Project RM 86-060-04
April, 1987

Canonie Environmental

Engineering Concepts

Reclamation Plan

Church Rock Site
Gallup, New Mexico

Prepared for:

UNC Mining and Milling
Gallup, New Mexico

Canonie Environmental

Canonie Environmental Services Corp.
6551 South Revere Parkway
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Englewood, Colorado 80111

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April 7, 1987

RM 86-060-04

Mr. Michael J. Brennan
Holland & Hart
Suite 2900
555 Seventeenth Street
Denver, Colorado 80202

Transmittal
Revised Draft Briefing Document
Reclamation Plan - Church Rock Site
UNC Mining and Milling
Gallup, New Mexico

Dear Mr. Brennan:

Enclosed are an original and five copies of the briefing document illustrating reclamation plan concepts for UNC Mining and Milling's Church Rock site near Gallup, New Mexico.

Very truly yours,

Michael J. Taylor, P.E.
Senior Vice President

MJT/klg

Enclosures

cc: Stanley Crout, Stephenson, Carpenter, Crout & Olmsted
Charles Johnson, UNC Mining and Milling

HOLLAND & HART
ATTORNEYS AT LAW

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April 9, 1987

HAND DELIVERED

Mr. Pete Garcia
U.S. Nuclear Research Commission
Region IV
Uranium Recovery Field Office
Post Office Box 25325
Denver, CO 80225

Re: UNC Mining and Milling
Conceptual Reclamation Plan

Dear Mr. Garcia:

On behalf of our client, UNC Mining and Milling, enclosed are three copies of UNC Mining and Milling's Conceptual Reclamation Plan for the Church Rock, New Mexico Mill and Tailings facility. We would like to meet with you to discuss the concepts set forth in this Plan as soon as possible. If you have any questions or comments regarding the enclosed prior to our meeting, please call me.

Sincerely yours,

Mike Brennan/ssb

Michael J. Brennan
for HOLLAND & HART

MJB/ssb
Encl.
cc: Mr. Charles G. Johnson

Engineering Concepts

Reclamation Plan

Canonie Environmental

BRIEFING DOCUMENT
ENGINEERING CONCEPTS
RECLAMATION PLAN
UNC MILLING OPERATION
GALLUP, NEW MEXICO

INTRODUCTION

This briefing document outlines concepts for United Nuclear Corporation's (UNC) proposed interim stabilization and final reclamation of the uranium mill and tailings disposal area at the Church Rock facility near Gallup, New Mexico. The purpose of the document is to allow regulatory agencies to review the concepts and to identify potential concerns prior to finalization of the design and preparation of the reclamation plan. The final plan will include radiological and engineering data in support of the concepts presented herein.

Site Description - The UNC mill and tailings disposal sites are located about 20 miles northeast of Gallup, New Mexico, in McKinley County. UNC owns the surface of Section 2, Township 16 North, Range 16 West, and Section 36, Township 17 North, Range 16 West, as shown on Figure 1. The mill and tailings sites are located in Section 2. The tailings disposal area occupies approximately 100 acres, and the mill site and facilities area occupy approximately 25 acres. The tailings disposal area has been subdivided by cross-dikes and contains the south cell, central cell, and north cell areas as illustrated on Figure 2. A stream channel referred to as the Pipeline Arroyo, an ephemeral drainage, lies between the facilities area/highway 566 and the tailings disposal area.

Operations - UNC began mill operations for the production of yellowcake in May, 1977. Ore for processing was primarily obtained from two underground mines owned and operated by UNC. Significant quantities of mine water (approximately 89,000 acre-feet) were discharged to Pipeline Arroyo during the period 1968 through 1986 by both UNC and Quivira Mining Company (Quivira) operations. UNC's mill employed a conventional acid leach,

solvent extraction process to produce yellowcake. The mill was designed to operate with a throughput of 4,000 tons per day (TPD).

Geology - The geology in the site area consists of Cretaceous age sandstones and shales overlain by Quaternary alluvium. As shown on Figure 2, the tailings area is located primarily on alluvium except in the northeast where bedrock is exposed at the surface. The bedrock present in the tailings area includes, in descending order:

- Dilco Coal Member (Dilco) of the Crevasse Canyon Formation.
- Upper Gallup Sandstone (Gallup) divided into:
  - Zone 3, upper sandstone.
  - Zone 2, shale and coal.
  - Zone 1, lower sandstone.
- Upper D-Cross Tongue Member of the Mancos Shale (Mancos).

The Dilco crops out in the central and northeastern portions of the tailings area. However, the base of this unit is located at an elevation above the top of the tailings, precluding contact of this unit with tailings seepage. Zone 3 and Zone 1 sandstone are covered by alluvium throughout the tailings area except in two locations. Zone 3 crops out directly beneath tailings in the northeast corner of the tailings area, and Zone 1 is exposed in the bottom of Borrow Pit No. 2 on the east side of the tailings area, as shown on Figure 2. The locations of Zone 3 and Zone 1 outcrops are significant because these strata are somewhat permeable and can transmit water. Zone 2 has very low permeability and acts as a barrier to water flow between Zone 1 and Zone 3. The Mancos underlies Zone 1 throughout the tailings area and is a barrier to the flow of water to underlying formations.

Hydrogeology - The hydrogeology of the UNC site is best described in two phases. The first phase represents site conditions prior to the onset of mining and milling activities. This pre-mining phase is characterized by the lack of a continuous ground water system in all near-surface geologic formations in the site vicinity. The second phase represents site conditions as they exist at the present time and the changes that have occurred as a result of the mining and milling activities. The following provides details on the pre- and post-mining and milling phases of the hydrogeologic site conditions:

- Pre-Mining and Milling - Prior to mining and milling activities, the near-surface bedrock units and the alluvium in the vicinity of the tailings disposal area were essentially unsaturated. The alluvium and exposures of the Gallup received minor amounts of water from direct precipitation. The exposures of the Gallup in the site area serve as a part of the recharge area for the Gallup aquifer to the north in the San Juan Basin. However, the recharge from precipitation did not result in saturated conditions at the site. Evidence of unsaturated conditions in these geologic formations comes from the construction log for the mine shaft and from the absence of water in geotechnical borings in the tailings area.

  According to the log for the UNC mine shaft sunk in 1968, water was first encountered at an elevation of approximately 6,700 feet. The location of the mine shaft is shown on Figure 2. The tailings disposal area is located at an approximate elevation of 6,980 feet. If a ground water system existed at a corresponding elevation of 6,700 feet under the tailings area, it would lie below the bottom elevation (6,800 feet) of Zone 1 (Figures 3 and 4).

  Geotechnical borings completed in 1968 and 1976 also support the conclusion that the tailings area was unsaturated prior to the mining activities. Boring HL-5 (1968) was air-drilled to an elevation of 6,834 feet and encountered no water during a 24-hour period following

completion of drilling (Figures 2 and 4). This boring was reportedly completed in alluvium. Furthermore, as shown on Section E-E (Figures 2 and 4), the bottom elevation of this borehole is below Zone 1. Borehole No. 76SHB-2W (1976) was drilled through alluvium ~~and Zone 3~~ and completed in the upper part of Zone 1 at an elevation of 6,820 feet (Section C-C, Figures 2 and 3). The borehole was reported to be dry with a possible perched zone at an elevation of about 6,932 feet. Therefore, both the alluvium and the Gallup in the vicinity of the UNC facility were unsaturated prior to the mining activities at the site.

o Post-Mining and Milling - Conditions at the site changed in 1968 as a result of discharge of mine water into the arroyo. Artificial recharge from the arroyo to the alluvium occurred via discharge of mine water from both the UNC and Quivira mines. The total volume of mine water discharged to the arroyo from the UNC mine (discharged from March, 1968, through February, 1983) and the Quivira mine (discharged from November, 1971, through February, 1986) was estimated to be 89,000 acre-feet. This discharge saturated portions of the alluvium and Zone 3 and Zone 1 of the Gallup creating a ground water system which is now described and referred to as the "local" system.

Partial saturation of the area by the discharged mine water is evident in the vicinity of both the borings discussed above which were reported dry when drilled. At the present time, the water level in the vicinity of Boring HL-5 is approximately 81 feet above the bottom of the boring and approximately 100 feet above the bottom of the boring in the vicinity of Boring 76SHB-2W.

The water discharged from the mines was of good quality and was characterized by low concentrations of TDS [approximately 500 milligrams per liter (mg/l)], neutral pH, and low nitrate (less than ten mg/l). However, as the mine water percolated through the alluvium, it dissolved various soluble constituents in the soil materials and evolved into a new water chemistry which is characteristic of the

local system. The evolved chemistry of the water that percolated through the alluvium is characterized by increased TDS (typically in the range of 2,000 to 5,000 mg/l) and increased nitrate (typically in the range of 10 to 300 mg/l). Because of the relatively inert geochemistry of Zone 3 and Zone 1 of the Gallup, further changes in the mine/alluvium water quality did not occur as it migrated into and through Zone 3 and Zone 1.

- o Tailings Seepage - Tailings disposal began in May, 1977, and continued through May, 1982. An estimated 2,460 acre-feet of tailings liquid was deposited with a total of approximately 1,230 acre-feet lost to evaporation and 280 acre-feet lost during the breach in 1979. The remaining total of approximately 950 acre-feet was available for either pore water retention or infiltration from the onset of tailings deposition until termination of disposal in 1982. The seepage from the tailings created a localized mound on top of the local system. The mound is currently located primarily in the north tailings cell and the borrow pit areas.

