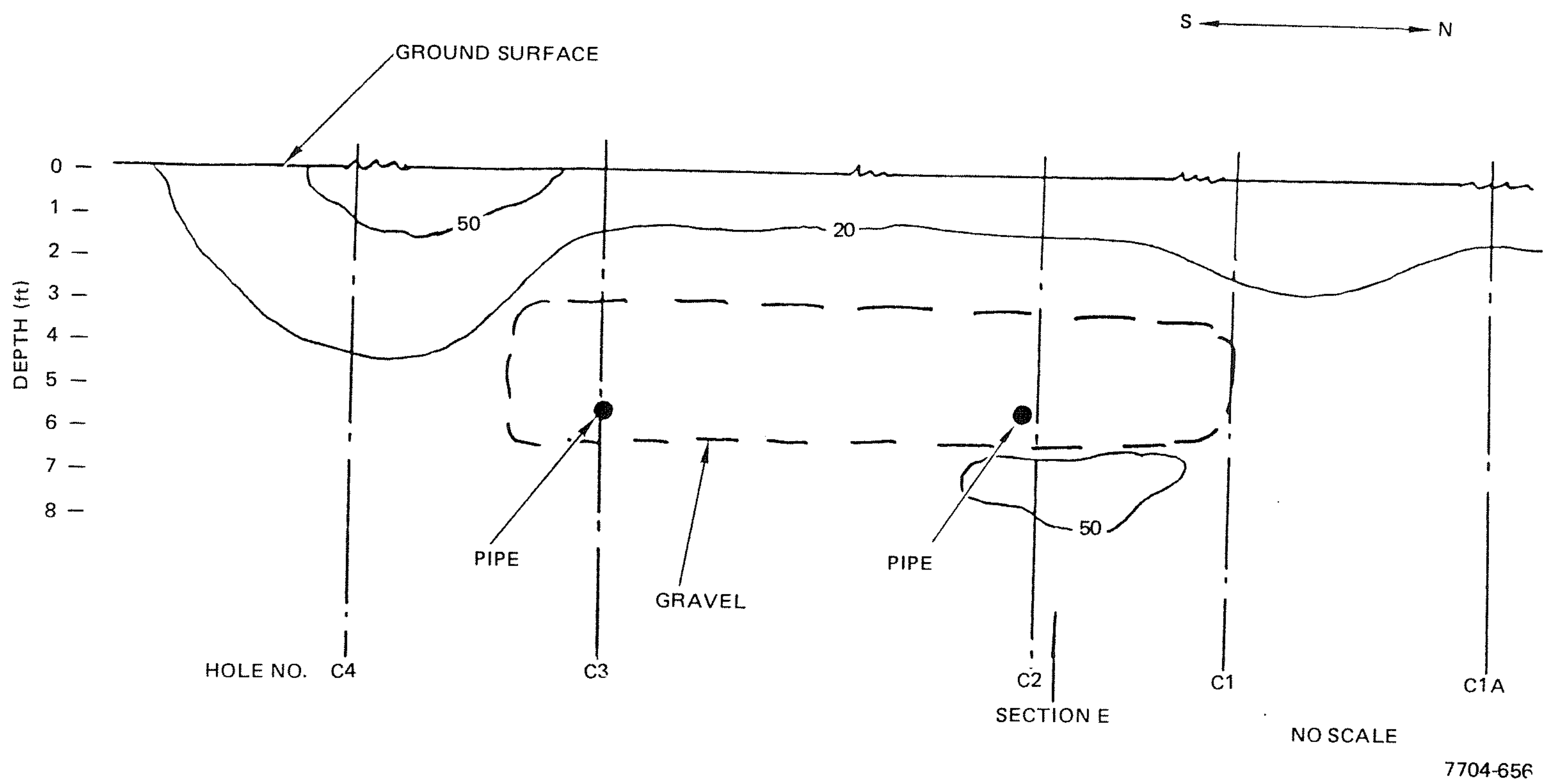

Figure 9. RMDF Leach Field Section D-D

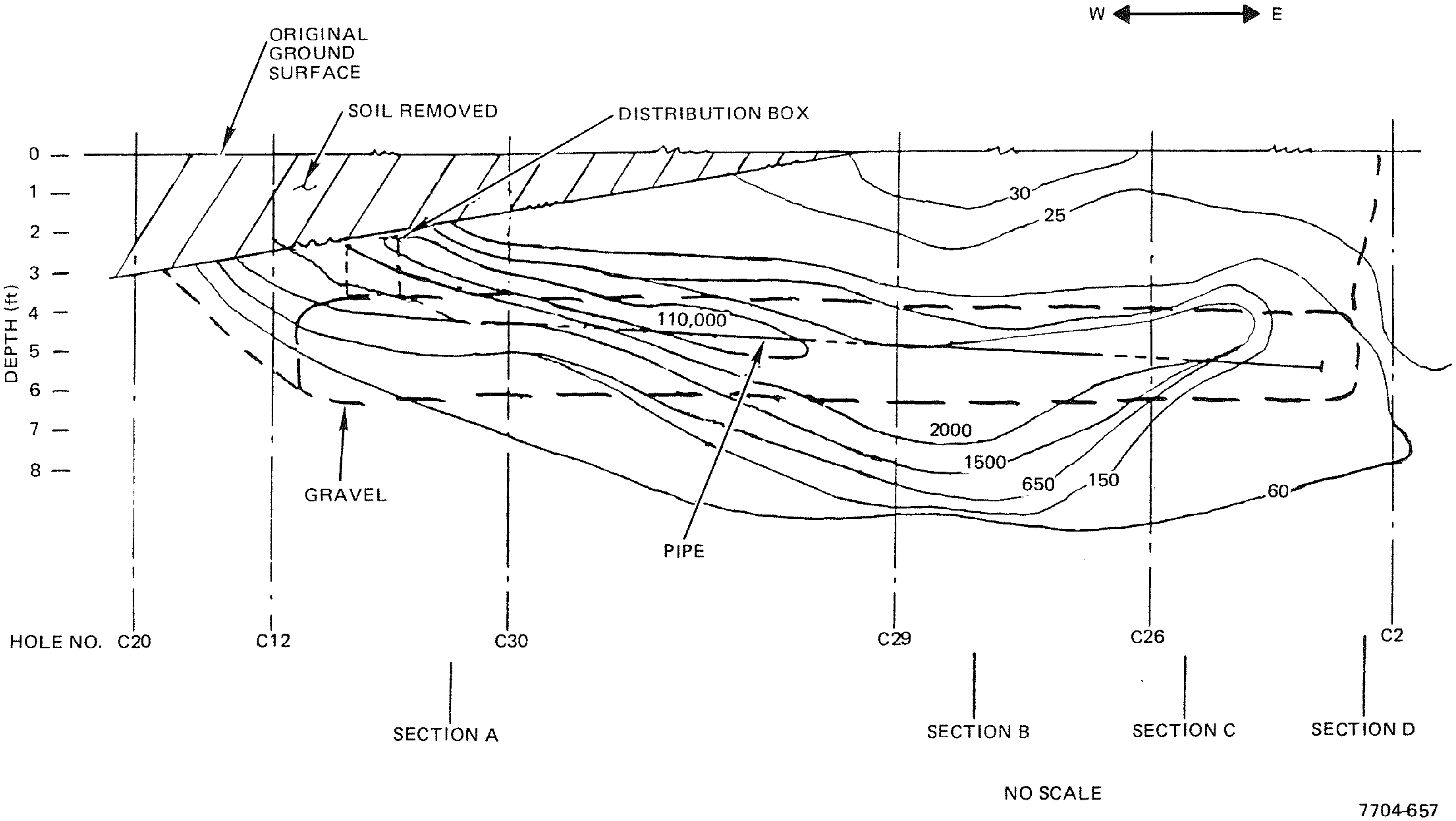

Figure 10. RMDF Leach Field Section E-E

No water samples were taken because the leach field was found to be dry.

Following the survey, the field was covered with plastic and plywood to protect the area from surface water that could percolate or run into the test holes and cause further migration of the radioactive materials.

During the leach field excavation (described in Section 3.0), the work was monitored and controlled by radiological surveys of the excavation. Water spray was used to suppress airborne contamination. Based on the minimal results of the air sampling monitors used during the hole drilling operation, it was determined that the airborne contamination would not likely exceed 25% of the applicable regulatory standard for occupational exposure with simple damp water spray control measures.

All of the leach field gravel was considered to be contaminated waste and was monitored after being placed in the shipping boxes. A thin window pancake GM survey instrument was used for this measurement. Readings at the surface of the boxes generally were in the range of 500 cpm (counts per minute), 0.12 mR/h gross β-γ — at contact. These were reduced to one-tenth of that value at 1 m.

