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UNITED STATES DEPARTMENT OF ENERGY
Albuquerque, New Mexico

Uranium Mill Tailings Remedial Action Project (UMTRAP)

Naturita, Colorado

NAT

Information for Reviewers

Preliminary Design for Review

May 1990

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

90-0739

INFORMATION FOR REVIEWERS

PRELIMINARY DESIGN FOR REVIEW
URANIUM MILL TAILINGS REMEDIAL ACTION PROJECT (UMTRAP)

NATURITA, COLORADO

MAY 1990

PREFACE

This volume, Information for Reviewers, is intended as a guide for person(s) reviewing the preliminary design documents for the Uranium Mill Tailings Remedial Action Project (UMTRAP) at Naturita, Colorado.

It summarizes the conceptual design plan and provides an overview of the Design and Supporting Documents and is intended to serve as a "roadmap" for the reviewers. It also addresses open issues that are being resolved or need to be resolved prior to the finalization of the Remediation Action Plan.

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*"Roadmap" to design and supporting documents.

SECTION A
OVERVIEW OF DESIGN AND SUPPORTING DOCUMENTS

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A.1 INTRODUCTION

This volume, Information for Reviewers, is the first of a series of volumes, listed in attached Table A.1. The design proper is presented in "Subcontract Documents", which includes the bid schedule (quantities), special conditions (contractual requirements), specifications (technical requirements) and drawings. The remaining volumes in this submittal are:

- Information for Bidders (4 volumes), which presents the "fact documents"; i.e., data which form the basis for design, and are provided to the prospective bidders for their review.

- Supporting Calculations and Reports (5 volumes), which include the analyses, computations and studies leading to the design presented.

- Cost Estimate which is an estimate of construction costs for completion of the remedial action.

A.2 BACKGROUND

Under the Uranium Mill Tailings Radiation Control Act (UMTRCA) OF 1978, Congress authorized remedial action for cleanup of 24 inactive processing sites including the Naturita site.

Under this Act, the low-level radioactive residual materials and miscellaneous waste in and around the abandoned mill site at Naturita will be excavated, transported and encapsulated in a containment Cell at the Dry Flats site.

The Naturita process site is located about two miles to the northeast of the town of Naturita (off State Highway 141) and the Dry Flats disposal site is about six road miles to the southeast of the Naturita process site. The project location

map is shown in Figure 1, (figures are presented towards the end of this report). The general site plan is shown in Figure 2.

The Naturita Process site consists of the abandoned Naturita Mill, Former Tailings Pile area, and GE Ore buying station located on the flood plain of the San Miguel river - between Highway 141 to the west and the San Miguel river to the east. The Ore Storage area which is also part of the Process site is located to the west of the Highway 141.

During 1976-77 the tailings at the Naturita Process site were transported to a heap leach plant (Durita Facility) which is located adjacent to the Coke Oven Borrow Area for reprocessing. However, the site also has residual contamination, consisting of the following materials:

- Soils in the mill yard.
- Subpile contamination in the former tailings pile area.
- Soils in the Ore Storage area.
- Windblown and waterborne tailings in the vicinity of the millsite and along and above the San Miguel river floodplain as far north as Calamity bridge.

An estimate of residual radioactive contaminated materials volume is presented below:

o Millyard Area:	216,000 cy
o Former Tailings Pile Area	126,000 cy
o Ore Storage Area	30,000 cy
o Windblown/Waterborne Materials including those in the Vicinity Properties	198,000 cy
Total	570,000 cy

The process site also has considerable amounts of scrap metals, process equipment, water tanks, miscellaneous machinery, trucks and tires; including buildings and foundations, with lower contamination levels than the soils. The total volume of these materials, upon demolition, is estimated to be about 9000 cy.

Hazardous materials at the process site consist of small amounts of PCBs, solvents, fuels, acids, oils, compressed gases, process chemicals, as well as asbestos-containing materials. To the extent possible most of these materials will be removed by the site owner prior to remedial action. Materials not removed will be subject to remedial action.

A.3 DESIGN APPROACH

Residual radioactive soils that exceed EPA Standards for Radium-226 concentrations, will be excavated and transported to the Dry Flats Disposal Site. Soils with Ra-226 concentrations greater than EPA limits range in depths from 0.5 ft to 10 ft over a total areal extent of about 130 acres at the processing site and adjacent vicinity properties.

At the Dry Flats Disposal Site, the contaminated materials will be consolidated and encapsulated in a disposal cell (see Figures 3 and 4) for long-term isolation and stabilization. The cover components of the disposal cell will be designed to limit radon flux and radon concentration to levels set by EPA, as well as limit infiltration rate and long-term seepage in accordance with currently applicable EPA standards on groundwater protection. The design controls are to extend over 1000 years to the extent reasonably achievable, and, in any case, for at least 200 years.

The Disposal Cell will be 1400 ft x 800 ft at the base x 30 ft height above the average ground surface. It will be located slightly to the east of a saddle which is a drainage divide. Since the disposal cell will be located adjacent to a drainage divide, it will be subject to only minor amounts of offsite runoff plus the runoff from the surface of the Disposal Cell. Permanent drainage ditches will be constructed at the base of the Disposal Cell to intercept this runoff and convey it offsite and into existing natural drainage. The design criteria for all permanent drainage features is the Probable Maximum Precipitation (PMP).

The Disposal Cell design is described in greater detail in Section B - Proposed Remedial Action Plan (which will be the basis for Chapter 4.0 of the Remedial Action Plan).

A.4 DESIGN DETAILS AND CRITERIA

The general features of the design are presented in the "Background" and in the "Design Approach". The key design details and the governing detailed criteria are in Section B, "Proposed Remedial Action Plan and Design", included below. The relationship between the design details and criteria and the supporting calculations and reports is shown in attached Table A.2.

TABLE A.1

LIST OF DOCUMENTS IN

PRELIMINARY DESIGN SUBMISSION

I. Information for Reviewers (1 volume)

- A. Overview of Design and Supporting Documents*
- B. Proposed Remedial Action Plan
- C. Open Issues

II. Subcontract Documents (1 Volume)

- A. Bid Schedule
- B. Special Conditions
- C. Specifications
- D. Drawings

III. Information for Bidders (4 Volumes)

IV. Supporting Calculations and Reports (5 volumes)

- Vol. I : Processing Site Permanent Features, Haul Routes
- Vol. II : Disposal Site Permanent Features (Geotechnical, Disposal Cell and Cover Design)'
- Vol. III: Disposal Site Permanent Features (Erosion Protection, Permanent Site Drainage, Demolition Debris Disposal)'
- Vol. IV : Temporary Facilities
- Vol. V : Quantities

V. Cost Estimate (1 Volume)

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* "Roadmap" to design and supporting documents.
' Critical to meeting EPA Standards.

TABLE A.2
RELATIONSHIP BETWEEN DESIGN DETAILS AND
CRITERIA WITH SUPPORTING CALCULATIONS AND REPORTS
(Sheet 1 of 6)

dRAP Design Detail or Criteria	Calculation Number/Volume	Title	Remarks
Pile Location	---	Naturita Fact Sheets	Contaminated materials from the Naturita millsite and surrounding areas will be relocated to a disposal cell at the Dry Flats Site.
Pile Layout	17-730-01-00 Vol. I	Radiologic Characterization - Excavation Plan and Quantities	The disposal cell will be constructed above grade; it will have a footprint of about 26 acres. The maximum height of the cell above existing ground surface will be about 30 feet.
	17-714-03-00 Vol. V	Disposal Cell Capacity	
Geomorphic	---	---	The disposal cell is located adjacent to a drainage divide; this results in minimal offsite flow. Thus the potential of gully formation that could undercut into the disposal cell apron is minimized. In addition the apron is keyed into the bedrock which is located within a few feet of the ground surface. Also see Section under Surface Water.
Seismicity	See Jacobs Engineering Group Report	Geologic, Geomorphic and Seismic Evaluation of the Dry Flats Uranium Tailing Disposal Site, Naturita, Colorado.	M_L = 6.2, 9.3 miles from site. On site peak horizontal acceleration = 0.21 g. (a_{max}).

TABLE A.2
RELATIONSHIP BETWEEN DESIGN DETAILS AND
CRITERIA WITH SUPPORTING CALCULATIONS AND REPORTS
(Sheet 2 of 6)

dRAP Design Detail or Criteria	Calculation Number/Volume	Title	Remarks
Hydrogeology	---	---	See related items under Radon/Infiltration Control, Vegetative Cover and Riprap Gradation and Drain Layers.
Surface Water	17-723-01-00 Vol. III	Site Hydrology, PMP Analysis	The design basis for all permanent drainage facilities at the Dry Flats Disposal Site is the PMP.
	17-738-01-00 Vol. III	Permanent Site Drainage - West and South Ditches	These riprap lined ditches will collect the runoff from the disposal cell surface and saddles to the west and south and convey these runoffs offsite to the natural drainage pattern. Headcutting at the ditch outlets will be prevented by keying these into the bedrock, located within a few feet of the ground surface.
Geotechnical	17-737-01-00 Vol. II	Design Geotechnical Parameters for Materials at Naturita Process Site, Coke Oven Borrow Site and Dry Flats Disposal Site.	Data used for stability and settlement analyses, and radon/infiltration barrier design.
	17-740-01-00 Vol. II	Disposal Cell Design - Slope Stability Analysis, Liquefaction Analysis	Slope Factors of Safety are adequate. There is no liquefaction potential at the disposal site as pile is founded on bedrock.

TABLE A.2
RELATIONSHIP BETWEEN DESIGN DETAILS AND
CRITERIA WITH SUPPORTING CALCULATIONS AND REPORTS
(Sheet 3 of 6)

dRAP Design Detail or Criteria	Calculation Number/Volume	Title	Remarks
Geotechnical (Contd.)	17-740-02-00 Vol. II	Disposal Cell Design - Settlement and Radon Barrier Cracking Potential	Total and differential settlements are relatively small and will not adversely impact the embankment.
	17-741-03-00 Vol. II	Disposal Cell - Frost Penetration Depth	The cover layers provide adequate frost protection to the radon barrier.
Radon/Infiltration Control	17-741-02-00 Vol. II	Disposal Cell Design - Radon/ Infiltration Barrier Thickness	The radon/infiltration barrier thickness provided will adequately reduce radon emission from the Disposal Cell under the following conditions: o Contaminated materials with the lowest level of radium content (in pCi/gm) will be placed adjacent to the top and side slopes of the cell. o Contaminated materials with higher radium content will be placed away from the top and side slopes and towards the inside of the cell.

