WM-68
10/24/90

PART 1086

UMTRA-DOE/AL

United States Department of Energy

Report of Final Audit
Remedial Action Construction
UMTRA Project
Green River, Utah

Preparation Date - October 1990

U.S. Department of Energy
UMTRA Project Office
Albuquerque, New Mexico

Uranium Mill Tailings Remedial Action Project UMTRAP

9011080155

FINAL AUDIT REPORT

GREEN RIVER, UTAH

OCTOBER, 1990

TABLE OF CONTENTS

LIST OF TABLES

1.0 SUMMARY

The Final Audit Report summarizes the results of all Quality Assurance Audits, In-process Surveillances, and Radiological Surveillances conducted at the Green River UMTRA Project Site.

All issues documented as audit or surveillance Findings/Recommendations have been resolved to the satisfaction of the UMTRA Project Office.

A recommendation for certification of the site by the U.S. Department of Energy (DOE) is given.

2.0 INTRODUCTION

This Final Audit Report consists of a summary of the Quality Assurance Audit, Radiological Surveillance, and In-Process Surveillance reports prepared by the Technical Assistance Contractor (TAC), as well as a summary of the reports of others audits and surveillances conducted by the DOE and the U.S. Nuclear Regulatory Commission (NRC). The Final Audit Report provides an independent assessment by the TAC of the compliance of the remedial action with plans, specifications, and standards. A recommendation to the DOE for certification of the site is included.

2.1 QUALITY ASSURANCE AUDITS

Quality Assurance Audits are conducted periodically by DOE, with assistance from the TAC, to verify that the procedures and systems required by the respective quality assurance programs are being implemented during remedial action. The Quality Assurance Audits are performed on the frequency of approximately one per year for each organization and subcontractor conducting UMTRA Project work. The results of the audits and followup actions for Green River are documented in Section 5.0; a summary is given in Table 2.1.

2.2 RADIOLOGICAL AND IN-PROCESS SURVEILLANCE REPORTS

Radiological and In-Process Surveillances are conducted by the TAC for DOE to provide an independent assessment that the quality of remedial action work is sufficient to ensure that the EPA standards and other site-specific requirements are met. These performance surveillances complement the quality assurance programs and audits, and provide a high degree of assurance that the remedial action tasks are accomplished in compliance with relevant specifications and standards. Performance surveillances are conducted at processing sites a minimum of once per construction season, or twice per remedial action. The results of the surveillances and followup actions for Green River are documented in Sections 3.0 and 4.0; a summary appears in Table 2.1.

2.3 OTHER QUALITY ASSURANCE AUDITS/SURVEILLANCES

Summaries of Quality Assurance audits and surveillances conducted by the DOE, NRC, TAC, or other agencies are included in Sections 4.0, 5.0 and 6.0 and summarized in Table 2.1. Included in the summaries will be DOE and contractor resolutions to Observations presented in the audit report. Any other audits made at Green River are reported in Section 6.0 and summarized in Table 2.1.

2.4 AUDIT PROCEDURES

Criteria and procedures for conducting UMTRA Project audits and surveillances are provided in the UMTRA Project Audit/Surveillance Program Plan (JEG, 1988).

Table 2.1 Summary of audits and surveillances

Type/date	Number of Findings	Number of Observations	Date Closed
TAC Radiological Surveillances			
May 8, 1989	0	7	7-26-90
TAC In-Process Surveillances			
April 13, 1989	0	13	5-03-90
May 9, 1989	0	9	6-08-90
July 11, 1989	0	10	8-17-89
August 29, 1989(unannounced)	0	14	9-27-89
October 10, 1989	0	5	11-16-89
November 21, 1989	5	11	7-05-90
March 26, 1990	0	5	7-05-90
TAC Quality Assurance Audits			
MK-ES			
November 16, 1989	1	10	1-09-90
MK-Albuquerque			
November 14, 1989	0	10	1-05-90
Other Audits/Surveillances			
NRC			
June 13, 1989	2	5	RAP Mod.
October 11, 1989	1	5	RAP Mod.
May 1, 1990	0	5	no response required

2.5 GENERAL STANDARDS

In 1978, the U.S. Congress passed Public Law 95-604, the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), declaring uranium mill tailings a potential health hazard to the public, and requiring that certain sites be designated for remedial action. The Green River site was included as one of these. The U.S. Environmental Protection Agency (EPA) was directed to promulgate radiological and nonradiological standards for decontamination of the sites, the DOE was authorized to initiate and manage the remedial actions, and the NRC was charged with concurring in the remedial actions and licensing the disposal sites. The standards which apply to all UMTRA Project sites, as promulgated by the EPA, are given in two subparts of 40 CFR Part 192:

- The standards in Subpart A are directed at controlling the stabilization of radioactive materials at the disposal sites, and are addressed by the engineering design specifications developed by the DOE Uranium Mill Tailings Remedial Action (UMTRA) Project Office for the disposal sites. Compliance with the Subpart A standards at the Green River site was determined indirectly during in-process surveillances which evaluated compliance with the approved final design of the disposal site.

- Subpart B standards define the conditions under which a site has been adequately decontaminated. In-situ measurements and analyses of soil samples from excavated areas were conducted by the Remedial Action Contractor (RAC), and the results compared to the cleanup standards for verification that contaminated materials had been removed. The TAC conducted Radiological Surveillances at the Green River site to provide an independent evaluation of the RAC's verification efforts.

3.0 RADIOLOGICAL SURVEILLANCES

Radiological surveillances are performed by the TAC for the DOE UMTRA Project Office to provide and independent assessment that the quality of remedial action work is sufficient to ensure that EPA standards are met. While quality assurance programs and audits provide a high degree of assurance that procedures are followed, radiological surveillances address whether the work actually results in a site which meets the EPA standards. Specific attention is given to the contractor's radiological survey plans and procedures, measurement techniques, and data management capabilities. The UMTRA Project Laboratory and field instrumentation are used for contractor cross-calibration purposes as well as for analyzing soil samples taken from the sites.

One radiological surveillance was conducted at the Green River site May 8-11, 1989. The surveillance involved approximately a four-day site visit by a two-person surveillance team from the Radiological Services Group of the TAC. During the site visit, measurements were made, samples were collected for analysis at the UMTRA/TAC laboratory to provide data for comparison with similar data used by the RAC for excavation control and verification, and a statistical evaluation of the RAC's data was conducted.

A detailed description of Radiological Surveillance activities is presented in the UMTRA Project Audit/Surveillance Program Plan (JEG, 1988). The following sections provide additional information regarding the surveillance and audit activities, and summarize the findings and resolutions.

3.1 SURVEILLANCE OBJECTIVES

Radiological Surveillances have three distinct objectives. The first objective is verification that remedial actions are meeting the EPA cleanup standards or other cleanup standards specified in the remedial action planning documents. The second objective is evaluation of excavation control methods used by the RAC to ensure that contaminated areas are not overexcavated, thereby preventing increased quantities of material for disposal, and escalated costs. The final objective of a surveillance is to review the general data management methods and procedures of the RAC, and provide a pathway for the exchange of ideas for technological improvements in the program.

Radiological Surveillance results are documented as either Findings or Observations, as described below. Findings presented in a Radiological Surveillance are based on one of the following criteria:

- Noncompliance with requirements of the site Remedial Action Plan, (RAP) Engineering Design, or UMTRA Project Office directives applicable to the site.

- o Evidence that the existing radiological measurement techniques may result in residual contamination levels in excess of established limits (underexcavation).

- o Evidence that the existing radiological measurement techniques may result in otherwise avoidable excavation of soils not contaminated in excess of the limits (avoidable overexcavation).

- o Evidence that some aspect of the contractor's radiological survey plans and procedures, measurement techniques, or data management capabilities are insufficient to allow eventual certification of the site.

The soil contamination limits are those specified by EPA standards, including site-specific modifications agreed to by the NRC or mandated by UMTRA Project Office directives. The probable impact of each Finding is indicated, as well as the TAC's recommended action for resolving the issue.

Observations are comments considered appropriate by the auditors to document topics of concern to the UMTRA Project Office, and to note noncritical areas where improvements in techniques or procedures could be made. Comments on proficiency, favorable comparisons, or developmental activities may be included as Observations.

3.2 SURVEILLANCE RESULTS

During the radiological surveillance of the Green River processing site conducted on May 8-11, 1989, the surveillance team collected split verification samples from six 100 m^2 plots on the processing site in addition to observing the sampling technique utilized by the RAC. A comprehensive review was also made of the RAC's radiological procedures and measurements, instrument calibration, Quality Assurance control, and data management/analysis. No findings and seven observations were presented in the radiological surveillance report, of which three document positive aspects of the radium-226 (Ra-226) sampling and analysis, general data management and the timely collection and analysis of disposal cell emanation samples. All issues of this radiological surveillance were satisfactorily closed out July 26, 1990.

3.3 SUMMARY AND CONCLUSIONS

One radiological surveillance was conducted at the Green River UMTRA site during Remedial Action Activities. No Findings and seven Observations were noted in the Radiological Surveillance report. Followup of Findings and Observations confirmed that all issues have been resolved to the satisfaction of the TAC UMTRA Project Office and the Radiological Surveillance was closed out.

4.0 QUALITY ASSURANCE IN-PROCESS SURVEILLANCES

In order to ensure that the approved construction plans and specifications were being properly followed and that the preplanned inspection points established by the NRC and DOE were being observed, the DOE/TAC team performed five in-process surveillances at the Green River site during remedial action activities, as well as a final close-out inspection upon completion of remedial action. These surveillances were independent of the contractor performing the work and did not relieve the contractor from any inspection or checking responsibilities that were required. Under the approved Remedial Action Inspection Plan (RAIP), these surveillances were performed by a team with members from different disciplines headed by the TAC Quality Assurance Department. Quality Assurance surveillances were conducted at the Green River site in April 1989, May 1989, July 1989, August 1989 and October 1989. The close-out inspections were conducted in November 1989 and March 1990.

Each surveillance conducted by the TAC involved approximately a two-day site visit by a team headed by the TAC Quality Assurance Department and supported by other TAC disciplines as necessary. Surveillances were also conducted by an NRC team. These surveillances also involved approximately a two-day visit. During the TAC surveillances, materials, records, and construction activities were verified using the approved RAIP, RAP, and plans and specifications for the Green River site. The following sections provide additional information regarding the surveillance activities and summarize the surveillance findings and resolutions.

4.1 SURVEILLANCE OBJECTIVES AND CHECKLIST

The Quality Assurance surveillances had three distinct objectives. The first objective was to verify compliance by the RAC to the approved RAP for the Green River site. To accomplish this, the approved RAP with any modifications was reviewed by the TAC Quality Assurance Department surveillance team leader and members, and a checklist was established made up of key construction activities and the methods used to perform them.

The second objective was to verify that the RAC was in compliance with the approved plans and specifications. The surveillance team accomplished this objective by review of documentation, and by observing construction activities as they were being performed.

The final objective of the surveillances was to verify that the approved RAIP for the Green River site was being implemented. This was accomplished by qualified personnel witnessing the performance of testing and inspection activities by staff in the field.

4.2 SURVEILLANCE RESULTS

In-process surveillance results are documented as either Findings/Recommendations or Observations with the former relating to non-compliance items and the latter relating to items observed during the site visit. The results of the surveillances and close-out inspections performed at the Green River site included five Findings/Recommendations and 67 Observations. All of the Findings/Recommendations were corrected to the satisfaction of the UMTRA Project office and the NRC. The five Findings/Recommendations noted during the surveillances and the close-out inspections required the following:

- Completion of final aerial photographs and the photograph specifications.
- Installation of surveillance and maintenance features including survey monuments, boundary monuments, site markers, entrance signs and perimeter signs.
- Completion of final site grading and placement of the last few loads of (rock) riprap. Final grades need to be confirmed by survey upon completion and included in the final as-built drawings.
- Grading and placement of type A (rock) riprap needs to be confirmed during the final remedial action close-out inspection.
- Monitor wells need to be inventoried, legibly labeled, capped and locked.

4.3 SUMMARY AND CONCLUSIONS

Five in-process surveillances and two remedial action close-out inspections were conducted at the Green River site. A total of five Findings/Recommendations and 67 Observations were noted. Followup of Findings/Recommendations confirmed that all required actions have been taken by the Remedial Action Contractor and all Findings/Recommendations have been resolved to the satisfaction of the TAC UMTRA Project Office.

5.0 QUALITY ASSURANCE AUDITS

During the performance of remedial action activities at the Green River site, there was one audit of MK-Environmental Services' activities in San Francisco and one audit of the MK-Ferguson Albuquerque Operations Office activities. These audits were performed by the TAC with support from the DOE UMTRA Project Office.

5.1 AUDIT OBJECTIVES

Quality assurance audits have two objectives. The first objective is to verify compliance by MK-Environmental Services and MK-Albuquerque to their approved QAPPs and supporting procedures. The second objective is to provide objective evidence of the effectiveness of the implementation of the approved QAPPs and supporting procedures.

5.2 AUDIT RESULTS

Audit results are documented as either Findings/Recommendations or Observations with the former relating to non-compliance items and the latter relating to items observed during the audit. The results of the audits included one Finding/Recommendation and 20 Observations. The one Finding noted during the audits required the following:

- The performance of hand-held calculator engineering QC checks on a regular basis for each in-house computer program utilized for calculations in support of the UMTRA Project.

5.3 SUMMARY AND CONCLUSIONS

One quality assurance audit was conducted of the MK-Environmental Systems activities in San Francisco and one audit of the MK-Ferguson Albuquerque Operations Office activities. A total of one Finding and 20 Observations were noted. Followup of Findings/Recommendations confirmed that all required actions have been taken by either MK-Environmental Systems or MK-Ferguson Albuquerque and all Findings/Recommendations have been resolved to the satisfaction of the TAC UMTRA Project Office.

6.0 OTHER AUDITS/SURVEILLANCES

In order to ensure that the approved construction plans and specifications and RAIP for the Green River site were being properly followed, the NRC performed two surveillances and a final walkover inspection. These surveillances and final walkover inspection were independent of the contractor performing the work and did not relieve the contractor from any inspection or checking responsibilities that were required. The NRC surveillances were performed on June 13 and October 11, 1989. The final NRC walkover inspection was conducted May 1, 1990.

Each surveillance conducted by the NRC involved approximately a one-day site visit. During these surveillances, materials, records, and construction activities were verified using the approved RAIP, RAP, and Plans and Specifications for the Green River site.

6.1 SURVEILLANCE OBJECTIVES

The surveillances had three distinct objectives. The first objective was to verify compliance to the approved RAP and any approved modifications.

The second objective was to verify compliance with the approved plans and specifications. This objective was accomplished by review of documentation and by observing construction activities as they were being performed.

The final objective was to verify that the approved RAIP for the Green River site was being implemented. This was accomplished by qualified personnel witnessing the performance of testing and inspection activities by staff in the field.

6.2 SURVEILLANCE RESULTS, NRC

Surveillance results in the NRC reports are documented as recommendations. The results of the surveillances performed at the Green River site included three recommendations. The three recommendations are as follows:

- Records indicate that the average moisture content (by volume) of the in-place tailings was approximately 7%. This represents an average 2% above the 5% agreed to in the 4/05/89 DOE/NRC meeting. The final RAP should address the impact of this on compliance with the EPA groundwater standards.

- o DOE intends to apply a binder material for temporary stabilization of the in-place contaminated material. Although application may be necessary, DOE should consider potential effects on constituent releases to groundwater and address this in the final RAP.

- o Discussions were held regarding acceptable justification of actual moisture/density tests that were performed. It was agreed that such justification would be provided in the RAP, subject to final approval by DOE. This would be a first step in the RAP/RAIP approval process. Other issues that need to be resolved include resolution of problems with moisture content and compliance with groundwater standards.

6.3 SUMMARY AND CONCLUSIONS

Two surveillances were performed by the NRC during remedial action activities at the Green River site and one final walkover inspection upon completion. A total of three recommendations were made by the NRC. Followup of recommendations by the NRC confirmed that all required actions have been taken by the RAC, and all recommendations have been satisfactorily resolved.

7.0 SUMMARY AND CONCLUSIONS

One Radiological Surveillance, two Quality Assurance Audits, five Quality Assurance In-Process Surveillances, and a Final Remedial Action Close-out Inspection were conducted at the Green River UMTRA Project site during remedial action activities. A total of six Findings/Recommendations and 94 Observations were noted during TAC activities, and three recommendations and 15 observations were noted during NRC activities. Followup of Findings/Recommendations and Observations confirmed that all required actions have been taken by the RAC, and all Findings/Recommendations have been satisfactorily resolved. The TAC concludes that the remedial action was conducted in accordance with the approved Remedial Action Plan, that the site conforms to the applicable EPA standards or to the agreed-upon deviations from those standards, and recommends the site for certification by the DOE.

DEPARTMENT OF ENERGY
ALBUQUERQUE OPERATIONS OFFICE
CONTRACT NO. DE-AC04-83AL18796

GREEN RIVER, UTAH

D R A F T

Completion Report

VOLUME 1

Remedial Actions
Contractor
for the
Uranium Mill Tailings
Remedial Actions
Project

MAY 1990

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

INDEX

SECTION I

EXECUTIVE SUMMARY

I. EXECUTIVE SUMMARY

The purpose of this completion report is to provide evidence that the final Green River, Utah, Processing/Disposal Site property condition is in accordance with the approved design, and that all Environmental Protection Agency (EPA) standards have been satisfied. Included as appendices, in order to support the stated conclusions, are the design calculations, as-built drawings and specifications, a summary of geotechnical testing performed, a description of the methodology utilized to obtain the radiological measurements which were used to verify the remedial actions, and the pre-remedial action and post-remedial action radiological measurements.

The principal objectives of the remedial action are to isolate and stabilize the tailings in such a manner as to prevent misuse by man and dispersal by natural forces, such as wind, rain and flood waters, to reduce radon emissions from the tailings pile, and the elimination of significant exposure to gamma radiation from the tailings pile. The controls are designed to be effective for 1,000 years where reasonably achievable, with a minimum performance period of 200 years.

The final Remedial Action Plan (RAP), which is to be approved by the Department of Energy, and concurred upon by the Nuclear Regulatory Commission (NRC) and the State of Utah, contains the conceptual design, which was used to develop the final approved design. During remedial action construction operations, there were conditions encountered which required design features which were not in the conceptual design. These conditions and the associated design changes are noted as three Class I Project Interface Documents (PID's), which will be incorporated into the final Remedial Action Plan, and are as follows:

PID No. 10-S-01 (approved by DOE in September, 1988)

The calculations for Radon Barrier thickness at Green River concluded that 3 inches was adequate to meet the requirements for radon emanation. The design documents required a 12-inch thick layer, however, the NRC did not feel this layer was constructable and based on their review comments, the layer thickness was changed to 18 inches.

PID No. 10-S-03, Rev. 3 (approved by DOE May 1, 1989)

To comply with the proposed EPA Groundwater Protection Standards, hydrological analyses indicated that a cover design revision and uncontaminated fill layer beneath the tailings were required. These proposed changes in design requirements were published in the Remedial Action Plan dated January 1989, specifically Volume III, Appendix F, and include the following:

1. Revising gradation of material used for radon barrier requiring a minimum of 70% by weight passing a No. 200 sieve in the first lift of barrier and minimum of 50% by weight passing a No. 200 sieve in subsequent layers with a maximum of 10% by weight retained on a No. 4 sieve for all layers.

2. Revise radon barrier thickness to 3 feet from 18 inches.

3. Add 6 feet of select fill Type A to the bottom of the tailings embankment.

4. Change bentonite specified from Envirogel-10 to Envirogel-200.

5. Increasing the bentonite additive from 3% to 6%.

6. Addition of specifications for moisture conditioning limitations mixing and compacting radon barrier materials amended with bentonite.

7. Revise the final cell grading plan to accommodate additional contaminant.

PID No. 10-S-6 (approved by DOE May 1, 1989)

To comply with a DOE request to reduce the number of haul trips from the Fremont Junction riprap source, the bedding source was changed to a gravel deposit known as Hastings Road which was close to the site. The DOE request stemmed from concern for safety raised by the State of Utah because of the long haul along the steep and winding highway route to Fremont Junction.

Through test results, the Hastings source, indicated bedding material with durability scores greater than 50 and would be subjected to occasionally saturated conditions (probably seldom - saturated).

The specifications incorporated the following provisions for the Hastings source.

1. Location in the Hastings source was approved by a professional geologist.

2. A rock quality score of 50% or greater based on specific gravity, absorption, sodium sulphate soundness and abrasion results.

3. Limit material to no more than 3% of clay lumps and friable particles in accordance to ASTM C142.

4. Requirements to strip source overburden containing deleterious materials.

All remedial action activities were completed in conformance with the specifications and drawings, and the as-built drawings, in our opinion, reflect an accurate depiction of the existing Processing/ Disposal site property condition.

MK-Ferguson Company

J.E. Oldham
Project Director

SECTION II

DESIGN ASSESSMENT

II. DESIGN ASSESSMENT

This section defines the requirements established for the inactive uranium processing/disposal site located near Green River, Utah and provides an assessment of the completed design with respect to the design requirements. The design criteria, which were formally approved by the U.S. Department of Energy and conditionally concurred upon by the Nuclear Regulatory Commission and the State of Utah, are given in Section II-A. Section II-B gives the design bases established by Morrison-Knudsen Engineers (MKE) to guide the design efforts. A Design Basis Summary to assess how specific design basis are satisfied by the design is given in Section II-C.

A. Design Criteria

"Remedial Action Plan (RAP) and Final Design for Stabilization of the Inactive Uranium Mill Tailings Site at Green River, Utah UMTRA-DOE/AL 050510.GRNO was provided to MK-Ferguson Company and Morrison-Knudsen Engineers, Incorporated, as guidance for design activities."

1. Purpose/Objectives:

The design objectives are to isolate and stabilize the uranium mill tailings for the purposes of preventing their misuse by man and dispersal by natural forces, reducing radon emissions from the tailings pile, eliminating significant exposure to gamma radiation from the tailings pile and protecting the groundwater beneath the disposal site from contamination by infiltration. The following major design objectives were established:

- Consolidate and stabilize contaminated materials in a disposal embankment above the elevation of the Probable Maximum Flood (PMF) in Brown's Wash.

- Reduce radon flux to the atmosphere from tailings and from other contaminated materials to levels not greater than 20 pCi/m^2s.

- o Design permanent features for stabilization of tailings and other contaminated materials to be effective for at least 1000 years to the extent achievable, and in any event, for at least 200 years.

- o Prevent human and animal disturbance of the disposal embankment.

- o Minimize, to the extent achievable, the impact of materials in the disposal embankment on ground and surface water.

- o In areas that will be released for unrestricted use, reduce Ra-226 contamination levels to less than 5 pCi/g above background levels in the top 15 cm of soil and to less than 15 pCi/g above background levels in any 15 cm thick soil layer beneath the top 15 cm.

- o Minimize the size of the restricted final disposal site.

- o Minimize the release of contaminants from the site during construction.

- o Minimize the area disturbed during construction.

- o Minimize the exposure of workers and the general population to contaminated materials.

2. Configuration and Essential Features:

The principal construction features of the Green River, Utah, UMTRA site are:

- o The excavation, placement, and stabilization of contaminated materials, from the tailings pile, including contaminated windblown surface areas of the site and adjacent areas, vicinity property materials, the debris from demolition of

contaminated buildings, and the contamination resulting from the decontamination of buildings, in a disposal embankment on a terrace located approximately 600 feet south of Brown's Wash.

- The disposal embankment covers approximately five acres and contains 381,788 cubic yards of contaminated material.

- The location of the mill site is approximately one-half mile east of the Green River and one mile south of the city of Green River. The disposal embankment is located southeast of the former mill site on a terrace 70 feet above the elevation of the flood plain of Brown's Wash, to protect the embankment against erosion from Brown's Wash and against undercutting by gully formation.

- The disposal embankment was constructed primarily below the ground surface. The foundation of the embankment extends into bedrock of the Dakota and Cedar Mountain Formations. As part of the ground water strategy, a 6 foot thick layer of Select Fill Type A was placed on the bottom of the embankment to serve as a buffer.

- The radon barrier was constructed of a 3 foot thick layer of compacted uncontaminated silty clay material mixed with six percent bentonite by weight to ensure a hydraulic conductivity of less than 2×10^{-8} cm/s.

- The erosion protection layer consisting of a 6 inch thick bedding layer and a 12 inch thick layer of Type A Riprap. The erosion protection layer was constructed to protect the infiltration/radon barrier and embankment from runoff from Probable Maximum Precipitation (PMP) and encroachment of gullies.

3. Environmental Requirements Stated:

- The design shall be based on reducing the average radon flux from the site to levels not exceeding 20 picocuries per square meter per second.

- The contaminant levels around the Green River Site and Encapsulation cell shall be reduced to levels which do not exceed 5 picocuries per gram of Ra-226 above background in the top 15 centimeters (cm) of soil, and do not exceed 15 picocuries per gram Ra-226 above background in any 15 cm layer below that depth.

4. Structural Requirements:

- The cover and drainage features shall be designed to protect against long-term erosion from wind and water and shall withstand runoff from the probable maximum precipitation forecasted for the Green River, Utah, area of 56.1 in/hr for a 2.5 minute duration.

- The embankment shall be covered with a layer of riprap placed and graded to form a uniformly distributed, dense compact mass.

- The encapsulation cell shall be designed to withstand a seismic event of magnitude (M_L) = 6.2 occurring at a radial distance of 9.5 miles from the site, with an on-site acceleration of 0.21g.

- The embankment design shall be effective for at least 1,000 years to the extent achievable, and in any evnet, for a minimum of 200 years.

- The below finish grade armoring Riprap consisted of a 6 inch lift of bedding, followed by a 6 inch lift of of Type A Riprap, then a layer of 36 inch Type B Riprap 20 feet wide covered by Type B Select Fill. (The configuration of the infiltration/radon barrier, bedding, and Type A and B Riprap layers are presented in Figure 2.1). Riprap toe protection will extend about 20 feet on the subsurface from the embankment toe to reduce erosion of the ground surface adjacent to embankment.

- The contaminated material was covered using a protective cover consisting of:

  a) Radon Barrier material,
  b) Bedding layer of Gravel, and
  c) Riprap layer of Basalt.

- Gullies existing near the disposal embankment were filled using a gravel fill material to a given elevation. The gullies were regraded to minimize potential of new gully formation or the enlargement of existing gullies.

- The mill and office building additions, and the roaster building were demolished. The contaminated debris was buried in the disposal embankment.

- The mill building, crusher building and office building were decontaminated to make them suitable for reuse.

- The remaining area of the disposal site was regraded to assure proper drainage, and seeded.

- Site survey and boundary markers were located around the embankment identifying the property as "U.S. Government Property - No Trespassing".

5. Quality Assurance Requirements:

- Quality assurance for design and construction shall comply with the UMTRA Project Quality Assurance Plan (DOE/AL-185) and the MK-Ferguson Company Quality Assurance Program Plan which complies with ANSI/ASME NQA-1-1979 with 1981 Addendum and 10 CFR 50, Appendix B as applied to the UMTRA Project.

6. Codes and Standards:

- Local and federal codes and standards shall be followed during design and construction. These shall include, but are not limited to the following:

AASHTO:	American Association of State Highway and Transportation Officials
ANSI:	American National Standards Institute
ASME:	American Society of Mechanical Engineers
ASTM:	American Society for Testing and Materials
CFR:	Code of Federal Regulations, as applicable (such as 40 CFR, Part 192, etc.)
CISPI:	Cast Iron Standard Pipe Institute
DOL/OSHA:	Department of Labor/Occupation Safety and Health Administration
ISRM:	International Society for Rock Mechanics
NEC:	National Electric Code
NEMA:	National Electric Manufacturers Association
PFI:	Pipe Fabricators Institute - Handbook of PVC Pipe Design and Construction.
UBC:	Uniform Building Code
UL:	Underwriters Laboratory
UPC:	Uniform Plumbing Code
USDOE:	DOE 6430.1 - General Design Criteria Manual

B. Design Bases Established by MKE to Meet the Approved Criteria

The means by which MKE assures that all elements of the design criteria are met is through Design Basis Memoranda (DBM). The Design Basis Memoranda are developed by the Lead Task Engineers under the direction of the Site Design Engineer. The Design Basis Memoranda address the given design criteria and produce site specific design requirements which then govern the final design. The Design Basis Memoranda, therefore, develops a subset of design requirements which must be addressed in order to assure that all elements of the design criteria are met.

The design bases established by MKE, for the Green River, Utah, UMTRA site, are:

10-520-02	General Design Criteria
10-523-01	Utility Abandonment and Relocation
10-531-01	Construction Facilities and On-Site Utilities
10-534-01	Retention Basin
10-535-02	Tailings Material Excavation and Final Embankment
10-537-02	Decontamination and Demolition of Structures and Buildings
10-538-01	Access and Haul Roads
10-539-01	Site Drainage, Grading and Stabilization

C. Design Basis Summary

10-520-02 General Design Criteria

The first DBM defines the purpose and objectives of the remedial action. It identifies the codes and standards which are to be used. It presents the general criteria for structural design, hydrology and hydraulics, geotechnical, wastewater handling, wastewater treatment and construction phase requirements.

10-523-01 Utility Abandonment and Relocation

The general requirements set forth in this DBM read as follows:

Any utilities within the final disposal site will be relocated, removed or decommissioned to preclude any future need for excavation or access within the embankment area. Other active utilities which may be affected by construction must be protected or rerouted. Each relocated system shall conform to current applicable standards. Any system which has a capacity to create a void passing through or under the stabilized tailings shall be removed, crushed or filled with a non-degradable material.

10-531-01 Construction Facilities and On-Site Utilities

This memorandum presents the basic information and guidelines for the preparation of specifications and designs for the construction facilities, including: Field offices, access control and radiological monitoring facilities, and vehicle and equipment decontamination and on-site utilities at the Green River site.

10-534-01 Retention Basin

This memorandum presents the basis for design of a wastewater retention basin for use during construction to protect against release of contaminants from the site and to provide runoff and sediment control.

10-535-02 Tailings Material Excavation and Final Embankment

This Design Basis Memorandum presents the basis for design of the tailings materials excavation and the final embankment at the Green River Site. The embankment will be designed to contain all contaminated materials from the Green River site and adjacent areas, and to provide long-term stability and radon control Contaminated materials will be excavated from existing tailings pile, mill yard and

windblown-contaminated areas and relocated to an on-site location south of the existing tailings pile.

10-537-02 Decontamination and Demolition of Structures and Buildings

The purpose of this memorandum is to establish the criteria for decontaminating and demolishing the existing buildings and foundations.

It also describes measures required to remove or fix to the surfaces all loose or removable contamination in the buildings and on building foundations, prior to demolition. Any building that shall remain on the site after completion of remedial action shall be decontaminated to meet the EPA limits specified.

10-538-01 Access and Haul Roads

This memorandum presents criteria and guidelines for any required design of access or haul roads for on-site stabilization of the tailings pile.

The determination of the need for road design will be made based on consultation with MK-F, permit requirements, and/or other conditions which may arise during design (e.g. State requirements).

Additional roads may be constructed within the work area at the Sub-contractor's option. Those roads will not be designed by the Remedial Action Contractor but will be subject to conditions specified elsewhere (e.g., Special Conditions and site drainage specifications).

10-539-01 Site Drainage, Grading and Stabilization

The purpose and scope of this memorandum is to provide the basic information and set the standards and guidelines for the site drainage, grading, and stabilization of disturbed land outside the embankment area at the Green River Site.

Long-term stability of the site requires provision for site drainage, suitable site grading, and stabilization measures. Ditches will be constructed to carry away surface runoff, and the disturbed area will be recontoured for good drainage and revegetated at the site and borrow areas as required.

SECTION III

REMEDIAL ACTION ASSESSMENT

III. REMEDIAL ACTION ASSESSMENT

A brief description of the pre-remedial action site conditions, and the remedial action and cleanup verification performed at the Green River, Utah UMTRA site is provided in the following paragraphs. Also stated is the geotechnical testing used to verify compliance in accordance with the design criteria, and the radiological verification methods applied to insure radiological cleanup to the EPA limits for the UMTRA project.

A. Pre-Remedial Action Site Conditions

1. Processing/Disposal Site

The Green River inactive uranium mill site is in Grand County, Utah, approximately one mile southeast of the city of Green River and 0.5 mile south of U.S. Highway 6 & 50 (U.S. 6 & 50). The 48 acre site is in Sections 15 and 22, Township 21 South, Range 16 East, Salt Lake Meridian, and is bordered by the mainline track of the Denver and Rio Grande Western (D&RGW) Railroad on the north and the recently completed Interstate 70 (I-70) on the south.

The 48 acre designated site (Figure 1) consists of the tailing pile (eight acres), the mill yard and ore storage area (23 acres), four main buildings, a water tower, and several small buildings. The buildings are all structurally sound and most are slightly contaminated.

Dispersion of tailings by wind and water erosion has contaminated approximately 30 acres. The total volume of contaminated materials, including the tailings, underlying soils, windblown contaminated soils, and vicinity property materials were originally estimated to be approximately 200,000 cubic yards (cy). During construction, a total quantity of 381,761 cubic yards of tailings and contaminated material were excavated and placed in the disposal cell.

Access to the mill yard was restricted by a six foot high security fence with locked gates. The tailing pile was also fenced to restrict vehicle and livestock access; however, pedestrian traffic was not restricted. The remainder of the site was not fenced and access was not restricted. Radiation warning signs were posted on the fences at the site.

The surface of the tailings pile was covered with a layer of earthen material averaging six inches thick. This cover had eroded in places. Also, riprap and ditches were placed around the north and east edges of the pile to control water runoff into Brown's Wash, which parallels the site on the north.

In order to stabilize the tailings and meet the EPA standards, the tailings and other contaminated materials were consolidated into a disposal cell located approximately 500 feet south and 70 feet higher in elevation than Brown's Wash. The site occupies a level area that is dissected by a shallow, ephemeral stream. This stream drains to the northwest, around the mill site. Bedrock is exposed in the bottom of the drainage near where the mill site fence parallels the site road.

The site surface was formed of sediment sand and gravel and was covered by sagebrush and wild forbes. A power line crosses the site area.

NOTE: Excerpts were taken from the "Remedial Action Plan and Final Design for Stabilization of the Inactive Uranium Mill Tailings at Green River, Utah" for the pre-remedial action site conditions.

B. Remedial Action and Cleanup Verification

Remedial Action at the Green River, Utah site consisted of :

- Constructing an access control, monitoring, and decontamination pad.
- Decontamination, restoration, and renovation of the office, mill, and crusher building. Demolition of the roaster and utility buildings.
- Sealing of monitoring wells.
- Installation of temporary fencing. (This fence became permanent).
- Removal and stockpiling of windblown contamination.
- Backfilling existing gullies with gravel fill.
- Construction of a retention basin including spillway.
- Construction of Brown's Wash Dike to prevent storm water from eroding the mill tailings stockpile area.
- Excavation of tailing embankment cell, including stockpiling select fills for later use.
- Construction of tailing embankment, starting with a 6 foot layer of Select Fill Type A on the bottom of the embankment to serve as a buffer.
- Excavation and placement of mill tailings, windblown contaminates stockpile, and the vicinity property contaminates stockpile.

- o Furnish and placement of bedding and riprap erosion protection material, as cover over the radon barrier layer.

- o Construction of a permanent ditch.

- o Demolition, disposal or demobilization of the construction facilities including the decontamination pad and retention basin.

- o Final site grading restoration and seeding of all disturbed areas.

- o Placement of warning sign, site boundary markers and site monuments.

The following photographs provide a pictorial history of the sequence of events during Remedial Action activities:

- o Figure 1, 07/88, Processing and Disposal Sites prior to Remedial Action.

- o Figure 2, 01/30/89, shows Brown's Wash Dike completed, construction of Retention Basin, and cell excavation.

- o Figure 3, 02/22/89, illustrates the placement of gravel fill and the completed retention basin.

- o Figure 4, 03/22/89, illustrates continued cell excavation.

- o Figure 5, 04/22/89, illustrates the placement of tailing and windblown contaminates in the tailing embankment and the placement of Type A select fill as backfill.

- o Figure 6, 05/31/89, shows placement of gravel fill and removal of Brown's Wash Dike.

- Figure 7, 06/30/89, illustrates the final contours of contaminated materials.

- Figure 8, 08/30/89, illustrates the placement of bedding and radon barrier material on the tailing embankment.

- Figure 9, 10/30/89, illustrates the placement of Type A & B riprap on and around the tailings embankment. Select fill Type B placement is also ongoing. Bedding and radon barrier material placement is complete.

- Figure 10, 11/28/89, shows the completed placement of all fills and riprap materials.

FIG. 1

FIG. 2

FIG. 3

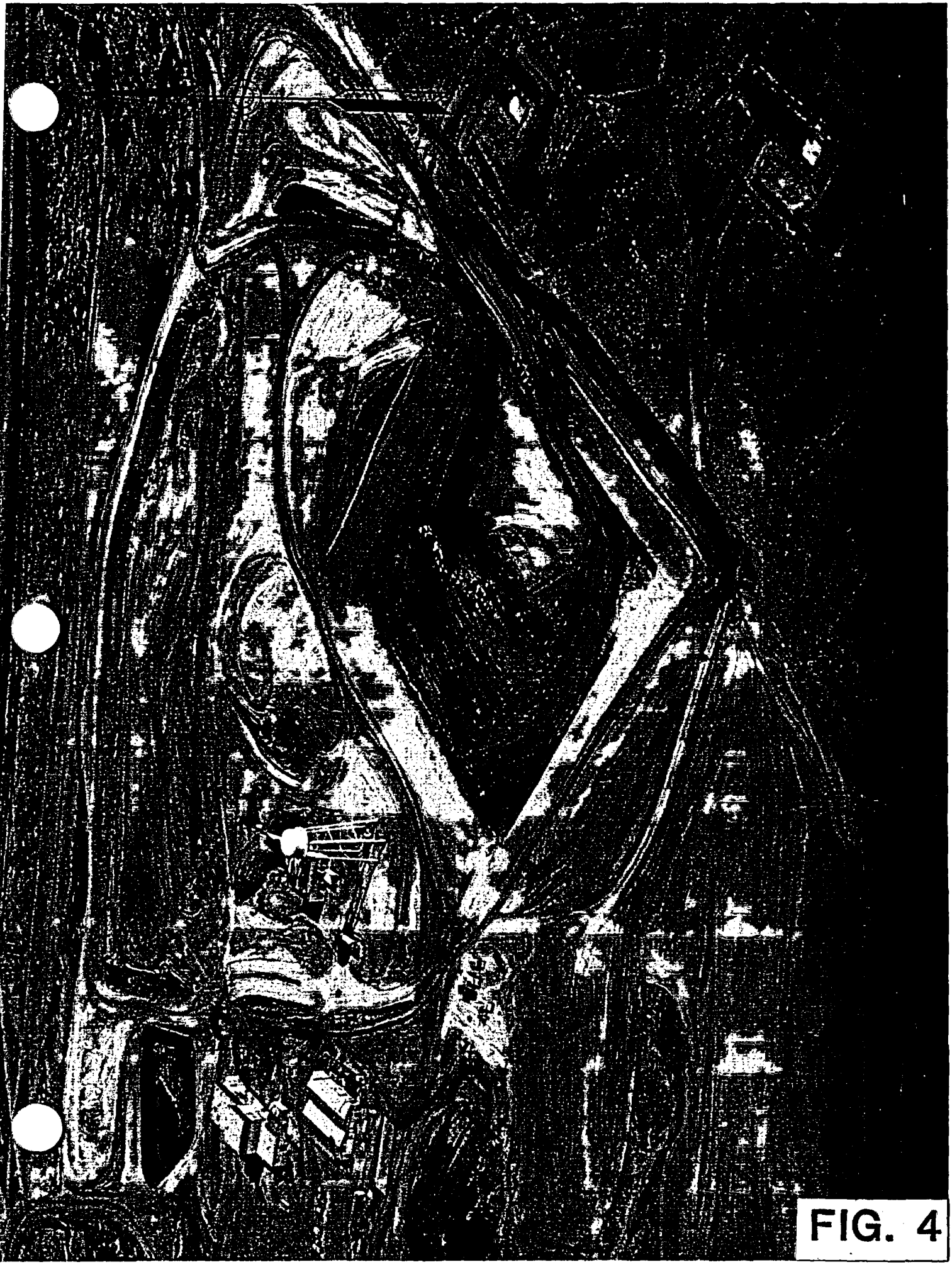


FIG. 4

FIG. 5

FIG. 6

FIG. 7

FIG. 8

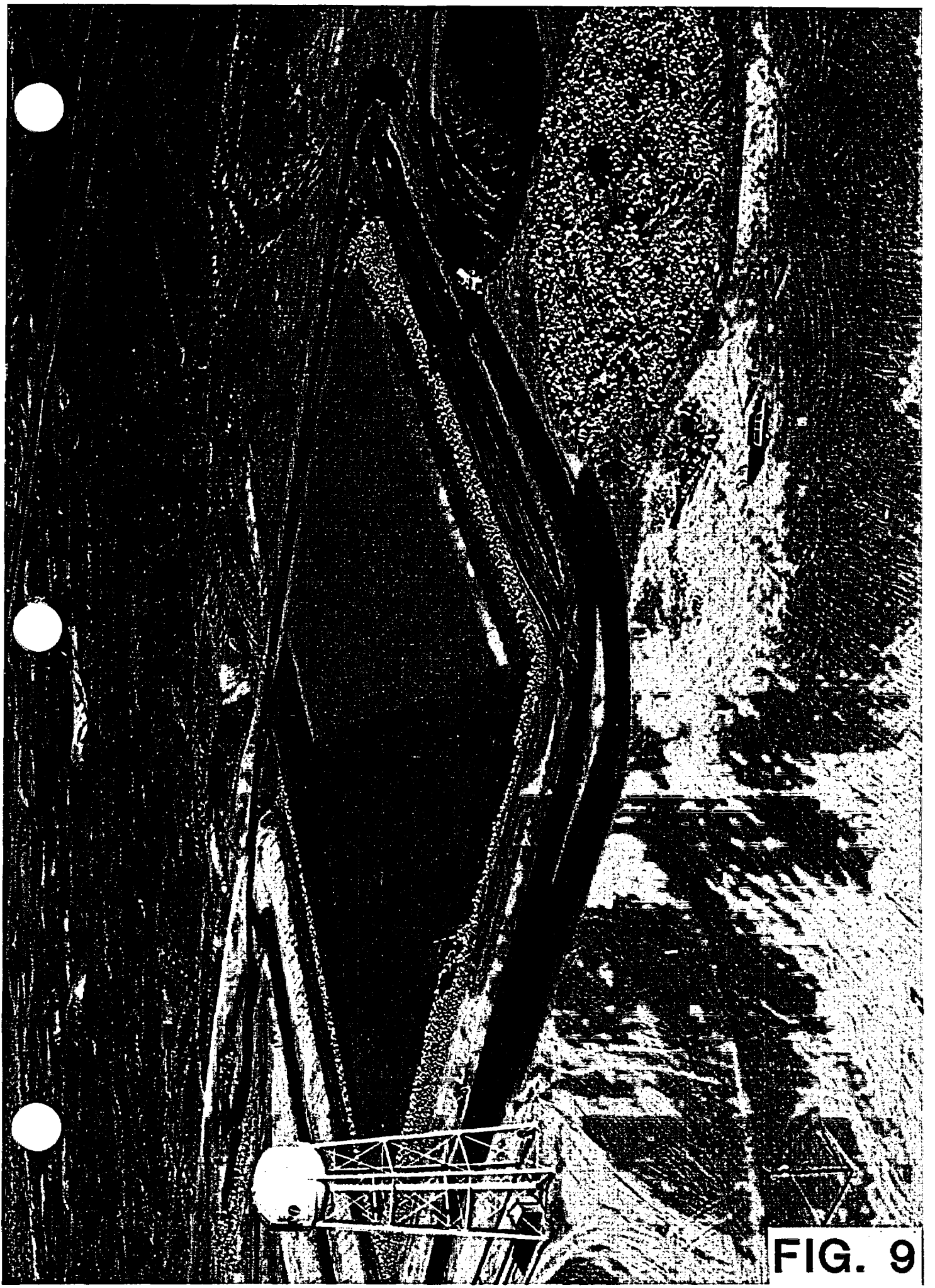


FIG. 9

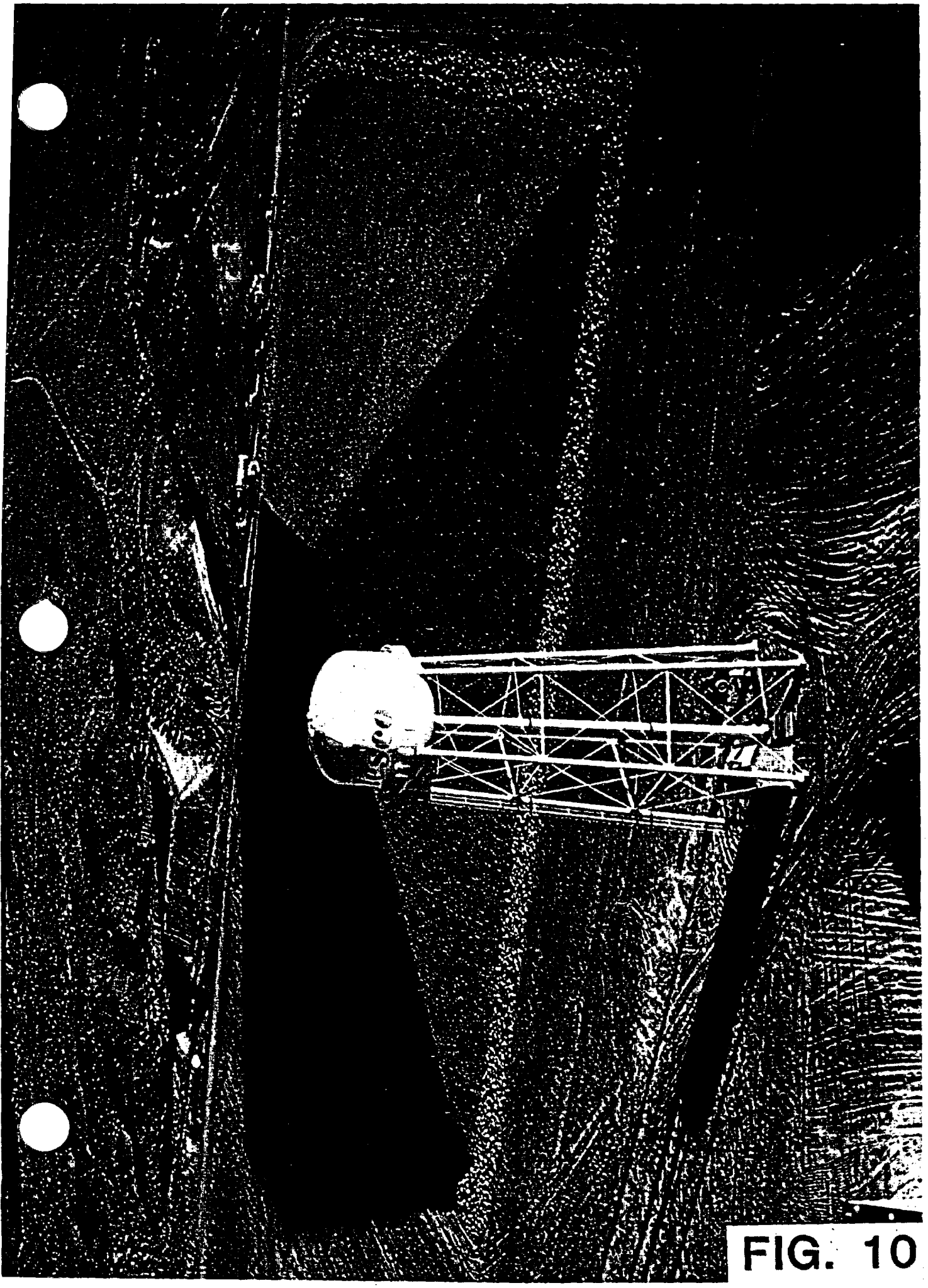


FIG. 10

C. Geotechnical Testing

Geotechnical tests performed fall within three categories.

1. Testing for exploratory reasons: These include investigations for potential sources of borrow material to meet the specification requirements. This work was performed under the direction of a soils engineer and/or a geologist.

2. Testing which was performed by an independent commercial testing laboratory as follows:

   - o Permeability testing, a required test for the Radon Barrier material.
   - o Sodium Sulfate Soundness testing for durability of Erosion Protection materials.
   - o Absorption testing, for durability of materials.
   - o Specific Gravity testing for durability of Erosion Protection materials.
   - o L.A. Abrasion testing for durability of Erosion Protection materials.

   These tests were performed by a commercial testing laboratory rather than on-site due to the expense of the testing equipment involved to perform these particular tests.

3. Field tests to verify that the work complies with the specified requirements:

The Remedial Action Inspection Plan describes the test methods and frequencies established by MK-Ferguson for performing tests. The Remedial Action Inspection Plan was submitted for DOE approval and NRC concurrence prior to its implementation. All personnel who performed the tests were qualified and certified in accordance with the requirements of the approved MK-Ferguson Quality Assurance Program Plan. Test results, quantities and actual test frequencies are contained in Appendix E. To summarize, the materials were tested as shown in the following chart to verify compliance of the work in accordance with the Design Specification requirements:

GEOTECHNICAL TESTING SUMMARY
GREEN RIVER, UTAH

	DENSITY TESTS (COMPACTION)					GRADATION TESTS			MOISTURE TESTS			DURABILITY TESTS	
TYPE OF MATERIAL	REQ. COMP.	AVG.	REQ. FREQ.	AVG.	# TESTS	REQ. FREQ.	AVG.	# TESTS	REQ. FREQ.	AVG.	# TESTS	REQ. # TESTS	# TESTS
TYPE A FILL	95%	98.4%	1000 CY	631 CY	83	2000 CY	1342 CY	39	N/A	N/A	N/A	N/A	N/A
TAILINGS	N/A	95.2%	N/A	4296 CY	79	N/A	N/A	N/A	2000	1336	254	N/A	N/A
RADON BARRIER	100%	101.6%	500 CY	251 CY	111	1000 CY	465 CY	60	N/A	N/A	N/A	N/A	N/A
SELECT RIPRAP													
TYPE A	N/A	N/A	N/A	N/A	N/A	*	N/A	4	N/A	N/A	N/A	4	4
TYPE B	N/A	N/A	N/A	N/A	N/A	*	N/A	4	N/A	N/A	N/A	4	4
SELECT BEDDING	N/A	N/A	N/A	N/A	N/A	*	N/A	4	N/A	N/A	N/A	4	4

*The frequency for gradation tests was: Initially, 1st 1/3, 2nd 1/3, and near completion of placement.

D. Radiological Verification:

o Soil Measurement Methods

Radiological verification of remedial action was conducted through the use of on-site Radium-226 (Ra-226) analysis of soil. Gamma-ray spectrometry systems employing two opposed 7.6 cm. x 7.6 cm (3 in. x 3 in.) NaI(Tl) detectors were used to measure the 1728 and 1764 keV gamma-rays from the Ra-226 daughter, Bismuth-214. All soil samples were dried and allowed to equilibrate prior to analysis. The associated error of this system, designated as the Opposed Crystal System (OCS), was empirically determined to be less than ± 20% at a concentration of 5.0 pCi/g Ra-226 (95% confidence level). The minimum detectable activity was similarly determined to be 1.7 pCi/g Ra-226, which is essentially the same value as background soil concentrations of Ra-226 in the Green River area (1.5 pCi/g).

o Soil Measurement Quality Control

The requirement for independent analysis of 5% of all verification soil samples was instituted at the Green River site. A summary of this data is presented in Appendix J.

Calibration and routine performance checks utilizing reference material standards (5.12 pCi/g Ra-226) from the Technical Measurements Center in Grand Junction, Colorado were routinely conducted on the Opposed Crystal Systems at the Green River site. Results of this quality assurance program for the 5.12 pCi/g standard is also presented in Appendix J.

The soil verification results presented in Appendix J were independently checked by the health physics technical staff, to ensure accuracy. This completed the final step in the quality assurance program for radiological testing.

- Grid Establishment, Survey, and Soil Sampling

  A description of gridding, surveying, and soil sampling requirements is included in the DOE-approved procedure entitled Verification Procedures for Vicinity Properties and Tailings Sites - RAC-015. The procedure (Revisions 2 and 3) is presented in Appendix J.

- Soil Verification Results

  The drawings presented in Appendix J, identified as drawings GRN-SV-001 through GRN-SV-007 show all soil verification grid locations. Each grid is identified by soil sample number. Radium-226 concentrations determined by OCS counting and independent quality control analytical results for Ra-226 and Th-230 are presented in accompanying tables for each drawing, by sample number. Appendix J, Figure J-1 presents OCS Ra-226 soil sample concentrations versus sample number (random). This figure clearly demonstrates that all verification soil samples met the EPA standards of 5.0 and 15.0 pCi/g Ra-226 plus background (1.5 pCi/g). Data is presented for approximately 4,200 soil samples.

- Radiological Analyses of Backfill Material

  Uncontaminated material was used as backfill to bring areas at the Green River site to final grade. Results of routine OCS analyses of the material indicated near background concentrations of Ra-226. Material with Ra-226 concentrations of less than 5.0 pCi/g was used for surface backfilling. All backfill material analytical data is presented in Appendix J.

E. Summary of Post Remedial Action Site Conditions:

The completed condition of the site is described in Appendix H. As demonstrated in Section III.D and Appendix H, the Green River site was cleaned up to meet criteria established in the Remedial Action Plan.

A total of approximately 381,788 cubic yards of contaminated material was placed into the cell. Vicinity property material accounted for 39,295 cubic yards.

Prior to the placement of cover materials on the cell, samples in the contaminated material were obtained in order to establish the final concentrations of Ra-226 in the cell and to adjust the radon barrier thickness so that the design criteria were met.

SECTION IV

CERTIFICATION BASIS

IV. CERTIFICATION BASIS:

The MK-Ferguson Company hereby certifies that remedial actions are completed at the Green River, Utah Uranium Mill Tailings Site in accordance with the requirements of:

- UMTRA-DOE/AL 050510.GRNO "Remedial Action Plan for Stabilization of the the Inactive Uranium Mill Tailings Site at Green River, Utah", dated December, 1989;

- Contract No. DE-AC04-83AL18796, Remedial Action Contract for the Uranium Mill Tailings Remedial Action Project;

- Approved drawings and specifications for remedial action activities at the Green River, Utah Uranium Mill Tailings Site, prepared for the Department of Energy by MK-Ferguson Company and Morrison-Knudsen Engineers, Inc.

Section II of this completion report demonstrates that the design was prepared in accordance with the approved design criteria and Remedial Action Plan for Green River, Utah. Section III demonstrates that work was completed and inspected to verify that it meets the requirements of the design. Based on the consistency and continuity between design requirements, detailed design, and completion of remedial action activities, MK-Ferguson recommends the Department of Energy certify the Green River, Utah, remedial action as being completed in accordance with the established agreements and EPA Standards.

DEPARTMENT OF ENERGY
ALBUQUERQUE OPERATIONS OFFICE
CONTRACT NO. DE-AC04-83AL18796

GREEN RIVER, UTAH

D R A F T

Completion Report

VOLUME 2
APPENDICES A-E

Remedial Actions
Contractor
for the
Uranium Mill Tailings
Remedial Actions
Project

MAY 1990

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

APPENDIX A

DESIGN CRITERIA

APPENDIX A

DESIGN CRITERIA INDEX

DBM NO. 10-520-02	GENERAL DESIGN CRITERIA
DBM NO. 10-523-01	UTILITY ABANDONMENT AND RELOCATION
DBM NO. 10-531-01	CONSTRUCTION FACILITIES AND ON-SITE UTILITIES
DBM NO. 10-534-01	RETENTION BASIN
DBM NO. 10-535-02	TAILINGS MATERIAL EXCAVATION AND FINAL EMBANKMENT
DBM NO. 10-537-02	DECONTAMINATION AND DEMOLITION OF STRUCTURES AND BUILDINGS
DBM NO. 10-538-01	ACCESS AND HAUL ROADS
DBM NO. 10-539-01	SITE DRAINAGE, GRADING AND STABILIZATION

GENERAL DESIGN CRITERIA

DEM NO. 10-520-02

UMTRA PROJECT - GRN
DESIGN BASIS MEMORANDUM NO. 10-520-02
GENERAL DESIGN CRITERIA

CONTENTS

1. PURPOSE

This memorandum presents the general criteria to be used in design for this project.

2. GENERAL REQUIREMENTS

A. Purpose and Objectives of Remedial Action

The purpose of this remedial action is to stabilize and control the uranium mill tailings and contaminated material at the Green River Site in a manner which complies with the EPA standards for the cleanup of inactive tailings sites (Ref. 1). Stabilization on-site is planned, consisting of relocation of the tailings pile and other contaminated materials to a more suitable location in the southeastern portion of the site. Consistent with these standards and other applicable criteria, the following major design objectives are to be accomplished (Ref. 1, 2, 3):

1. Provide reasonable assurance that releases of Radon-222 to the atmosphere from the covered tailings materials at the site will not exceed an average of 20 picocuries per square meter per second ($20 pCi/m^2 s$).

2. Stabilization controls to be effective for up to 1000 years, to the extent reasonably achievable, with minimum maintenance and, in any case, for at least 200 years.

3. Prevent inadvertent human intrusion.

4. Ensure that existing or anticipated beneficial uses of ground and surface water are not adversely affected.

5. Reduce contaminant levels in areas to be released for unrestricted use, upon completion of remedial action, to Ra-226 levels averaged over any area of 100 square meters which do not exceed the background by more than: (1) 5 picocuries per gram averaged in the top 15 centimeters of soil and (2) 15 picocuries per gram above background in any 15 centimeter layer below that depth.

6. Reduce gamma radiation levels in any habitable or occupied buildings to levels which do not exceed 20 micro R/h above background and reduce contaminant levels such that radon daughter concentrations (including background) do not exceed 0.02 working levels (WL).

7. Minimize land area to be used for the final disposal area.

8. Protect against releases of contaminants from the site during construction.

9. Provide runoff and sediment control.

10. Minimize areas disturbed during construction and minimize exposure to contaminated materials.

B. Codes and Standards

The design shall follow local and national codes and standards during design and construction. These shall include, but are not limited to, the most recent published issue of the following codes and standards:

AASHTO American Association of State Highways and Transportation Officials

ANSI American National Standards Institute

ASME American Society of Mechanical Engineers

ASTM American Society for Testing and Materials

AWWA American Water Works Association

CFR Code of Federal Regulations, as applicable (such as 40 CFR, Part 192, etc.)

CISPI Cast Iron Standard Pipe Institute

DOL/OSHA Department of Labor - Occupational Safety and Health Administration

NEC National Electric Code

NEMA National Electric Manufacturers Association

PFI Pipe Fabricators Institute - Handbook of PVC Pipe Design and Construction

UBC Uniform Building Code

UL Underwriters Laboratory

UPC Uniform Plumbing Code

USDOE DOE 6430.1 - General Design Criteria Manual

Any other applicable city, county, state, and Federal codes and regulations. In the event of a conflict, the most stringent code shall apply.

3. STRUCTURAL DESIGN

A. Structural Codes

The following codes and standards of current issue are applied in selection of design stresses:

1. Uniform Building Code (UBC) 1985.
2. Building Code Requirements for Reinforced Concrete (ACI 318-83).
3. Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings (AISC 1980).

B. Design Stresses

1. Reinforced Concrete

Ultimate strength design shall be used in proportioning of reinforced concrete members in accordance with ACI-318-83. Three class designations of concrete shall be used as follows:

Class Designation	Required 28-Day Compressive Strength
A	4,000 psi
B	3,000 psi
C	2,500 psi

Reinforcement shall consist of deformed bars ASTM 615, Grade 60.

2. Structural Steel

Structural steel design will follow AISC Specifications covering ASTM grades of steel.

4. HYDROLOGY AND HYDRAULICS

A. Design Floods and Storms

The following floods shall be used in design:

1. During Remedial Action

   a) Ten-year, 24-hour storm event to size wastewater retention basin (Ref. 3, Sec. 3.3.6 and Ref. 4, Sec. 4.3).

   b) Ten-year, 6-hour precipitation (Ref. 6, Sec. 4.5.2) to determine collection ditch size and erosion protection (Ref. 4, Sec. 4.3.B.4).

   c) Twenty-five year, six-hour storm event for retention basin emergency spillway outlets (Ref. 5, Sec. 816.46) and diversion ditches. A minimum freeboard of one foot will be provided (Ref. 6, Sec. 4.4.3).

2. After Remedial Action (Ref. 2, Sec. 2.2.2f):

   a) Use flow rates and velocities based on the Probable Maximum Precipitation (PMP) storm event to determine stable rock sizes and other erosion protection requirements for portions of the embankment that may be inundated and any drainage ditches, unless this leads to unreasonable cost.

   b) Use PMP rainfall intensity and sheet flow rates for design of the embankment cover erosion protection system, except as noted in a) of this section.

5. GEOTECHNICAL

A. Embankment Design

The embankment will be designed to contain all contaminated materials from the existing tailings pile and the off-pile and windblown areas and contaminated demolition debris to provide long-term stability, and to meet radon control requirements.

B. Embankment Slopes

1. Top Slope - The minimum top slopes of the embankment shall be sufficient to provide drainage and prevent ponding. (Ref. 2, Sec. 2.2.2c)

2. Side Slope - The slope for the embankment sides shall be no steeper than that required to provide the following minimum factors of safety:

Minimum Acceptable Factors of Safety (Ref. 4, Chapter 10)

Analysis	End of Construction	Long Term
Static	F.S. = 1.3	F.S. = 1.5
Pseudo-Static	F.S. = 1.0	F.S. = 1.1

Further criteria for embankment design is included in design basis memorandum No. 10-535-01, Tailings Material Excavation and Final Embankment.

C. Radon Barrier (Ref. 3, Sec. 3.2)

The thickness of cover needed to achieve the prescribed radon flux, discussed under General Requirements, will be determined by using the computer code RAECOM, which calculates radon flux for a given cover thickness.

D. Cover Protection (Ref. 3, Sec. 3.1.4)

The radon barrier will be protected by a layer of rock designed to protect against erosion of the soil cover from the flood resulting from the design storm (Sec. 4.A.2).

E. Excavation of Contaminated Soil

Excavation limits (horizontal and vertical) for areas to be released for unrestricted use are to be established from the most recent radiological survey data. Contaminant levels in these areas will be reduced to satisfy the criteria given under 2.A.5 of the General Requirements.

6. WASTEWATER HANDLING (Ref. 2, Sec. 3.2.2)

During remedial action, runoff from contaminated areas, ground water collected from excavation dewatering and all wastewater will be discharged into retention basins.

7. WASTEWATER TREATMENT (Ref. 2, Sec. 3.2.1)

The treatment method shall, if possible, consist of ponding to allow solids to settle and the wastewater to evaporate.

8. CONSTRUCTION PHASE REQUIREMENTS

Design shall adhere to the following construction phase requirements:

- All construction activities shall be planned and conducted to minimize, to the extent practicable, disturbing areas of uncontaminated land and worker exposure to contaminated

materials. Prevailing wind shall be considered in locating staging and other facilities to reduce the risk of contamination by windblown materials.

- o Care must be taken to protect against releases of contaminants from the site during construction.
- o Flood protection, runoff and sediment control, and storage of wastewater must be provided during construction.
- o Dust generated by excavation, earth movement, vehicle use, and similar activities shall be controlled and minimized. (Special emphasis shall be placed on controlling dust that will originate from building decontamination and demolition, temporary stockpiling, or mixing of contaminated materials.)
- o Inconveniences to the public must be minimized by considering working schedules and construction vehicle activities.
- o All work shall comply with the provisions of permits and agreements established with public agencies and private land owners.

9. REFERENCES

1. EPA, 40 CFR Part 192: "Standards for Remedial Actions at Inactive Uranium Processing Sites," Federal Register, Volume 48, No. 3, January 5, 1983.
2. U. S. Department of Energy, Design Criteria for Stabilization of Inactive Uranium Mill Tailings Sites, UMTRA-DOE/AL-050424.0049, June 1984.
3. U.S. Department of Energy, Plan for Implementing EPA Standards for UMTRA Sites, UMTRA-DOE/AL-163, January 1984.
4. Morrison-Knudsen Engineers, UMTRA Design Procedures Manual.
5. U.S. Department of Interior, "Code of Federal Regulation, CFR 30, Part 816, Chapter VII, Subchapter K: Permanent Program Performance Standards - Surface Mining Activities, Federal Register, Office of Surface Mining, July 1985.
6. U.S. Department of Energy, Remedial Action Plan and Site Conceptual Design for Stabilization of the Inactive Uranium Mill Tailings at Green River, Utah, Draft, UMTRA-DOE/AL-050510.GRN0, January-1987.

UTILITY ABANDONMENT AND RELOCATION

DEM NO. 10-523-01

UMTRA PROJECT - GRN
DESIGN BASIS MEMORANDUM NO. 10-523-01
UTILITY ABANDONMENT AND RELOCATION

CONTENTS

1. GENERAL REQUIREMENTS

All known existing utilities on site (gas, culverts, sewer, telephone, power and water) are shown in Ref. 2, Figure 0.7.1. Any utilities within the final disposal site will be relocated, removed or decommissioned to preclude any future need for excavation or access within the embankment area. Other active utilities which may be affected by construction must be protected or rerouted. Each relocated system shall conform to current applicable standards. Any system which has a capacity to create a void passing through or under the stabilized tailings shall be removed, crushed or filled with a non-degradable material. (Reference 1, Sec. 2.2.6).

2. DESIGN GUIDELINES

A. Construction drawings will show all known surface and underground utilities on or near the site. Additionally, the Subcontractor will be required to verify the location and type of each utility in his work area.

B. Construction drawings will show the proposed plan of relocation and/or abandonment of the utilities, and will define the limits of the work to be performed by the Subcontractor.

3. REFERENCES

1. U.S. Department of Energy, Design Criteria for Stabilization of Inactive Uranium Mill Tailings Sites, UMTRA-DOE/AL-050424.0049, June 1984.

2. U.S. Department of Energy, Remedial Action Plan and Site Conceptual Design for Stabilization of the Inactive Uranium Mill Tailings at Green River, Utah, Draft, UMTRA-DOE/AL-050510.GRN0, January 1987.

CONSTRUCTION FACILITIES AND ON-SITE UTILITIES

DEM NO. 10-531-01

UMTRA PROJECT - GRN
DESIGN BASIS MEMORANDUM NO. 10-531-01
CONSTRUCTION FACILITIES AND ON-SITE UTILITIES

CONTENTS

1. PURPOSE

This memorandum presents the basic information and guidelines for the preparation of specifications and designs for the construction facilities and on-site utilities at the Green River site.

2. SCOPE

Included in the memorandum are the following construction facilities: field offices, access control and radiological monitoring facilities (including change and wash facilities), and vehicle and equipment decontamination pad (Ref. 1, Sec. 5.3). Guidelines for the provision of on-site utilities during construction are also provided.

3. GENERAL REQUIREMENTS

A. The design and location of individual facilities within the access control area will take into consideration the control of and ease of access to the site, especially to the contaminated areas.

B. Temporary facilities, which may be required during mobilization and start-up, need not meet the detailed criteria given below; however, general requirements for prevention of the spread of contamination must be met in any case.

C. The design will follow the general design criteria given in DBM No. 10-520-01, General Design Criteria (Ref. 1).

D. All facilities covered by this DBM will be provided by the Subcontractor unless otherwise noted.

4. FIELD OFFICES

A. General

Field offices will be required for the DOE representative, and for supervisory, engineering, administrative, security and health personnel. The Subcontractor is to supply field offices for these personnel, and for his own requirements.