The clay pipe read up to 3 to 4 mR/h gross β-γ, using a Technical Associates Cutie Pie with a 4-in. chamber. These components were placed in the center of some boxes to use the gravel as shielding. The sandstone rock surface exposed by removing the gravel and contaminated soil was surveyed to locate radioactive material penetrations. Cracks or porous areas were given special attention. Radiation measurements were made of the in situ surface and by taking selected soil samples to the laboratory for more accurate measurement. Initially, some areas read 500 to 4000 cpm. Water puddling in the excavation read 1.65 nCi/ml. As these areas were removed and boxed, the reading continually decreased. Soil samples were then taken only in areas showing greater than 300 cpm on the survey instrument. As the work progressed, this limit was lowered to 150 cpm. The soil samples measured under the limits of the higher range had activity from 312 to 2667 pCi/g. Samples taken relative to the lower limit consistently showed less than 100 pCi/g.

Other than the identified contaminated cracks, all soil samples read less than 100 pCi/g. A crack filled with porous material was found along the north wall of the excavation. Samples taken from the crack measured up to 2500 pCi/g. This crack was excavated approximately 10 ft below the rock surface and was found to split and wander under the leach field excavation. This network of cracks was sampled for contamination. The tests indicated 500 to 900 pCi/g above the target activity level of 100 pCi/g. Two smaller cracks (shown on Figure 11) also exhibited small soil areas with activity above 100 pCi/g. It is estimated that no more than 0.6 mCi remain in all three cracks. The radioactive material is identified as primarily Sr-90 + Y-90. Four soil solubility analyses were performed to determine the migration potential of the radioactive material in the cracks. All the samples but one showed only minor contamination in the leachate. The one was just over MPC for Sr-90 at 4.18×10^{-7} μCi/ml.

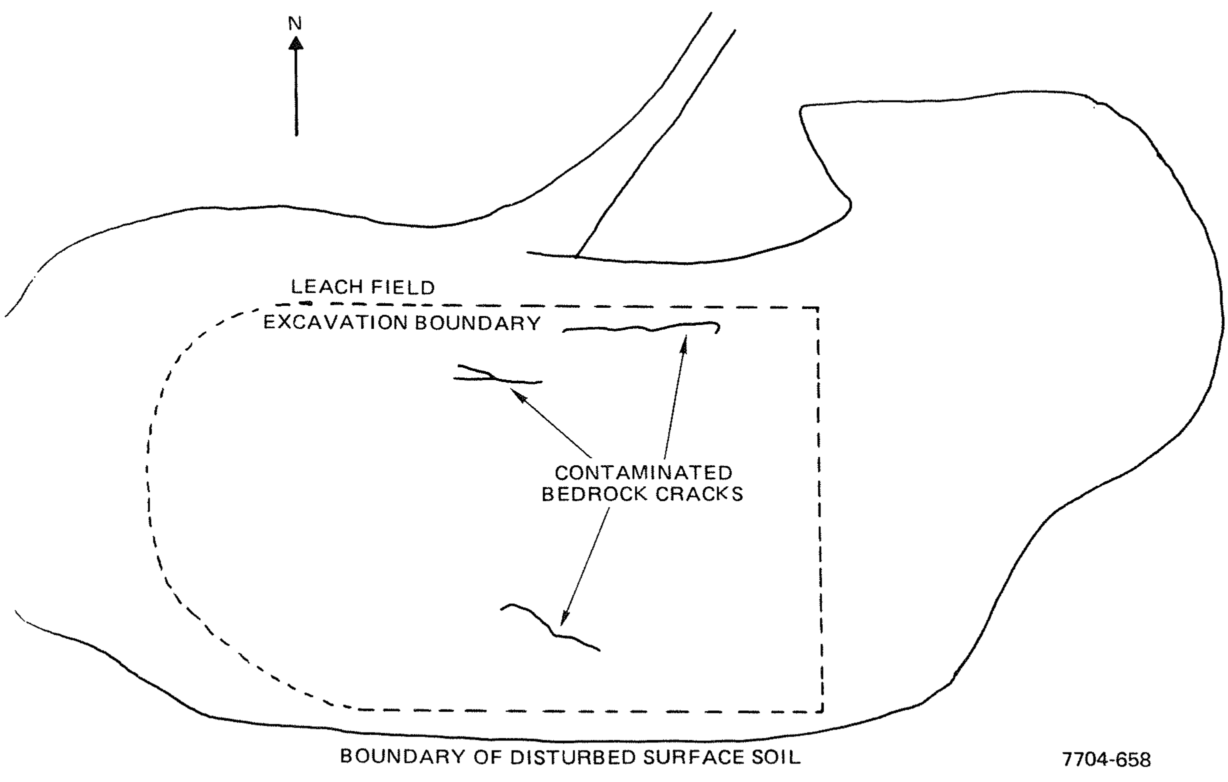

Figure 11. Location of Remaining Contamination in RMDF Leach Field

The soil sampling technique consisted of carefully removing about 2 g of soil, drying on an electric hot plate, and counting in a Nuclear Chicago automatic counting system with a KCl standard and with an average background of 30 cpm in the β channel and a counting efficiency factor of 3.6 dpm/cpm* for β. The efficiency factor corrects the net count rate for geometric and electronic detection efficiency and for absorption in the sample. Alpha contamination was not suspected for this area; however, had any occurred, it would have been detected with this automatic counting system. None was detected.

During the excavation process, 580 soil samples, 8 vegetation samples, and 23 water samples were analyzed for gross β-γ activity. The results were used to guide the soil removal operation for the remaining contaminated soil.

Smear samples were taken on the boxes of removed soil at the RMDF as they were brought into the area and as they were being loaded for shipment. None had over 50 dpm/100 cm^2.

Upon completion of the decontamination, the maximum dose rate detected from the newly placed fill and surrounding vegetation was 0.06 mrad/h with an average background of 0.03 mrad/h throughout the area. These measurements were made with a thin window ion chamber which also measures β radiation. A follow-up survey was performed with a NaI scintillator. This showed a range of 30 to 50 μR/h throughout the leach field area, apparently from radioactive material at the RMDF, just a few hundred feet away. No contribution from the leach field itself could be detected. This is reasonable because of the large amount of clean overburden placed over the excavated leach field. For this reason, the penetrating radiation component was assumed to be zero in the dose assessment. A final random soil sampling of the ground surface indicated less than 50 pCi/g gross β-γ. Background is 13 μR/h in this general area.

The site was left with a minor amount of radioactive material in three cracks in the sandstone rock. The cracks are more than 10 ft below the surface and have been sealed with a bituminous asphalt mastic to prevent the percolation of water through the cracks.

*dpm/cpm = disintegrations per minute/counts per minute

3.0 PROJECT SUMMARY

3.1 ENGINEERING PHASE

A decontamination plan was prepared for the RMDF outlining the objectives and the precautions required in achieving the objectives. Upon approval, an Activities Requirement Document was prepared for the leach field decontamination activity. In general, the approach outlined in the Activities Requirement Document was to survey the field by boring test holes and taking soil samples from selected locations. The results of this sampling were to be charted as isopleths of the radioactivity concentration. The results of these tests were discussed in Section 2.0. Based upon this knowledge, detailed working plans were prepared outlining the specific procedures and methods to be employed in safely removing the radioactively contaminated soil and gravel. These working plans were kept on the job site and were followed by the operations personnel, and the performance was certified by the Quality Assurance Department of Atomics International (AI).

3.2 OPERATIONS PHASE

The decontamination progressed over several years of intermittent activity. The contamination was uncovered in 1975 by the exploration of the distribution box. The removal of all plant materials from the site followed. The site was fenced, posted, and protected from any further activity. During 1976, the decontamination plans were prepared, and the test holes were bored. The field, perforated with the test holes, was protected from rainwater and storm runoff during the intense winter rainfall of 1977/1978 by the plywood and sheet plastic protective cover shown in Figure 12. Early in 1978, the cover was removed and salvaged.

Excavation of the noncontaminated overburden started in mid-1978 at the west end of the field and progressed easterly using a conventional backhoe (shown in Figure 13). The material having the highest level of radiation was removed next to reduce the radioactive background at the site and to eliminate the possibility of spreading this material, since the only working access to the other end of the field was across this area.