Both the local flow system and the seepage mound represent transient hydrogeologic conditions at the site. Since the original sources of water (i.e., mine water discharge and later seepage from tailings disposal) have been removed, eventually the system will return to the unsaturated condition that was documented to have existed prior to mining and milling activities at the site.

CURRENT ACTIVITIES

Radiological Survey - UNC has completed a radiological survey of the mill facilities and property near and adjacent to the tailings disposal area and Pipeline Arroyo. From this site survey and information previously collected, the following conclusions were made regarding radiological conditions at the Church Rock site:

- Background Radium Contents and Gamma Survey - Three representative areas were selected for collection of data to determine the background levels for Radium-226 in the soils and background gamma exposure readings. Soil samples for radium content analyses were collected at 36 locations. The results of the background sample analyses showed that the weighted mean for Radium-226 in the soil was 0.78 pCi/g with a standard deviation of ±0.53 pCi/g. A total of 150 gamma readings were collected, 50 in each area. From these readings, it was determined that the mean background external gamma radiation exposure rate was 15 uR/hr with a standard deviation of ±1.35 uR/hr.

- Wind-Blown Tailings - The prevailing wind at the site is from the southwest and has resulted in limited tailings dispersal to an area northeast of the north tailings cell. The approximate areal extent of wind-blown tailings is shown on Figure 5. The radiological survey showed that there were no other areas of wind-blown tailings. The reclamation plan provides for removal of the contaminated soils in the wind-blown area to a depth of approximately six inches (15 cm) and placement of those soils in the tailings disposal area as part of interim stabilization.

- Catch Basins I and II - As shown on Figure 5, two catch basins are located to the east of the mill facilities area. These two basins collected surface runoff from the mill and ore storage areas. Radiological measurements taken from these catch basins show that Radium-226 concentrations exceed the 5 pCi/g requirements of NRC 10 CFR 40, Appendix A standards. By-product-contaminated materials in these two basins will be removed and placed in the tailings disposal area during final reclamation.

- Facilities Area - UNC plans ultimately to remove all facilities except the administrative offices, garage and shop building, and guardhouse as shown on Figure 5. The radiological survey did not reveal elevated

levels of Radium-226 in the soil or asphalt outside of these buildings. The radiological survey in other areas showed some elevated levels of Radium-226, and contaminated soils in these areas will be removed and placed in the tailings disposal area after building/equipment and asphalt removal. UNC will monitor the radiological concentrations in these areas during mill demolition and asphalt removal to determine the areal extent of the contamination and its depth.

- o Cover Material - An investigation was conducted to determine the radiological characteristics of soil material, located on-site, for potential use as tailings cover material. The results of these investigations show that the soil material within and adjacent to the Pipeline Arroyo is suitable for use as the final cover material over the tailings area. Radium concentrations are below regulatory requirements, and the physical characteristics (moisture, grain-size distribution, porosity, etc.) provide for a soil material suitable for reduction of radon emanation to acceptable levels.

Surface Water Hydrology/Geotechnical - Several investigations and analyses were performed within and adjacent to the Pipeline Arroyo. These included the following:

- o Geotechnical investigations to determine soil and rock physical properties for use in cover design and riprap evaluation;
- o Geomorphic investigations for development of long-term hydraulic channel characteristics;
- o Probable Maximum Flood (PMF) calculations by standard hydrograph generation techniques to identify the impact of the flood on the channel; and

- o Development of a channel reconfiguration to pass flows equivalent to the PMF.

INTERIM STABILIZATION PLAN

The interim stabilization plan addresses methods for drainage of stored water and initial stabilization of tailings. The primary activities to be performed as part of this plan are as follows:

- o Drain Borrow Pit No. 2.
- o Grade tailings.
- o Remove soil contaminated with wind-blown tailings.
- o Place 8- to 12-inches of interim soil cover and revegetate.

The work performed as part of these activities is described in the following sections.

Drain Borrow Pit No. 2 - Prior to initiation of earthwork for the interim stabilization plan, UNC will drain approximately 123 acre-feet of water stored in Borrow Pit No. 2 (Figure 5). The water within the pit has been pH-neutralized using an existing lime treatment system. Drainage will be performed by pumping water through a spray system onto the tailings sands during dry periods of the year. The spray system will help minimize wind-blown tailings dispersal prior to placement of the interim soil cover. The system will be designed and operated so that the entire volume of the pond can be eliminated by evaporation over approximately a two-year period.

Grade Tailings - Tailings will be graded during interim stabilization as shown on Figures 6 and 7. This grading will provide slopes for the final reclamation and assist in preventing recharge from rain and snow.

The tailings present on-site consist of approximately 70-75 percent coarse sands and 25-30 percent slimes. Of the approximately 100 acres of exposed tailings, about 25 to 30 acres of slimes are exposed at the surface. Given

the much higher radium content and, therefore, potential radon flux of the slimes as compared to the sands, a layer of coarse sands will be placed over the slimes to limit radon flux at the surface. The exposed slimes will be covered with a minimum seven-foot thickness of compacted coarse tailings. This layer of coarse tailings will provide a uniform surface for placement of the 8 to 12 inches of interim soil cover. To minimize long-term soil cover losses due to water erosion and to minimize recharge, the tailings will be graded to provide positive drainage.

Remove Soil Contaminated with Wind-Blown Tailings - As shown on Figure 5, relatively limited wind-blown tailings dispersal has occurred in an area north and east of the north tailings cell. The approximate area that is impacted (Figure 5) will have approximately the top six-inch layer of soil removed and placed in the tailings impoundment. This material will be used as part of the soil cover for interim stabilization.

Place 8- to 12-Inch Soil Cover and Revegetate - A total soil cover thickness of 8 to 12 inches will be placed over the regraded tailings. This soil material will be obtained from the regraded area west of the tailings disposal area and adjacent to the Pipeline Arroyo and from the wind-blown tailings area. This interim soil cover will reduce the potential for additional contamination by wind-blown tailings. After soil placement the area will be disked or harrowed for seed bed preparation. The area will be planted with a wheat grass (e.g., crested wheat grass) or a cover crop of wheat or barley. The vegetative cover will aid in prevention of soil erosion from both wind and water.

Tailings Seepage - Several alternatives were investigated to treat tailings seepage at the UNC site. However, only one alternative, "No Action," was considered to be appropriate based on the following general conclusions regarding the site's hydrogeology:

- No naturally-occurring near-surface ground water was present in the site area prior to mining and milling activities. The ground water

system affected by tailings seepage was created solely by discharge of mine water and seepage from tailings disposal. Therefore, no useable natural aquifer has been affected by the mining and milling activities. Because mine water discharge from the UNC and Quivira mines ceased in 1986 and tailings disposal stopped in 1982, the local water system and the seepage mound developed in the tailings area will gradually dissipate without adversely affecting human health or the environment. Once the hydraulic gradient has flattened, the only mechanism for migration of seepage will be that due to dip of bedrock.

- The geochemical properties of the alluvium have neutralized acidic seepage. Studies indicate that seepage is neutralized within several feet below the contact between tailings and alluvium. Water quality data from wells completed in the alluvium generally indicate that seepage has been neutralized in the alluvium. Wells completed entirely in the alluvium show no significant evidence of acidity which is the primary indication of seepage. The alluvium will continue acting as a buffer zone to further neutralize seepage from the tailings.

- Zone 3 and Zone 1 of the Gallup which underly the alluvium were impacted by the seepage primarily where tailings directly contacted the bedrock. Zone 3 was contacted by tailings seepage in the northeast section of the north tailings cell, and Zone 1 was contacted by seepage from Borrow Pit No. 2. Investigation of possible remedial activities focused on the plume in Zone 3, shown on Figure 1, due to its possible continued migration to the northeast. However, as previously indicated, the Zone 3 bedrock is anticipated to return to an unsaturated condition and, therefore, no remediation is warranted. Similarly, since the driving head causing migration of contaminants into Zone 1 will be removed when Borrow Pit No. 2 is drained and the plume in Zone 1 is apparently stabilized (i.e., pH is either not changing or is becoming more neutral), no remedial action in Zone 1 is considered necessary.

- The nearest water supply well tapping the Gallup Sandstone (Zone 3) is located approximately 1.7 miles northeast of the tailings site (Figure 1). This well is used primarily to water stock grazing in the area. Calculations of dissipation of the seepage mound with time indicate that the predicted maximum extent of the plume in Zone 3 is approximately 1,200 feet to the northeast from the present location. As shown on Figure 1, a distance of approximately 6,200 feet is predicted to separate this nearest water supply well from the edge of the plume after the seepage mound has dissipated. Accordingly, seepage is not expected to reach the well under current conditions.

The following is a brief description of the selected alternative for the attenuation of tailings seepage.

Proposed Seepage Attenuation - The tailings seepage and stored mine discharge water will be subjected to natural attenuation and neutralization processes with time. Borrow Pit No. 2 will be drained as part of the interim reclamation efforts, the tailings will be regraded to reduce recharge, and the Zone 1 and Zone 3 ground water extraction wells which currently discharge to Borrow Pit No. 2 will be turned off. The ground water mound in the tailings area (Zone 1 and Zone 3) created by mine water discharge and seepage from tailings disposal will dissipate with time. The existing hydraulic gradient in Zone 3 and Zone 1 will gradually flatten and, as a result, further migration of seepage from the tailings will be negligible.