B. Design Guidelines

1. It is desirable to locate the field offices outside the restricted area so that visitors and personnel who are not required to go to the construction area can reach the field offices without entering the restricted area.

2. The existing office building at the site will be used for Contractor's and Subcontractor's offices.

5. ACCESS CONTROL AND RADIOLOGICAL MONITORING FACILITIES

A. General

Access to the restricted (fenced) area will be through the access control point located adjacent to the single site entrance/exit, where a lockable gate will be installed. It will be the responsibility of the Contractor to implement the environmental, health and safety plan for this site, including the following:

1. Control authorized traffic entering and leaving the restricted area.

2. Prevent unauthorized traffic from entering the restricted area.

3. Maintain records, logs of entry and significant events and provide storage facilities for Contractor-owned radiation monitoring equipment.

B. Design Guidelines

1. An access control trailer will be provided at the access control point.

2. The access control trailer will have a minimum width of 8 feet and a minimum total floor space of 400 square feet and will include work space for health physics technicians and security personnel, desks, storage space for record logs and files, supplies, protective clothing and monitoring equipment.

3. Change facilties will be located at or near the access control point. These facilities are intended for use by personnel working in controlled areas who are unable to meet surface contamination limits when leaving through access control.

4. The change facilities will include wash and shower facilities, change area and lockers.

5. Water from the change facility will be directed to a sump, for sampling prior to spraying on the tailings, or routed directly to retention basin.

6. DECONTAMINATION PAD

A. General

A decontamination pad (hereafter referred to as the decon pad) will be required during construction to provide a controlled space for the inspection and decontamination of any vehicle or construction equipment prior to leaving the site.

B. Design Guidelines

1. The decon pad will be located near the access control point .

2. To provide ample space for cleaning contaminated construction equipment and allow vehicles that do not need decontamination to pass the cleaning area. The decon pad will have a minimum width of 30 feet and a minimum length of 100 feet (Ref. 2, Sec. 3.4).

3. The decon pad and sump will be designed, constructed and maintained by the Subcontractor to withstand anticipated traffic loads from construction vehicles and equipment.

4. Waste water from vehicle washing will be drained to a holding tank or pit pending disposal in the contaminated area (Ref. 2, Sec. 3.4 and Ref. 3, Sec. 4.5.5). Site drainage around the decon pad will be diverted away from the pad, so that only runoff from direct rainfall on the pad will drain into the holding chamber. The holding chamber will have, as a minimum, storage capacity for three days of anticipated decontamination or cleaning waste water. A washwater recycling system will be required to reduce generation of contaminated wastewater.

5. High-pressure water will be used to clean the contaminated vehicles (Ref. 2, Sec. 3.4). In addition, a hose with running water will be provided in the decon pad area for other cleaning purposes. Cleaning facilities and accessories will be provided by the Subcontractor.

7. ON-SITE UTILITIES

A. General

The Subcontractor will provide all on-site utilities for construction use, both for himself and for all authorized personnel.

B. Design Guidelines

1. The Subcontractor is to arrange for phone service for the field offices. Telephone services at the site can be obtained from Mountain Bell. Electricity is available from Utah Power and Light. Water is available from the City of Green River.

2. The Subcontractor is to provide sufficient portable toilets within the restricted area, and at least one toilet will be provided outside the restricted area (near the access control point).

8. REFERENCES

1. UMTRA PROJECT - GRN Design Basis Memorandum No. 10-520-01, "General Design Criteria".

2. U.S. Department of Energy, Design Criteria for Stabilization of Inactive Uranium Mill Tailings Sites, UMTRA-DOE/AL-050424.0049, June 1984.

3. U.S. Department of Energy, Remedial Action Plan and Site Conceptual Design for Stabilization of the Inactive Uranium Mill Tailings at Green River, Utah, Draft, UMTRA-DOE/AL-050510.GRNO, January 1987,

RETENTION BASIN

DEM NO. 10-534-01

UMTRA PROJECT - GRN
DESIGN BASIS MEMORANDUM NO. 10-534-01
RETENTION BASIN

CONTENTS

1. PURPOSE

This memorandum presents the basis for design of a wastewater retention basin for use during construction to protect against release of contaminants from the site and to provide runoff and sediment control. (Ref. 1, Sec. 3.2) Runoff from land outside the affected area will be diverted away from the site.

2. SCOPE

The wastewater retention basin will be designed to receive waters resulting from (Ref. 1, Sec. 3.2.2 and Ref. 5, Sec. 4.5.2):

- o Decontamination activities, including equipment and truck washing.
- o Stormwater runoff from contaminated areas.
- o Wastewater from washing protective clothing.
- o Shower and wash basin wastewater.
- o Site dewatering.

This memorandum shall be used in conjunction with DBM No. 10-520-01, General Design Criteria (Ref. 2).

3. DESIGN CRITERIA

The following criteria shall be applicable to the design:

A. Effluent limitations: The discharge from the retention basin shall meet the discharge limits of the National Pollutant Discharge Elimination System (Ref. 1, Sec. 3.2.2 and Ref. 5, Sec. 4.5.2).

B. Sediment storage: Sufficient volume will be provided to store the estimated total sediment to be collected during the entire construction period. Soil loss shall be estimated by using the Modified Universal Soil Loss Equation (Ref. 4, Sec. 4.4.B.2 and Ref. 5, Sec. 4.5.2).

C. Storm Runoff Storage: In addition to sediment storage and wastewater inflow, the retention basin shall be sized to provide the capacity required for stormwater runoff entering the pond from a 10-year, 24-hour precipitation event and mean daily input (Ref. 3, Sec. 816.46 and Ref. 5, Sec. 4.5.2).

D. Emergency Spillway: An emergency spillway shall be provided to safely discharge the peak flow from a 25-year, 6-hour precipitation event (Ref. 3, Sec. 816.46). A minimum freeboard of one foot will be provided (Ref. 5, Sec. 4.5.2). There shall be no outflow through the emergency spillway during the collection of the runoff resulting from the 10-year, 24-hour precipitation event plus mean daily input (Ref. 3, Sec. 816.46). Any spillway overflow conditions shall comply with the provisions of the National Pollutant Discharge Elimination System (NPDES) Permit issued by the U.S. Environmental Protection Agency (Ref. 1, Sec. 3.2.2).

E. Dewatering: Surface area of the pond will be provided to maximize evaporation of wastewater to the extent practicable. Other means of dewatering will be provided as required to meet discharge permit requirements.

F. Leakage and Seepage: The basin shall be designed to prevent contamination of surface water and groundwater resulting from leakage and seepage of the stored wastewater.

G. Removal of Sediments: To allow for large volumes of sediment carried during a single large storm, sediments shall be removed from the retention basin, and placed in the tailings embankment, when the volume of sediments accumulates to 60 percent of the design sediment storage volume (Ref. 1, Sec. 3.2.2).

4. <u>POST REMEDIAL ACTION REQUIREMENTS</u>

A. The shutdown and clean-up of the retention basin will be guided by applicable sections of CFR 30 Part 816 (Ref. 3).

B. Upon completion of remedial action work, contaminated sediments, sludges and other materials from the bottoms, sides and ditches of the retention basin will be excavated and incorporated into the embankment.

C. During construction of the retention basin, uncontaminated excavated material shall be stockpiled for future restoration purposes. After final removal of contaminated sediments, the retention basin and the disturbed adjacent areas shall be filled, contoured for drainage and vegetated.

5. REFERENCES

1. U.S. Department of Energy, Design Criteria for Stabilization of Inactive Uranium Mill Tailings Sites, UMTRA-DOE/AL-050424.0049, June 1984.

2. UMTRA PROJECT-GRN Design Basis Memorandum No. 10-520-01, "General Design Criteria".

3. U.S. Department of Interior, "Code of Federal Regulation, CFR 30, Part 816, Chapter VII, Subchapter K: Permanent Program Performance Standards - Surface Mining Activities, Federal Register, Office of Surface Mining, July 1985.

4. Morrison-Knudsen Engineers, "UMTRA Design Procedures Manual".

5. U.S. Department of Energy, Remedial Action Plan and Site Conceptual Design for Stabilization of the Inactive Uranium Mill Tailings at Green River, Utah, Draft, UMTRA-DOE/AL-050510.GRNO, January, 1987.

TAILINGS MATERIAL EXCAVATION AND FINAL EMBANKMENT

DEM NO. 10-535-02

UMTRA PROJECT - GRN
DESIGN BASIS MEMORANDUM NO. 10-535-02
TAILINGS MATERIAL EXCAVATION AND FINAL EMBANKMENT

CONTENTS

1. PURPOSE

This Design Basis Memorandum presents the basis for design of the tailings materials excavation and the final embankment at the Green River Site. The main feature of the proposed work is stabilization on-site of the Green River tailings and other contaminated material.

2. SCOPE

The embankment will be designed to contain all contaminated materials from the Green River site and adjacent areas, and to provide long-term stability and radon control. Contaminated materials will be excavated from existing tailings pile, mill yard and windblown-contaminated areas and relocated to an on-site location south of the existing tailings pile.

3. DESIGN CRITERIA AND GUIDELINES

A. Excavation of Contaminated Materials

Contaminated materials will be excavated to levels of contamination which meet the requirements of Ref. 4. Excavation limits and depths will be defined on the construction plans based on the most recent radiological survey data. Final excavation limits will be based on field radiological surveys during construction. The excavated areas will be regraded to provide drainage, and vegetated.

B. Final Embankment

1. The embankment area and layout will be consistent with the requirement that stabilization controls will be effective for up to 1,000 years, to the extent reasonably achievable, and in any case for at least 200 years (Ref. 1, Sec. 1.3.b).

2. The embankment will contain tailings and subsoils from the existing pile, contaminated soils excavated from mill area, and windblown and waterborne deposit areas in the vicinity, and any other contaminated materials such as wood, organic debris and demolition debris (Ref. 1, Sec. 2.2.2).

3. The configuration of the final embankment will be based on the following factors: good engineering practice, the estimated quantity of contaminated materials, economics of construction, and availability of land. The embankment system shall not extend into areas outside the designated site, onto floodplains, or into other areas which will reduce the performance of the remedial action, without prior written approval from the UMTRA Project office of the Department of Energy (Ref. 1, Sec. 2.2.2b).

4. The tailings will be densified by compaction to reduce the potential for long-term differential settlement to a level which will avoid 1) a degree of cracking in the radon barrier layer that would cause exceedence of the limit on radon flux, or 2) flow concentrations on the erosion protection layer.

5. A layer of uncontaminated earthen material will be installed as a cover over the embankment to serve as a radon and infiltration barrier (Ref. 1, Sec. 2.2.2e and Ref. 5, Sec. 5.C). This layer will be designed to provide reasonable assurance that releases of radon-222 from the tailings embankment will not exceed an average release of 20 picocuries per square meter per second.

6. A layer of rock will be provided to protect the cover against erosion of the soil cover by runoff from the design storm (Ref. 1, Sec. 2.2.2f). One or more filter or bedding layers will be required between the radon barrier and rock cover protection (Ref. 3, Ch. 5, Sec. 5.1.6.6).

7. Adequacy of embankment side slopes will be determined by detailed analysis of tailings properties, slope stability and erosion protection requirements (Ref. 2, Sec. 3.1.5). The minimum top slope shall be sufficient to promote drainage and prevent ponding (Ref. 1, Sec. 2.2.2c).

8. If wood or other organic debris is placed within the tailings embankment, it shall be chipped or otherwise reduced in size. It shall then be distributed throughout the tailings in such manner as to avoid settlement, stability, and seepage problems.

9. The embankment will be designed to withstand the design earthquake without significant adverse effects.

10. The embankment construction will be sequenced to place most of the tailings and subsoils from the existing pile over lesser contaminated materials from windblown and water-borne deposit areas to reduce the potential for adverse affects of tailings seepage into ground water. The embankment will comprise the following materials in order from bottom to top:

a. Contaminated materials from windblown and water-borne deposit areas.

b. Any demolition debris from abandoned utilities, buildings, waste piles, or other sources will be placed in the lower portions of the embankment and surrounded with compacted relocated soils. Quantities of such debris should be minor.

c. Relocated tailings and subsoils from the existing pile.

d. Radon barrier.

e. Filter and/or bedding zone or zones.

f. Rock cover.

4. REFERENCES

1. U.S. Department of Energy, Design Criteria for Stabilization of Inactive Uranium Mill Tailings Sites, UMTRA-DOE/AL-050424.0049, June 1984.

2. U.S. Department of Energy, Plan for Implementing EPA Standards for UMTRA Sites, UMTRA-DOE/AL-163, January 1984.

3. Morrison-Knudsen Engineers, UMTRA Design Procedures Manual.

4. UMTRA Project - GRN Design Basis Memorandum No. 10-520-01, "General Design Criteria".

DECONTAMINATION AND DEMOLITION OF STRUCTURES AND BUILDINGS

DEM NO. 10-537-02

UMTRA PROJECT - GRN
DESIGN BASIS MEMORANDUM NO. 10-537-02
DECONTAMINATION AND DEMOLITION
OF STRUCTURES AND BUILDINGS

CONTENTS

1. PURPOSE

The purpose of this memorandum is to provide the basic information and set the guidelines for preparation of drawings and specifications for decontamination and demolition of buildings, structures, and foundations at the Green River site.

2. SCOPE

This memorandum establishes the criteria for decontaminating and demolishing the existing buildings and foundations.

It will also describe measures required to remove or fix to the surfaces all loose or removable contamination in the buildings and on building foundations, prior to demolition. Any building that shall remain on the site after completion of remedial action shall be decontaminated to meet the limits specified in References 4 and 5.

3. DECONTAMINATION

Specifications for decontamination shall be written to require the following:

A. Decontamination will be performed by experienced crews supplied with adequate protective equipment (coveralls, respirators, gloves, boots and eye protection) using nuclear grade industrial vacuum cleaners.

B. Contaminated water from washdown activities will be used as a dust suppressant within the contaminated area only or monitored and disposed of in the retention basin.

C. Strict maintenance of the HEPA filters and proper disposal of contents and filters will be required where decontamination is performed by use of vacuum cleaners.

4. DEMOLITION

Specifications for demolition shall require that:

A. Loose or removable contamination in buildings be removed or fixed to the surfaces prior to demolition, as required to prevent the spread of contamination to uncontaminated areas or for health physics protection.

B. Application of contamination fixants prior to demolition be done under the supervision of health physicists, who will specify protective clothing and equipment.

C. Protective equipment for personnel be required during the use of cutting torches, jack hammers or other equipment for demolition of building structures. Appropriate engineering controls be used to prevent dispersion of contaminated dust during demolition.

D. Open burning will not be permitted.

5. PROTECTION AND SAFETY

All work shall be conducted in accordance with the RAC's approved health and safety program.

6. DISPOSAL OF MATERIAL

Specifications for disposal of material shall require the following:

A. Contaminated organic materials, such as wooden demolition debris and grubbed vegetation will be evenly distributed throughout the embankment, without nesting and without exceeding a specified percentage of the stored volume. Non-contaminated organics can be removed from the site (Ref. 1, Sec. 2.2d).

B. Rubble pieces will be placed in the lower portions of the embankment and surrounded with compacted tailings. Debris shall not be nested but instead placed in layers and tailings compacted within and around the individual pieces of debris in order to eliminate voids and, thereby, minimize differential settlement (Ref. 1, Sec. 2.2.2d).

C. Salvage of uncontaminated materials by the Subcontractor will not be allowed unless approved by the RAC.

D. Open burning will not be permitted.

7. REFERENCES

1. U.S. Department of Energy, Design Criteria for Stabilization of Inactive Uranium Mill Tailings Sites, UMTRA-DOE/AL-050424.0049, June 1984.

2. U.S. Department of Energy, UMTRA Project Environmental Health and Safety Plan, DOE/AL-150224.0006 (Revised), June 1984.

3. U.S. Department of Energy, Remedial Action Plan and Site Conceptual Design for Stabilization of the Inactive Uranium Mill Tailings at Green River, Utah, Draft UMTRA-DOE/AL-050510.GRNO, January 1987.

4. U.S. Environmental Protection Agency, "Standards for Remedial Actions at Inactive Uranium Processing Sites", 40 Code of Federal Regulations, Ch. I, Part 192, 1987.

5. U.S. Nuclear Regulatory Commission, Uranium Recovery Field Office, Region IV, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for By-Product or Source Material", Denver, Colorado, September 1984.

ACCESS AND HAUL ROADS

DEM NO. 10-538-01

UMTRA PROJECT - GREEN RIVER
DESIGN BASIS MEMORANDUM NO. 10-538-01
ACCESS AND HAUL ROADS

CONTENTS

1. PURPOSE AND SCOPE

This memorandum presents criteria and guidelines for any required design of access or haul roads for on-site stabilization of the tailings pile. For example, design of the following roads may be required.

A. Temporary access road to the access control and staging areas.

B. Haul road or roads connecting borrow areas with existing roads or with the construction site.

C. Haul road between tailings pile and final embankment area.

The determination of the need for road design will be made based on consultation with MK-F, permit requirements, and/or other conditions which may arise during design (e.g. State requirements).

Additional roads may be constructed within the work area at the Subcontractor's option. Those roads will not be designed by the Remedial Action Contractor but will be subject to conditions specified elsewhere (e.g., Special Conditions and site drainage specifications).

Design will take into consideration drainage, safety requirements and maintenance. Road drainage features will be integrated with the total site drainage plan to provide adequate drainage and erosion control.

2. TEMPORARY ACCESS ROAD

Design and construction of these roads will be performed by the Subcontractor according to permit requirements and Subcontractor's own needs.

3. HAUL ROADS

A. Construction of these roads will be performed by the Subcontractor according to permit requirements to be set before developing each particular borrow area.

B. Existing roads will be used to haul borrow materials to the site as much as practicable. Requirements and restrictions for using these roads will be established by others.

SITE DRAINAGE, GRADING AND STABILIZATION

DEM NO. 10-539-01

UMTRA PROJECT - GRN
DESIGN BASIS MEMORANDUM NO. 10-539-01
SITE DRAINAGE, GRADING AND STABILIZATION

CONTENTS

1. PURPOSE AND SCOPE

The purpose and scope of this memorandum is to provide the basic information and set the standards and guidelines for the site drainage, grading, and stabilization of disturbed land outside the embankment area at the Green River Site.

2. GENERAL REQUIREMENTS

Long-term stability of the site requires provision for site drainage, suitable site grading, and stabilization measures. Ditches will be constructed to carry away surface runoff, and the disturbed area will be recontoured for good drainage (Ref. 1, Sec. 3.2.1). Restoration and vegetation of disturbed areas at the site and borrow areas will be required (Ref. 1, Sec. 2.2.4).

3. CONSIDERATIONS AND CRITERIA

A. Runoff from off-site areas will be diverted away from the site during construction by constructing diversion ditches.

B. Collection ditches will be designed to collect runoff and wastewater from contaminated areas and direct it to the retention basin.

C. Flow rates for permanent and temporary ditches will be determined in accordance with Ref. 2, Sec. 4.4A and Ref. 7, Sec. 4.A.1, based on the appropriate rainfall intensities of the various storm events. The rainfall intensities for the 10-year and 100-year storm events will be determined with the use of the "Rainfall Frequency Atlas of the United States" and "Precipitation - Frequency Atlas of the Western United States" (Refs. 3 and 6). Rainfall intensities for larger storms will be determined from Refs. 4 and 5. Ditch velocities will be determined using the Manning formula and appropriate input parameters.

D. Runoff from the embankment will be conveyed to adjacent grades as sheet flow to the maximum extent practicable. Design shall verify that erosion potential due to sheet flow on adjacent grades is adequately small.

E. If necessary permanent ditches will be designed to convey the runoff from the design storm. They will be constructed to channel surface runoff into natural drainage streams or adjacent grades.

F. Where feasible, the site grading and permanent ditches will have a gradient small enough that flow velocities will be non-erosive as the flow is directed into the natural drainage patterns.

G. Existing gullies near the embankment will be filled with erosion-resistant gravel and soils to inhibit gully migration (Ref. 8, Fig. 4.4). Drainage patterns will be altered to the extent practicable to reduce inflow to those gully areas.

H. Site grading of disturbed areas at the site and borrow areas will be designed to facilitate drainage (Ref. 1, Sec. 3.2.1).

I. Restoration and vegetation of disturbed areas at the site and borrow area will be accomplished to the extent necessary to control erosion to acceptable levels.

4. REFERENCES

1. U.S. Department of Energy, Design Criteria for Stabilization of Inactive Uranium Mill Tailings Sites. UMTRA-DOE/AL-050424.0049, June 1984 .

2. Morrison-Knudsen Engineers UMTRA Design Procedures Manual.

3. U. S. Weather Bureau, "Rainfall Frequency Atlas of the United States," U. S. Department of Commerce, Technical Paper No. 40, Washington, D.C., 1961.

4. U.S. Dept. of Commerce, "Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages", Hydrometerological Report No. 49, National Weather Service, NOAA, 1977.

5. U.S. Dept. of Commerce, "Probable Maximum Precipitation Estimates, United States Between the Continental Divide and 103rd Meridian", Hydrometeorological Report No. 55, National Weather Service, NOAA, 1984.

6. National Weather Bureau, "Precipitation-Frequency Atlas of the Western United States", NOAA Atlas 2, Volume IV, New Mexico, 1973.

7. UMTRA Project - GRN Design Basis Memorandum No. 10-520-01, "General Design Criteria".

8. U.S. Department of Energy, Remedial Action Plan and Site Conceptual Design for Stabilization of the Inactive Uranium Mill Tailings Site at Green River, Utah, (Draft) UMTRA-DOE/AL 050510.GRN0, UMTRA Project Office, Albuquerque Operations Office, New Mexico, January 1987.

APPENDIX B

DESIGN CALCULATIONS

(REFER TO VOLUMES 4, 4A, 4B AND 4C)

APPENDIX C

TECHNICAL SPECIFICATIONS

(AS-BUILT)

UMTRA PROJECT

SUBCONTRACT DOCUMENTS GRN

GREEN RIVER, UTAH

TABLE OF CONTENTS

DIVISION 2 - SITEWORK

* P.I.D. 10-S-16

SECTION 02051

DEMOLITION AND DECONTAMINATION

PART 1 - GENERAL

1.1 SCOPE

A. This Specification Section describes the requirements for the demolition and decontamination of structures, utilities and facilities and removal and disposal of demolished materials and debris as specified in this Section.

B. Existing structures and facilities to be demolished include, but are not limited to, the following. Detail descriptions of these structures, utilties and facilities are contained in a separate document entitled "Information for Bidders":

1. Office Building Addition
2. Mill Building Addition
3. Roaster Building
4. Fences
5. Culverts
6. False ceiling of assembly building.

C. Decontamination pad and the sump constructed under this Subcontract shall be demolished and disposed of as specified in this Section.

D. Existing structures to be decontaminated and saved include the following. Detailed descriptions of these structures are contained in a separate document entitled "Information for Bidders".

1. Mill Building
2. Office Building
3. Crusher Building

[E. If underground structures, including but not limited to, slabs, foundations and abandoned communication duct banks that are not shown on Subcontract Drawings, or not visible from the surface, or not foreseen by the Subcontractor are encountered, they may be left in place if all of the following conditions are met:

1. If the concrete is decontaminated, and if soil is not contaminated below it,

2. If the top of the concrete is at least 2 feet below finish grade, and

3. If the concrete was not shown on the Subcontract Drawings and was not visible from the surface at the time of Subcontract award.]*

1.2 WORK NOT INCLUDED

A. Identification of the contents of the structures and vessels; and removal and disposal of hazardous waste material will be as specified in Section 00800, Article SC-7.

B. Removal of contaminated material from underneath the Crusher Building and disposal of contaminated material.

1.3 RELATED WORK

A. Section 00800 - Special Conditions: Articles SC-7, SC-8 and SC-9

B. Section 02090 - Sealing Monitor Wells

C. Section 02200 - Earthwork

D. Section 02771 - Membrane Liner

E. Section 02832 - Chain Link Fence and Gates

F. Section 02833 - Woven Wire Fence

1.4 DEFINITIONS

A. Demolition: Demolition includes complete dismantling, cutting and breaking up of structures, including all solid contents and associated services and utility lines includ-

* P.I.D. 10-S-04

ing their foundations and below grade slabs and footings. Irrespective of the depth of excavations, all foundations shall be removed, demolished and disposed of as specified in this Section. Demolition also includes removal and disposal of demolished materials and debris, as shown on the Subcontract Drawings and as specified in this Section.

B. Utility: For the purpose of this Section, utility means any service, such as electric power systems; gas distribution systems; telephone; water distribution; storm drain; and sanitary sewer services.

C. Decontamination: Decontamination of structures entails the removal of alpha- and beta-gamma-emitting nuclides to acceptable levels as established by the Nuclear Regulatory Commission and the Environmental Protection Agency.

1.5 SUBMITTALS

A. General submittal requirements are specified in Section 01300.

B. Twenty days prior to the start of Work, the Subcontractor shall submit to the Contractor, for review, a demolition plan including the following:

1. Methods of demolition to be used.

2. Methods of decontamination and protecting structures, and facilities to be salvaged.

3. Schedule showing dates and structures to be demolished.

4. List of equipment to be used.

1.6 PROTECTION

The structures and facilities not to be demolished shall be protected from damage during their decontamination and during demolition of adjoining structures.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 DEMOLITION

A. During the execution of this Subcontract, if chemically hazardous or toxic waste material, in addition to the already identified materials, is suspected or encountered, the Site Manager shall be immediately notified for identification and subsequent disposition.

B. Locations of buildings, utilities and other structures to be demolished are shown on the Subcontract Drawings; however, the Subcontract Drawings do not show the locations of all foundations, rubble and debris, concrete pads, and the like required to be demolished and cleaned up.

C. Pollution Controls:

1. Water sprinkling, temporary enclosures, and other Contractor-approved methods shall be used to limit the amount of airborne dust and dirt to the lowest practical level. Demolition work shall comply with governing regulations pertaining to environmental protection.

2. Water shall not be used if it is likely to create hazardous or objectionable conditions such as ice, flooding, or pollution. An approved water-based biodegradable wetting agent (surfactant) such as Dupont "Duponol WAQ" or equal shall be used to reduce the quantity of water required.

D. Removal of Contaminated Materials from Structures and Facilities to be Salvaged: The Subcontractor shall remove contaminated materials from below existing foundations, walls, ceilings and floors of the structures and facilities to be salvaged, as required by the Contractor, and as specified herein and in Section 02200.

E. Demolition:

1. Permit requirements are specified in Article SC-12 of the Special Conditions.

2. Buildings, foundations and other structures shall be demolished by methods required to complete the work in accordance with governing regulations.

3. Pieces of wood, concrete, and masonry shall be cut or broken up to be no greater than 3 feet in any dimension.

4. Structural steel members and other long items shall be cut or broken up in 10-foot lengths or smaller.

5. Removal or plugging of the utility shall not be undertaken until written approval for such work has been obtained from the Contractor.

6. Relocation of lines, where required, will be performed by others. When the abandoned line is connected to a line that will continue to be used, the abandoned line shall be disconnected first and the in-use line shall be sealed before plugging the abandoned line. The Subcontractor shall remove all subsurface lines encountered in excavations and shall solidly plug the on-site ends with a concrete grout, unless otherwise directed. Subsurface lines to be plugged or removed shall include mains shown on the Subcontract Drawings and all sub-mains and laterals connecting the buildings to the mains even though not specifically shown on the Subcontract Drawings.

7. The Contractor will obtain approval from the affected utility companies including, but not limited to, Utah Power and Light Co., Mountain Bell Telephone Co., and City of Green River before disturbing utilities. Utilities shall be protected from damage by demolition operations until they are removed from service. The Subcontractor shall remove and dispose of all abandoned telephone and power poles in the tailings embankment excavation area.

8. All utility pipes, conduits and ducts shall be cut to sizes no greater than 20 feet in length. Solid metals, concrete, masonry and wooden members shall be broken or cut in pieces to be no greater than 3 feet in any dimension and no more than 27 cubic feet in volume. Metal objects with voids shall be crushed to sizes no greater than 27 cubic feet in volume with least dimension not exceeding 6 inches.

9. Underground tanks, vats, and the like shall be emptied of contents prior to removal and demolition. The contents will be identified by the Contractor for making a determination of safe handling and disposal procedures. The wastes will be disposed of as specified in Section 00800, Article SC-7.

10. After demolition of structures and removal of demolished materials and debris, the areas shall be backfilled with uncontaminated fill materials to provide positive drainage.

3.2 DISPOSAL OF DEMOLISHED MATERIALS AND DEBRIS

A. Demolished materials and debris shall be disposed of in the tailings embankment as specified in Section 02200 and as required by the Contractor.

B. Burning of materials will not be permitted.

C. Salvage: The Subcontractor will be permitted, at his option, to decontaminate and salvage as his property, economically salvageable materials such as large steel beams. Salvage of materials, equipment accessories and incidentals will not be allowed without prior approval of the Contractor as specified herein. Bid Schedule prices shall not reflect costs of such salvages. During the term of the Subcontract, the Subcontractor may propose a salvage operation for a particular material or equipment. No material or equipment will be allowed to leave the site until after the radiation surveying by the Contractor is complete and the Contractor is satisfied with the results of such surveying. The Subcontractor shall be responsible for all Contractor's costs for radiation surveying related to salvage of materials or equipment.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement for payment for the following will be on a lump sum basis:

1. Demolition and disposal of existing structures, facilities and utilities.

2. Decontamination of existing structures, facilities and utilities.

4.2 PAYMENT

A. Payment for demolition and disposal of existing structures, facilities and utilities will be by the lump sum price quoted therefor in the Bid Schedule. The price quoted shall include full compensation for furnishing all labor, materials, tools, equipment, incidentals, and for performing all work including all clearing, demolishing, breaking of the debris into small pieces, removal and

decontamination of facilities where required, backfilling the areas with uncontaminated fill materials, and removal and disposal of demolished materials and debris as specified in this Section and in Section 02200.

B. Payment for decontamination of existing structures, facilities and utilities will be by the lump sum price quoted therefor in the Bid Schedule. The price quoted shall include full compensation for furnishing all labor, materials, tools, equipment, incidentals, accessories, and for performing all work including clearing, dusting, washing, vacuuming, removal and reinstalling portions or fixtures, decontaminating, and removal and disposal of debris as specified in this Section and in Section 02200.

END OF SECTION 02051

SECTION 02090

SEALING MONITOR WELLS

PART 1 - GENERAL

1.1 SCOPE

A. This Specification Section describes the requirements for sealing of existing test wells. The approximate locations of the known wells to be sealed are shown on the Subcontract Drawings.

B. All known wells to be sealed are shown on the Subcontract Drawings. All other wells shall be protected, unless otherwise directed by the Contractor.

1.2 RELATED WORK

Section 02051 - Demolition and Decontamination

1.3 APPLICABLE PUBLICATIONS

A. The Publications listed below form a part of this Specification to the extent referenced. The Publications are referred to in the text by the basic designation only:

1. Environmental Protection Agency (EPA): Manual of Water Well Construction Practices, EPA-570/9-75-001.

2. American Society for Testing and Materials (ASTM): C150-85 Standard Specification for Portland Cement (Rev. A).

3. Utah Administrative Rules for Water Well Drillers.

1.4 SITE CONDITIONS

Subcontract Drawings show all known wells on and in the vicinity of the site and work areas. Wells not designated to be sealed shall be protected to prevent damage or contamination with foreign substances during construction. Such wells, if damaged, shall be reconstructed by the Subcontractor at no cost to the Contractor.

1.5 QUALITY CONTROL

Well sealing operations shall be performed by a well drilling contractor licensed by the State of Utah.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Approved sealing materials are as follows:

1. Cement used for sealing mixtures shall meet the requirements of ASTM C150 "Standard Specification for Portland Cement," type V (high sulfate resistance).

2. Cement grout shall be composed of one sack of Portland Cement (94 pounds), with 3 to 5 percent, by weight, of commercially processed sodium bentonite, to not more than 6 gallons of potable water in order to achieve a weight of not less than 15 pounds per gallon. The weight of the neat cement shall be sufficient to prevent flow of water into the well from any aquifer penetrated. Calcium chloride may be added to a Portland cement grout to accelerate the set, but it shall not exceed two (2) pounds per sack of dry cement.

PART 3 - EXECUTION

3.1 GENERAL

A. Wells shall be sealed in a manner that is compatible with the well design and so as not to act as a conduit for future contamination of groundwater. Detailed well sealing criterion are outlined in the Environmental Protection Agency (EPA) Manual of Water Well Construction Practices, EPA-570/9-75-001, Article 56, pages 133-142. The basic premise of the EPA criteria is to seal abandoned wells and to restore, as much as possible, the geohydrologic regime in existence before the well was constructed. The following criteria shall apply to all wells to be sealed on and in the vicinity of the site:

1. All wells shall be sealed in such a manner that they will not act as a conduit for fluids to flow from the

specific strata in which they were originally encountered.

2. All wells shall be located in the field and sealed by the Subcontractor prior to the beginning of stripping, grading or other surface-disturbing activities that will hinder the detection and sealing of wells. If any well cannot be located after a reasonable search, the Subcontractor shall, prior to the commencement of the well sealing operations, submit to the Contractor a written report documenting the well number, the areas covered and the effort spent in the search.

3. Upon discovery of any unknown wells during the earthwork operations, the Subcontractor shall give the Site Manager immediate verbal notice followed by written confirmation within 24 hours.

4. Wells shall be sealed according to the following procedures:

   a. The Subcontractor shall check each well to be sealed for obstructions that may interfere with the sealing operation and shall remove any such obstructions prior to starting filling operations.

   b. In order to seal the well properly it is preferable to remove the well casings by methods approved by the Contractor as outlined in Article 56 of the EPA Manual of Water Well Construction Practices. Upon removal, if the casings or the materials are found to be contaminated, they shall be decontaminated as required by the Contractor, or disposed of in the tailings embankment as specified in Section 02051. If casing removal is not feasible, the casing shall be perforated, ripped or otherwise disintegrated by methods outlined in Article 56, to ensure grouting of the entire annular space between the casing and the borehole.

   c. The approved methods for the placement of a grout seal shall be as follows:

      1) In wells where casing is removed, the cement grout shall be introduced at the bottom of the well or interval to be sealed (or filled) and placed progressively upward to the top of the well. The grout shall be placed by the use of grout pipe, drop pipe, tremie, cement bucket

or dump bailer, in such a way as to avoid segregation or dilution of the sealing materials. Dumping grout material from the top of the well shall not be permitted.

2) In wells where casing is not removed, the calculated amount of cement grout required to fill the well interval plus the annular space outside the lining shall be placed within the space to be grouted, running the grout through a special cementing packer manufactured for this purpose and installed immediately above the perforated or ripped zone. The grout shall be injected at a pressure calculated to be at least 50 psi greater than the normal hydrostatic pressure within the well at the point of injection.

d. For all wells located in areas where the construction grade elevation will be greater than or equal to the existing grade surface, existing casings and cement grout seals shall be removed to a minimum depth of 2 feet below the existing grade surface, or as required by the Contractor. Grouting shall extend from the bottom of the hole to 2 feet below the existing grade. The interval from the top of the grout to the existing grade surface shall be filled with a mixture of uncontaminated fine-grained (ML or CL) soil and a minimum of 25 percent by weight of commercially processed sodium bentonite and shall be hand-tamped, as required.

e. For all wells located in areas where the construction grade surface will be less than the existing grade surface (i.e. in areas of proposed cut), the existing casings and cement grout seals shall be removed to a minimum of 2 feet below the grade cut elevation as shown on the Subcontract Drawings or as required by the Contractor. Grouting shall extend from the bottom of the hole to 2 feet below the grade cut elevation. The interval from the top of the grout to the existing surface shall be filled with a mixture of uncontaminated fine-grained (ML or CL) soil and a minimum of 25 percent by weight of commercially processed sodium bentonite and shall be handtamped, as required.

5. The Subcontractor shall provide the following notification of the well sealing operation:

a. The Subcontractor shall notify the Contractor one week prior to commencement of well sealing operations.

b. Upon completion of well sealings, the Subcontractor shall submit a Report of Permanent Well Abandonment for each abandoned well to the Utah Engineer's Office, Division of Water Rights. These reports shall be filed on the applicable State form and within the time period required by the Utah Administrative Rules for Water Well Drillers. A copy of the reports shall be submitted to the Contractor.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Measurement for payment for sealing of monitor wells will be by the linear feet of wells sealed. The measurement will be from bottom of well to the top of seal.

4.2 PAYMENT

Payment for sealing of monitor wells will be by the unit price per linear foot quoted therefor in the Bid Schedule. The price quoted shall include full compensation for furnishing all materials, equipment, tools, accessories, incidentals, labor, and for performing the work specified in this Section including decontamination and disposal of materials and equipment.

END OF SECTION 02090

SECTION 02110

SITE CLEARING

PART 1 - GENERAL

1.1 SCOPE

A. This Specification Section describes the requirements for the following:

1. Clearing and cleaning of vegetation, stripping of topsoil, and disposal of cleared and stripped materials from Work areas.

2. Clearing and cleaning of vegetation, soil and debris from the Brown's Wash Area.

1.2 DEFINITIONS

A. Clearing and Cleaning: Clearing is defined as removing brush, other vegetation and trees. All such vegetation and trees shall be cleared down to the natural ground surface. For the Brown's Wash Area, clearing and cleaning shall also include removal of soil and debris from the culverts.

B. Stripping of Topsoil: This shall consist of the removal of uncontaminated topsoil, including all roots, organic materials, vegetation, and other unsuitable material, by blading with a bulldozer or other equivalent means. Depth of stripping shall be minimum 6 inches.

1.3 RELATED WORK

A. Section 02200 - Earthwork: Disposal of Contaminated Materials

B. Section 02935 - Seeding

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 PRESERVATION OF PROPERTY

Existing improvements, adjacent property, utility and other facilities, and trees and plants that are not to be removed shall be protected from injury or damage.

3.2 CLEARING

A. Clearing shall be performed on all areas of construction activities including Brown's Wash channel on the upstream and downstream of the existing culvert as shown on the Subcontract Drawings. Contaminated cleared materials shall be kept separate from uncontaminated cleared materials.

B. Uncontaminated cleared materials shall be disposed of as Subcontractor's property.

C. Contaminated cleared material shall be reduced in size as required by the Contractor and disposed of in the tailings embankment as specified in Section 02200.

D. Clearing and Cleaning from Brown's Wash Area:

1. Clearing and cleaning from the Brown's Wash Area shall include clearing of all vegetation upstream and downstream of the existing culvert crossing, removal of soil and debris from the culverts, and removal and disposal of the cleared soil and debris offsite as Subcontractor's property.

2. The area shall consist of a 75-foot wide strip of Brown's Wash, 300 feet upstream and 100 feet downstream of the existing culvert crossing including the four (4) 10-foot diameter culverts.

3.3 STRIPPING

A. Uncontaminated Areas: Stripping will be required in the following areas:

1. Beneath all fills in areas where excavation is not otherwise required;

2. Beneath areas of riprap protection where excavation is not otherwise required.

3. In areas of excavation where excavated materials are to be used as fill.

B. Contaminated Areas: In areas of excavation where the contaminated surfaces are covered by vegetation, the removal of topsoil may be carried out together with the excavation in one operation.

C. Stripped material shall be disposed of as specified in Article 3.4.

3.4 DISPOSAL OF UNCONTAMINATED TOPSOIL

Stockpiling of uncontaminated topsoil shall be performed only when required by the Contractor upon his determination that there is sufficient uncontaminated organic topsoil in the area to justify the operation; otherwise the materials shall be disposed of in an approved spoil area or as Subcontractor's property. The stockpile area shall be on the Site as designated by the Contractor. Stockpiled topsoil shall be used in finish grading and seeding of the site. Seeding is specified in Section 02935.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. With the exception of the following item, separate measurement for payment will not be made for work specified in this Section. All such other work will be considered incidental to the applicable related items of work specified elsewhere in this Subcontract.

1. Clearing and Cleaning from Brown's Wash Area.

B. Measurement for payment for clearing and cleaning from Brown's Wash Area will be by square yards of the area cleared and cleaned.

4.2 PAYMENT

A. Payment for clearing and cleaning from Brown's Wash Area will be by the unit price per square yard quoted therefor in the Bid Schedule. The price quoted shall include full

compensation for furnishing all labor, materials, equipment, tools, accessories and incidentals and for performing all work including, but not limited to, all clearing on the upstream and downstream sides of the culverts, removal of soil and debris from the pipes and restoring roadways and the like.

B. With the exception of clearing and cleaning from Brown's Wash Area, separate payment will not be made for work specified in this Section. Full compensation for such other work will be considered incidental to the applicable related items of work specified elsewhere in this Subcontract.

END OF SECTION 02110

SECTION 02141

DEWATERING AND DRAINAGE

PART 1 - GENERAL

1.1 SCOPE

A. This Specification Section describes the requirements for dewatering and drainage of work areas and disposal of surface water.

B. If the groundwater level is higher than the bottom of excavation, the Subcontractor shall dewater the excavation, as required, for performance of work in the dry. Stormwater shall be removed from the excavation to maintain dry conditions.

C. A dewatering scheme for work in uncontaminated areas is not shown on the Subcontract Drawings. The Subcontractor shall, as required, design and construct additional gravity or pump systems or a combination of both systems for dewatering of uncontaminated water from work areas.

D. A gravity dewatering scheme for work in contaminated areas is limited to the temporary drainage ditch as shown on the Subcontract Drawings. The Subcontractor shall, as required, design and provide additional gravity or pump system or a combination of both systems for dewatering of water from contaminated work areas. Dewatering from windblown tailings and off-pile areas shall be accomplished incrementally as removal of contaminated materials proceeds.

E. The Subcontractor shall furnish, install and maintain drainage pipes (includes culvert pipes) shown on the Subcontract Drawings.

1.2 DESCRIPTION

A. The work of this Section includes, but is not limited to: dewatering the excavations by installing sump pumps in the excavations and disposal of water by providing drainage facilities including swales, ditches, interceptor dikes, collection ditches, diversion ditches, pipes, and other drainage structures. Water from uncontaminated areas shall be pumped, or allowed to flow by gravity, to drainage ditches leading to existing drainage courses that flow

offsite. Water from contaminated areas shall be pumped, or allowed to flow by gravity, to drainage ditches leading to the wastewater retention basin. Wastewater from decontamination pad shall be collected into the sump and excess water shall be allowed to flow into the wastewater retention basin [and may be used for dust control in contaminated excavation areas and haul roads.]* [Text Deleted]*

B. The Subcontractor shall be responsible for designing, scheduling, utilizing, providing, and maintaining any dikes, ditches, channels, flumes, drains, sumps, pumping equipment, monitoring wells, other subsurface dewatering devices, and other temporary diversion and protective work necessary to ensure that construction shall be performed in areas free from water.

1.3 WORK NOT INCLUDED

Drainage work related to the construction of temporary facilities specified in Section 01500 is not included in the scope of work of this Section.

1.4 RELATED WORK

A. Section 01300 - Submittals

B. Section 02200 - Earthwork

C. Section 02771 - Membrane Liner

D. Section 02935 - Seeding

1.5 APPLICABLE PUBLICATIONS

A. The Publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only:

1. American Association of State Highway and Transportation Officials (AASHTO):

M36-86 Corrugated Steel Pipe, Metallic Coated for Sewers and Drains

2. National Corrugated Steel Pipe Association (NCSPA):

Installation Manual for Corrugated Steel Pipe

* P.I.D. 10-S-03, Rev. 3

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. The Subcontractor shall furnish all materials, equipment and appurtenances required for furnishing, installing and removing dewatering facilities, and shall also supply sufficient standby pumping and auxiliary equipment to preclude any interference to pumping operations during periods of breakdown and maintenance.

B. Drainage Pipes shown on Subcontract Drawings:

1. Drainage pipes: Drainage pipes (CSP) shown on the Subcontract Drawings shall be corrugated steel pipe conforming to AASHTO M36, Type I (circular section), and shall be provided complete with fittings, coupling bands, and all required accessories.

2. Diameters of pipes shall be as shown on the Subcontract Drawings. Unless otherwise indicated on the Subcontract Drawings the thickness of the pipe shall be 16 gage minimum.

PART 3 - EXECUTION

3.1 DEWATERING PROCEDURES

A. Water from uncontaminated areas shall be pumped, or allowed to flow by gravity to natural drainage courses. Erosion protection features including, but not limited to, silt fences, check dams, temporary detention ponds and the like shall be provided by the Subcontractor, if required, to minimize off-site siltation in the receiving stream. Subcontractor shall submit to the Contractor, for review, his design, layout and calculations, fifteen days prior to the construction of such features.

B. Water from contaminated areas shall be pumped or allowed to flow by gravity to drainage ditches leading to the wastewater retention basin. [Water from the wastewater retention basin may only be used for dust control on contaminated excavation areas and on contaminated haul roads.]* Silt fences may be required in some areas during excavation. [Water shall not be permitted to pond in the tailings embankment area.]*

C. The water level in excavation shall be maintained below the lowest point in the excavation until the backfilling

* P.I.D. 10-S-03, Rev. 3

of the excavation has been completed, unless otherwise approved by the Contractor.

3.2 SEEDING AND MULCHING

Sides and inverts of ditches, not finished with membrane liner or riprap protection, shall be seeded and mulched as specified in Section 02935.

3.3 WASTEWATER RETENTION BASIN AND DRAINAGE DITCHES

Wastewater retention basin and drainage ditches shown on the Subcontract Drawings shall be constructed as specified in Sections 02200 and 02771.

3.4 DRAINAGE PIPES SHOWN ON SUBCONTRACT DRAWINGS

A. Unless otherwise shown on the Subcontract Drawings, excavation, installation, backfilling and compaction for drainage pipes shown on the Subcontract Drawings shall conform to the requirements of the National Corrugated Steel Pipe Association (NCSPA). All pipes utilized for temporary drainage during construction shall be removed by the Subcontractor at the completion of site work.

B. The Subcontractor shall be responsible for the maintenance and repair of the drainage pipes and for restoration of the roadways disturbed during installation of drainage pipes. The restoration of roadways shall include furnishing and placing aggregate base and asphalt concrete pavement to match with existing structural section of the roadway.

3.5 MAINTENANCE

The Subcontractor shall be responsible for the maintenance of drainage facilities during construction. Drainage ditches and pipes may require periodic cleaning. Pipes and ditches shall be kept free of sediment deposits, debris and other materials that may restrict or prevent drainage. The Subcontractor, when directed by the Contractor, shall remove and replace all items not functioning properly, including membrane liner, because of clogging, damage, or deterioration.

3.6 REMOVAL

A. When no longer required for water control and as determined by the Contractor:

1. Dewatering equipment shall be removed and disposed of as Subcontractor's property.

2. Contaminated sediments deposited in ditches and the wastewater retention basin shall be removed and placed in the tailings embankment as specified in Section 02200 and as required by the Contractor.

3. Areas occupied by the wastewater retention basin, dike, spillway, and temporary drainage ditches shall be restored and graded as specified in Section 02200.

4. Culverts designated for removal and disposal shall be removed and disposed of as Subcontractor's property.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate measurement for payment will not be made for dewatering and drainage.

4.2 PAYMENT

A. Separate payment will not be made for dewatering and drainage. Full compensation for furnishing all materials, equipment, labor, tools, accessories, incidentals, and for performing all work as specified in this Section including, but not limited to, the construction of additional lined and unlined temporary drainage ditches, construction of silt fences, check dams, temporary detention ponds or other facilities, the provision of pumps, sumps, other accessories and incidentals, pipes, pipe supports, excavation and backfill of pipes and pipe supports, etc., if required, will be considered to be included in the applicable related item/s of Work specified in this Subcontract.

END OF SECTION 02141

SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.1 SCOPE

A. This Specification Section covers the following:

1. The earthwork for, or related to, the following:

a. Excavation of materials from various areas of the site, including the following:

1) Removal of windblown contaminated materials.

2) Removal of contaminated materials from the tailings pile and the foundation of the Crusher Building.

3) Construction of wastewater retention basin.

4) Construction of drainage ditches.

5) Construction of access control and parking areas.

6) Finish grading of the site.

7) Construction of tailings embankment foundation.

8) Vicinity properties (contaminated) material being stockpiled by others.

b. Fill with materials including the following:

1) Construction of tailings embankment.

2) Construction of wastewater retention basin and Brown's Wash dike.

3) Construction of drainage ditches.

4) Construction of access control and parking areas.

5) Finish grading of the site.

2. Disposal of contaminated and uncontaminated demolished materials and debris resulting from work specified in Sections 02051, 02090 and 02110 in the construction of the tailings embankment.

1.2 WORK NOT INCLUDED

A. Earthwork related to the construction of offsite construction facilities specified in Section 01500 is not included in this Section.

B. Earthwork for pipe trenches is not included in this Section.

1.3 RELATED WORK

A. Section 00800 - Special Conditions: Definitions

B. Section 01300 - Submittals

C. Section 01500 - Construction Facilities

D. Section 02051 - Demolition and Decontamination

E. Section 02090 - Sealing Monitor Wells

F. Section 02110 - Site Clearing

G. Section 02141 - Dewatering and Drainage

H. Section 02278 - Erosion Protection

I. Section 02935 - Seeding

1.4 DEFINITIONS

A. Contaminated materials and uncontaminated materials are defined in Article SC-1 of the Special Conditions.

B. Excavation: Excavation shall include excavation of all materials encountered regardless of the nature of the materials, including topsoil, silt, clay, sand, gravel, talus, soft or disintegrated rock, boulders or detached pieces of solid rock that can be effectively loosened or broken down by ripping in a single pass with a late model tractor-mounted hydraulic ripper equipped with one digging point of standard manufacturer's design adequately sized

for use with and propelled by a crawler-type tractor rated between 210- and 240-net flywheel horsepower, operating in low gear, or where it is impracticable to classify by use of the ripper described above, the excavation can be defined as material that can be loosened or broken down by a 6-pound drifting pick. The drifting pick shall be Class D, Federal Specification GGG-H-506D, with handle not less than 34 inches in length. Excavation shall exclude rocks requiring drilling and blasting operations. Excavation shall be classified into the following categories:

1. Contaminated Materials Excavation.

2. Uncontaminated Materials Excavation.

C. Contaminated Materials Excavation: Contaminated materials excavation shall include excavation of contaminated materials from various areas of the site, including, but not limited to, the existing tailings pile, windblown areas, the wastewater retention basin, vicinity property stockpile, building foundations, access control and parking areas, southeast drainage ditch and Brown's Wash dike foundation.

D. Uncontaminated Materials Excavation: Uncontaminated materials excavation shall include excavations of uncontaminated materials from various areas of the site including, but not limited to, excavations for tailings embankment, drainage ditches, retention basin, access control and parking areas, trenches, and site grading.

E. Overexcavation: Overexcavation is defined as excavation carried out beyond the lines and grades indicated on the Subcontract Drawings or in the Subcontract Specifications.

F. Percent Maximum Density: Percent maximum density is a percentage of the maximum density obtained by the test procedure presented in ASTM D698.

G. Topsoil: Topsoil for use as seed bed shall be free of any admixture of subsoil, foreign matter, toxic substances, and any material or substance that may be harmful to plant growth.

H. Tailings Embankment: See Section 00800, Article SC-1

I. Subgrade Preparation: Subgrade preparation includes fine grading and compaction of soils in excavations including drainage ditches, backfills, embankments, and areas upon which bedding materials, riprap, aggregate base courses, or other features are to be constructed.

J. Cover: Cover shall consist of the layers of following fill materials placed over the relocated contaminated materials in the tailings embankment as shown on the Subcontract Drawings:

1. Radon barrier material.

2. Bedding material.

3. Riprap material.

K. Vicinity Properties Materials: These are contaminated materials from areas other than the processing site. The materials shall include contaminated organic and inorganic soil, broken concrete, bricks, asphalt concrete, tree stumps, wooden members, metal objects, pipes, miscellaneous drainage structures, and the like.

L. Finish grading of the site shall include excavation, fill and backfill of the various areas of the site including, but not limited to, backfilling of retention basin, trimming and shaping of retention basin dikes, removal of Brown's Wash dike, temporary drainage ditches, sumps, and temporary facilities areas as shown on the Subcontract Drawings.

M. Common Uncontaminated Material Fill: See Part 2 of this Section.

N. Select Uncontaminated Material Fill: See Part 2 of this Section.

1.5 APPLICABLE PUBLICATIONS

A. The Publications listed below form a part of this Specification to the extent referenced. The Publications are referred to in the text by the basic designation only:

1. American Society for Testing and Materials (ASTM):

D422-63	Test Method for Particle-Size Analysis of Soils
D698-78	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. (2.49-kg) Rammer and 12-in. (305-mm) Drop.

D1556-82 Test Method for Density of Soil in Place by the Sand-Cone Method

D2167-84 Test Method for Density and Unit Weight of Soil In-Place by the Rubber-Balloon Method

D2216-80 Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures

D2922-81 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

D3017-78 Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

D4643-87 Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method

2. U.S. Federal Specifications:

GGG-H-506D Hoe, Mattock, and Pick

1.6 QUALITY ASSURANCE

A. The Contractor will take soil samples and perform moisture-density tests to ascertain that the work is being performed in compliance with these Specifications. Samples may be taken on the fill itself. The Contractor will conduct the density and other tests on the fill and related laboratory testing as specified in Article 3.6. The Subcontractor shall remove surface material and render assistance as necessary to enable sampling and testing.

B. Methods of Sampling and Testing:

1. In-Place Density: ASTM D1556, D2167, or D2922

2. Moisture Content: ASTM D2216, D3017, or D4643

3. Laboratory Moisture-Density Relations: ASTM D698

4. Gradation: ASTM D422

C. Suitability of Materials: The suitability of all materials for foundations and backfill will be determined by the Contractor in accordance with the requirements specified in this Section. Fill material shall be approved material from borrow areas or required excavations.

D. The Contractor may direct that inspection trenches or test pits be cut into fills to determine that the Specifications have been met. Such trenches or pits will be of limited depth and size, and shall be backfilled with the material excavated therefrom, or other fill material meeting the requirements for the zones cut into. Backfill shall be compacted to a density at least equal to that specified for adjacent fills.

E. When the Contractor directs inspection trenches or test pits to be excavated into fills and backfills and materials are found to meet all Specification requirements, the excavation and refilling shall be paid for as additional work pursuant to the applicable provisions of the General Conditions. Inspection trenches or test pits, and the refilling of the same, shall be at the Subcontractor's expense when it is found that the materials do not meet the Specification requirements.

F. Tolerances: See Specification Section 01052, Article 1.6.

1.7 SUBMITTALS

General submittal requirements are specified in Section 01300.

1.8 PROTECTION

A. The Subcontractor shall protect the following:

1. Trees, shrubs and other features remaining as a portion of final grading.

2. Bench marks and monuments, existing structures, fences, walks, pavings, curbs, etc. from equipment and vehicular traffic.

3. Utilities not specified for removal.

4. Excavations from cave-in by shoring, bracing, sheetpiling, underpinning or by other methods.

5. Bottoms of excavations and soil adjacent to and beneath structure foundations from frost.

6. Perimeters of excavations to prevent surface water runoff into excavation.

7. Monitor wells not to be sealed.

8. Existing structures and facilities not to be demolished.

PART 2 - PRODUCTS

2.1 UNCONTAMINATED FILL MATERIALS

A. General:

1. Uncontaminated fill material shall further be divided into the following categories:

   a. Common (General) Fill

   b. Select Fill, Type A

   c. Select Fill, Type B

   d. Radon Barrier Fill

   e. Gravel Fill

2. Common fill and select fill materials shall be obtained from required excavations to the extent available. Where the excavated materials do not meet the requirements of the Specifications or they are not available, the materials shall be furnished from Subcontractor's borrow areas, unless otherwise specified herein.

3. Radon barrier materials shall be obtained from the designated borrow areas. Gravel fill materials shall be furnished by the Subcontractor.

4. The Subcontractor shall make his own determination of any processing that may be required, and shall perform testing as required to ensure that the materials meet the Specification requirements, including materials from specified borrow areas.

5. Submittals for approval of sources proposed for use by the Subcontractor shall include boring logs, borrow area maps and supporting laboratory test data. The Subcontractor also shall provide evidence of availability, right of access to private property including access by the Contractor for sampling and testing, and his plan for hauling the materials to the site. Submittals for approval of sources for uncontaminated fill materials shall be received by the Contractor at least 30 days before use of the material at the site. The Contractor may perform additional tests to determine if the materials meet the requirements specified herein.

6. Approval will be based on evidence of compliance with the requirements specified herein and on verification by the Subcontractor that the volume of materials available is sufficient for construction requirements.

7. Common Fill:

   a. Common fill materials for top 6 inches of fill used in finish grading of the site shall be a mixture of available topsoil and generally fine grained excavated uncontaminated materials.

   b. Common fill to be used as fill or backfill below the top 6 inches of fill used in finish grading of the site shall have a maximum particle size not greater than the compacted lift thickness in any dimension, except as noted hereinafter. Individual large stones shall be distributed within the fill materials to provide visual void-free mass, and be able to meet the requirements of Article 3.8 or Article 3.5.D.10, as applicable.

8. Select Fill, Type A, Materials:

   a. Select fill, Type A, materials shall be soils excavated from the tailings embankment foundation area. It shall not contain more than 5 percent of combined particles larger than one-inch and excavated bedrock particles, as determined by the Contractor.

   b. The Subcontractor shall be responsible to perform selective excavation and stockpiling to produce suitable select fill materials including avoiding mixing of otherwise suitable materials with gravel deposits and bedrock.

9. Select Fill, Type B, Materials: Select fill B materials shall be soils excavated from areas within the final site boundary. Select fill B materials shall not contain material from shale bedrock excavation.

B. Radon Barrier Materials: Radon barrier materials shall be obtained from borrow areas indicated on the Subcontract Drawings. The materials shall conform to the following requirements:

1. Radon barrier materials shall be free from organic matter or other deleterious substances.

2. Radon barrier materials shall consist of soils from the designated borrow source obtained from a minimum of 2 feet below the existing ground surface.

3. Radon barrier materials placed in the first lift over contaminated materials will comprise soils with a minimum of 70 percent by weight passing a No. 200 sieve. Radon barrier materials placed in the remaining lifts shall comprise soils with a minimum of 50 percent by weight passing the No. 200 sieve. All radon barrier materials shall comprise soils with a maximum of 10 percent by weight retained on a No. 4 sieve. Testing for percentage passing or retained on specified sieves shall be according to ASTM D422.

4. Radon barrier materials shall be screened or otherwise processed to reduce clod sizes to 1 inch or smaller prior to mixing with bentonite and moisture conditioning.

5. Bentonite: Bentonite shall be untreated sodium bentonite, suitable for use in a variety of liquid or effluent conditions, "Envirogel 200", as manufactured by Wyo-Ben, Inc., Billings, Montana, or approved equal. Bentonite shall meet the requirements of Specification 13A of the American Petroleum Institute.

C. Gravel Fill Materials:

1. Gravel fill materials shall be obtained from borrow areas indicated on the Subcontract Drawings or from Subcontractor's own sources, as approved by the Contractor. The Subcontractor shall notify the Contractor 30 days prior to use of proposed materials from sources other than the borrow areas indicated on the Subcontract Drawings. Any such sources shall be made

accessible to the Contractor for sampling or testing at least 30 days prior to use of the proposed materials.

2. Gravel fill materials shall conform to the following requirements:

   a. Particle sizes shall be reasonably well graded within the limits shown below when determined in accordance with ASTM D422:

Sieve Size or Sieve No.	Percentage by Weight Passing Specified Sieve Size or No.
6-inch	100
3/8-inch	20-80
No. 4	10-50
No. 200	0-25

   b. Gravel fill materials shall be obtained from natural sand and gravel deposits with less than 5 percent by volume of deleterious materials, including clay lumps, friable particles, and organic matter.

2.2 CONTAMINATED FILL MATERIALS

Contaminated materials defined in Article SC-1 of the Special Conditions resulting from the clearing, stripping and excavation operations in contaminated areas. These materials shall include materials excavated from tailings pile, windblown areas, contaminated sediments from drainage ditches and wastewater retention basin, sump, and materials from underneath the floor slabs of contaminated structures.

2.3 DEMOLISHED MATERIALS AND DEBRIS

A. Contaminated and uncontaminated demolished materials and debris: Section 02051.

B. Contaminated Cleared Materials: Section 02110.

2.4 VICINITY PROPERTIES MATERIALS

See Article 1.4 K

2.5 EQUIPMENT

A. Vibratory rollers specified for compaction of gravel fill in Article 3.5.D.7 shall have a total static weight of not less than 20,000 pounds with at least 90 percent of the weight transmitted to the ground through a single smooth steel drum when the roller is in a level position. The diameter of the drums shall be a minimum of five feet and a maximum of five feet and six inches, and the width shall be a minimum of six feet and be equipped with suitable cleaning devices to keep them free of any accumulation of material. The frequency of vibration during operation shall be between 18 cps and 25 cps and the dynamic force applied by the roller shall be not less than 40,000 pounds at the operating frequency. The roller shall be self-propelled or suitable for towing by a crawler tractor with a minimum drawbar rating of 50 horsepower at speeds not exceeding three miles per hour. A Koehring/Bomag Model BW10S Vibratory Roller (tractortowed), or approved towed or self-propelled equal shall be used. Prior to the use of a vibratory roller in the work, the Subcontractor shall furnish manufacturer's data, drawings, and computations to verify compliance with the above specifications for approval by the Contractor.

B. Mixer: The mixer for mixing bentonite with the radon barrier material shall be capable of thoroughly mixing and controlling the percentage, by weight, of bentonite, soil, and water. The mixer shall be one of the following, or approved equal:

1. Self-propelled road mixer, Seaman TO-730H.

2. Portable pug-mill.

3. Portable drum roll asphalt plant, Cedarapids 4820 (with continuous flow process).

4. A Caterpillar SS 250 rototiller-type mixer.

C. Equipment for spreading bentonite on the ground, if used, shall be capable of uniformly spreading the specified amount of bentonite in one or two passes, where the second pass may be made transverse to the first pass. Equipment for spreading bentonite will be subject to Contractor's approval.

D. All equipment for spreading and mixing bentonite, and for moisture conditioning radon barrier materials mixed with bentonite, will be subject to approval by the Contractor.

E. Compaction equipment for contaminated materials shall be a smooth-drum vibratory roller manufactured for the purpose of soil compaction. The minimum static weight of the roller drum shall be 160 pounds per lineal inch of drum width. The minimum centrifugal force applied to the roller drum at the operating frequency shall be 475 pounds per lineal inch of drum width. Operating frequency of the vibratory system shall be 1500 to 1800 vibrations per minute. The drum diameter shall be 58-62 inches. The roller shall be capable of operating at speeds of 2-3 miles per hour. The drum shall be equipped with a suitable cleaning device to keep it free of any accumulation of material. Roller used shall be BOMAG Model BW 213D, Caterpillar Model CS-553, or approved equal. Prior to the use of the vibratory roller in the work, the Subcontractor shall obtain approval from the Contractor. The Subcontractor shall furnish equipment manufacturer's data, drawings, specifications, and computations to the Contractor to verify compliance with the above specifications.

PART 3 - EXECUTION

3.1 PROTECTION OF EXPOSED SURFACES AND SLOPES

A. During seasonal shutdowns and during other periods of prolonged exposure (more than six weeks) of excavated or filled areas, the Subcontractor shall provide labor, materials and equipment, as required by the Contractor, to maintain and protect exposed surfaces of uncontaminated and contaminated materials against wind erosion and excessive stormwater erosion. Prior to the application of protective erosion control measures, the exposed surfaces shall be sloped to drain and compacted with a tracked vehicle up and down the slope to eliminate ruts and ridges formed by construction equipment. Unless otherwise approved by the Contractor, acceptable methods of erosion protection are as follows:

1. Spraying with Water containing Chemical Additives: Acceptable chemical additive is "Soil Seal Concentrate" as manufactured by Soil Stabilization Products Company of Merced, California, or approved equal. Mixing and application shall be in accordance with the manufacturer's recommendations, or

2. Covering exposed surfaces with geotextile fabric such as "Supac" as manufactured by Phillips Fibers Corporation of San Jose, California, or approved equal. Handling and installation shall be as recommended by the manufacturer of the product.

B. Contaminated Materials: Contaminated material stockpiles shall be maintained to prevent ponding of stormwater and to promote stormwater runoff, to the maximum practical extent.

3.2 EARTHWORK - GENERAL

A. Preparation:

1. Required lines, levels, contours and datum shall be identified before the start of earthwork operations.

2. The Subcontractor shall verify the existing above-ground and underground utilities, identify them, and notify the Contractor immediately of his finding, if any, for appropriate action.

B. Dewatering and Drainage: Prior to commencement of earthwork operations, the Subcontractor shall verify that the dewatering and drainage facilities are constructed and operational in accordance with the requirements of Section 02141.

C. In order to avoid cross-contamination of uncontaminated material, the contaminated and uncontaminated materials shall be kept separated during earthwork operations. Stockpiles of contaminated materials shall be placed on contaminated areas and the drainage collected in the retention basin.

D. Earthwork shall conform to lines and grades indicated on the Subcontract Drawings or specified in this Section.

E. The excavated uncontaminated materials shall be used as fill in various areas of the sites including the construction of dikes, general fill, roadway fill, structure fill, backfill, and fill for the final grading of the sites, as required. Uncontaminated excavated material may be stockpiled for later use.

F. Temporary drainage ditches shall be constructed and maintained to provide drainage during construction.

G. Borrow area excavation, and restoration if required, shall conform to the requirements of the authority having jurisdiction over such areas.

H. Moisture Addition to Contaminated Materials:

1. Moisture shall only be added to contaminated materials for environmental dust control requirements. The Subcontractor shall use special measures such as fine spray nozzles to add moisture to contaminated materials, as approved by the Contractor, to minimize the amount of moisture added for dust control. The Subcontractor shall perform his operations to minimize the need for moisture addition to the extent practicable. Moisture addition shall not be permitted for the convenience of the Subcontractor. Water from the wastewater retention basin may only be used for dust control in contaminated excavation areas and on contaminated haul roads.

2. Dust control moisture shall be added to fill materials at the place of excavation preceding placement of fill materials in the tailings embankment. Moisture shall not be added in the tailings embankment area except when it is determined to be absolutely necessary for environmental dust control. At no time shall contaminated water be used in the tailings embankment.

3.3 EXCAVATION

A. General:

1. Excavation shall be carried out to reach the lines and grades indicated on the Subcontract Drawings or specified herein, or, in the case of contaminated materials, as required by the Contractor's Health Physics Personnel.

2. At all times, the Subcontractor shall conduct his operations in such a manner as to prevent free standing water and contamination of uncontaminated materials. The Subcontractor shall, as a minimum, take the following measures to safeguard against such problems:

a. Water leaving a contaminated excavation area or contaminated area otherwise disturbed by construction activities shall be routed into the retention basin as specified in Section 02141.

b. Exposed surfaces of contaminated and uncontaminated materials excavations shall be protected from erosion as specified in Article 3.1 above.

3. The Subcontractor shall remove all excavated material from the excavation site and dispose of it in fills required at the site or use it for other purposes, as approved by the Contractor.

4. Unsuitable or low density subgrade material not readily capable of in-place compaction shall be excavated as directed by the Contractor and disposed of as specified in Article 3.4.