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Figure 12. Protective Plywood and Plastic Sheeting Covering Leach Field

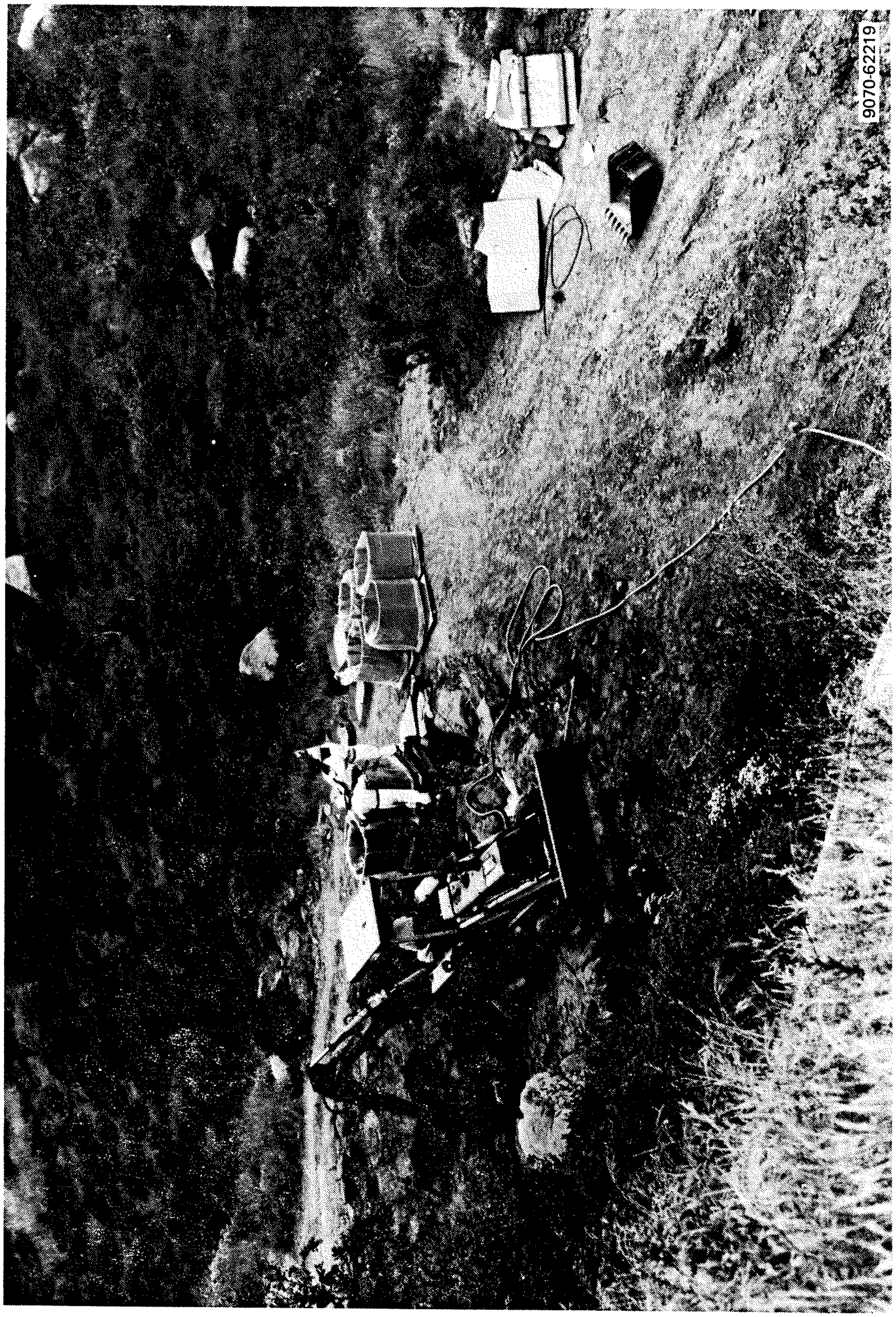

Figure 13. Initiation of Leach Field Excavation

Figure 14. Filling Plastic-Bag-Lined Box with Contaminated Soil

The noncontaminated overburden was moved to the east end and stockpiled for backfill material. The backhoe was used to place the contaminated gravel and soil in plastic-lined boxes (shown in Figure 14). The filled boxes were transported directly to the RMDF yard by a mobile overhead crane (shown in Figures 15, 16, and 17). As required, water was sprinkled on work areas to control dust; no runoff was permitted.

The remaining loose gravel and soil left by the backhoe was removed with hand shovels to the underlying sandstone rock surface. Radiological surveys indicated that some radioactive material had penetrated the pores and fractures in the rock. A Hy-Ram* was used to crush and split off the surface of the rock about 6 in. deep in each pass. This material was scraped up and removed with a skip loader. The final scraping was done by hand to ensure complete removal. All remaining contaminated areas were processed with the same techniques to ensure complete removal of radioactive materials.

Several small areas continued to show radioactive material in loosely cemented fractures and relatively uncemented cracks (illustrated in Figure 18). This contamination was followed using the same rock removal techniques, except more localized, which resulted in mining out holes up to 10 ft deep (illustrated in Figures 19 and 20). Figure 21 illustrates the protective covering used at this stage of the project to protect the workings from a summer rainstorm.

In the fall of 1978, three contaminated cracks remained. These were mapped for location and radioactive material concentration. The areas were coated with a bituminous mastic to seal out percolation water that might increase the radioactive material penetration. The whole field was then backfilled with compacted earth and finished to a grade several feet lower than the original surface. The compaction method is illustrated in Figure 22. The final appearance of the field site is illustrated in Figure 23. It was graded and contoured to pass surface water to the west, and erosion control was provided by seeding a rye grass cover crop on all of the disturbed soil areas.

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*Hydraulic actuated jackhammer equipped with a 4-in.-diameter chisel point attached to the arm of a backhoe