Although calculations indicate that the plume in Zone 3 will not reach the nearest water supply well, as discussed above, this well could be plugged and a replacement well could be constructed. The replacement well would be completed in a water-bearing formation located stratigraphically below the upper D-Cross Tongue Member of the Mancos which is the lower boundary of the formations affected by tailings seepage.

UNC believes that the passive natural attenuation of the seepage is the best alternative for treating tailings seepage at this site for several reasons. These reasons are:

- Protection of human health and the environment.
- Substantial reduction of the total cost of site closure. A cost savings of several millions of dollars is anticipated if this option is implemented.
- Reduction of the time required for reclamation activities.

FINAL RECLAMATION PLAN

The primary activities for final reclamation are as follows:

- Mill decommissioning.
- Backfilling and grading of Borrow Pit No. 2.
- Placement of a final soil cover.
- Reconfiguration of the Pipeline Arroyo.
- Revegetation of disturbed areas.

These activities are described further in subsequent paragraphs.

Mill Decommissioning - UNC has already accomplished part of the mill decommissioning by removal and sale of selected equipment. However, this equipment constitutes a relatively small portion of mill facilities. UNC plans to obtain release for unrestricted use of the guardhouse, administrative building, and garage and shop building, as shown on Figure 5. These buildings and associated parking lots will be used during performance of the reclamation work.

The remaining mill facilities, unsaleable equipment and buildings, concrete, piping and foundation materials to a depth of three feet below

grade, and other appurtenances will be demolished and removed. These materials will be buried in Borrow Pit No. 2, as shown on Figure 6. Clean soil from a borrow area will be used, if required, as cover and graded so that the area can be revegetated.

Backfilling and Grading of Borrow Pit No. 2 - Borrow Pit No. 2 will be backfilled with mill debris along with contaminated soils from within Catch Basins I and II. Concurrent with backfilling of the debris, soil from the existing stockpile located adjacent to Borrow Pit No. 2 (Figure 6) or elsewhere on-site will be used to provide access and ultimately as cover to bring the fill to the final grade.

Placement of a Final Soil Cover - Preliminary calculations of the final soil cover thickness to limit radon emanation were performed using RAECOM as outlined by NUREG CR-3533. The primary input values used in this program are shown on Figure 8. The calculated cover thickness to limit radon emanation is approximately 3.5 feet.

Additional allowances were made for wind and water erosion over the 1,000-year design life of the final soil cover. Using values from the New Mexico Soil Conservation Service, wind erosion will account for an approximate loss of about 0.45 feet of soil with water erosion accounting for a loss of about 0.05 feet of soil over a 1,000-year period. Therefore, the total proposed cover thickness will be approximately four feet.

The final cover soils will be placed in maximum one-foot thick lifts and compacted. The final lift will be compacted and the surface scarified for seed bed preparation. Figures 9 and 10 show contours after the final soil cover has been placed.

The majority of the soil used for the cover will be obtained from within the arroyo. Since modification of the arroyo will be necessary to adequately provide passage of the Probable Maximum Flood (PMF) without

encroachment on the tailings, the soil removed during this process will be used for the cover.

Reconfiguration of the Pipeline Arroyo - The current Pipeline Arroyo channel is not capable of carrying the predicted PMF without encroachment on, and possible erosion of, the tailings. In order to control the flow associated with the PMF, the following objectives were used to design a modified channel:

- Pass the PMF with no encroachment on the tailings area;
- Provide a stable base level for the channel to maximize its longevity and minimize head cutting; and
- Prevent gully formation on slopes adjacent to the tailings cover.

The proposed design data and modified channel cross sections are shown on Figures 11 and 12. Riprap or other suitable erosion protection will be required at critical sections as shown on the listed figures. Various rock sources have been investigated with the material currently identified as most desirable being limestone from quarries near Pinedale, New Mexico. Fabriform (concrete-filled synthetic forms) is also being considered.

The location of the selected reconfigured channel design is shown on Figures 9 and 10. In the alluvium, the channel will have a bottom width of 20 feet and 3H:1V side slopes. At the nickpoint (Figure 9), the channel will be cut approximately 25 feet into the sandstone of Zone 3 of the Gallup Formation. In the rock, the channel side slopes will be steepened to 1-1/2H:1V to reduce rock excavation quantities. Riprap will be placed at 3H:1V side slopes on any soil surfaces above the rock outcrop that would be contacted by the PMF (Figure 11). Incision of the channel into the nickpoint will ensure that the channel does not migrate toward the tailings disposal area. All flows will be concentrated within the channel. Lateral

migration of the channel above the nickpoint will be limited to the formation of meanders. The channel profile above the nickpoint, as shown on Figure 9, is steep enough to ensure that no channel sedimentation will occur that would raise the channel bottom and cause significant flows in the overbank area.

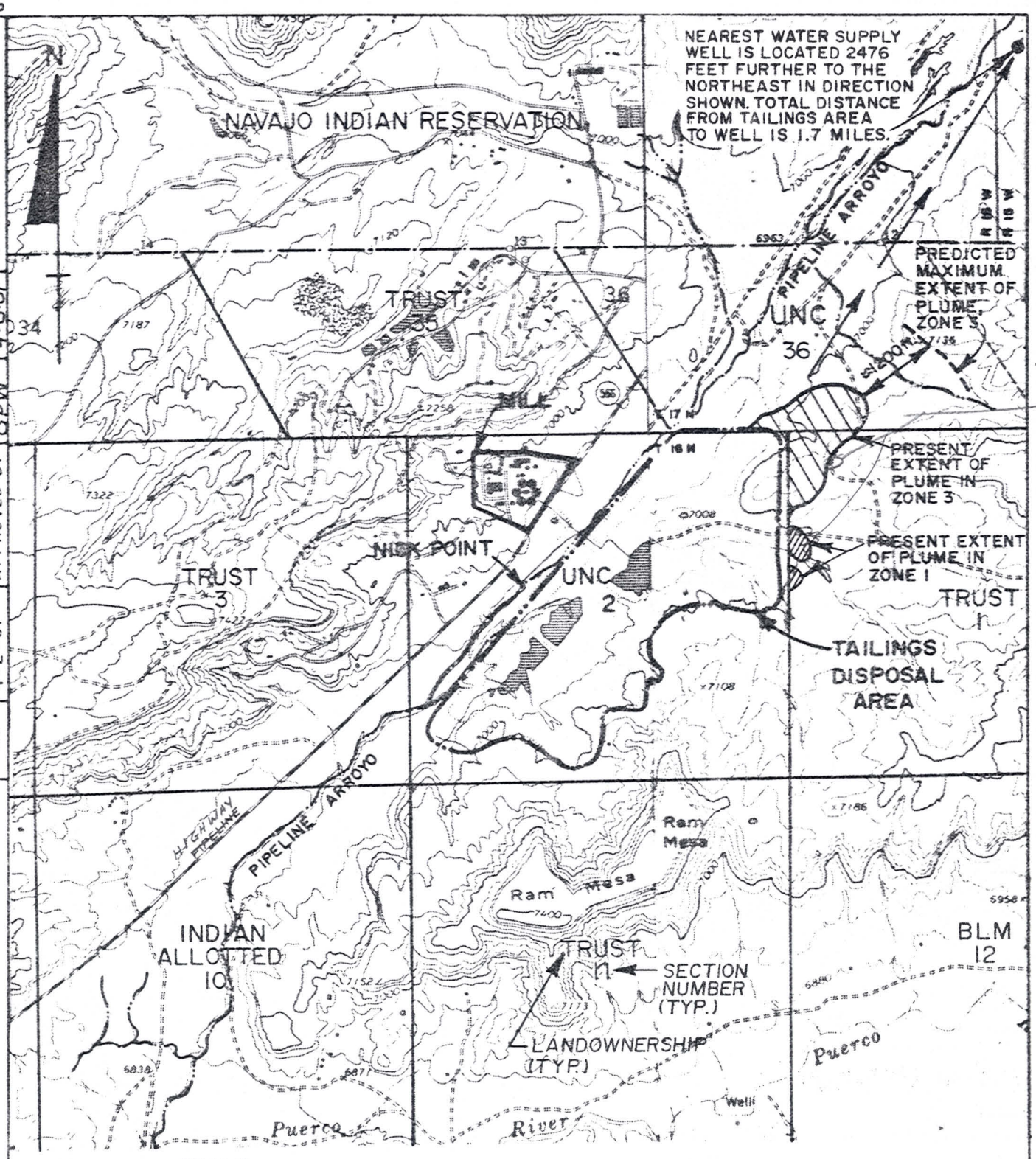
A base control section will be constructed of riprap at the outlet of the channel from UNC's property. This structure, which is shown on Figure 12, will prevent both downcutting of the channel from its present level and migration of headcuts from the downstream direction. Thus, the altered channel profile shown on Figure 12 will be maintained. This structure will also contain the PMF and all smaller flows and resist lateral migration of the channel.

Revegetation of Disturbed Areas - Following all earthwork operations, all disturbed areas, including the cover, will be seeded for revegetation. The areas will be reseeded with a permanent seed mixture that is native to the Church Rock site. A majority of the seeding will be accomplished by drill seeding. Fertilizer and mulch will be applied to enhance seed germination and reduce soil erosion loss.