5. Adequate working space for safety of personnel shall be provided within the limits of the excavation.

6. Except as otherwise noted, care shall be exercised to preserve the material below and beyond the lines of all excavation. Where excavation is carried below grade, the Subcontractor shall backfill to the required grade or to indicated invert grade, as specified, and recompact the backfill to meet the existing conditions, except for embankment subgrade on bedrock.

7. Excavation for the convenience of the Subcontractor shall conform to the limits approved by the Contractor and shall be at no additional expense to the Contractor. Excavation for the convenience of the Subcontractor shall not be permitted in bedrock for the tailings embankment foundation.

8. Excavated material shall be placed at sufficient distance from edge of excavations to prevent cave-ins or bank slides.

9. Where practicable, suitable materials removed from excavation shall be used as fill or backfill.

10. Uncontaminated material excavation shall not be permitted on the existing slopes between the final tailings embankment and Brown's Wash unless otherwise specified.

B. Contaminated Materials Excavation:

1. The Subcontractor shall minimize the open excavation area of contaminated materials at any time during excavation work. The Subcontractor shall operate from one or two sides at one time, progressing uniformly to opposite sides for completion, unless directed otherwise by the Site Manager. Contaminated materials shall be excavated to the depths indicated on the Subcontract Drawings, or as required by the Contractor,

and placed in the proper part of the tailings embankment. The contaminated material will be excavated generally in priority of its placement in the embankment to minimize rehandling and stockpiling.

2. During the excavation operation, tests will be performed by the Contractor to determine radioactive contamination of the material to be excavated.

3. The Subcontractor shall add moisture to materials prior to excavation of fill materials, as required, to control dust as specified in Article 3.2.H above.

4. Excavation of Contaminated Materials from Underneath the Foundation of Crusher Building:

   a. Contaminated material from underneath the floor slab of the southeast room of the Crusher Building shall be removed and the excavation backfilled with uncontaminated material and compacted as specified.

   b. For detailed description of the extent of contamination, see "Information for Bidders".

   c. The floor slab, if removed by the Subcontractor, shall be reconstructed with matching structural concrete and reinforcement, otherwise the holes repaired and patched. The structural concrete and the reinforcement shall be as approved by the Contractor.

C. Uncontaminated Materials Excavation:

1. Drainage Ditches Excavation:

   a. General: Ditches shall be cut accurately to the cross sections and grades where indicated. Contaminated materials shall first be excavated and placed in the tailings embankment or stockpiled. All roots, stumps, rock, and foreign matter in the sides and bottom of ditches shall be trimmed and dressed or removed to conform to the slope, grade, and shape of sections indicated. Care shall be taken not to excavate ditches below the grades indicated. Excessive ditch excavation shall be backfilled to grade with satisfactory, thoroughly compacted material. Ditches shall be maintained until final acceptance of the Work.

b. Ditches shall be excavated true to line and grade. Any erosion which occurs to ditch excavation shall be repaired with compacted backfill. All such repairs shall be at Subcontractor's expense and shall not be included in pay quantities, unless otherwise shown on the Subcontract Drawings.

c. Drainage ditch subgrade shall be prepared as specified in Article 3.7 below. Finish grading shall be done in such a manner that the side slopes are rendered smooth surfaces. All rocks, brush, roots, large clods, and other objects shall be removed.

2. Wastewater Retention Basin Excavation:

a. The wastewater retention basin shall be constructed to the lines and grades shown on the Subcontract Drawings. Contaminated materials shall first be excavated and stockpiled or placed in the tailings embankment as shown on the Subcontract Drawings, then the excavation and fill for the retention basin shall be accomplished.

b. The retention basin shall be demolished when no longer required and the area graded as shown on the Subcontract Drawings and as specified in this Section.

c. Construction of the retention basin shall also conform to the requirements specified in Section 02141.

3. Radon Barrier Borrow Area Excavation:

a. Borrow area shall meet all permit and negotiated requirements as required by the Contractor.

b. Necessary clearing, grubbing, and disposal of debris shall be performed by the Subcontractor as incidental operations to the borrow excavation.

c. The material shall be excavated after stripping the topsoil to a minimum depth of 2 feet.

3.4 DISPOSAL OF EXCAVATED MATERIALS

A. Contaminated Materials: All contaminated materials excavated from the tailings pile, retention basin, other areas of the site and vicinity properties, and demolished

materials and debris resulting from all sources shall be used in the construction of the tailings embankment as specified herein. Contaminated material will be placed in the tailings embankment by priority generally as specified herein. Radiological monitoring of contaminated materials or construction expediency may change placement priority, as directed by the Contractor.

B. Uncontaminated Materials:

1. Materials excavated from the site, including excavations for trenches, drainage ditches and retention basin which do not classify as contaminated materials, shall be used as uncontaminated material fill for construction of various features including site grading, or stockpiled for later use.

2. Where used in fills, such material shall be transported directly from the excavation and placed in its final position in such fills whenever possible. If required by the Subcontractor's schedule, the material may be placed temporarily in stockpiles at approved locations. Material in stockpile shall be protected from contamination of any kind that would render it unsuitable for use in fills.

3. Select Fill, Type A, shall be used in the construction of the tailings embankment.

4. Select Fill, Type B, shall be used as fill and backfill for finish grading of the site within the final site boundary area.

5. All other areas requiring uncontaminated fill shall be filled with common fill.

C. Garbage, refuse, debris, oil, and any waste material which is harmful to the environment shall be removed from the job site and disposed of offsite in a manner approved by the authority having jurisdiction over the offsite disposal facility.

D. All operations in the stockpile areas throughout the Work shall be in strict conformity with the requirements of this Section. The Subcontractor shall ensure that silty water from the stockpile areas does not enter nearby waterways. If required, temporary berms and detention ponds shall be constructed by the Subcontractor.

3.5 FILL CONSTRUCTION

A. General Requirements:

1. Fill materials shall be placed and compacted to the lines and grades shown on the Subcontract Drawings or as required by the Contractor.

2. Prior to placement of uncontaminated fill materials, the subgrade will be radiologically surveyed by the Contractor to confirm that EPA standards have been met. These radiological surveys may cause delays to backfill operations of up to seven working days. The Subcontractor shall plan his work accordingly.

3. If any portion of the materials placed as fill does not meet the specified requirements, the Subcontractor shall remove such material and replace it with fill materials meeting the specification at no additional cost to the Contractor.

4. Constructed fills shall be maintained to meet the requirements of this Specification until final completion and acceptance of the Work. This shall include all measures to prevent erosion or contamination during construction, including contamination by radioactive material. During seasonal or other extended shutdowns, all exposed surfaces shall be protected with special treatments specified in Article 3.1 above.

5. The Contractor will perform additional in-place density and moisture content tests within the first 1000 cubic yards of windblown-contaminated material placement and within the first 1000 cubic yards of placement of contaminated materials from the main tailings pile. The Subcontractor shall compact the materials as specified in Article 3.5.D.4, but may be directed to vary the number of passes and to construct multiple lifts. The Contractor will select the contaminated materials to be used. The Subcontractor shall cooperate with the Contractor in performing these additional tests, including tests between successive passes.

B. Placing Requirements:

1. Prior to placement of materials, the in-place density of the subgrade for the retention basin dike shall be as specified in Article 3.8. Subgrade preparation, where required, shall be as specified in Article 3.7.

2. No material shall be placed on any portion of the subgrade or against or upon any structure until consent to place such fill has been obtained from the Contractor.

3. Fill materials may require moisture conditioning (wetting or drying) prior to compaction. Some tailings may require spreading and extended drying time prior to compaction. Moisture addition to contaminated materials shall be as specified in Article 3.2.H.

4. Fill materials shall be placed in continuous and approximately horizontal layers for their full length and width unless otherwise specified or specifically permitted by the Contractor.

5. Method of dumping and spreading the materials shall ensure uniform distribution of the material.

6. Unless otherwise specified herein, loose thickness of each layer of contaminated and uncontaminated materials shall not be greater than that required to achieve the required compaction, and in no case shall exceed 12 inches.

7. Cover Construction:

   a. Three-foot thick radon barrier shall be placed in four lifts. Each lift shall be approximately 9-inch thick compacted. The first lift shall be spread over the final contaminated material surface by a bulldozer ensuring that no underlying contaminated materials surface is disturbed.

   b. Moisture content of preceding in-place radon barrier lift with the exception of top two inches shall be maintained at not less than optimum minus one percent. The moisture content shall be maintained as specified until the next lift, including bedding material, is placed and compacted. The Contractor will verify this specification requirement, as necessary, by testing in-place moisture content of samples taken from 2 to 4 inches beneath the top surface of the compacted radon barrier lift.

   c. Moisture added to the radon barrier materials shall be applied in a manner that prevents runoff onto contaminated materials.

d. Placement and compaction of bedding and erosion protection materials shall be as specified in Section 02278.

8. Unless otherwise indicated, fill materials shall be placed to a grade no flatter than 2 percent to facilitate drainage of water. In areas where ponding cannot be prevented or ponding has occurred and fill is required to be placed, placing shall begin only after the area is dewatered and permission to place is obtained from the Contractor.

9. Materials shall not be placed on frozen subgrade or embankment material foundations, nor shall frozen material be used as fill.

10. Disposing of bulky materials shall be done with care to minimize the volume of voids created in the disposal embankment fill. Pieces of wood, concrete, and steel members shall be cut or broken up as specified in Section 02051, and placed to avoid nesting. Such bulky materials shall be placed in the lower lifts of the tailings embankment as determined by the Contractor. Bulky materials from vicinity properties materials stockpile and from the demolition of temporary facilities at the end of construction shall be placed as low as practicable within the embankment.

11. When no longer needed for control of contamination, as determined by the Contractor, the temporary drainage ditches, retention basin, sumps, and the like shall be removed and the area restored and finish graded as shown on the Subcontract Drawings.

12. When fill is placed against an existing slope steeper than 3 (horizontal) to 1 (vertical), except the excavation slope for the tailings embankment foundation, the existing slope shall be terraced as the fill is constructed. Terraces shall be cut nearly horizontal a minimum of 6 feet into the existing slope as the fill is brought up in layers. Material cut for terraces shall be used for the adjacent fill, if suitable, or shall be used elsewhere for site grading.

C. Mixing Bentonite:

1. Mixing of bentonite shall not be accomplished in-place. If bentonite is mixed on the ground, loose material to be mixed with bentonite shall be placed on a 1-foot thick layer of specified radon barrier material rolled to a firm condition to avoid contamination by unacceptable materials.

2. Radon barrier material shall be thoroughly mixed with the specified equipment with a minimum of six percent, by weight, of the specified bentonite. The dry weight of radon barrier material without bentonite is to be multiplied by 0.06 to determine the minimum dry weight of bentonite to be added to the radon barrier material. The Subcontractor shall be responsible for spreading and mixing the specified amount of bentonite. The Contractor will verify that the proper amount of bentonite is mixed with radon barrier material based on respresentative measurements of soil and bentonite weights and on representative moisture contents of soil and bentonite.

3. Moisture conditioning of radon barrier materials prior to, during, and following mixing with bentonite shall be at a suitable level or levels to achieve a thorough composite mixture, shall permit uniform and effective addition of any required additional moisture, and will be subject to approval by the Contractor.

4. Mixing of bentonite with radon barrier material shall produce a thoroughly mixed, uniform composite mixture, as approved by the Contractor. The Contractor will verify thorough mixing to a uniform condition by visual inspection. The method of mixing shall be subject to approval by the Contractor. If a pug mill is used, ASTM C94 will be used as a guide for mixing soil and bentonite, as approved by the Contractor. The Contractor reserves the right to suspend or require the Subcontractor to modify operations in the event that problems with dust and windborne bentonite affects the amount and uniformity of bentonite mixing, as determined by the Contractor.

D. Compaction Requirements:

1. Each layer of fill materials, except gravel fill and contaminated materials, shall be compacted to a minimum density specified in Article 3.8.

2. During compaction, the moisture content of fill material shall be maintained to achieve specified density and as otherwise specified herein. Uniform moisture distribution shall be obtained by disking, blading, or other methods approved by the Contractor prior to compaction of a layer except for contaminated materials.

3. The Subcontractor shall minimize the moisture content of contaminated materials during and following placement and compaction to the extent practicable. The Contractor will monitor dust control moisture added to contaminated materials.

4. Contaminated materials shall be placed and compacted as follows:

   a. Contaminated material shall be placed in approximately 10-inch thick maximum loose lifts prior to compaction. Contaminated materials other than tailings pile and subpile materials, as determined by the Contractor, shall be compacted by a minimum of four passes of a Caterpillar 825 tamping-foot roller and four passes of the roller specified in Article 2.5.E. Contaminated materials from the tailings pile and subpile shall be compacted by a minimum of four passes of the roller specified in Article 2.5.E. The roller specified in Article 2.5.E shall be operated at a speed between two to three miles per hour with the vibratory mechanism operating.

   b. All contaminated materials shall be placed at a moisture content less than 3 percent below optimum moisture content determined according to ASTM D698. Contaminated materials shall be allowed to dry, as neccessary, to meet this moisture content requirement prior to placement in the tailings embankment. The Subcontractor may be permitted to promote drying by scarifying, harrowing, or other means, as approved by the Contractor.

5. Select Fill Type A materials shall be compacted at a moisture content from optimum to 4 percent below optimum moisture content as determined by ASTM D698.

6. If the rolled surface of any layer of the fill in place is too wet for proper compaction of the layer of fill material to be placed thereon, it shall be removed, allowed to dry or worked with harrow, scarifier, or other suitable equipment to reduce the water

content to the required amount, and then re-compacted before the next succeeding layer of fill is placed.

7. Fill placed at densities lower than the specified minimum density or at moisture contents outside the specified acceptable range of moisture content shall be reworked to meet the density and moisture requirements or removed and replaced by acceptable fill compacted to meet these requirements.

8. The final layer of compacted contaminated material shall be bladed to a uniform and smooth grade as indicated on the Subcontract Drawings, then compacted by the use of a smooth drum roller.

9. Radon Barrier: Compaction of radon barrier shall be accomplished according to the following requirements:

   a. Radon barrier materials shall be moisture conditioned a minimum of two hours prior to compaction. Moisture shall be added as necessary to maintain a moisture content for two hours prior to compaction equal to or greater than optimum moisture content, as determined according to ASTM D698. Except for the uppermost lift of radon barrier placed on a 5(H):1(V) slope, moisture shall not be mixed or otherwise worked into radon barrier materials after placement of the materials over the contaminated materials.

   b. In placing and working the first layer of radon barrier, care shall be taken to avoid mixing in any of the underlying radiologically contaminated soil.

   c. During compaction of radon barrier materials, moisture content shall be maintained within zero to plus three percent of the optimum moisture content as determined by ASTM D698.

   d. Compaction of radon barrier shall be accomplished using tamping foot rollers.

   e. The radon barrier shall be compacted in four lifts as specified in 3.5.B.7.a above.

   f. Once minimum specified density is achieved for radon barrier, additional compaction shall not be performed.

g. The top surface of the underlying compacted radon barrier shall be scarified to a depth of 1 inch to 2 inches just prior to placement of the overlying loose lift. Scarification shall be accomplished by suitable equipment capable of accurate depth control.

h. [Except for 2(H):1(V) slopes,]* the top surface of the final layer of radon barrier shall be compacted with the tamping foot roller, then bladed and compacted by the use of a smooth drum roller. [2(H):1(V) slopes may be rolled with a smooth-drum roller or by back-dragging a bulldozer blade to remove loose material and provide a smooth, firm surface.]*

10. Gravel fill materials shall be placed as shown on the Subcontract Drawings and shall be compacted by a minimum of four passes of the specified vibratory roller.

11. Brown's Wash dike shall be constructed by dumping common materials excavated from the tailings embankment area as shown and shaping in the form of a dike as shown on the Subcontract Drawings. Compaction of the fill shall be accomplished by routing of the hauling equipment. Dike shall be removed as part of finish grading of the Site.

12. Uncontaminated fill material in the stockpile areas shall be placed by spreading with a bulldozer and track walking. Compaction shall be accomplished by routing of hauling and spreading equipment units.

13. Compaction of common fill with more than 30 percent retained on a 3/4-inch standard sieve:

    a. Materials placed as common fill shall not total greater than 3 foot compacted thickness in any area, except in the areas of the existing tailings pile, retention basin, and nearby areas, as approved by the Contractor.

    b. Prior to compaction, materials shall be moisture conditioned as approved by the Contractor.

    c. Compaction shall be accomplished by any of the following combinations of passes and equipment, or approved equal combination:

        1) Two passes of a Caterpillar Compactor Model 825C.

* P.I.D. 10-S-14

2) Two passes of a BOMAG Vibratory Roller Model 213D.

3) Two passes of a Raygo Vibratory Roller Model 400A.

4) Three passes of a track-type tractor with ground pressure of 9.8 pounds per square inch or greater.

5) Four passes of a fully-loaded Caterpillar Wheel Tractor-Scraper Model 631E.

d. Materials shall not be used as backfill against structures.

e. Materials shall not be subject to requirements of Article 3.8.A.

3.6 FIELD QUALITY CONTROL

A. General: The Contractor will take samples and perform tests throughout the construction period, and the Subcontractor shall cooperate in providing access for the Contractor to areas where testing is to be performed and shall schedule his placing to avoid interference with the testing operations.

B. Tests: The Contractor will perform the following tests on a regular basis.

1. In-place density and moisture content tests for compacted materials where density is specified will be as follows:

a. One test per 1000 cubic yards of select fill materials.

b. One test per 500 cubic yards of radon barrier materials.

c. One test per 3000 cubic yards of common fill materials except retention basin dike which will be one test per 1,000 cubic yards.

d. At least two tests for each day of material placement in excess of 150 cubic yards for each material.

2. In-place moisture content tests for contaminated materials, one test per 2000 cubic yards. Moisture content tests will be performed to represent the moisture conditions at the time of placement.

3. Percentage by weight passing the No. 200 sieve and percentage by weight retained on the No. 4 sieve on radon barrier materials at a minimum of one test per 1000 cubic yards of material placed with an absolute minimum of one gradation performed per day of placement. Gradation of material will be determined on material prior to mixing with bentonite.

4. Gradation of gravel fill materials, a minimum of one test per 2000 cubic yards of material placed; and a minimum of one test for each day of material placement in excess of 150 cubic yards.

3.7 SUBGRADE PREPARATION

A. Subgrade Preparation: Subgrade preparation includes fine grading and, where specified, compaction of excavations, backfills, embankments (including stockpiles) upon which fill, backfill, gravelly backfill, pavement, surfacing, base, subbase, and riprap or other structures are constructed. Compaction shall be as specified in Article 3.8 below.

B. Soft spots developed during working shall be removed or corrected.

C. Subgrade in bedrock excavation for the tailings embankment shall be excavated to the lines indicated on the Subcontract Drawings. Loose material shall be removed to the extent practicable. Subgrade shall not be compacted prior to Select Fill Type A layer placement. The Subcontractor shall get the tailings embankment subgrade inspected and approved by the Contractor prior to placement of Select Fill Type A materials. The Subcontractor shall minimize disturbance to the subgrade once Contractor's approval has been obtained.

D. The entire surface of the subgrade for retention basin dike shall be plowed, harrowed, and mixed to a depth of at least 6 inches. Compaction shall be carried out for the full area below finished subgrade to at least the density

specified in Article 3.8 below. Soft areas developed or encountered during working shall be corrected as specified in Paragraph B.

3.8 COMPACTION DENSITIES

A. Each layer of embankment and backfill shall be compacted to at least the following percentage of maximum dry density, as determined by the ASTM D698 test method:

1.	Subgrade for Retention Basin Dike:	90 percent
2.	Road Embankment:	98 percent
3.	Select Uncontaminated Material, Type A	95 percent
4.	Other Embankments:	90 percent
5.	Radon Barrier:	100 percent
6.	Trench Backfill:	95 percent
7.	Site Restoration:	90 percent

3.9 DISPOSAL OF DEMOLISHED MATERIALS AND DEBRIS

A. All demolished materials and debris including contaminated cleared materials shall be disposed of in the tailings embankment conforming to the applicable provisions of this Section and as required by the Contractor.

B. During construction of the tailings embankment, provision shall be made to leave required space at proper location in the embankment for the placement of the demolished materials and debris.

C. At locations around debris where compaction is impractical to accomplish according to requirements of Article 3.5.D.4.a, alternate methods of compaction shall be used, as approved by the Contractor. Alternate methods of compaction shall achieve the same densities obtained in the same materials compacted according to Article 3.5.D.4.a.

3.10 VICINITY PROPERTIES MATERIALS

A. Vicinity properties materials will be delivered and stockpiled near the tailings embankment area by others. The location of the stockpile is shown on the Subcontract Drawings. The approximate quantity is estimated at 25,000 cubic yards. The delivery and stockpiling operations are expected to continue during the term of this Subcontract. The Subcontractor shall excavate the materials from the stockpile only after the delivery to the site of all materials is completed or as otherwise directed by the Contractor, transport to the tailings embankment, and place in the tailings embankment.

B. Organic material shall be distributed throughout any layer to avoid large pockets in one area. The placement shall conform to the applicable provisions of this Section and as required by the Contractor.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement for payment for the following items of excavations and fills will be by the cubic yards of material excavated. The quantities for payment will be computed from lines and dimensions shown, or by average end area method from surveys conducted before and after excavation operations as shown on the Subcontract Drawings, or by the methods determined by the Contractor. Separate measurement for payment will not be made for temporary stockpiling or for placement of the materials in their final locations.

1. Excavation of contaminated materials from existing tailings pile, wastewater retention basin foundation and Brown's Wash dike foundation and placement in tailings embankment. (Bid Schedule Item 401)

2. Excavation of contaminated materials from other areas of the Site and placement in tailings embankment. Other areas of the site shall include, but not be limited to, drainage ditches, and windblown areas. (Bid Schedule Item 402)

3. Excavation of contaminated materials under the Crusher Building foundation and placement in tailings embankment. (Bid Schedule Item 403)

4. Excavation of vicinity property materials from stockpile and placement in tailings embankment. (Bid Schedule Item 404)

B. Measurement for payment for the following items of excavation will be by the cubic yards of materials excavated. The quantities for payment will be computed from lines and dimensions shown, or by average end area method from surveys conducted before and after excavation operations as shown on the Subcontract Drawings, or by the methods determined by the Contractor.

1. Excavation of uncontaminated materials from southeast diversion ditch. (Bid Schedule Item 212)

2. Excavation of uncontaminated materials for retention basin. (Bid Schedule Item 214)

3. Excavation of uncontaminated materials from tailings embankment area. (Bid Schedule Item 801)

C. Measurement for payment for the following items of fills will be by the cubic yards of materials placed. The quantities for payment will be computed from lines and dimensions shown, or by average end area method from surveys conducted before and after placement as shown on the Subcontract Drawings, or by the methods determined by the Contractor. Separate measurement for payment will not be made for excavation, transportation and stockpiling of materials.

1. Placement of excavated uncontaminated Materials as common fill for retention basin dikes. (Bid Schedule Item 213)

2. Placement of excavated uncontaminated materials as common fill or backfill for final site grading of the area outside of the final site boundary. (Bid Schedule Item 802)

3. Placement of excavated uncontaminated materials from tailings embankment area as select fill, Type B, for finish grading of the site within the final site boundary. (Bid Schedule Item 803)

4. Placement of excavated uncontaminated materials from tailings embankment area as select fill, Type A for tailings embankment. (Bid Schedule Item 405)

5. Placement of excavated uncontaminated materials as common fill for Brown's Wash dike. (Bid Schedule Item 215)

D. Measurement for payment for the following items of fills will be by the cubic yards of materials placed. The quantities for payment will be computed from lines and dimensions shown, or by average end area method from surveys conducted before and after placement as shown on the Subcontract Drawings, or by the methods determined by the Contractor.

1. Furnish and place radon barrier material (including bentonite) in tailings embankment. (Bid Schedule Item 501)

2. Furnish and place gravel fill materials in the gullies. (Bid Schedule Item 804)

E. Separate measurement for payment will not be made for the following items, and such work will be considered incidental to the related items of work:

1. Subgrade preparation.

2. Excavation for diversion drainage ditches.

3. Stockpiling of excavated materials.

4. Required rehandling of materials.

5. Disposal of demolished materials and debris.

6. Excavation of fill placed for Brown's Wash dike and the wastewater retention basin dike.

F. Overexcavation: Overexcavation for the Subcontractor's convenience or due to error or lack of control by the Subcontractor will not be measured for payment and, instead, shall be backfilled with compacted contaminated or uncontaminated fill, as required, at the Subcontractor's expense.

G. Separate measurement for payment will not be made for any other excavations or fills specified in this Section.

H. Measurement for payment for disposal of demolished materials and debris resulting from work specified in Section 02051 of this Subcontract will be as specified in Section 02051.

4.2 PAYMENT

A. Payment for the items of Article 4.1.A above will be by their applicable unit prices per cubic yard quoted therefor in the Bid Schedule. The prices quoted shall include full compensation for excavating, hauling, and placing the excavated materials in their final locations including all clearing at the processing site, stripping, grading, shaping, preparing subgrade, compacting, temporary stockpiling and required rehandling.

B. Measurement for payment for the items of Article 4.1.B above will be by their applicable unit prices per cubic yard quoted therefor in the Bid Schedule. The prices quoted shall include full compensation for excavating, hauling, and placing the excavated materials in temporary stockpiles, or in spoil areas if excess or unsuitable for use as fill, as required, including all clearing at the processing site, stripping, grading, shaping, and compacting such stockpiles or areas as specified.

C. Payment for the items of Article 4.1.C above will be by their applicable unit prices per cubic yard quoted therefor in the Bid Schedule. The prices quoted shall include full compensation for hauling the materials from excavated areas or retrieving the materials from temporary stockpiles, as required, and placing the excavated materials in their final locations including all clearing at the processing site, stripping, grading, shaping, preparing subgrade, and compacting or consolidating, as required.

D. Payment for items of Article 4.1.D above will be by their applicable unit prices per cubic yard quoted therefor in the Bid Schedule. The prices quoted shall include full compensation for obtaining required permits for borrow sources, developing and closing of borrow sources, obtaining the materials from borrow sources including clearing, stripping, excavating, hauling the materials from excavated areas, and placing the excavated materials in their final locations including preparing subgrade, moisture conditioning and compacting, as required. Royalties for radon barrier borrow material will be paid for by the Contractor.

E. Separate payment will not be made for the items mentioned in Article 4.1.E above. All costs for such work will be considered to be included in the prices quoted for the applicable related items of work.

F. Separate payment will not be made for any other excavations or fills specified in this Section. All costs for excavations or for furnishing and placing such fills will be considered to be included in the related items of excavation.

G. Payment for disposal of demolished materials and debris resulting from the work specified in Section 02051 of this Subcontract will be as specified therein.

END OF SECTION 02200

SECTION 02278

EROSION PROTECTION

PART 1 - GENERAL

1.1 SCOPE

This Specification Section describes the requirements for furnishing and placing riprap and bedding materials for tailings embankment cover, riprap toe protection, and spillway for wastewater retention basin.

1.2 WORK NOT INCLUDED

Erosion protection related to the construction of temporary facilities specified in Section 01500 with the exception of the wastewater retention basin is not included in the scope of work of this Specification.

1.3 RELATED WORK

A. Section 01300 - Submittals

B. Section 02200 - Earthwork: Subgrade Preparation

1.4 APPLICABLE PUBLICATIONS

A. The Publications listed below form a part of this Specification to the extent referenced. The Publications are referred to in the text by the basic designation only:

1. American Society for Testing and Materials (ASTM):

C88-83	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C117-84	Test Method for Materials Finer than 75 um (No. 200) Sieve in Mineral Aggregates by Washing
C127-84	Test Method for Specific Gravity and Absorption of Coarse Aggregate

C131-81 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

C136-84a Method for Sieve Analysis of Fine and Coarse Aggregates (Rulers or Templates may be Substituted for Sieves for Gradation of Particles Larger Than 3 Inches)

C142-78 Test Method for Clay Lumps and Friable Particles in Aggregates

C535-81 Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

2. International Society for Rock Mechanics (ISRM), 1981, Rock Characterization Testing and Monitoring, ISRM Suggested Methods, E. T. Brown, Editor, Pergamon Press, New York:

Suggested Method for Determining Indirect Tensile Strength by the Brazil Test. pp. 120-121

Suggested Method for Determination of the Schmidt Rebound Hardness pp. 101-102

1.5 PERMITS

The Contractor will provide permits for the use of borrow areas shown on the Subcontract Drawings as specified in Article SC-12 of Special Conditions. If the Subcontractor uses other sources for erosion protection materials, he shall be responsible for obtaining all required permits.

1.6 SUBMITTALS

A. If the Subcontractor determines to use other sources for erosion protection materials, a site inspection report containing the information specified in Article 2.1.A.2 below shall be submitted, in triplicate, to the Contractor for review and approval of the source, in accordance with the requirements of Section 01300.

B. During production of riprap and bedding materials from approved sources, the Subcontractor shall submit test results, in triplicate, including, as a minimum, the tests specified in Section 2.1.C.1.c. for a minimum of three representative samples of each type of material produced. Test locations and materials to be tested shall be selected at the direction of the Contractor during production.

C. The Subcontractor shall submit, in writing, the name and qualifications of his proposed testing laboratory to the Contractor for approval.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material Sources: Erosion protection materials shall be obtained from sources approved by the Contractor. Every change in source of materials shall require approval from the Contractor.

1. Approval of the source as a borrow area does not mean that all materials excavated will meet the requirements of this Specification. Processing, selective quarrying, or both, will generally be necessary to meet the gradation and quality requirements of this Section.

2. Subcontractor-Proposed Source: The basis for approval of sources proposed by the Subcontractor for Bedding and Riprap Types A and B, except riprap for spillway for wastewater retention basin, shall be as follows:

   a. A site inspection report by an engineering geologist which will include, as a minimum, an evaluation of soundness, hardness, and durability for three samples representative of the proposed source. The evaluation of durability shall be based in part on petrographic examination of rock types available from the source. Representativeness of samples shall be determined by the Contractor, based on precise location and source of sample taken in relation to the whole borrow area. The site inspection report shall include location of all samples and methods of sampling.

   b. If available, examples of successful uses of the material including riprap that has been in place on other project sites for more than 20 years, rock that has functioned satisfactorily as foundation stone or building facing for 50 years or more, and abandoned quarry faces which have maintained their integrity after not being worked for approximately 50 years or more. Durability shall be indicated by lack of significant weathering or loss of volume and strength over decades of exposure to natural weathering elements.

c. The Subcontractor shall have a qualified laboratory perform the six (6) types of tests listed in Table A on each sample (minimum of 3 samples) obtained from the proposed source. Special attention shall be given to ensure that the samples are representative of the proposed rock materials. Test samples shall be obtained from within the precise locations of rock deposits from which materials will be produced.

Results of the specified tests shall be used to obtain rock quality scores using the criteria given in Table A. The score for each test is determined by multiplying the appropriate weighting factor by the score (0 to 10) based on the specific test result. The final score for each sample is the ratio of the sum of the individual test scores (six tests) to the maximum possible score, expressed as a percentage. To be acceptable, the final score must be no less than 80 percent.

3. Fremont Junction Source: Materials from the Fremont Junction Source that meet the following requirements are approved for Riprap Type B, Riprap Type A, and bedding:

a. Only particles larger than 8-inch sieve size shall be processed. The Subcontractor shall screen, crush, or otherwise process materials to meet requirements of Article 2.1.C.

b. The Subcontractor shall determine the need for and the extent of stripping of overburden materials containing deleterious materials (approx. 5 ft.). In particular, the upper portion of the gravel, cobble, and boulder stratum containing very weathered particles shall not be included in materials to be excavated and processed for riprap and bedding materials.

c. Materials to be processed shall be obtained from the following areas:

1) Area 1: South of the road only.

2) Area 2: Existing boulder pile only: Until all 36-inch or less material is used.

3) Areas 3, 4, 5 and 6.

d. The approximate locations of the abovementioned areas are shown on "Fremont Junction Site Map" included in the Information to Bidders, Volume 4, dated August, 1988.

4. Stipulations for use and Rehabilitation of Fremont Junction Source Material Site:

a. The following stipulations apply to all areas of borrow site included in Sevier and Emery Counties.

b. Prior to removal of any mineral material from the site, the top 6-8 inches of surface soil shall be removed. This surface soil shall be so placed so that it is not disturbed, compacted, or mixed with other soils or material. When material removal operations have been completed, the surface soil should be uniformly spread back over the disturbed areas of the material site.

c. All pit slopes shall be reshaped to a 4:1 final slope. This shall be done prior to replacing surface soil.

d. All disturbed areas shall be reseeded using the following seed mixture:

Name	Pound of Pure Live Seed/Acre
Pubescent Wheatgrass	3
Indian Ricegrass	4
Fairway Crested Wheatgrass	3
Yellow Sweetclover	2
Total	12

e. Seeding shall occur in the fall, no earlier than October 1. Only good quality certified seed shall be utilized. Seeding shall be done utilizing a drill [except as provided for below]*. Drags shall be placed behind the drill to ensure proper coverage of the seed with soil. Drill seeding shall be done on the contour and not up and down slopes. In areas where the drill cannot be used,

* P.I.D. 10-S-16

[the following alternative methods may be used, subject to the approval of the Contractor:

1) Broadcasting: Seed shall be hand broadcast, or broadcast by some other suitable method. The seed shall be covered with soil by hand raking or some other suitable method. Where seed is broadcast, the rate of application shall be double the rate of application in Subsection 2.1.A.4.d.

2) Hydroseeding: Seed shall be applied by hydroseeder to provide an even distribution of seed. The rate of application shall be 15 to 18 pounds of pure live seed per acre. Mulch shall be applied over the seed at a rate of 1.5 tons per acre, using clean grass hay mulch. A binder approved by the Contractor shall be applied to the mulch. Mulch shall be crimped into the soil where practical. All hydroseeding materials and operations shall be subject to approval by the Contractor.]*

f. Compacted areas such as roads, crushing sites, etc. shall be ripped to 6 inches to loosen the compacted soil surface and provide a more desirable seed bed.

g. Motor oil, lubricants, coolants, asphalt, tar, oils, etc. shall not be disposed of within the boundaries of the material site.

h. All debris, garbage, asphalt, and other materials generated as a result of use of the material site shall be removed from the site and be properly disposed of.

i. No holes, pits, equipment or facilities which would endanger human life, livestock or wildlife shall be maintained at the site during extraction of material or upon completion of use.

j. All survey monuments in the vicinity of the material site shall be located, marked, and protected from any type of disturbance. If monuments are destroyed, obliterated, or damaged, Utah Department of Transportation (UDOT) will, at the Sub-

* P.I.D. 10-S-16

contractor's expense, secure the services of a registered land surveyor to restore the monument at the same location or reference the monument so its exact location can be determined. Surveying procedures outlined in the Manual of Surveying Instruction for the Survey of Public Lands of the United States, latest edition, will be followed.

k. Appropriate measures shall be taken to control and prevent soil erosion on disturbed areas.

l. All test pits which remain on the material site after material removal is completed, shall be filled-in, reshaped and reseeded.

m. Disturbances created by material removal operations shall not be visible from Interstate 70. A protective berm shall be left on the west portion of the material site. No disturbance shall be allowed within 75 feet of the edge of the pit. Existing trees shall not be destroyed unless an agreement between UDOT and United States Bureau of Land Management (BLM) indicates trees can be removed.

n. Any large boulders or rocks remaining on the material site after completion of removal operations shall be buried so they are not visible.

o. It is preferred that no stockpiles be left on the material site. However, if stockpiles must be left, they shall be located in one specific pile in one specific area and the stockpile shall preferably be located in the bottom of the pit so that it is not readily visible.

p. All reasonable and necessary precautions shall be taken during construction and material removal operations to protect and preserve historic or prehistoric ruins and artifacts on or adjacent to the material site. Previously discovered archeological finds will be staked out by the Contractor. Should other such sites, ruins, or artifacts be discovered during construction or material removal operations, the activities shall be immediately suspended in the area in question and the BLM District Manager notified of the suspected values.

5. Hastings Road Source: Materials from the Hastings Road source that meet the following requirements are approved for bedding:

   a. The actual location of the Hastings Road source will be subject to approval by the Contractor.

   b. Bedding materials to be placed in the tailings embankment shall have a rock quality score of 50 percent or greater according to Table A. Scoring shall be based on results of tests for specific gravity, absorption, sodium sulphate soundness, and abrasion. Scoring shall be calculated as specified in Article 2.1.A.2.c, second pagragraph.

   c. The Subcontractor shall determine the need for and extent of stripping of overburden materials containing deleterious materials. Stripping will be subject to the approval of the Contractor.

   d. Material shall contain no more than 3 percent of clay lumps and friable particles when tested in accordance with ASTM C142.

B. The materials shall be free from radioactive or other contamination.

C. Riprap Materials:

   1. All riprap and bedding materials except riprap for spillway for wastewater retention basin:

      a. Riprap Type "A" and "B" material shall be sound stone, resistant to abrasion, free from cracks, seams, weathering rinds and other defects as shown in the petrographic examination. Riprap Type "A" and "B" material having more than 10 percent sandstone, by volume will not be acceptable.

      b. Excepting bedding materials, the shape of at least 75 percent of the material, by weight, shall be such that the minimum dimension is not less than one third of the maximum dimension.

      c. For record purposes the following tests shall be performed and the results shall be provided to the Contractor in accordance with Article 1.6.B.:

Test	Designation
Riprap Type A and Bedding	
Gradation	ASTM C117 ASTM C136
Specific Gravity (Saturated Surface Dry Basis)	ASTM C127
Absorption	ASTM C127
Soundness	ASTM C88
Abrasion	ASTM C131
Riprap Type B	
Gradation	ASTM C117 ASTM C136
Schmidt Rebound Hardness	ISRM Method
Splitting Tensile Strength (Modified-Loading Rate Shall Cause Failure in 1 to 3 minutes)	ISRM Method

2. Riprap materials for wastewater retention basin spillway shall meet either the requirements of Articles 2.1.C.1 above or the following requirements:

   a. Riprap shall consist of durable field or quarry stone approved by the Contractor, and shall be sound, hard, and free from seams, cracks, or other structural defects.

   b. Riprap materials shall have a wear not greater than 40 percent when tested in accordance with ASTM C535.

3. Gradation: Maximum nominal size for Type A Riprap shall be 4-1/2 inch and maximum nominal size for Type B riprap shall be 36 inches. Riprap materials shall be reasonably well graded within the following limits:

U.S. Standard Sieve Size (Square Openings)	Percent Passing (by weight)
Riprap Type A	
4-inch	70-100
3-inch	39-88
2-inch	8-32
1-1/2-inch	0-17
1-inch	0-5
Riprap Type B	
30-inch	96-100
25-inch	62-100
22-inch	46-95
18-inch	32-50
15-inch	20-38
10-inch	0-10

D. Bedding Materials:

1. Bedding materials shall be obtained from a riprap borrow area or from the Hastings Road Source approved by the Contractor. The Subcontractor shall process the materials, as required, to meet the gradation requirement specified below.

2. Individual bedding material particles shall not exceed the specified layer thickness and materials shall be reasonably well graded within the following limits. The maximum nominal size of the material shall be 4 inch.

U.S. Standard Sieve Size (Square Openings)	Percent Passing (by weight)
3-inch	100
1-1/2-inch	95-100
1/2-inch	50-100
No. 4	18-58
No. 10	0-15
No. 20	0-5

E. Source Quality Control: The Subcontractor shall provide a qualified engineering geologist to monitor materials acquisition and production to ensure that only materials acceptable under Article 2.1.C.1.a and b. as confirmed by the Contractor are processed. During excavation or blasting of materials, the Contractor will inspect the site to ensure that stripping and material selection procedures are adequate to prevent inclusion of deleterious materials in processed materials. The Contractor reserves the right to inspect and test the materials.

PART 3 - EXECUTION

3.1 PLACEMENT AND COMPACTION

A. Where the required bedding material thickness is 6 inches or less, the bedding material shall be spread and compacted in one layer. Where the required thickness is more than 6 inches, the material shall be spread and compacted in two or more layers of approximately equal thickness and the maximum compacted thickness of any one layer shall not exceed 6 inches.

B. Each layer of bedding material placed on a 5(H):1(V) slope shall be compacted either by two passes of a 2- to 3-ton working weight vibratory smooth-drum roller or by a minimum of two passes of a Caterpillar Model D-3 or D-6 track-type tractor. Bedding material placed on the 2(H):1(V) slope shall be compacted to a firm condition using either the equipment specified for compacting bedding elsewhere on the embankment or a John Deere Model 690 track-mounted backhoe with a plate compactor, or an alternative method approved by the Contractor. The Contractor will verify that excessive compaction is not performed which results in damage to the radon barrier surface.

C. Riprap material shall be placed so that the larger pieces are uniformly distributed and the smaller pieces serve to fill the spaces between them to provide well-keyed, densely placed layers of the specified thicknesses.

D. Riprap material may be placed by end-dumping and may be spread by bulldozers or other suitable equipment.

E. Construction equipment carrying contaminated materials shall not be allowed to move over placed riprap and bedding layers except at equipment crossovers as designated

by the Contractor. Each crossover shall be cleaned of all contaminating materials as approved by the Contractor before additional materials are placed in those areas. Other construction equipment may move over placed riprap and bedding layers. The Contractor may restrict such traffic to minimize damage to completed layers. Areas of riprap and bedding layers damaged by construction equipment shall be restored to meet the requirements of the Specifications.

3.2 TOLERANCES

A. The material layers shall be placed generally to the limits and thicknesses shown on the Subcontract Drawings within the following tolerances:

1. Top of bedding material shall be within 0.1 foot of elevations shown on the Subcontract Drawings.

2. The minimum in-place thickness of riprap shall not be less than 90 percent of the thickness shown.

3. The maximum in-place thickness of riprap shall not be more than 125 percent of the thickness shown.

4. Local irregularities in the top surface of in-place riprap will be permitted provided that such irregularities do not form noticeable mounds, ridges, swales or depressions which in the opinion of the Contractor could cause concentrations of surface runoff or form ponds or gullies.

3.3 FIELD QUALITY CONTROL

A. The placement of the materials will be monitored to ensure that the following requirements are met:

1. Only materials from sources approved by the Contractor are placed.

2. The correct type of material is being placed.

3. The material being placed is clean and free of unsuitable material.

4. The material is being loaded, transported and placed in a manner which minimizes segregation and degradation.

5. The material is being placed to line and grade within the tolerances and limits designated in Article 3.2 above.

6. The material placed meets the gradation requirements specified.

B. Materials segregated or not placed according to the above requirements shall be regraded or adjusted, using appropriate equipment, to conform with the tolerances and limits given above, at no additional cost to the Contractor.

C. Materials not meeting the requirements of this Section shall be removed and replaced with specified materials at no additional cost to the Contractor. Rejected materials shall be disposed of at designated disposal sites and at no additional cost to the Contractor. Materials not meeting the grading requirements shall be reprocessed or discarded. The Contractor may require modification of the processing and grading operations to ensure that the specified grading requirements are met.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement for payment for furnishing and placing of the following materials will be by the cubic yards of material placed. The quantities will be calculated from the lines and dimensions shown on the Subcontract Drawings and from field surveys conducted before and after placement.

1. Riprap Material, Type A

2. Riprap Material, Type B

3. Bedding Material

4.2 PAYMENT

Payment for furnishing and placing the materials of Article 4.1.A above, will be by their applicable unit prices per cubic yard quoted therefor in the Bid Schedule. The prices quoted shall include full compensation for the development of the source (where applicable) including

obtaining required permits (if applicable), clearing, stripping and excavating; processing the materials; testing and evaluating the materials; transporting to placement locations; placing; compacting and consolidating complete in place including the specified rehabilitation of the source. Permits and royalty payments for use of materials from the Fremont Junction Source will be provided by the Contractor.

END OF SECTION 02278

TABLE A

ROCK QUALITY SCORING CRITERIA

	Weighting Factor			Score											
	Lime-stone	Sand-stone	Igne-ous	10	9	8	7	6	5	4	3	2	1	0	
Specific Gravity	12	5	9	2.75	2.70	2.65	2.60	2.55	2.50	2.45	2.40	2.35	2.30	<2.3	
Absorption (%)	13	5	2	0.1	0.3	0.5	0.67	0.83	1.0	1.5	2.0	2.5	3.0	>3.0	
Sodium Sulfate (%)*	4	3	11	1	3	5	6.7	8.3	10	12.5	15	20	25	>25	
Abrasion (%)**	1	8	1	1	3	5	6.7	8.3	10	12.5	15	20	25	>25	
Schmidt Hammer	11	13	3	70	65	60	54	47	40	32	24	16	8	<8	R-4
Tensile Strength (psi)	5	4	10	1400	1200	1000	833	666	500	400	300	200	100	<100	

1. Scores derived from Tables 6.2 and 6.7 of Ref. 1.
2. Any rock to be used must be qualitatively rated at least "fair" in a petrographic examination conducted by a geologist experienced in petrographic analysis.
3. Weighting Factors derived from Table 7 of Ref. 2, based on inverse of ranking of test methods for each rock type.
4. Test methods should be standardized (ASTM, e.g.) and should be those used in Ref. 2.

Ref. 1 Lindsey, C.G., Long, L.W., and Begej, C.W. (1982), Long-Term Survivability of Riprap for Armoring Uranium Mill Tailings and Covers: A Literature Review, U.S. Nuclear Regulatory Commission, NUREG/CR-2642.

Ref. 2 De Puy, G.W., "Petrographic Investigations of Rock Durability and Comparisons of Various Test Procedures," Engineering Geology, Vol. 2, No. 2, July 1965.

* 5 cycles

** 100 revolutions

SECTION 02771

MEMBRANE LINER

PART 1 - GENERAL

1.1 SCOPE

This Specification Section describes the requirements for furnishing, installing, maintaining, removal and disposal of membrane liner systems for wastewater retention basin and spillway.

1.2 SYSTEM DESCRIPTION

A. Liner system shall consist of liner, adhesives and accessories required for sterilizing ground and installing liner, vents and other appurtenances.

B. The retention basin and spillway, where lining is required, will carry water produced from stormwater runoff, decontamination and dewatering operations, including minor amounts of sediment.

C. The installed liner will be installed without a protective earthen cover and will be exposed to all natural weathering elements, such as direct sunlight, cold and hot air temperatures, snow, ice and wind.

D. The wastewater retention basin and spillway are anticipated to be in operation for 1 to 2 years.

1.3 RELATED WORK

A. Section 01300 - Submittals

B. Section 02200 - Earthwork

1.4 APPLICABLE PUBLICATIONS

A. The Publications listed below forms a part of this Specification to the extent referenced. The Publications are referred to in the text by the basic designation only:

1. National Sanitation Foundation (NSF):

SN54 (Revised Nov. 85)
Flexible Membrane Liners

2. Federal Standard (FS):

101C Test Methods for Puncture Resistance and Elongation Test (Method 2065.1)

101C Test Method for Puncture Resistance (Method 2031)

1.5 QUALITY ASSURANCE

A. Manufacturer: The manufacturer of the liner shall have manufactured in excess of 10,000,000 square feet of membrane liner. The manufacturer shall also certify in writing that the liner meets or exceeds the NSF Standard 54 physical properties as specified in this Section and shall withstand a minimum of 3 years of outdoor weathering without cover. The manufacturer shall also certify that the liner material is formulated from 100 percent virgin domestic, first quality raw materials.

B. Fabricator: The liner fabricator shall have fabricated in excess of 10,000,000 square feet of liner.

C. Installation: The Installation Supervisor shall have supervised installation of lining material in excess of 1,000,000 square feet.

D. Installation Workers Qualifications: The installation workers shall have installed a minimum of 1,000,000 square feet of membrane liners.

1.6 SUBMITTALS

A. General submittal requirements are specified in Section 01300.

B. The Subcontractor shall submit the following to the Contractor for review and approval 30 days before placement of the material:

1. Product data.

2. Samples of material and accessories.

3. Certificate signed by the manufacturer that the system proposed meets the Specification.

4. Installation details.

5. Fabricator's or manufacturer's installation instructions.

6. Test reports.

7. Qualifications of installer and supervisor in accordance with the requirements of Article 1.5.C.

8. Certification from a recognized independent testing laboratory that the liner meets the requirements of this Specification and is suitable for its intended purpose.

1.7 SITE CONDITIONS

The Green River Project Site elevations range from 4070 feet to 4144 feet above sea level. Recorded temperatures range from a high of 107°F to a low of -25°F. The average wind speed at the Site is 4.2 mph. High winds of 19 to 38 mph occur approximately two percent of the time.

1.8 WARRANTY

A. Liner materials and factory seams shall be warranteed to be free from defects in materials and workmanship for a period of 2 years from the date of acceptance. Installation and field seams shall be waranteed free of defects for a period of 2 years from the date of acceptance.

B. Upon written notification by the Contractor, the Subcontractor shall promptly and completely repair or replace defective lining materials on site which become apparent during such 2-year period. Such repair or replacement shall be done at no cost to the Contractor. The Subcontractor shall be responsible for removal of all liquids, dirt, soil, or contaminated materials required to enable him to carry out the necessary repairs.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

The liner material shall be the product of a manufacturer successfully engaged in the business of manufacturing liner materials for the last ten years.

2.2 MATERIAL

A. The thermoplastic elastomer lining material shall be manufactured from a synthetic rubber compound and shall be high density polyethylene (HDPE), chlorinated polyethylene (CPE), or polyvinyl chloride (PVC), specifically compounded for use in hydraulic facilities. In addition, the lining material shall be formulated to withstand a minimum of 3 years of outdoor exposure without cover.

B. The liner shall have a smooth uniform surface with no visible defects and shall be free of holes, blisters, gels, undispersed ingredients and any contamination or defect that may affect its serviceability. The liner shall be uniform in thickness with a maximum 10 percent deviation from the nominal thickness. The edges shall be straight and free of nicks and cuts. Inspection for pinholes shall be made prior to shipment to the field.

C. The liner material shall be specifically compounded to conform to the physical properties set forth in the National Sanitation Foundation Standard SN 54 and the standards set forth below.

Property	Test Method	Data
High Density Polyethylene (HDPE)		
Gauge (Nominal)		40 mils
Puncture Resistance	FED STD 101C Method 2065.1	175 lbs. min.
Chlorinated Polyethylene (CPE)		
Gauge (Nominal)		30 mils
Puncture Resistance	FED STD 101C Method 2065.1	175 lbs. min.
Polyvinyl Chloride (PVC)		
Gauge (Nominal)		30 mils
Puncture Resistance	FED STD 101C Method 2031	130 lbs. min.

2.3 FABRICATION

The roll goods shall be factory fabricated into optimum sized panels up to 20,000 square feet, using an approved seaming method as prescribed by the manufacturer. When the seam is tested for shear and peel, failure of the material including the seam shall not occur at the bonded surfaces.

PART 3 - EXECUTION

3.1 GENERAL

The liner systems shall be installed as shown on the Subcontract Drawings and as recommended by the manufacturer and the fabricator.

3.2 GROUND SURFACE PREPARATION

A. Surfaces to be lined shall be smooth and free of sharp rocks and vegetation. If the liner is not applied within 15 days of surface preparation, the surface shall be protected against growth of vegetation by the application of a suitable short-lived soil sterilant as approved by the Contractor. The soil sterilant used shall be compatible with the liner material to ensure against damaging the liner.

B. Certification from the Installation Supervisor shall be required stating that the surface on which the liner is to be placed is acceptable. No installation of lining shall commence until this certification is furnished to the Contractor. The receiving surface shall be kept in the accepted condition until the installation of the lining is accomplished.

3.3 FIELD SEAMS

A. PVC/CPE Liner: All field seams for PVC or CPE liner materials shall be performed using only the fabricator's approved methods, adhesives and application directions. The minimum width of overlap of field seams shall be 4 inches. The contact surfaces of the panel overlap shall be cleaned to remove all dirt, dust or other foreign materials. A nominal 6-inch overlap of liner panels shall be allowed to keep dirt out of the field seams. When bonding the seams, the temperature of the sheet and adhesive shall be not less than 55°F. Artificial heat shall be applied if ambient conditions create lower temperatures.

B. HDPE Liner:

1. Field joints shall be made with overlapping adjacent sheets and inserting a ribbon of fusion joining resin between the overlapping sheets or over the joint between them. Appropriate alternate seaming procedures as recommended by the manufacturer or fabricator such as a hot air or hot wedge method may

be proposed for the Contractor's approval. The minimum width of overlap of field seams shall be 3 inches.

a. Joints between liner sheets shall be field welded using the fabricator's fusion joining apparatus and technique. The joining procedure shall consist of softening the liner material by heated air. Directly following the application of heat, a minimum 1-1/2 inch wide hot strip of the same HDPE from which the sheet is made shall be extruded between the overlapping sheets. The overlapping sheets shall then be pressed together with a minimum pressure of 14 psi to form the fusion joint.

b. Penetrations through the liner for pipes, flashings, patches, and the like shall be field welded using a fusion joint gun. The joining procedure will consist of softening the liner material by heated air. Directly following the application of heat, a hot strip of the same high density polyethylene from which the sheet is made shall be extruded over the joint to produce the fusion joint.

c. Prior to fusion joining, all areas to become joint interfaces shall be cleansed of dust and dirt.

d. Fusion joining shall not take place unless the sheet is dry and shall not be attemped when the ambient temperature is below 45°F or above 90°F as determined by the Contractor.

3.4 INSPECTION AND TESTING

A. HDPE Liner:

1. All fusion joined seams shall be visually examined and probed for voids or imperfect bonds for their lengths.

2. All fusion joined seams shall be ultrasonically tested along their entire lengths with a testing device furnished by the Subcontractor. The device shall be capable of locating weld defects including internal cracks, unjointed interfaces, voids, cavities, gravel inclusions and other foreign particles above 1 mm (0.04 inches) in size. The Subcontractor shall furnish to the Contractor a copy of the ultrasonic test results coordinated with the seam pattern shown on the approved Shop Drawings.

3. All seams made for the HDPE liner shall be tested using vacuum testing in addition to ultrasonic testing. Vacuum testing shall consist of placing a rectangular box (approximately 30 inches long) into the liner seam. The section chamber shall be connected to the vacuum pump. A foaming agent shall be applied to the seam area under test to indicate possible leaks. The seam shall be maintained under 5 psig suction for a minimum of 10 seconds, and certification given to the Contractor that the seams will provide a film tearing bond. The test areas shall have a minimum of 3-inch overlay from the previous test section.

4. Defects found during the testing shall be repaired and retested. Such tests and adjustments shall be repeated until, in the opinion of the Contractor, the repairs are satisfactory and complete. All repairs shall be made by the Subcontractor at no additional expense to the Contractor.

5. The Subcontractor shall furnish to the Contractor, on a daily basis, if requested, seam samples for testing cut from that days installation. The samples may be tested to determine strength and durability. Any seams not meeting the requirements specified herein shall be repaired by the Subcontractor at no additional expense to the Contractor.

6. The Subcontractor shall repair all areas damaged by sampling immediately after the sample is taken. The repairs shall be made at no additional expense to the Contractor.

B. PVC/CPE Liner:

1. All field seams shall be air lance tested along their entire lengths using one eighth inch orifice at 50 psi.

2. Defects found during the testing shall be repaired and retested,. Such tests and adjustments shall be repeated until, in the opinion of the Contractor, the repairs are complete. All repairs shall be made by the Subcontractor at no additional expense to the Contractor.

3. The Subcontractor shall furnish to the Contractor, on a daily basis, if requested, seam samples for testing cut from that days installation. The samples may be tested to determine strength and durability. Any

seams not meeting the requirements specified herein shall be repaired by the Subcontractor at no additional expense to the Contractor.

4. The Subcontractor shall repair all areas damaged by sampling immediately after the sample is taken. The repairs shall be made at no additional expense to the Contractor.

3.5 GAS VENTS AND LINER HOLD-DOWNS

A. Gas vents as recommended by the manufacturer and the fabricator and approved by the Contractor shall be installed in the liner around the perimeter of the basin. Vents shall have a minimum diameter of 4 inches, located 6 inches below the top of the dike and at a maximum spacing of 50 feet on centers.

B. Liner hold-downs, as recommended by the manufacturer and the fabricator and approved by the Contractor, shall be installed over the liner on the embankment and excavation slopes. The hold-downs shall be placed on 30-foot centers or over every field seam, whichever is closer.

3.6 ANCHORING

During installation, necessary precautions shall be taken to insure the liner will not be damaged or moved by wind, rain or dust. The liner shall be installed in such a manner that the liner will be protected from damage or movement by wind, water, and dust. Venting to prevent damage to the liner shall be provided by the Subcontractor per the manufacturer's recommendations.

3.7 TEMPORARY EROSION PROTECTION-CONSTRUCTION PHASE

A. Synthetic membrane shall be placed on the prepared wastewater retention basin subgrade including the emergency spillway, as shown on the Subcontract Drawings.

B. The Subcontractor shall maintain and if required, repair synthetic membrane to provide protection from runoff erosion and contamination.

3.8 REMOVAL AND DISPOSAL OF MEMBRANE LINER

After the completion of the construction phase or when retention basin is no longer required, the synthetic membrane shall be removed, decontaminated and disposed of as required by the Contractor. If the membrane cannot be decontaminated by practical means, it shall be disposed of by cutting into strips, shredding and placing in the tailings embankment in a manner that would not induce settlement and inhibit water migration. Membrane liner shall be disposed of in the embankment by distributing among fill materials to avoid concentration in one area.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Measurement for payment for furnishing and installing of membrane liner for the wastewater retention basin and spillway will be by the square yards of material installed. The quantities for payment will be calculated from the lines and dimensions shown on the Subcontract Drawings. The surfaces shall be measured parallel to the liner material installed.

4.2 PAYMENT

Payment for furnishing and installing of membrane liner for the wastewater retention basin and spillway will be by the unit price per square yard quoted therefor in the Bid Schedule. The price quoted shall include full compensation for furnishing all labor, materials, tools, equipment, Installation Supervisor, incidentals and for performing all work as specified including, but not limited to, preparation of subgrade, installation of vents and temporary hold-downs, and anchoring, maintaining, removal and disposal of the liner.

END OF SECTION 02771

SECTION 02832

CHAIN LINK FENCE AND GATES

PART 1 - GENERAL

1.1 SCOPE

A. This Specification Section describes the requirements for furnishing, installing, maintaining and removing chain link fencing including gates, posts, fittings, hardware, and concrete footings.

1.2 RELATED WORK

A. Section 01300 - Submittals

B. Section 02051 - Demolition and Decontamination

C. Section 02833 - Woven Wire Fences

1.3 DEFINITIONS

Definitions of fencing components shall be in accordance with ASTM F552.

1.4 APPLICABLE PUBLICATIONS

A. The Publications listed below form a part of this Specification to the extent referenced. The Publications are referred to in the text by the basic designation only:

1. Chain Link Fence Manufacturers Institute:

   a. Standards for Galvanized Steel Chain Link Fence Fabric

   b. Industrial Steel Specifications for Fence Posts, Gates, and Accessories

   c. Standards for Chain Link Fence Installation

2. American Society for Testing and Materials (ASTM):

   A120-84 Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses

A123-84 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A153-82 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A239-73 Test Method for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles by the Preece Test (Copper Sulfate Dip) (R1983)

A370-87 Standard Test Methods and Definitions for Mechanical Testing of Steel Products

A392-84 Specification for Zinc-Coated Steel Chain-Link Fence Fabric

C33-86 Specification for Concrete Aggregates

C94-86 Standard Specification for Ready-Mixed Concrete (Rev. B)

C150-86 Standard Specification for Portland Cement

F552-83 Standard Definitions of Terms Relating to Chain Link Fencing

1.5 SHOP DRAWINGS

Pursuant to the provisions of Section 01300, three black-line or blue line prints and a reproducible transparency of fully detailed shop drawings of fence, gate and hardware, including footings and installation details, shall be submitted to the Contractor for review.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reusable materials salvaged from demolition work specified in Section 02051 shall be utilized, to the extent practical, in the construction of the fence and gates specified in this Section.

B. General: Fencing shall include fabric, framework, concrete footings, gates, closure at grade depressions, hardware, and all appurtenances and accessories as required for a complete installation. All members, except fittings, shall be steel, hot-dip galvanized after fabrication. Fittings shall be malleable iron, wrought iron, or pressed steel, hot-dip galvanized after fabrication. Fence

fabric and tension wire shall be zinc-coated as specified. Heights of fences shall be as shown on the Subcontract Drawings. Tolerance for fabric height is ±1 inch.

C. Fence Fabric: No. 9 gage, chain-link steel wire helically woven into 2-inch diamond mesh, hot-dip galvanized, conforming to ASTM A392. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage. Loops of knuckled selvage shall be closed or nearly closed with a space not exceeding the diameter of the wire. The twisted wire shall be twisted in a closed helix of 1-1/2 machine turns equivalent to three full twists, and cut at an angle to provide sharp barbs. The wire ends beyond the twist shall be at least 1/4-inch long. Steel wire for the fabric, when drawn to the wire gage specified, shall have a minimum tensile strength of 75,000 pounds per square inch when tested in accordance with ASTM A370. Coating of fabric shall be Class II, 2.0 ounces of hot-dip zinc galvanizing per square foot of uncoated wire surface. The Standard length of fabric roll shall be 50 linear feet ±1 percent. Each roll shall be a one-piece length. Tolerance for fabric heights shall be plus or minus 1 inch.

D. Posts:

1. Post shall be Schedule 40 galvanized pipe. Use shall be in accordance with the following table except as noted on the Subcontract Drawings. All pipe shall conform to ASTM A120 for weight and galvanized coating. Line post shall be spaced at no more than 10-foot centers.

Post Type and Shape	Nominal Pipe Size, Inches
2. End, Corner and Pull Posts:	
Round	2.5
3. Intermediate or Line Posts:	
Round	2.0
4. Gate Posts:	
Single Leaf Gate Opening Width:	
6 Feet and Less:	
Round	2.5
6 to 13 Feet:	
Round	3.5
13 to 18 Feet:	
Round	6.0
Over 18 Feet:	
Round	8.0

E. Post-Bracing Assembly: Horizontal braces shall be 1-1/4 inch Schedule 40 steel pipe, conforming to ASTM A120. Diagonal truss type braces shall be 3/8-inch diameter galvanized steel rods with turnbuckle adjustment. Couplings, fittings, and attachment accessories shall be included as required. Horizontal braces (intermediate rails) shall be provided at all corners, terminals, pulls, and at gate posts.

F. Wire Ties and Clips: Wire ties or clips shall be provided for attaching fabric to line posts, top rail, or tension wire. Wire ties and clips shall be at intervals not greater than 15 inches when attaching fabric to line posts, and the space interval shall not exceed 24 inches when attaching fabric to top rails or tension wire. Wire ties and clips shall be not less than the fabric wire gage size and of the same material and coatings. The minimum weight for zinc coated wire ties and clips is 0.8 ounces of zinc per foot of coated surface area.

G. Tension Wire, Zinc-Coated Steel: Tension wire for top and bottom edge support of fence fabric shall be No. 7 gage marcelled or crimped coil spring hard tempered carbon steel wire with minimum tensile strength of 70,000 psi, and zinc coating of not less than 1.20 ounce per square foot of coated area.

H. Post Caps: Post caps shall be standard malleable iron, wrought iron, or pressed steel, galvanized, designed as a weathertight closure cap for tubular posts.

I. Stretcher Bars: Stretcher bars shall be one-piece lengths equal to full height of fabric with a minimum crossection of 3/16 inch by 3/4 inch. Provide one stretcher bar for each gate and end post, and 2 for each corner and pull post.

J. Stetcher Bar Bands: Bands shall be heavy pressed steel, or malleable iron, spaced not over 15 inches on center to secure stretcher bars to end, corner, pull, and gate posts.

K. Gates:

1. Gates shall be of chain link fabric, single- or double-leaf swing type as shown on the Subcontract Drawings and furnished complete with all hardware and accessories as required. For payment purposes, the size of the gate shall be measured in terms of the length of each gate leaf.

2. Gate Frames: Frames shall be round pipe to match posts in accordance with the following table:

Gate Size	Nominal Pipe Size
Leaf Width 8 Feet or Less: Round	1-1/4 Inch Schedule 40
Leaf Width Over 8 Feet: Round	1-1/2 Inch Schedule 40

3. Fabrication of Gates: Assemble gate frames by welding or with fittings and rivets for rigid connections. When fittings are used as the construction method for gate frames, the frames shall be fitted with 5/16-inch minimum diameter truss rods. The frames shall be zinc-coated after fabrication. When frames are not zinc-coated after fabrication the welds shall be coated with a zinc rich paint. Use same fabric as for fence. Install fabric with stretcher bars at vertical edges, and tie wires at top and bottom edges. Attach stretcher bars to gate frame at not more than 15 inches on center. Attach hardware with rivets or by other means which will provide security against removal or breakage. Provide additional horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware, and accessories. Provide diagonal crossbracing consisting of 3/4-inch diameter adjustable length truss rods on gates where necessary to provide frame rigidity without sag or twist. All gates shall be constructed so that they may be operated by one person.

4. Gate Hardware: Provide the following hardware and accessories for each gate:

   a. Gate Hinges: Gate hinges shall be of adequate strength for the gate, and shall have large bearing surfaces for clamping or bolting in position. Hinge action shall be such that gates may be easily opened and closed by one person. Hinges shall provide for full 180° swing of gate leaf.

   b. Latch: Forked type or plunger-bar type to permit operation from either side of gate. Provide padlock eye as integral part of latch. Locking

devices shall be constructed so that the center drop rod or plunger bar cannot be raised when locked.

c. Keeper: Provide keeper, which automatically engages the gate leaf and holds it in the open position until it is manually released, for each gate leaf.

d. Double Gates: Provide gate stops for double gates, consisting of mushroom type or flush plate with anchors. Set in concrete to engage the center drop rod or plunger bar. Provide locking device and padlock eyes as an integral part of the latch, requiring one padlock for locking both gate leaves.

L. Accessories: Furnish all miscellaneous materials and accessories, ties, clips, anchors and fastenings as required for a complete installation. Unless otherwise specified, all ferrous items shall be hot dip zinc-coated with an average weight of not less than 1.2 ounces of zinc per square foot of coated surface area.

M. Galvanizing:

1. Fence and gate framework, hardware and appurtenances shall be hot dip galvanized per ASTM A120, A123, or A153 as applicable.

2. Galvanizing of wire fabric shall be after weaving in accordance with ASTM A392, immersions when tested in accordance with ASTM A239.

2.2 FABRICATION

Chain link fencing shall be fabricated and pre-assembled by the manufacturer in the factory or shop as far as practicable.

2.3 CONCRETE

Concrete: ASTM C94; 2000 psi at 28 days; normal Portland cement conforming to ASTM C150; 3-inch to 5-inch slump; maximum 1-inch size aggregates conforming to ASTM C33; and clean water.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of fencing shall be in accordance with the Subcontract Drawings, shop drawings, and the manufacturer's detailed installation drawings, instructions, and recommendations. All posts shall be plumb and rigid after installation. Chain-link fabric shall be smooth and uniformly stretched tight and straight. Tension wires shall be pulled taut.

B. Chain-link fabric shall be extended to provide approximately 4 inches clearance to the surfaces of grade depressions, drainage swales or ditches. The extended fabric shall be the same piece of the fencing material or a piece of fabric securely attached or welded to adjacent fabric of the fencing. A stretcher bar shall be provided through the vertical height of the fence at the lowest point in the depression to stiffen the extended fabric. The stretcher bars shall be threaded through and attached to the fabric by wire ties. At drainage ditches or swales, no line posts shall be installed within 5 feet of the centerline of the drainage ditches or swales. Line posts shall be spaced evenly from the centerline of the ditch or swale.