TABLE A.2
RELATIONSHIP BETWEEN DESIGN DETAILS AND
CRITERIA WITH SUPPORTING CALCULATIONS AND REPORTS
(Sheet 4 of 6)

dRAP Design Detail or Criteria	Calculation Number/Volume	Title	Remarks
Radon/Infiltration Control (Contd)			The saturated hydraulic conductivity of the radon/infiltration barrier will be of the order of 10^{-8} cm/sec. When this is combined with additional design features of a vegetative cover (which increases evapotranspiration potential) and drain layers (that intercept and conduct infiltration water away from the contaminated materials), the infiltration rate into the contaminated materials is expected to be negligible.
Vegetative Cover	17-741-01-00 Vol. II	Disposal Cell Vegetative Cover Design	The vegetative cover increases the evapotranspiration rate of the cell cover and reduces the potential percolation into the disposal cell. Calculations show that this cover will not develop gullies under a design PMP storm. The vegetative cover has a 2.0 percent down slope and a maximum length of about 310 feet. The top 6-inches consists of a graded rock-soil matrix.
Erosion Barrier	17-739-01-00 Vol. III	Inventory and Test of Rock Sources Suitable for Use as Riprap Erosion Protection at Dry Flats Site	This study identifies the most economical rock sources that can provide the required size and quantity and also pass the NRC quality criteria.

TABLE A.2
RELATIONSHIP BETWEEN DESIGN DETAILS AND
CRITERIA WITH SUPPORTING CALCULATIONS AND REPORTS
(Sheet 5 of 6)

dRAP Design Detail or Criteria	Calculation Number/Volume	Title	Remarks
Erosion Barrier (Contd)	17-739-02-00 Vol. III	Erosion Protection - Disposal Cell	D_{50} min. rock sizes calculated for disposal cell side slope.
	17-739-03-00 Vol. III	Disposal Cell - Riprap Toe Protection	D_{50} min. rock sizes calculated for apron and key trench.
	17-739-04-00 Vol. III	Riprap Gradation and Drain Layers	Gradation limits of rock riprap and drainage/filter layers calculated.
Construction	17-706-01-00 Vol. IV	Construction Water Requirements	Estimates of construction water requirements at the Naturita Process Site and the Dry Flats Disposal Site.
	17-725-01-00 Vol. IV	Naturita Process Site - Sediment Volumes	This and the following calculations pertain to temporary construction facilities.
	17-725-02-00 Vol. IV	Naturita Process Site - Wastewater Retention Basin	
	17-733-01-00 Vol. IV	Interceptor Ditch - Naturita Process Site	
	17-733-02-00 Vol. IV	Flood Control Dike - Naturita Processing Site	
	17-725-03-00	Collector Ditches and Wastewater Retention Basin - Dry Flats Disposal Site	

TABLE A.2
RELATIONSHIP BETWEEN DESIGN DETAILS AND
CRITERIA WITH SUPPORTING CALCULATIONS AND REPORTS
(Sheet 6 of 6)

dRAP Design Detail or Criteria	Calculation Number/Volume	Title	Remarks
Wastewater Treatment	17-725-02-00 Vol. IV	Wastewater Retention Basin - Naturita Process Site	Based on retention basin water balance calculations, the volumes of wastewaters generated over the the construction period will be relatively low. At the end of the construction period, a portable wastewater treatment plant may be used to treat any wastewaters accumulated at the Naturita and Dry Flats retention basins.
	17-725-03-00 Vol. IV	Wastewater Retention Basin - Dry Flats Disposal Site	
Construction Schedule	---	---	Construction is estimated to take about 31 calendar months, which includes two winter seasons. This schedule could possibly be compressed to about 18 months.
Cost Estimate	---	---	A preliminary project cost estimate will be submitted following about a month of the Preliminary Design submittal date.

SECTION B
PRELIMINARY FINAL REMEDIAL ACTION PLAN
SITE DESIGN

B.1 INTRODUCTION

This section discusses the following design items for remedial action at the Naturita, Colorado UMTRA sites:

- o Remedial Action Objectives
- o Permanent Design Features
- o Construction Features
- o Construction Activities and Schedule

Maps, drawings, and tables relevant to the design are provided in this section and in the appendices of this report.

The design must satisfy the PL95-604 and EPA standards restricting release of contaminated materials into the environment and limiting release of radon gas and gamma radiation from tailings, contaminated soils and other contaminated materials. The following is presented to demonstrate compliance of the preliminary design with current EPA standards.

B.2 SUMMARY OF THE PROPOSED REMEDIAL ACTION

The main feature of the remedial action is relocation and stabilization of contaminated materials from the processing site at Naturita to a disposal cell at Dry Flats site. Contaminated materials to be relocated will include:

- o Contaminated materials from within the designated Naturita process site, consisting of the abandoned Naturita Mill site, former Tailings Pile area, and adjacent GE Ore buying station area.

- Windblown and waterborne contaminant materials in areas designated as Vicinity Properties, that are adjacent to the Naturita Process site.

- Contaminants resulting from decontamination and/or demolition of buildings and structures.

The disposal cell will cover approximately 26 acres and will contain approximately 600,000 cubic yards of contaminated materials. The actual quantity will depend on the extent of contaminated material excavated during construction. The disposal cell configuration is shown in Figure 3.
(All figures are presented towards the end of this report).

At the disposal cell location on the Dry Flats site, there are bedrock outcrops under the footprint. In some locations there is a shallow soil cover of 1 ft to 2 ft of clayey, or silty, sandy soil (CL, ML or SP), which is underlain by weathered shale and/or sandstone. The topsoil could be used for construction of the disposal cells vegetative cover. Thus the foundation excavation depths will be determined by balancing the total materials needed for cell covers vs. the total materials available from several other sources including foundation excavation. The objective will be to minimize the volume of earthwork.

The cover for the contaminated materials cell will consist of several distinct layers, as shown in Figure 4. The design function of the various layers are described below:

- Radon/Infiltration Barrier - 18-inch thick to serve the following functions:

  - Limit radon flux to 20 pCi/m^2. sec over the disposal cell.

  - Limit radon concentration in the air above the disposal site to 0.5 pCi/l.

  - Reduce permeability to approximately 10^{-6} cm/sec.

The radon/infiltration barrier will be constructed of the sandy to clayey material found in the Coke Oven borrow site. Preliminary laboratory tests indicate that the compacted radon barrier material has a saturated permeability of the order of 10^{-6} cm/sec.

- o Bio-Intrusion Barrier - The design function of the 12-inch bio-barrier is to protect the radon barrier from burrowing animals and plant roots. It will be constructed of Type A riprap, which has a D_{50} min of 3-inches and D_{100} max. of 6 inches.

- o Rooting Medium/Frost Barrier - The design functions of the rooting medium/frost barrier are:

  - Facilitate plant growth in the cell's vegetative cover and thus increase evapotranspiration potential and reduce infiltration potential into the cell.

  - Prevent frost penetration into the radon barrier.

- o Rock-Soil Matrix - The 6-inch thick rock soil matrix will be constructed at the top of the disposal cell, with a 2.0 percent slope. The matrix gradation will be designed to facilitate plant growth as well as prevent erosion and gully formation under of design Probable Maximum Precipitation (PMP) conditions.

- o Rock Riprap - The 5H:IV side slopes of the disposal cell will be covered by a 12-inch thick riprap layer of gravel and cobbles to protect erosion. The erosion protection layer extends into the apron constructed around the base of the cell, and keys into the bedrock. The rock riprap has been designed to withstand the effects of runoff resulting from a PMP storm.

- o Filter, Bedding and Drain Layers - The filter and the bedding layers are designed to prevent migration of particles between relatively coarse and fine materials. The drain layers are designed to

intercept any water that may infiltrate through the upper layers and drain it in a direction parallel to the surface slope of the disposal cell. Plan, profile and typical cross-sections of the proposed embankment are shown on Figures 3 and 4 (enclosed at the end of this report).

Runoffs from the disposal cell surface and from saddles to the west and south of the cell will be collected and conveyed to the existing natural drainage by the West and South ditches. These ditches will be riprap lined, designed to withstand the flows resulting from a PMP storm. The ditch outlets will be keyed into the bedrock to prevent headcutting.

All buildings and structures at the Naturita processing site will be demolished. The demolition debris and non-hazardous materials resulting from decontamination of buildings and structures are proposed to be buried in a trench adjacent to the disposal cell (see Figure 4.1).

Hazardous materials, other than the radioactive materials from the Naturita processing site, will be sent off-site to approved disposal areas. Asbestos will be containerized and buried in the tailings embankment. Mixed waste will also be buried in the tailings embankment.

Excavated and disturbed areas at the processing site, disposal site and borrow sites will be regraded (or backfilled) as required to promote drainage and subsequently revegetated. Areas outside the final disposal site boundary at Dry Flats and the entire area within the processing site will be released for use after completion of remedial action. Any disturbed wetlands will be restored or may be exempt from cleanup by use of Supplemental Standards.

B.2.1 Site Acquisition Requirements

The Dry Flats disposal site is located on federal lands, under the administration of BLM. DOE has made an application to BLM for withdrawal of the required land for permanent location of the disposal cell.

B.3 DESIGN DETAILS - PERMANENT DESIGN FEATURES

B.3.1 Introduction

Permanent design features for cleanup of the processing sites and adjacent areas and for stabilization of the disposal cell are described in more detail below. Factors considered in the design, including subsurface conditions, engineering properties of the tailings, and requirements for erosion and radon control are described and their effect on layout and construction of the disposal cell is discussed. All design approaches, unless otherwise discussed in the following sections, are outlined in the Technical Approach Document (TAD) (DOE, 1989b). Where applicable, alternatives considered are discussed as justification for the selected design.

B.3.2 General Requirements

Codes and Standards - The detailed design shall comply with the EPA standards and all requirements applicable to the UMTRA Project. In addition, the detailed design shall comply with all the criteria, methods, and approaches set out in the TAD (DOE, 1989b) and the Standard Review Plan (NRC, 1985).

In the event of conflict between the documents, the DOE shall issue a ruling as to which shall prevail, and this shall be the standard adopted during final design.

B.3.3 Disposal Cell Location

All of the contaminated materials including those from the windblown and vicinity properties will be relocated and stabilized in a containment cell situated at the Dry Flats site.

The Dry Flats site is about six road miles to the Southeast of the Naturita Process site, and can be accessed from the Process Site as follows: 0.8 miles south-southeast on State Highway 141, then 2.4 miles south on State Highway 90, followed by 3.2 miles southeast on an existing county road (a dirt road).

The disposal cell is located near a drainage divide; thus the erosion potential due to any offsite surface runoff at the disposal cell base is not significant.

B.3.4 Disposal Cell Layout

The disposal cell occupies about 26 acres of the base; the base slopes gently to the southeast (average slope = 2.5 percent) between elevations of 5960 and 5920. The highest point on the top surface of the disposal cell is at Elev. 5968. The top of the disposal cell slopes down at 2.0 percent and the sides slope down at 5H:1V. The disposal cell capacity is about 600,000 cu yd. Depending on the final total volume of contaminant materials, this capacity can be increased or decreased by raising or lowering the top surface. To provide smooth transition of the cell's surface runoff into the adjacent drainage pattern and also to prevent potential gully formation and encroachment into the base, the design provides for (Figure 3):

- Limited grading on the north and east sides of the cell.
- Riprap apron along the base of the cell.
- Riprap ditches on the west and the south sides of the cell. These are described in greater detail in Section B.3.5.