WEJ/SdP/kt/bk/klg

FIGURES

102340



DRAWING NUMBER RM86-060-A15

DWE	4-8-87
QPW	4-8-87
CHECKED BY	
APPROVED BY	
J. Majali	4-2-87
DRAWN BY	

REVISIONS

NO.	DATE

LOCATION MAP

PREPARED FOR

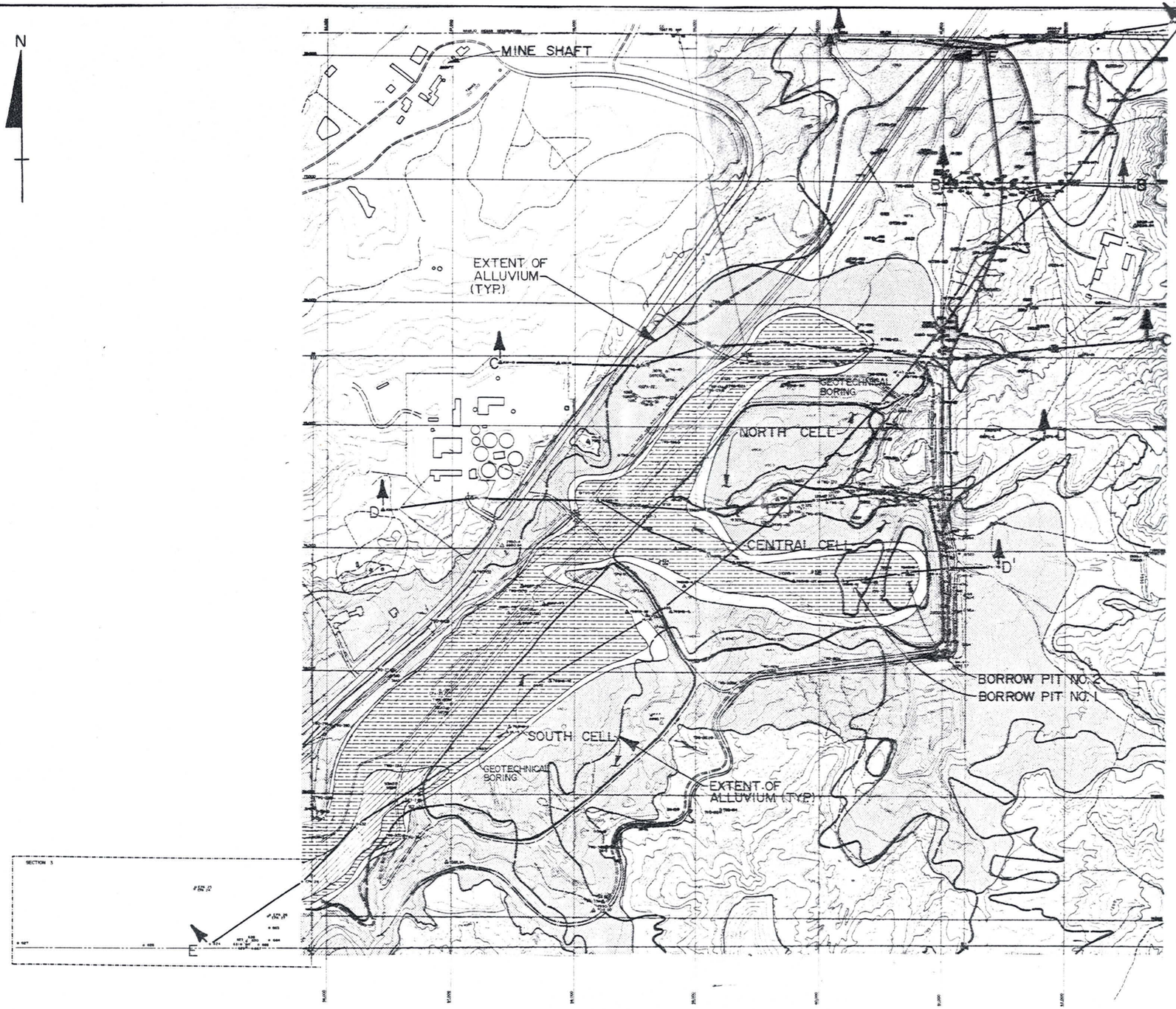
UNITED NUCLEAR CORPORATION
GALLUP, NEW MEXICO

Canonie Environmental

REFERENCE:

- U.S.G.S. 7.5 MINUTE TOPOGRAPHIC MAPS OF HARD GROUND FLATS, NEW MEXICO AND OAK SPRING, NEW MEXICO, DATED 1963. SCALE: 1"=2000'

DATE: 4-2-87 SCALE: AS SHOWN	FIGURE 1	DRAWING NUMBER RM86-060-A15



LEGEND:

- WELL
- GEOTECHNICAL BOREHOLE
- DEEP BOREHOLE

UPPER CRETACEOUS

- CREVASSE CANYON FORMATION DILCO COAL MEMBER (Kcdc)
- UPPER GALLUP SANDSTONE-ZONE 3 ($KguZ_3$)
- UPPER GALLUP SANDSTONE-ZONE 2 ($KguZ_2$)
- UPPER GALLUP SANDSTONE-ZONE 1 ($KguZ_1$)
- MANCOS SHALE-UPPER D-CROSS TONGUE MEMBER (Kmdu)

NOTES:

1. SEE FIGURE 3 FOR SECTIONS A-A, B-B AND C-C.
2. SEE FIGURE 4 FOR SECTION E-E.

SCALE
400 0 400 800 FEET

REFERENCE:

-COMPOSITE OF TOPOGRAPHIC MAPS PROVIDED BY UNITED NUCLEAR CORP. DRAWING NOS. 1798-A, AND C-1797-B. DATED: MAY 1, 1985. SCALE: 1" = 200'.

-GEOLOGY FROM FIGURE 84-6 TITLED "GEOLOGIC MAP, SEC. 2, T16N, R16W, NEW MEXICO, SCALE 1" = 275', D'APPOLONIA, 1980. REVISIONS 1986 BY CANONIE.