C. Gates shall be installed plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricate. Gates shall operate smoothly and easily to minimize noise.

D. All posts shall be embedded into concrete except intermediate or line posts, which may be mechanically driven 3'6" into the ground, as shown on the Subcontract Drawings.

E. Dimensions of drill holes for post footings and concrete embedment of the posts shall be as shown on the Subcontract Drawings.

F. Line posts shall be spaced at no more than 10-foot centers.

G. Corner posts shall be installed at all changes in direction where the deflection angle exceeds 30 degrees.

3.2 CONCRETE PLACEMENT

Concrete shall be placed around posts in a continuous pour. Each post shall be checked for vertical and top alignment, and shall be held in position during placement and finishing operations.

3.3 MAINTENANCE AND REMOVAL

The fence and gates constructed under the Subcontract shall be maintained during the term of the Subcontract and later removed and disposed of as Subcontractor's property when no longer required.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement for payment for chain link fence will be by the linear feet of fence installed and removed as shown on the Subcontract Documents and as accepted by the Contractor. Measurements will be made along the top of the fence to the nearest foot.

B. Measurement for payment for furnishing and installing following chain link gates will be by the number of each size and type of gate installed. For payment purposes each gate leaf will be considered as a gate unit:

1. Size: 3-foot long, One Number.

2. Size: 12-foot long, Two Numbers.

4.2 PAYMENT

A. Payment for chain link fence will be by the unit price per linear foot quoted therefor in the Bid Schedule. Payment shall include full compensation for furnishing all labor, tools, equipment, and incidentals, and for performing all work involved in constructing, maintaining, and removing fences, including any clearing, stripping, tree removal, excavation, concrete or cement, complete in place, as shown on the Drawings and as accepted by the Contractor.

B. Payment for furnishing and installing chain link gates will be by the unit price per each type and size quoted therefor in the Bid Schedule.

C. Unit prices quoted shall include full compensation for furnishing labor, materials, tools, equipment and accessories, and for performing all work including, but not limited to, clearing, stripping, tree removal, excavation, maintenance, removal and disposal of fence and gates.

END OF SECTION 02832

SECTION 02833

WOVEN WIRE FENCE

PART 1 - GENERAL

1.1 SCOPE

This Specification Section describes the requirements for furnishing, installing, maintaining and removing woven wire fence as shown on the Subcontract Drawings and as specified in this Section.

1.2 APPLICABLE PUBLICATIONS

A. The Publications listed below form a part of this Specification to the extent referenced. The Publications are referred to in the text by the basic designation only:

1. American Society for Testing and Materials (ASTM):

A116-81	Specification for Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
A121-86	Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
C33-86	Specification for Concrete Aggregates
C94-86	Standard Specification for Ready-Mixed Concrete (Rev. B)
C150-86	Standard Specification for Portland Cement

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fencing shall include woven wire, posts, barbed wire, and all appurtenances and accessories required for complete installation.

B. Barbed wire shall conform to the requirements of ASTM A121, and shall consist of three lines of double stranded 12-1/2-gage galvanized wire with either 2-point or 4-point barbs spaced at 5-inch intervals. Galvanizing shall be Class 3.

C. Rectangular woven wire shall be 12-1/2-gage galvanized steel wire conforming to the requirements of ASTM A116 Class 3 coating. The height shall be 32 inches consisting of eight horizontal wires with vertical stays spaced 6 inches apart.

D. Line post shall be tee, channel or U-bar shape, 1.33 lbs. per foot.

E. Braces shall be 1-1/4-inch Schedule 40 steel pipe, or steel angle section, 2 x 2 x 3/16 inches.

F. End, corner and pull posts shall be 2-inch Schedule 40 steel pipe, or steel angle section 2-1/2 x 2-1/2 x 1/4 inches.

G. Hardware for connecting members shall conform to commercial standards.

2.2 CONCRETE

Concrete: ASTM C94; 2000 psi at 28 days; normal Portland cement conforming to ASTM C150; 3-inch to 5-inch slump; maximum 1-inch size aggregates conforming to ASTM C33; and clean water.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Wire fence shall be constructed in accordance with the details shown on the Subcontract Drawings unless otherwise directed by the Contractor.

B. Line posts shall be set plumb and to the depth and spacing shown on the Subcontract Drawings.

C. Fence wire shall be stretched by mechanical stretcher or other device designed for such use. The length between pull posts shall not exceed 660 feet for woven wire.

3.2 CONCRETE PLACEMENT

Concrete shall be placed around posts in a continuous pour. Each post shall be checked for vertical and top alignment, and shall be held in position during placement and finishing operations.

3.3 MAINTENANCE AND REMOVAL

The fence constructed under the Subcontract shall be maintained during the term of the Subcontract and later removed and disposed of as Subcontractor's property when no longer required.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Measurement for payment for woven wire fence will be by the linear feet of fence installed as shown on the Subcontract Drawings and as accepted by the Contractor. Measurements will be made along the top of the fence to the nearest foot.

4.2 PAYMENT

Payment for woven wire fence will be by the unit price per linear foot quoted therefor in the Bid Schedule. Payment shall include full compensation for furnishing all labor, tools, materials, equipment, and incidentals, and for performing all work involved in constructing, maintaining and removing fences, including any clearing, stripping, tree removal, excavation, concrete work, complete in place, as shown on the Subcontract Drawings.

END OF SECTION 02833

SECTION 02935

SEEDING

PART 1 - GENERAL

1.1 SCOPE

This Specification Section covers seeding to establish a permanent vegetation cover for the final graded areas at the processing site.

1.2 MATERIAL STORAGE

A. Seeds shall be stored in sealed waterproof containers in a cool, dry location and shall be kept out of direct sunlight until ready for use.

B. Fertilizer shall be delivered and stored in waterproof containers which will show the chemical analysis and name of manufacturer.

C. Soil preparation materials such as manure or mountain peat shall be delivered and stockpiled.

PART 2 - MATERIALS

2.1 SEED MIX

A. The following seed mixture shall be used for seeding of final grades:

Seed Species	Seeding Rate (Pounds of Pure Live Seed Per Acre) Drill
Shadscale	1.0
Rincon Fourwing Saltbush	1.0
Castle Valley Clover Saltbush	1.0
Alkali Sacaton	0.25
Sand Dropseed	0.10
Paloma Indian Ricegrass	3.00
Total	6.35

B. The seeding rates shown are for drill applied [or in areas where hydroseeding is permitted]*. These rates shall be increased by 100 percent if broadcasting method of application is used. [Text Deleted]*

2.2 ACCEPTANCE OF SEED

Final acceptance of seed will be made by the Contractor based on the following: Seed shall be furnished separately or in mixture in standard sealed containers with (1) seed name; (2) lot number; (3) net weight; (4) percentages of purity and of germination; and (5) percentage of maximum weed seed content clearly marked for each kind of seed. The Subcontractor shall furnish the Contractor duplicate copies of a statement by the vendor, certifying that each lot of seed has been tested by a recognized laboratory for seed testing within 30 days of date of delivery. This statement shall include: (1) name and address of laboratory, (2) date of test, (3) lot number for each kind of seed, and (4) results of tests as to name, percentages of purity and of germination, and percentage of weed content, for each kind of seed furnished, and, in case of a mixture, the proportions of each kind of seed.

2.3 FERTILIZER

Fertilizer shall be a standard commercial grade and provide the minimum percentage of available nutrients specified. Fertilizer shall be furnished in new, clean, and sealed containers with the name, weight, and guaranteed analysis of contents clearly marked.

2.4 MULCH

Mulch shall be native or locally grown hay consisting of grass or grass and alfalfa. Mulch shall be in an air-dry condition and suitable for placing with mulch blower equipment. Final acceptance of mulch will be by the Contractor.

2.5 WATER

Water used in the planting or care of vegetation shall be free of concentrations of oils, acids, alkalies, salts, or any substance that are injurious to plant life.

* P.I.D. 10-S-16

PART 3 - EXECUTION

3.1 PREPARATION

A. Timing: All final grades not covered by gravel or riprap shall be seeded using the seed mixes specified in Article 2.1.A above. Seeding materials shall not be applied during windy weather, when the ground is excessively wet or frozen, or when snow is present.

B. Grading and Seedbed Preparation: Before applying seed for permanent cover of a given area, stockpiled topsoil and select fill shall be put in place evenly and the area shall be graded as shown on the Subcontract Drawings, with surfaces sloping gradually towards drainage courses, with no enclosed low spots where water can accumulate. Areas to be seeded that have been damaged by erosion, compaction or other causes shall be restored prior to seeding. [Except for rocky areas outside the final site boundary which cannot be cultivated,]* areas [to be seeded]* shall be cultivated by contour cultivating 4 to 6 inches deep to provide a reasonably firm but friable seedbed. [In areas which can be cultivated a]* minimum of 6 inches of surface soil shall be in a loose condition at the time of fertilizer and seed application. [Determination and preparation of rocky areas outside the final site boundary which cannot be cultivated shall be subject to approval by the Contractor.]*

C. Enrichment: Drainage ditches and final grades shall be enriched by applying fertilizer to the surface of prepared soil prior to the application of the seed and mulch. Fertilizer consisting of 77% nitrogen (N_2) and 23% phosphate (P_2O_5) shall be applied at the rate of 260 pounds per acre, unless Subcontractor can demonstrate to the Contractor that a different fertilizer mix or a lesser rate of application is justified on the basis of laboratory testing of the soil to be seeded.

3.2 APPLICATION

A. Seeding shall be completed during the period of September 1 [to]* November [30]*. Seed shall be applied by either a rangeland drill[,]* broadcasting[, or, where permitted, by hydroseeding,]* at the rates specified. The rangeland drill shall have [a]* spacing of 12 inches and seed depth of 1/2 to 1 inch. The soil shall be compacted following

* P.I.D. 10-S-16

seeding[, except where hydroseeding is used. Where permitted, seed shall be applied by hydroseeder to provide an even distribution of seed.]*

B. Mulch shall be applied to seeded areas as soon as practical at a rate of 1.5 tons per acre. The purpose of the mulch is to promote growth and provide temporary stabilization. Mulch shall be secured into the soil with a crimping disk implement or by other suitable equipment as approved by the Contractor[, except where hydroseeding is permitted. Mulch placed over seed spread by hydroseeding shall be secured by crimping or other means, subject to approval by the Contractor].* Mulching shall not be done in the presence of [free-standing]* water.

3.3 CARE DURING CONSTRUCTION

The Subcontractor shall be responsible for protecting and caring for areas seeded before final acceptance of the work. The Subcontractor shall repair any damage to seeded areas caused by construction operations without additional compensation.

3.4 PLANT ESTABLISHMENT

Since seed applied in the late fall is intended to germinate the following spring, the Subcontractor shall be responsible for seeded areas 180 days following seeding. If satisfactory growth is not established by the end of this period, reseeding by the Subcontractor will be required at no cost to the Contractor.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement for payment for seeding will be by the acres of surfaces actually seeded and approved. Quantities shall be computed from measurements and surveys of the seeded planes.

B. Separate measurement for payment will not be made for any incidental work and services, including, but not limited to, loosening the surface, applying lime and fertilizer, mulching, and watering related to seeding of cuts and fill areas.

* P.I.D. 10-S-16

4.2 PAYMENT

Payment for seeding will be by the unit price per acre quoted therefor in the Bid Schedule. The price quoted shall include full compensation for furnishing all materials, tools, equipment, incidentals, labor, and for performing all work specified herein for complete work.

END OF SECTION 02935

APPENDIX D

AS-BUILT DRAWINGS

UNITED STATES
DEPARTMENT OF ENERGY

UMTRAP
URANIUM MILL TAILINGS REMEDIAL ACTION PROJECT

AS-BUILT DRAWINGS

GREEN RIVER, UTAH

REGISTERED PROFESSIONAL ENGINEER
No. 7246
PATRICK M. GRIFFIN
STATE OF UTAH

	3								
	2								
	1								
	Δ	5-15-90	AS-BUILT	MSP	PBS	DLD	DPC	DLD	
	0	12-8-88	ISSUED FOR CONSTRUCTION	—	—	—	—	—	—
ISSUED FOR QA SIG.	NO.	DATE	REVISIONS	BY	CK	E&D MGR.	CHIEF ENG.	QA MGR.	DOE APP.

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

DESIGNED	DRAWN RBC
CHECKED DBA	
INSPECTED E.D. Bruce	
RECOMENDED	
APPROVED	DATE 1-26-88
D.L. Jones 20 JAN 88 A.D. Cavalcade 08 JAN 88	
DOE PROJECT ENGINEER	DATE 2/11/88

GREEN RIVER SITE
GREEN RIVER, UTAH

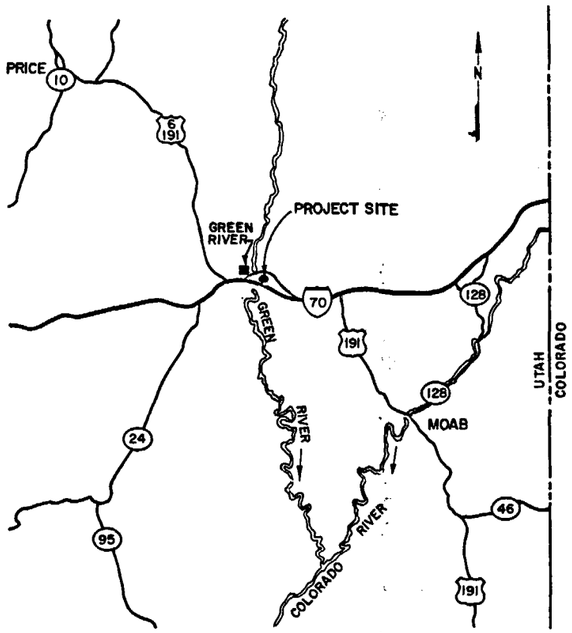
TITLE SHEET

MORRISON-KNUDSEN ENGINEERS, INC.
A DIVISION OF MORRISON-KNUDSEN COMPANY
UMTRA PROJECT
180 HOWARD ST. SAN FRANCISCO, CA 94105

PROJECT NO. DE-AC04-83AL18796

DRAWING NO. GRN-PS-10-0501

REV. —



LOCATION MAP

10 0 10 20 30

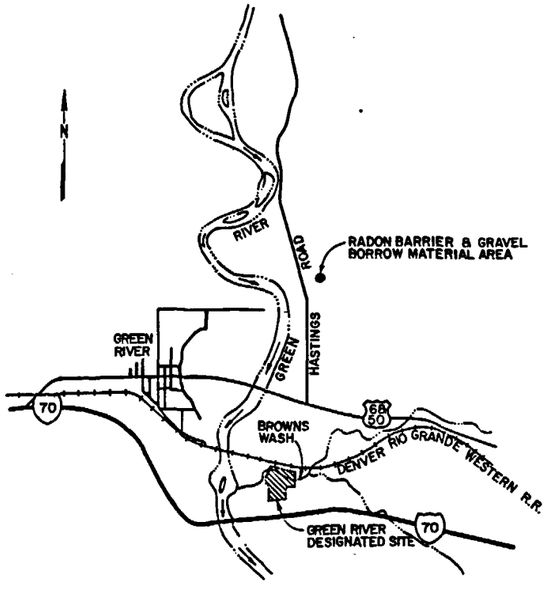
SCALE MILES

LEGEND:

- STATE BOUNDARY
- 191 U.S. HIGHWAY
- 70 INTERSTATE
- RAILROAD

LIST OF DRAWINGS

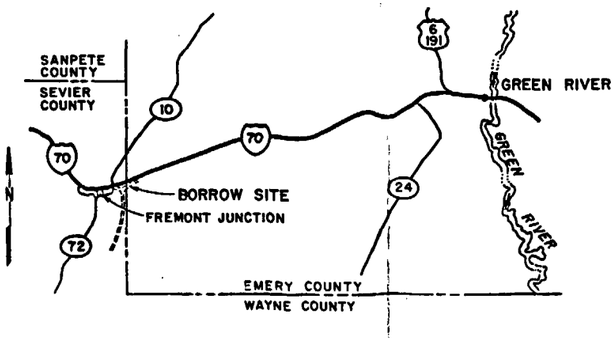
	DRAWING NO.	DRAWING TITLE
	GRN-PS-10-0501	TITLE SHEET
	GRN-PS-10-0502	LOCATION MAP, VICINITY MAP AND LIST OF DRAWINGS
	GRN-PS-10-0503	DEMOLITION, DECONTAMINATION AND TEMPORARY FENCING PLAN
	GRN-PS-10-0504	FINAL SITE PLAN
*	GRN-PS-10-0505	CONSTRUCTION FACILITIES AND SITE DRAINAGE
*	GRN-PS-10-0506	EXISTING UTILITIES LOCATION PLAN
	GRN-PS-10-0507	HORIZONTAL AND VERTICAL CONTROL
*	GRN-PS-10-0508	WASTEWATER RETENTION BASIN PLAN AND DETAILS
*	GRN-PS-10-0509	ACCESS CONTROL AND CONTRACTOR'S OFFICE AREAS PLAN AND DETAILS
*	GRN-PS-10-0510	MISCELLANEOUS SECTIONS AND DETAILS
*	GRN-PS-10-0511	CONTAMINATED MATERIAL EXCAVATION PLAN (SHEET 1 OF 2)
*	GRN-PS-10-0512	CONTAMINATED MATERIAL EXCAVATION PLAN (SHEET 2 OF 2)
	GRN-PS-10-0513	CONTAMINATED MATERIAL EXCAVATION SECTIONS & MISCELLANEOUS DETAILS
	GRN-PS-10-0514	TAILINGS EMBANKMENT FOUNDATION EXCAVATION PLAN
	GRN-PS-10-0515	TAILINGS EMBANKMENT FOUNDATION SECTIONS
	GRN-PS-10-0516	TAILINGS EMBANKMENT AND FINAL SITE GRADING PLAN
	GRN-PS-10-0517	TAILINGS EMBANKMENT AND FINAL SITE GRADING SECTIONS AND DETAILS
	GRN-PS-10-0518	MONITOR WELL ABANDONMENT AND BORING LOCATION PLAN
	GRN-PS-10-0519	AS-BUILT TOPOGRAPHIC MAP
SURVEILLANCE AND MAINTENANCE PLAN	GRN-PS-10-0601	LOCATIONS OF MONUMENTS, MARKERS AND SIGNS
SURVEILLANCE AND MAINTENANCE PLAN	GRN-PS-10-0602	AERIAL PHOTOGRAPHY AND MAPPING PROJECT AREA



VICINITY MAP

2000 0 2000 4000 6000 8000

SCALE FEET



RIPRAP BORROW SITE MAP

10 0 10 20

SCALE MILES

NOTES: (AS-BUILT)

*1. AS-BUILT CONDITIONS DO NOT APPLY TO THE FOLLOWING DRAWINGS: GRN-PS-10-0505, GRN-PS-10-0506, GRN-PS-10-0508, GRN-PS-10-0509, GRN-PS-10-0510, GRN-PS-10-0511 AND GRN-PS-10-0512.

2. FOR AS-BUILT SURFACE CONTOURS REFER TO AS-BUILT TOPOGRAPHIC MAP, DRAWING NO. GRN-PS-10-0519.

3. LOCATIONS OF SITE MARKERS, MONUMENTS AND SIGNS ARE SHOWN ON DRAWING NO. GRN-PS-10-0601.

REGISTERED PROFESSIONAL ENGINEER No. 7305 PATRICK B. GRIFFIN STATE OF UTAH

NO.	DATE	REVISIONS	BY	CK	E&D MGR.	CHIEF ENG.	QA MGR.	DOE APP.
△	5-15-90	AS-BUILT	MSF	PBS	DMD	[illegible]	[illegible]	
△	9-2-88	ADDED RIPRAP BORROW SITE MAP	KLR	MM	ESF	JHD		
△	1-28-88	ISSUED FOR CONSTRUCTION	—	—	—	—	—	—

QA MK-F

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

GREEN RIVER SITE
GREEN RIVER, UTAH

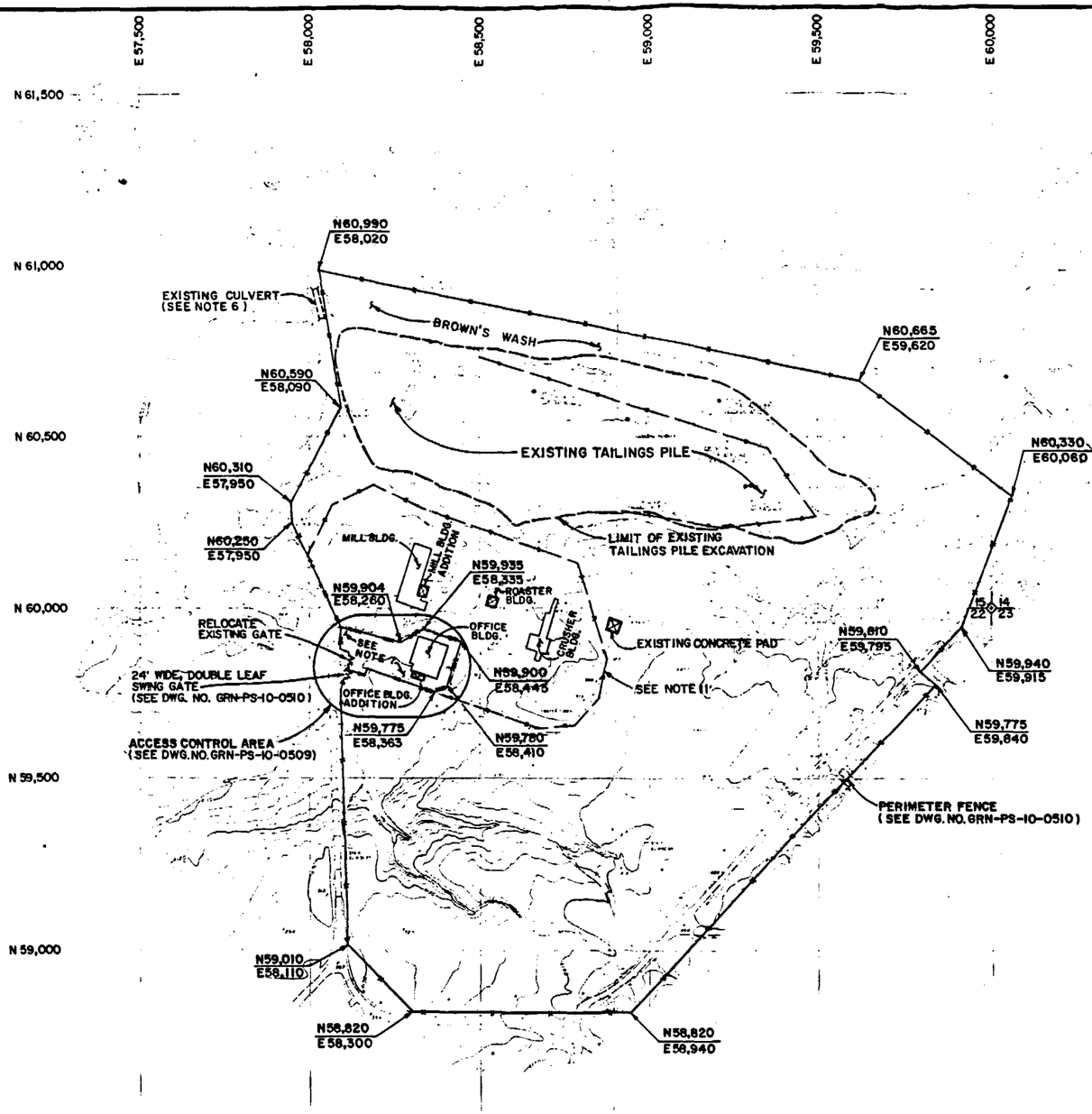
LOCATION MAP, VICINITY MAP AND LIST OF DRAWINGS

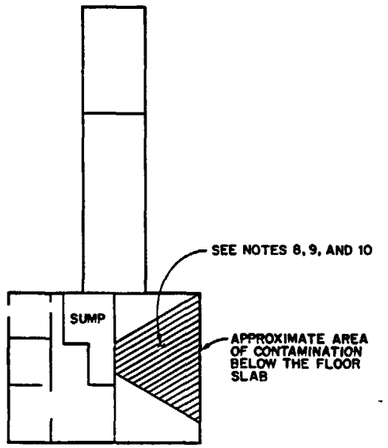
DESIGNED	DRAWN E.C.G.		
CHECKED			
INSPECTED			
RECOMMENDED			
APPROVED	DATE 1-28-88	DOE PROJECT ENGINEER	DATE 2/1/88

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY
UMTRA PROJECT
180 HOWARD ST. SAN FRANCISCO, CA 94105

PROJECT NO. DE-AC04-83AL18796

DRAWING NO. GRN-PS-10-0502 REV -





CRUSHER BUILDING
NOT TO SCALE

200 0 200 400
SCALE FEET

NOTES:

1. SUBCONTRACTOR SHALL REMOVE EXISTING FENCES AS SHOWN AT THE BEGINNING OF CONSTRUCTION.
2. EXISTING CHAIN LINK FENCE MAY BE REUSED AS PERIMETER FENCE.
3. PERIMETER FENCE SHALL BE REMOVED ONLY AFTER COMPLETION OF ALL SUBCONTRACT WORK.
4. EXISTING BUILDINGS AND OTHER MISCELLANEOUS STRUCTURES SHALL BE DEMOLISHED BY THE SUBCONTRACTOR AS SHOWN. BUILDINGS AND OTHER STRUCTURES TO BE SAVED SHALL BE DECONTAMINATED AS SPECIFIED.
5. SUBCONTRACTOR SHALL PROTECT EXISTING STRUCTURES TO BE SAVED DURING DEMOLITION.
6. SUBCONTRACTOR SHALL CLEAR EXISTING CULVERTS AND AREA OF BROWN'S WASH 300 FEET UPSTREAM AND 100 FEET DOWNSTREAM OF VEGETATION AND DEBRIS.
7. AREA ENCLOSED BY CHAIN LINK FENCE SHOWN SHALL BE DECONTAMINATED, INCLUDING EXCAVATION OF CONTAMINATED MATERIALS, PRIOR TO USE OF OFFICE BUILDING FOR CONSTRUCTION OFFICE FACILITIES.
8. APPROXIMATE AREA OF CONTAMINATED MATERIAL BELOW FLOOR SLAB IN THE CRUSHER BUILDING IS AS SHOWN. ACTUAL AREA OF CONTAMINATION WILL BE DETERMINED IN THE FIELD.
9. ESTIMATED DEPTH OF CONTAMINATED MATERIAL EXCAVATION IS 18" BELOW FLOOR SLAB. THE FLOOR SLAB IS ESTIMATED TO BE 3 TO 4 FEET THICK
10. FOLLOWING REMOVAL OF CONTAMINATED MATERIAL, ALL DISTURBED FLOOR AREAS SHALL BE RESTORED TO ORIGINAL CONDITIONS
11. SUBCONTRACTOR SHALL COMPLETE DEMOLITION AND DECONTAMINATION OF ALL STRUCTURES AND CLEAN UP OF ALL CONTAMINATED MATERIALS WITHIN THE BOUNDARY OF THE EXISTING FENCE WITHIN 120 DAYS OF RECEIPT OF NOTICE-TO-PROCEED.
12. POINT SOURCE OF CONTAMINATION WITHIN THE OFFICE BUILDING CONCRETE FLOOR SLAB SHALL BE DECONTAMINATED.

REFERENCE DRAWINGS:

GRN-PS-10-0509 ACCESS CONTROL AND CONTRACTOR'S OFFICE AREAS PLANS AND DETAILS
GRN-PS-10-0510 MISCELLANEOUS SECTIONS AND DETAILS

LEGEND:

- 4140 — EXISTING SITE FEATURES & CONTOURS (JULY 1982 SURVEY)
- N61,500 — CONSTRUCTION GRID COORDINATE
- EXISTING FENCE TO BE SAVED
- CHAIN LINK FENCE TO BE INSTALLED
- WOVEN WIRE PERIMETER FENCE TO BE INSTALLED
- EXISTING FENCE TO BE DEMOLISHED
- EXISTING STRUCTURES & BUILDINGS TO BE DEMOLISHED
- EXISTING STRUCTURES & BUILDINGS TO BE DECONTAMINATED & SAVED

REGISTERED PROFESSIONAL ENGINEER
No. 7986
PATRICK B. GRIFFIN
STATE OF UTAH

NO.	DATE	REVISIONS	BY	CK	E&D MGR.	CHIEF ENG.	QA MGR.	DOE APP.
3	5-15-90	AS-BUILT, DECONTAMINATED AND DEMOLISHED STRUCTURES ONLY	MSP	PBG	Mid	pm	(Init)	
2	9-2-88	ADDED NOTES 9 AND 12	VCR	pm	Griffin	JKH		
1	1-28-88	ISSUED FOR CONSTRUCTION	—	—	—	—	—	—

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

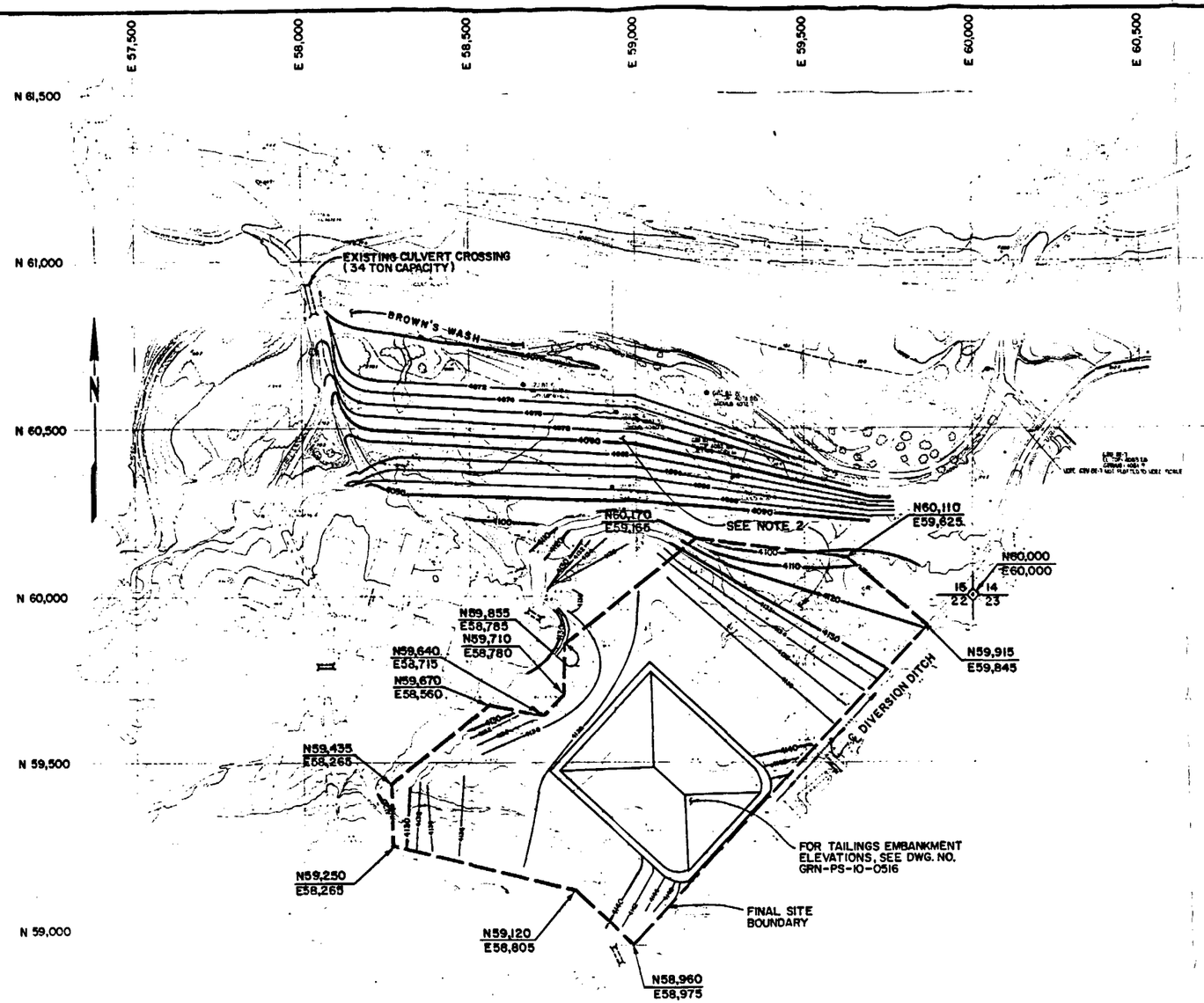
GREEN RIVER SITE
GREEN RIVER, UTAH

DEMOLITION, DECONTAMINATION AND TEMPORARY FENCING PLAN

DESIGNED	DRAWN	CHECKED	INSPECTED	RECOMMENDED	APPROVED	DATE	DOE PROJECT ENGINEER	DATE
	RBC					1-28-88		2/1/88

MORRISON-KNUDSEN ENGINEERS, INC.
A BOMFORD-A-RUDSEN COMPANY
UMTRA PROJECT
180 HOWARD ST. SAN FRANCISCO, CA 94105

PROJECT NO. DE-AC04-83AL18796
DRAWING NO. GRN-PS-10-0503
REV. -



200 0 200 400
SCALE FEET

NOTES:

1. TOPOGRAPHY TAKEN FROM OLYMPUS AERIAL SURVEYS, INC., SALT LAKE CITY, UTAH (JULY 1982).
2. FOR AS-BUILT SURFACE CONTOURS IN ALL AREAS REFER TO AS-BUILT TOPOGRAPHIC MAP DWG. NO. GRN-PS-10-0519.

REFERENCE DRAWINGS:

GRN-PS-10-0503	DEMOLITION, DECONTAMINATION AND TEMORARY FENCING PLAN
GRN-PS-10-0511	CONTAMINATED MATERIAL EXCAVATION PLAN (SHEET 1 OF 2)
GRN-PS-10-0512	CONTAMINATED MATERIAL EXCAVATION PLAN (SHEET 2 OF 2)
GRN-PS-10-0516	TAILINGS EMBANKMENT AND FINAL SITE GRADING PLAN
GRN-PS-10-0519	AS-BUILT TOPOGRAPHIC MAP

LEGEND:

- EXISTING SITE FEATURES & CONTOURS (JULY 1982 SURVEY)
- 4090 — FINAL CONTOURS
- N61,500 — CONSTRUCTION GRID COORDINATE
- DRAINAGE DITCH
- CULVERT

REGISTERED PROFESSIONAL ENGINEER No. 7346 STATE OF UTAH

QA MK-F	NO.	DATE	REVISIONS	BY	CK	E&D MGR.	CHIEF ENG.	QA MGR.	DOE APP.
	3	5-15-90	AS-BUILT	MKP	PBG	DAS	PKE	CWM	
	2	5-2-89	REVISED TAILINGS EMBANKMENT GRADING	PBG	PKE	SF	CWM		
	1	1-28-88	ISSUED FOR CONSTRUCTION	—	—	—	—	—	—

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

DESIGNED — DRAWN RBC
CHECKED
INSPECTED
RECOMMENDED
APPROVED — DATE 1-28-88

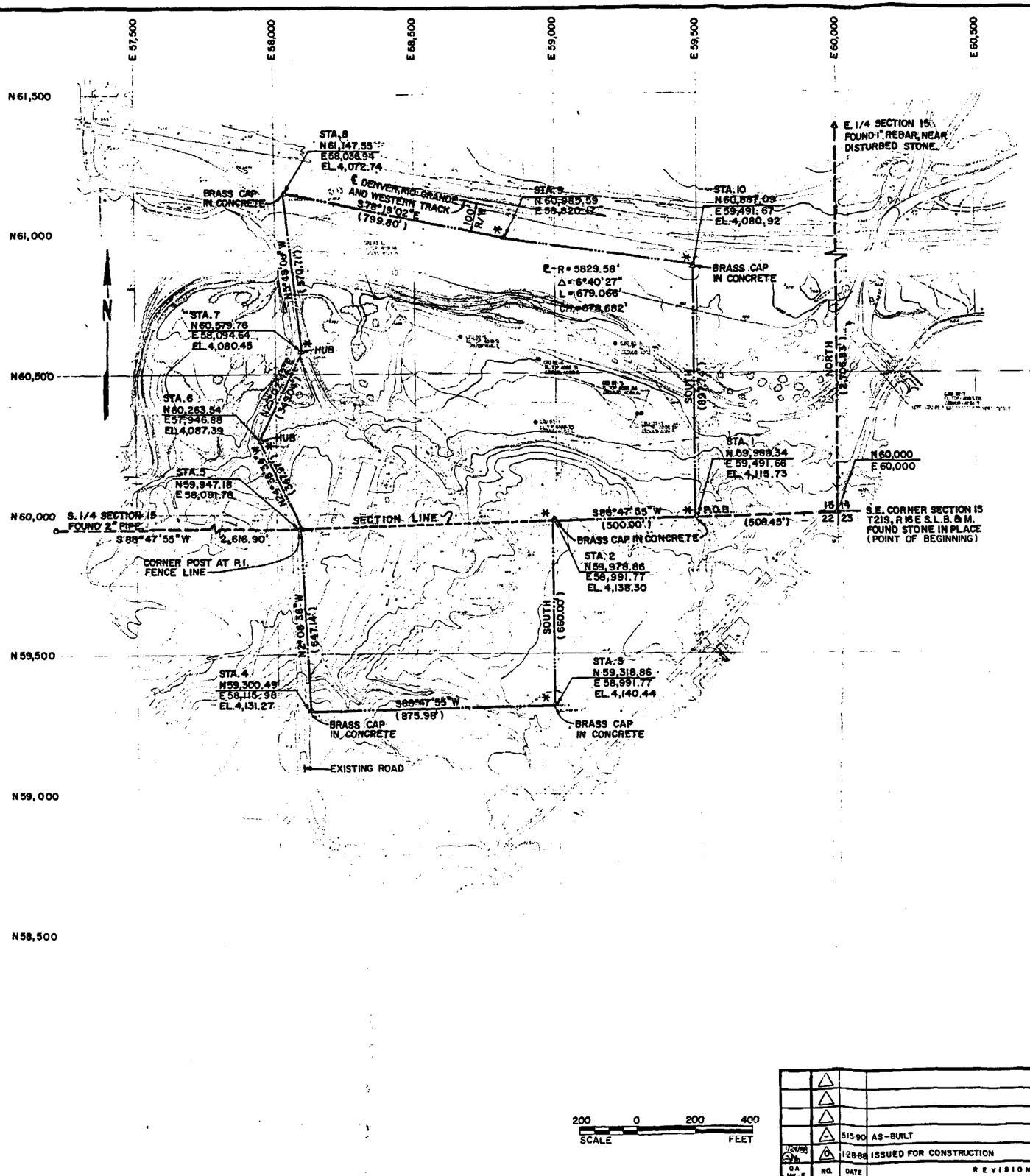
GREEN RIVER SITE
GREEN RIVER, UTAH

FINAL SITE PLAN

DOE PROJECT ENGINEER — DATE 2/1/88

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY
UMTRA PROJECT
180 HOWARD ST. SAN FRANCISCO, CA 94105

PROJECT NO. DE-AC04-83AL18796
DRAWING NO. GRN-PS-10-0504 REV. —



NOTES:

1. SURVEY DESCRIPTION:
   BEGIN AT A POINT SOUTH 88°47'55" WEST 508.45 FEET ALONG THE 1/4 SECTION LINE FROM A STONE MARKING THE SOUTHEAST CORNER OF SECTION 15, TOWNSHIP 21 SOUTH, RANGE 16 EAST, SALT LAKE BASE AND MERIDIAN FROM WHICH THE EAST 1/4 CORNER OF SAID SECTION 15 IS NORTH 2,706.83 FEET AND RUNNING THENCE SOUTH 88°47'55" WEST 500.00 FEET, THENCE SOUTH 660.00 FEET, THENCE SOUTH 88°47'55" WEST 875.98 FEET, THENCE NORTH 2°08'36" WEST 647.14 FEET, THENCE NORTH 24°36'34" WEST 347.97 FEET, THENCE NORTH 23°02'42" EAST 349.04 FEET, THENCE NORTH 5°48'08" WEST 570.71 FEET TO THE SOUTHERLY RIGHT-OF-WAY LINE OF THE DENVER RIO GRANDE AND WESTERN RAILROAD, THENCE SOUTH 78°19'02" EAST 799.80 FEET ALONG SAID RIGHT-OF-WAY TO THE POINT OF TANGENCY WITH A 5,829.58 FOOT RADIUS CURVE TO THE LEFT, THENCE CONTINUING ALONG SAID RIGHT-OF-WAY AND THE ARC OF SAID CURVE 679.066 FEET, THENCE SOUTH 897.74 FEET TO THE POINT OF BEGINNING.
2. THE ORIGINAL LAND SURVEY MAP FOR THE GREEN RIVER MILL TAILINGS PROCESSING SITE WAS DEVELOPED BY WESTERN DESIGN CONSULTANTS, JULY 7, 1982.
3. THE ORIGINAL GREEN RIVER MILL TAILINGS PROCESSING SITE TOPOGRAPHIC SURVEY MAP WAS DEVELOPED BY AERIAL SURVEYS, INC., JULY 1982.

REFERENCE DRAWINGS:

LEGEND:

- 4140 — EXISTING SITE FEATURES & CONTOURS (JULY 1982 SURVEY)
- N61,500 — CONSTRUCTION GRID COORDINATE
- △ — EXISTING SURVEY MONUMENT (1962)
- *△ — SURVEY MONUMENT REMOVED (1988)

REGISTERED PROFESSIONAL ENGINEER — No. 7346 — PATRICK H. GRIFFITH — STATE OF UTAH

4/29/88

NO.	DATE	REVISIONS	BY	CK	E&D MGR.	CHIEF ENG.	QA MGR.	DOE APP.
5	15-90	AS-BUILT	MSF	PBG	DRS	[illegible]	[illegible]	
4	12-88	ISSUED FOR CONSTRUCTION	—	—	—	—	—	—

QA MNG'R

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

DESIGNED JKM | DRAWN E.C.G.
CHECKED
INSPECTED
RECOMMENDED
APPROVED — DATE 1/28/88

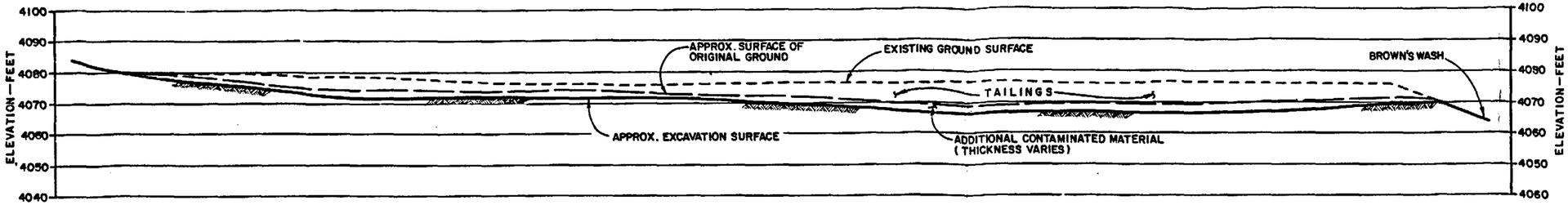
GREEN RIVER SITE
GREEN RIVER, UTAH

HORIZONTAL AND VERTICAL CONTROL

DOE PROJECT ENGINEER — DATE 2/1/88

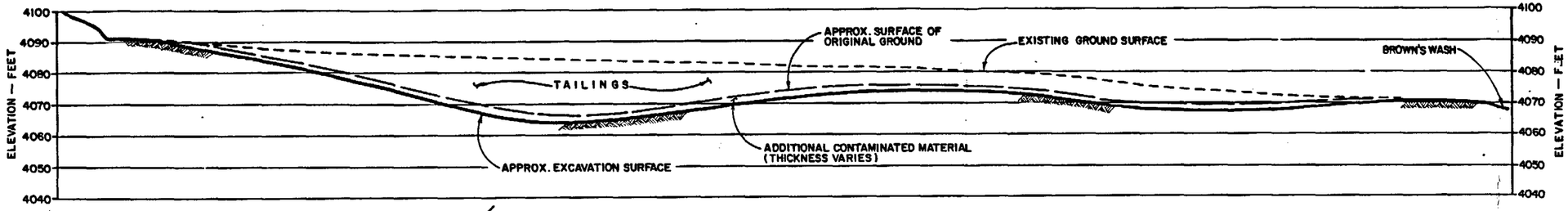
MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY
UMTRA PROJECT
100 HOWARD ST SAN FRANCISCO, CA 94105

PROJECT NO. DE-AC04-83AL18796
DRAWING NO. GRN-PS-10-0507
REV. —



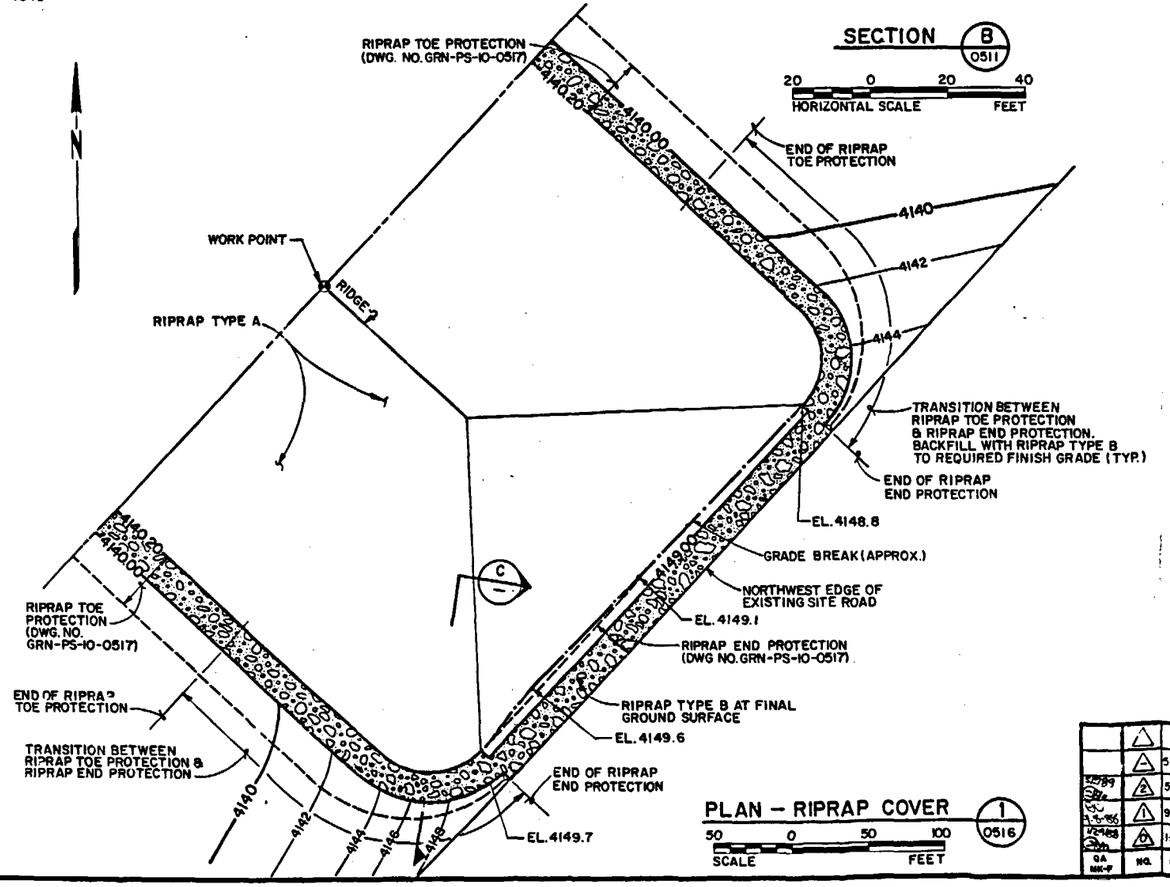
SECTION A 0511

20 0 20 40
HORIZONTAL SCALE FEET



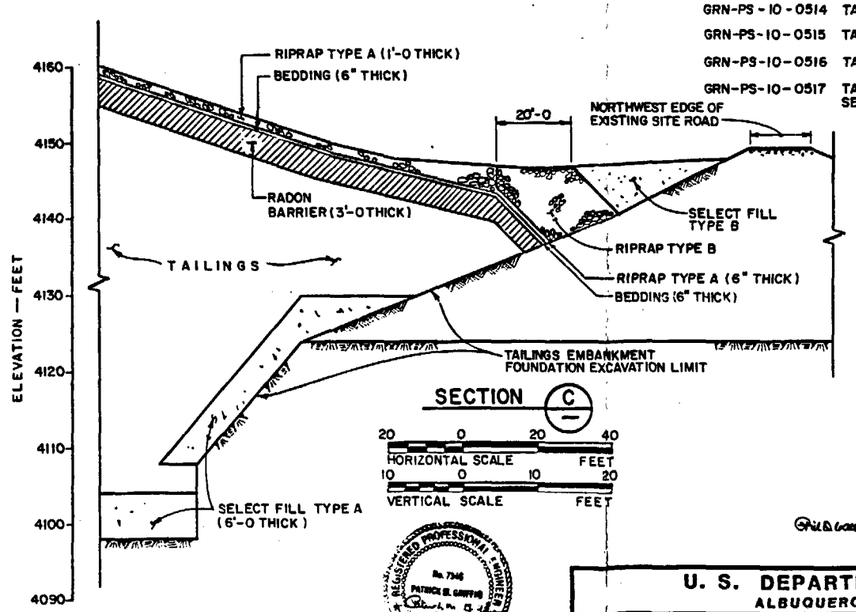
SECTION B 0511

20 0 20 40
HORIZONTAL SCALE FEET



PLAN — RIPRAP COVER 1 0516

50 0 50 100
SCALE FEET



SECTION C —

20 0 20 40
HORIZONTAL SCALE FEET
10 0 10 20
VERTICAL SCALE FEET

REGISTERED PROFESSIONAL ENGINEER No. 7346 PATRICK M. GRIFFIN STATE OF UTAH

Phil & Lucas 1/21/88

REFERENCE DRAWINGS:

GRN-PS-10-0511	CONTAMINATED MATERIAL EXCAVATION PLAN (SHEET 1 OF 2)
GRN-PS-10-0512	CONTAMINATED MATERIAL EXCAVATION PLAN (SHEET 2 OF 2)
GRN-PS-10-0514	TAILINGS EMBANKMENT FOUNDATION EXCAVATION PLAN
GRN-PS-10-0515	TAILINGS EMBANKMENT FOUNDATION SECTIONS
GRN-PS-10-0516	TAILINGS EMBANKMENT & FINAL SITE GRADING PLAN
GRN-PS-10-0517	TAILINGS EMBANKMENT & FINAL SITE GRADING-SECTIONS & DETAILS

QA MGR-P	NO.	DATE	REVISIONS	BY	CK	E&D MGR.	CHIEF ENG.	QA MGR.	DOE APP.
	5	5-15-90	AS-BUILT	MSP	FBG	JMS	[illegible]	[illegible]	
1/2-89	4	5-2-89	REVISED RIPRAP COVER AND SECTIONS	FBG	[illegible]	[illegible]	[illegible]		
1/2-88	3	9-2-88	REVISED THICKNESS OF RADON BARRIER	CCR	[illegible]	[illegible]	[illegible]		
1/2-88	2	12-8-88	ISSUED FOR CONSTRUCTION	—	—	—	—	—	—

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

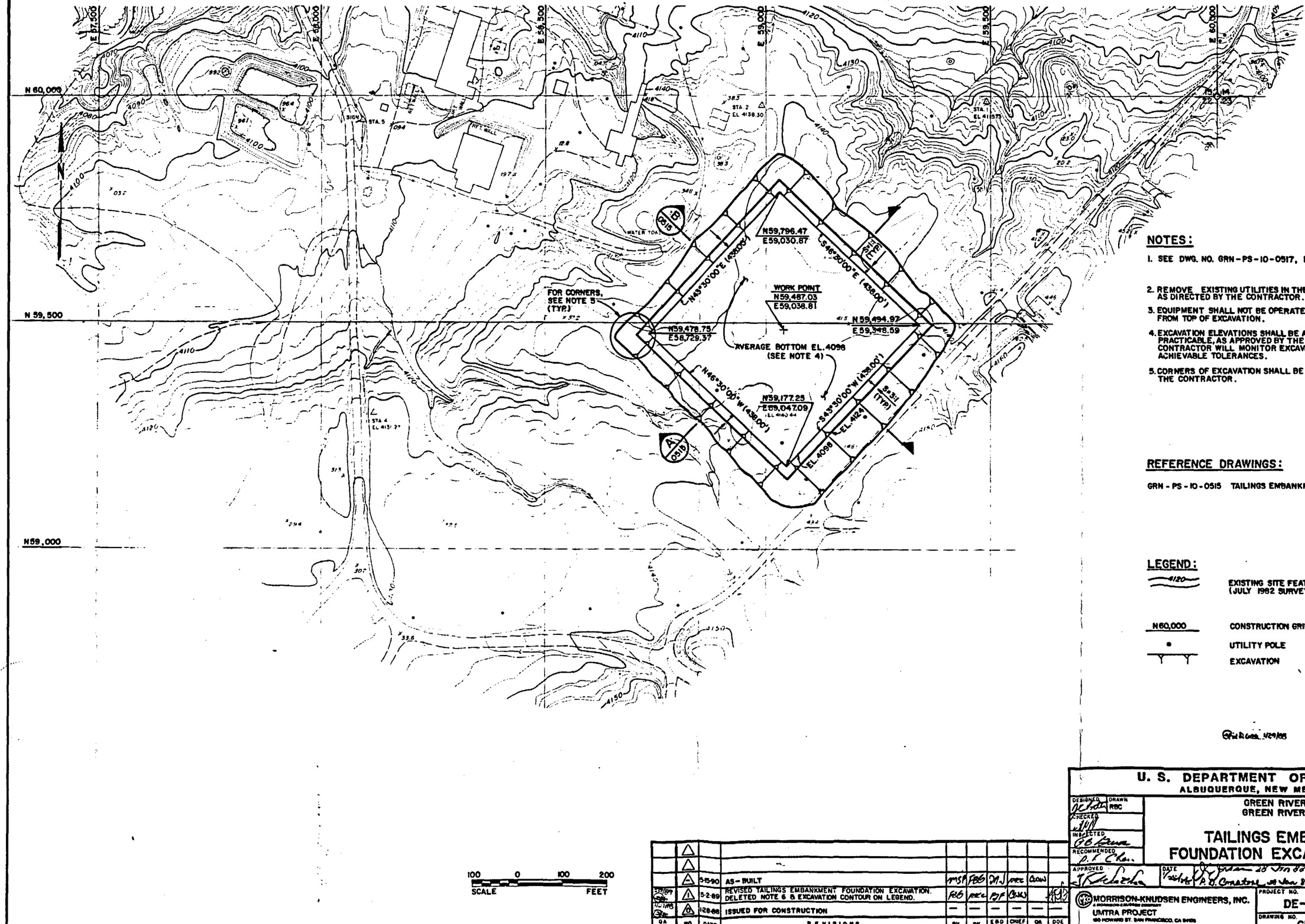
GREEN RIVER SITE
GREEN RIVER, UTAH

CONTAMINATED MATERIAL EXCAVATION SECTIONS & MISCELLANEOUS DETAILS

DESIGNED [illegible]	DRAWN RBC		
CHECKED [illegible]			
INSPECTED [illegible]			
RECOMMENDED [illegible]			
APPROVED [illegible]	DATE 1/26/88	DOE PROJECT ENGINEER [illegible]	DATE 1/21/88
APPROVED [illegible]	DATE 28 Jan 88	DOE CONTRACTING OFFICER [illegible]	

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY
UMTRA PROJECT
180 HOWARD ST. SAN FRANCISCO, CA 94105

PROJECT NO. DE-AC04-83AL18796
DRAWING NO. GRN-PS-10-0513
REV. —



NOTES:

1. SEE DWG. NO. GRN-PS-10-0517, FOR EXCAVATED SLOPES.
2. REMOVE EXISTING UTILITIES IN THE AREA OF EXCAVATION AS DIRECTED BY THE CONTRACTOR.
3. EQUIPMENT SHALL NOT BE OPERATED CLOSER THAN 10 FEET FROM TOP OF EXCAVATION.
4. EXCAVATION ELEVATIONS SHALL BE ACHIEVED TO TOLERANCES PRACTICABLE, AS APPROVED BY THE CONTRACTOR. THE CONTRACTOR WILL MONITOR EXCAVATION TO DETERMINE ACHIEVABLE TOLERANCES.
5. CORNERS OF EXCAVATION SHALL BE ROUNDED AS DIRECTED BY THE CONTRACTOR.

REFERENCE DRAWINGS:

GRN - PS - 10 - 0515 TAILINGS EMBANKMENT FOUNDATION SECTIONS

LEGEND:

- 4120 — EXISTING SITE FEATURES & CONTOURS (JULY 1982 SURVEY)
- N60,000 — CONSTRUCTION GRID COORDINATE
- • — UTILITY POLE
- EXCAVATION

REGISTERED PROFESSIONAL ENGINEER — No. 7980 — PATRICK W. GRIFFITH — STATE OF UTAH

Grid Resolution 1/29/88

	△								
	△								
	△								
	△	5-5-90	AS-BUILT	MSR	FBG	DAJ	PRE	CLOW	
5/5/89	△	5-2-89	REVISED TAILINGS EMBANKMENT FOUNDATION EXCAVATION. DELETED NOTE 6 & EXCAVATION CONTOUR ON LEGEND.	FBG	PRE	PJF	CLOW		
11-1-88	△	12-8-88	ISSUED FOR CONSTRUCTION	—	—	—	—	—	—
QA DOC. F	NO.	DATE	REVISIONS	BY	CK	E&D MGR.	CHIEF ENG.	QA MGR.	DOE APP.

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

DESIGNED	DRAWN RBC
CHECKED	
INSPECTED	
RECOMMENDED	
APPROVED	DATE 1/26/89

GREEN RIVER SITE
GREEN RIVER, UTAH

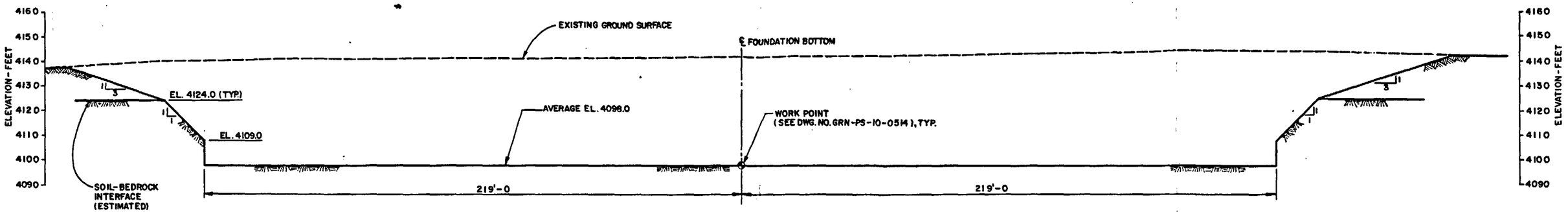
TAILINGS EMBANKMENT FOUNDATION EXCAVATION PLAN

P. D. Croston 28 Jan 88 — DOE PROJECT ENGINEER — DATE 2/1/89

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY
UMTRA PROJECT
180 HOWARD ST. SAN FRANCISCO, CA 94105

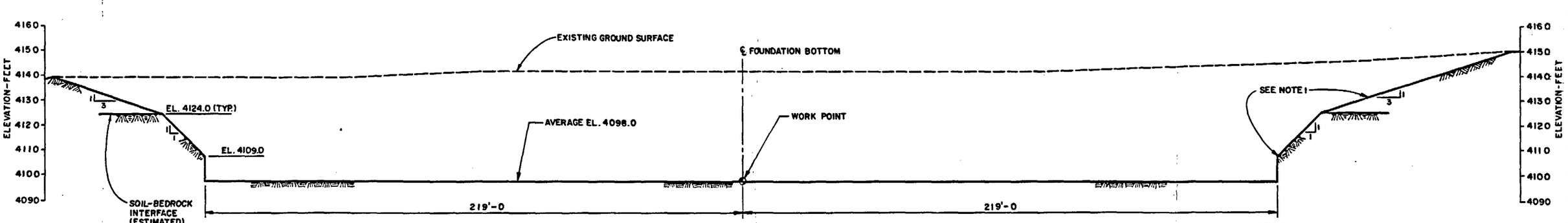
PROJECT NO. DE-AC04-83AL18796

DRAWING NO. GRN-PS-10-0514 — REV. —



CROSS-SECTION A 0514

20 0 20 40
SCALE FEET



CROSS-SECTION B 0514

20 0 20 40
SCALE FEET

NOTES:

1. EXCAVATION BEYOND THE LIMITS SHOWN, ON THIS SIDE ONLY, SHALL BE PERMITTED TO PROVIDE AN ACCESS RAMP, AS APPROVED BY THE CONTRACTOR.

REFERENCE DRAWINGS:

GRN-PS-10-0514 TAILINGS EMBANKMENT FOUNDATION EXCAVATION PLAN

REGISTERED PROFESSIONAL ENGINEER — No. 7246 — PATRICK B. GRIFFIN — STATE OF UTAH

QA MK-F	NO.	DATE	REVISIONS	BY	CK	E&D MGR.	CHIEF ENG.	QA MGR.	DOE APP.
	5	5-5-90	AS-BUILT	MSP	PBG	DNA	APC	CWS	
5/2/89	4	5-2-89	REVISED TAILINGS EMBANKMENT EXCAVATION SURFACE	PBG	JDR	RJF	CWS		
1/27/88	3	12-8-88	ISSUED FOR CONSTRUCTION	—	—	—	—	—	—

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

DESIGNED JCH — DRAWN BH — CHECKED JHH — INSPECTED C.O. Brown — RECOMMENDED R.F. Lee

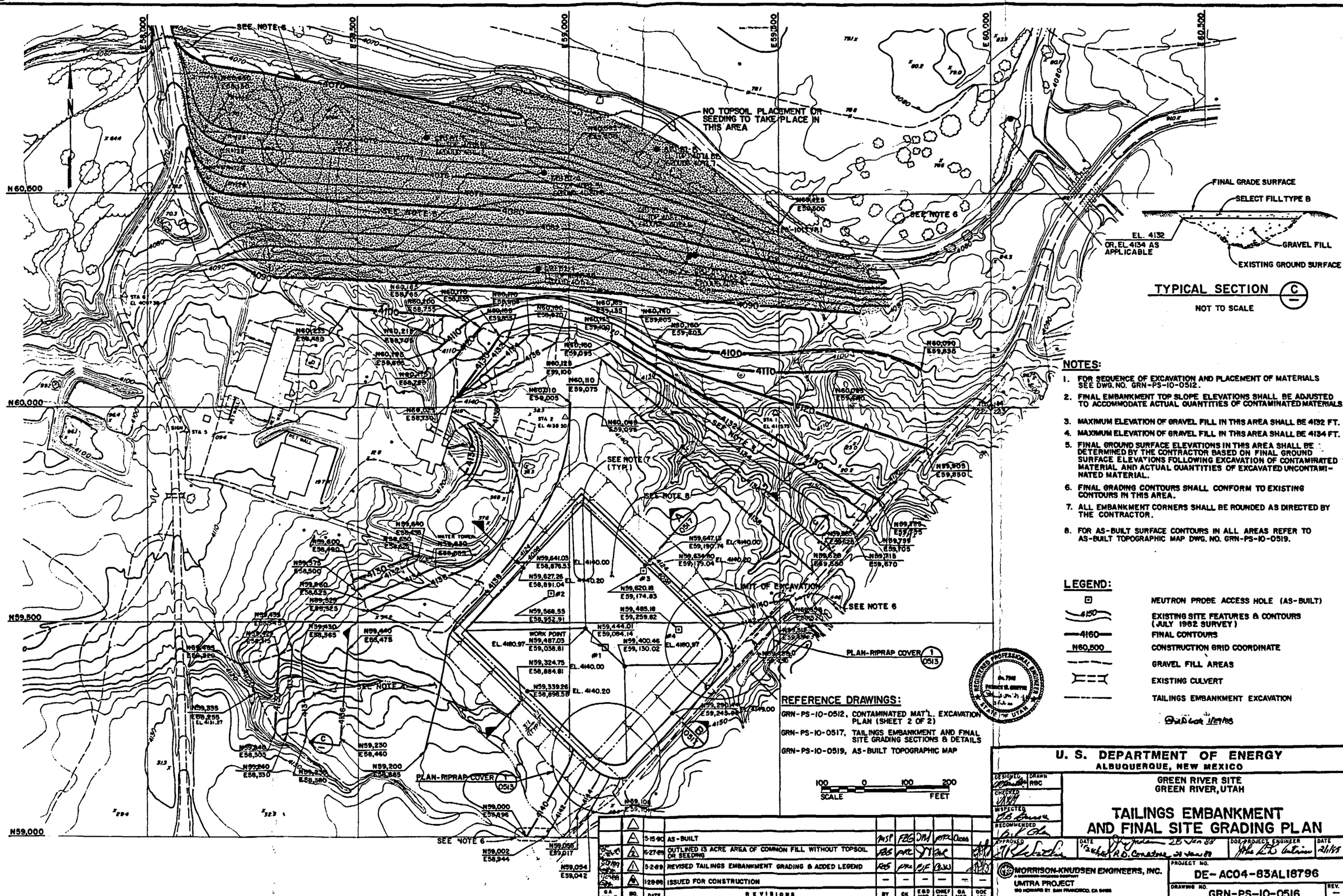
GREEN RIVER SITE
GREEN RIVER, UTAH

TAILINGS EMBANKMENT FOUNDATION SECTIONS

APPROVED J.K. Sackett — DATE 11/28/88 — C.O. Christensen 28 Nov 88 — DOE PROJECT ENGINEER John K. Eichelberger — DATE 2/1/89

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY
UMTRA PROJECT
180 HOWARD ST. SAN FRANCISCO, CA 94105

PROJECT NO. DE-AC04-83AL18796
DRAWING NO. GRN-PS-10-0515
REV. -



NOTES:

1. FOR SEQUENCE OF EXCAVATION AND PLACEMENT OF MATERIALS SEE DWG. NO. GRN-PS-10-0512.
2. FINAL EMBANKMENT TOP SLOPE ELEVATIONS SHALL BE ADJUSTED TO ACCOMMODATE ACTUAL QUANTITIES OF CONTAMINATED MATERIALS.
3. MAXIMUM ELEVATION OF GRAVEL FILL IN THIS AREA SHALL BE 4132 FT.
4. MAXIMUM ELEVATION OF GRAVEL FILL IN THIS AREA SHALL BE 4134 FT.
5. FINAL GROUND SURFACE ELEVATIONS IN THIS AREA SHALL BE DETERMINED BY THE CONTRACTOR BASED ON FINAL GROUND SURFACE ELEVATIONS FOLLOWING EXCAVATION OF CONTAMINATED MATERIAL AND ACTUAL QUANTITIES OF EXCAVATED UNCONTAMINATED MATERIAL.
6. FINAL GRADING CONTOURS SHALL CONFORM TO EXISTING CONTOURS IN THIS AREA.
7. ALL EMBANKMENT CORNERS SHALL BE ROUNDED AS DIRECTED BY THE CONTRACTOR.
8. FOR AS-BUILT SURFACE CONTOURS IN ALL AREAS REFER TO AS-BUILT TOPOGRAPHIC MAP DWG. NO. GRN-PS-10-0519.