Figure 15. Attachment of Crane Sling to Contaminated Soil Container

Figure 16. Crane Hoisting Soil Container from Leach Field

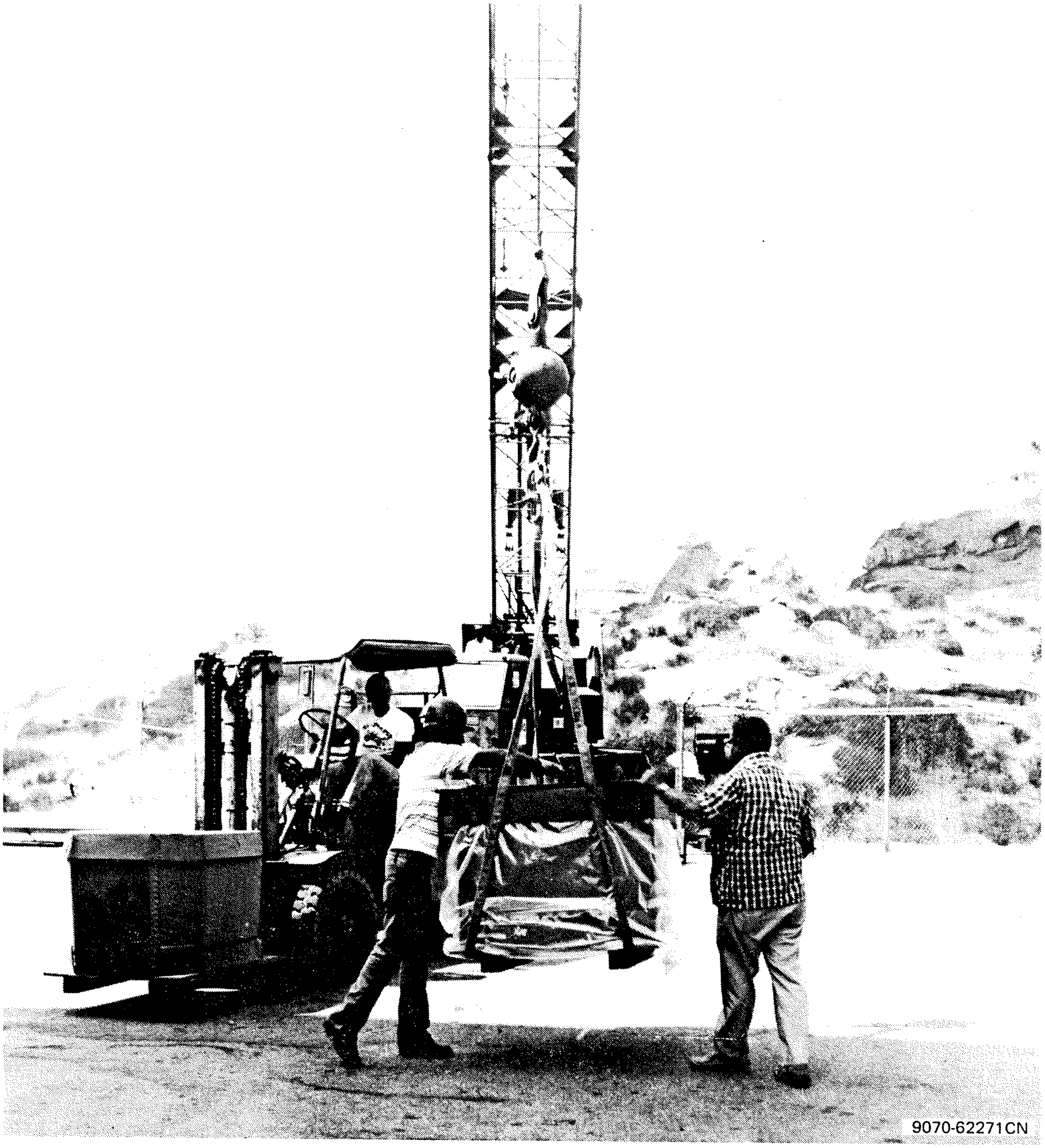

Figure 17. Receipt of Contaminated Soil Container at RMDF

Figure 18. Contaminated Rock Fractures

Figure 19. Contamination Removal from Rock Fracture

Figure 20. Close-up Photograph of Contamination Removal from Rock Fracture

Figure 21. Covering to Protect Leach Field from Rain

Figure 22. Compaction of Clean Overburden

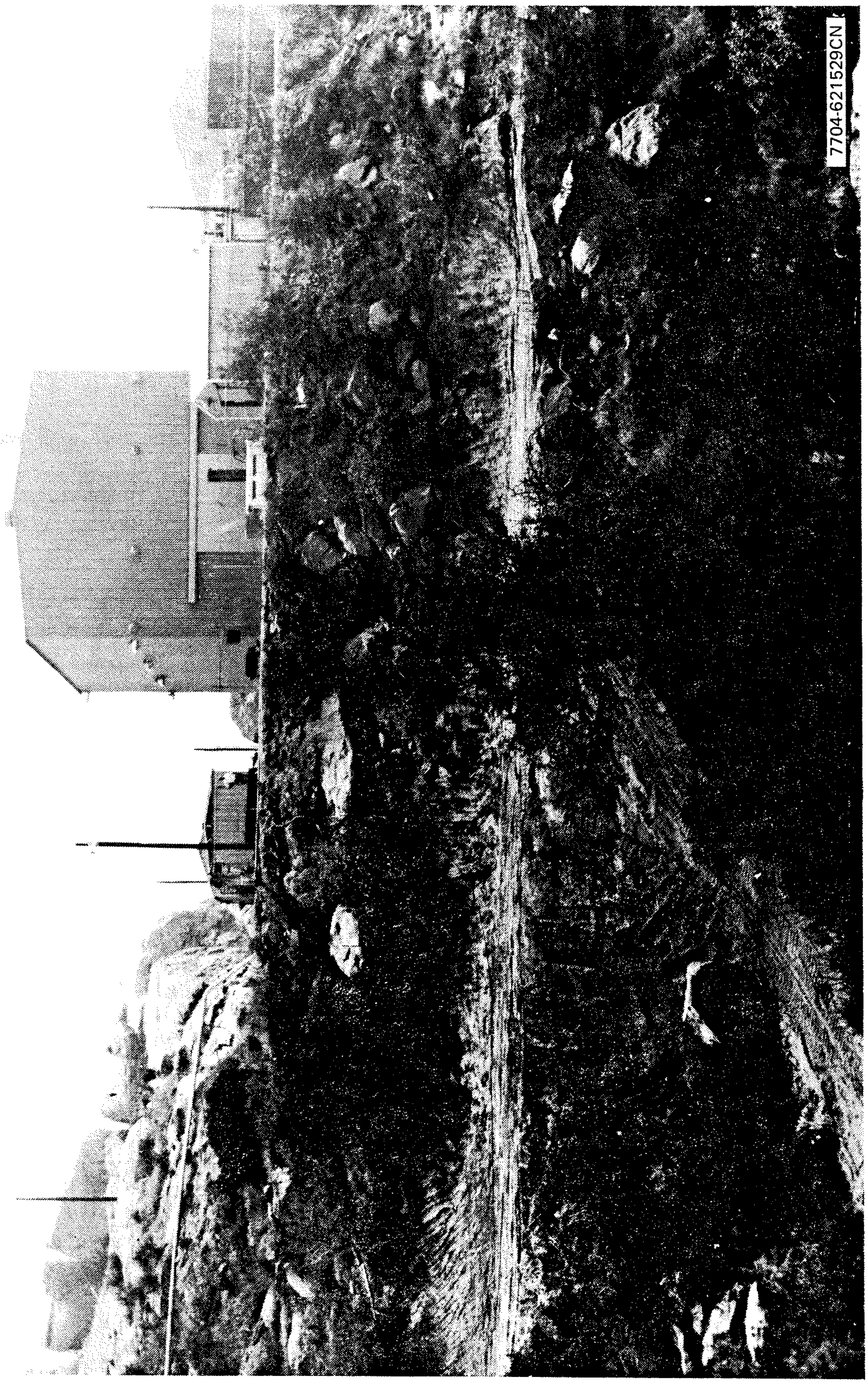

Figure 23. Appearance of Leach Field after Back-filling and Compaction

3.3 WASTE MANAGEMENT

3.3.1 Radioactive Waste Transportation and Burial

All radioactively contaminated material was boxed and then transported by commercial truck to the licensed NECO burial site at Beatty, Nevada, or to the government-owned Rockwell Hanford site near Richland, Washington. Only LSA material was removed from the RMDF leach field.

Packaging of soil was standardized: knockdown, corrugated-cardboard tri-wall boxes were used, each with an attached plywood pallet and approximately 27 ft^3 of space (shown in Figure 24). The inside of the box is lined with a plastic bag that is large enough to drape over the outside to protect the outside surface of the box from contamination during the filling operation. The box is closed by tying and folding the bag over the top of the contained soil, covering it with a cardboard lid, and banding the box in two directions to secure the lid and provide added strength (see Figures 25 and 26).

Each knockdown box kit cost about $30. The box can be erected for filling in just a few minutes, and the kit takes little space to store. Regular shipments were made from the RMDF to keep a low inventory of filled boxes.

3.3.2 Disposition Site

The contaminated soil from the leach field was sent in part to each of two sites. The choice of receiving site was made for reasons that did not involve the leach field contaminated soil conditions, as either site was equally acceptable.

The bulk of the material, 28,150 ft^3, was sent to the NECO site at Beatty, Nevada. This site is operated by U.S. Ecology (formerly Nuclear Engineering Company, NECO) under a State of Nevada license, as well as an NRC license for Special Nuclear Material. The remainder, 8100 ft^3, was sent to the Rockwell