SITE AND GEOLOGIC MAP SECTION 2, T 16 N, R 16 W

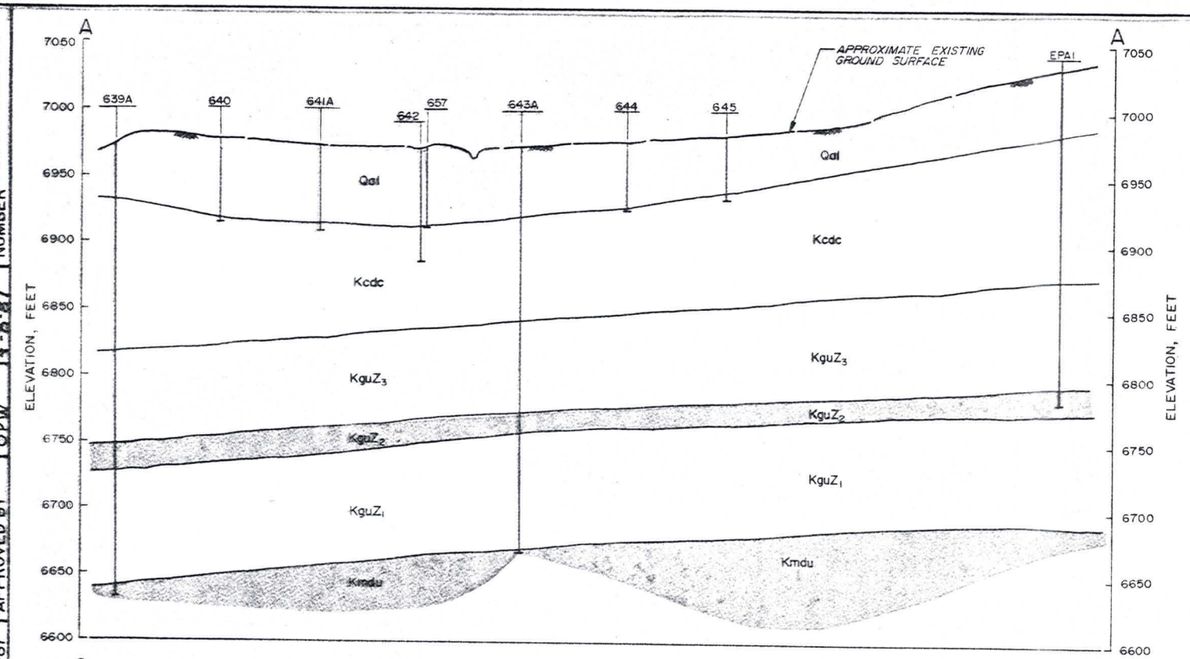
PREPARED FOR

UNITED NUCLEAR CORPORATION GALLUP, NEW MEXICO

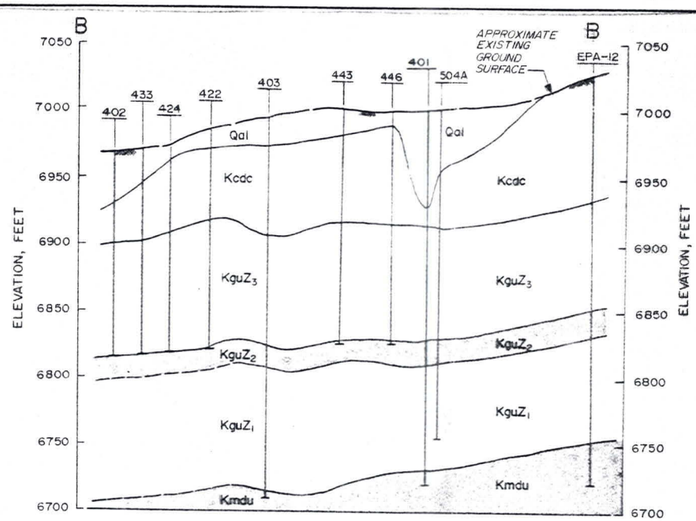
Canonie Environmental

DATE: 2-27-87	FIGURE 2	DRAWING NUMBER RM86-060-E38
SCALE: AS SHOWN		

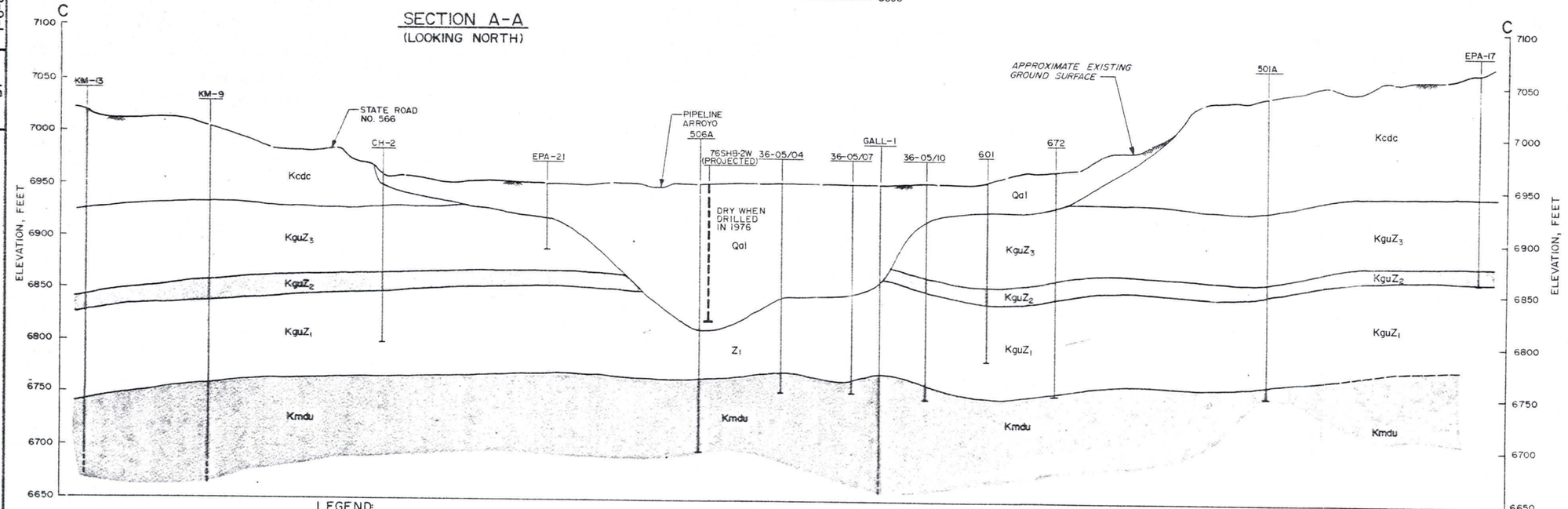
REVISIONS NO.	DATE	DRAWN BY		TR 2-27-87	CHECKED BY	DWE	4-8-87	DRAWING NUMBER RM86-060-E38
					APPROVED BY	DPW	4-8-87	



SECTION A-A
(LOOKING NORTH)



SECTION B-B
(LOOKING NORTH)



LEGEND:

QUATERNARY	Qal	ALLUVIUM
UPPER CRETACEOUS	Kcdc	CREVASSE CANYON FORMATION DILCO COAL MEMBER
	$KguZ_3$	UPPER GALLUP SANDSTONE-ZONE 3
	$KguZ_2$	UPPER GALLUP SANDSTONE-ZONE 2
	$KguZ_1$	UPPER GALLUP SANDSTONE-ZONE 1
	Kmdu	MANCOS SHALE-UPPER D CROSS TONGUE MEMBER

EPA-21
BOREHOLE, FOR EXACT ELEVATION AND DEPTH REFER TO APPENDIX A.

SECTION C-C
(LOOKING NORTH)

VERTICAL SCALE
50 0 50 100 FEET

HORIZONTAL SCALE
200 0 200 400 FEET

VERTICAL EXAGGERATION = 4X

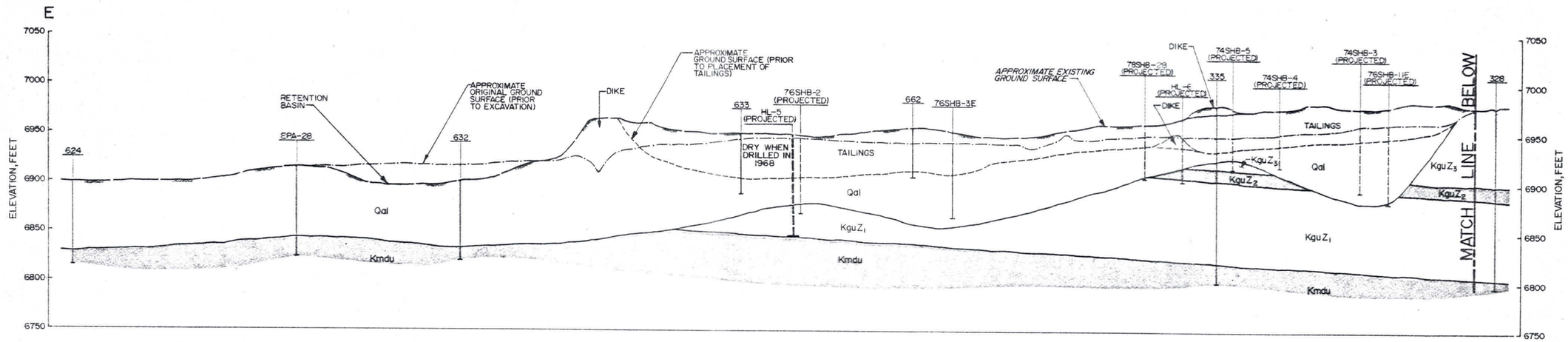
CROSS SECTIONS
A-A, B-B, AND C-C
PREPARED FOR
UNITED NUCLEAR CORPORATION
GALLUP, NEW MEXICO

Canonie Environmental

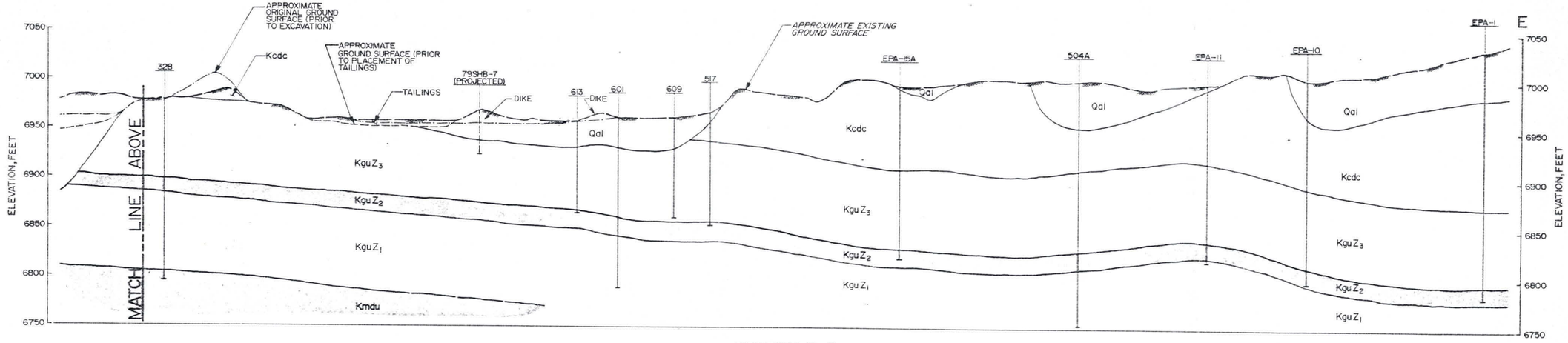
DRAWN BY	J.M.M.	1-6-87	
CHECKED BY	DWE	4-8-87	DRAWING NUMBER RM86-060-E9
APPROVED BY	GPW	4-8-87	
REVISIONS	NO.	DATE	

DATE: 1-6-87
SCALE: AS SHOWN
FIGURE 3
DRAWING NUMBER RM86-060-E9

REVISIONS	NO.	DATE
DRAWN BY		ATH 1-5-87
CHECKED BY		DWE 4-8-87
APPROVED BY		CPW 4-8-87
DRAWING NUMBER		RM86-060-E11



SECTION E-E
(LOOKING NORTHWEST)



SECTION E-E
(LOOKING NORTHWEST)

LEGEND:

QUATERNARY	Qal	ALLUVIUM
UPPER CRETACEOUS	Kcdc	CREVASSE CANYON FORMATION DILCO COAL MEMBER
	$KguZ_3$	UPPER GALLUP SANDSTONE-ZONE 3
	$KguZ_2$	UPPER GALLUP SANDSTONE-ZONE 2
	$KguZ_1$	UPPER GALLUP SANDSTONE-ZONE 1
	Kmdu	MANCOS SHALE-UPPER D-CROSS TONGUE MEMBER

643A — BOREHOLE, FOR EXACT ELEVATION AND DEPTH REFER TO APPENDIX A.