The non-radioactive demolition debris resulting from the demolition of buildings, structures, plant equipment and miscellaneous debris at the Naturita process site will be buried in a trench adjacent to the disposal cell.

B.3.5 Geomorphic

The disposal cell is located adjacent to a drainage divide, such that any offsite runoff that could impact the base of the cell is minimal. The surface runoff that flows to the base of the cell are generated mostly at the cell surface, plus some additional runoff from two saddles-one to the south and the other to the west of the cell.

To provide for a smooth transition of these surface runoffs into the existing drainage pattern and also to prevent potential gully formation and encroachment into the base of the cell, the design provides (Figure 3) for:

- Limited grading on the north and east sides of the cell (to promote sheet flow).

- Riprap aprons along the entire periphery of the base, keyed into the bedrock; the shale or sandstone bedrock is located at a relatively shallow depth (1' to 2') below the ground surface.

- Riprap ditches paralleling the west and the south sides of the cell (West ditch, South ditch), which collect the runoff from the two saddles immediately to the west and south of the cell, plus the runoff from the cell's surface and convey these to existing drainage patterns. The ditch outlets are keyed into the bedrock.

B.3.6 Seismicity

The design seismic magnitudes are adopted from a preliminary draft report by Jacobs Engineering Group, Inc. entitled "Geologic, Geomorphic, and Seismic Evaluation of the Dry Flats Uranium Mill Tailings Disposal Site, Naturita, Colorado." These are:

1. Magnitude: 6.2 (M_L) at an epicentral distance of 9.3 miles from the site. On site peak horizontal acceleration = 0.21g (a_{max}).

2. For pseudo-static slope stability analysis

- End of construction condition, K_h = 0.11 (50% of a_{max}).
- Long term condition, K_h = 0.14 (67% of a_{max}).
- Required minimum factor of safety, $(F.S.)_{min}$ = greater than or equal to 1.0.

B.3.7 Hydrogeology

The design features for groundwater protection are:

1. Vegetative Cover: The top surface of the disposal cell consists of a 36-inch thick soil cover to promote native species vegetative growth. Such

growth will enhance evapotranspiration from the root zone, thereby reducing potential infiltration into the cell. The upper 6-inch of the soil cover consists of a rock-soil matrix to increase stability of the top slope and reduce gully erosion potential, and the lower 30-inches of soil serves as the rooting medium and provides frost protection for the underlying radon/infiltration barrier.

2. Drain Layers: The two 6-inch thick drain layers, one below the vegetative cover frost barrier and the other above the radon barrier (Figure 4) will intercept any water that may infiltrate through the upper layers, and drain it in a direction parallel to the surface slope of the disposal cell. This will prevent buildup of any hydraulic head over the radon/infiltration barrier and further reduce infiltration potential into it.

3. Radon/Infiltration Barrier: The 18-inch thick radon/infiltration barrier will have a saturated hydraulic conductivity of the order of 10^{-8} cm/sec, which is much lower than that of the contaminated materials and will minimize infiltration into the stabilized materials, thus minimizing the rate of leachate production.

The disposal cell top surface, side slope and base have been contoured to shed rainfall and direct these away from the cell. Ponding will be avoided.

B.3.8 Surface Water

As stated in Section B.3.5, the disposal cell is located in the relatively higher elevations of the a drainage divide; surface runoffs that could impact the base of the cell are generated mostly off the cell surface and to a lesser extent off the two saddles immediately to the west and to the south of the cell. These surface waters are conveyed to the adjacent natural drainage by limited grading and by using riprapped aprons and ditches to prevent gully formation, headcutting and undercutting at the base of the cell. The runoffs resulting from a design PMP storm has been considered in these designs.

Alternative Considered: An alternative whereby the disposal cell would be moved about 600 feet to the west of the current location, and would straddle one of

the saddles in the drainage divide, was considered. However, the saddle would have reduced the cell capacity for the given surface area unless the saddle was excavated. Further, any leachate leakage would potentially contaminate both sides of the watersheds, as opposed to potential contamination on only one side of the watershed under the current location of the cell. Thus, this alternative has not been considered any further.

B.3.9 Geotechnical Considerations

The principal geotechnical considerations used to design the disposal cell are slope stability and settlement. Liquefaction potential is minimal considering the site climate, subsurface conditions and design provisions for reduced infiltration - such as cell contouring, vegetative cover and relatively impermeable radon/infiltration barrier.

Analyses of slope stability was made for static and dynamic (earthquake) conditions. Earthquake conditions were simulated using a pseudo-static approach. The pseudo-static horizontal design acceleration was set equal to one-half and two-thirds of the maximum site horizontal acceleration for end of construction and long term stability, respectively. Strength values for contaminated materials, foundation soil, radon barrier and frost cover materials were based on laboratory tests and/or engineering judgment. Conservative strength values were assumed for rock bedding and riprap materials. The slope stability analysis concluded that design slopes would remain stable under static and dynamic conditions.

The total long-term settlement of materials in the disposal cell will be very small due to compaction of the cell materials, as well as due to the granular non-plastic nature of the contaminated materials. Settlement of the shale/sandstone foundation will be negligible, as all the soil will be removed. Therefore, the adverse effects of total and differential settlement on the integrity of the radon/infiltration barrier are considered to be small and within acceptable limits.

B.3.10 Radon/Infiltration Control

A radon/infiltration barrier consisting of uncontaminated soil will be constructed over the disposal cell to limit emanation of radon to the levels set by EPA Standards and to inhibit infiltration into underlying contaminated materials. Based on measurements of current contamination levels, a 18-inch thick radon/infiltration barrier is designed to reduce radon flux to beneath 20 pCi/m^2s. The 18-inch thickness is based on maintaining at least a 4.5-foot thick material of relatively low contamination level (such as some of the windblown materials) between the radon barrier and the higher level contaminated materials. The thickness of the radon/infiltration barrier may be changed during construction based on radiation data from in-place contaminated materials.

Silty and sandy clay obtained from the Coke Oven borrow site will be used to construct the radon/infiltration barrier. Geotechnical tests, including compaction, shear strength and permeability tests have been performed on the soil samples. Results indicate that radon/infiltration barrier material when compacted to at least 100 percent of maximum dry density as determined by ASTM D-698, will reliably produce a laboratory saturated permeability on the order of 10^{-6} cm/sec. Construction features that will be used to protect against defects in the radon/infiltration barrier include:

- Provide a rough surface between lifts by scarifying prior to placement of overlying lift.
- Maintain constant moisture content during construction.
- Limit lift thickness to ensure thorough compaction.
- Facilitate uniform layer properties by restricting clod sizes to 2 inches or smaller.
- Compaction by appropriate equipment.

B.3.11 Erosion Protection

Design provisions for erosion protection of the Disposal Cell consist of the following:

- Top Slope - A relatively mild 2.0 percent slope, a 36-inch thick vegetative cover, the upper 6-inch of which will be constructed of a graded rock-soil matrix to resist erosion and gully formation.

- Side Slopes Base Aprons, Key Trenches and Permanent Drainage Ditches - Rock riprap that meets NRC's long-term durability criteria will be used to provide erosion protection of these design elements. The riprap blankets on the side slopes will have a 12-inch thickness laid on a 12-inch drain/filter layer. The base aprons will have a 24-inch thickness which will transition into a riprap-filled trench of trapezoidal cross-section. Since the depth to bedrock is shallow, on the order of 1-2 feet, the trench will have to be excavated into bedrock along part of its length.

Riprap and bedding material size requirements are shown on Table B.1. These materials could be obtained from several privately owned sources, or sources located in Montrose County and BLM properties - all within a 20-mile radius of the Dry Flats site. The durability of rock from these sources was determined to be satisfactory based on the results of tests performed on rock samples.

Site design also provides for limited grading to promote sheet flow, (see Figure 3). All graded areas will be seeded or riprapped.

TABLE B.1
EROSION PROTECTION REQUIREMENTS FOR DISPOSAL CELL

Riprap Type	Maximum Rock Size $D100_{max}$ (inch)	Location*
A	6.0	Side slopes, bio-intrusion layer, south ditch, west ditch.
B	12.0	Key trench.
B1	3.0	Primary bedding-between relatively coarse and fine materials. It also serves the function of a drain layer.
B2	3/8-inch	Secondary bedding-between primary bedding and relatively finer material.

* See Figure 4 for layer locations.

B.4.4 CONSTRUCTION FEATURES

B.4.1 Introduction

Implementation of the final remedial action plan will require construction activities to be conducted at the processing site and at the disposal site. The salient features of the construction activities are described below.

B.4.2 Overview

Construction features are described below to provide an overview of implementation of remedial action. Construction features include staging areas, decontamination facilities, temporary drainage ditches, dewatering, wastewater collection and retention systems. Location and sizes of construction features may be changed to facilitate construction activities.

A woven wire perimeter fence will be constructed around each of the sites to control traffic in and out of the sites and to prevent unauthorized entry. Access to a site will be accomplished by means of a gate on the access road. Decontamination pads will be constructed at all of the sites. Vehicles leaving contaminated areas will be monitored and then washed, if necessary, to prevent the spread of contamination.

Temporary diversion ditches will be constructed to prevent off-site surface water runoff from entering the sites during remedial action operations. Collection ditches on the sites will channel on-site contaminated runoff water to the wastewater retention basins or to contained low areas where runoff can be pumped to the retention basins.

Dewatering activities during contaminated material excavations is expected to be minimal since excavation depths are generally shallow. Should dewatering be necessary during an unusually high flood stage of the adjacent San Miguel river a contractor designed dewatering system will be installed at the Naturita site to remove groundwater from the excavation(s). At both Naturita and Dry Flats site, a portable wastewater treatment plant could be used at the end of construction to process the accumulated contaminated water before discharge.

At the Naturita site the following utilities are existing:

- o 3-inch dia HP gas line and buried cathodic protection cables, meter station - Rocky Mountain Natural Gas.
- o Buried telephone lines - Nucla-Naturita Telephone Company.
- o 3-wire overhead line - Colorado Ute Power.

The above facilities will be protected during construction.

B.4.3 Contaminated Materials Transportation

Existing state Highways 141 and 90 will be the primary haul route for the contaminated materials, with a connecting access road from Highway 90 to the Dry Flats disposal site. The total haul distance is about six miles. Recent site survey and detailed assessment of the project's transportation needs have identified improvements in the following areas:

- o Construct new access road from Highway 141 into Naturita site.
- o Improve existing Highway 141 intersection with Highway 90.
- o Presently an existing dirt road off Highway 90 provides access to the Dry Flats site. Substantial improvement of this dirt road will be required, including construction of a new intersection at Highway 90 and the Access road.