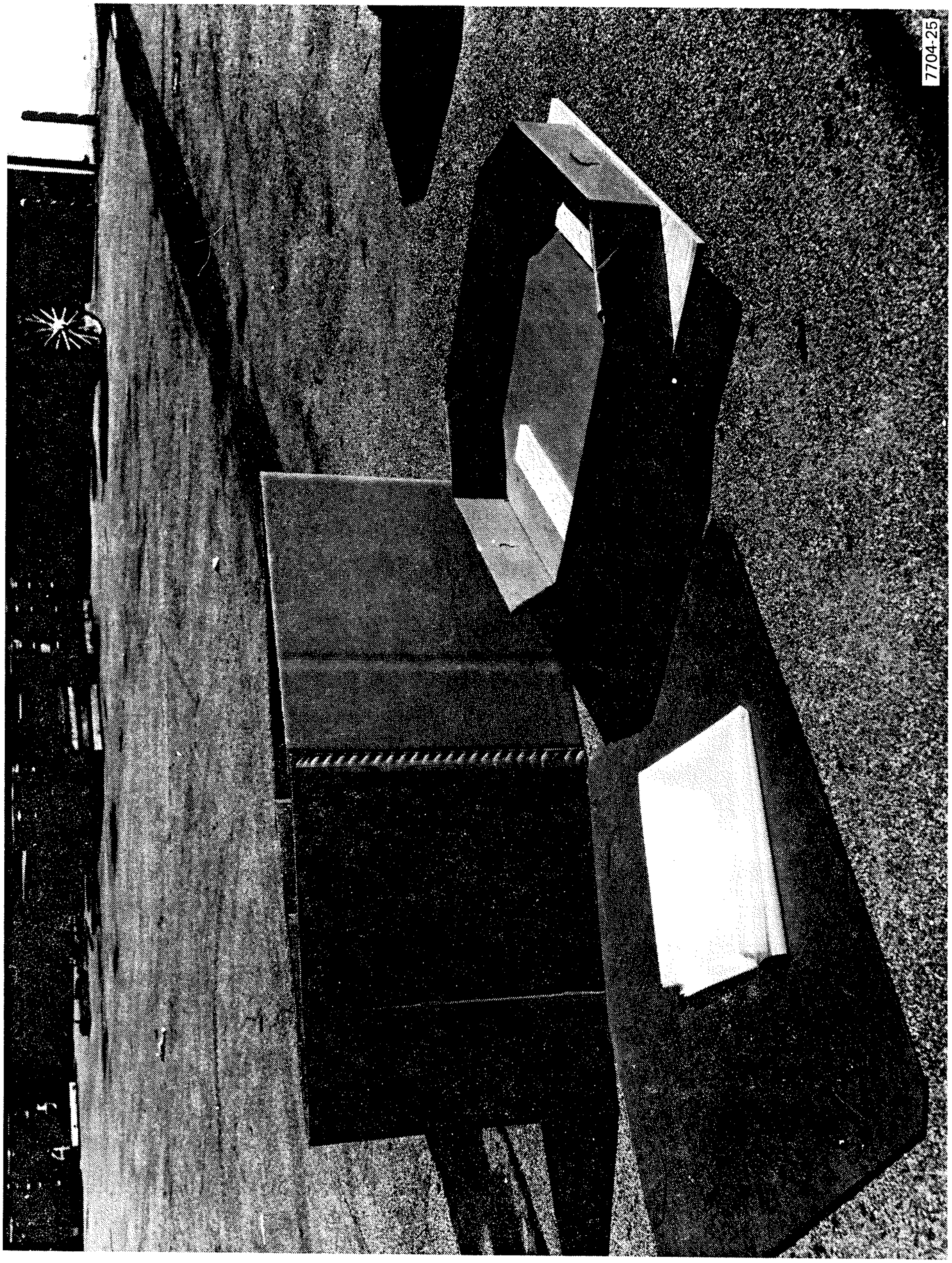

Figure 24. Components of Contaminated Soil Container

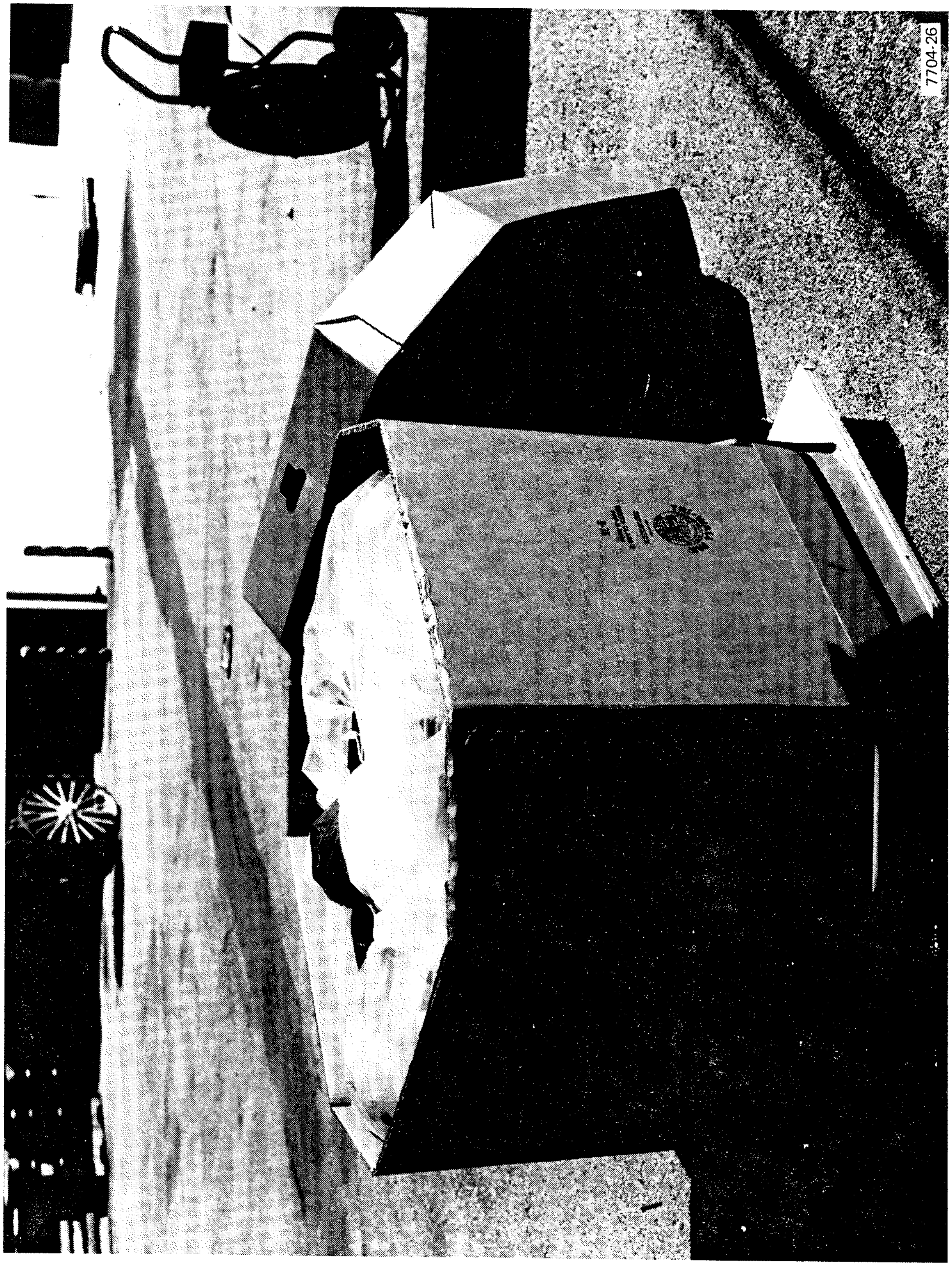

Figure 25. Container Filled with Bagged Contaminated Soil

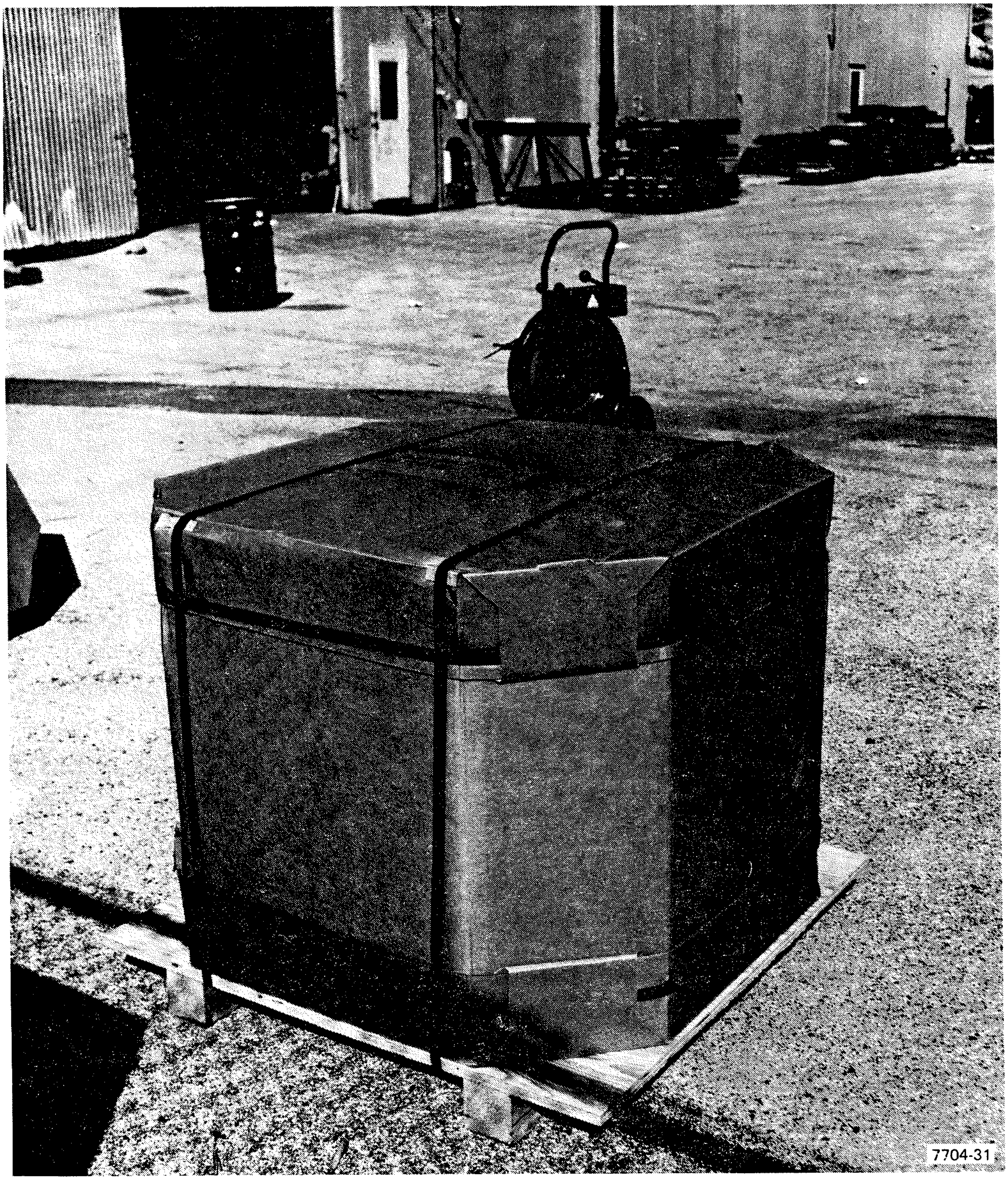

Figure 26. Container Banded to Pallet and Ready for Shipment

Hanford site near Richland, Washington. This site is operated by Rockwell Hanford Operations, a division of Rockwell International, Energy Systems Group, for the Department of Energy.

The cost of burial at Beatty was increased from \$2.65 to \$3.80/ft^3 during this project. The cost of burial at Rockwell Hanford was constant at about \$.70/ft^3. However, since the travel distance is substantially greater to Rockwell Hanford, the cost differential was not great.

The transportation cost to Beatty was \$775 for one 40,000-lb truck load. The transportation to Richland was \$1300.

The boxes were transported in a closed van-type truck. The loading operation is shown in Figure 27. Only one layer of boxes could be placed in the van without exceeding its weight limit.

3.3.3 Construction Materials Processed

There were no construction materials from the RMDF leach field that were processed as radioactive waste. All the lumber and sheeting used for temporary weather protection were salvaged for use at other areas within the RMDF or for the construction of waste shipping boxes.

3.3.4 Soil and Other Waste Processed