VERTICAL SCALE
50 0 50 100 FEET

HORIZONTAL SCALE
200 0 200 400 FEET

VERTICAL EXAGGERATION = 4X

CROSS SECTION E-E

PREPARED FOR

UNITED NUCLEAR CORPORATION
GALLUP, NEW MEXICO

Canonie Environmental

DATE: 1-5-87	FIGURE 4	DRAWING NUMBER RM86-060-E11
SCALE: AS SHOWN		

N

NORTHEAST CHURCH ROCK MINE AREA

SECTION 35

SECTION 36

APPROXIMATE EXTENT OF WIND BLOWN TAILINGS

MILL FACILITIES AREA TO BE RECLAIMED

QUIVIRA FACILITIES

E 60,000

E 62,000

E 64,000

N 78,000

N 76,000

N 74,000

N 72,000

CATCH BASIN NO. 2

NORTH CELL

PROPOSED UNRESTRICTED USE AREA

CATCH BASIN NO. 1

PREDOMINANT WIND DIRECTION

CENTRAL CELL

BORROW PIT 2

PIPELINE ARROYO

SECTION 3

SECTION 2

SECTION 1

SOUTH CELL

APPROXIMATE LIMITS OF TAILINGS DISPOSAL AREA

SOUTH DIVERSION DITCH

STATE ROAD 566

SECTION 10

SCALE
400 0 400 800 FEET

REFERENCE:
TOPOGRAPHIC MAP OF SEC 2, T 16 N., R 16 W., N.M.P.M. & VICINITY. PROVIDED BY UNITED NUCLEAR CORPORATION, GALLUP, NEW MEXICO. DATED: MAY 1, 1978. SCALE: 1" = 400'.

RADIOLOGICAL SURVEY
STUDY AREAS

PREPARED FOR

UNITED NUCLEAR CORPORATION
GALLUP, NEW MEXICO

Canonie Environmental

DATE: 3-12-87	FIGURE 5	DRAWING NUMBER RM86-060-E40
SCALE: AS SHOWN		

RM86-060-E4e
RM86-060-E4b

REVISIONS	NO.	DATE

DRAWN BY: RLS 12.7.86
CHECKED BY: Don Rodriguez 3-12-87
APPROVED BY:
DWE 4-8-87
QPW 4-8-87
DRAWING NUMBER RM86-060-E40

MATCH LINE TO FIGURE 7

MILL AREA

REMOVE EXISTING TAILINGS MATERIALS FROM THE VICINITY OF CATCH BASIN NO.1

BORROW PIT 2

DRAINAGE DITCH

EXISTING SOIL STOCKPILE

ACCESS ROAD (TYP.)

DRAINAGE SWALE TO ARROYO

RIPRAPPED SOUTH DRAINAGE CHANNEL

SOUTH DIVERSION DITCH

STATE ROAD 566

EL PASO NGP PIPELINE & RIGHT OF WAY

20ft (TYP)

NOTES:

1. WINDBLOWN TAILINGS BETWEEN THE CENTRAL AND NORTH CELLS SHALL BE GRADED INTO THE CELLS BEFORE COVER PLACEMENT.
2. 8-12 INCH SOIL COVER SHALL BE PLACED OVER THE GRADED TAILINGS SHOWN.
3. BORROW PIT 2 SHALL BE USED FOR DISPOSAL OF MILL FACILITIES DURING FINAL RECLAMATION.
4. WELLS THAT LIE WITHIN THE AREA TO BE DISTURBED WILL BE PLUGGED FROM THE BASE OF THE WELL TO THE SURFACE WITH PLUG MIX.

LEGEND:

6980 — ELEVATION OF GRADED TAILINGS, FEET

APPROXIMATE LIMITS OF TAILINGS AFTER GRADING

SCALE
200 0 200 400 FEET

REFERENCE:
TOPOGRAPHIC MAP PROVIDED BY UNITED NUCLEAR CORPORATION DRAWING NO. 1258-A DATED: MAY 1, 1985. SCALE: 1"=200'

CONCEPTUAL INTERIM STABILIZATION PLAN SOUTH END

PREPARED FOR

UNITED NUCLEAR CORPORATION GALLUP, NEW MEXICO

Canonie Environmental

DRAWN BY	CHECKED BY	APPROVED BY	DWE	4-8-87	DRAWING NUMBER RM86-060-E35
J.M. Majail 1-16-87	J.M. Majail 2-19-87		QPW	4-8-87	

REVISIONS: NO. | DATE

DATE: 2-19-87
SCALE: AS SHOWN

FIGURE 6

DRAWING NUMBER RM86-060-E35

1-16-87

RM86-060-E13

NO.	DATE	REVISIONS

DRAWN BY	D.L. Rodriguez 2-19-87
CHECKED BY	DWE 4-8-87
APPROVED BY	OPM 4-8-87
DRAWING NUMBER	RM86-060-E39

E15

NOTES:

1. WINDBLOWN TAILINGS BETWEEN THE CENTRAL AND NORTH CELLS SHALL BE GRADED INTO THE CELLS BEFORE COVER PLACEMENT.
2. 8-12 INCH SOIL COVER SHALL BE PLACED OVER THE GRADED TAILINGS SHOWN.
3. BORROW PIT 2 SHALL BE USED FOR DISPOSAL OF MILL FACILITIES DURING FINAL RECLAMATION.
4. WELLS THAT LIE WITHIN THE AREA TO BE DISTURBED WILL BE PLUGGED FROM THE BASE OF THE WELL TO THE SURFACE WITH PLUG MIX.

LEGEND:

6965 — ELEVATION OF GRADED TAILINGS, FEET

APPROXIMATE LIMITS OF TAILINGS AFTER GRADING

NAVAJO INDIAN RESERVATION

SHAFT

MILL AREA

MATCH LINE TO FIGURE 6

REMOVE EXISTING TAILINGS MATERIALS FROM CATCH BASIN NO. 1

REFERENCE:
- TOPOGRAPHIC MAP PROVIDED BY UNITED NUCLEAR CORPORATION. DRAWING NO. 1796-4 DATED: MAY 1, 1986. SCALE: 1" = 200'.

POTENTIAL BORROW AREA

HAUL ROAD

ACCESS ROAD

BORROW PIT 2

DRAINAGE DITCH

35 3/2 SEC. CORNER

35 36 2 SEC. CORNER

36 2/1 SEC. CORNER

SCALE
200 0 200 400 FEET

CONCEPTUAL INTERIM STABILIZATION PLAN NORTH END

PREPARED FOR

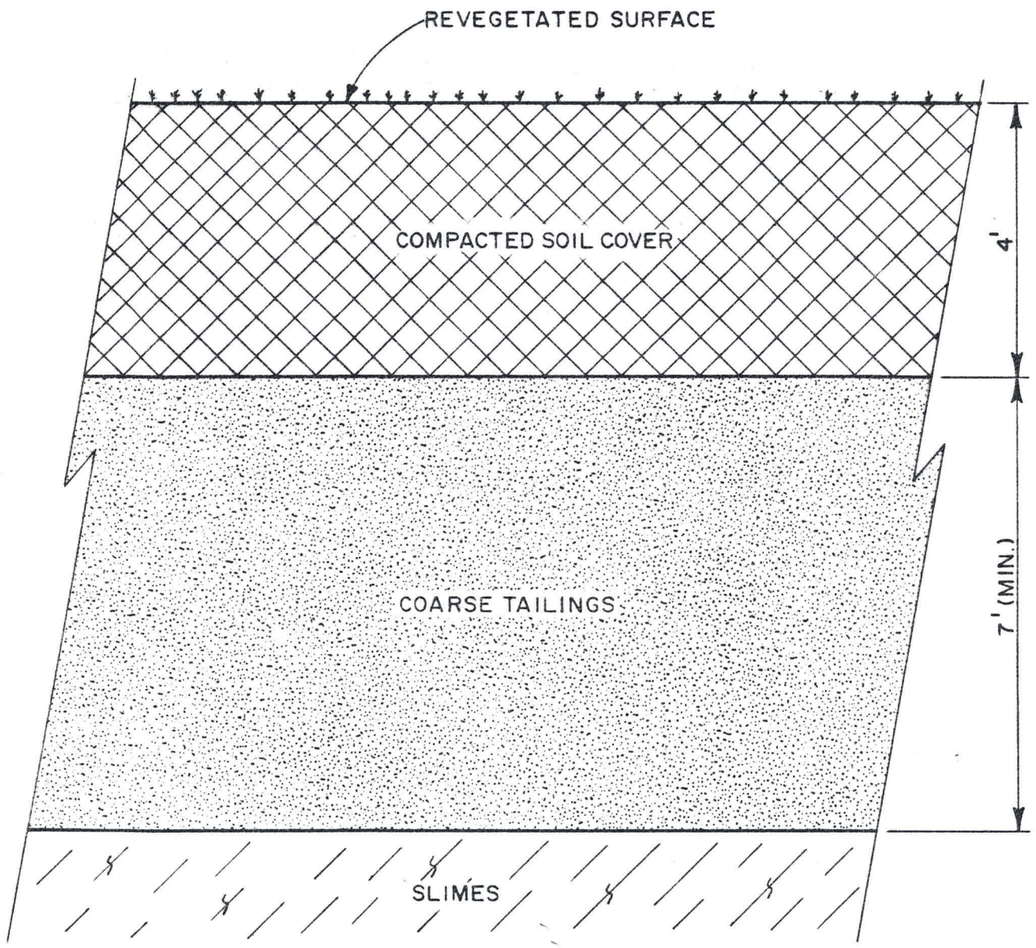
UNITED NUCLEAR CORPORATION GALLUP, NEW MEXICO