LEGEND:

- NEUTRON PROBE ACCESS HOLE (AS-BUILT)
- 4150 — EXISTING SITE FEATURES & CONTOURS (JULY 1982 SURVEY)
- 4160 — FINAL CONTOURS
- N60,500 — CONSTRUCTION GRID COORDINATE
- GRAVEL FILL AREAS
- EXISTING CULVERT
- TAILINGS EMBANKMENT EXCAVATION

REFERENCE DRAWINGS:

GRN-PS-10-0512, CONTAMINATED MAT'L. EXCAVATION PLAN (SHEET 2 OF 2)

GRN-PS-10-0517, TAILINGS EMBANKMENT AND FINAL SITE GRADING SECTIONS & DETAILS

GRN-PS-10-0519, AS-BUILT TOPOGRAPHIC MAP

REGISTERED PROFESSIONAL ENGINEER No. 7982 PHILIP B. GRIFFIN STATE OF UTAH

QA MK-F	NO.	DATE	REVISIONS	BY	CK	E&D SUPR.	CHIEF ENG.	QA MGR.	DOE APP.
	3	5-15-90	AS-BUILT	MSP	FBG	DMJ	JOPER	Ocass	
5-24-89	2	5-27-89	OUTLINED 13 ACRE AREA OF COMMON FILL WITHOUT TOPSOIL OR SEEDING	FBG	PMC	DMJ	PMC		
5-30-89	1	5-2-89	REVISED TAILINGS EMBANKMENT GRADING & ADDED LEGEND	FBG	PMC	PJF	DMJ		
1-5-88	0	12-8-88	ISSUED FOR CONSTRUCTION	—	—	—	—	—	—

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

DESIGNED	DRAWN	DATE
	RBC	
CHECKED		
MJSP		
INSPECTED		
RECOMMENDED		
APPROVED	DATE	DOE PROJECT ENGINEER / DATE
	1/26/89	21/88

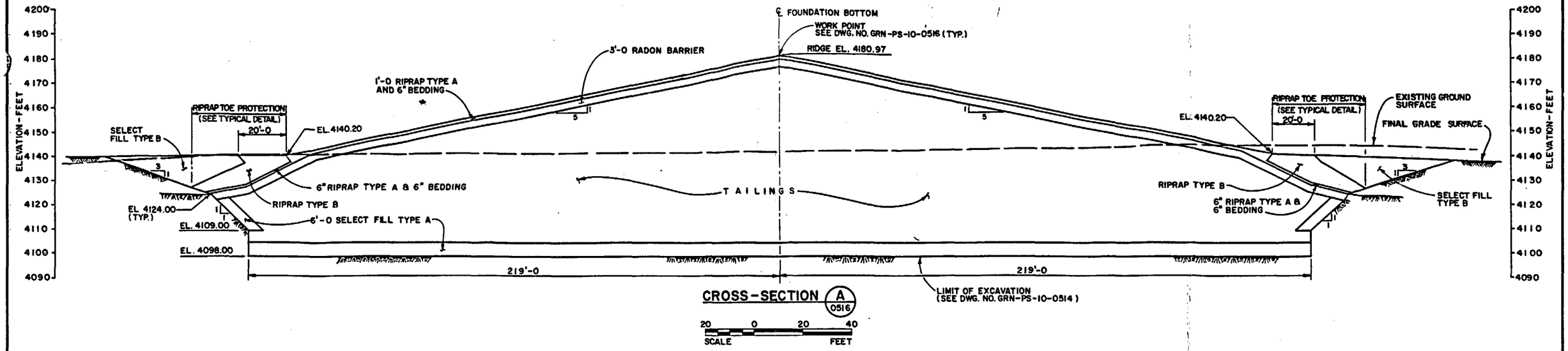
GREEN RIVER SITE
GREEN RIVER, UTAH

TAILINGS EMBANKMENT AND FINAL SITE GRADING PLAN

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY
UMTRA PROJECT
155 MONTGOMERY ST. SAN FRANCISCO, CA 94105

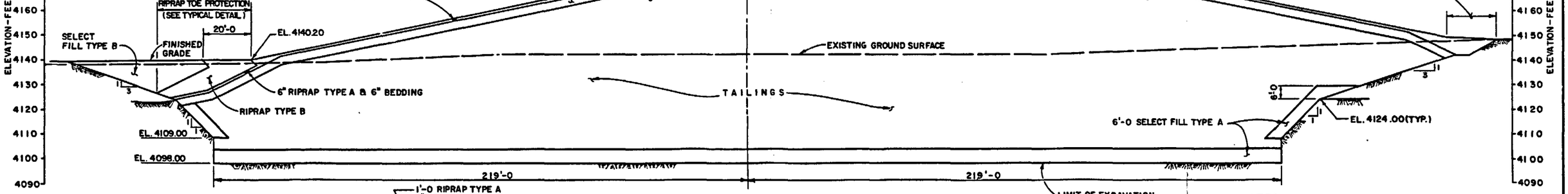
PROJECT NO. DE-AC04-83AL18796

DRAWING NO. GRN-PS-10-0516 REV. —



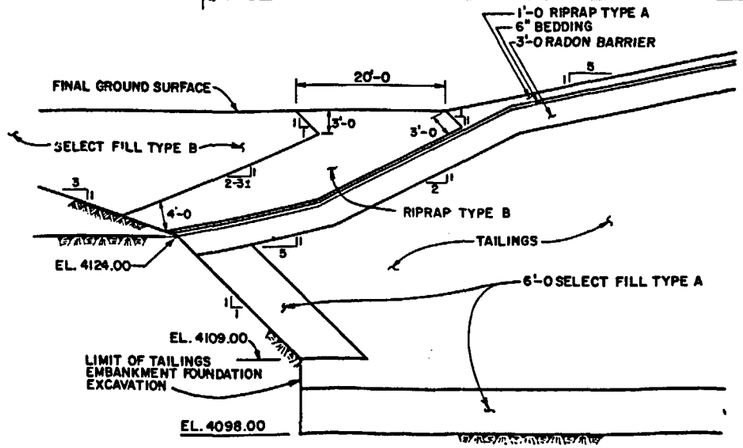
CROSS-SECTION A 0516

SCALE 20 0 20 40 FEET



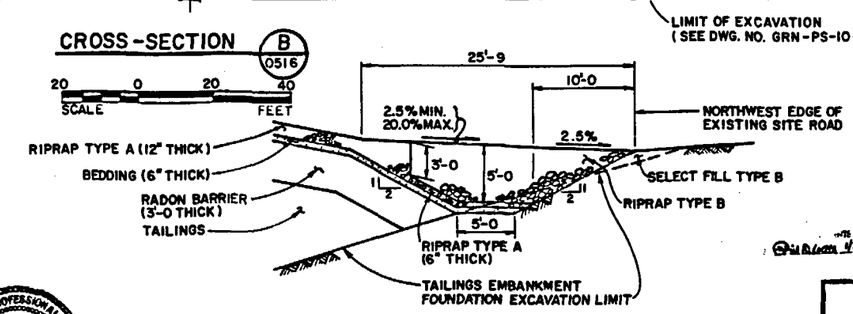
CROSS-SECTION B 0516

SCALE 20 0 20 40 FEET



RIPRAP TOE PROTECTION DETAIL

SCALE 10 0 10 FEET



RIPRAP END PROTECTION DETAIL

NOT TO SCALE

REGISTERED PROFESSIONAL ENGINEER — No. 7996 — PATRICK B. GRIFFIN — 5 Feb 88 — STATE OF UTAH

NOTES:

1. FINAL RADON BARRIER LAYER THICKNESS SHALL BE DETERMINED BY THE CONTRACTOR.
2. INTERSECTION OF TOP SLOPE AND SIDE SLOPE SHALL BE APPROXIMATELY AS SHOWN.
3. FINAL TAILINGS EMBANKMENT ELEVATIONS WILL BE DETERMINED BY THE CONTRACTOR.

REFERENCE DRAWINGS:

GRN-PS-10-0514 TAILINGS EMBANKMENT FOUNDATION EXCAVATION PLAN
GRN-PS-10-0516 TAILINGS EMBANKMENT & FINAL SITE GRADING PLAN

NO.	DATE	REVISIONS	BY	CK	E&D MGR.	CHIEF ENG.	QA MGR.	DOE APP.
4	5-15-90	AS-BUILT	MSP	PBG	DNA	[illegible]	CWM	
3	5-2-89	REVISED CROSS-SECTION A & B AND RIPRAP PROTECTION DET.	PBG	[illegible]	EJF	CWM		
2	9-2-88	REVISED THICKNESS OF RADON BARRIER	CCL	MK	EJF	MJD		
1	1-29-88	ISSUED FOR CONSTRUCTION	—	—	—	—	—	—

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

DESIGNED K Wood — DRAWN RBC — CHECKED CWM — INSPECTED A.C. Lange — RECOMMENDED P.K. Chen — APPROVED [illegible] DATE 1-29-88

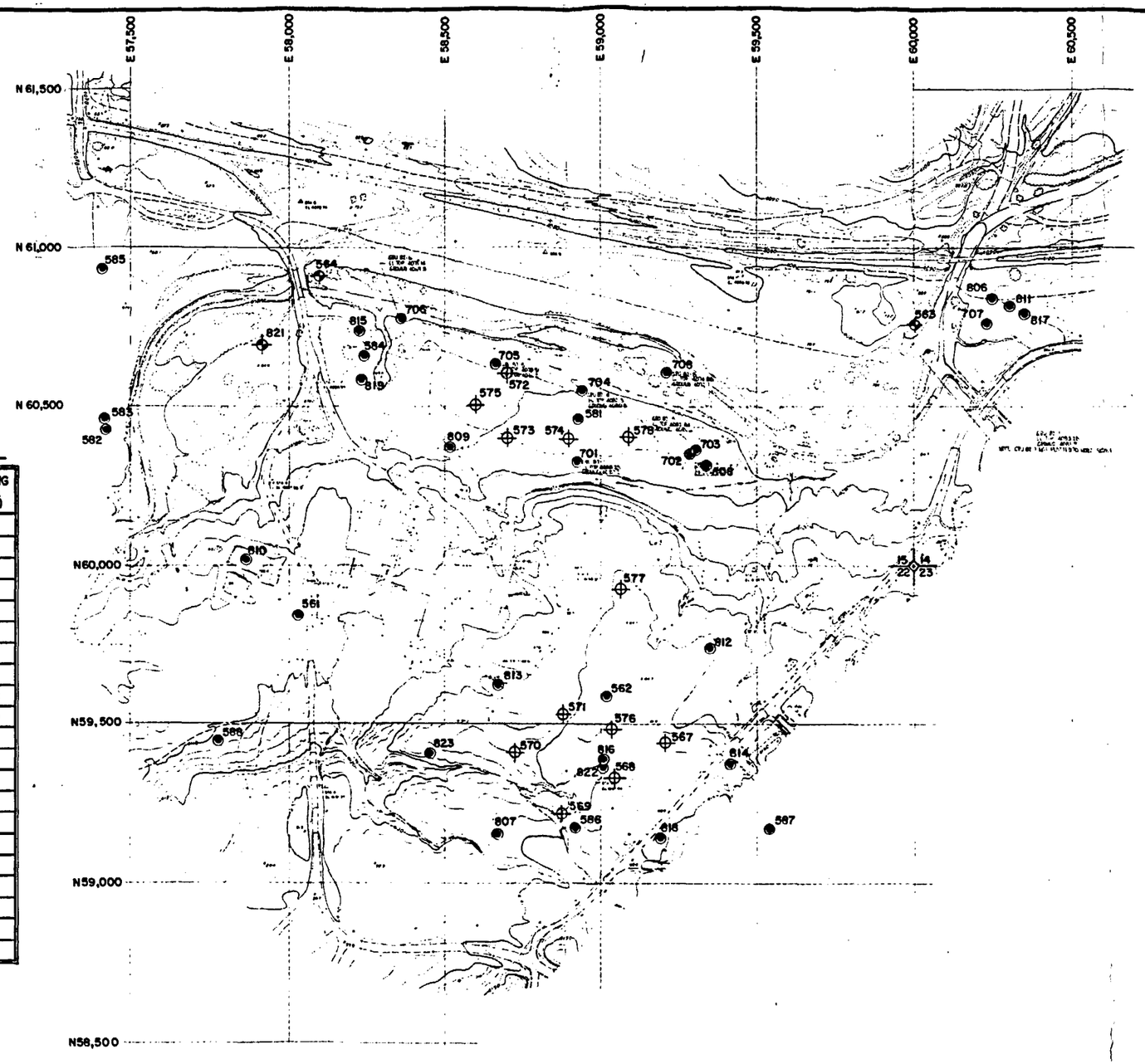
GREEN RIVER SITE
GREEN RIVER, UTAH

TAILINGS EMBANKMENT AND FINAL SITE GRADING SECTIONS AND DETAILS

DOE PROJECT ENGINEER [illegible] DATE 2-1-88

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

PROJECT NO. DE-AC04-83AL18796
DRAWING NO. GRN-PS-10-0517 REV. -



NOTES:

1. GROUNDWATER DATA AND SUBSURFACE EXPLORATION LOGS ARE AVAILABLE FROM THE CONTRACTOR.
2. MONITOR WELLS TO BE SAVED SHALL BE PROTECTED DURING CONSTRUCTION AND SHALL NOT BE CUT OR DISTURBED UNLESS DIRECTED OTHERWISE BY THE CONTRACTOR. MONITOR WELLS TO BE PROTECTED DURING CONSTRUCTION SHALL BE CAREFULLY SUPPORTED IF EXCAVATION BELOW EXISTING GROUND SURFACE IS REQUIRED, UNLESS DIRECTED OTHERWISE BY THE CONTRACTOR.
3. THE SUBCONTRACTOR SHALL NOTIFY THE CONTRACTOR IMMEDIATELY IF ANY WELLS NOT SHOWN ARE ENCOUNTERED DURING CONSTRUCTION. SUCH WELLS SHALL BE PROTECTED UNLESS DIRECTED OTHERWISE BY THE CONTRACTOR.
4. MONITOR WELLS SHOWN TO BE RETAINED MAY NOT INDICATE ALL WELLS TO BE PROTECTED OR PRECISE LOCATIONS. ANY WELLS NOT SHOWN ON THIS DRAWING DISCOVERED DURING CONSTRUCTION SHALL BE REPORTED TO THE CONTRACTOR AS SPECIFIED.
5. THE FOLLOWING WELLS SHALL BE RETAINED AND PROTECTED: 582, 583, 584, 585, 588, 707, 806, 807, 810, 811, 812, 813, 815, 817, 818 AND 823. THE CONTRACTOR WILL PROVIDE COORDINATES OF THESE WELLS.

LEGEND:

- EXISTING SITE FEATURES & CONTOURS (JULY 1982 SURVEY)
- N61,500 CONSTRUCTION GRID COORDINATE
- BOREHOLE
- WELL POINT
- MONITOR WELL
- PROPOSED RADIOLOGICAL HOLES

TABLE 1 - MONITOR WELLS ABANDONED AND SEALED-1988

WELL	COORDINATES		WELL DEPTH (FT.)*	WELL DIA. (IN.)	CASING DEPTH (FT.)*	CASING I.D. (IN.)
	NORTH	EAST				
561	59,838.7	58,028.8	143.5	6.0	143.5	2.0
562	59,585.9	59,014.3	129.5	6.0	129.5	2.0
563	60,760.1	60,003.5	15.0	2.0	15.0	2.0
564	60,917.7	58,100.1	15.0	2.0	15.0	2.0
581	60,450.2	58,932.9	85.0	8.0	85.0	4.0
586	59,171.8	58,915.7	166.5	8.0	166.5	4.0
587	59,177.2	59,540.5	185.0	8.0	185.0	4.0
701	60,330.9	58,929.2	57.0	8.0	57.0	4.0
702	60,355.8	59,295.1	26.0	8.0	26.0	4.0
703	60,357.7	59,301.7	28.0	8.0	28.0	4.0
704	60,556.4	58,941.0	23.0	8.0	23.0	4.0
705	60,640.1	58,665.7	20.0	8.0	20.0	4.0
706	60,779.0	58,379.2	18.0	8.0	18.0	4.0
708	60,605.4	59,218.6	11.0	8.0	11.0	4.0
808	60,317.9	59,333.8	80.0	8.0	80.0	4.0
809	60,371.1	58,519.2	175.0	8.0	175.4	4.0
814	59,377.7	59,412.5	60.0	8.0	60.0	4.0
816	59,392.3	59,003.8	62.0	8.0	60.0	4.0
819	60,583.3	58,230.8	166.0	8.0	166.0	4.0
821	60,689.9	57,916.6	7.0	2.0	7.0	2.0
822	59,366.8	59,003.1	35.0	8.0	35.0	- 4.0

* DEPTH FROM GROUND SURFACE AT THE TIME OF INSTALLATION. CASING IS SCH. 40 FLUSH JOINT THREADED PVC.

SCALE 200 0 200 400 FEET

NO.	DATE	REVISIONS	BY	CK	E&O MGR.	CHIEF ENG.	QA MGR.	DOE APP.
	5-15-90	AS-BUILT	MSP	PBC	DMS	[illegible]	Cooke	
A	12-88	ISSUED FOR CONSTRUCTION	—	—	—	—	—	—

QA MGR-F

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

DESIGNED | DRAWN RBC | CHECKED | INSPECTED G.O. Bunce | RECOMMENDED

GREEN RIVER SITE
GREEN RIVER, UTAH

MONITOR WELL ABANDONMENT AND BORING LOCATION PLAN

APPROVED | DATE 1/26/88 | DOE PROJECT ENGINEER | DATE 2/1/88

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

PROJECT NO. DE-AC04-83AL18796

DRAWING NO. GRN-PS-10-0518 REV. -

NOTE:

1. SURVEY BY INTERMOUNTAIN TECHNICAL SERVICES, INC., GRAND JUNCTION, COLORADO. PHOTOGRAPHY DATE MARCH 31, 1990.
2. AS-BUILT CONTOURS IN THIS AREA BY JOHANSEN AND TUTTLE ENGINEERING, PRICE, UTAH. SURVEY DATE MAY 11, 1990.

E 57,000 E 58,000 E 59,000 E 60,000 E 61,000

N 61,000 N 60,000 N 59,000 N 58,000

SEE NOTE 2

LEGEND:

- PAVED ROAD
- GRADED OR UNIMPROVED ROAD
- RAILROAD
- FENCE
- STRUCTURE OR BUILDING
- POLE
- CULVERT

200 0 200 400
SCALE FEET

NO.	DATE	REVISIONS	BY	CK	E&D MGR.	CHIEF ENG.	QA MGR.	DOE APP.
△	5-15-90	AS-BUILT	JCP	FBS	MJ	pec	Cwm	

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

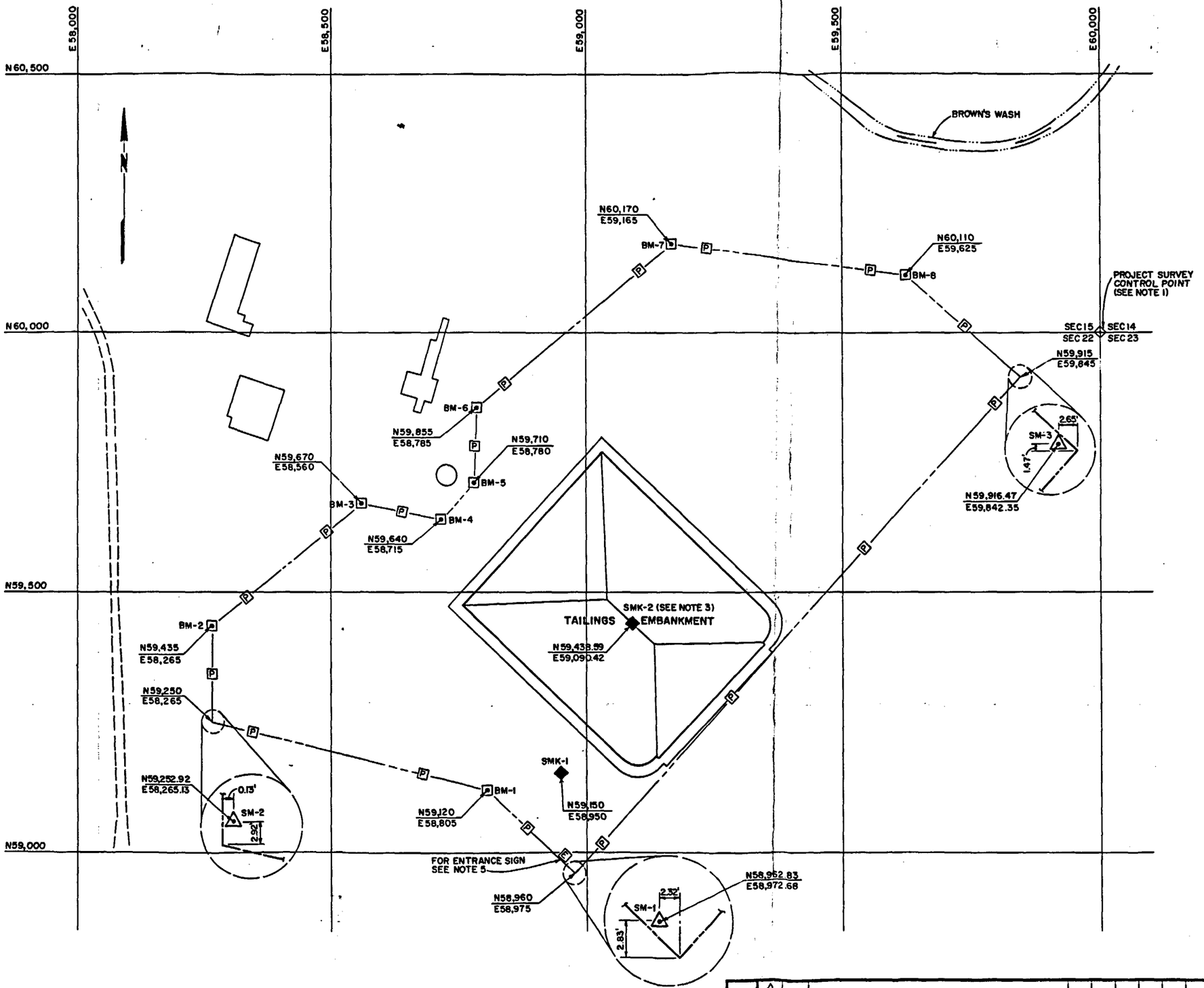
DESIGNED | DRAWN RBC
CHECKED
INSPECTED
RECOMMENDED
APPROVED | DATE | DOE PROJECT ENGINEER | DATE

GREEN RIVER SITE
GREEN RIVER, UTAH

AS-BUILT TOPOGRAPHIC MAP

MORRISON-KNUDSEN ENGINEERS, INC.
UMTRA PROJECT

PROJECT NO. DE-AC04-83AL18796
DRAWING NO. GRN-PS-10-0519 REV. —



NOTES:

1. PROJECT SURVEY CONTROL POINT (N60,000, E60,000) IS LOCATED AT THE NORTHEAST CORNER OF SECTION 22, T21S, R16E, SALT LAKE BASE AND MERIDIAN.
2. COORDINATES OF SURVEY MONUMENTS, BOUNDARY MONUMENTS, AND SITE MARKERS ARE AS SHOWN. (AS-BUILT).
3. SURFACE ON WHICH MESSAGE IS INCISED FACES SOUTHEAST. (AS-BUILT).
4. PERIMETER SIGNS SHALL BE LOCATED AS SHOWN BY SCALING POSITION ALONG SITE BOUNDARY. STEEL POSTS FOR SIGNS SHALL BE LOCATED 1 FOOT INSIDE THE SITE BOUNDARY. SIGNS SHALL BE POSITIONED PARALLEL TO THE NEAREST SITE BOUNDARY, UNLESS DIRECTED OTHERWISE BY THE CONTRACTOR, AND SHALL FACE OUTWARD.
5. ENTRANCE SIGN SHALL BE PLACED 1 FOOT INSIDE THE SITE BOUNDARY LOCATED AND ORIENTED FOR MAXIMUM VISIBILITY CLOSE TO ACCESS ROAD AND AS DIRECTED BY THE CONTRACTOR.

NOTE: (AS-BUILT)

6. PROJECT SURVEY CONTROL POINT LOCATION BY STATE PLANE COORDINATES IS N238,371.48, E2,399,479.92 PIN ELEVATION 4110.9.

LEGEND:

- SM-2 — PERMANENT SURVEY MONUMENT
- BM-2 — PERMANENT BOUNDARY MONUMENT
- SMK-1 — SITE MARKER
- P — PERIMETER SIGN
- EXISTING SURVEY MONUMENT
- SITE BOUNDARY
- N59,000 — CONSTRUCTION GRID COORDINATE
- EXISTING ROADWAY
- EXISTING STRUCTURE OR BUILDING
- E — ENTRANCE SIGN

QA Reviewed FOR QUALITY REQUIREMENTS 9/13/89

SCALE 100 0 100 200 FEET

NO.	DATE	REVISIONS	BY	CK	ENG MGR.	CHIEF ENG.	QA MGR.	DOE APP.
△								
△								
△								
△	5-15-90	AS-BUILT	MSP	PBG	DMJ	pm	CLWS	
△	9-11-89	ISSUED FOR CONSTRUCTION	—	—	—	—	—	—

QA MK-F

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

DESIGNED FLC | DRAWN B.H. | CHECKED WOC | INSPECTED DPL | RECOMMENDED DPL

GREEN RIVER SITE
GREEN RIVER, UTAH
SURVEILLANCE AND MAINTENANCE PLAN

LOCATIONS OF MONUMENTS, MARKERS, AND SIGNS

APPROVED F.J. FELIZ — DATE 9/11/89

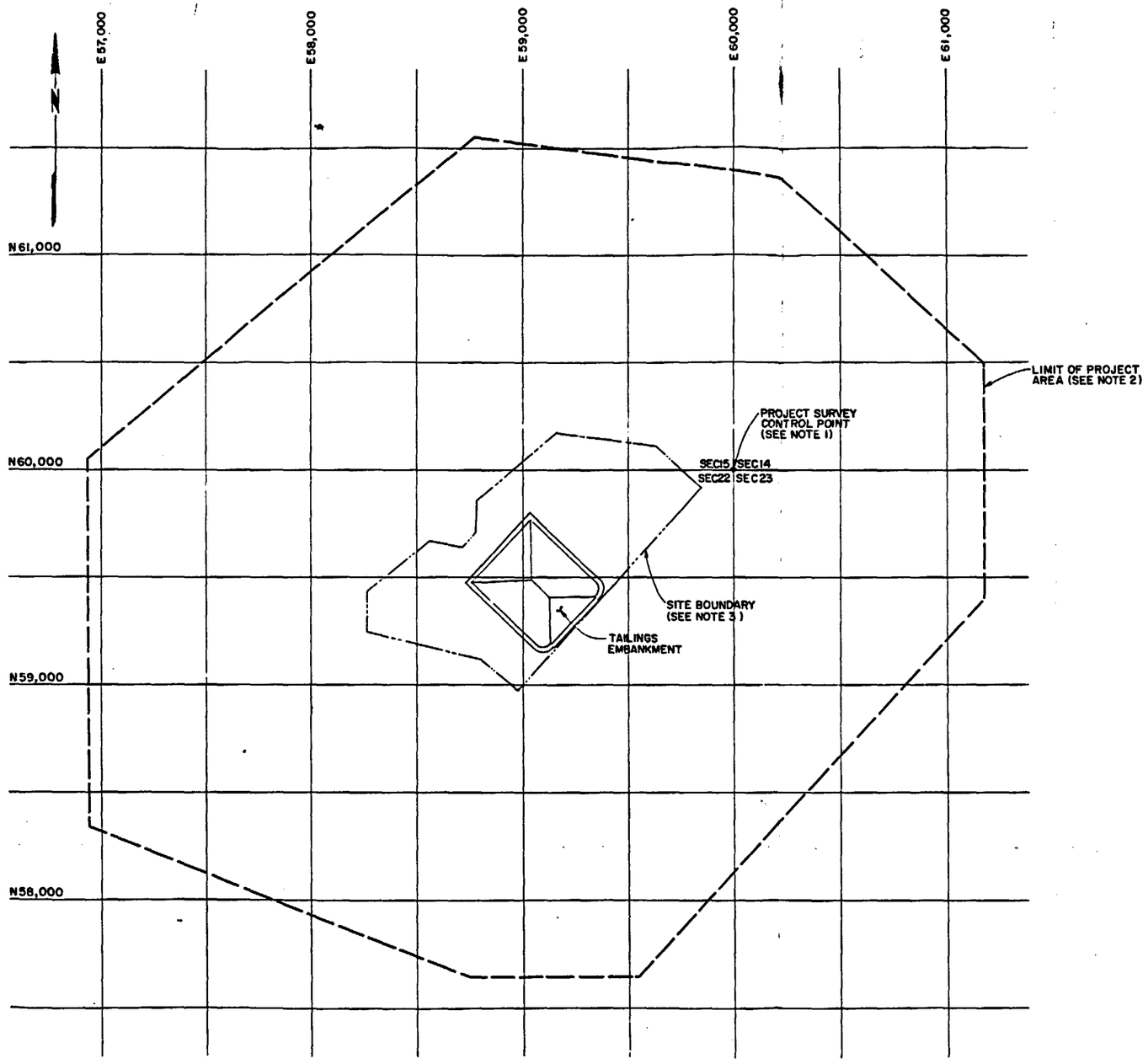
E.S. Smith 9/12/89 — DOE PROJECT ENGINEER Chris S. Watson — DATE 9/13/89

MORRISON-KNUDSEN ENGINEERS, INC.
UMTRA PROJECT

PROJECT NO. DE-AC04-83AL18796

DRAWING NO. GRN-PS-10-0601 — REV. —

B502511G0003800/UMTRAD



NOTES:

1. PROJECT SURVEY CONTROL POINT (N60,000, E60,000) IS LOCATED AT THE NORTHEAST CORNER OF SECTION 22, T21S, R16E, SALT LAKE BASE AND MERIDIAN.
2. THE PROJECT AREA IS TO BE COVERED BY VERTICAL PHOTOGRAPHS.
3. THE AREA DEFINED BY THE SITE BOUNDARY IS TO BE INCLUDED IN EACH OBLIQUE PHOTOGRAPH, AS SPECIFIED.

REFERENCE DRAWINGS:

GRN - PS - 10 - 0601, LOCATIONS OF MONUMENTS, MARKERS, AND SIGNS

LEGEND:

N60,000 CONSTRUCTION GRID COORDINATE

QA REVIEWED FOR QUALITY ASSURANCE REQUIREMENTS
P.L. Smith 9/13/89

300 0 300 600
SCALE FEET

NO.	DATE	REVISIONS	BY	CK	ENG MGR.	CHIEF ENG.	QA MGR.	DOE APP.
△								
△								
△								
△	5-1990	AS-BUILT	MSP	FJG	DAJ	mac	Cancel	—
△	9-1989	ISSUED FOR CONSTRUCTION	—	—	—	—	—	—

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

DESIGNED FJG | DRAWN B.M.
CHECKED W.O.C.
INSPECTED P.F.L.
RECOMMENDED P.M.L.
APPROVED F.J. FELTZ 9/11/89 | E.S. Smith 9/11/89 | DOE PROJECT ENGINEER Chris D. Watson 9/13/89

GREEN RIVER SITE
GREEN RIVER, UTAH
SURVEILLANCE AND MAINTENANCE PLAN

AERIAL PHOTOGRAPHY AND MAPPING PROJECT AREA

MORRISON-KNUDSEN ENGINEERS, INC.
UMTRA PROJECT

PROJECT NO. DE-AC04-83AL18796
DRAWING NO. GRN-PS-10-0602 REV. —

APPENDIX E

MATERIAL TESTING SUMMARY REPORT

APPENDIX E

MATERIAL TESTING SUMMARY REPORT

This appendix contains a summary of all field and laboratory geotechnical test results. All inspections and tests were performed in accordance with the Green River, Utah Remedial Action Inspection Plan and the Design Specifications. All inspections and tests were in compliance with the specified requirements, unless noted otherwise.

APPENDIX E

MATERIAL TESTING SUMMARY REPORT

INDEX

TYPE A SELECT FILL

TYPE A SELECT FILL

- The Type A select fill was acquired from the top portions of the cell embankment excavation after top soil had been removed.

- Samples were obtained from the Type A select fill stockpile and tested prior to placement in the cell embankment. The tests were conducted to analyze particle size distribution, maximum density, and optimum moisture in accordance with ASTM C-136 and ASTM D-698.

- The Type A select fill material was placed at the bottom and around the perimeter of the cell embankment. The primary equipment used was as follows: Caterpillar 631 E Scrapers for loading, hauling and dumping; Caterpillar D-7, D-9 and D-10 Dozers for spreading loose lifts to 12 inches or less; and a Caterpillar 825 Sheepsfoot and 553 Smooth Drum Roller for applying compaction.

- The required degree of compaction for the Type A fill was 95% of the maximum dry density as determined in accordance with ASTM D-698. The required frequency for verifying compaction was one field density test for each 1,000 cubic yards of material placed.

- Compaction control was accomplished by performing in-place soil density tests in accordance with ASTM D-1556 and ASTM D-2922.

- The average percent compaction obtained for the Type A fill was 98.4% which was determined from a total of 83 passing field density tests. There were 52,339 cubic yards of material placed, which divided by 83 passing tests, equals one field density test performed for each 631 cubic yards of Type A material placed.

- There were 12 failing density tests within 9 different areas, all of which required rework in order to satisfy the specified compaction requirements. All areas which were known to require rework, were reworked and retested in accordance with the specified requirements.

- The required frequency for maximum density determinations was a minimum average of one for each 15,000 cubic yards of Type A fill material placed. There were 9 maximum dry density determinations performed in accordance with ASTM D-698. Considering there were 52,339 cubic yards of Type A fill material placed, this provides a frequency of one maximum dry density determination test performed for each 5,815 cubic yards of material placed.

- The required frequency for one-point tests was a minimum average of one for each five field density tests performed. There were 17 one-point proctor tests performed to ensure that the correct maximum dry density value was utilized when performing field density tests. Considering that there were a total of 83 field density tests performed, this provides a frequency of one one-point proctor test for each 4.9 field density tests performed.

- The required frequency for sand cone correlations was one for each ten Type A fill nuclear density tests performed. Considering 14 sand cone comparisons were performed for 66 nuclear density tests, the average equaled 4.7 nuclear density tests per sand cone comparison.

- One sand cone comparison out of the 14 taken was not within the allowable limits of plus or minus 2% on density. All tests taken since the last comparison were re-evaluated and retested in accordance with the specified requirements.

- The Type A fill material was moisture conditioned as needed to achieve acceptable compaction and to maintain uniformly distributed moisture within the specified requirements. This was accomplished by either the addition of water or allowing the material to dry after scarification.

- The Type A fill was required to have moisture during compaction at between optimum moisture and minus 4% of optimum moisture as determined by ASTM D-698.

- Moisture control was accomplished by performing in-place moisture tests in accordance with ASTM D-2216, D-3017 and D-4643.

- From the 83 passing moisture tests taken on the Type A fill, the average moisture was 8.4% with the average deviation from optimum moisture content of 1.5%.

- There were 5 failing moisture tests within 5 areas, all of which required rework in order to satisfy the specified moisture requirements. All areas which were known to require rework, were reworked and retested in accordance with the specified requirements.

- One oven dried moisture sample was required for every ten microwave moisture samples conducted. From 33 microwave oven moistures conducted, 6 oven dried moisture comparisons were performed. This equates to an average of one oven dried moisture for every 5.5 microwave moistures.

- Gradation samples were acquired from in-place Type A fill material and tested in accordance with ASTM C-136.

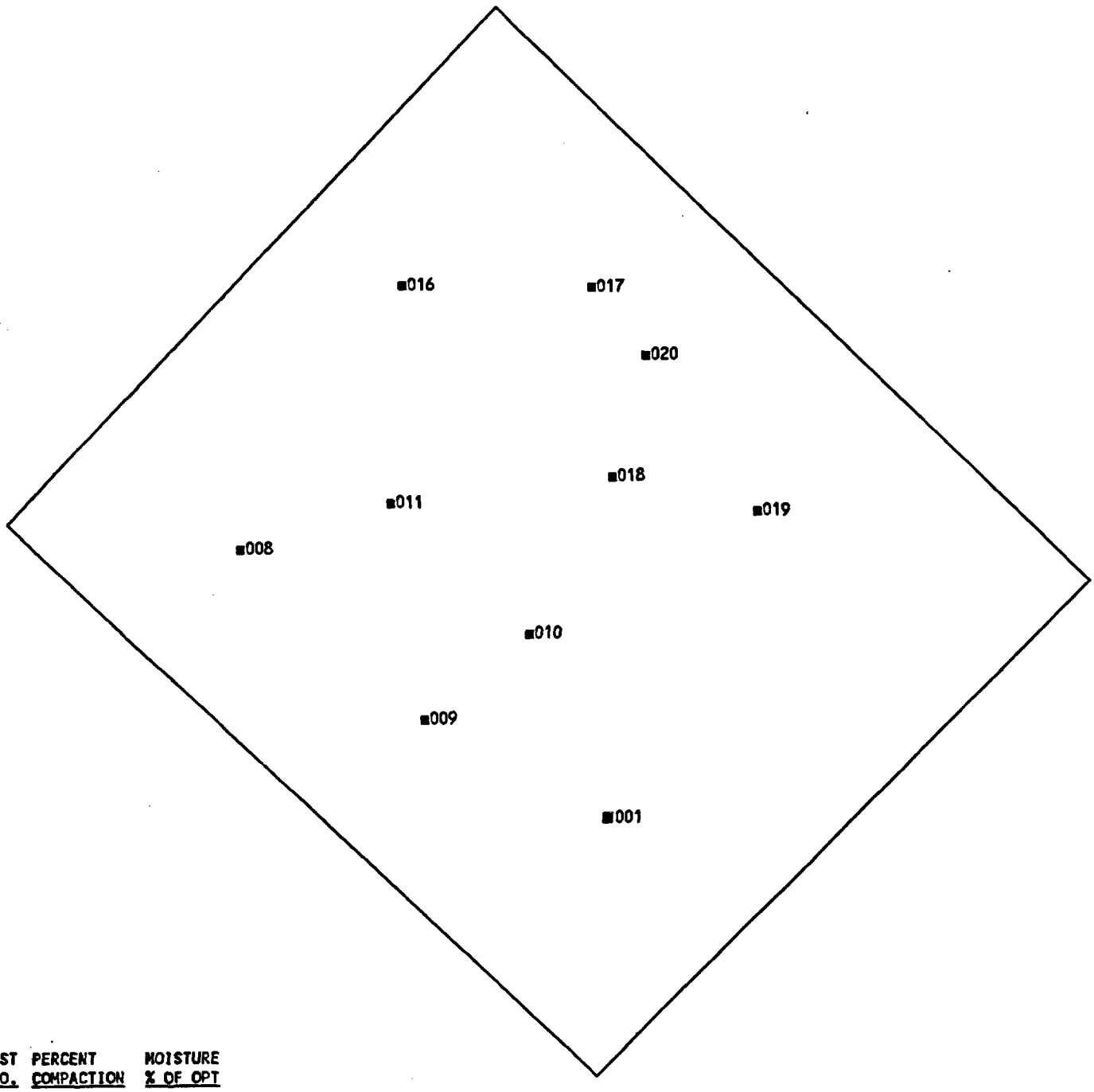
- The required frequency for performing gradations tests was a minimum of one test for every 2,000 cubic yards of Type A fill material placed. The specified gradation required 95 to 100 percent passing the 1 inch screen. All 39 gradation tests conducted passed, representing 52,339 cubic yards of material placed, which provides a test frequency of one gradation test for each 1,342 cubic yards of Type A fill material placed.

- All tests and inspections were performed in strict accordance with the specification requirements.

- The following data has been provided identifying each Type A fill material density test location.

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

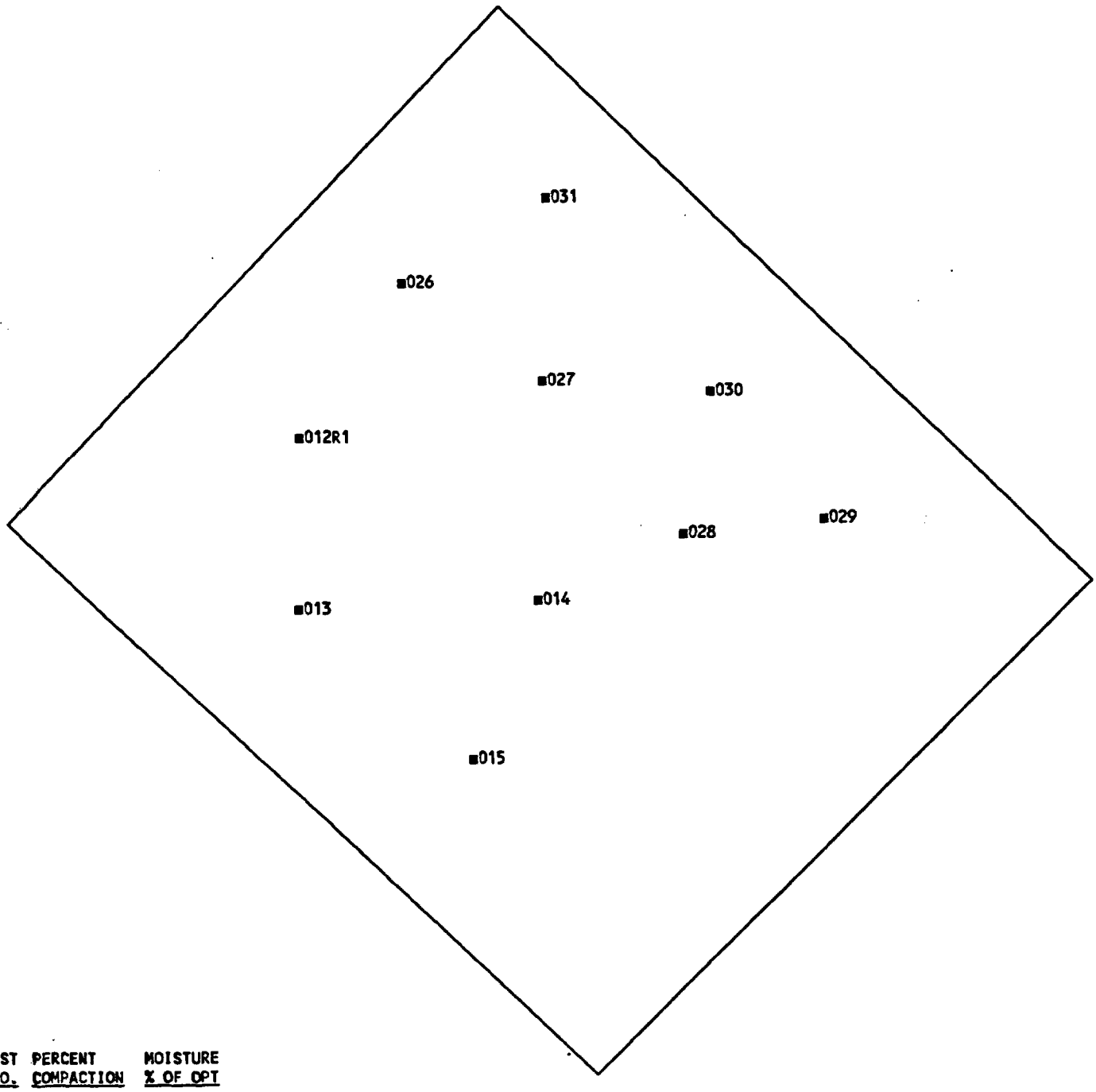
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4099



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
001	98.4	-1.2
008	97.2	-1.4
009	95.4	-3.9
010	95.5	-3.4
011	95.7	-4.0
016	97.4	-2.4
017	95.6	-2.1
018	96.9	-2.2
019	96.1	-1.5
020	95.2	-1.0

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

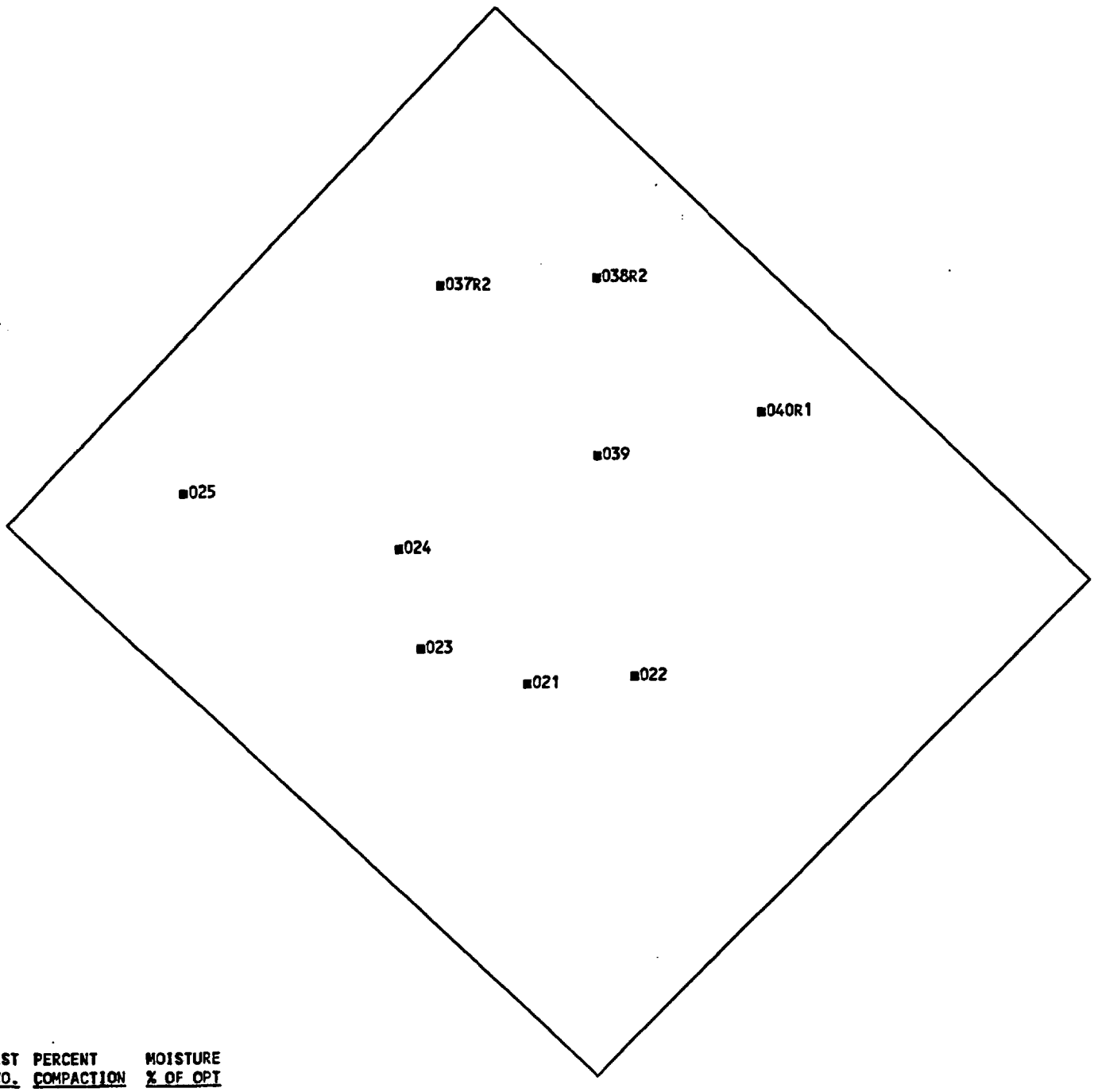
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4100



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
012R1	95.2	-1.1
013	95.3	-3.9
014	95.1	-1.6
015	97.4	-3.4
026	95.2	-3.9
027	99	-1.2
028	98.5	-2.3
029	97.1	-1.0
030	96.4	-1.5
031	95.4	-1.6

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

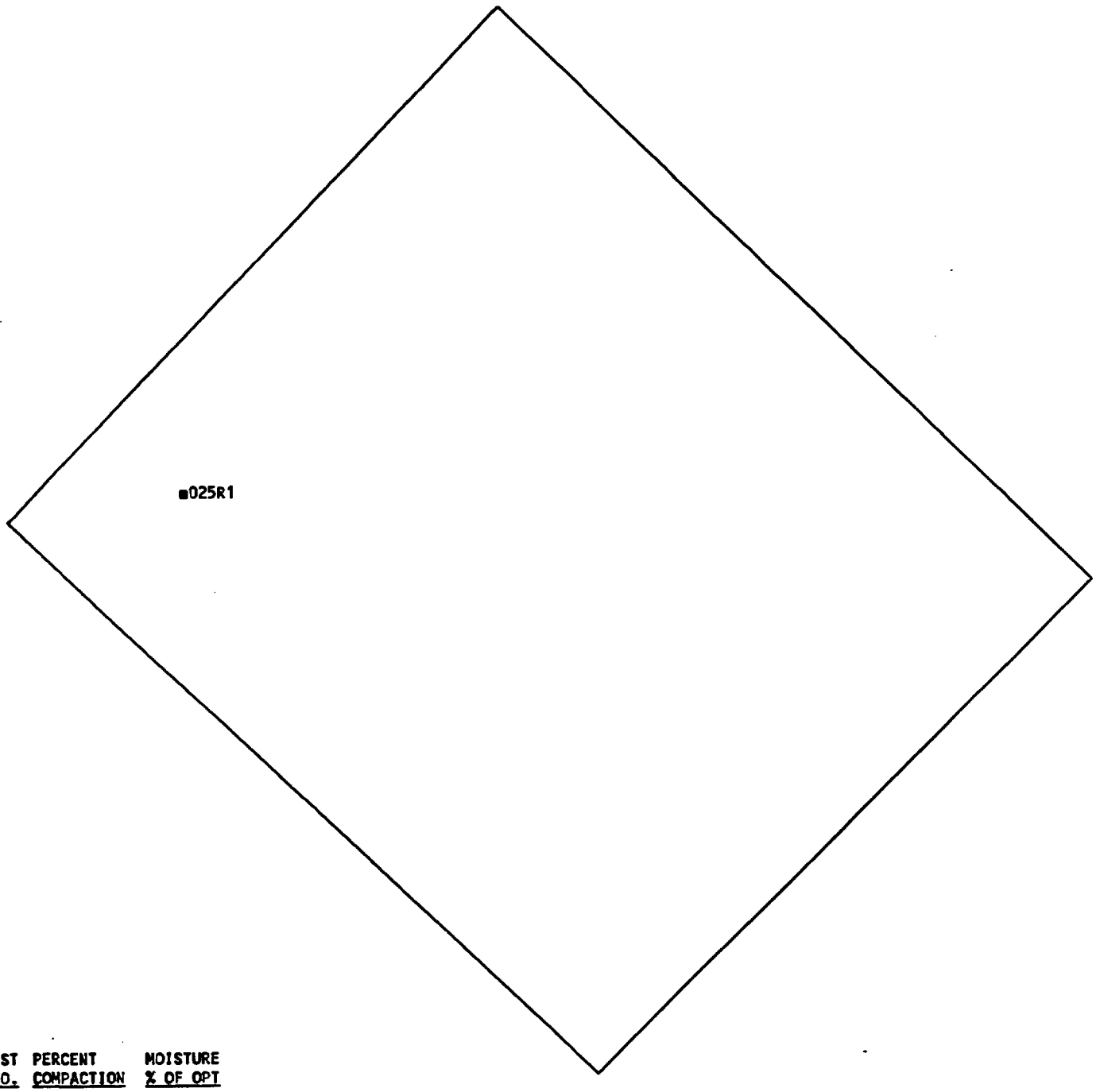
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4101



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
021	96.3	-2.1
022	95.5	-1.8
023	97.5	-0.5
024	97.6	-0.1
025	98	+0.7
039	99.8	-0.3
037R2	99.9	-3.1
038R2	95.6	-1.9
040R1	98.9	-2.0

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

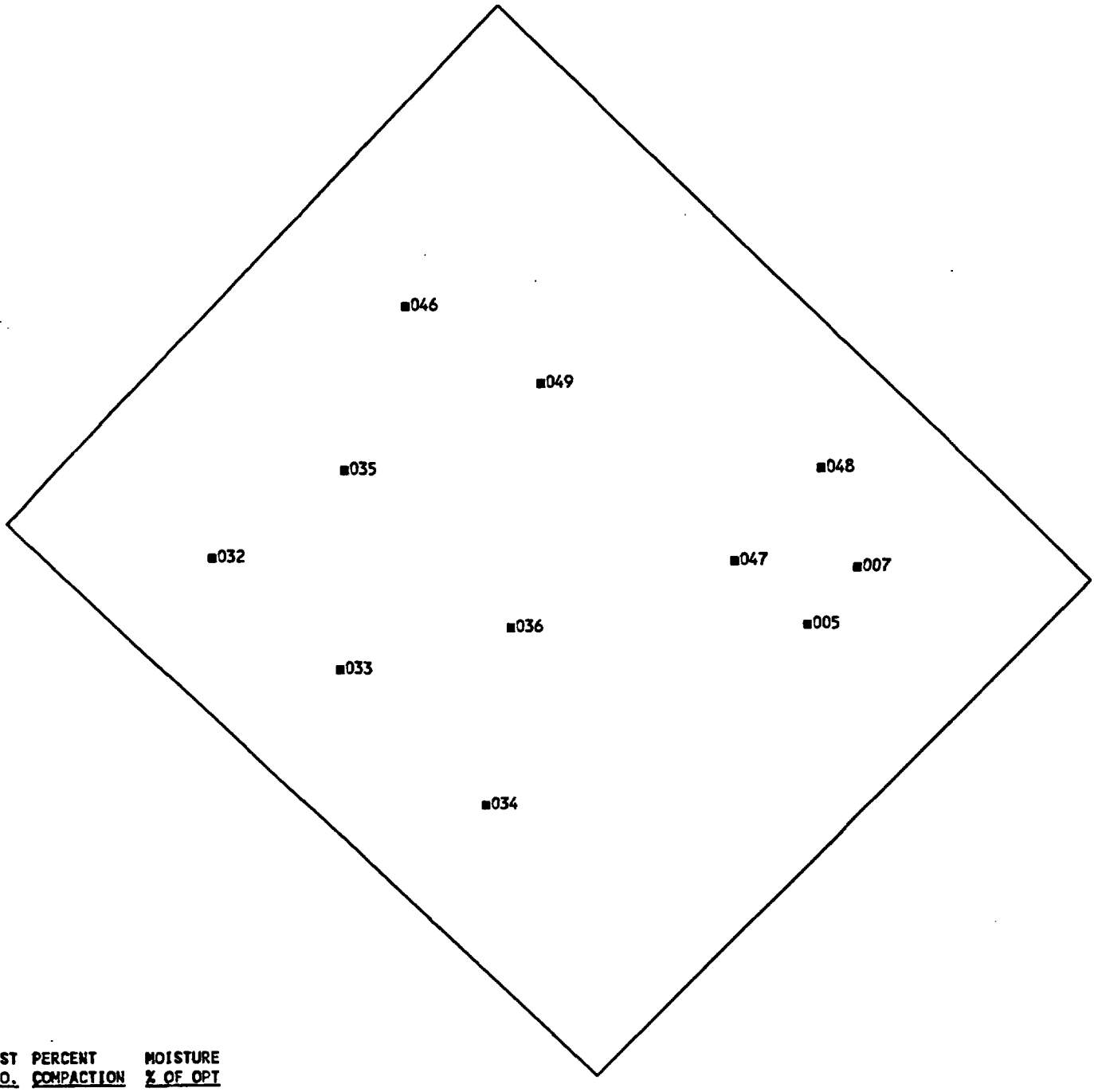
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4101



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
025R1	98.5	-0.6

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

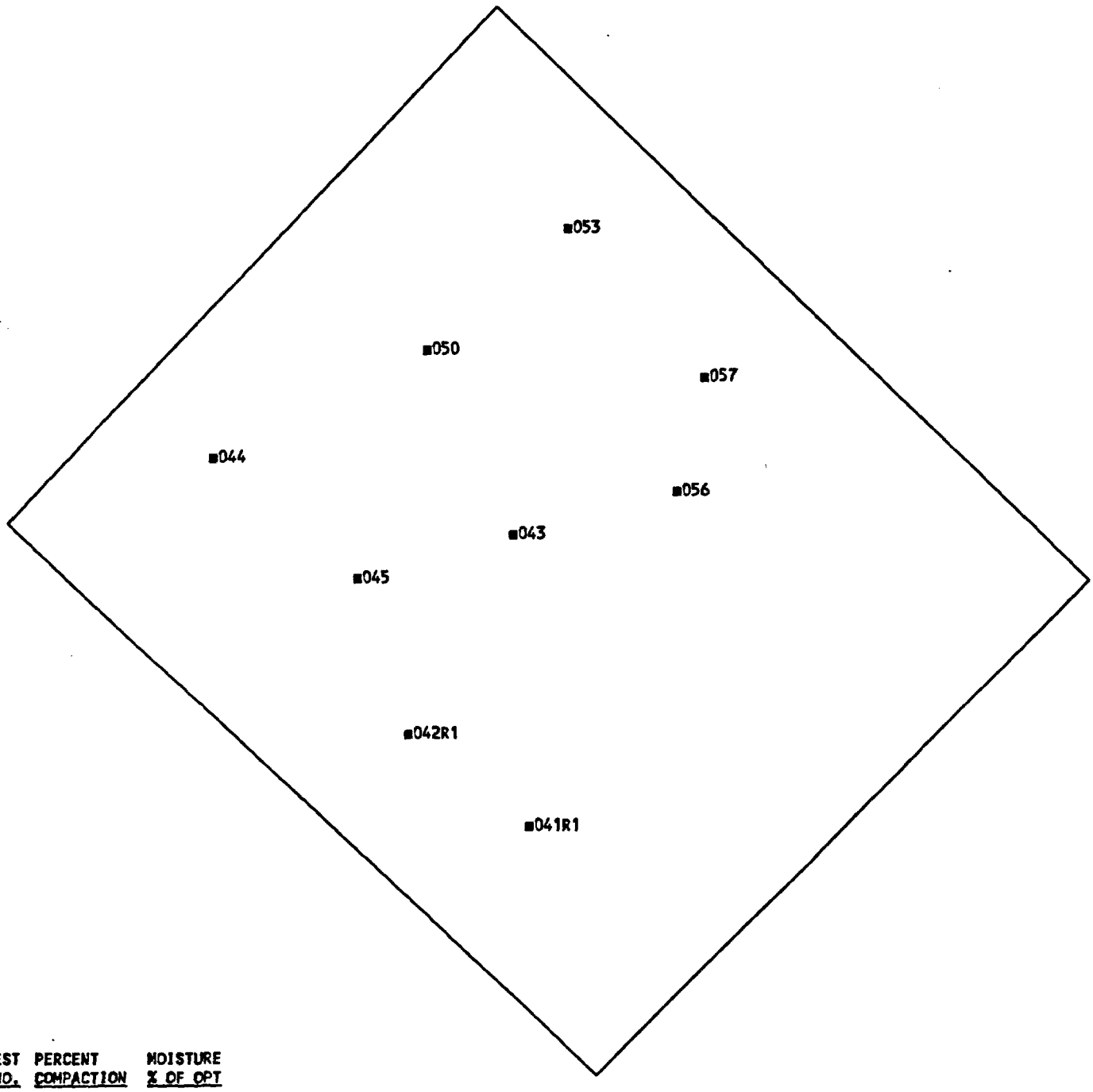
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4102



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
005	96.1	-2.0
007	98.5	-4.1
032	98.2	-1.2
033	97.4	-1.6
034	96	-3.3
035	97.5	-2.8
036	97.5	-1.9
046	98.2	-3.0
047	97	-0.8
048	98.3	-3.3
049	99.2	-2.7

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

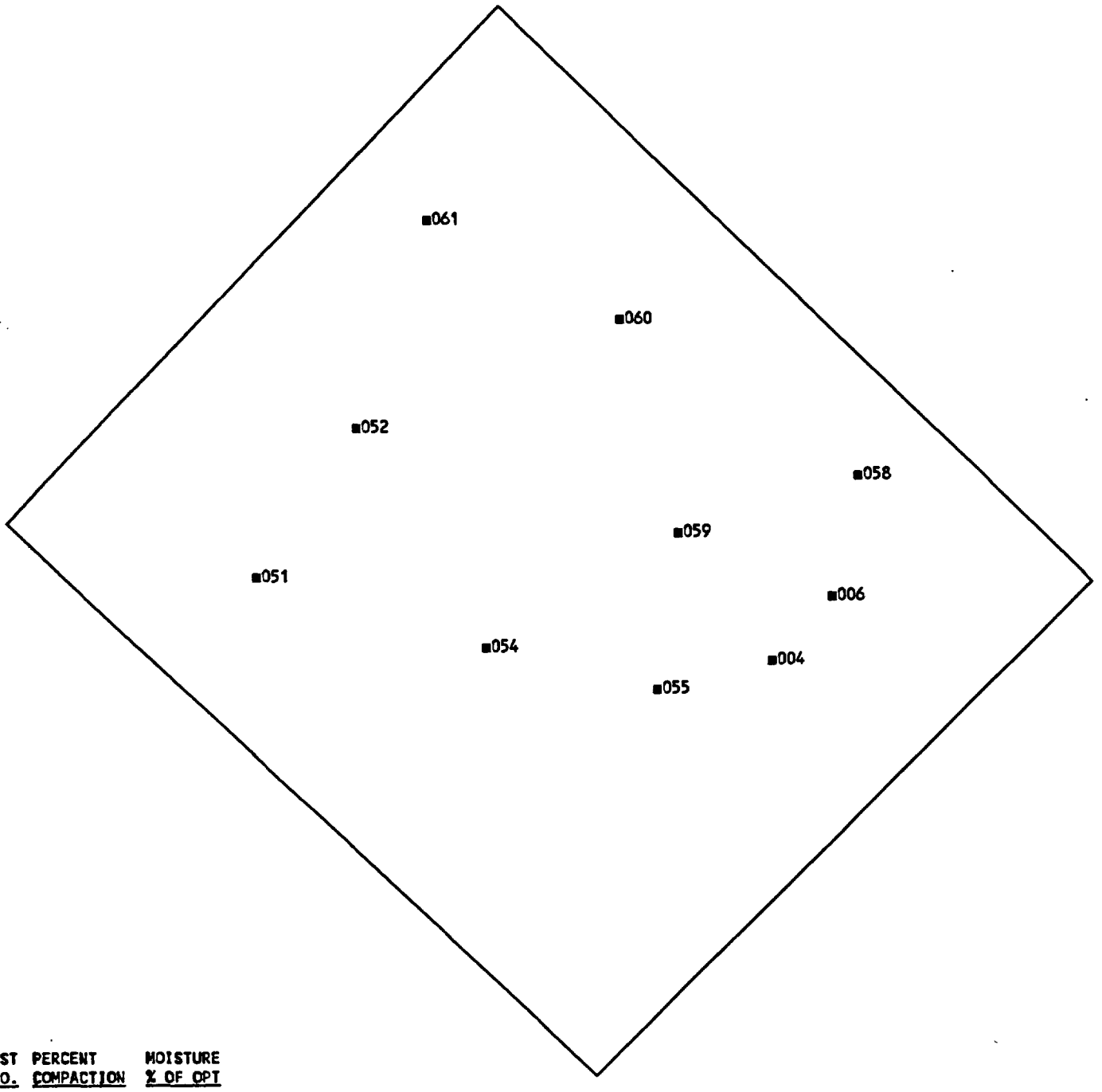
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4103



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
043	95.9	-2.9
044	97.4	-3.0
045	96.2	-2.2
041R1	96.1	-3.2
042R1	97.6	-1.6
050	99.7	-2.4
053	95.8	-3.3
056	98.6	-2.5
057	98.2	-1.6

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

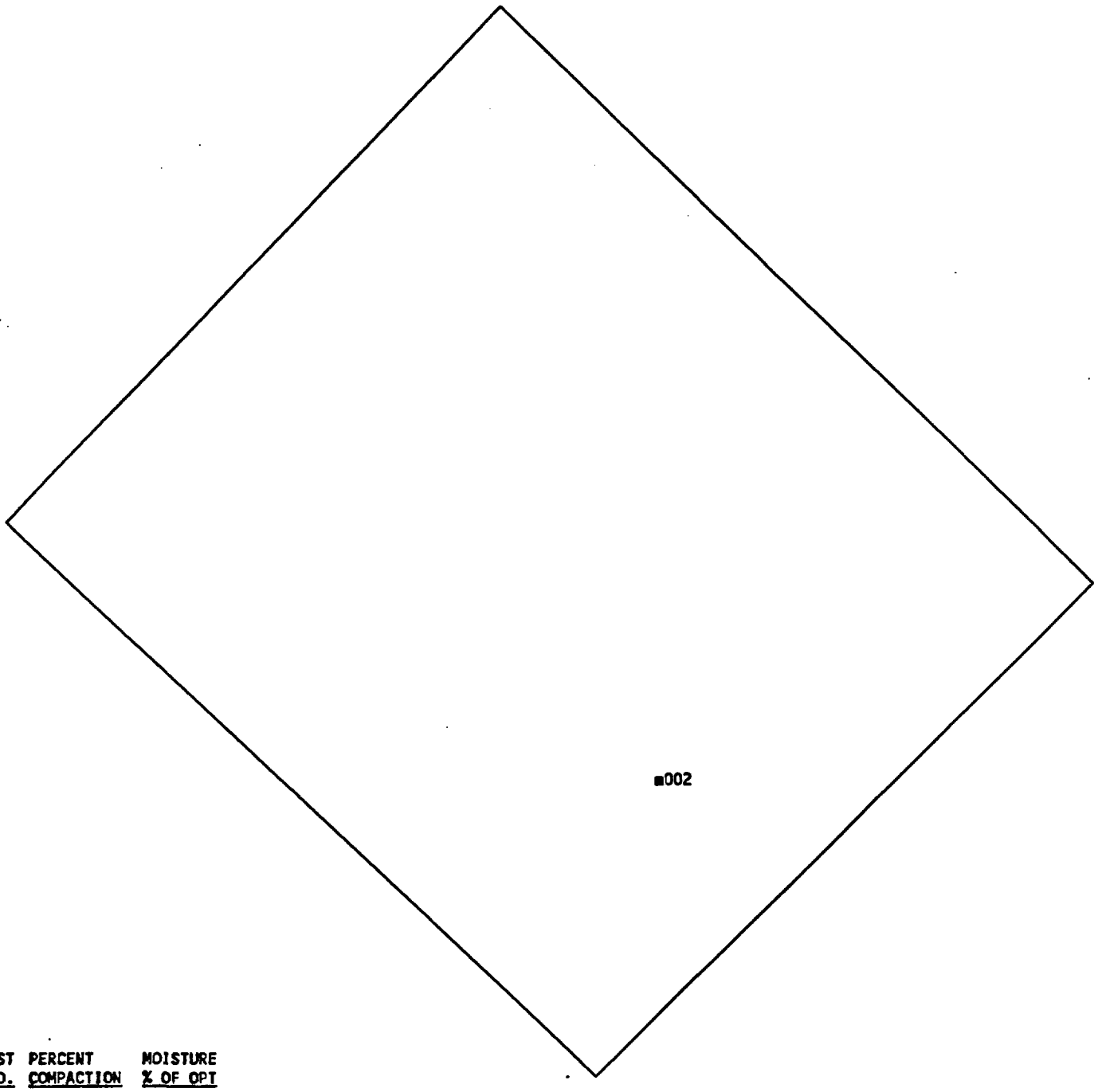
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4104