The leach field decommissioning generated a total of 1450 boxes of soil, 62 drums of water, and miscellaneous pieces of material that were processed and packaged for shipment to offsite burial. This represents 36,250 ft^3 or 1600 tons of material. The water was processed by evaporation to sludge at the RMDF, and the resultant material was solidified by the cementation process. The solidified sludge was disposed of as solid radioactive waste material, and it is included in the above volume and tonnage.

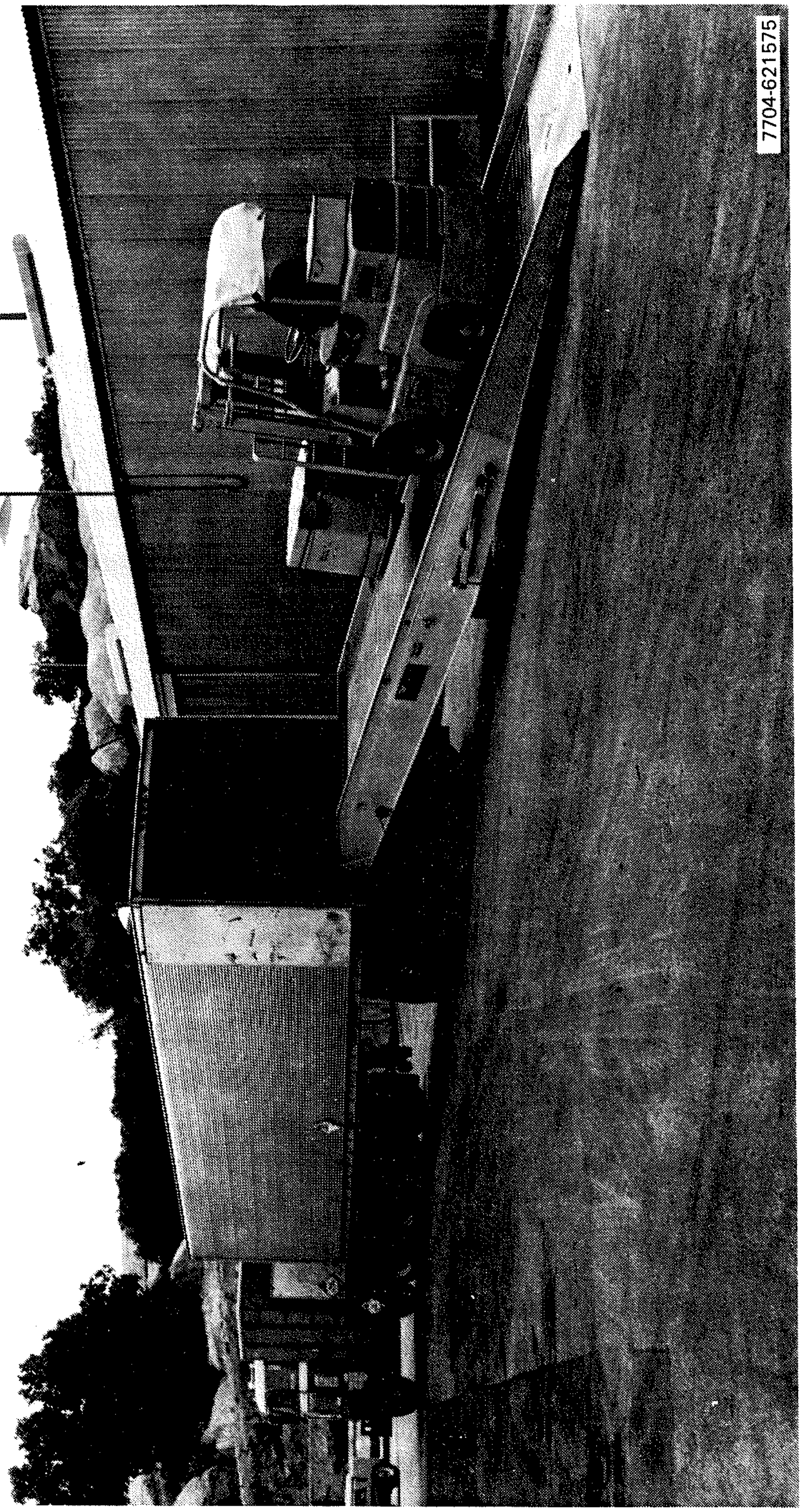

Figure 27. Loading of Soil Containers into Closed Van

3.4 SPECIAL PROBLEMS AND SOLUTIONS

The leach field was used for sanitary waste disposal from 1959 through 1961 and was considered a potential biological hazard. It remained unused for the intervening 15 years. Being idle this long assured that no harmful virus or bacteria would remain and that the protective precautions employed for handling radioactive materials were more than sufficient protection against any potential remaining biological hazard.

The leach field was at the base of a steep bank, and it was located about 50 ft north and 30 ft below the RMDF storage yard. It was not feasible to cut a road in the bank; therefore, vehicle access was provided by a steep bulldozed dirt road in the canyon to the north-east. This road is shown clearly in Figures 28 and 29. The travel distance to this road from the gate of the RMDF, near Building 034, was 1 mile. The mobile crane positioned in the RMDF yard at the top of the bank moved boxed soil and equipment directly between the leach field and the RMDF, avoiding the difficult surface transportation. Personnel and light equipment used the road for access.

3.5 EQUIPMENT/PROCESS DEVELOPMENT

No unique equipment was used. All of the earth-moving equipment was rented or contractor-owned and was easily decontaminated and released.