Canonie Environmental

DATE: 2-20-87	FIGURE 7	DRAWING NUMBER RM86-060-E39
SCALE: AS SHOWN		

RM86-060-E15

102340



COVER DESIGN PARAMETERS							
MATERIAL	RADIUM CONTENT	EMANATION COEFFICIENT	DRY DENSITY	% MOIST.	% SAT.	POROSITY	DIFFUSION COEFFICIENT (pCi/m^2sec)
COVER SOIL	0.78 pCi/g	.08	99 pcf	13.6	54	.40	.0095
COARSE TAILINGS	189 pCi/g	.22	105 pcf	10.5	43	.40	.0143
SLIMES	574 pCi/g	.26	76 pcf	35	83	.54	.0031

NOTE:

1. TOTAL SOIL COVER THICKNESS TO ACCOUNT FOR VARIOUS DESIGN FACTORS IS AS FOLLOWS:

RADON ATTENUATION	3.50 FEET
WIND EROSION	.45 FEET
WATER EROSION	.05 FEET
TOTAL DEPTH =	4.00 FEET

CONCEPTUAL COVER DESIGN
PREPARED FOR
UNITED NUCLEAR CORPORATION
GALLUP, NEW MEXICO

Canonie Environmental

DATE: 3/13/87	FIGURE 8	DRAWING NUMBER RM86-060-B41
SCALE: NTS		

DRAWN BY	T.Q.C. 3/13/87	CHECKED BY DWE	4-8-87	DRAWING NUMBER RM86-060-B41
		APPROVED BY QPW	4-8-87	

REVISIONS

NO.	DATE

DRAWN BY	CHECKED BY	APPROVED BY	DWG	DWG
JMM 1-16-87	J.M. Malloll 2-17-87		4-8-87	4-8-87

DRAWING NUMBER RM86-060-E33

RM86-060-E13

RECLAIMED MILL AREA

MATCH LINE TO FIGURE 10

APPROXIMATE LIMITS OF PMF EVENT

REGRADED CATCH BASIN AREA

RECLAIMED BORROW PIT 2

ACCESS ROAD

DRAINAGE SWALE

TAILINGS COVER (SEE FIGURE 8)

MODIFIED NICK POINT

RECONFIGURED PIPELINE ARROYO

STATE ROAD 566

BASE CONTROL STRUCTURE

DRAINAGE SWALE INV. EL. 6954

REGRADED STOCK PILE

ACCESS ROAD

SOUTH DIVERSION DITCH

RIPRAPPED SOUTH POND DRAINAGE CHANNEL

CUNDRAIN

LEGEND:

—6985— ELEVATION OF FINAL GRADE, FT.

NOTE:

1. FINAL SOIL COVER CONTOURS SHOWN PROVIDE FOR A CONCEPTUAL 5 FOOT SOIL COVER THICKNESS. THE ACTUAL THICKNESS AS CALCULATED USING RAECOM SHALL BE 4 FEET AS SHOWN ON FIGURE 8.

REFERENCE

- TOPOGRAPHIC MAP PROVIDED BY UNITED NUCLEAR CORPORATION. DRAWING NO. 7796-M. DATED: MAY 1, 1985. SCALE: 1"=200'

SCALE

200 0 200 400 FEET

CONCEPTUAL FINAL RECLAMATION PLAN SOUTH END

PREPARED FOR

UNITED NUCLEAR CORPORATION GALLUP, NEW MEXICO

Canonie Environmental

DATE: 2-17-87	FIGURE 9	DRAWING NUMBER RM86-060-E33
SCALE: AS SHOWN		

REVISIONS

NO.	DATE

DRAWN BY	Don Rodriguez	2-20-87
CHECKED BY	DWE	4-8-87
APPROVED BY	RPW	4-8-87
DRAWING NUMBER	RM86-060-E36	

NO.	DATE	REVISIONS

N

NAVAJO INDIAN RESERVATION

SHAFT

APPROXIMATE LIMITS OF PMF EVENT

RECONFIGURED PIPELINE ARROYO

APPROXIMATE LIMITS OF PMF EVENT

DOWNDRAIN

RECLAIMED MILL AREA

35 SEC. CORNER T 17 N

ACCESS ROAD

36 SEC. CORNER

MATCH LINE TO FIGURE 9

REGRADED CATCH BASIN AREA

RUNOFF CONTROL DITCH

DRAINAGE SWALE

TAILINGS COVER (SEE FIGURE 8)

LEGEND:

6970 ELEVATION OF FINAL GRADE, FEET

NOTE:
FINAL SOIL COVER CONTOURS SHOWN PROVIDE FOR A CONCEPTUAL 5 FOOT SOIL COVER THICKNESS. THE ACTUAL THICKNESS AS CALCULATED USING RAECOM SHALL BE 4 FEET AS SHOWN ON FIGURE 8.

SCALE
200 0 200 400 FEET

REFERENCE:
- TOPOGRAPHIC MAP PROVIDED BY UNITED NUCLEAR CORPORATION, DRAWING NO. 1796-4, DATED MAY 1, 1985, SCALE 1" = 200'

CONCEPTUAL FINAL RECLAMATION PLAN NORTH END

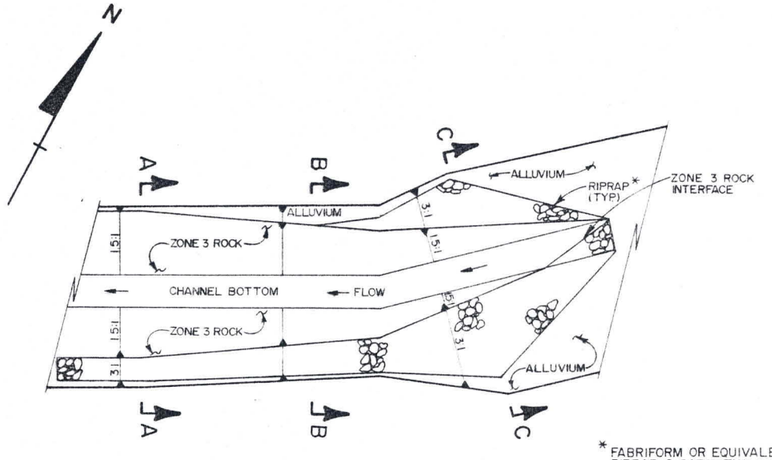
PREPARED FOR

UNITED NUCLEAR CORPORATION GALLUP, NEW MEXICO

Canonie Environmental

DATE: 2-20-87	FIGURE 10	DRAWING NUMBER RM86-060-E36
SCALE: AS SHOWN		

RM86-060-E15

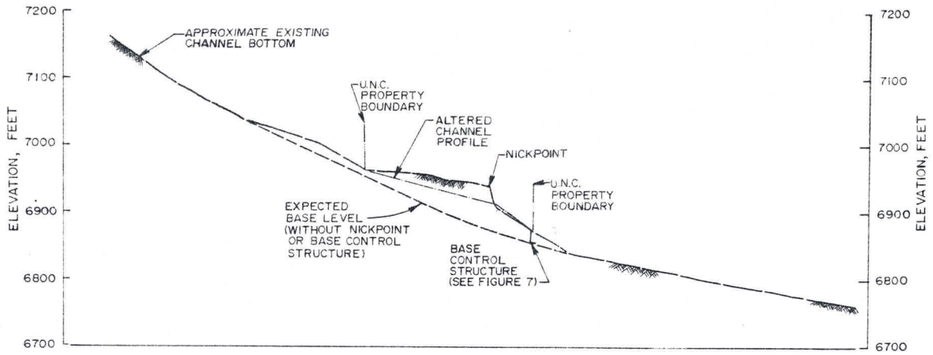


PLAN

* FABRIFORM OR EQUIVALENT MAY BE SUBSTITUTED FOR RIPRAP. SUBSTITUTION MAY CHANGE CONFIGURATION SHOWN.