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
004	95.2	-3.6
006	97.8	-3.6
051	99.1	-2.7
052	100.6	-2.3
054	96.8	-1.1
055	97.2	-1.4
058	97.7	-3.8
059	97.2	-2.1
060	96.1	-2.9
061	96	-3.7

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

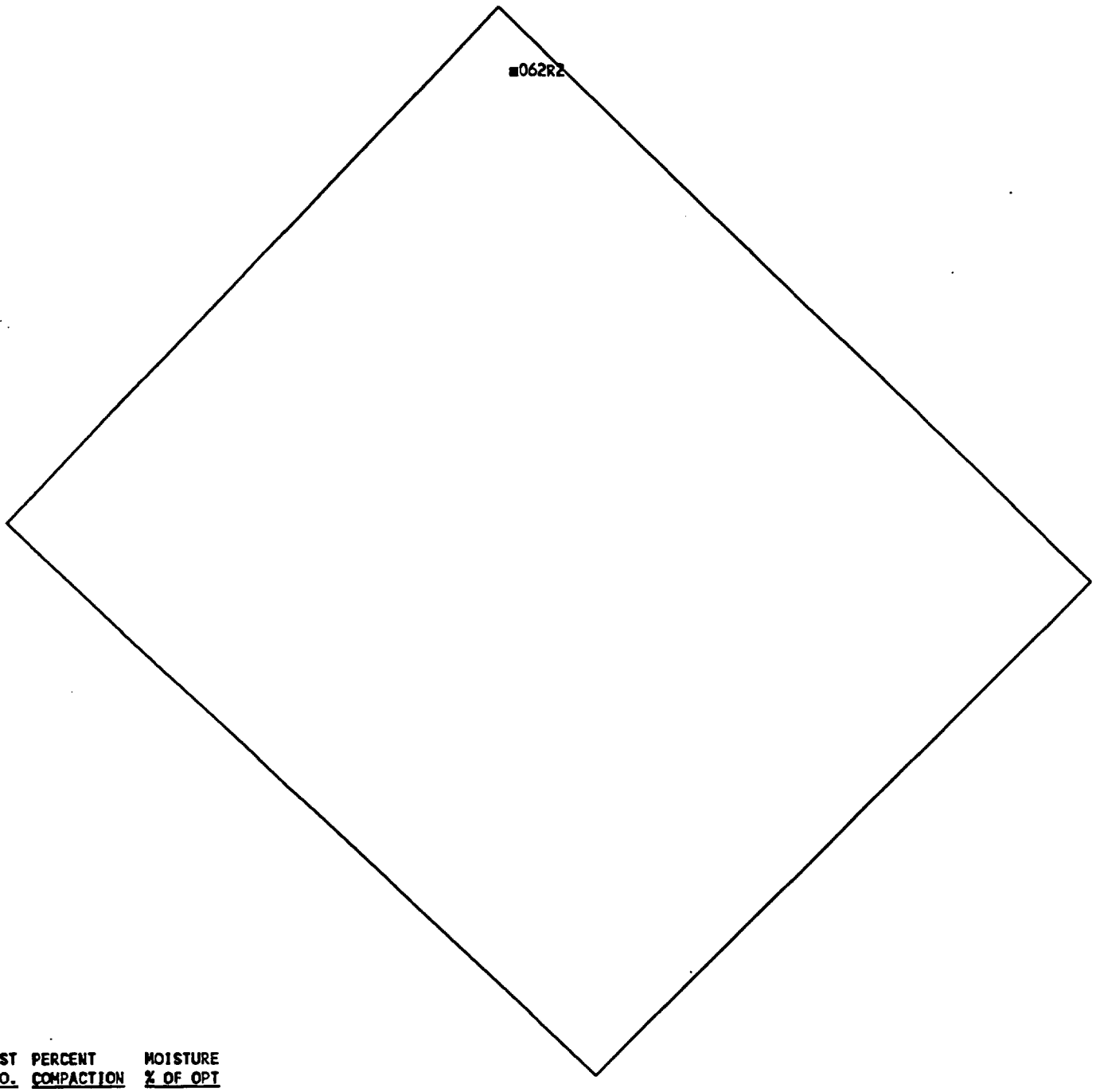
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4108



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
002	96.5	-3.5

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

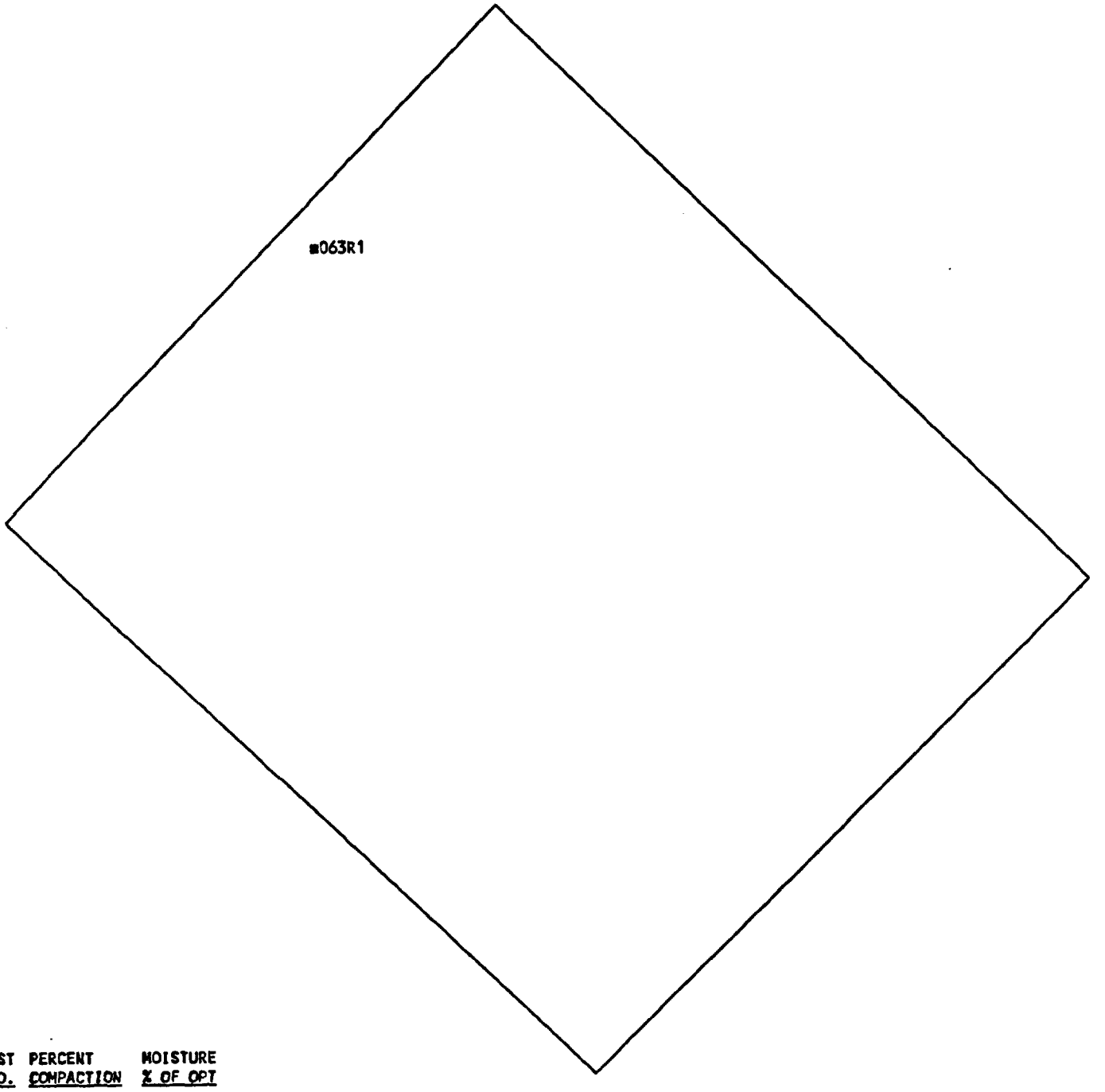
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4110



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
062R2	95.5	-0.8

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

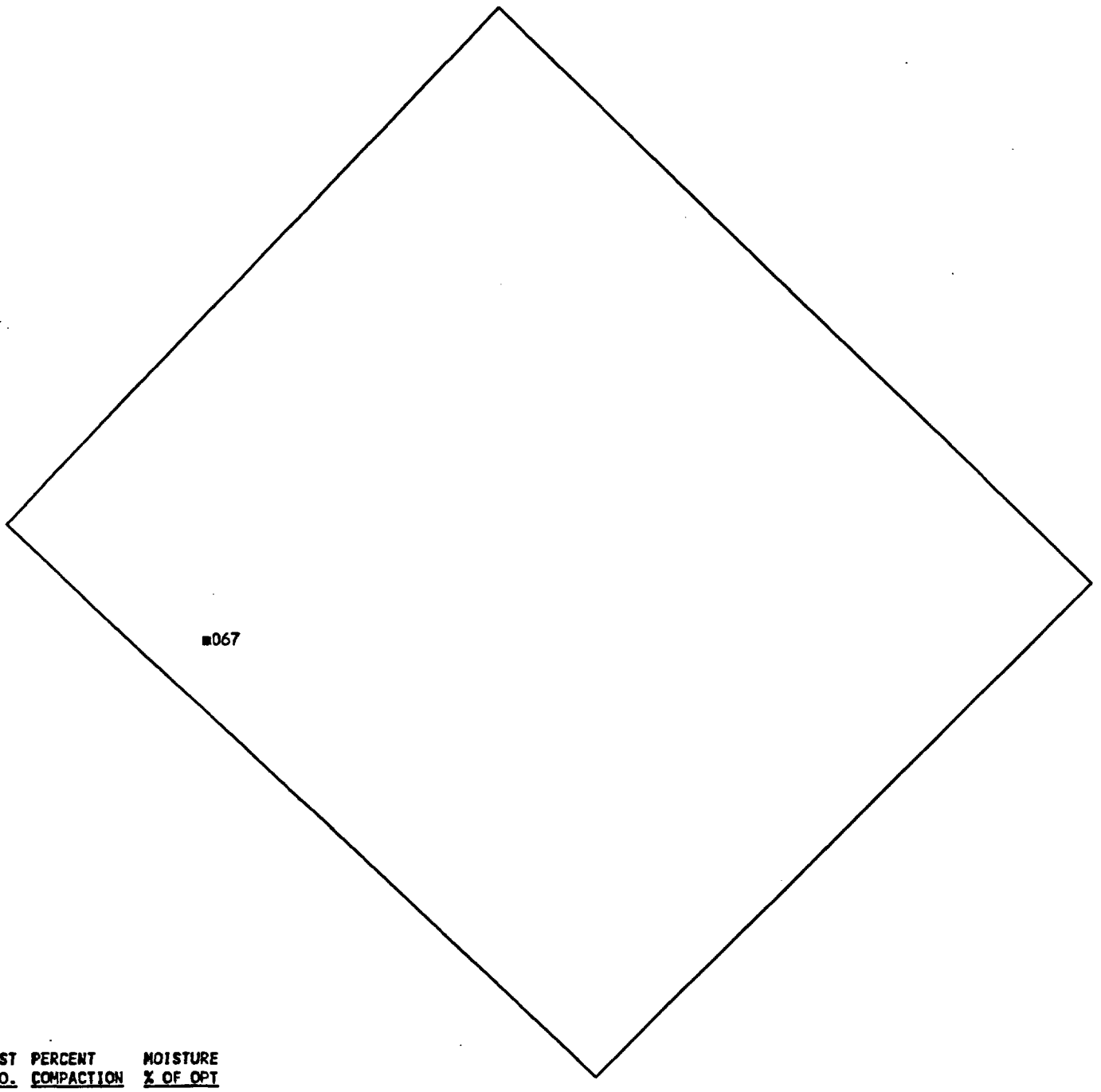
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4111



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
063R1	96.1	-3.4

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

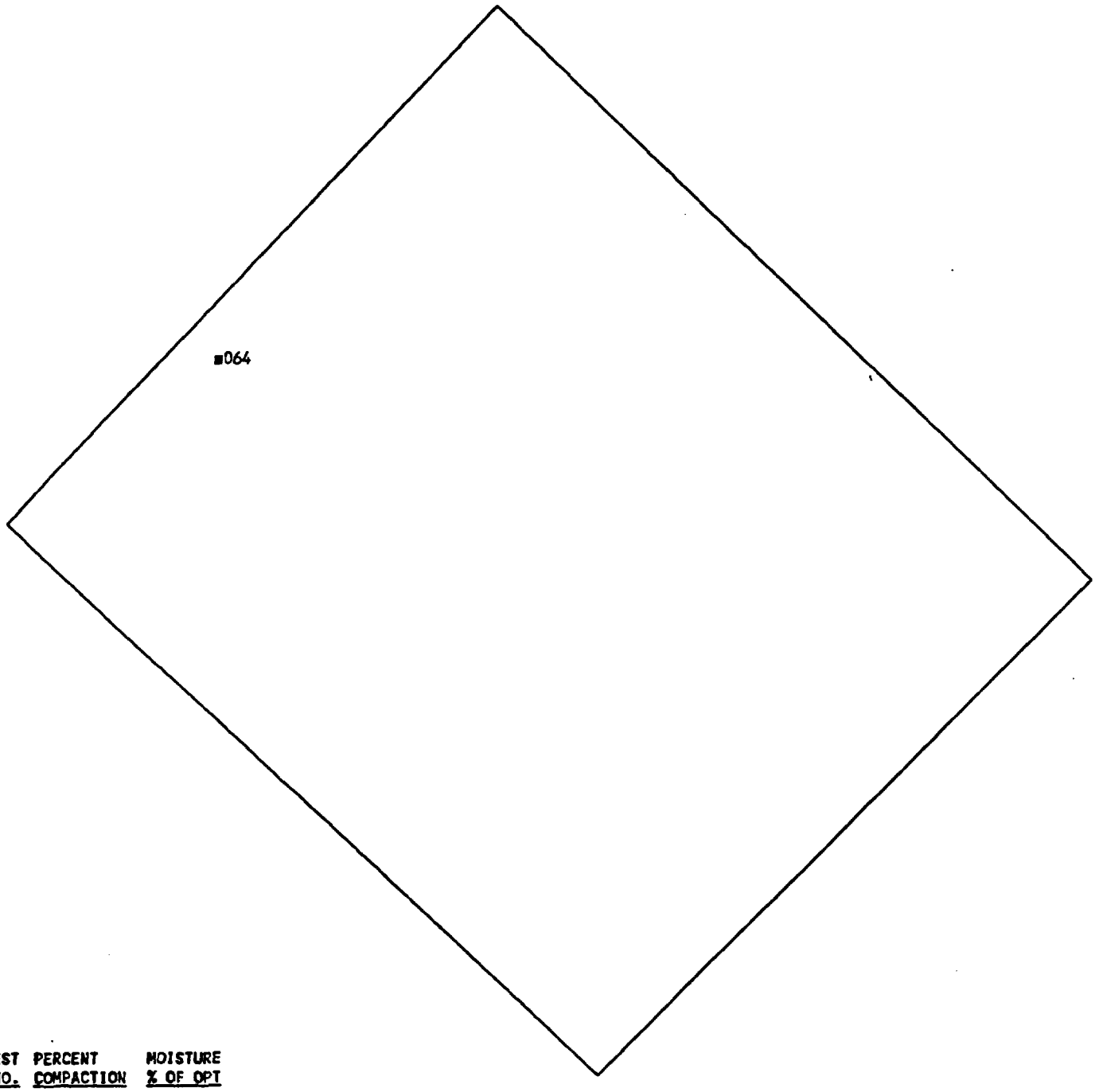
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4112



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
067	97.6	-3.5

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

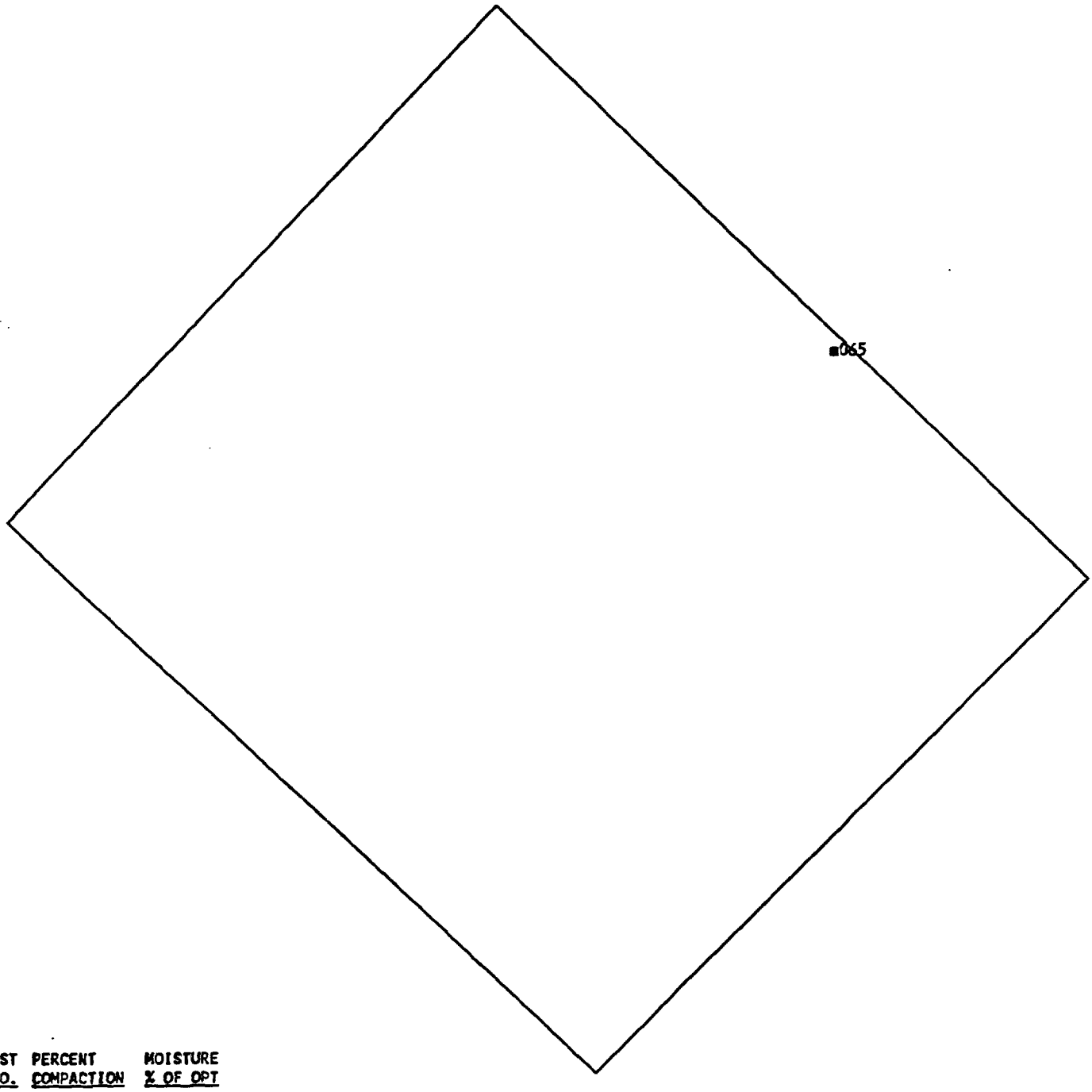
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4113



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
064	96	-3.6

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

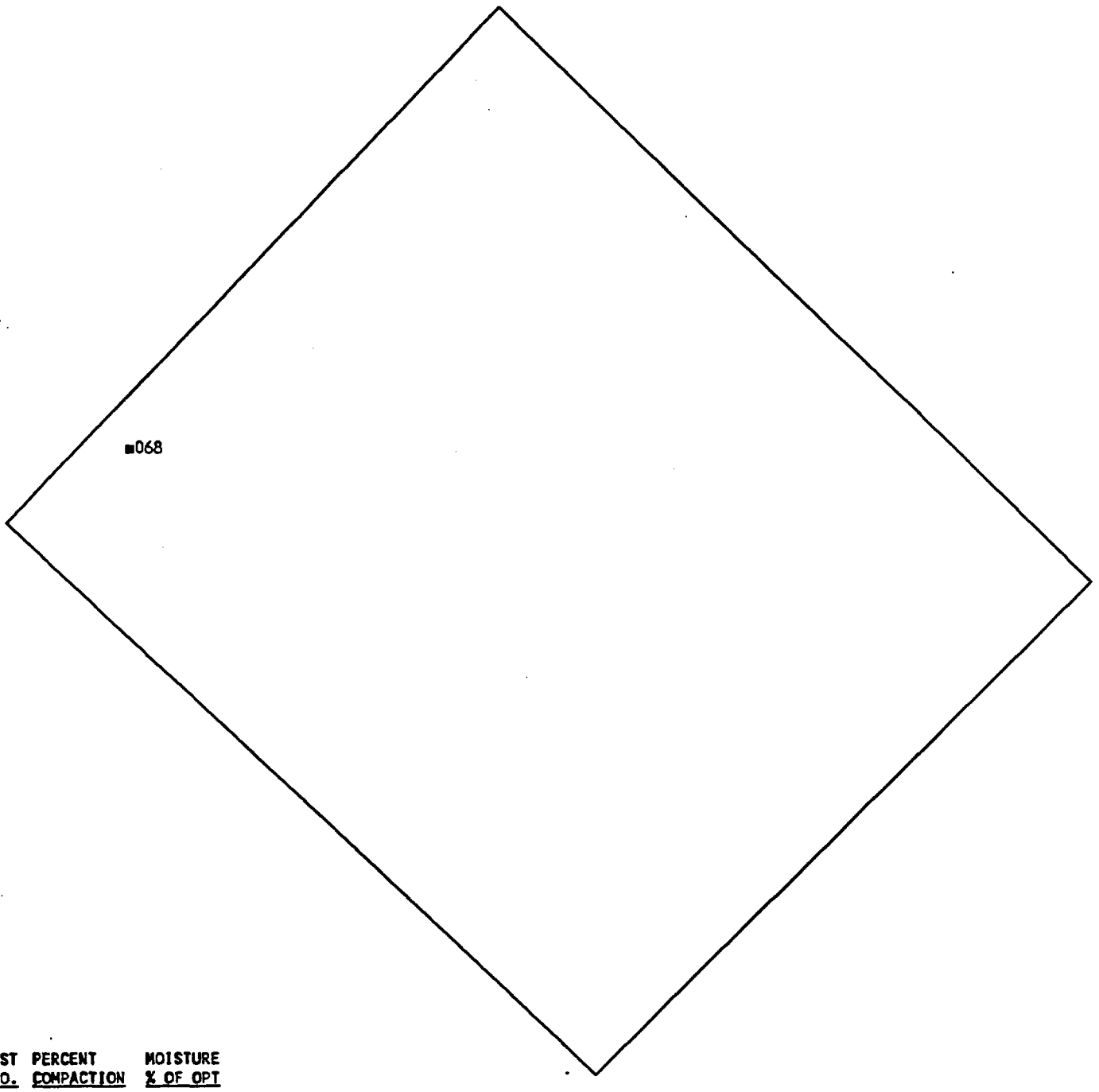
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4114



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
065	99.6	-3.4

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

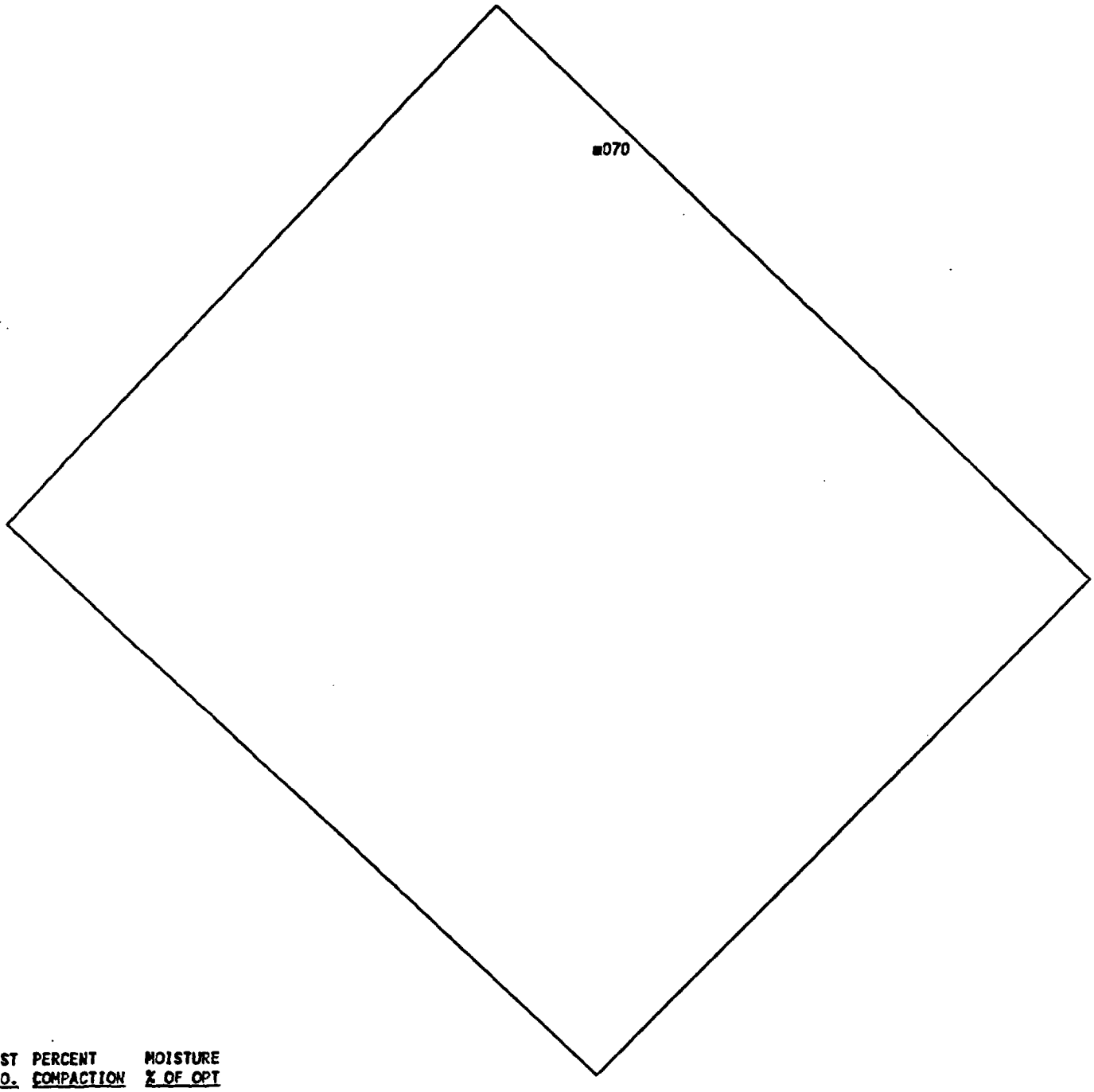
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4115



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
068	100	-3.9

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

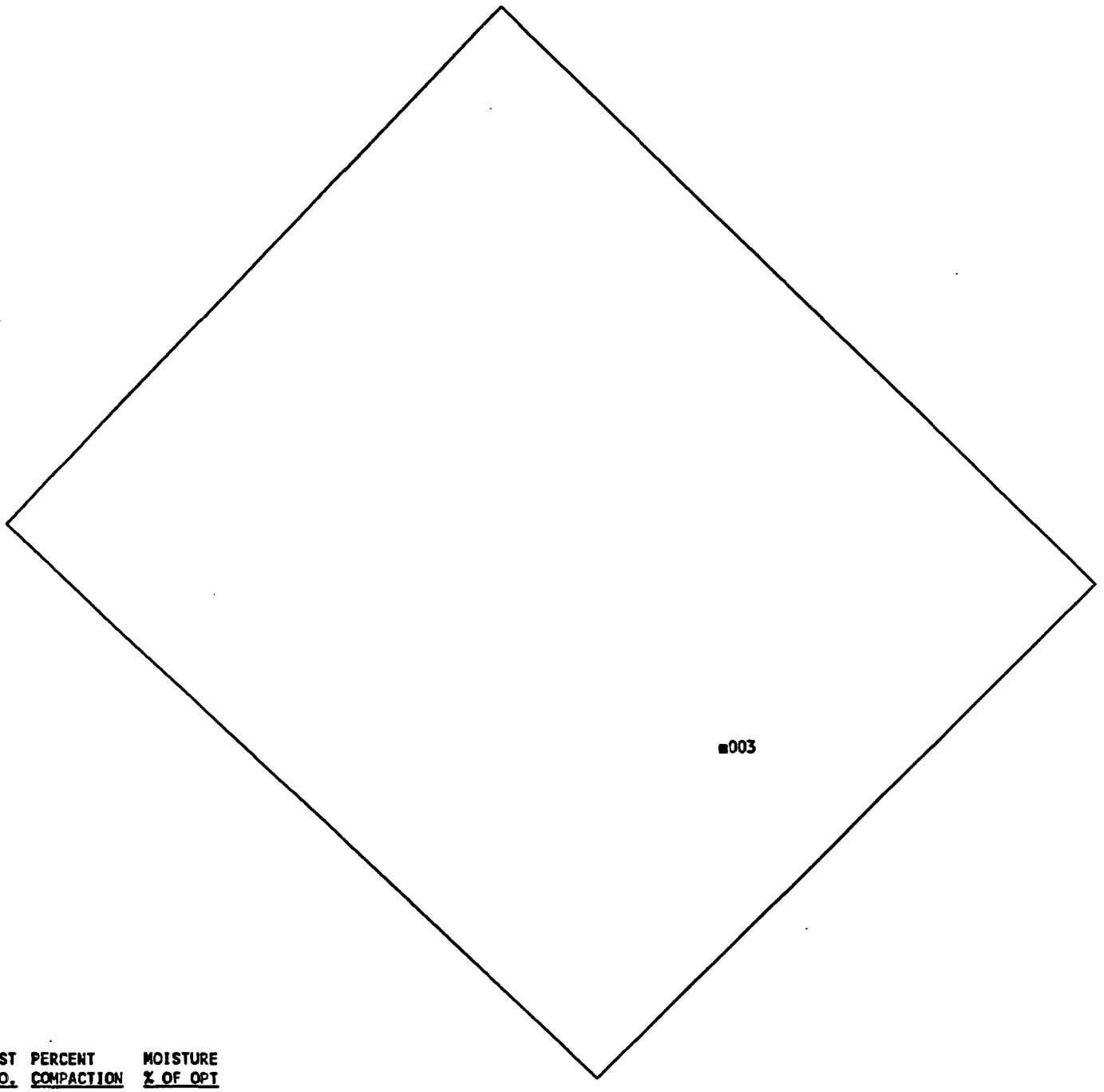
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4116



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
070	99.5	-2.7

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

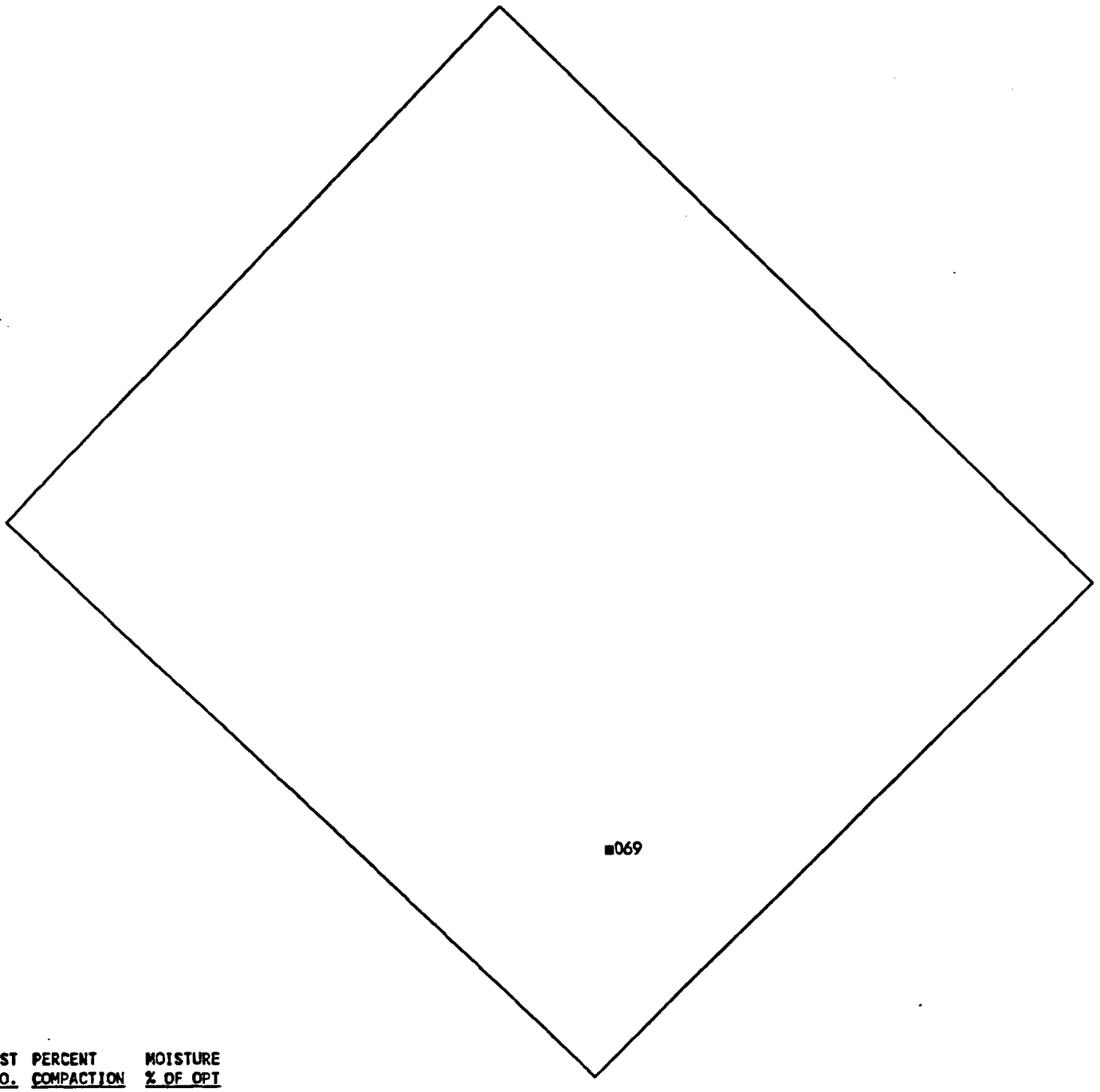
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4117



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
003	96.2	-2.0

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

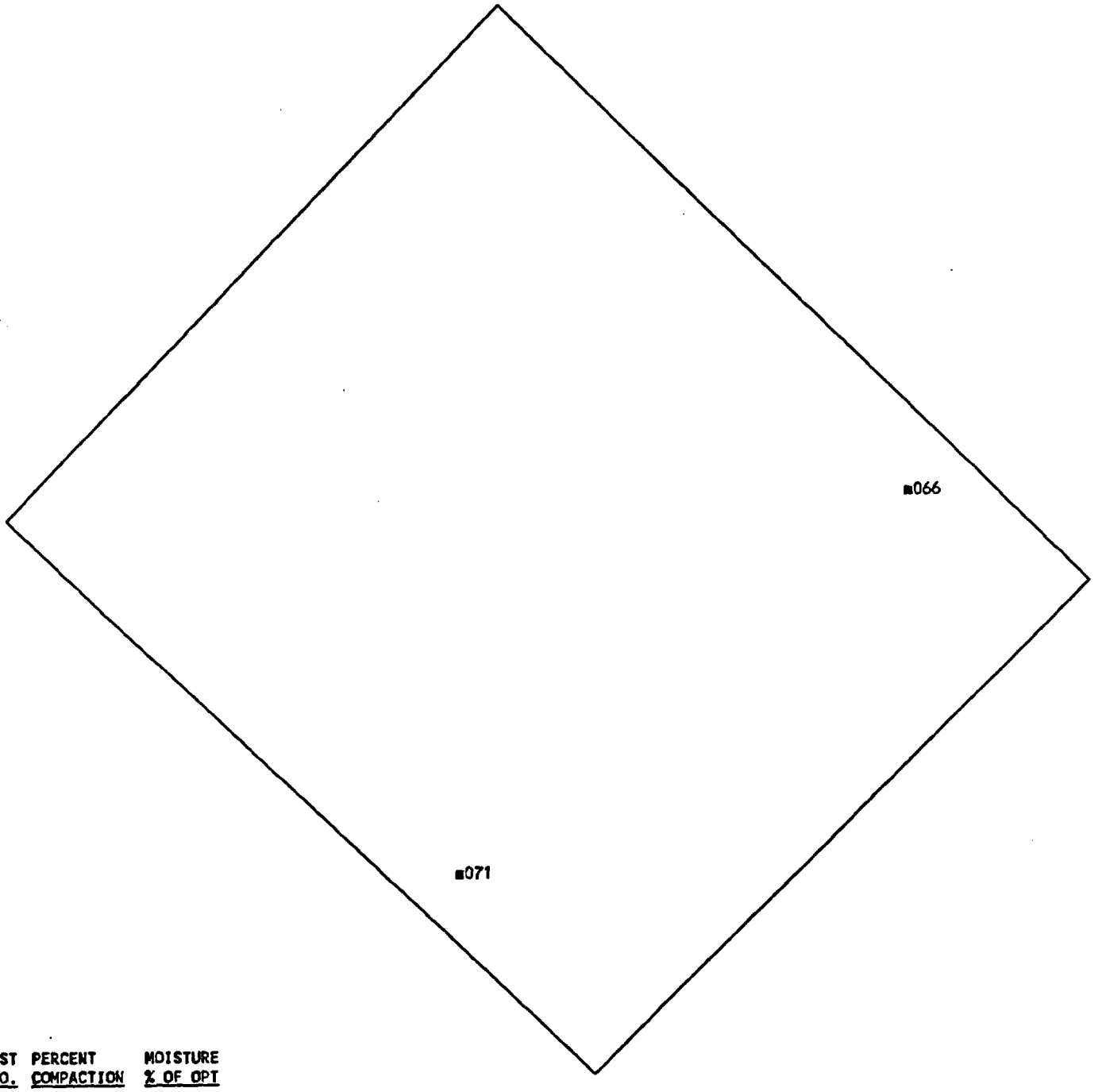
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4118



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
069	99.1	-1.1

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

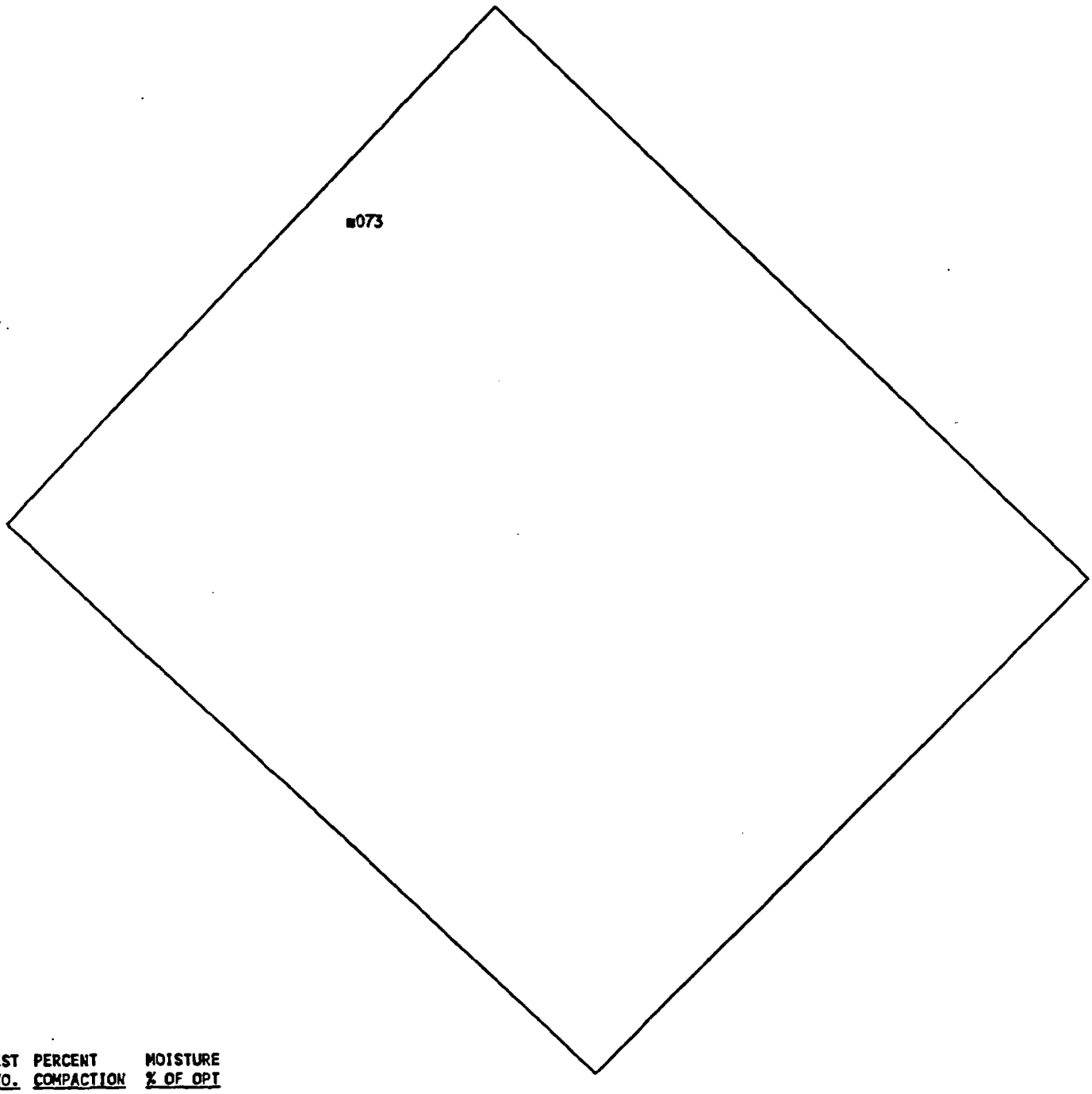
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4119



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
066	103	-3.7
071	97.8	-1.9

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

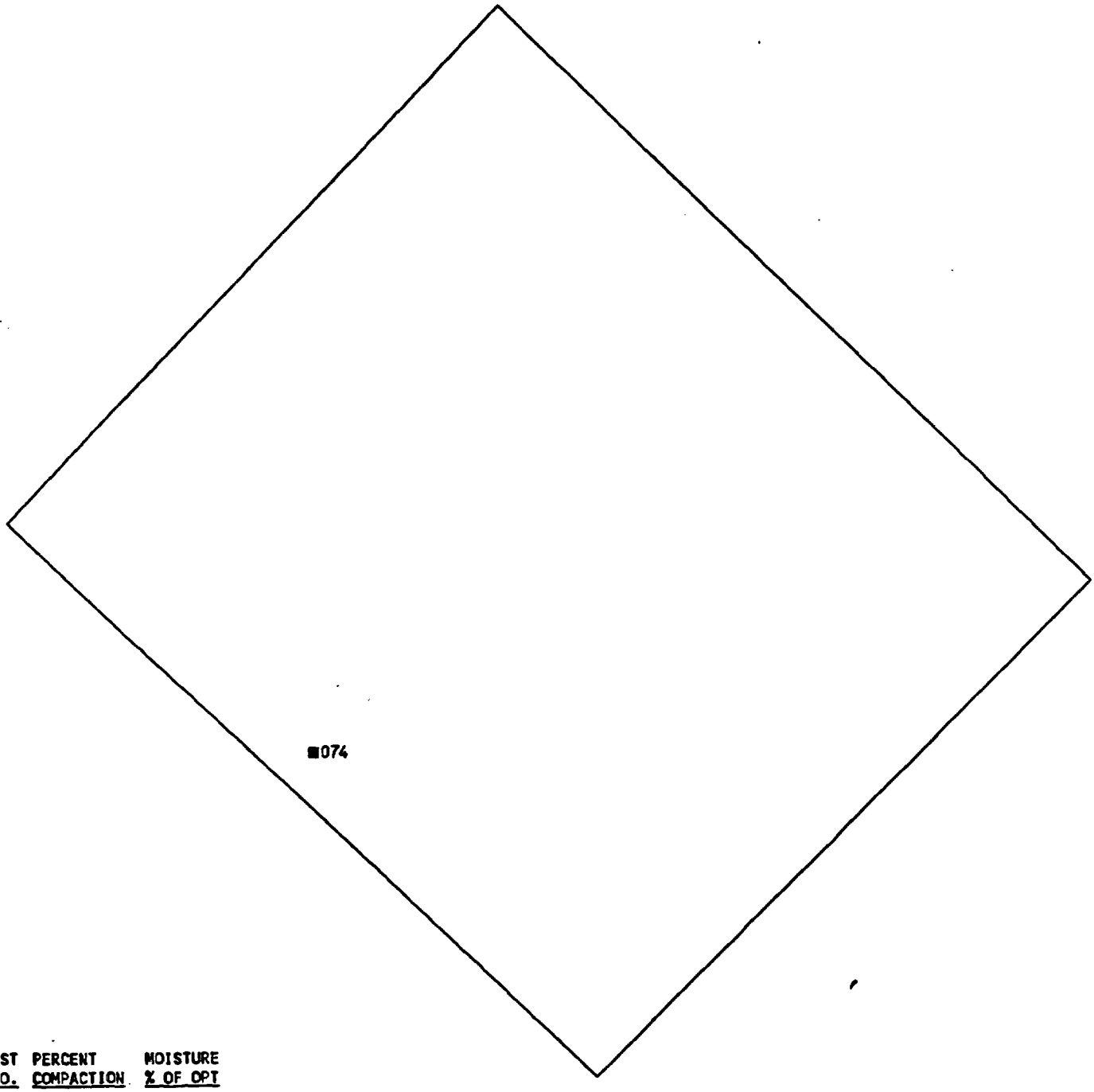
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4120



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
073	95.8	-3.0

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

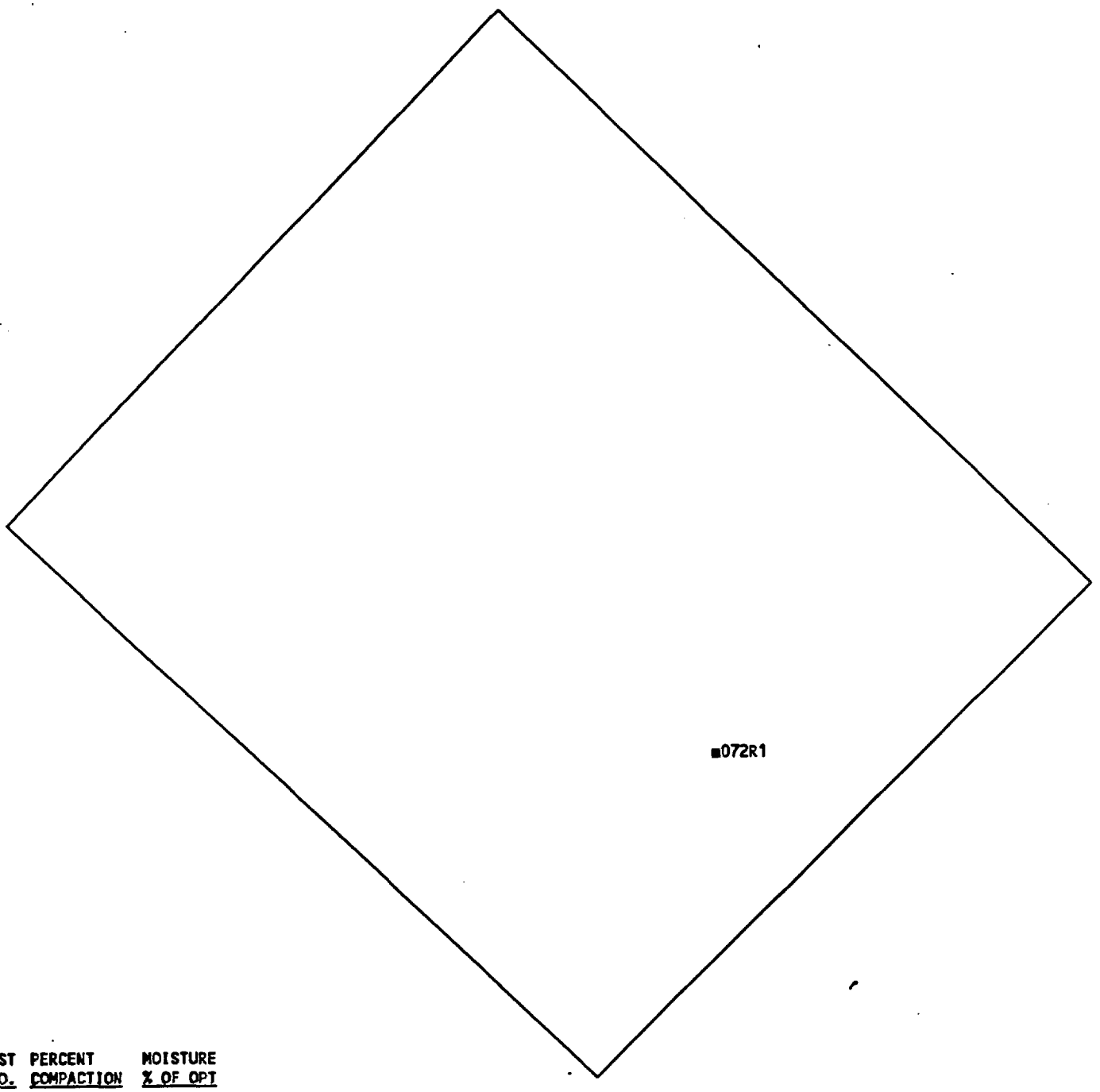
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4121



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
074	98.6	-2.8

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

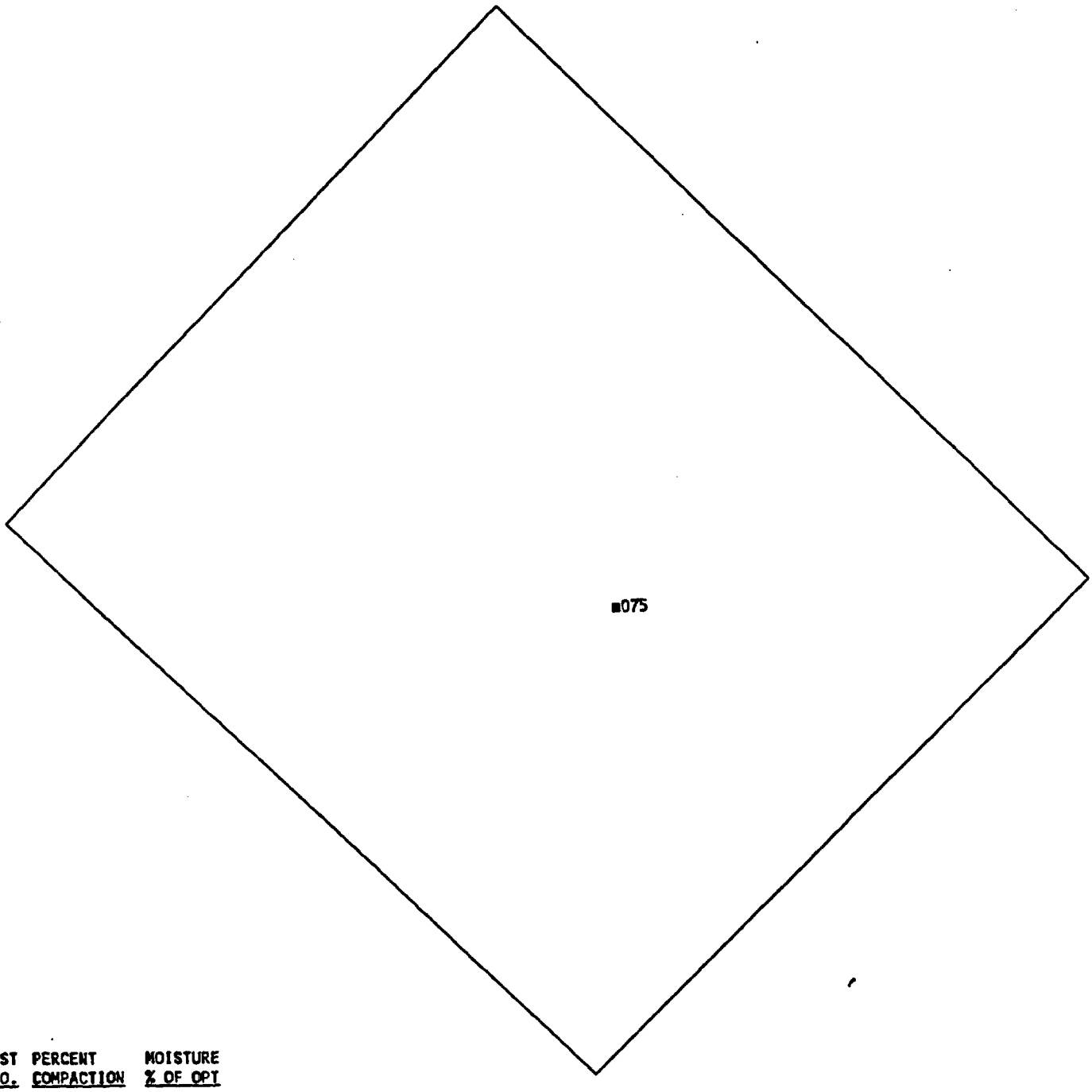
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4122



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
072R1	95.9	-1.6

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

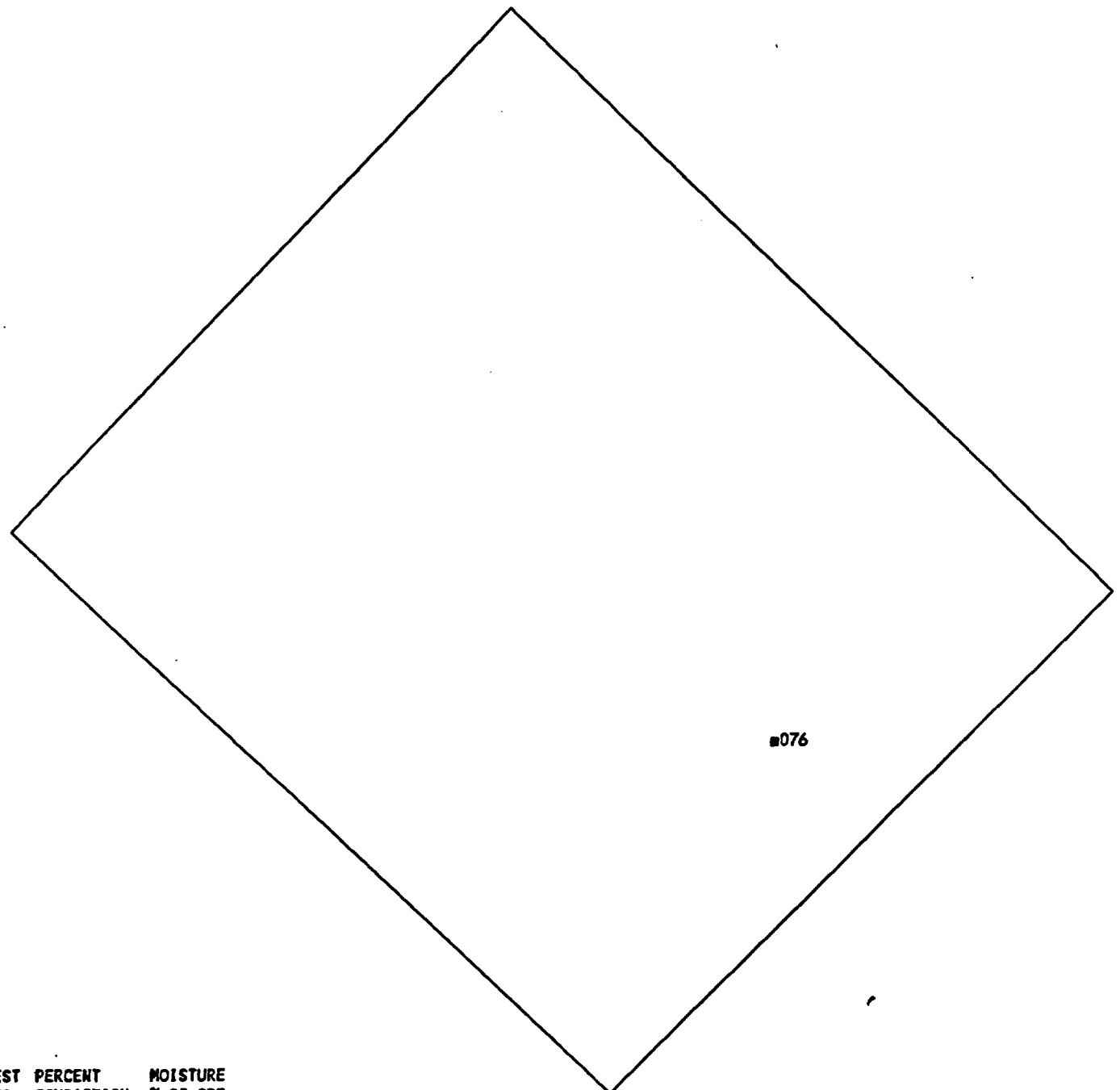
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4124



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
075	99.7	-3.8

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

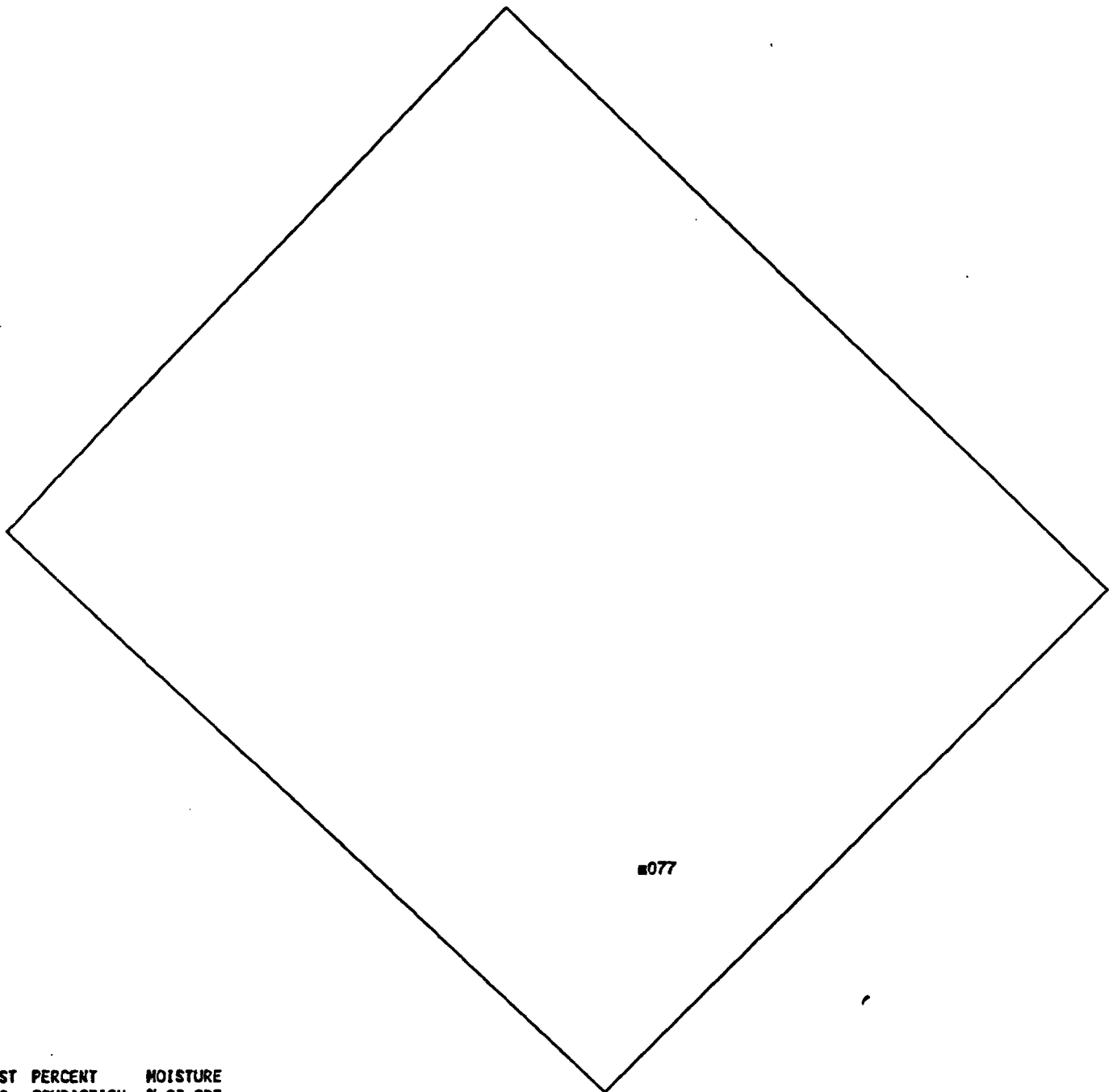
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4125



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
076	95	-0.8

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

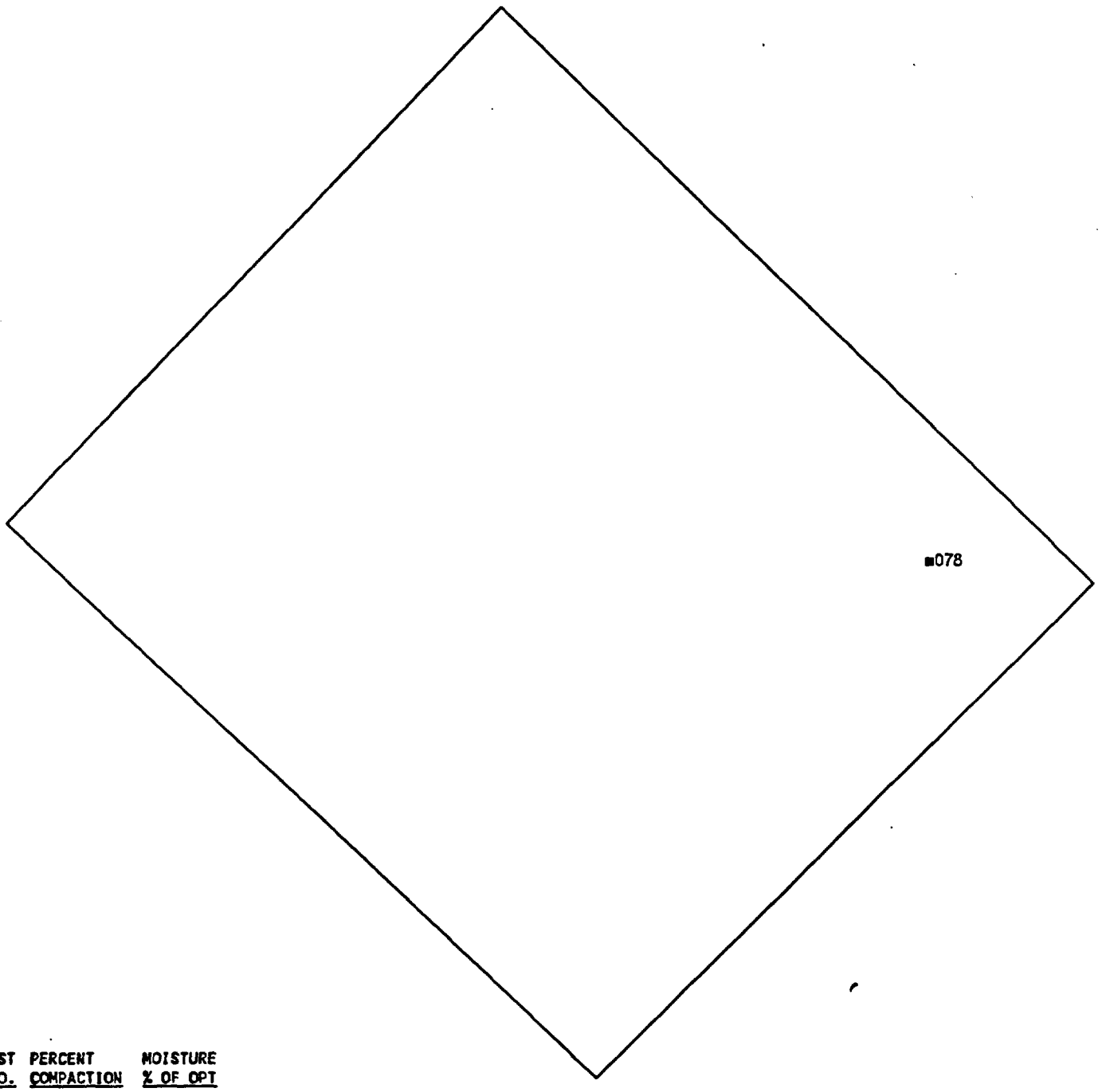
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4127



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
077	98.4	-1.6

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

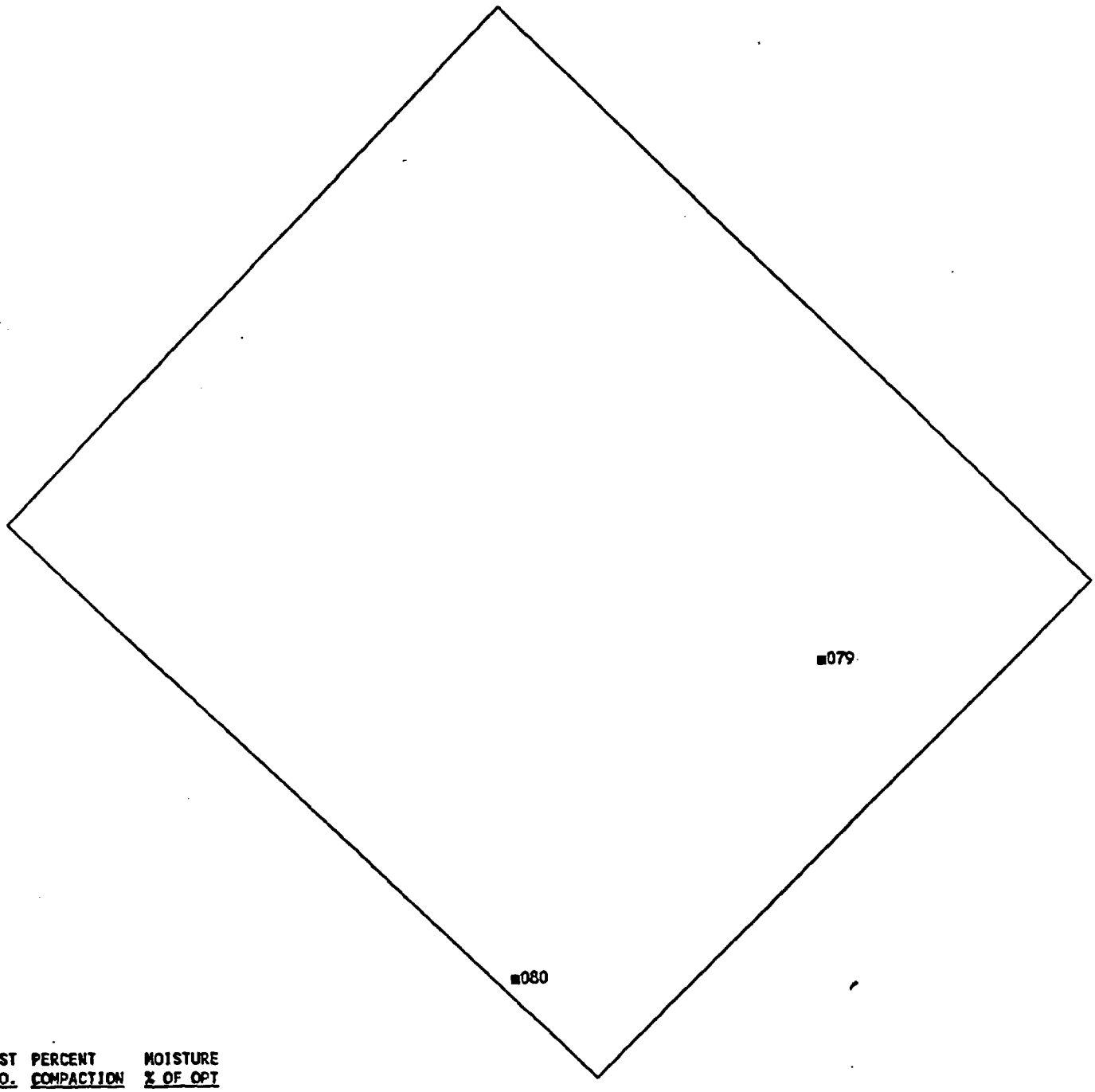
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4128