The Access road at the Dry Creek crossing will require a major bridge. A permanent bridge could be constructed or a temporary Bailey bridge installed - to be determined during final design stage. (See Open Issues).

Since contaminated materials are located on both east and west banks of the San Miguel river, alternative river crossings presently considered are a Bailey bridge installation at the Naturita site or use of the existing Calamity bridge further downstream. This issue will be resolved during the final design stage.

B.4.4 Drainage, Erosion Control, and Wastewater Retention Basin

Surface water runoff from uncontaminated areas will be diverted to off-site areas. Surface water runoff from contaminated areas will be collected and drained to a wastewater retention basin.

Contaminated runoff will either be retained in the retention basin and evaporated, or treated as necessary and discharged. To the extent practical, contaminated water will be evaporated or used as compaction water to moisture-condition tailings and other contaminated materials.

Treatment and discharge may be necessary if runoff during the construction period exceeds the basin capacity, or if the water in the retention basin does not evaporate before completion of construction. Controlled discharges from the retention basin will meet effluent limits established by a Federal or State point discharge (NPDES) permit. Emergency uncontrolled discharge will be used only if necessary to prevent failure of the retention basin.

Temporary diversion ditches, designed to carry runoff resulting from a 10-year, 24-hour storm event, will prevent uncontaminated runoff from entering the site. Wastewater collection ditches are also designed to carry peak flow from a 10-year, 24-hour storm to the retention basin.

The wastewater retention basins which will be installed at the Naturita and Dry Flats site will receive discharge from:

- Contaminated areas including windblown offpile areas.
- Decontamination of trucks and other equipment (normally the truck and equipment washwater will be recycled and reused until it gets too polluted for further use as washwater at which time it will be discharged into the retention basins).
- Washbasins and shower facilities.

The retention basins at the two sites are sized to retain runoff resulting from a 10-year, 24-hour storm in addition to the maximum storage required for normal

stormwater runoff and wastewater generated from remedial action activities. The retention basins will also have sufficient capacity to hold the total estimated sediment inflow during construction operations. The basin spillway will safely discharge peak runoff from a 25-year storm while one foot of freeboard is maintained between the top of the embankment and the water surface at a time when the spillway is flowing at design elevation.

B.4.5 Wastewater Treatment

Portable wastewater treatment plants will be moved to the Naturita and the Dry Flats sites in order to treat any contaminated runoff accumulated in the wastewater retention basins over the construction period. The retention basins have been sized to accumulate all runoff over a 18-month construction period. If design capacities appear to be exceeding, the wastewater could be treated and discharged as needed.

B.4.6 Dewatering and Moisture Conditioning

Excavation depths in the San Miguel river flood-plain areas are generally shallow - between 1.5 to 5 feet. Hence elaborate seepage controls, such as a slurry wall, will not be needed during excavation. Further, excavation in the flood-plain areas could be scheduled during a low water-stage in the San Miguel river, which would minimize dewatering needs. If this is not possible, a dewatering system will be designed and any contaminated water generated from dewatering operations will be pumped into the retention basin.

Tests show that the compaction of contaminated materials, radon barrier and foundation excavation materials will require moisture conditioning. To the extent practicable, compaction of contaminated materials could be performed by using waters accumulated in the retention basin. Arrangements for supply of additional construction water will have to be made, such as from the San Miguel river.

B.4.7 [illegible]on

[illegible] structures at the Naturita mill site will be demolished. The [illegible] including several scrap heaps of metals and miscellaneous debris will [illegible]ed in a trench adjacent to the Disposal Cell. Hazardous materials will [illegible]sent off-site to approved disposal sites. Contaminated asbestos will be buried within the tailings embankment.

B.4.8 Equipment Decontaminated Pad

Equipment leaving contaminated areas will be monitored for contamination. To prevent contaminated materials from being carried out of construction areas, a decontamination pad with a holding tank and pump will be provided to wash contaminated equipment.

At each of the two sites one or more decontamination pads and associated equipment will be needed to maintain transportation of contaminated materials at close enough intervals to meet the construction schedule. It is left up to the subcontractor to use as many decontamination pads as necessary to meet the construction schedule.

B.4.9 Dust Control

Dust generated by excavation, earth movements, vehicle use, temporary stockpiling of materials and similar activities will be controlled by spraying water and/or water-based surfactants. Special care will be taken to control dust created by decontamination and demolition of buildings and by temporary stockpiling or mixing of contaminated materials.

Retention basin water could be used to control dust on the tailings embankment; however, only uncontaminated water will be used to control dust in clean areas.

Schedules for spraying the roads and embankment areas will vary daily and will be adjusted as required. The frequency of spraying will increase when combinations of low soil moisture and high wind speed are encountered.

B.4.10 Borrow Sites

Potential gravel and clay sources as shown in Figure 5, all of which are within a 20-mile radius of the Dry Flats site. Primary borrow source for fine-grained materials is the Coke Oven site, which is in BLM's jurisdiction, located within about two miles of the Dry Flats site.

There are four privately owned and two Montrose County owned sand and gravel pits. The Dry Flats gravel deposit is on BLM land. Laboratory tests indicated that these sand and gravel sources are of acceptable quality based on NRC criteria.

Archaeological Sites - No historic or cultural resources have been identified at the Naturita site. Dry Flats site and the Coke Oven borrow site appear to contain areas having some historic or cultural significance. Cultural resources clearance will be obtained for all areas to be disturbed during construction.

B.5.11 Construction Sequence

The following construction sequence is planned for the remedial action. However, the construction Subcontractor will be allowed to execute his work as he chooses within the constraints of the project specifications and Contractor approval. The actual construction sequence, therefore, may differ somewhat from the planned sequence. A more detailed construction sequence will be found in the Specifications.

- Following mobilization, the first task will be to develop the project's haul route - by improving/reconstructing the existing transportation and access roads.

- Construct the temporary construction facilities including the access control and decontamination areas at both the Naturita and the Dry Flats site.

- Demolition activities at Naturita site; the demolished materials are to be stockpiled at designated areas. Excavate foundation for the

Disposal Cell at the Dry Flats site. The foundation materials are to be stockpiled for construction of the cell's vegetative cover/frost barrier.

- Begin disposal cell construction. This will involve excavation of contaminated materials at the Naturita site and designated Vicinity Properties and transportation to the Dry Flats site and placement in the Disposal Cell. The operation is to be streamlined to enable simultaneous excavation and placement such that stockpiling or double handling of contaminated materials will be avoided. Materials with the highest level of contamination will generally be excavated first as these are to be placed towards the bottom of the Disposal Cell. Initially, however, limited excavation in the windblown areas (where materials have a lower level of contamination) will be required in order to construct the temporary construction facilities - such as the flood control dike, the interceptor ditch, access road, access control and decon pad areas and the retention basin and collector ditch areas. These excavated materials having a relatively lower level of contamination will be stockpile in designated areas - until these can be placed on top of the relatively "hotter" material in the Disposal Cell.

  Cut and fill resulting from foundation excavation and site grading and miscellaneous construction activities at the Dry Flats site will be balanced to the extent practicable. Any excess materials will be transported to the Naturita and Coke Oven borrow site for site restoration, using the same trucks that would bring in the contaminated materials from the Naturita site.

- Haul demolished materials and scrap piles stockpiled at the Naturita site to the Dry Flats site and deposit and compact these in a trench adjacent to the Disposal Cell.

- Following placement of all contaminated materials, dismantle/demolish all temporary facilities that cannot be decontaminated and place these in the Disposal Cell. This applies to sediments in the

wastewater retention basins and any contaminated soils adjacent to the temporary facilities.

- Construct the radon barrier along the sides of the Disposal Cell, followed by placement of drain layer, a frost barrier, another (upper) drain layer and riprap.

- Construct the top cover of the Disposal Cell consisting of the following layers in ascending order: radon barrier, a secondary filter, a primary filter, a bio-intrusion layer (riprap), primary filter (which also serves as a drain layer), secondary filter, rooting medium/frost barrier including a top six inches of rock-soil matrix. Seed/plant approved vegetative cover on the top slope.

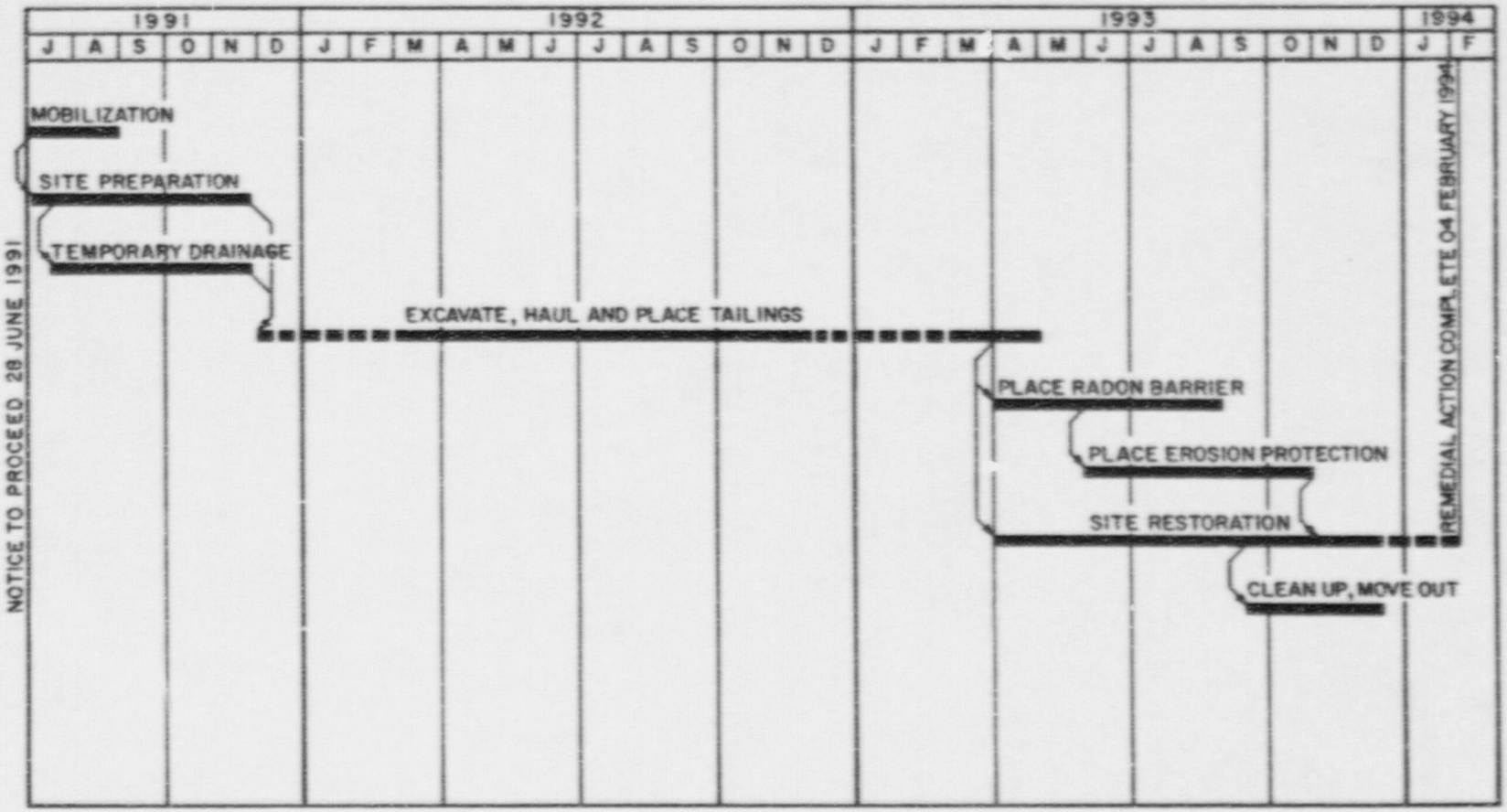
- Construct the riprap aprons, the key trenches and the permanent site grading and drainage ditches.