NICKPOINT INCISION

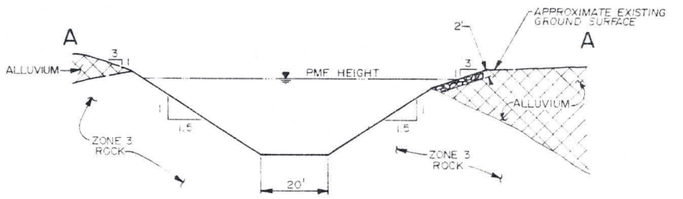
SCALE
40 0 40 FEET



PIPELINE ARROYO CHANNEL PROFILE

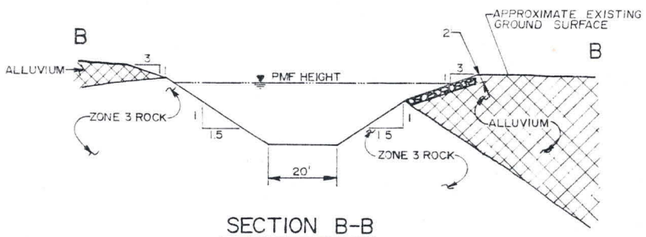
VERTICAL SCALE
100 0 100 FEET

HORIZONTAL SCALE
4000 0 4000 FEET



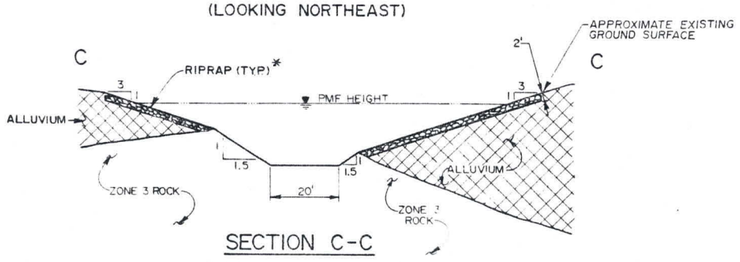
SECTION A-A

(LOOKING NORTHEAST)



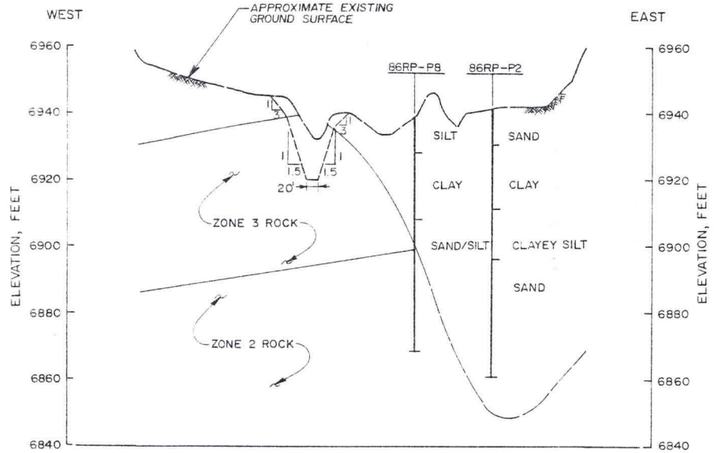
SECTION B-B

(LOOKING NORTHEAST)



SECTION C-C

(LOOKING NORTHEAST)



CHANNEL CROSS SECTION

(LOOKING NORTH)
100 FEET NORTHEAST OF NICKPOINT

VERTICAL SCALE
20 0 20 FEET

HORIZONTAL SCALE
100 0 100 FEET

PROPOSED MODIFICATIONS
PIPELINE ARROYO CHANNEL
AND NICKPOINT

PREPARED FOR

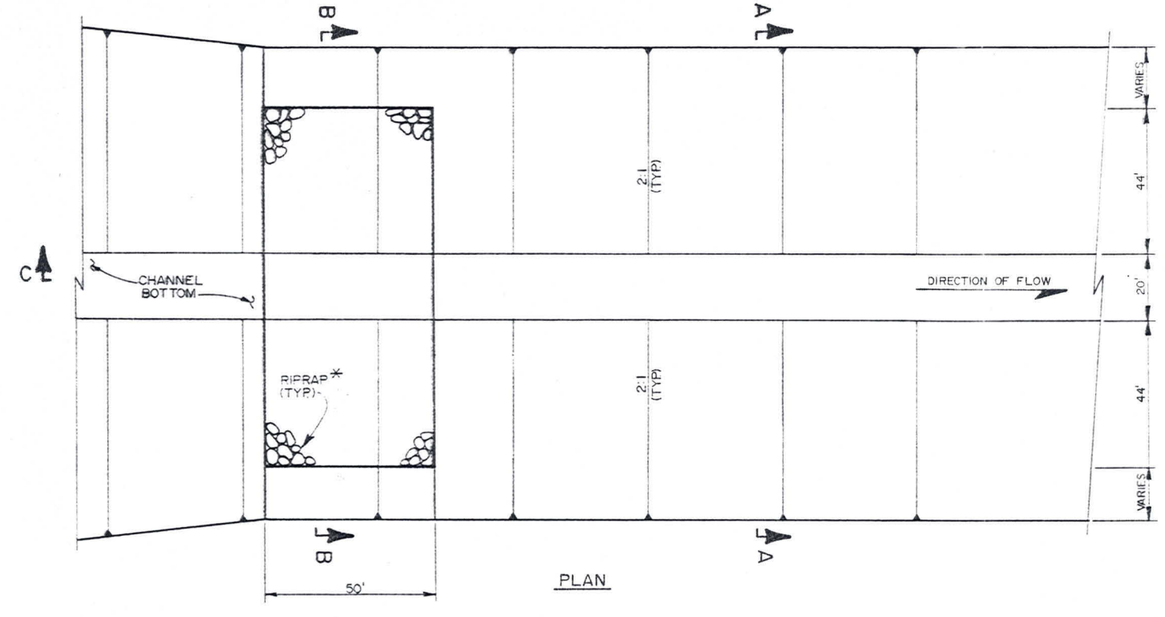
UNITED NUCLEAR CORPORATION
GALLUP, NEW MEXICO

Canonie Environmental

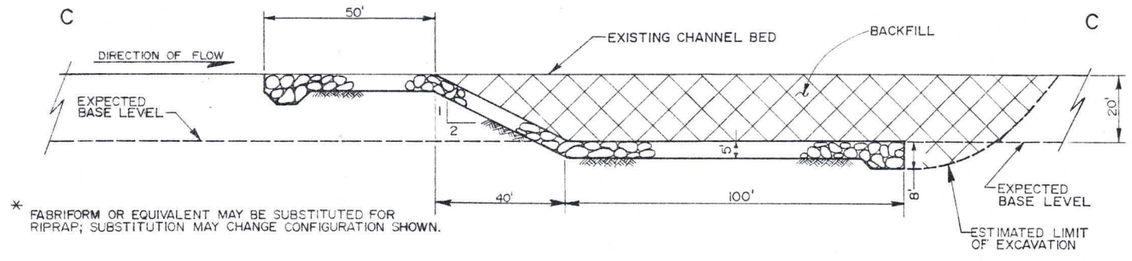
DATE: 2-20-87	FIGURE 11	DRAWING NUMBER RM86-060-E-37
SCALE: AS SHOWN		

REVISIONS	NO.	DATE

DRAWN BY: D.J.R & J.M.M 2-20-87
CHECKED BY: DWE 4-8-87
APPROVED BY: DJW 4-8-87
DRAWING NUMBER: RM86-060-E37



PLAN



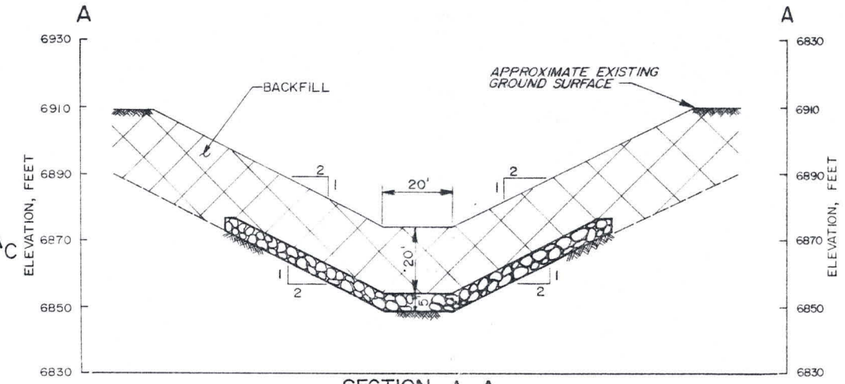
* FABRIFORM OR EQUIVALENT MAY BE SUBSTITUTED FOR RIPRAP; SUBSTITUTION MAY CHANGE CONFIGURATION SHOWN.

SECTION

BASE CONTROL STRUCTURE

(LOOKING NORTHEAST)

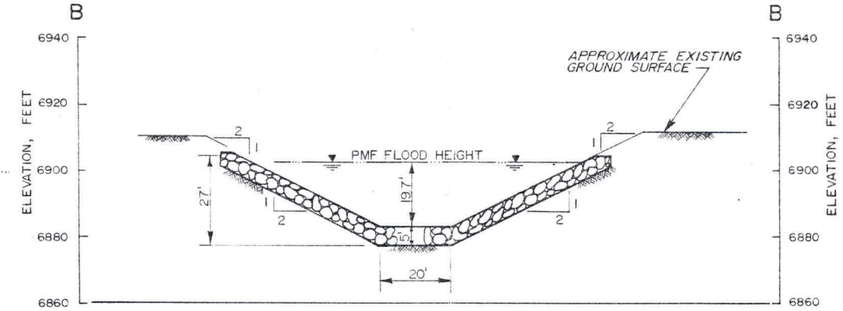
SCALE 20 0 20 40 FEET



SECTION A-A

(LOOKING SOUTHWEST)

SCALE 20 0 20 40 FEET



SECTION B-B

(LOOKING SOUTHWEST)

SCALE 20 0 20 40 FEET

BASE CONTROL STRUCTURE
PLAN AND SECTIONS

PREPARED FOR

UNITED NUCLEAR CORPORATION
GALLUP, NEW MEXICO

CanonieEnvironmental

DATE: 2-20-87	FIGURE 12	DRAWING NUMBER RM86-060-E-34
SCALE: AS SHOWN		

REVISIONS	NO.	DATE
DRAWN BY	J.M. Majdi	2-20-87
CHECKED BY	DWG	4-8-87
APPROVED BY	CPM	4-8-87
DRAWING NUMBER	RM86-060-E34	