3.6 RADIATION EXPOSURE

3.6.1 Total for Project

The group of people working on the RMDF leach field decommissioning project varied, as particular talents and personnel availability from other similar assignments permitted. The ESG work force was supplemented by contractor personnel, who did much of the work in the leach field. Packaging, handling, and warehousing other radioactive waste materials at the nearby RMDF is included in the total exposure because the operation involves simultaneous exposure to radioactive waste from several projects. No effort was made to provide selective

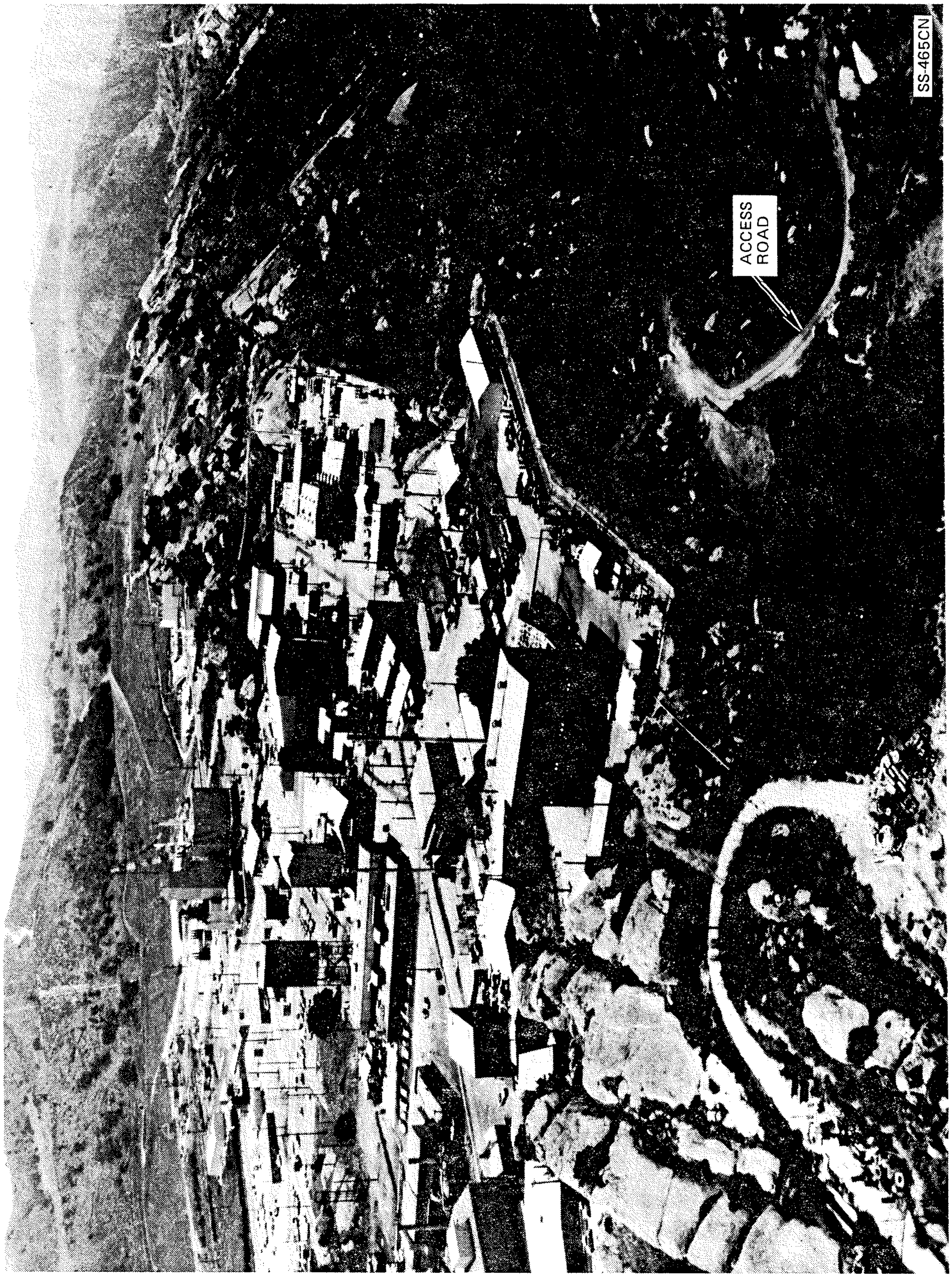

Figure 28. Access Road to RMDF Leach Field

Figure 29. Close-up Photograph of Access Road

dosimetry for individual projects. Including all of these activities together, the total group exposure to both ESG employees and outside contractors was 2.58 man-rem.

3.6.2 Maximum Individual Dose

The estimated maximum integrated dose received by an individual assigned to the project over the time of active decontamination was 1280 mrem from all sources. This was primarily due to operations with radioactive waste from other projects at the RMDF.

3.6.3 Average Individual Dose

The estimated average individual dose for all workers assigned to the decontamination project, exclusive of supervision and other nonexposed personnel, was 184 man-rem as read from film badge dosimeters. The routine bioassay of all workers assigned to this project showed negligible internal exposure.

3.6.4 Health Physics

The RMDF leach field decommissioning followed guidance contained in DOE's Manual Chapter 0524 for radiological safety and for maintaining personnel exposure to as low as reasonably achievable (ALARA). This overall plan was implemented for the specific task of RMDF leach field decontamination in the ESG Safety Plan.

The ESG manager of Health, Safety & Radiation Services (HS&RS) was responsible for establishing standards of safety; examining proposed operations for hazards; determining the safety measures that were necessary; and evaluating the degree of compliance with safety measures, contract safety requirements, licenses, and regulations. Members of the HS&RS staff prepared an Operational Safety Plan in support of the decontamination plan; reviewed all operational procedures documentation; and provided day-to-day health physics, industrial hygiene, and safety surveillance of the activities. They also reviewed the qualifications of persons assigned to work in the radiologically posted areas, and they established that these persons were fully qualified "radiation workers" possessing sufficient familiarity with the operations in the posted areas to allow them to work safely in these areas.

Since decommissioning is a series of nonroutine activities, primary protection was provided by continuous monitoring of radiation exposures and contamination and by a continuing review and evaluation of the individual activities to minimize potential exposures to radiation and radioactive contamination.

Written plans for the decontamination had detailed reviews, including consideration of various approaches and their effectiveness in minimizing radiation exposure and the spread of radioactive contamination. These reviews considered working times; the radiological and biological hazards involved; and the proper use of protective clothing, shielding, and remote handling equipment, although no remote handling was employed.

A monitoring program was implemented as required by the operations underway. This included, wherever appropriate, the use of area air samplers and radiation and contamination surveys. Monitoring and protective equipment were designated as necessary and included personal film badges, special badges for tasks with potential high exposure risk (processed at suitable intervals), protective clothing appropriate to the working conditions, and respirators chosen according to the hazard.

Dosimetry results, as recorded by film badges and bioassay data, and radiation and contamination surveys were evaluated to determine possible means of improving the control procedures and to ensure exposures remained as ALARA.

For operations in areas in which conditions were not changing, radiation levels were posted. In most instances, however, the radiation level changed significantly during the course of the work and was monitored frequently.

Procedures for major operations were submitted for review and approval to the Isotopes Committee of the AI Nuclear Safeguards Review Panel; this committee considers effective implementation of the ALARA program in the activities under review.

3.6.5 Public and Personnel Safety

There were no anticipated large or difficult radiation control problems with the RMDF leach field decontamination activity. Therefore, no special procedures or precautions beyond the normal project activities were prepared. The work proved to be adequately controlled using the standarized procedures developed for other similar projects at the ESG SSFL.

3.6.6 Protective Procedures

The protective procedures included those designed to protect workers and the public from unnecessary exposure to the low-level radiation present at the site. Continuous air sampling was performed during soil drilling operations. Water spray dust control was employed for this and other operations that might generate airborne radioactive contamination. Protective clothing was required. Complete containment of all transported radioactive waste was required. Frequent monitoring of waste prior to removal ensured that no unplanned exposure would occur.

The leach field area was fenced and posted as a radiologically controlled area before and during the decommissioning activities. The boundaries of the controlled areas varied in order to meet the site conditions and operations being performed at the time.

A Restricted Access Area Entry Permit was completed for each shift (depending on the operation to be performed). The HS&RS representative specified on the permit the protective clothing, monitoring devices, and respiratory protection required to proceed with the described task. The requirements varied depending on the degree of contamination and radiation levels involved.

3.6.7 Equipment, Materials, and Instrumentation Requirements

The following types of radiation monitoring equipment were operational and available during the site preparation and removal of radioactive or contaminated components:

1) α counting system, 1 minimum
2) β counting system, 1 minimum
3) Juno survey meters, 4 minimum
4) GM survey meters, 2 minimum
5) Personnel survey monitors, 2 minimum
6) Air samplers, 2 minimum
7) Dosimeters, 10 minimum
8) Dosimeter charger, 1 minimum
9) Visitor film badges, 12 minimum.

Film badges were worn by all persons entering the radiologically posted areas. Radiation exposure to personnel was maintained at ALARA levels.

4.0 PROJECT COST AND SCHEDULE

4.1 COST

The cost of decontaminating the RMDF leach field was accumulated by the Rockwell International accounting system. The effects of having an experienced work force and well-equipped support facilities in close proximity to the decommissioned site must be considered in making comparisons with other projects.

The active portion of the RMDF was a significant advantage in that waste materials could be processed easily, e.g., concentrating liquids, combining box loadings, and filling shipments to the burial site with a mix from other waste-generating activities. The availability of a Health Physics laboratory that could rapidly process and analyze the radioactivity of soil samples permitted almost continuous excavation activity while ensuring complete removal of all radioactive materials.