- Site restoration of all disturbed areas including borrow areas and wetlands, site cleanup and demobilization.

B.4.12 Construction Schedule

The overall remedial action for the UMTRA Naturita Project is scheduled to last about 31 months (see Naturita Remedial Action Summary Schedule). The schedule could possibly be compressed to about 18 months. This will be studied in greater detail during the Final Design phase.

UMTRA PROJECT
NATURITA REMEDIAL ACTION
SUMMARY SCHEDULE



SECTION C
OPEN ISSUES

SECTION C
OPEN ISSUES

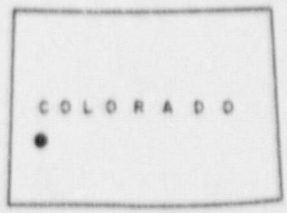
Major outstanding issues to be resolved during the Final Design phase are:

- Groundwater protection standards at the Dry Flats site.
- Mineral rights claim at the Dry Flats disposal site.
- Coke Oven Borrow site:
  - Quantity of fine-grained material that can be obtained to meet construction requirments.
  - Mining claims.
  - Radioactive contamination of Surface Soils.
  - Resolution of MOU with BLM allowing expansion of Coke Oven Borrow Area.
  - Additional field investigation.
- Vicinity Property ownership at millsite is not clear.
- Installation of temporary Bailey bridge across San Miguel river vs. using existing Calamity bridge for remedial action activities on the east bank of San Miguel river.
- Installation of temporary Bailey bridge on Dry Flats Access road at Dry creek vs. construction of permanent bridge.
- Use of Supplemental Standards for cleanup of vicinity properties and wetlands at the Millsite and on vicinity properties.
- Water rights from Foote Cypress and Maupin for use during construction.

SECTION D
FIGURES

VICINITY MAP

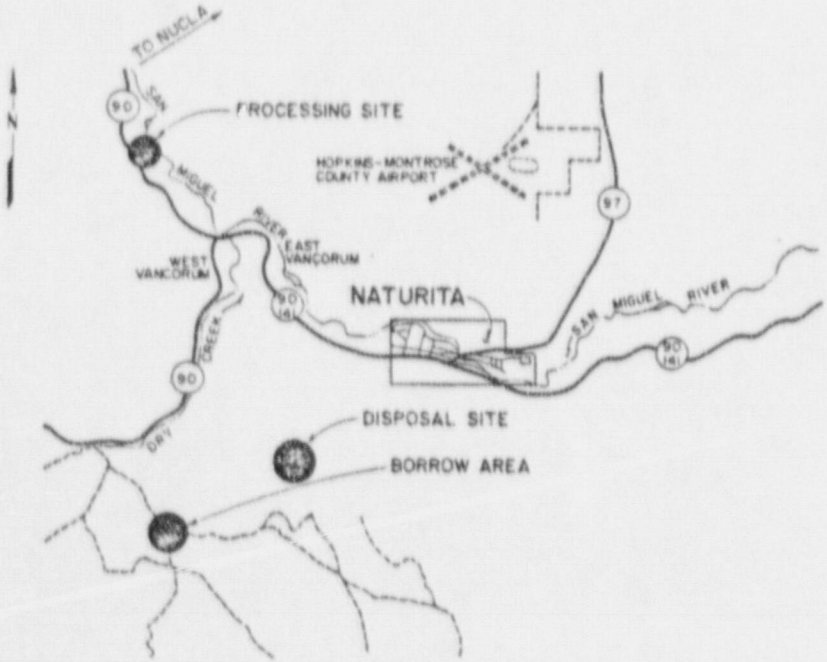
10 0 10 20
SCALE MILES



KEY MAP

LEGEND:

- 550 — UNITED STATES HIGHWAY
- 141 90 — PRIMARY STATE HIGHWAY
- ---------- UNIMPROVED ROAD
- ——— STATE BOUNDARY
- ——— COUNTY BOUNDARY



LOCATION MAP

4000 0 4000 8000
SCALE FEET

NATURITA SITE
NATURITA, COLORADO

VICINITY MAP & LOCATION MAP

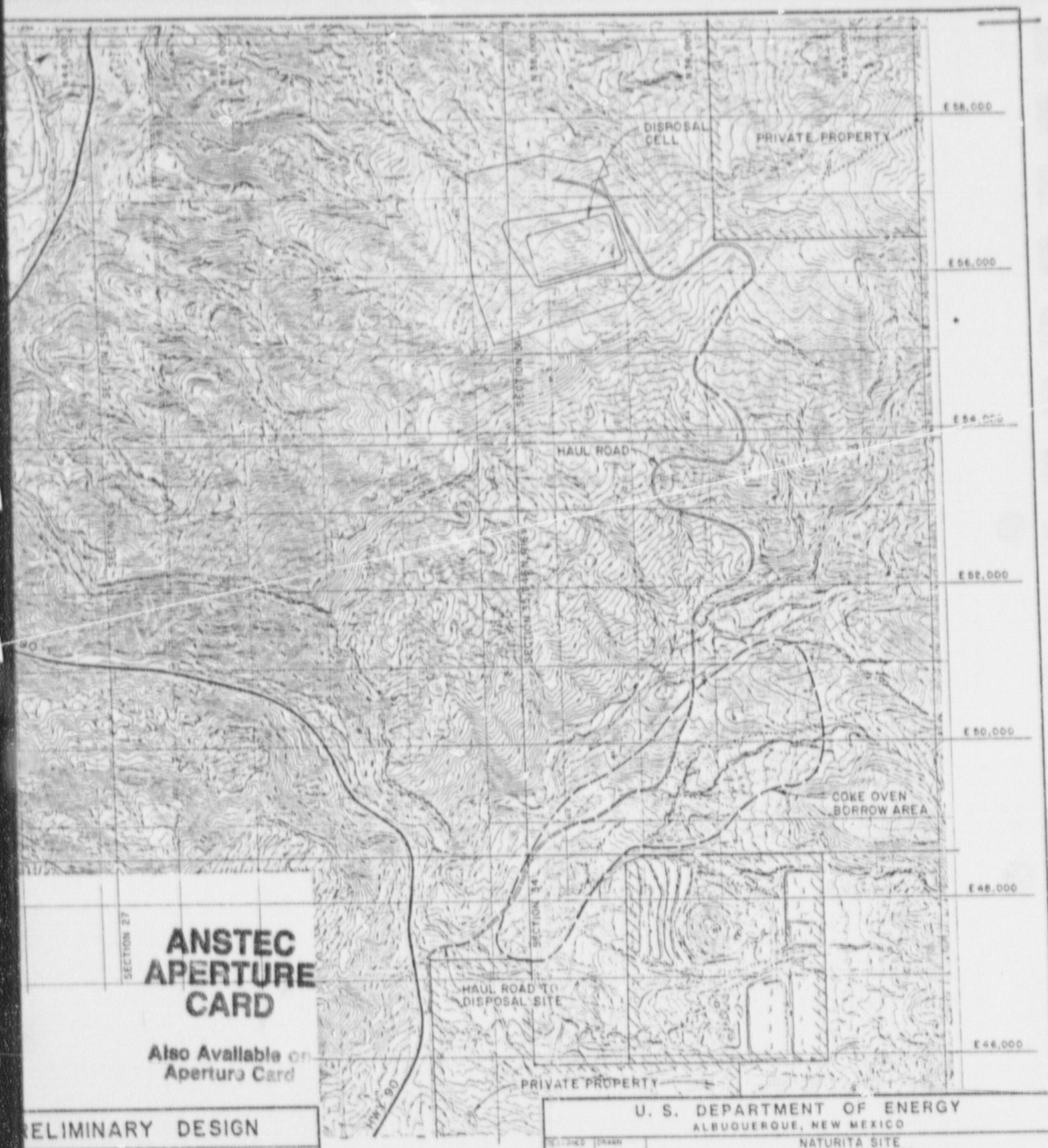
FIGURE 1

NOTE:

1. COORDINATES ARE REFERENCED TO PROJECT GRID SYSTEM.
2. SECTION AND TRACT LINE LOCATIONS ARE APPROXIMATE ONLY.
3. FOR PROPERTY BOUNDARIES AT THE PROCESSING SITE REFER TO DWG. NO. NAT-GE-10-0014