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
078	96.5	-1.9

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

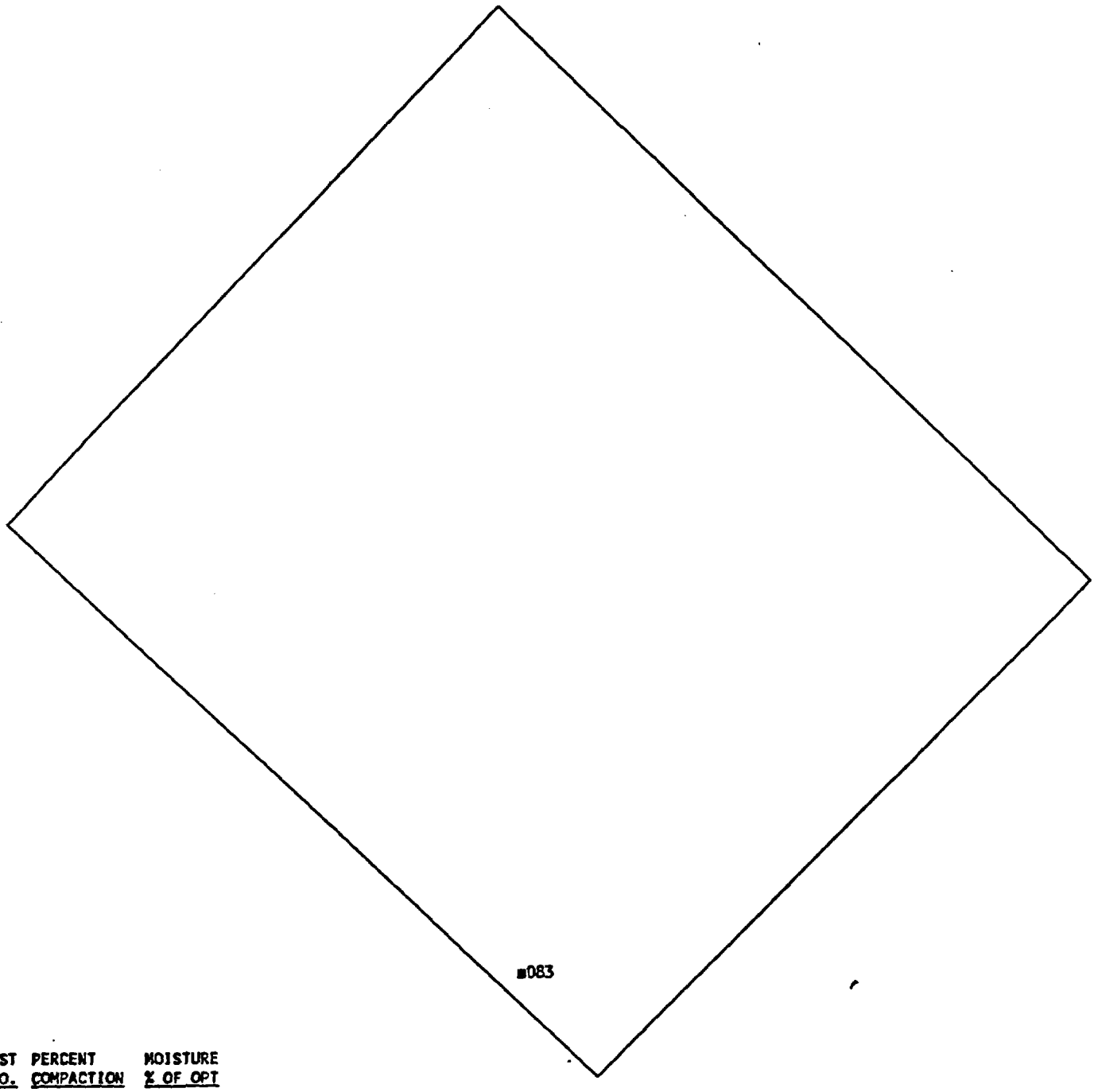
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4129



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
079	98.3	-3.2
080	99.2	-1.8

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

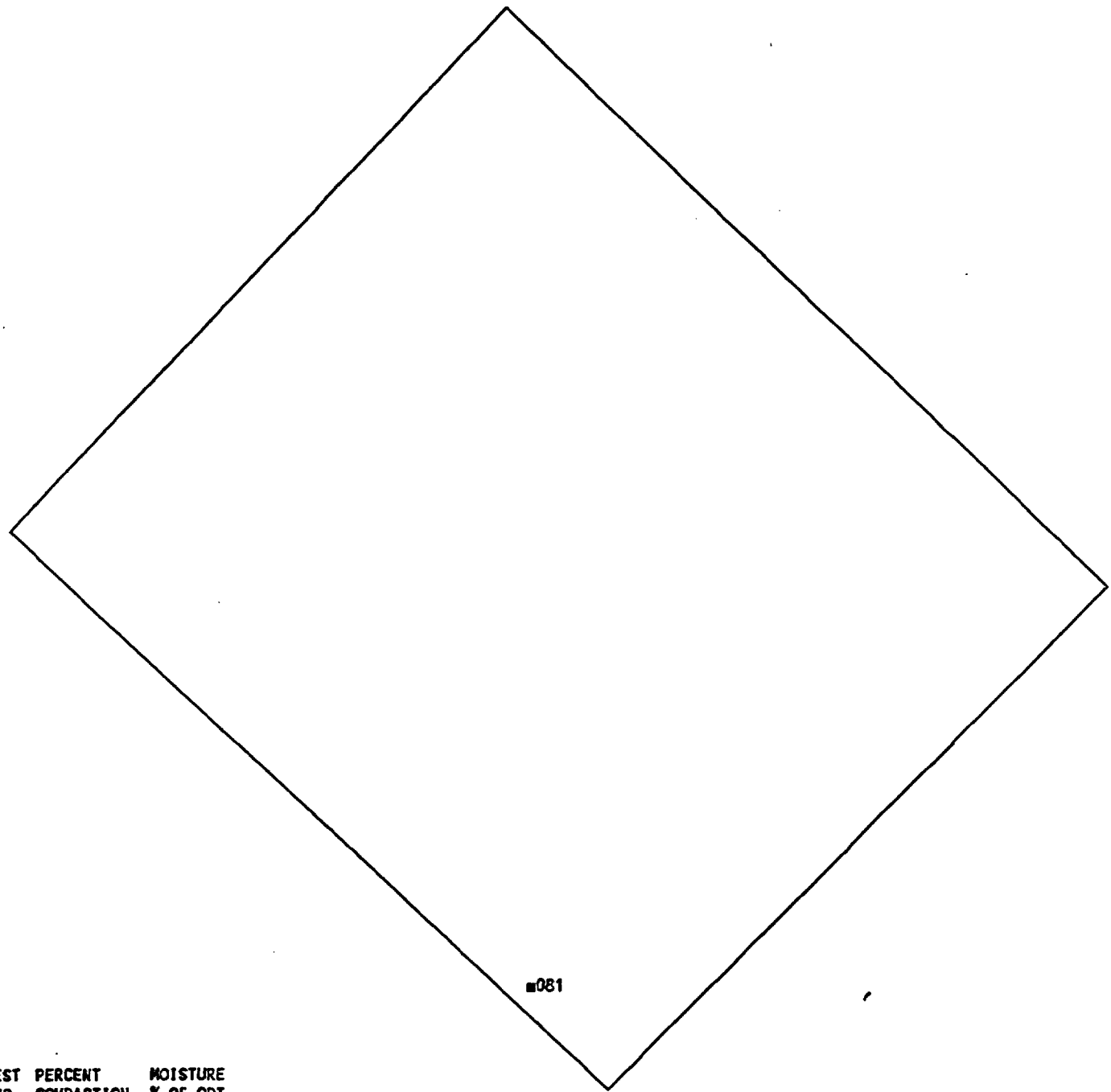
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4129



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
083	98.1	-0.1

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

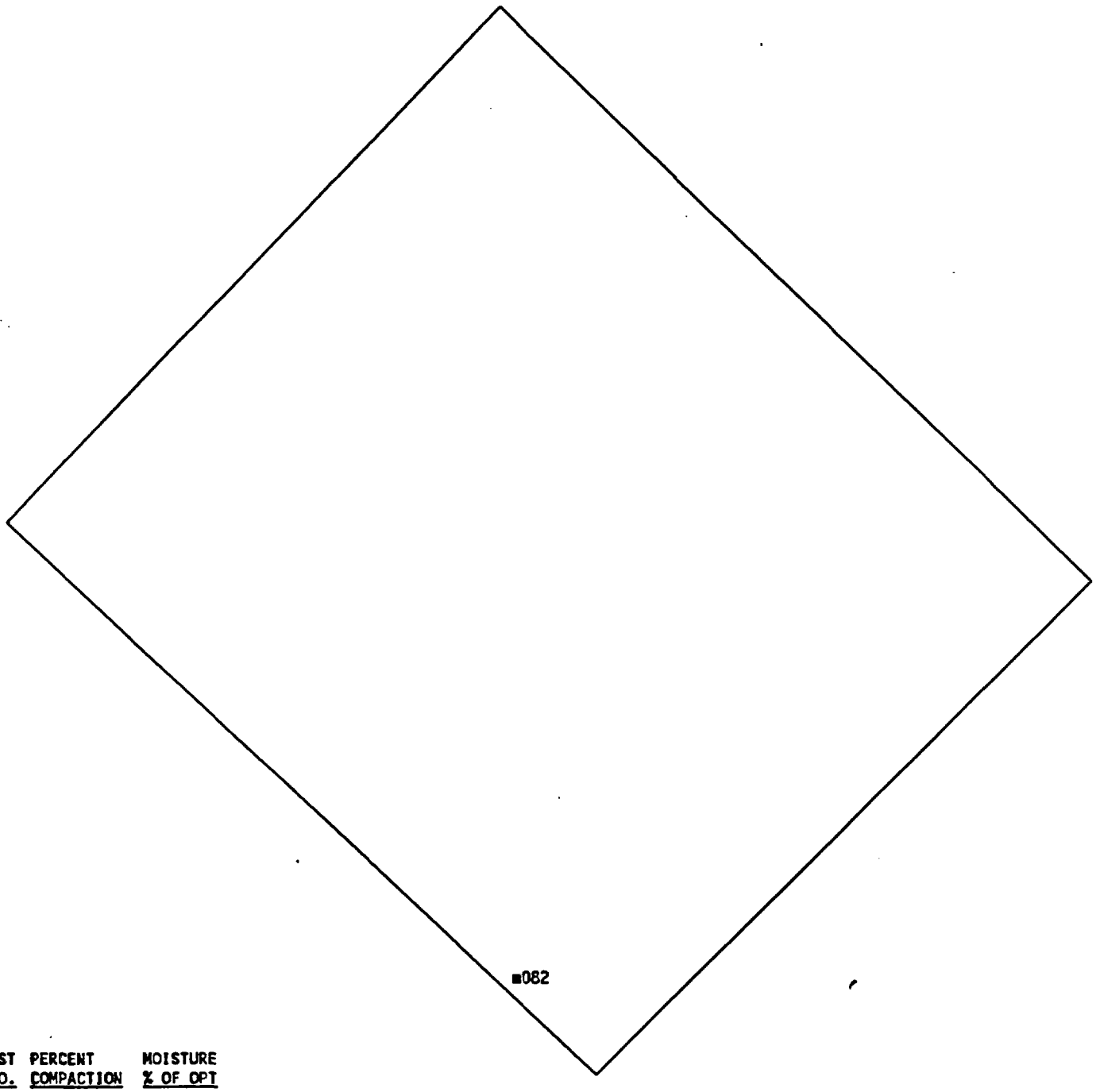
GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4130



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
081	97.4	+0.0

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

GREEN RIVER
SELECT FILL A - MOISTURE DENSITY
ELEVATION - 4130



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
082	95.3	-1.7

CONTAMINATED MATERIAL

CONTAMINATED MATERIAL

- The contaminated material requiring encapsulation was placed and compacted with the following equipment: Caterpillar 631 E Scrapers for excavating, hauling, and placing; Caterpillar D-7, D-9, and D-10 Dozers and a Caterpillar 14G Grader for spreading lifts to 10" or less; a Caterpillar CS-553 and CS-551 Vibratory Smooth Drum Roller, a Bomag BW 213D Vibratory Smooth Drum Roller, and a Caterpillar 825 Tamping Foot Roller for compacting.

- In-place density and moisture trial compaction tests were required within the first 1,000 cubic yards placed for both windblown/vicinity property contaminated material and contaminated materials from the main tailings pile. Thereafter, density and moisture tests were required by the Green River, UT Remedial Action Inspection Plan once for each 6,000 cubic yards of contaminated material placed. The design documents did not require moisture and density tests. No degree of compaction was specified for the contaminated material.

- Compaction control was accomplished by performing in-place soil density tests in accordance with ASTM D-1556. Maximum density was determined in accordance with ASTM D-698.

- The vicinity property and windblown contaminated material was the first to be placed in the cell embankment. Within the first 1,000 cubic yards placed, trial compaction tests were conducted on each of four lifts placed, which received four passes with a vibratory smooth drum roller. Two of the four field density tests taken for trial compaction fell below 90% of the maximum density. Thereafter, four additional passes with a tamping foot roller were conducted which yielded density tests in excess of 90% of the maximum density.

- Four passes with a vibratory smooth drum roller and four passes with a tamping foot roller were conducted on all of the vicinity property and windblown contaminated material after the trial compaction tests were conducted.

- The contaminated material from the main tailings pile was the next to be placed in the cell embankment. Within the first 1,000 cubic yards of tailings contaminated material placed, 9 trial compaction tests were conducted on the four constructed lifts, which received four passes with a vibratory smooth drum roller. All 9 field density tests taken were in excess of 90% of the maximum density.

- Four passes with a vibratory smooth drum roller were conducted on all of the material from the main tailings pile.

- The average percent compaction obtained was 95.2%, which was determined from a total of 79 passing field density tests performed on encapsulated contaminated material. There were 339,377 cubic yards of contaminated material placed, which divided by 79 passing field density tests provides a frequency of one field density test performed for each 4,296 cubic yards of contaminated material placed.

- One field density test taken representing one area, fell below 90% of the maximum density at 89.0%. After additional compaction was conducted over the area, a retest was taken which was in excess of 90% of the maximum density.

- The required frequency for one-point proctor tests was a minimum of one for each five field density tests performed. There were 35 one-point proctor tests performed to ensure that the correct maximum dry density was utilized when performing field density tests. Considering that there were a total of 79 field density tests performed, this provides a frequency of one one-point proctor test for each 2.3 field density tests performed.

- The required frequency for maximum dry density determinations was a minimum average of one for each 10,000 cubic yards of material placed. There were 44 maximum dry density determination tests performed in accordance with ASTM D-698. Considering there was a total of 339,337 cubic yards of contaminated material placed, this provides a frequency of one maximum dry density determination test performed for each 7,713 cubic yards of material placed.

- Continuous monitoring was performed during material placement to ensure that the loose lift thickness did not exceed ten inches.

- The Design Specifications and Remedial Action Inspection Plan required the contaminated material to have a moisture content of below minus 3% of the optimum moisture as determined in accordance with ASTM D-698. The Remedial Action Inspection Plan also required the tailings material be placed at an average moisture content of less than 5.0% by volume, and that windblown and vicinity property materials be placed at an average moisture content of less than 10.6% by volume. The moisture test frequency specified was one for every 2,000 cubic yards placed.

- The contaminated materials were placed in the cell embankment at moisture contents as low as reasonably achievable and all passing moisture tests were below minus 3% of optimum moisture.

- Moisture tests were taken in accordance with ASTM D-2216 and D-4643.

- Considering there were 254 passing moisture tests performed and 339,377 cubic yards of contaminated material placed, this provides a test frequency of one moisture test for each 1,336 cubic yards of contaminated material placed. From the 254 passing moisture tests, the lowest moisture content was 1.1%, the highest moisture content was 9.2% and the average was 5.1%.

- Jacobs Engineering collected all available field data and reported the average volumetric moisture content for the tailings material to be 7.1% and 10.6% percent for the windblown/vicinity property material. Since the volumetric moisture contents were not addressed in the design specifications, the reported volumetric moisture contents have no basis for violation. However, the Remedial Action Inspection Plan (RAIP) has been violated because it specified tailings to be placed with a 5.0% or less volumetric moisture content, while the actual was 7.1%, equaling to an excess of 2.1%. Jacobs Engineering, the Technical Assistance Contractor for the Department of Energy, has evaluated the volumetric moisture contents in the Final Remedial Action Plan.

- The RAIP stated that exceptions to the specified volumetric values due to environmental conditions and the construction processes while placing and/or compacting contaminated materials should be documented. The RAIP also mentioned that the contaminated materials moisture content should be as low as reasonably achievable, without causing undue health hazards to workers and the general public, and in ensuring compliance to local, state, and federal health and safety standards in effect at the time of construction. Documentation has been contained in the Quality Control records of water logs for dust control as specified by the State of Utah to comply with the State's 20 percent opacity requirement and of situations when health physics personnel requested additional dust control to prevent violating the contaminated airborne particulate requirements for the UMTRA Project. It must be emphasized that minimal amounts of water were added to the contaminates to satisfy these requirements and that the contaminated materials were placed in the cell at moisture contents as low as reasonably achievable.

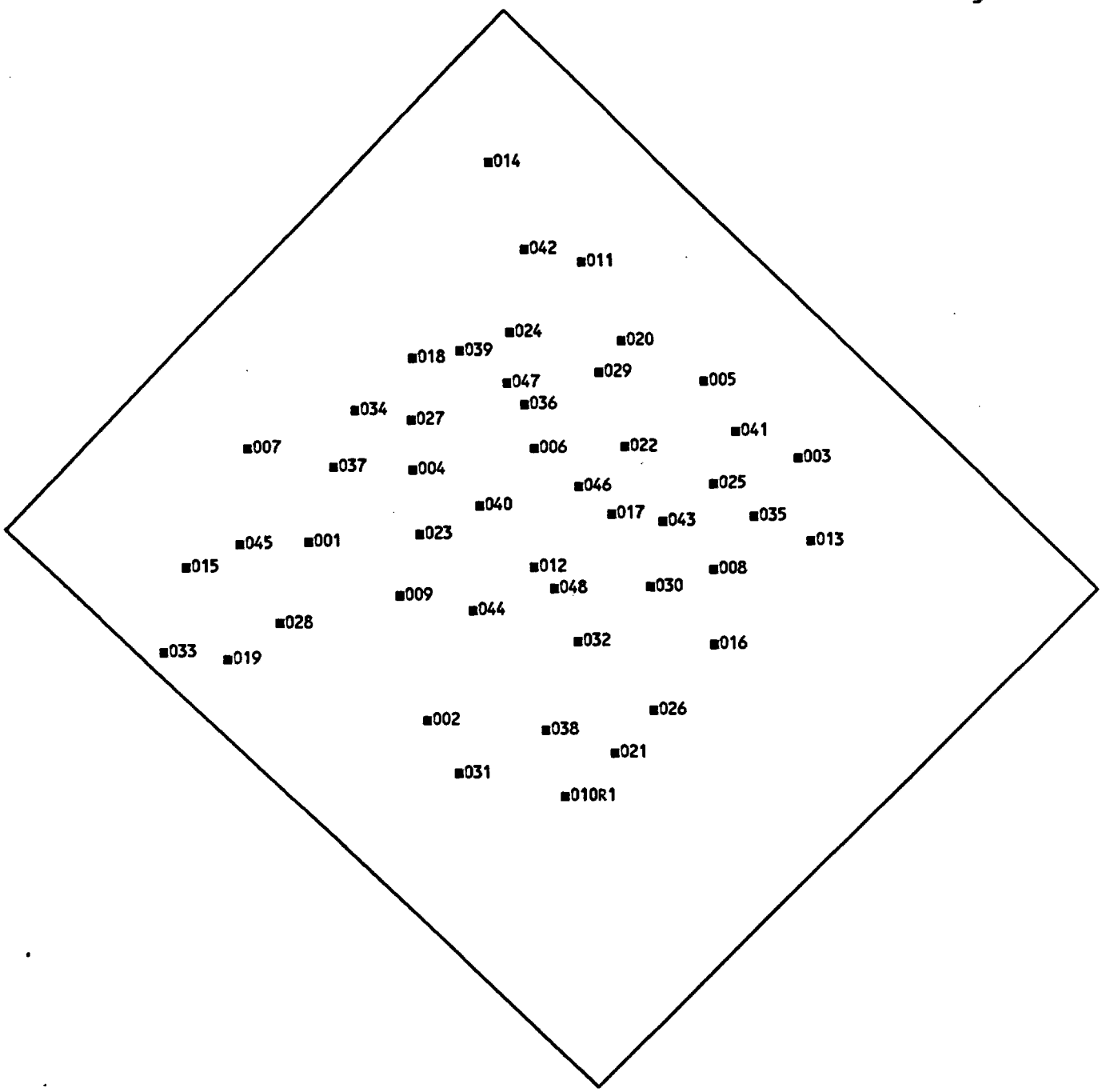
- There were 11 failing moisture tests within 9 areas, all of which required rework in order to satisfy the specified minus 3% of optimum moisture requirement. All areas which were known to require rework, were reworked and retested in accordance with the specified requirements.

- One oven dried moisture test was required for every ten microwave moisture tests conducted. From 386 microwave oven moisture tests conducted, 75 oven dried moisture comparisons were performed. This equates to an average of one oven dried moisture for every 5.1 microwave moistures.

- The following data has been provided identifying each contaminated material density test location.

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

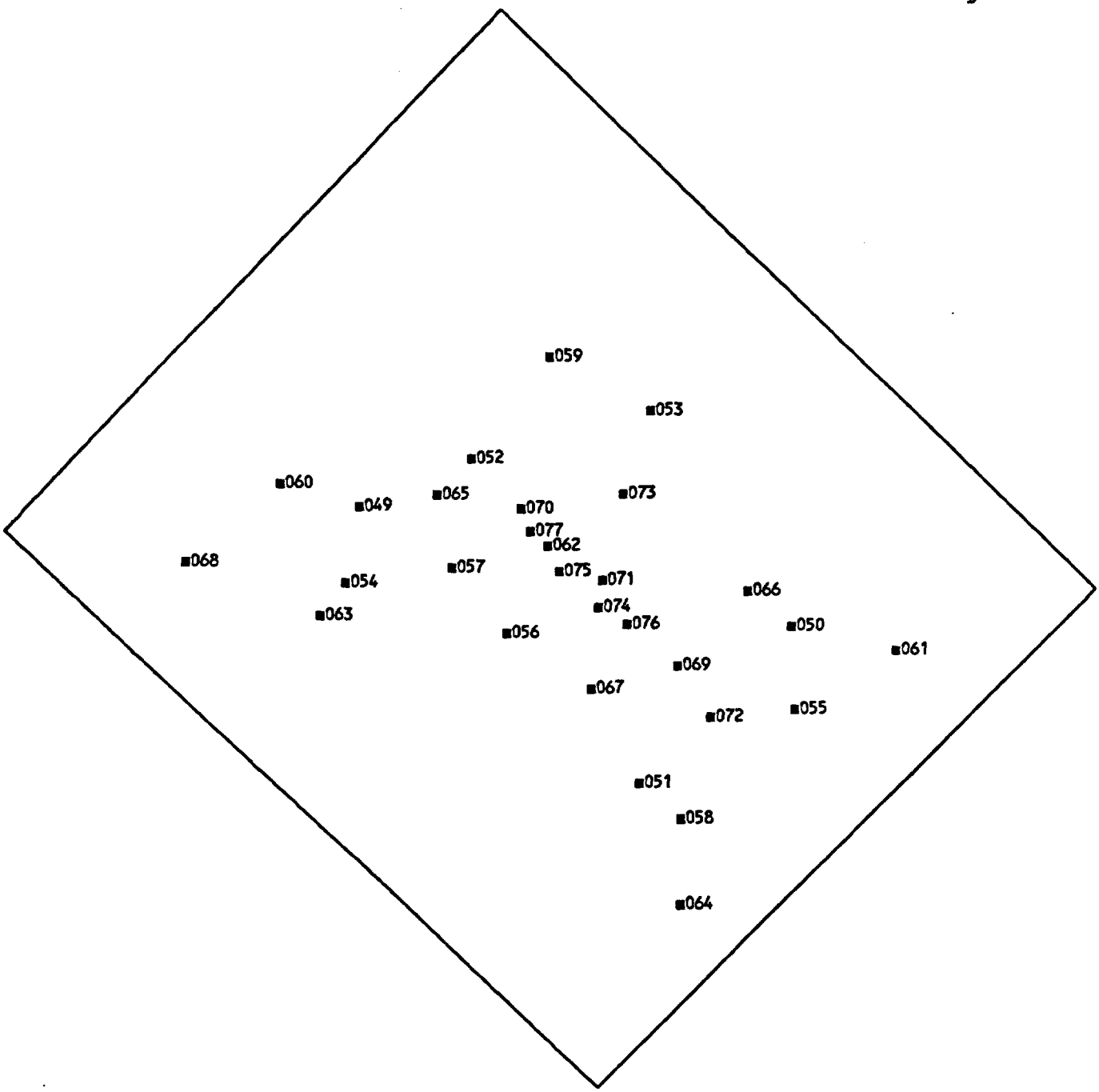
GREEN RIVER
CONTAMINATED MATERIAL - MOISTURE DENSITY



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT	TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT	TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT	TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
001	97.8	-7.7	013	96	-4.5	025	99.7	-4.4	037	90.9	-6.8
002	91.3	-5.1	014	94.7	-6.4	026	98.3	-6.1	038	93.7	-7.3
003	90.3	-5.6	015	96.8	-4.6	027	98.4	-6.2	039	94.3	-9.9
004	90.3	-5.1	016	96.4	-5.6	028	96.2	-6.0	040	90	-7.6
005	91.1	-3.4	017	93.7	-4.0	029	91.1	-5.4	041	98	-10.6
006	94.4	-4.6	018	96.9	-5.3	030	97	-6.6	042	95.2	-9.1
007	92.2	-3.8	019	94.8	-3.8	031	90.3	-5.6	043	95.8	-8.8
008	94.5	-3.0	020	95.7	-4.6	032	98.6	-7.2	044	95.2	-10.8
009	94.4	-5.3	021	90.5	-4.0	033	91.6	-3.8	045	95.2	-11.1
010R1	95.1	-5.6	022	96.1	-3.1	034	92.5	-3.1	046	96.8	-12.2
011	96.3	-3.3	023	91.9	-4.9	035	97.1	-5.2	047	96.6	-11.7
012	94.5	-5.1	024	96.8	-6.0	036	96.9	-6.8	048	99.7	-12.2

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

GREEN RIVER
CONTAMINATED MATERIAL - MOISTURE DENSITY

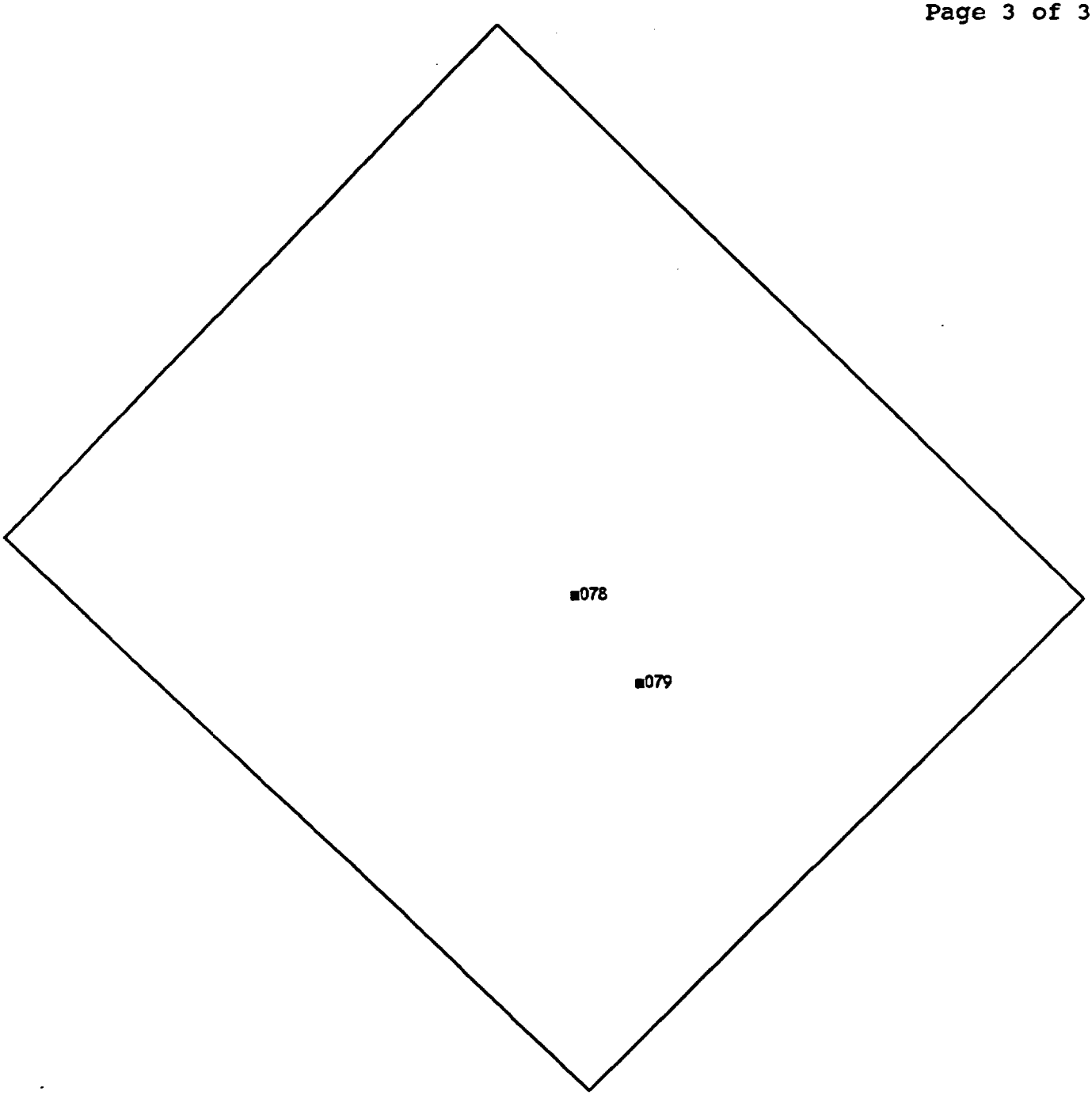


TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT	TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT	TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
049	97.4	-9.9	061	98.8	-9.0	073	96.9	-11.1
050	97.1	-9.8	062	100	-9.4	074	94.3	-10.8
051	93.5	-9.4	063	97.7	-13.1	075	95.7	-8.9
052	94.6	-10.1	064	97.1	-8.3	076	95.7	-9.6
053	91.7	-8.4	065	96.5	-9.7	077	96.4	-7.6
054	93	-7.5	066	91.4	-9.0			
055	95.8	-10.5	067	93.9	-7.8			
056	95.7	-10.5	068	95	-6.6			
057	96.9	-8.9	069	99.4	-9.0			
058	96	-11.8	070	96.1	-9.9			
059	95.8	-11.0	071	93.5	-8.8			
060	95.2	-11.1	072	95.1	-8.8			

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

GREEN RIVER

CONTAMINATED MATERIAL - MOISTURE DENSITY



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
078	92.7	-4.6
079	96.6	-5.0

RADON BARRIER

RADON BARRIER

- The radon barrier material was obtained from the approved Hasting's borrow source. M-K Engineers and Jacobs Engineering had both investigated the source prior to approval.

- The excavated radon barrier material from Hasting's source was required to be placed on a one foot pad of radon barrier material and mixed with 6% untreated sodium bentonite. The primary equipment used to acquire this percentage and obtain a uniform mixture was as follows: a Case Unimog MB 4/94 and a Scott 60 P 829 for spreading; and a Caterpillar SS 250 and a Bros LSPRM-8A for mixing.

- After the material was placed on the pad and before bentonite was added, the excavated material had to meet a gradation for the first lift of 90 to 100 percent passing the #4 sieve and 70% passing the #200 sieve. All other lifts except the first could have greater than or equal to 50% passing the #200 sieve. The gradation test frequency was one for every 1,000 cubic yards placed.

- Gradation tests conducted were in accordance with ASTM C-136 and ASTM D-422.

- A total of 60 gradation tests were taken with all 60 gradation tests passing specification requirements. There were 27,911 cubic yards of radon barrier material placed, which divided by 60 gradation tests, equals one gradation test for every 465 cubic yards of material placed.

- After the radon barrier material had passed gradation requirements, bentonite was applied and mixed as specified. For the total production quantity of 27,911 cubic yards of compacted radon barrier material, there were 67 passing percent bentonite verifications taken to ensure proper proportions. This yields a frequency of one verification for every 417 cubic yards of radon barrier material placed. There were no specified frequency requirements for percent bentonite verifications.

- Radon barrier material was required to have a moisture content at above optimum moisture content for at least 2 hours prior to placement.

- Moisture control was accomplished by performing in-place moisture tests in accordance with ASTM D-2216 and D-4643.

- A total of 67 moisture tests were taken after at least a 2 hour conditioning period with all 67 moisture tests passing at above optimum moisture. From a total of 27,911 cubic yards of radon barrier material placed, the average equals 1 moisture test for every 417 cubic yards of radon barrier material placed. No specific frequency was required for verifying the 2 hour conditioning period.

- Radon barrier material was placed on top of the contaminated material in four lifts of approximately 9 inches for a final depth of three feet. The primary equipment used for placing the material was as follows: Belly Dump Trucks and End Dump Trucks for hauling and dumping; a Caterpillar D-3, D-6, D-7 Dozer for spreading; a Caterpillar 433 Tamping Foot Roller and a Rago 220 Tamping Foot Roller for compacting; and a Rago Smooth Drum Roller for compacting the final lift.

- The required degree of compaction for the radon barrier material was 100% of the maximum dry density as determined in accordance with ASTM D-698. The required frequency for verifying compaction was one field density test for each 500 cubic yards of material placed.

- Compaction control was accomplished by performing in-place soil density tests in accordance with ASTM D-1556.

- The average percent compaction obtained was 101.6% which was determined from a total of 111 passing field density tests. There were 27,911 cubic yards of radon barrier material placed, which divided by 111 passing tests, equals one field density test performed for each 251 cubic yards of radon barrier material placed.

- There were 52 failing field density tests within 38 different areas, all of which required rework in order to satisfy the specified compaction requirements. All areas which were known to require rework, were reworked and retested in accordance with the specified requirements.

- The required frequency for performing maximum density determinations was a minimum average of one for each 15,000 cubic yards of radon barrier material placed. There were 14 maximum dry density determinations performed in accordance with ASTM D-698. Considering there were 27,911 cubic yards of radon barrier material placed, this provides a frequency of one maximum dry density determination test performed for each 1,994 cubic yards of material placed.

- The required frequency for one-point proctor tests was a minimum of one for each 5 field density tests performed. There were 30 one-point proctor tests performed to ensure that the correct maximum dry density value was utilized when performing field density tests. Considering that there were a total of 111 field density tests performed, this provides a frequency of one one-point proctor for each 3.7 field density tests performed.

- During compaction, the radon barrier material was required to have a moisture content between optimum moisture and plus three percent of optimum moisture as determined by ASTM D-698. After the specified compaction had been achieved, the material was not allowed to dry below -1% of optimum moisture prior to placement of the next lift.

- Moisture control was accomplished by performing in-place moisture tests in accordance with ASTM D-4643 and ASTM D-2216.

- From the 111 passing moisture and density tests taken on radon barrier material after compaction, the average moisture content was 15.8% with a high of 17.7% and a low of 13.5%. The optimum moisture content used ranged from a high of 14.7% to a low of 13.3%. The average percent moisture above optimum moisture was 1.6%.

- There were 27 failing moisture tests within 21 areas, all of which required rework in order to satisfy the specified moisture requirements during compaction. All areas which were known to require rework, were reworked and retested in accordance with the specified requirements.

- Once the moisture and density requirements were achieved during compaction, 161 moisture tests were taken to verify that the radon barrier material had not dried to -1% below optimum moisture prior to the next lift being placed. Considering that 27,911 cubic yards of radon barrier material was placed, the average equaled 1 moisture test per 173 cubic yards of material placed.

- There were 5 failing tests out of the 161 moisture tests taken. All 5 areas were either removed or reworked in order to satisfy the specified moisture requirements. All areas which were known to require rework, were reworked and retested in accordance with the specified requirements.

- One oven dried moisture test was required for every ten microwave moisture tests conducted. From 423 microwave moisture tests conducted, 89 oven dried moisture comparisons were performed. This equates to an average of one oven dried moisture test for every 4.8 microwave moisture tests performed.

- An independent commercial testing laboratory was required to obtain block samples for testing hydraulic conductivity every 2,000 cubic yards of radon barrier material placed.

- Fox and Associates of Colorado, Incorporated conducted the specified hydraulic conductivity tests on 14 samples extracted from the in-place radon barrier. The test results were evaluated by the design engineers and found to be acceptable. All 14 samples were reported to have a hydraulic conductivity of 2 x 10 to the minus 8 centimeters per second or less after reaching full saturation with constant head pressure and steady state flow. See Table 1 on Page 6 for test results of the 14 permeability blocks taken on the in-place radon barrier material.

- For the 27,911 cubic yards placed, there was one hydraulic conductivity test taken for every 1,994 cubic yards of radon barrier material placed.

- All tests and inspections were performed in strict accordance with the specification requirements.

- The following data has been provided identifying each radon barrier density test location.

TABLE 1

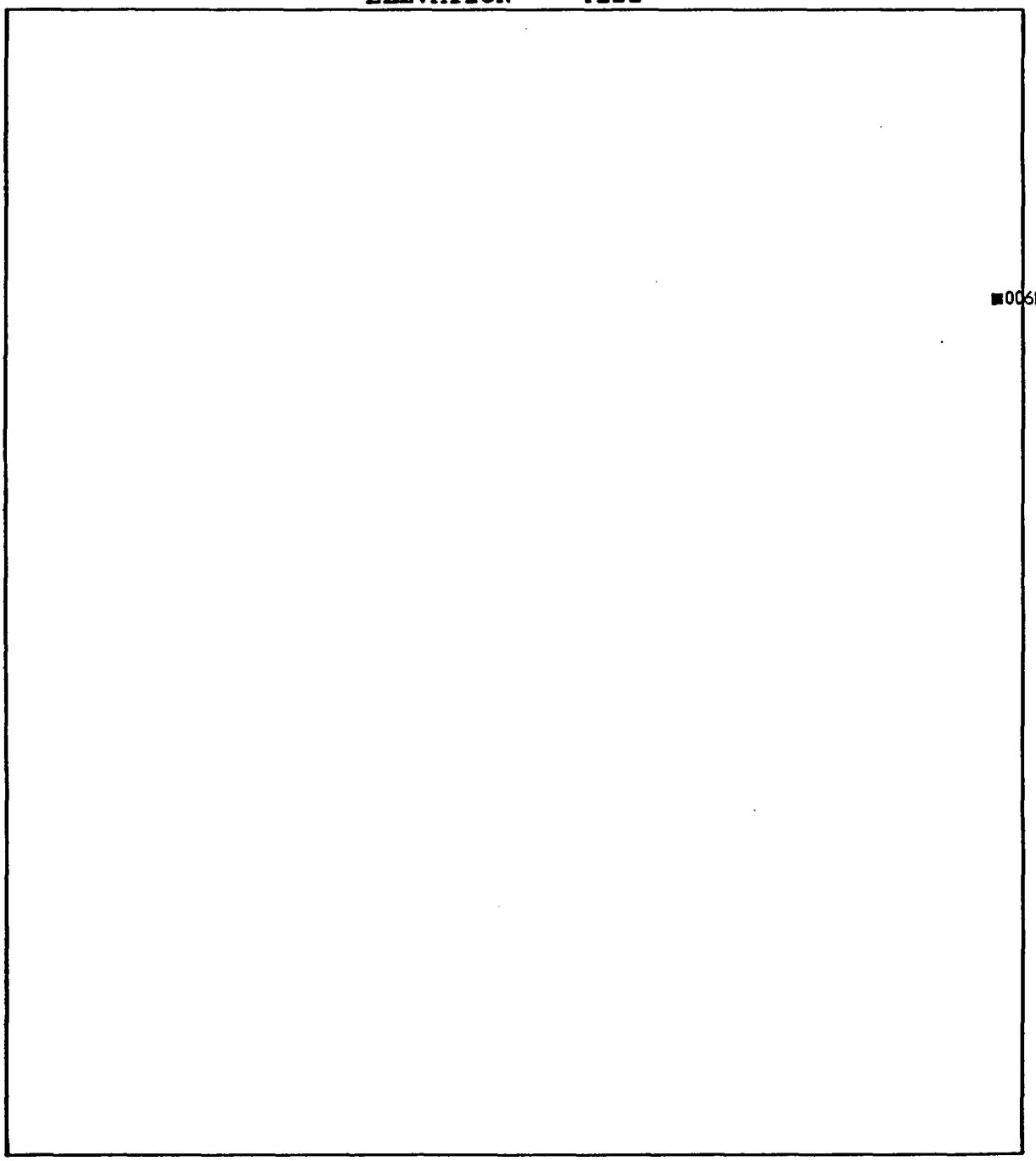
GREEN RIVER, UTAH

PERMEABILITY TEST RESULTS OF IN-PLACE RADON BARRIER

Block/Sample No.	Permeability Value (Cm/Sec)	Block/Sample No.	Permeability Value (Cm/Sec)
PB-1	5.8×10^{-9}	PB-8	2.8×10^{-9}
PB-2	6.2×10^{-9}	PB-9	1.3×10^{-8}
PB-3	5.8×10^{-9}	PB-10	1.3×10^{-8}
PB-4	3.8×10^{-9}	PB-11	2.0×10^{-9}
PB-5	3.4×10^{-9}	PB-12	1.7×10^{-9}
PB-6	7.8×10^{-9}	PB-13	2.4×10^{-9}
PB-7	1.5×10^{-8}	PB-14	2.9×10^{-9}

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

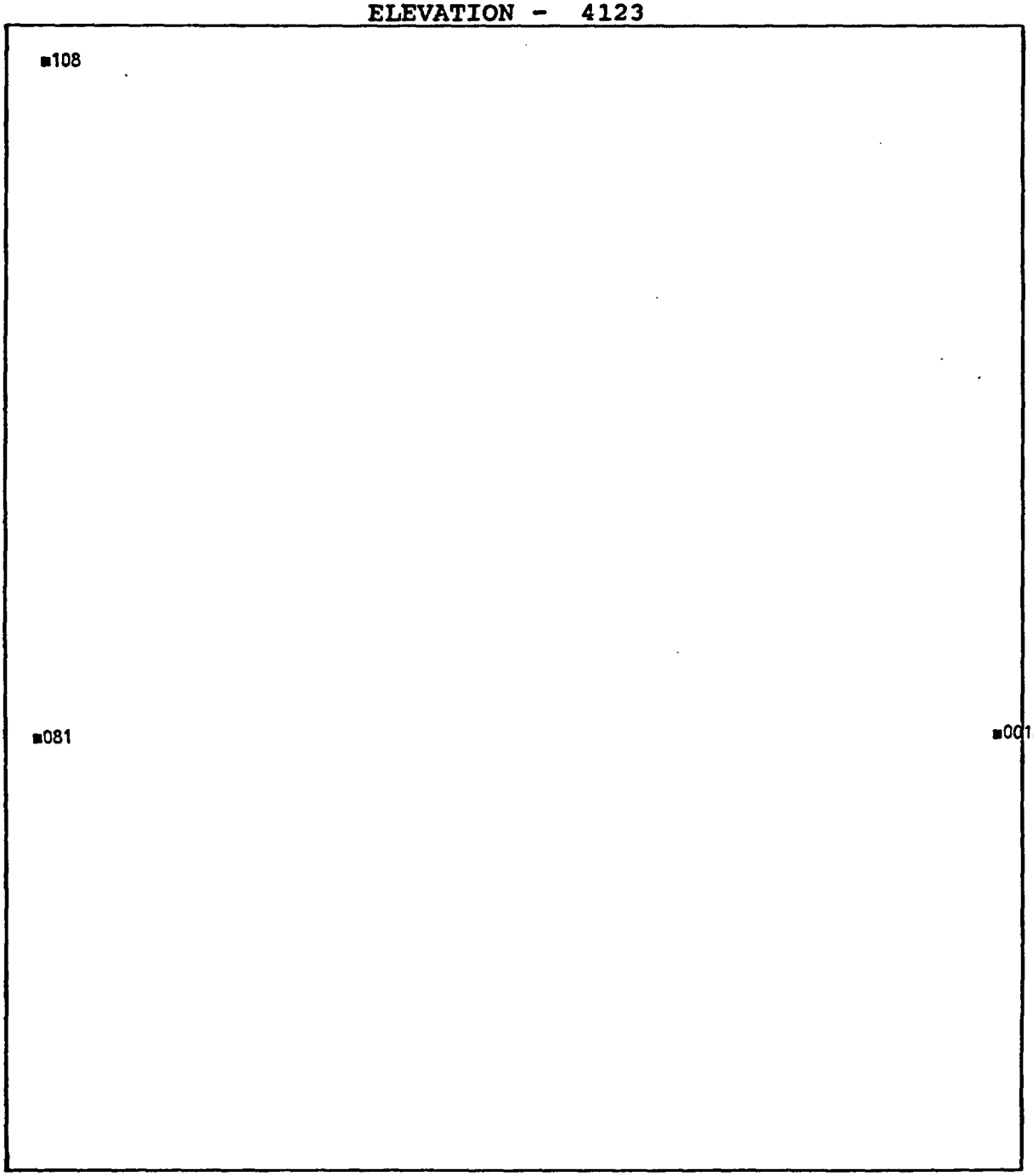
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4122



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
006R1	100.3	+1.9

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

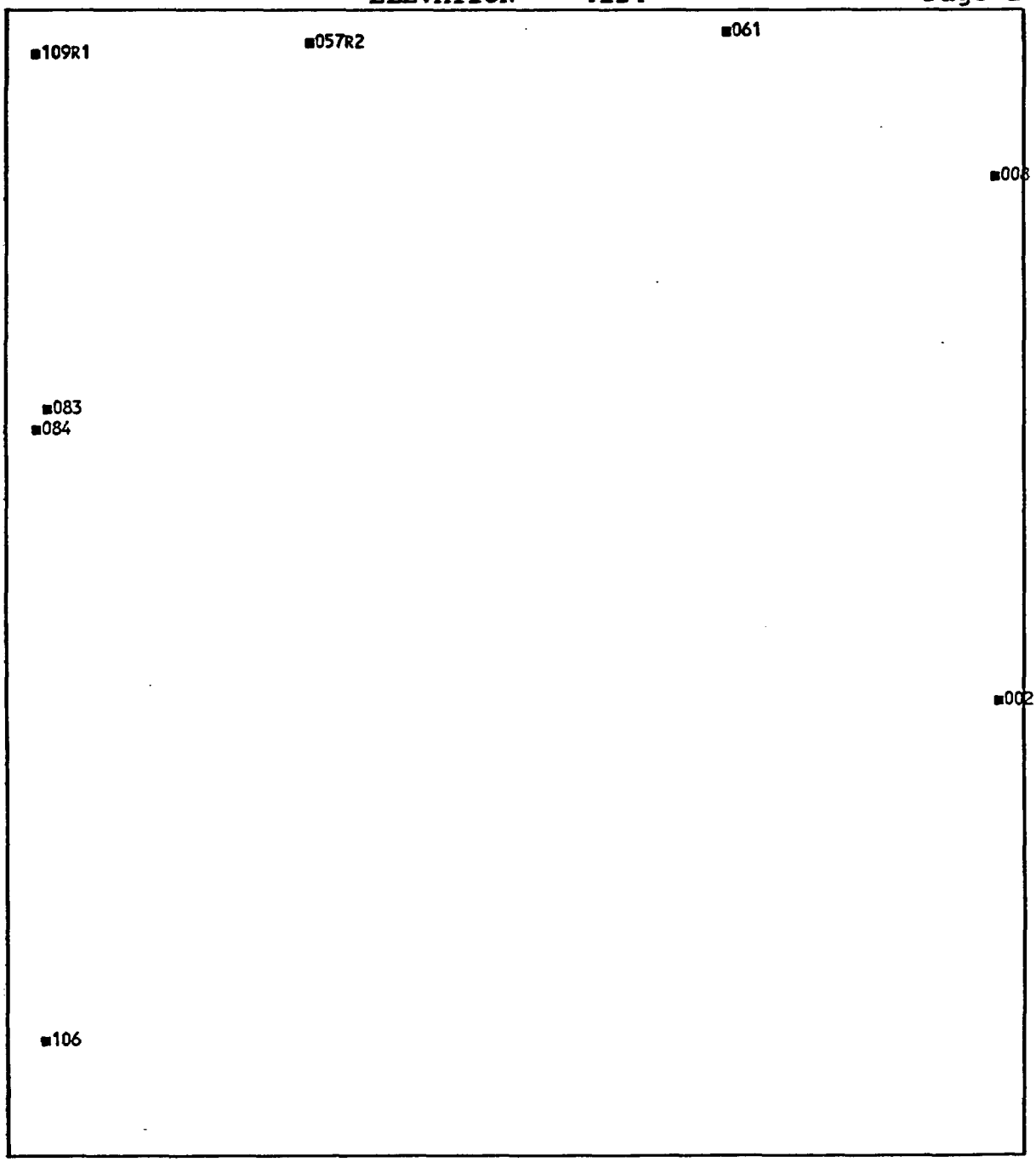
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4123



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
001R1	101.7	+0.8
081	100.9	+2.3
108	101.2	+0.4

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

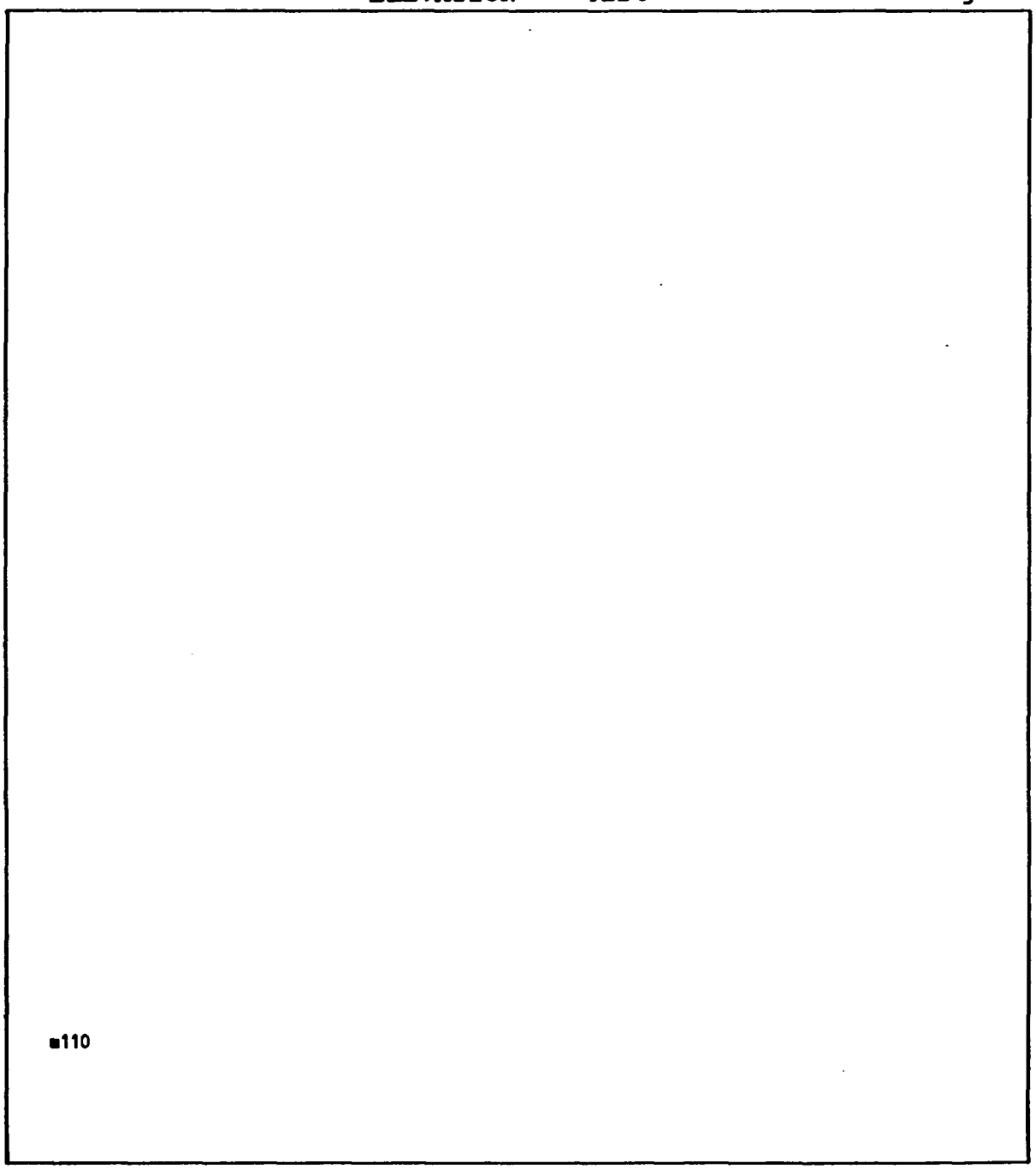
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4124



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
002	100.4	+0.0
008	102.8	+2.8
057R2	100.4	+2.1
061	100.3	+2.0
083	105	+0.0
084	100.3	+2.1
106	100.3	+1.9
109R1	100.4	+0.4

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

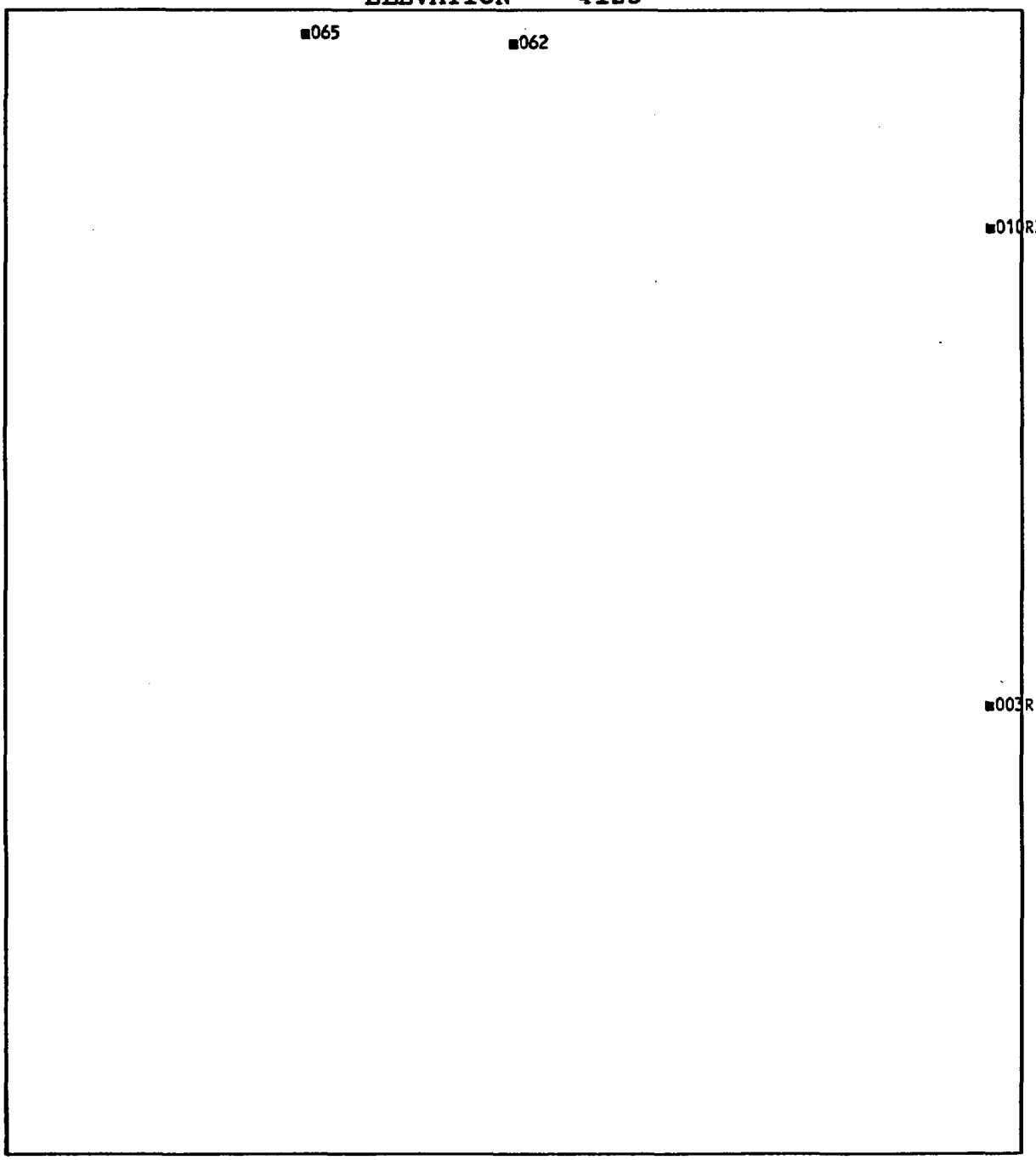
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4124



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
110	103.2	+0.0

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

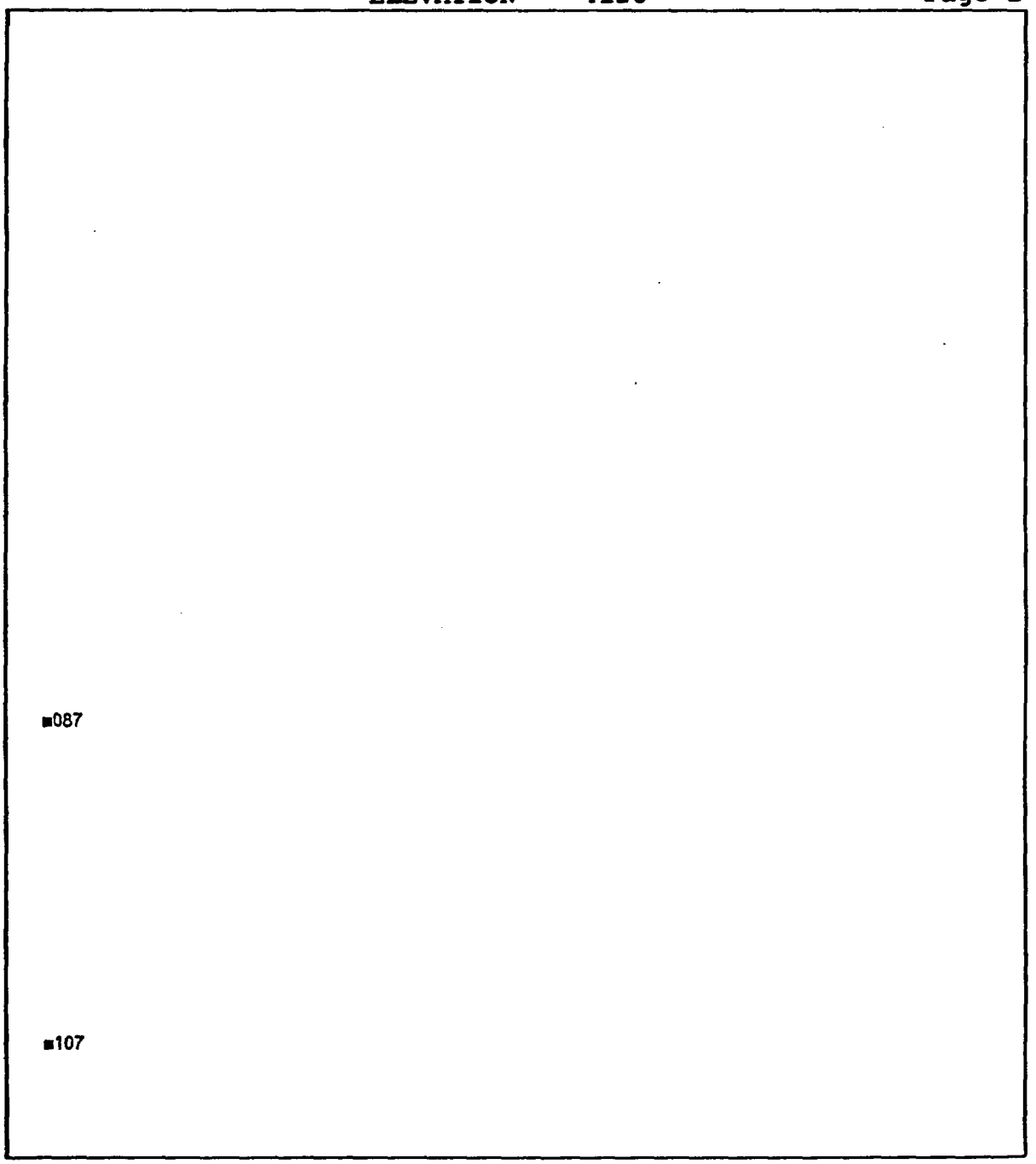
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4125



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
003R1	100	+1.8
010R2	102	+0.6
062	105.9	+0.6
065	100.8	+2.5

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

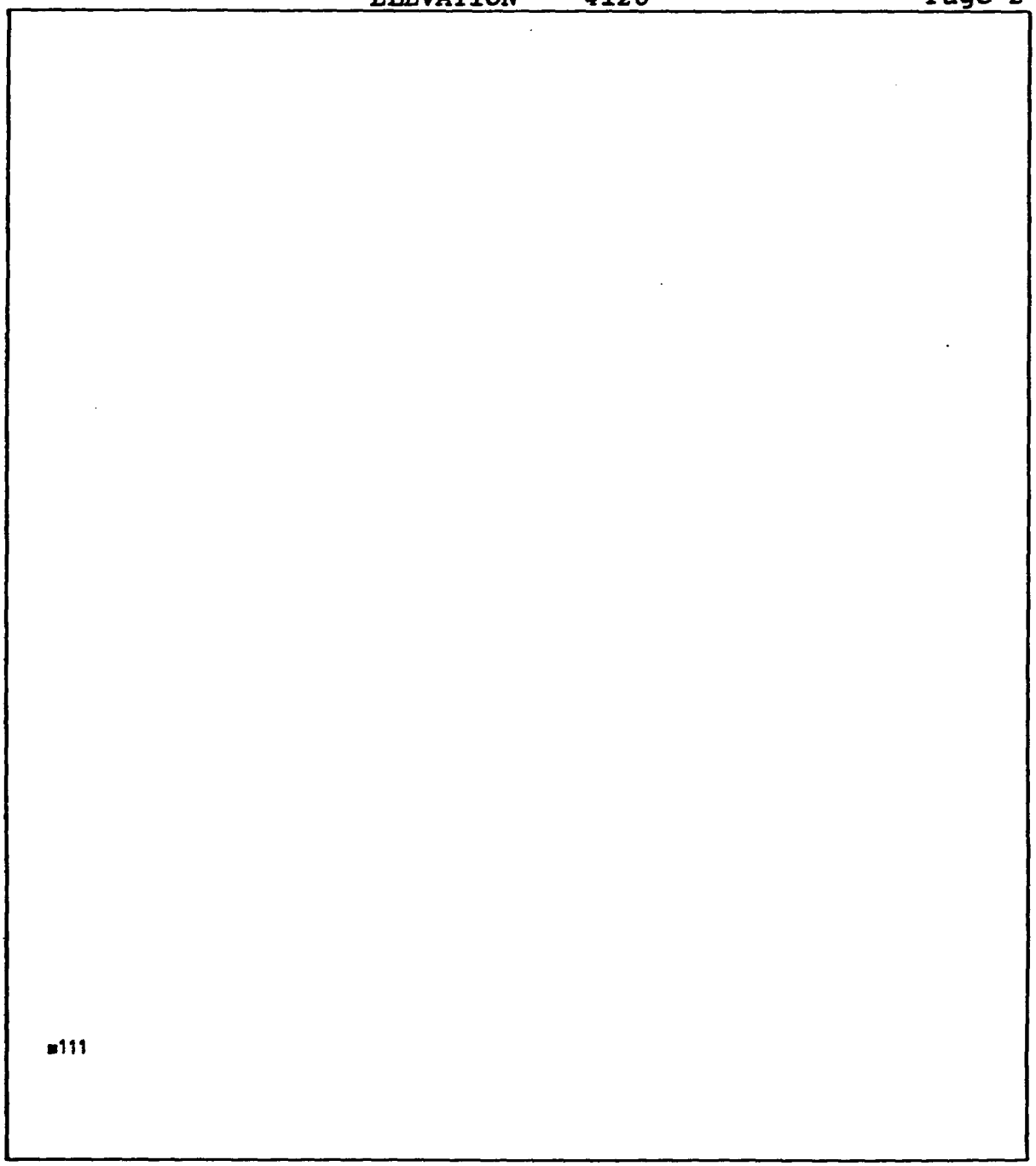
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4126



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
087	104.8	+0.5
107	100.2	+1.0