The work crews were drawn as needed from an experienced group working on other similar activities, therefore reducing training and idle time accumulation. Also, independent contractors worked several jobs together, contributing special machinery at the site on short notice.

There were no costs compiled in the Health Physics area for the instruments and recorders used, since these are all government-owned general laboratory equipment used for many government contract activities. Only the direct-charge monitoring costs were recorded. The total of these costs is $40,000.

The administrative hours required to manage the task comprise monitoring of cost and schedule performance, quality assurance, and procurement. The total time recorded is 2900 man-hours.

The Engineering activity included preparing plans and procedures for the decommissioning work and supervising the contractors employed to do the work. The Engineering activity is recorded as 8100 man-hours.

Purchased labor from contractors included all skilled and unskilled labor. Skilled labor includes machine operators and riggers; unskilled labor includes general laborers for hand digging and material sorting.

The RMDF leach field project salvaged some of the overburden dirt to use as backfill in the completed excavation. The backfill was finished off at a grade lower than the grade that previously existed over the leach field; therefore, very little "new" local soil was needed to complete the backfill. In essence, any cost that was recovered is reflected in lower earthmoving costs.

The plastic sheeting and wood used for the temporary weather protection were salvaged for use in other operations. Some of the wood and plastic was used for construction of special shipping boxes. It is estimated that the salvage value of these materials did not exceed $10,000.

There is little if any value assigned to this small area within the large (90 acre) leasehold. It is not usable for construction.

	Hours	Dollars
Labor hours (Rockwell)	12,000	
Labor dollars (Rockwell)		312,000
Material and purchased labor (including transportation and burial from Section 3.0)		411,000
General expense and fee		128,000
Total cost		851,000
Less estimated salvage		10,000
Net cost		841,000

4.2 SCHEDULE

The project schedule, Figure 30, reflects the actual progress of the job but excludes the preliminary activities associated with the initial discovery and protective measures.

In retrospect, one important facet of the RMDF leach field decontamination is apparent. Timely action following the identification of the site condition would definitely have shortened the schedule with a corresponding decrease in overall project cost. Specifically, the test bore holes to document the condition of the leach field opened pathways to contaminated subsoil. Several years of inaction permitted rainwater intrusion to these holes resulting in the increased spread of contamination.

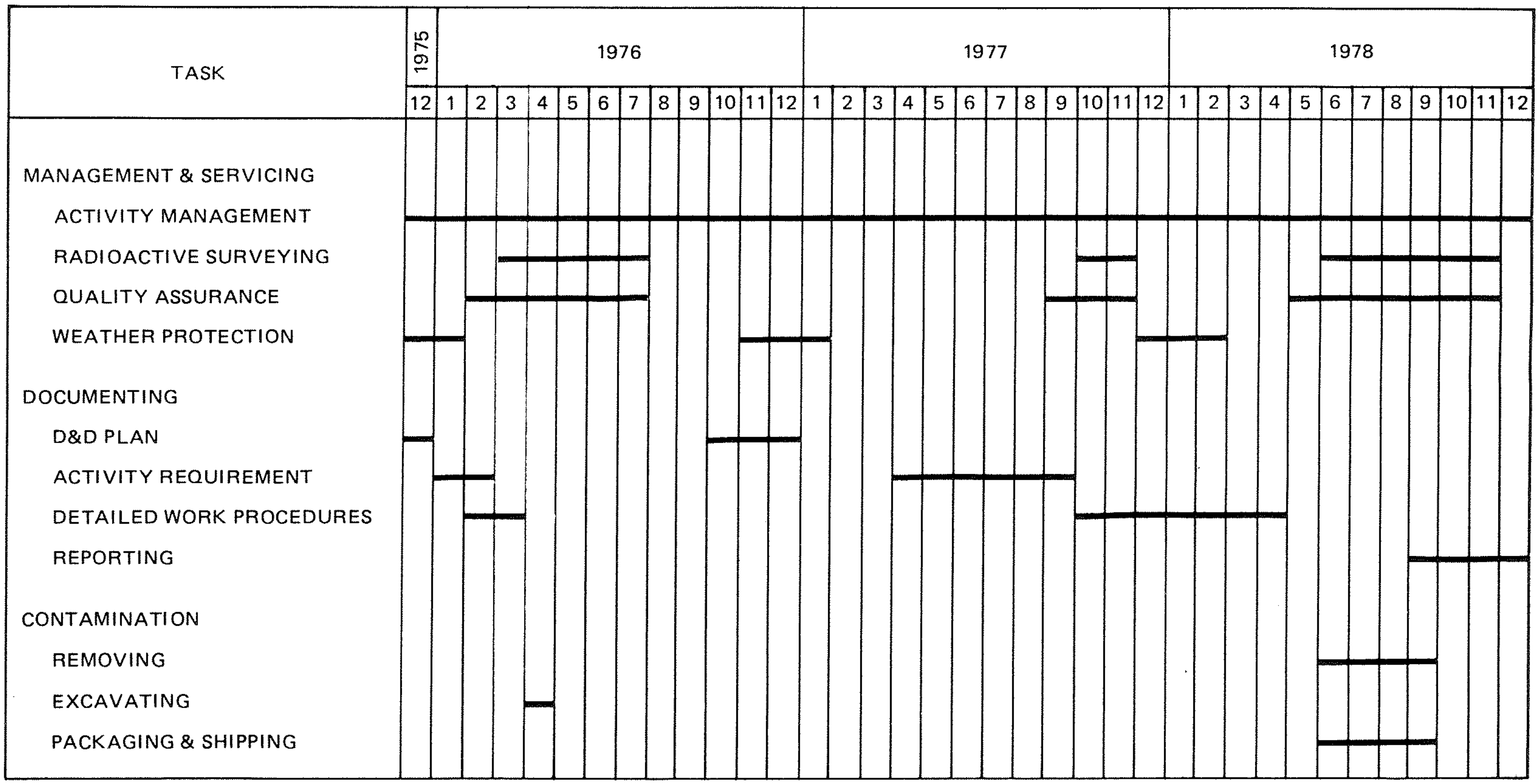

Figure 30. RMDF Decontamination Schedule (Leach Field)

5.0 SITE RELEASE

The use of radioactive materials in California is licensed and regulated by the Nuclear Regulatory Commission (NRC), in the case of special nuclear materials, or by the State of California Department of Health, in the case of source and byproduct materials. Government owned or controlled facilities are exempt from licensing when there is demonstrated government use or need. When DOE is the responsible agency, the DOE Operations Manual provides guidance and direction.

Industrial safety requirements at ESG-owned facilities are defined by the California Occupational Safety and Health Administration (Cal-OSHA) regulations, as administered by the California Department of Occupational Safety and Health. Industrial safety requirements at DOE-owned facilities are defined by DOE Immediate Action Directive No. 0504-33, as administered by DOE-OES.

The site was under federal government control and exempt from federal and state licensing regulations during the performance of the decontamination. This exempt status will extend as long as the land is government controlled; however, in the event the optioned land were to revert to ESG, the state regulations would apply. For this reason, the facility and land identified for unrestricted use has been decontaminated to a level that is projected to be acceptable to the State of California for an unlicensed area.

The site is in a radiological condition to be released for unrestricted use as shown in "Radioactive Materials Disposal Facility Leach Field Environmental Evaluation Report," DOE-SF-3.

The site has been requested to be released for unrestricted use.

6.0 CERTIFICATION OF COMPLETION

Both Rockwell International Health Physics personnel and contractor health physicists worked on the RMDF leach field decontamination activity. Health and Safety Analysis Reports were completed during the life of the project. Copies are maintained at ESG headquarters. Soil analyses were performed by ESG and duplicate samples were analyzed by Teledyne Isotopes of Westwood, New Jersey.

The final radiation survey consisted of 79 random soil samples taken from the surface of the leach field cover. They showed the gross beta specific activity of the cover soil to range from 15 to 46 pCi/g. The 2-g soil samples were counted on a Nuclear Chicago automatic system with a KCl standard with an average background of 30 cpm and a counting efficiency factor of 3.6 dpm/cpm. A complete walk-through survey of the field was conducted using a Technical Associates Model CP-7 beta-gamma ion chamber. The maximum dose rate detected was 0.06 mrad/h with an average background dose rate of 0.03 mrad/h throughout the field.

7.0 PROPERTY DISPOSAL

The leach field site is in a remote location that is not suitable for any foreseeable construction and most probably will be left to revert to its natural state.

Transfer of the property to Rockwell International is contingent on concurrence by the State of California that the property is suitable for unrestricted use and would be free from any licensing requirements.