800 0 800 1600
SCALE FEET

PR
E&D MAN



RELIMINARY DESIGN

AGER	CHIEF ENGINEER	QA MANAGER

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

NATURITA SITE
NATURITA, COLORADO

GENERAL SITE PLAN

DESIGNED	DRAWN
CHECKED	
CORRECTED	
APPROVED	DATE

DOE PROJECT ENGINEER — DATE

MORRISON-KNUDSEN ENGINEERS, INC.
UMTRA PROJECT

PROJECT NO. DE-AC04-83AL18796

DRAWING NO. NAT-GE-10-0003 REV. A

9712030084-01

DATE	REVISIONS	BY	CK	ENG MGR	CHIEF ENG	QA MGR	DOE APP
	ISSUED FOR PRELIMINAR REVIEW						

FIGURE 2

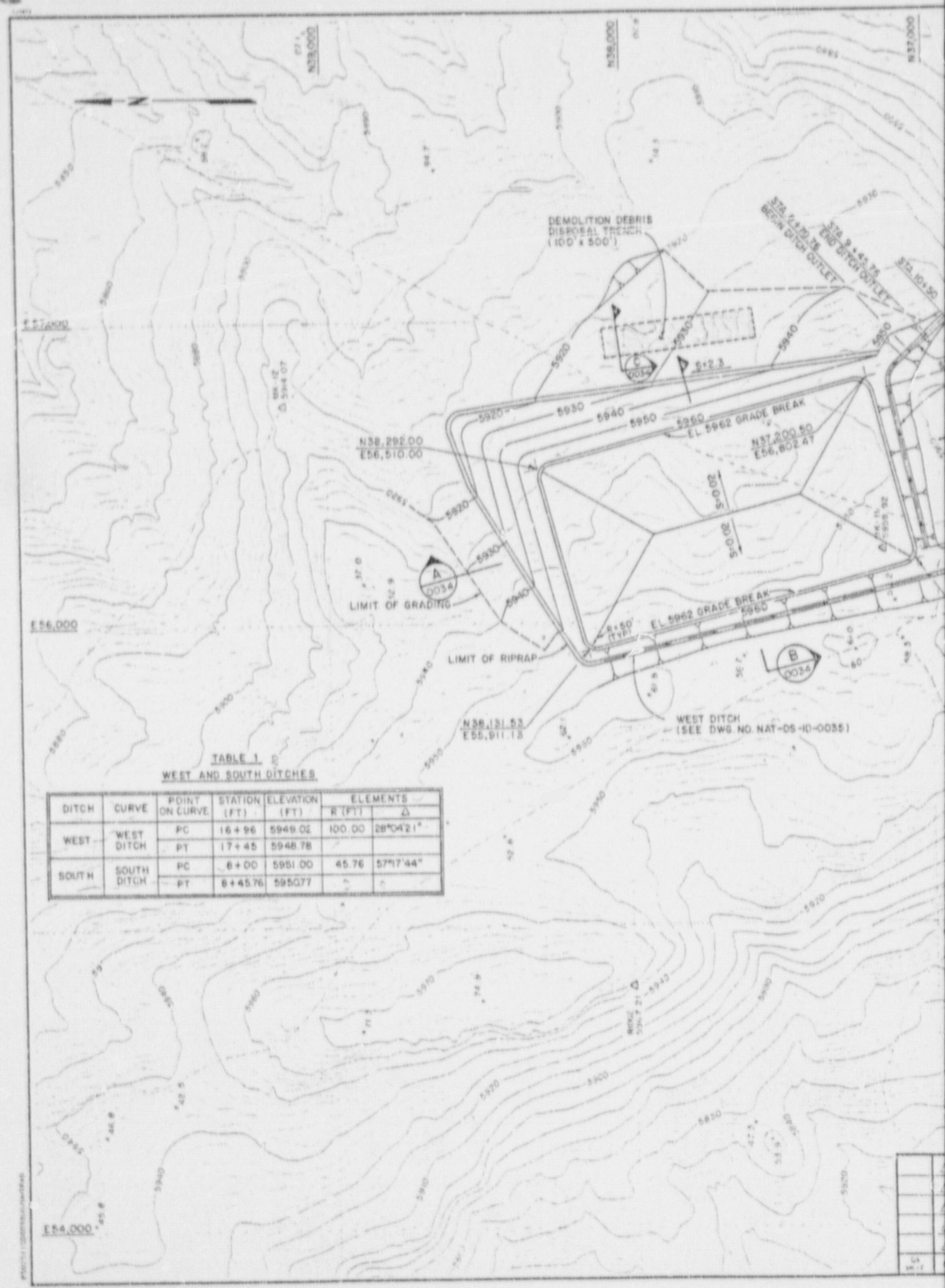
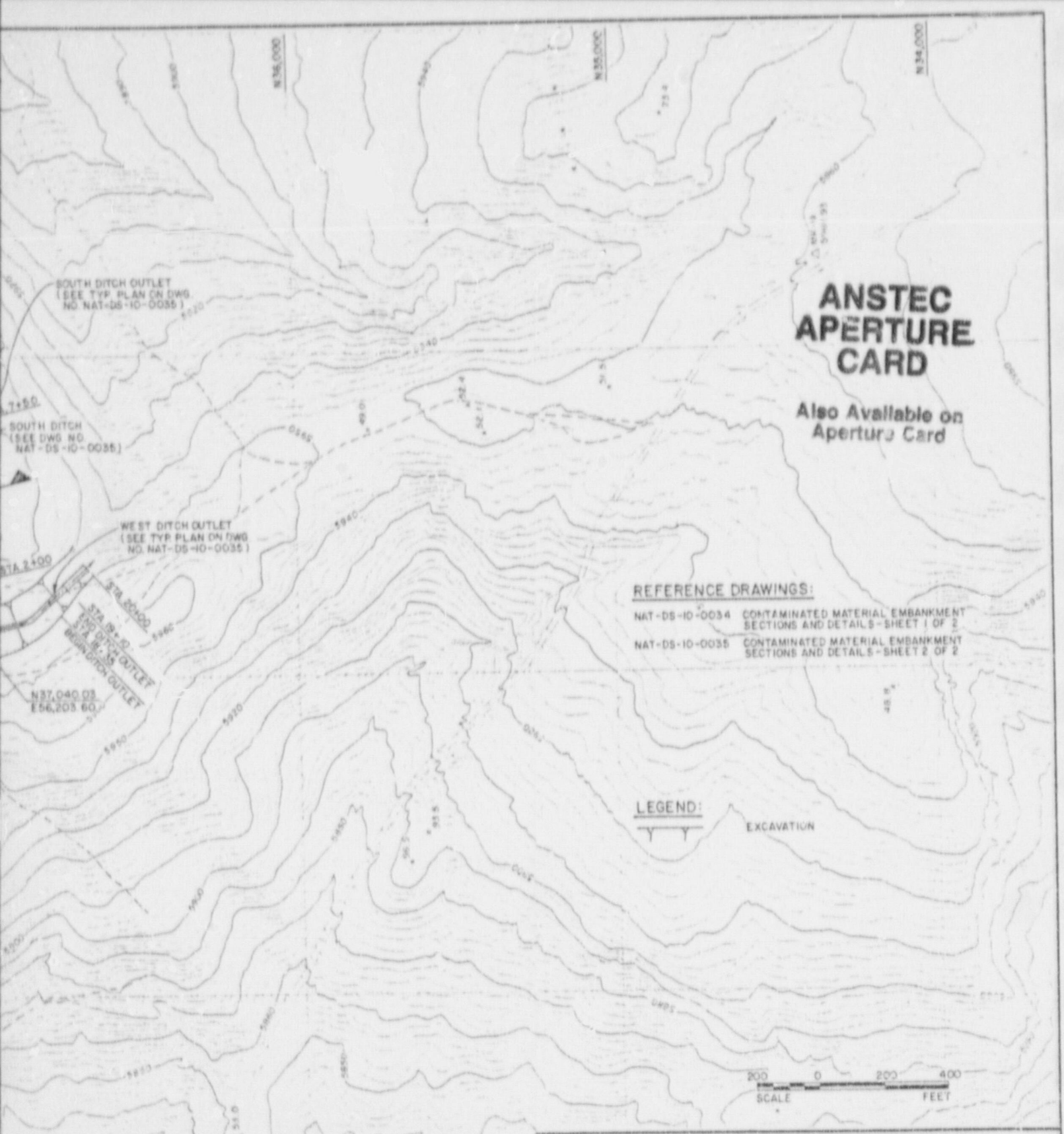


TABLE 1

WEST AND SOUTH DITCHES

DITCH	CURVE	POINT ON CURVE	STATION (FT)	ELEVATION (FT)	ELEMENTS	
					R (FT)	Δ
WEST	WEST DITCH	PC	16+96	5949.02	100.00	28°04'21"
		PT	17+45	5948.78		
SOUTH	SOUTH DITCH	PC	8+00	5951.00	45.76	57°17'44"
		PT	8+45.76	5950.77	"	"



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U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

DRAWN BH
DESIGNED
INSPECTED
RECOMMENDED
APPROVED DATE DOE PROJECT ENGINEER DATE

DRY FLATS DISPOSAL SITE
NATURITA, COLORADO

CONTAMINATED MATERIAL EMBANKMENT
GRADING PLAN AND EROSION PROTECTION

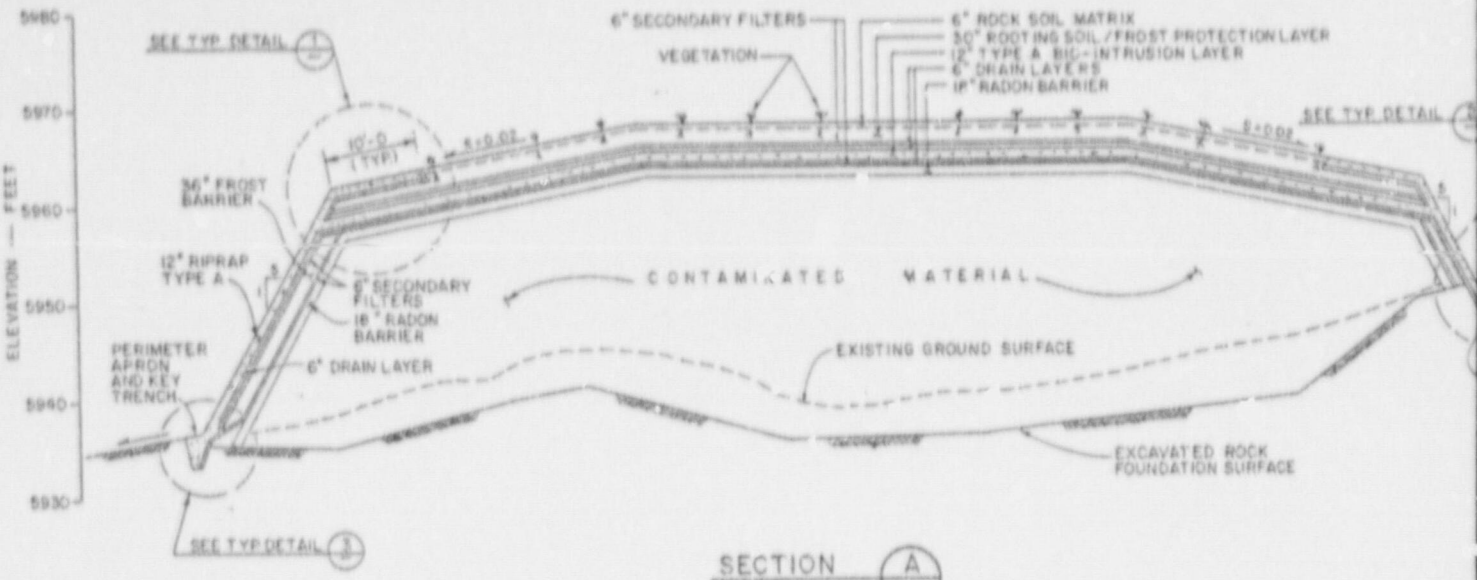
MORRISON-KNUDSEN ENGINEERS, INC.
LATRA PROJECT
180 HOWARD ST., SAN FRANCISCO, CA 94105

PROJECT NO: DE-AC04-83AL18796
DRAWING NO: NAT-DS-10-0033 REV. A

DATE	REVISIONS	BY	CK	E&D MGR.	CHIEF ENG.	QA MGR.	DOE APP.
4-20-90	ISSUED FOR PRELIMINARY REVIEW						

9712030084-02

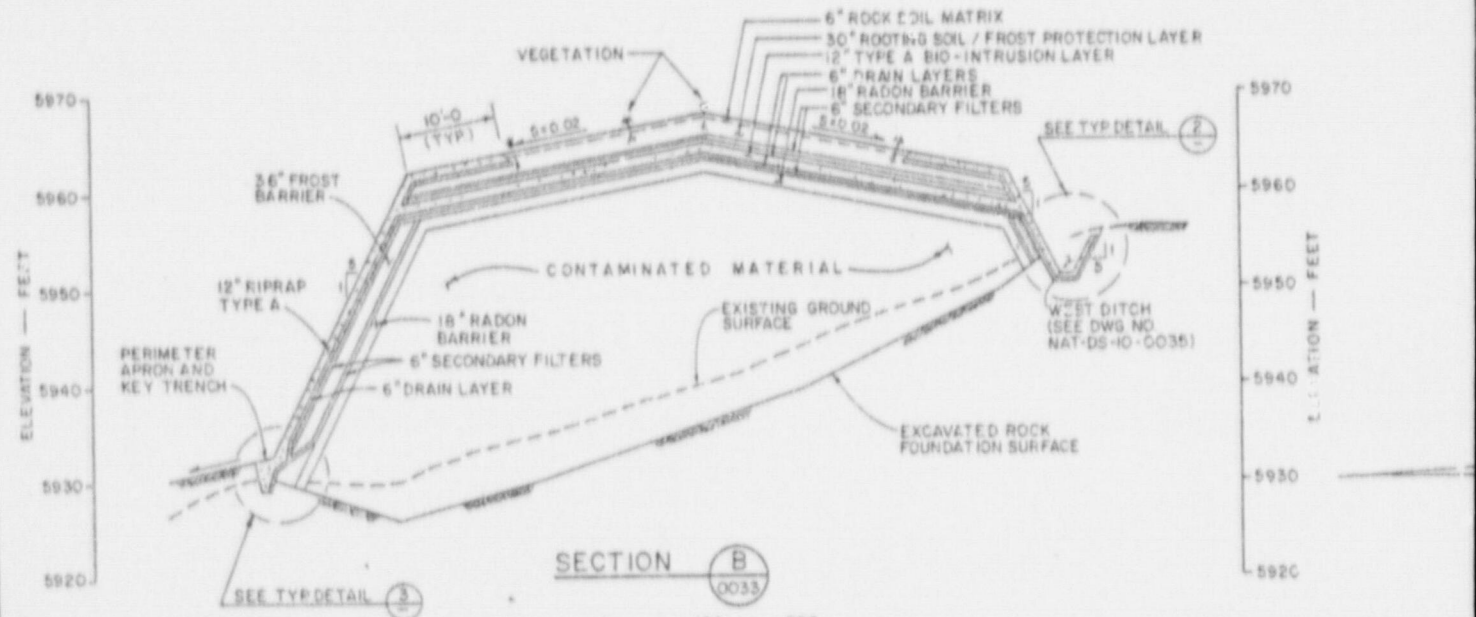
FIGURE 3



SECTION A (0033)

100 0 100 200 HORIZONTAL SCALE FEET

10 0 10 20 VERTICAL SCALE FEET



SECTION B (0033)

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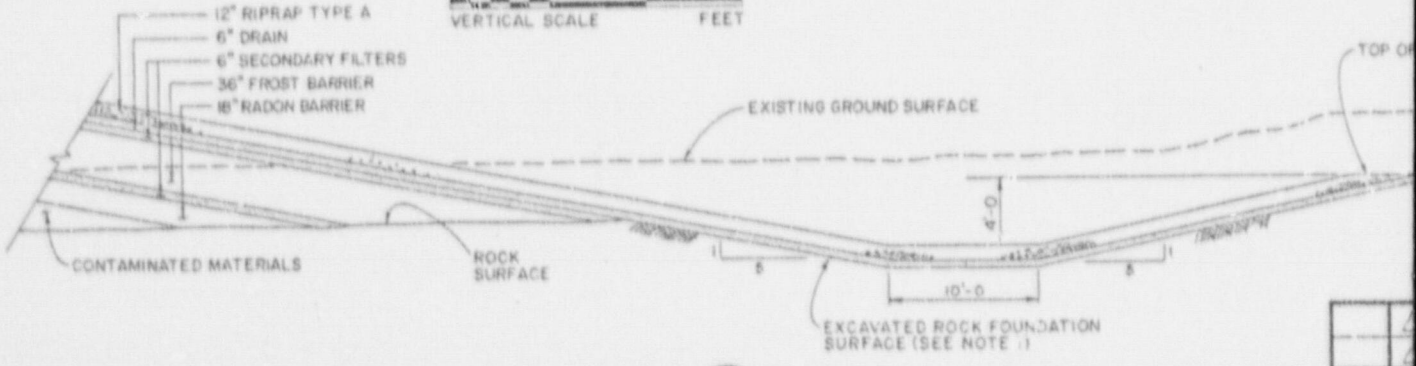
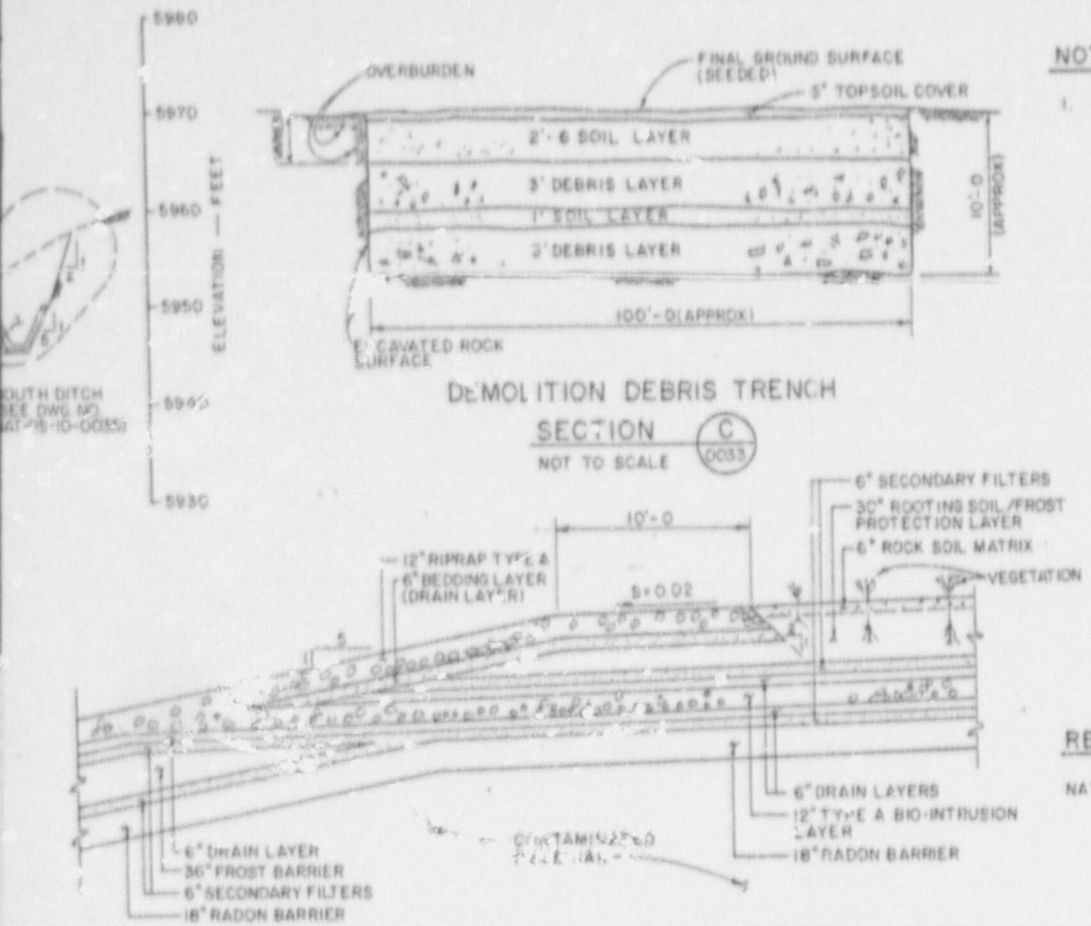
10 0 10 20 VERTICAL SCALE FEET



TYPICAL DETAIL 2

NOT TO SCALE

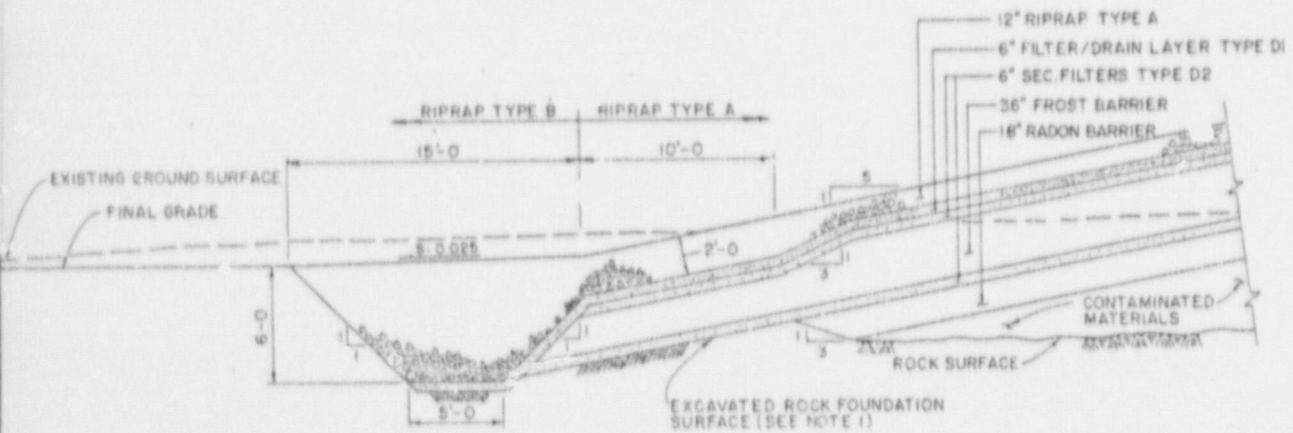


DEMOLITION DEBRIS TRENCH SECTION (C / 0033)

NOT TO SCALE

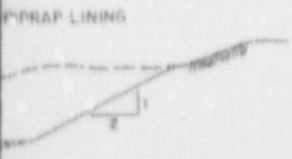
TYPICAL DETAIL (1)

NOT TO SCALE



TYPICAL DETAIL (3)

NOT TO SCALE



NOTES:

1. ANY OVEREXCAVATION INTO ROCK BEYOND THE LINES AND GRADES SHOWN SHALL BE BACKFILLED BY CONTRACTOR-APPROVED MATERIALS.

REFERENCE DRAWINGS:

NAT-PS-10-0033	CONTAMINATED MATERIAL EMBANKMENT GRADING PLAN AND EROSION PROTECTION

PRELIMINARY REVIEW		
E&D MANAGER	CHIEF ENGINEER	QA MANAGER

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

DESIGNED E. LANN RBC/
DRAWN
CHECKED
INSPECTED
RECOMMENDED
APPROVED DATE
DOE PROJECT ENGINEER DATE

DRY FLATS DISPOSAL SITE
NATURITA, COLORADO

CONTAMINATED MATERIAL EMBANKMENT SECTIONS AND DETAILS
(SHEET 1 OF 2)

MORRISON-KNUDSEN ENGINEERS, INC.
UMTRA PROJECT

PROJECT NO. DE-AC04-83AL18796

DRAWING NO. NAT-DS-10-0034 REV. A

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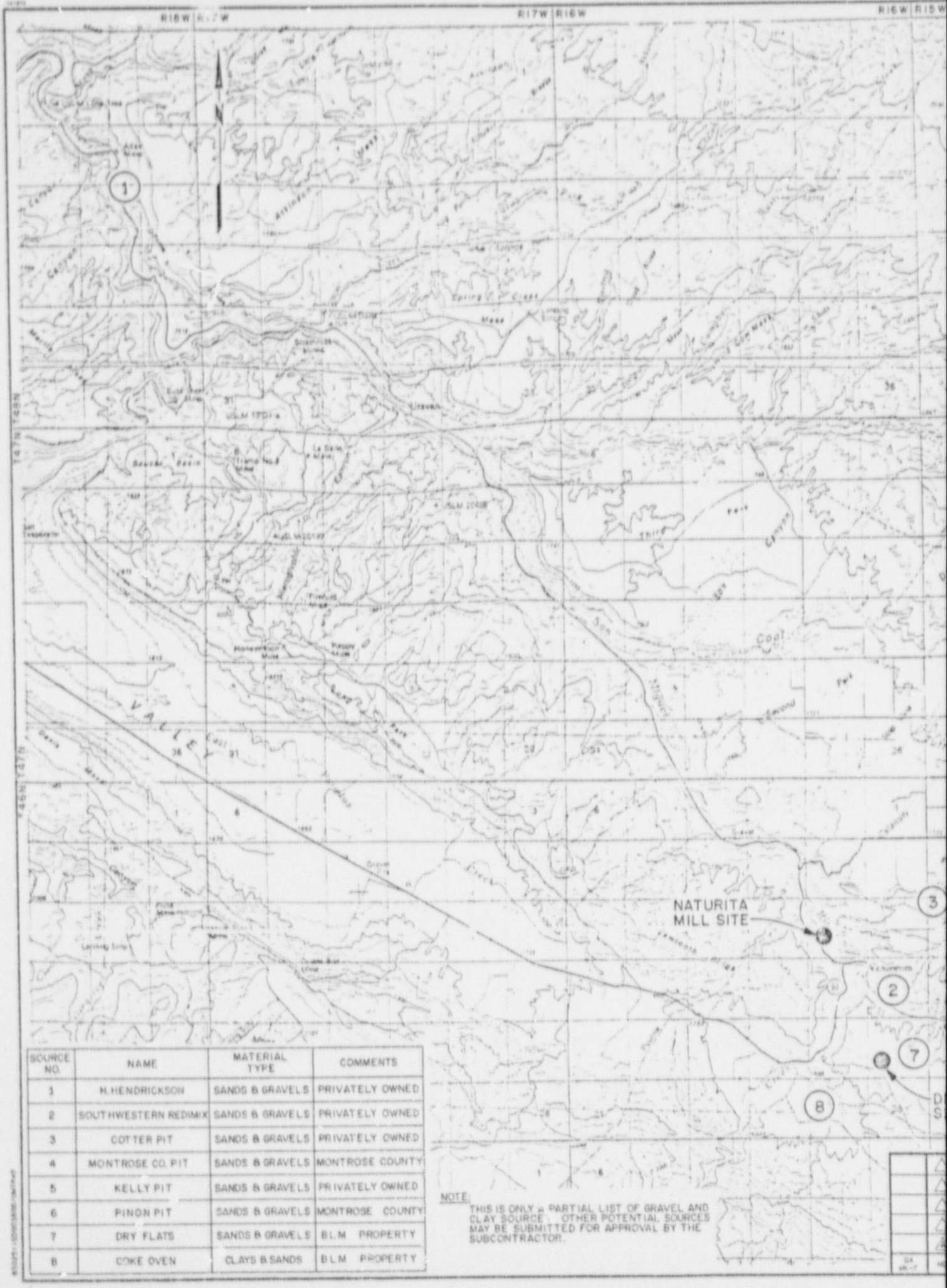
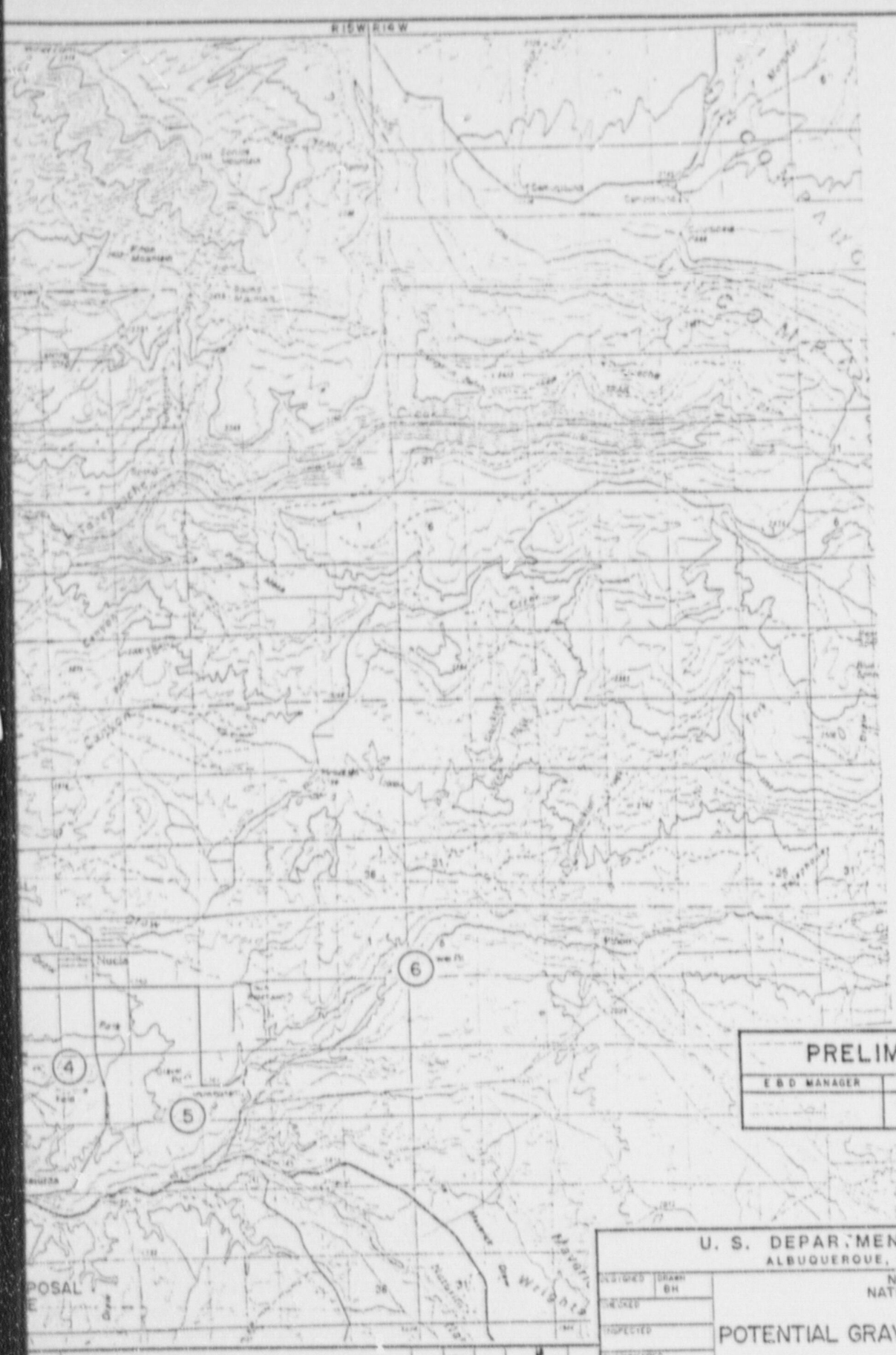
2	12/90	ISSUED FOR PRELIMINARY REVIEW	—	—	—	—	—	—

FIGURE 4



SOURCE NO.	NAME	MATERIAL TYPE	COMMENTS
1	H. HENDRICKSON	SANDS & GRAVELS	PRIVATELY OWNED
2	SOUTHWESTERN REDIMIX	SANDS & GRAVELS	PRIVATELY OWNED
3	COTTER PIT	SANDS & GRAVELS	PRIVATELY OWNED
4	MONTROSE CO. PIT	SANDS & GRAVELS	MONTROSE COUNTY
5	KELLY PIT	SANDS & GRAVELS	PRIVATELY OWNED
6	PINON PIT	SANDS & GRAVELS	MONTROSE COUNTY
7	DRY FLATS	SANDS & GRAVELS	BLM PROPERTY
8	COKE OVEN	CLAYS & SANDS	BLM PROPERTY

NOTE:
THIS IS ONLY A PARTIAL LIST OF GRAVEL AND CLAY SOURCES. OTHER POTENTIAL SOURCES MAY BE SUBMITTED FOR APPROVAL BY THE SUBCONTRACTOR.



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E & D MANAGER	CHIEF ENGINEER	QA MANAGER

5,000 0 5,000 10,000
SCALE FEET

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

DESIGNED | DRAWN BH
CHECKED
INSPECTED
ECONOMICS

NATURITA SITE
NATURITA, COLORADO

POTENTIAL GRAVEL AND CLAY SOURCES

APPROVED | DATE | DOE PROJECT ENGINEER | DATE

MORRISON-KNUDSEN ENGINEERS, INC.
UMTRA PROJECT

PROJECT NO. DE-AC04-83AL18796

DRAWING NO. NAT-GE-10-0004 REV. A

NO	DATE	REVISIONS	BY	CK	E&D MGR.	CHIEF ENG.	QA MGR.	DOE APP.
0		ISSUED FOR PRELIMINARY REVIEW	---	---	---	---	---	---

9712030084-04

FIGURE 5