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

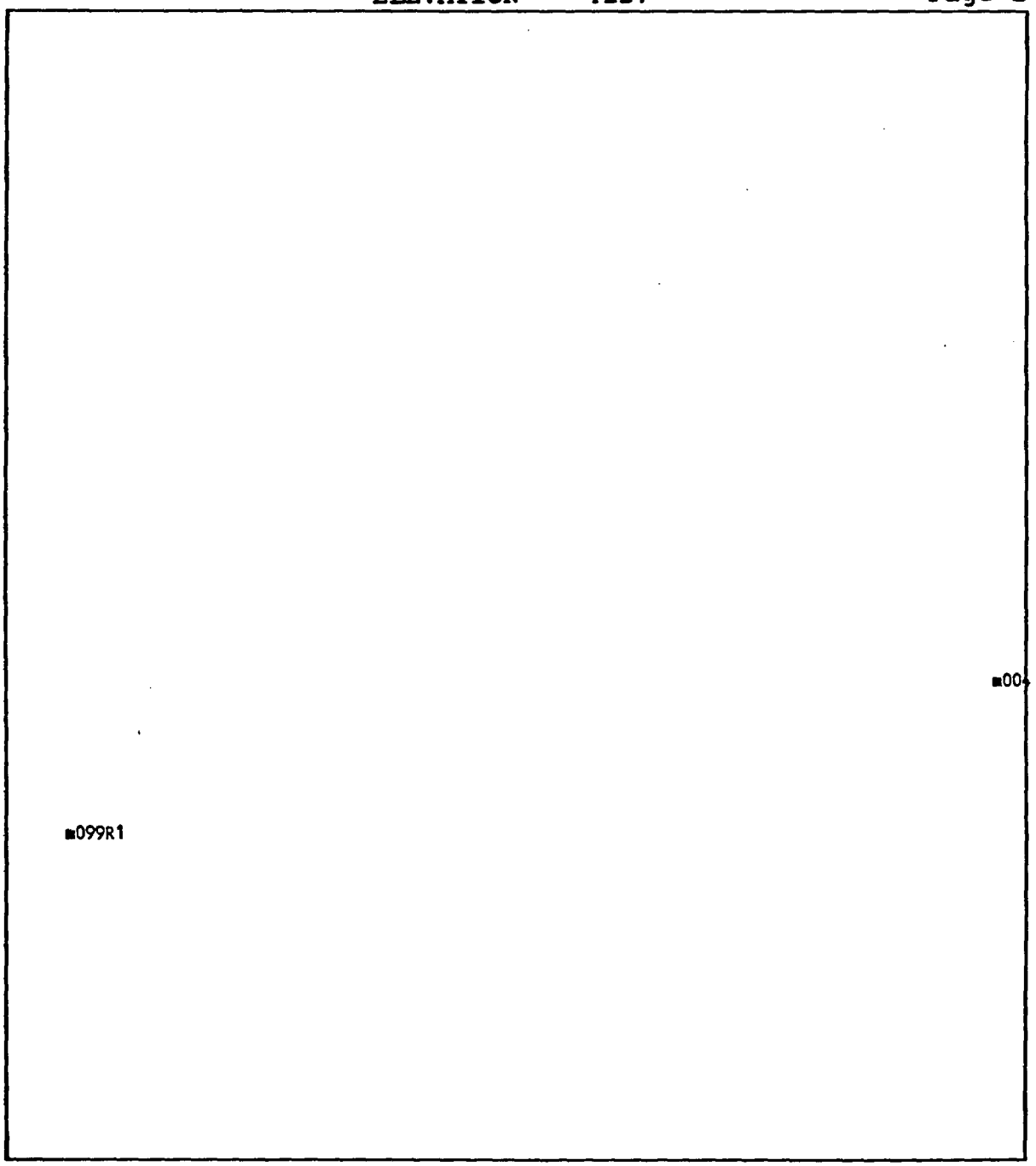
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4126



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
111	100.4	+0.9

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

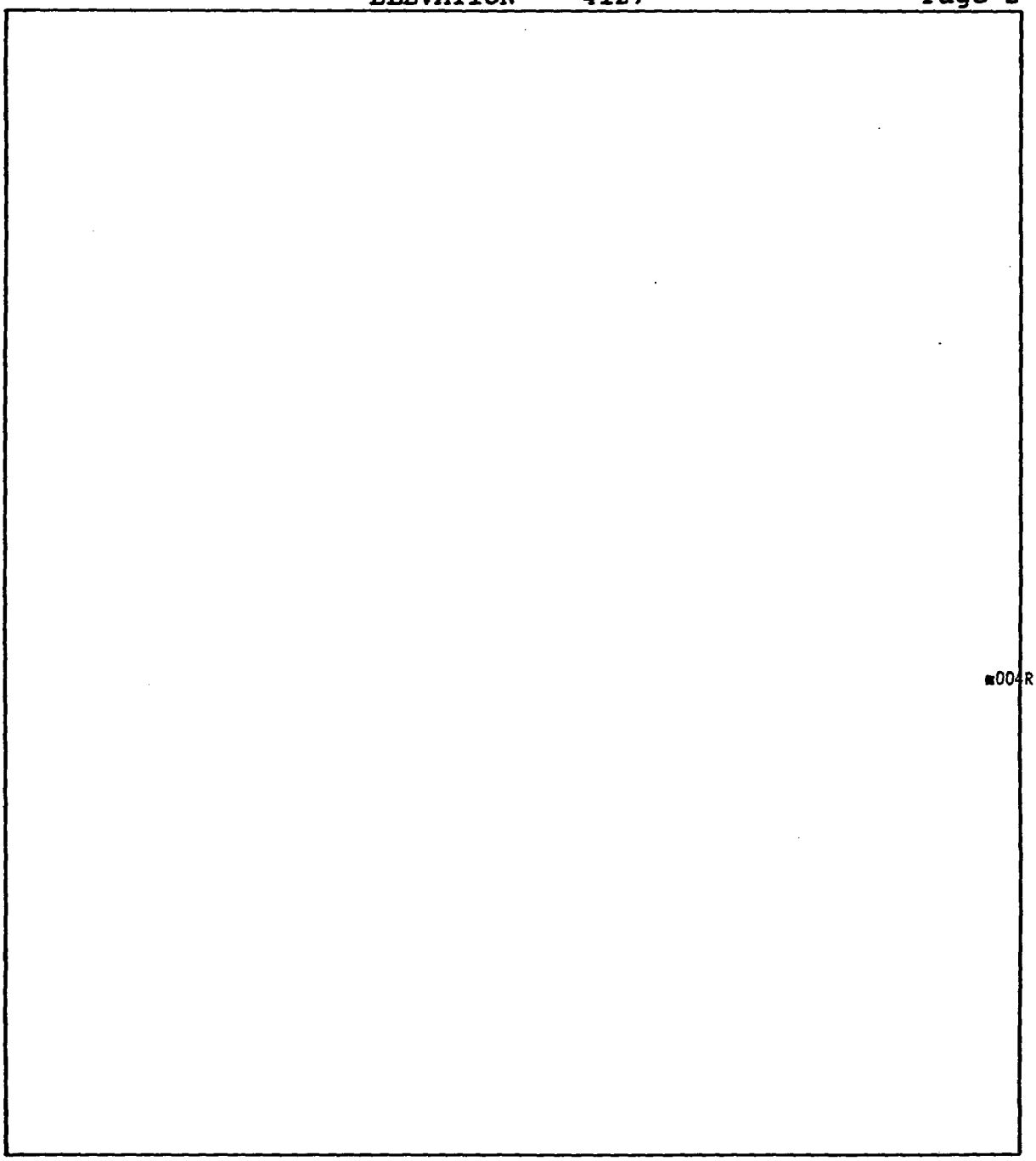
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4127



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
004	100.5	-0.8
099R1	102.8	+1.7

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

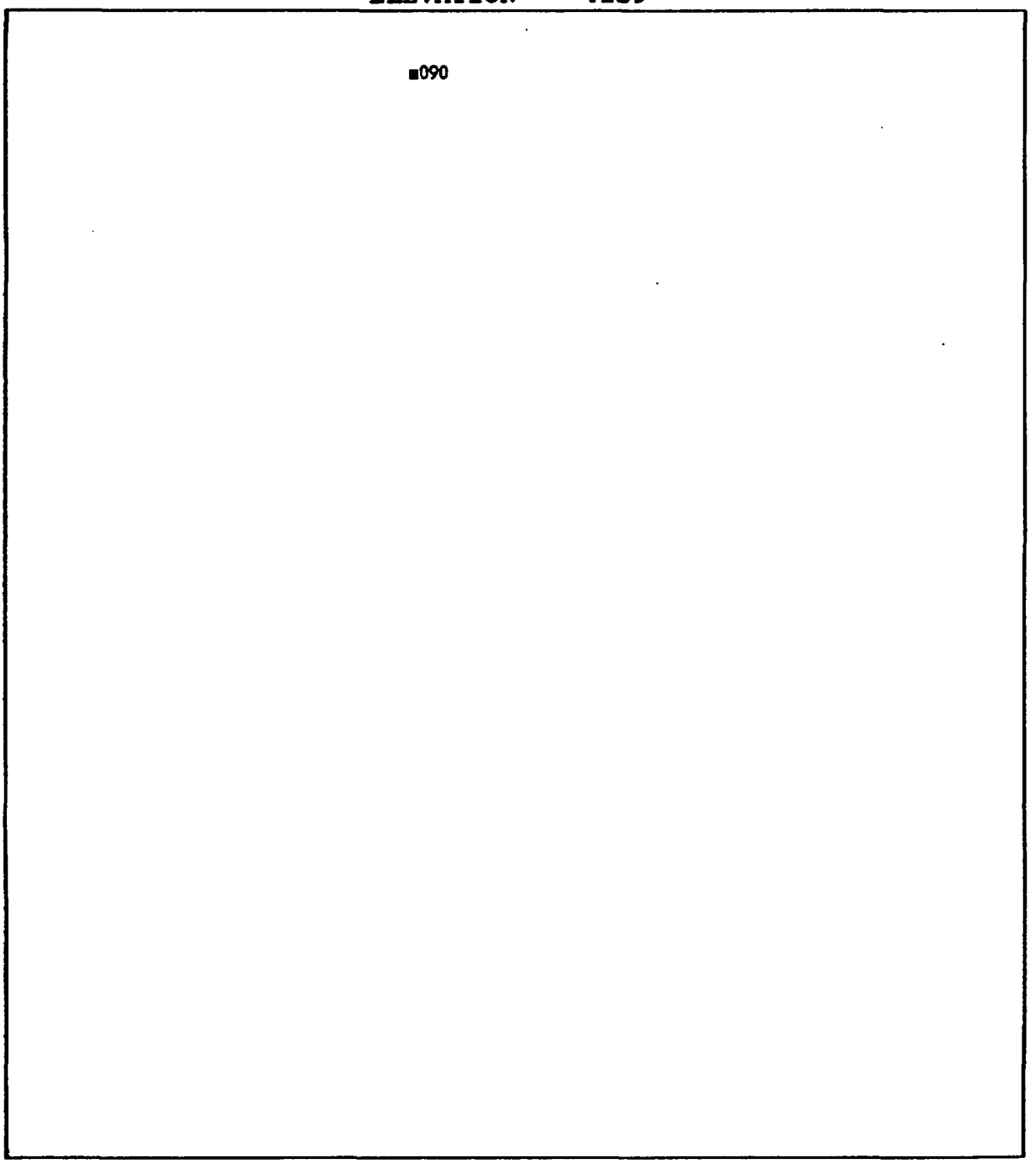
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4127



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
004R1	101.8	+2.8

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

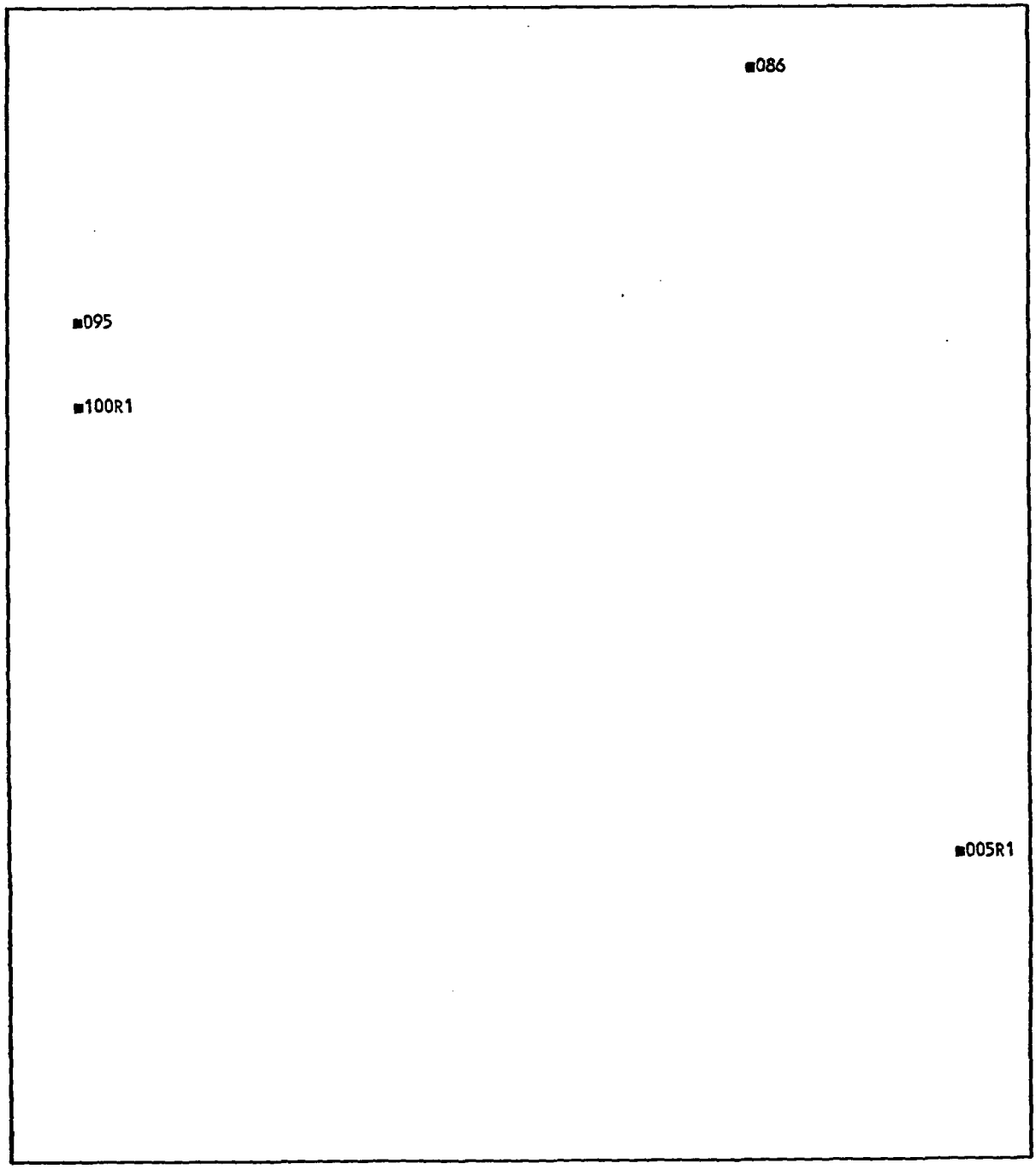
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4129



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
090	100.1	+1.1

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

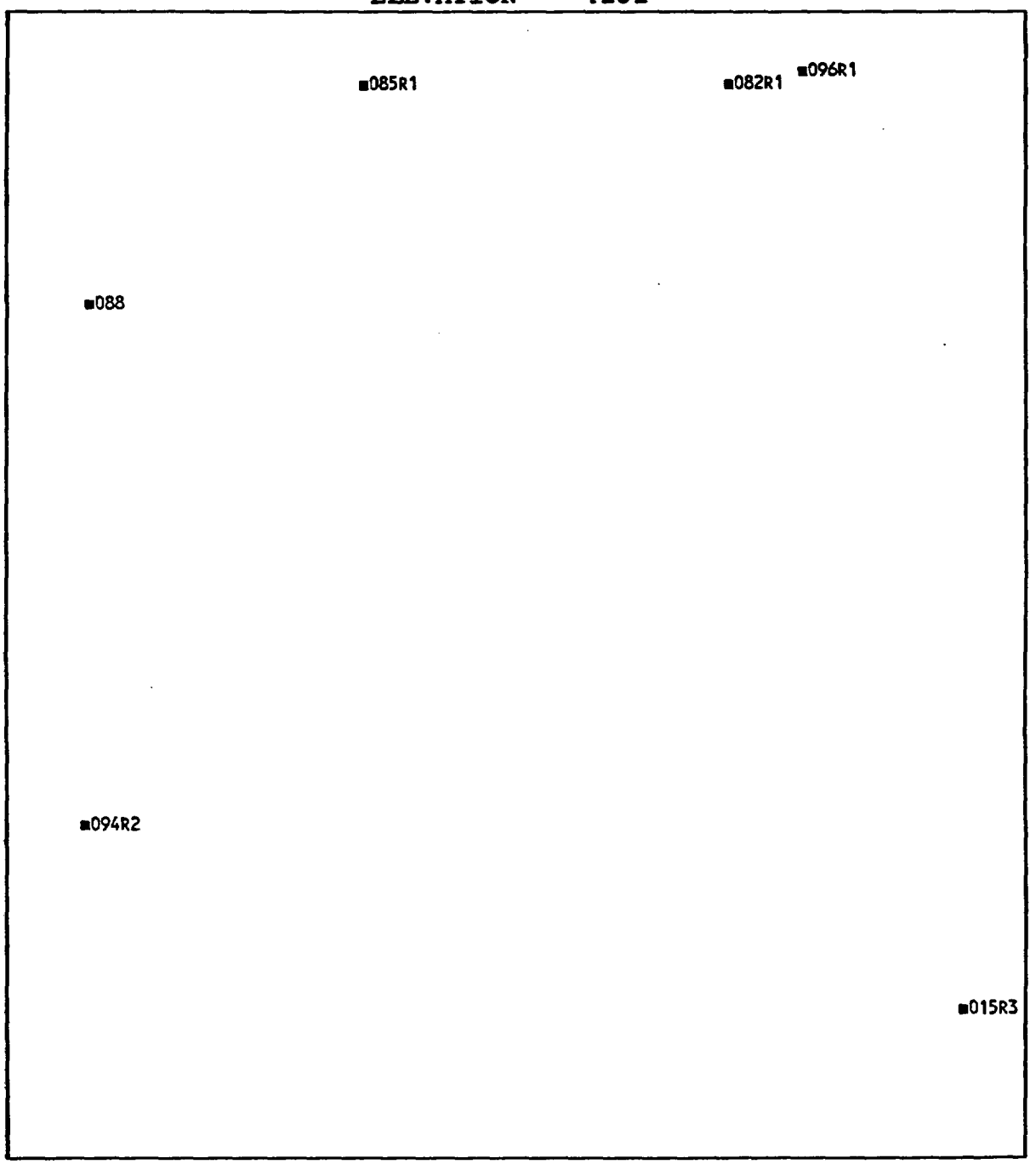
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4130



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
005R1	101.2	+1.8
086	104	+1.8
095	103.6	+2.6
100R1	101.6	+1.5

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

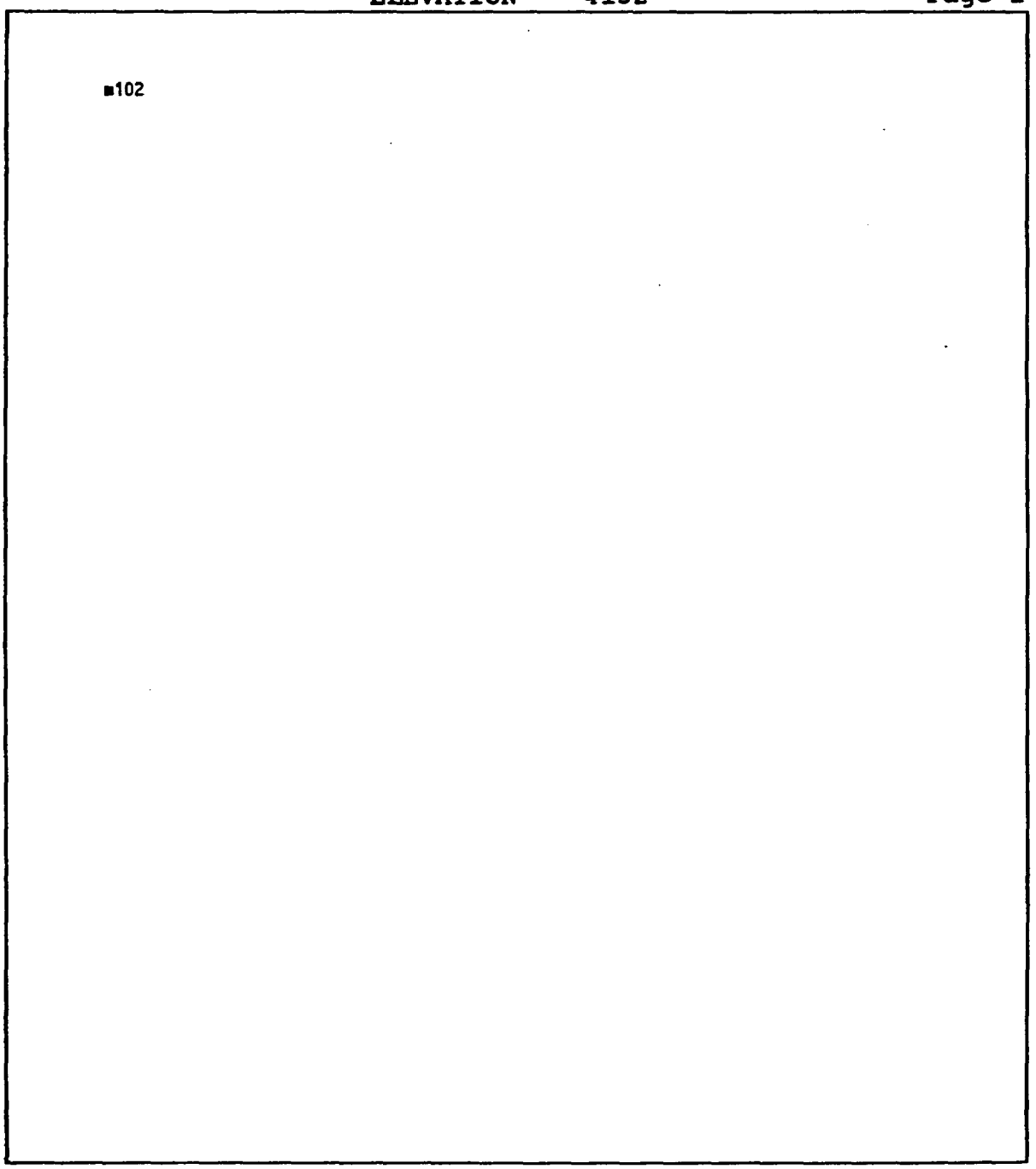
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4131



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
015R3	104.7	+3.0
082R1	100.2	+2.4
085R1	100.4	+3.0
088	100.9	+1.8
094R2	104.3	+2.1
096R1	104.4	+0.5

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

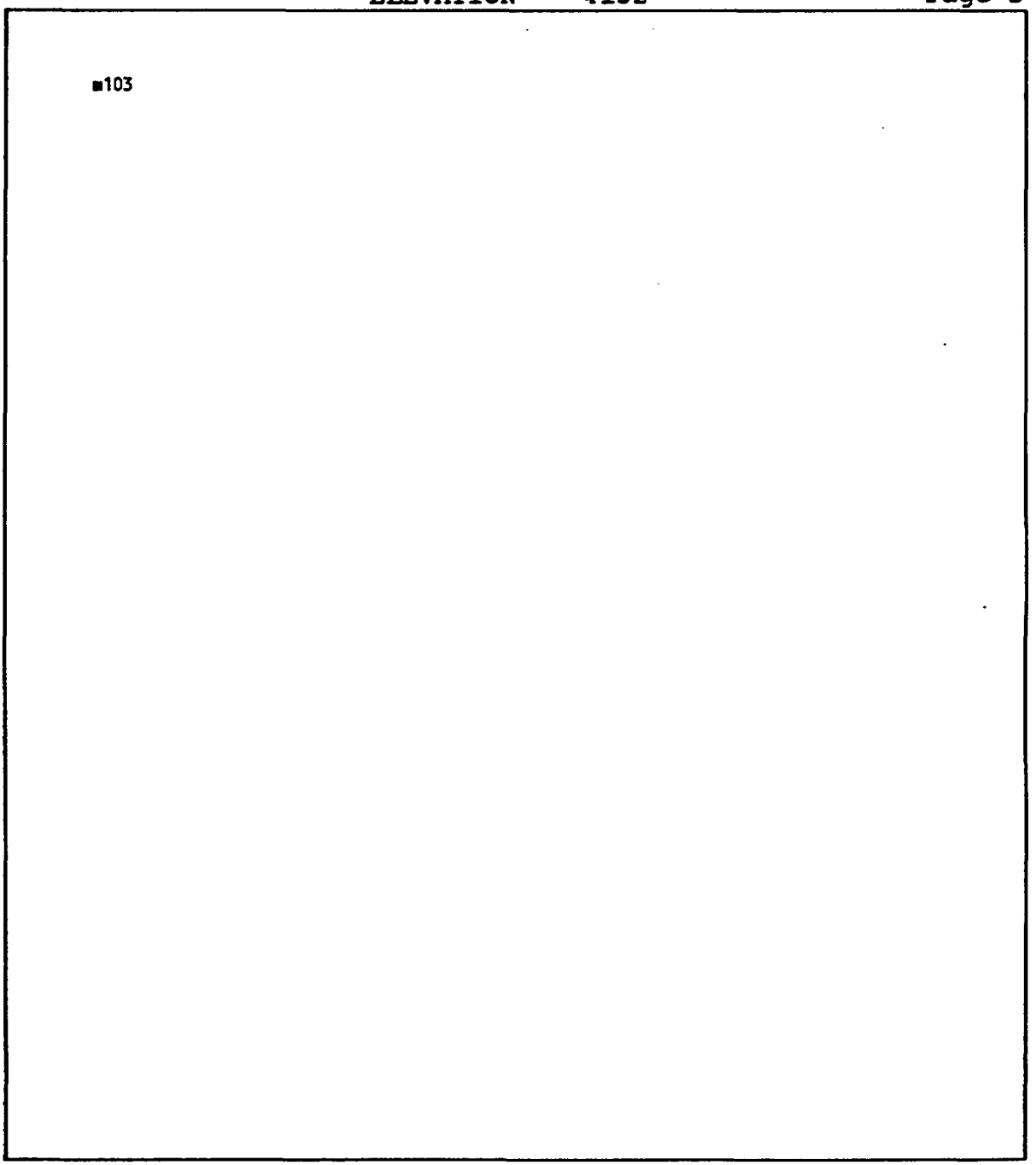
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4132



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
102	100.7	+0.8

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

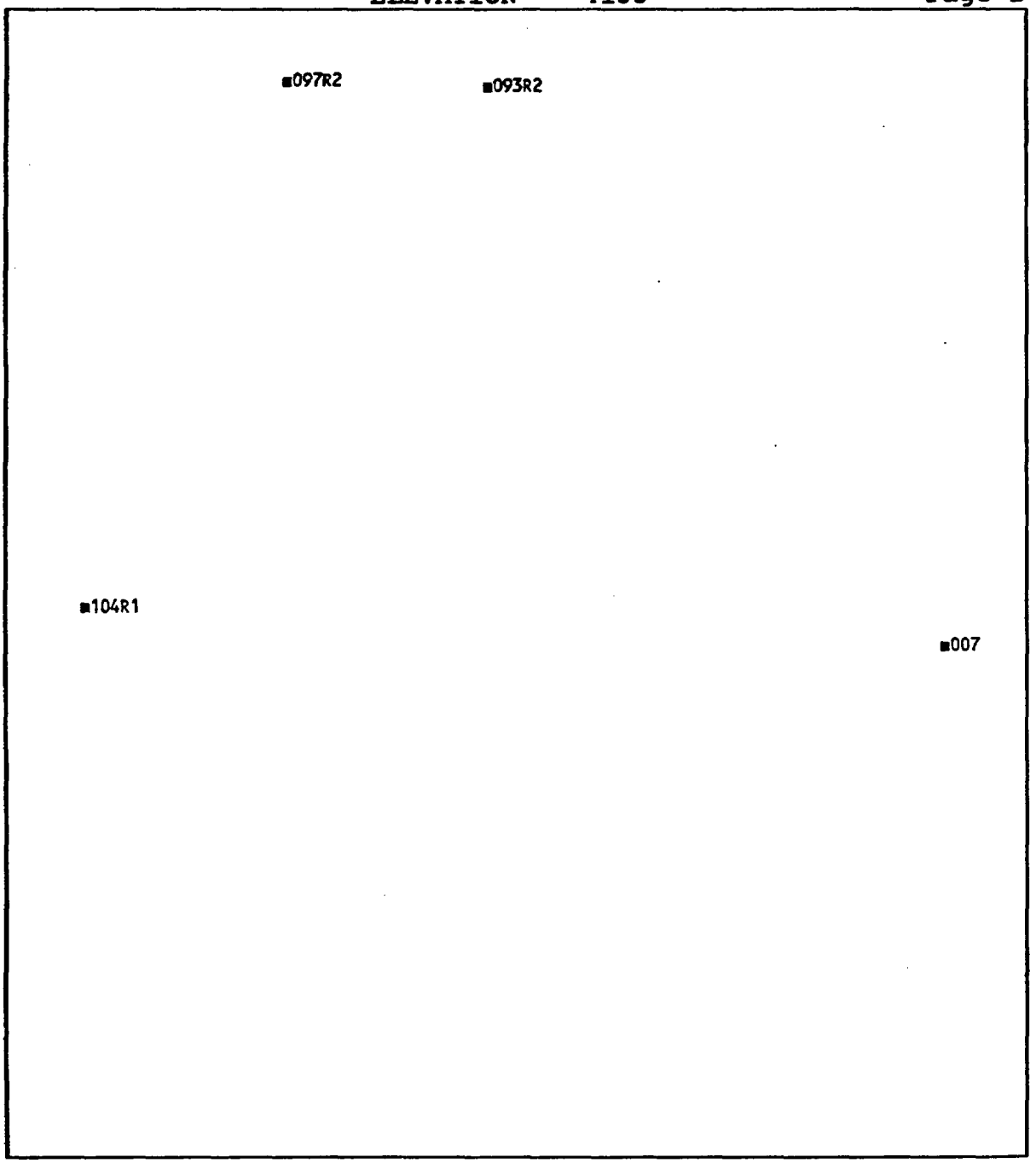
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4132



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
103	100.2	+1.6

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

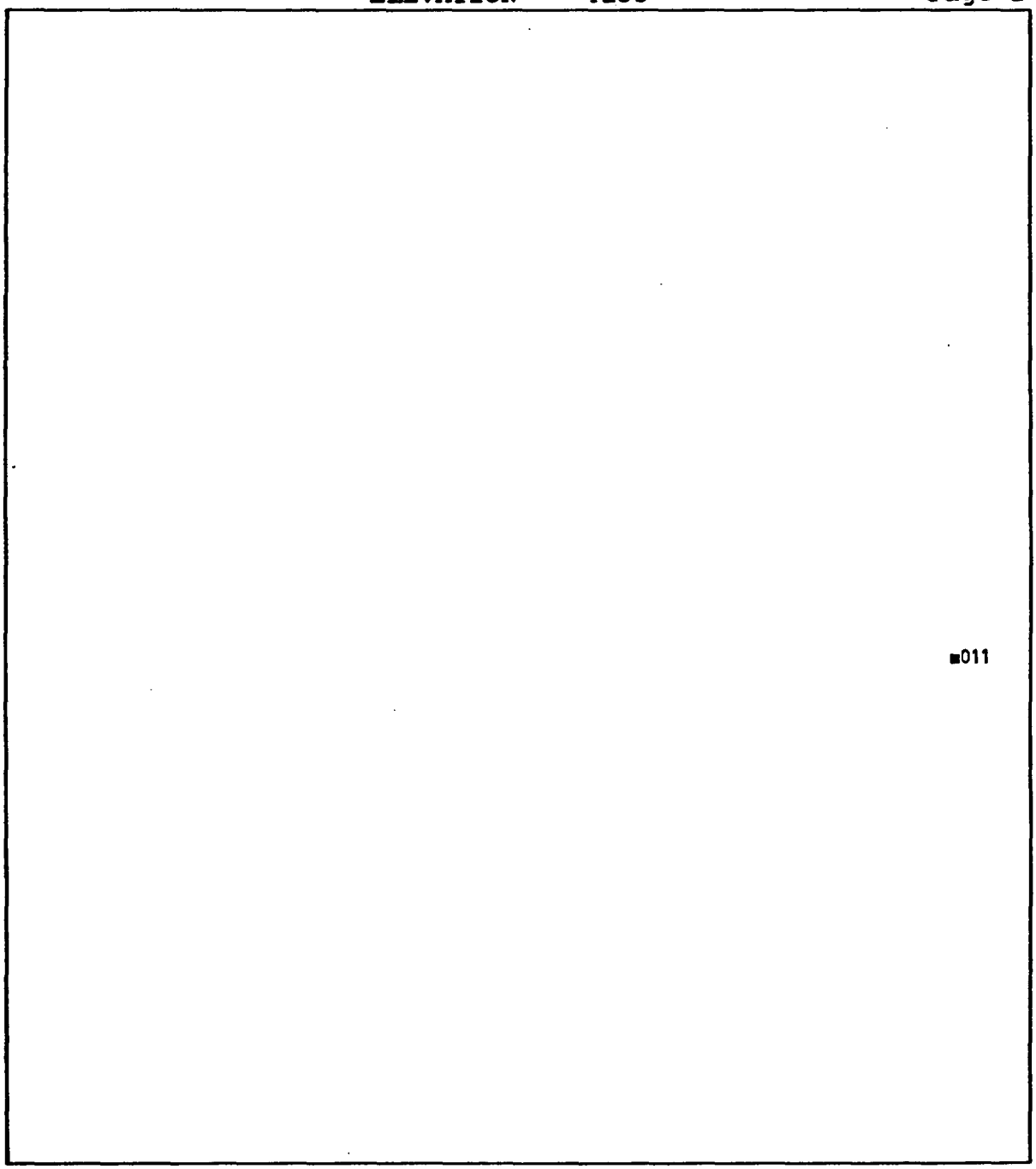
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4133



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
007	101.2	+2.3
093R2	100.3	+2.3
097R2	100.3	+2.2
104R1	100.8	+2.3

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

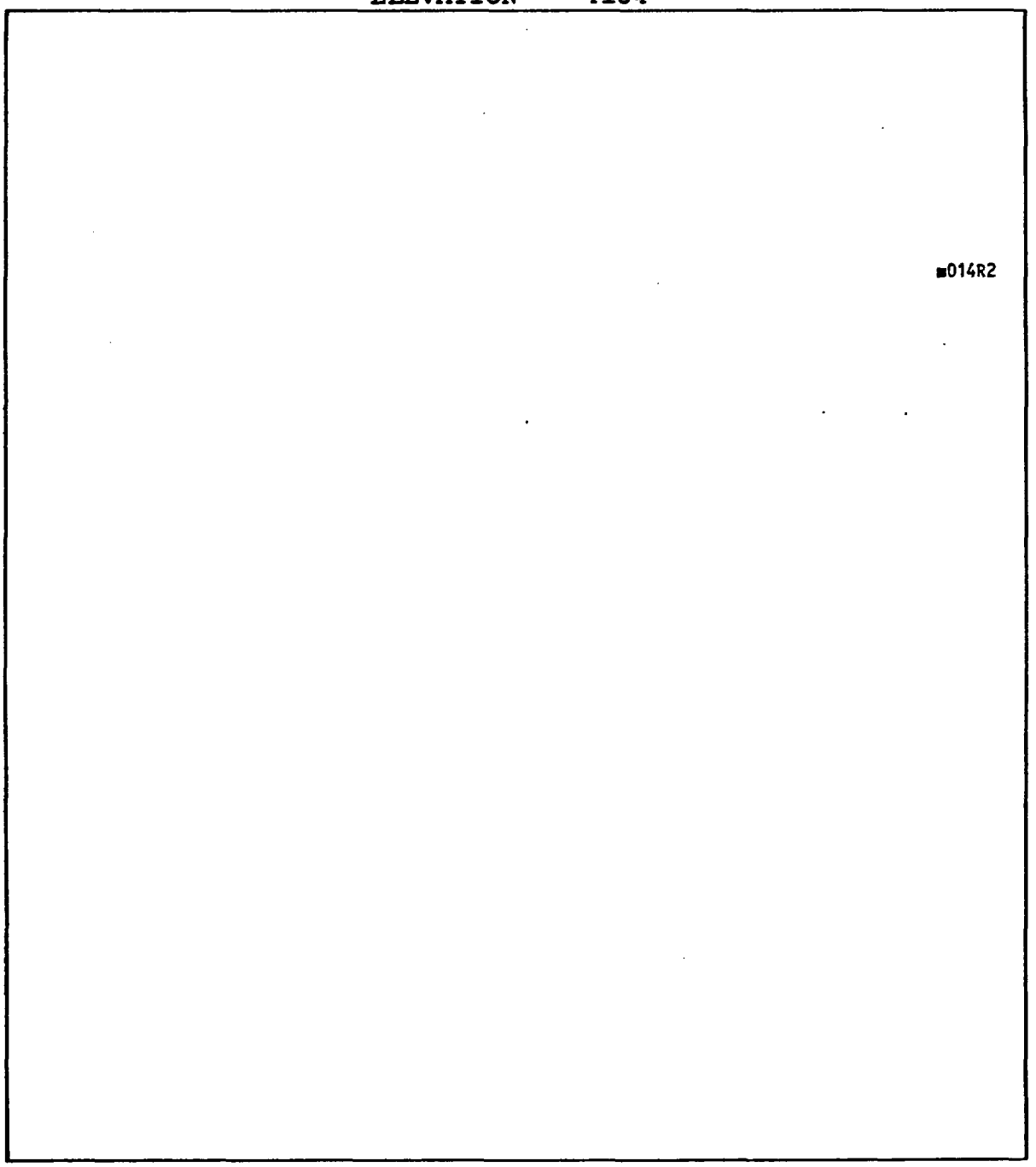
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4133



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
011	100.6	+2.7

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

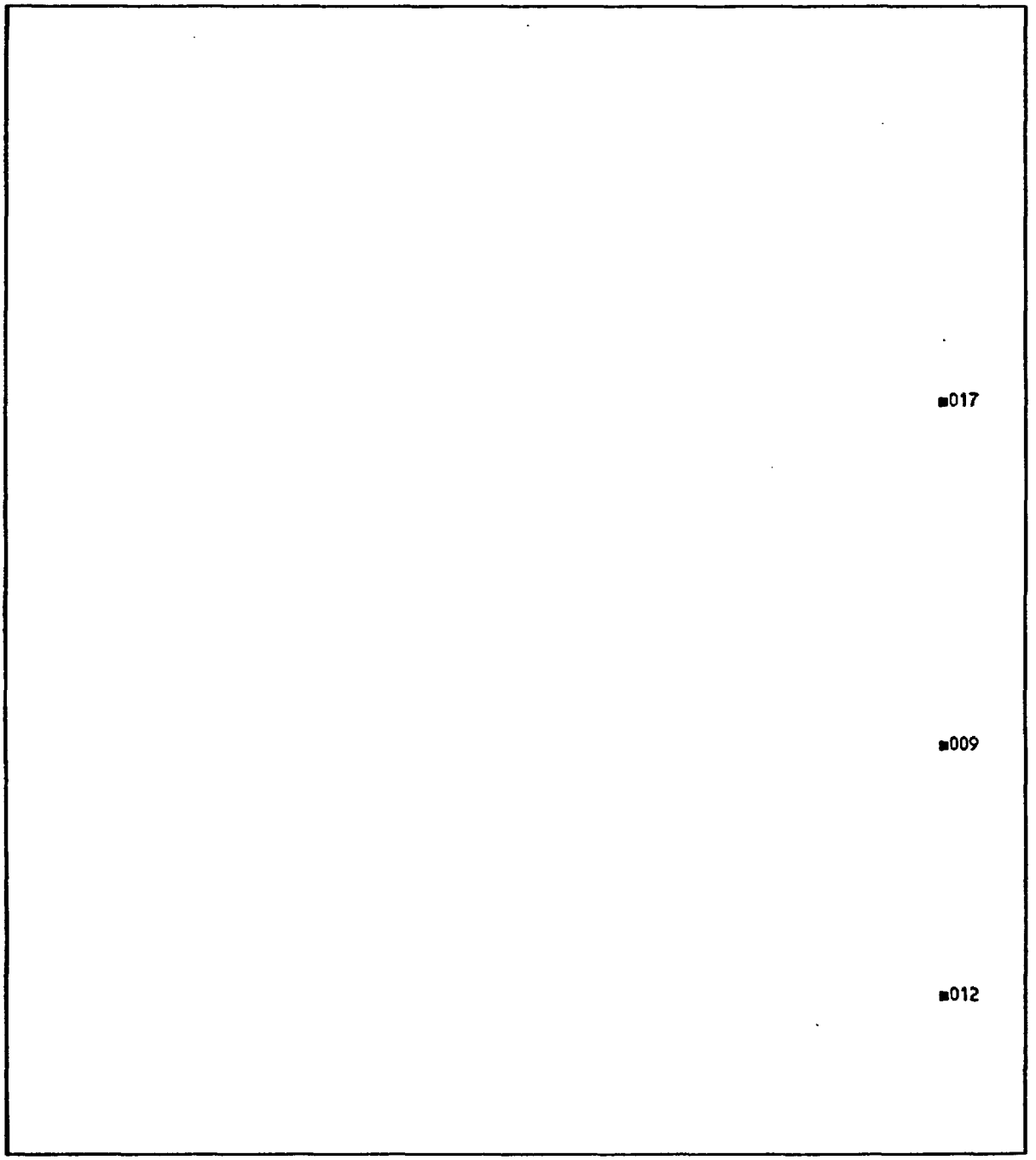
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4134



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
014R2	103.4	+2.7

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

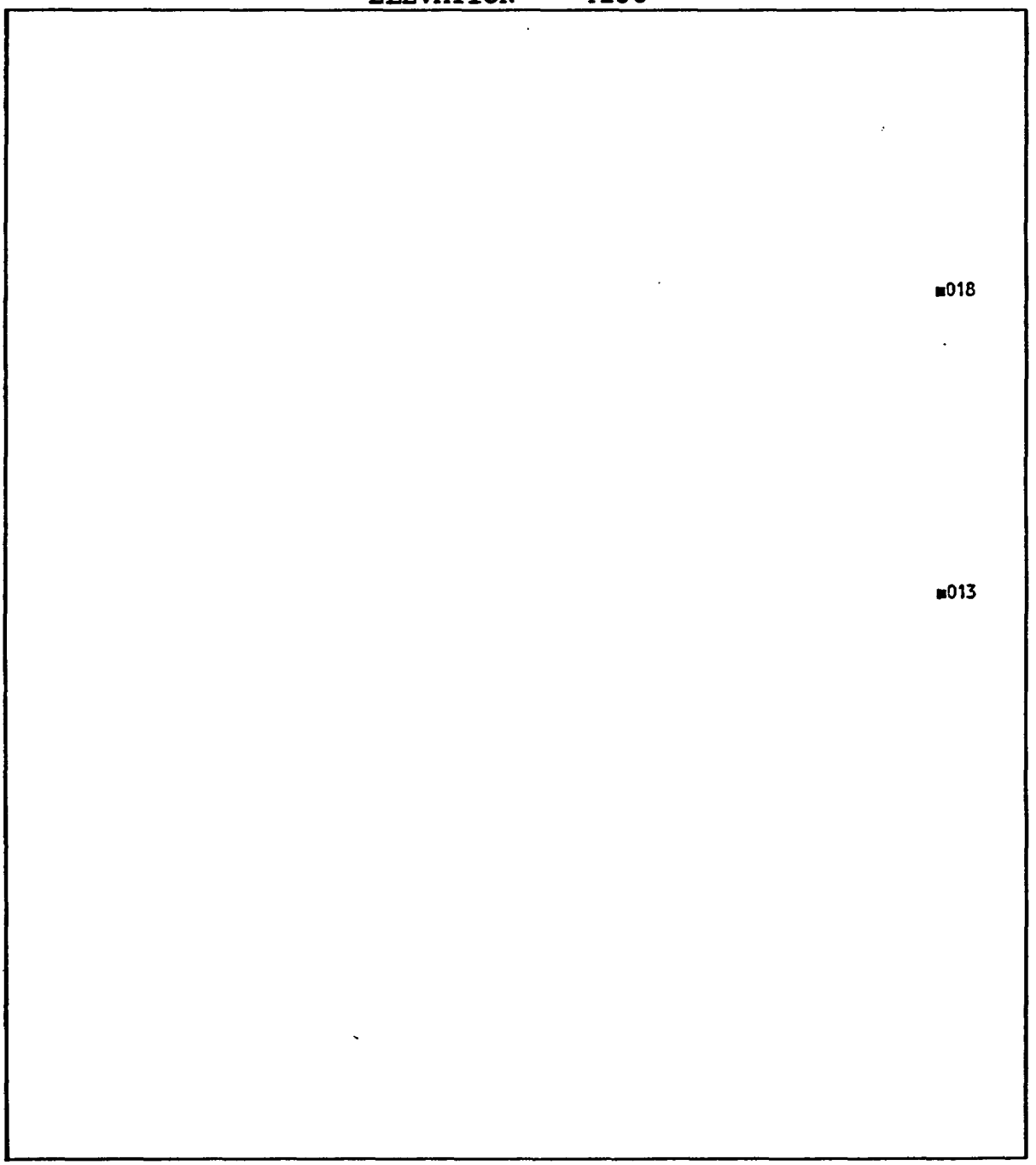
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4135



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
009	100.3	+0.0
012	100.7	+2.4
017	102.1	+1.9

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

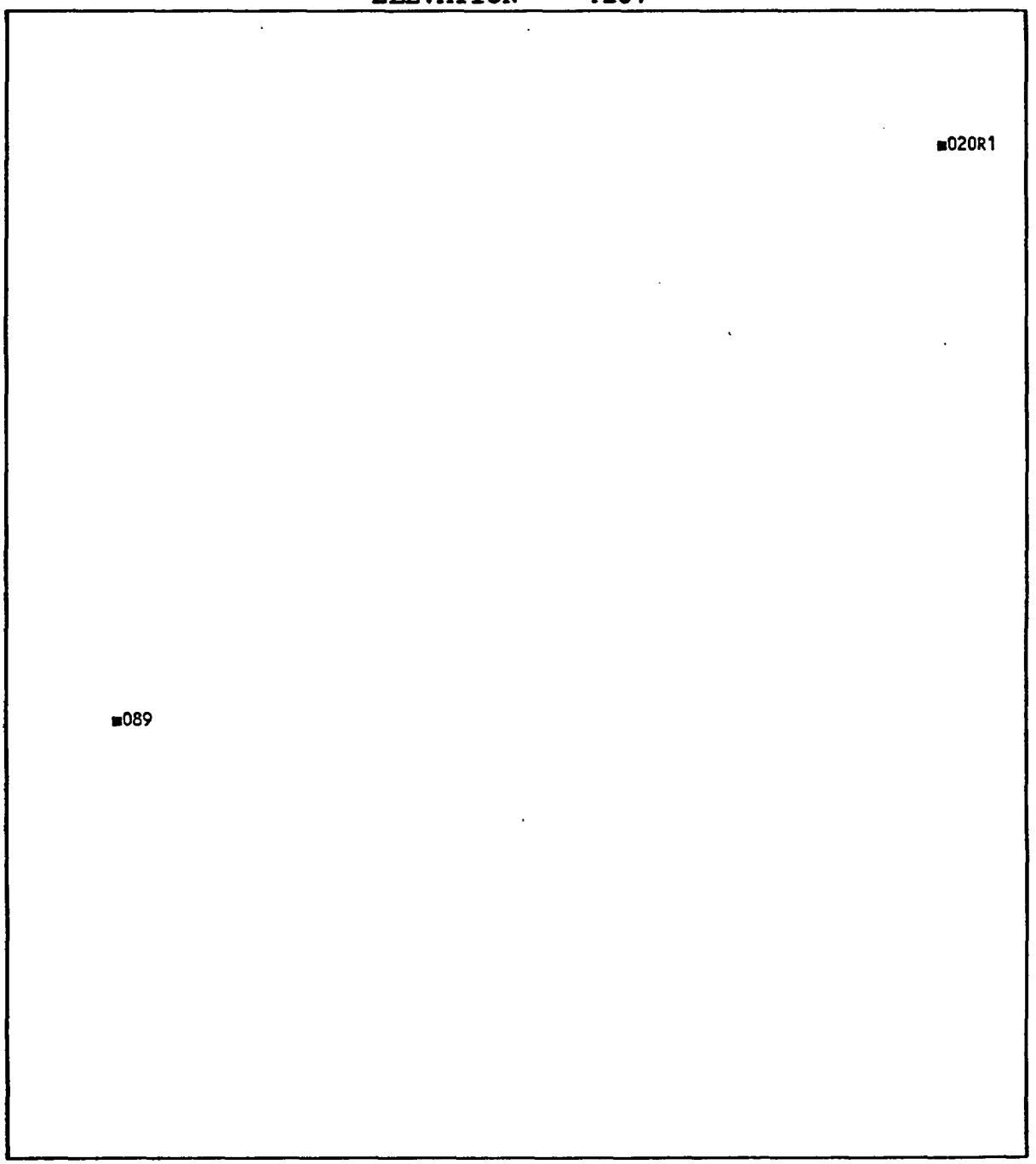
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4136



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
013	100.5	+1.8
018	102.1	+2.6

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

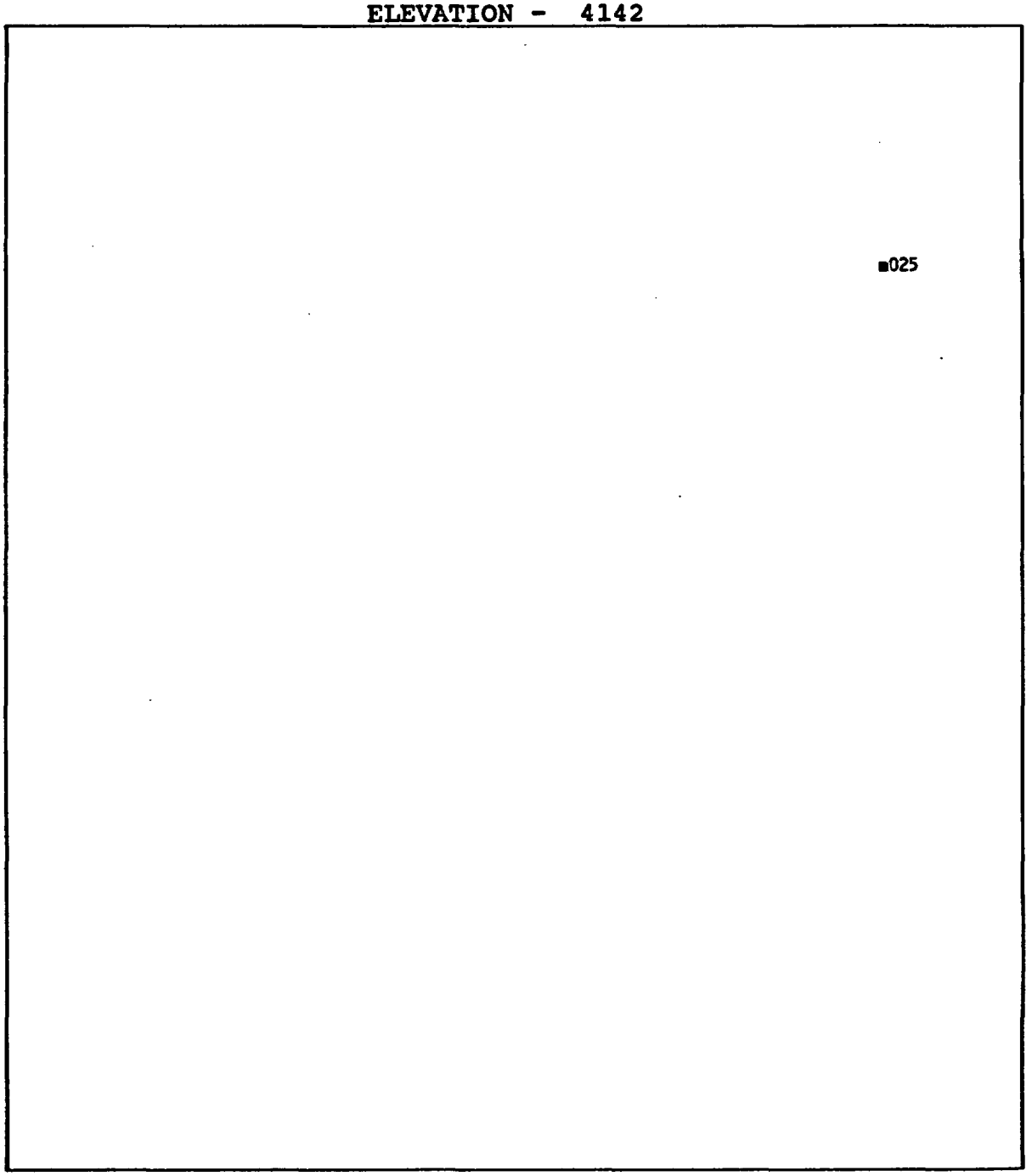
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4137



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
020R1	100.1	+0.7
089	101.3	+1.3

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

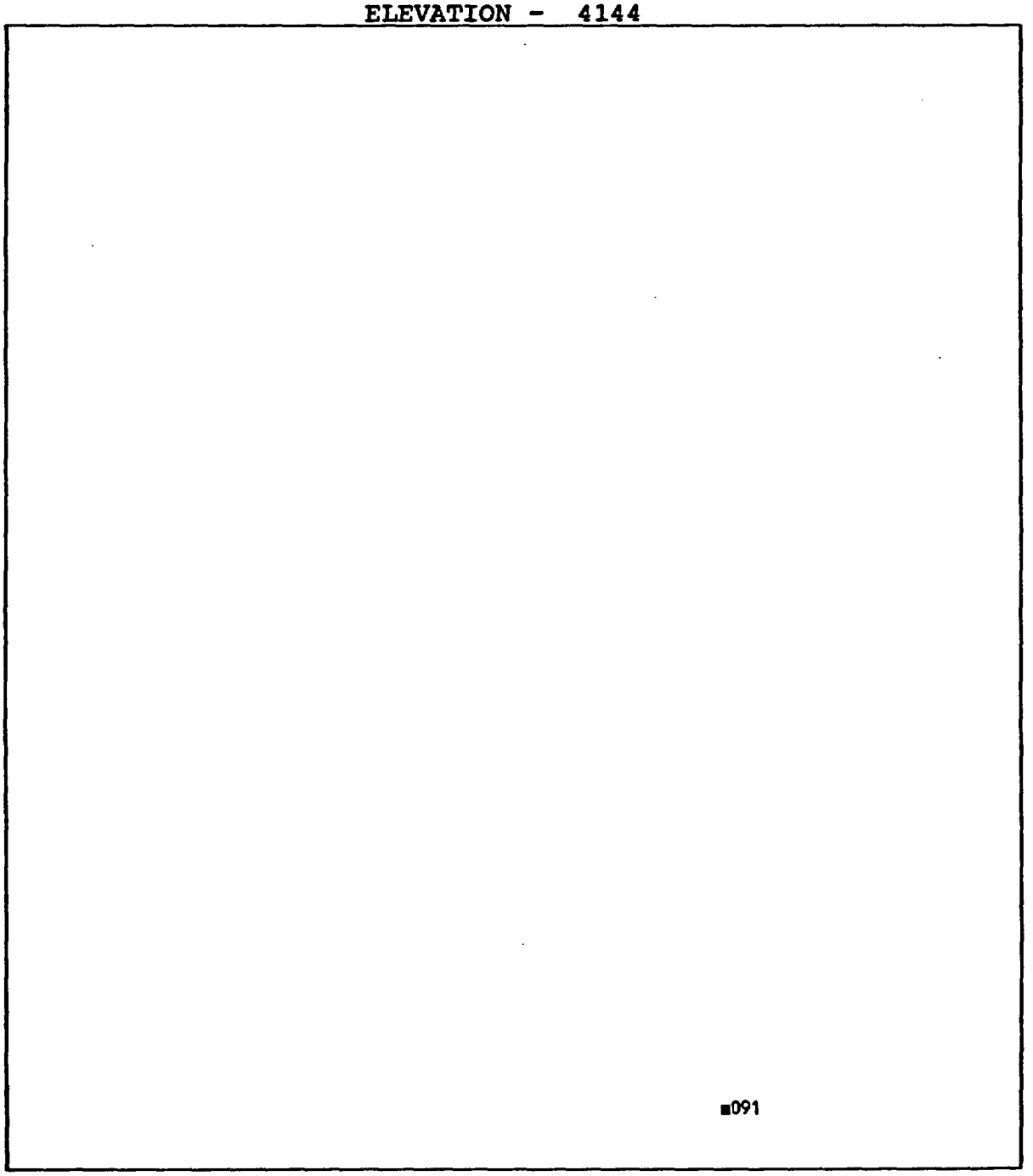
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4142



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
025	102.6	+1.2

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

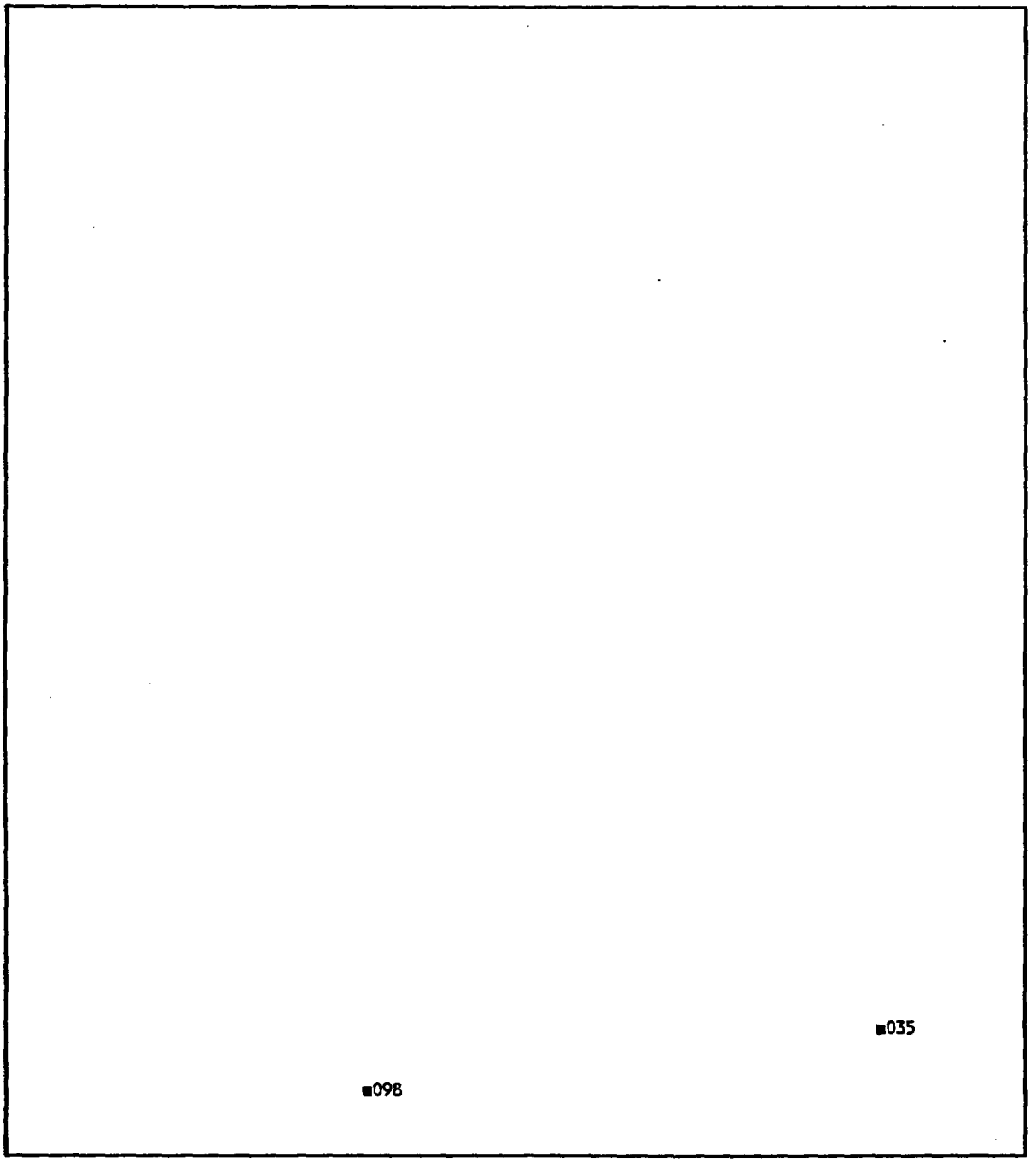
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4144



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
091	101	+0.6

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

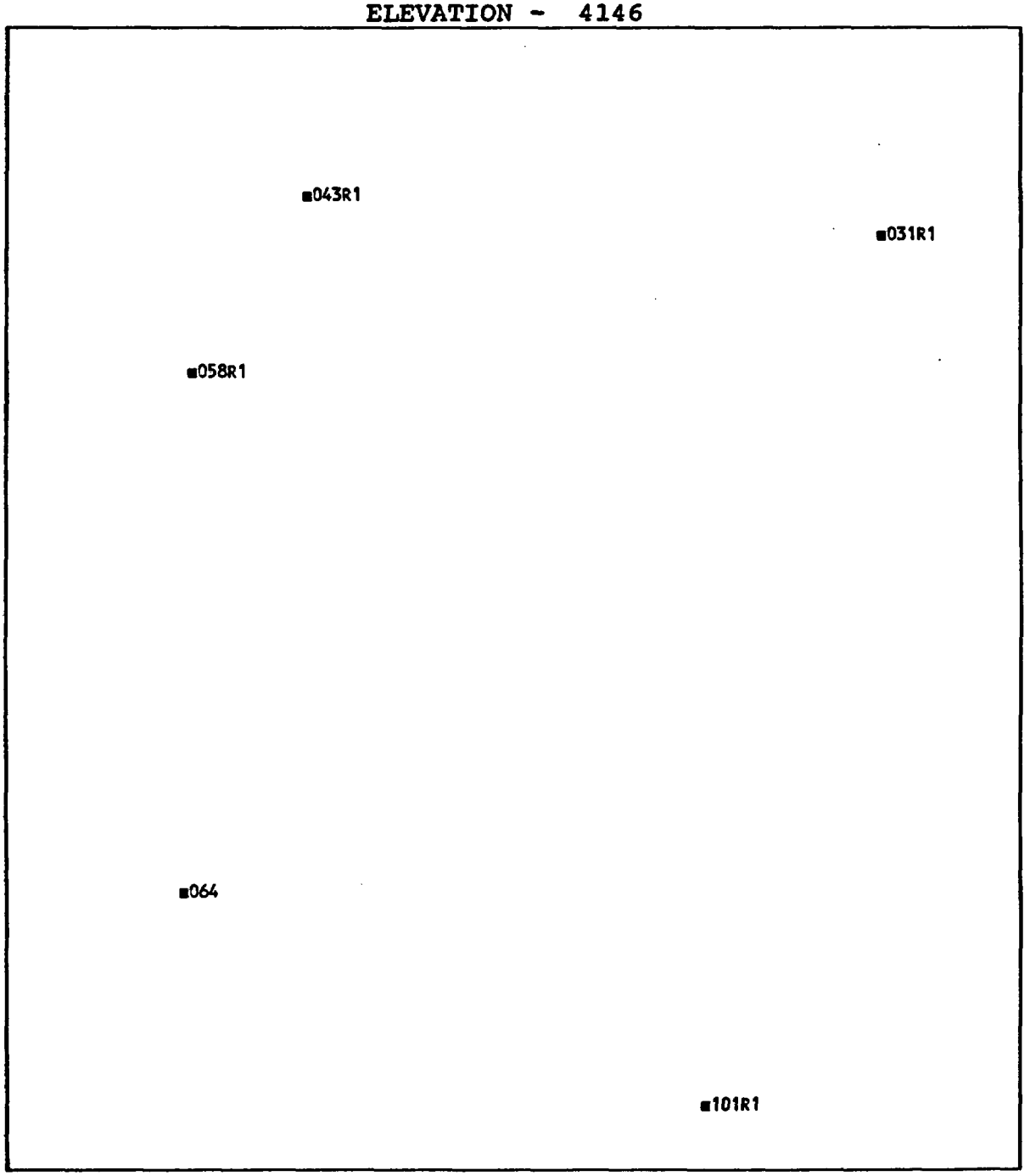
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4145



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
035	100.8	+0.6
098	100.1	+2.7

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

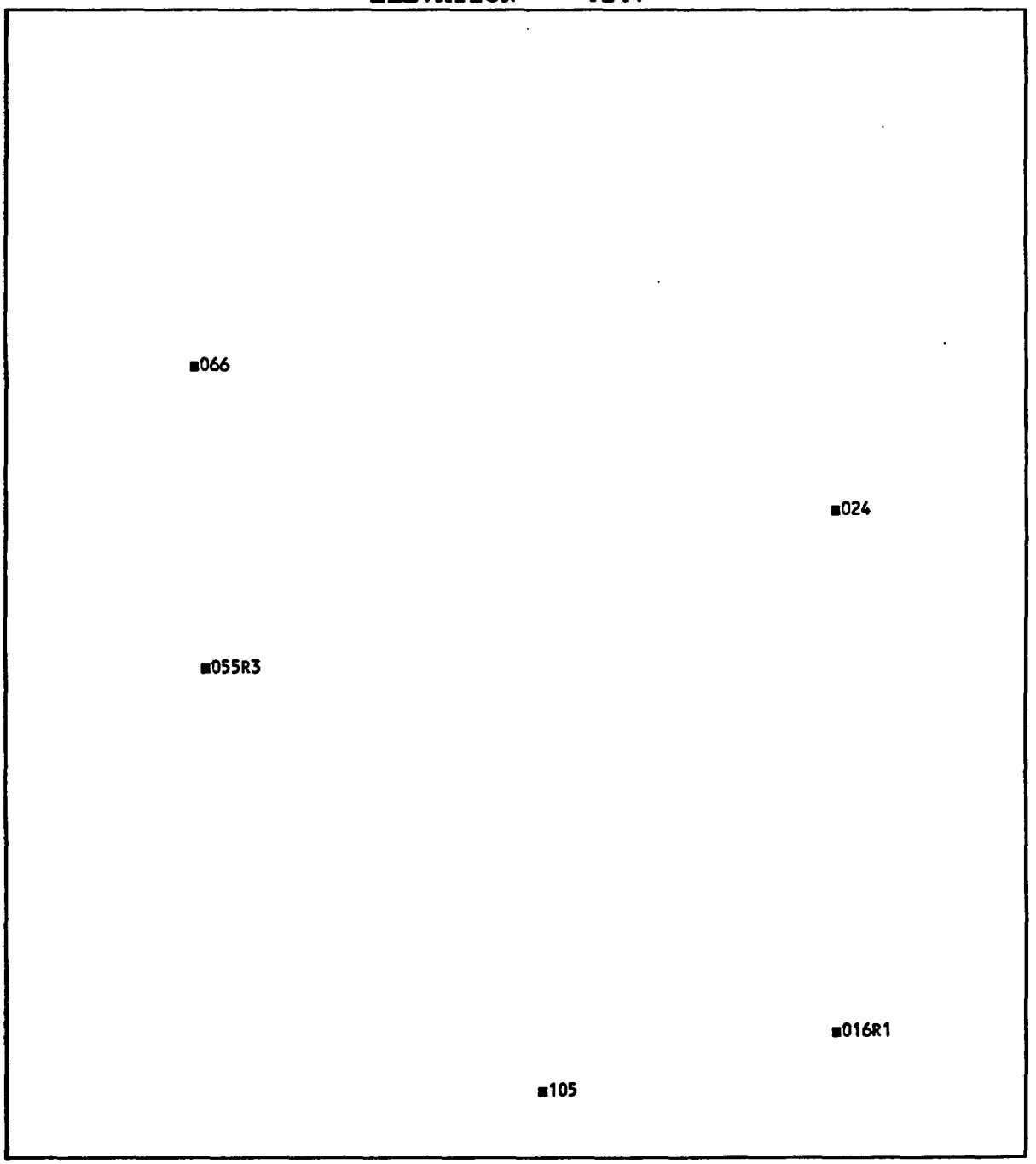
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4146



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
031R1	101.3	+1.1
043R1	100.3	+2.9
058R1	105	+1.7
064	102.1	+0.2
101R1	101.1	+1.2

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

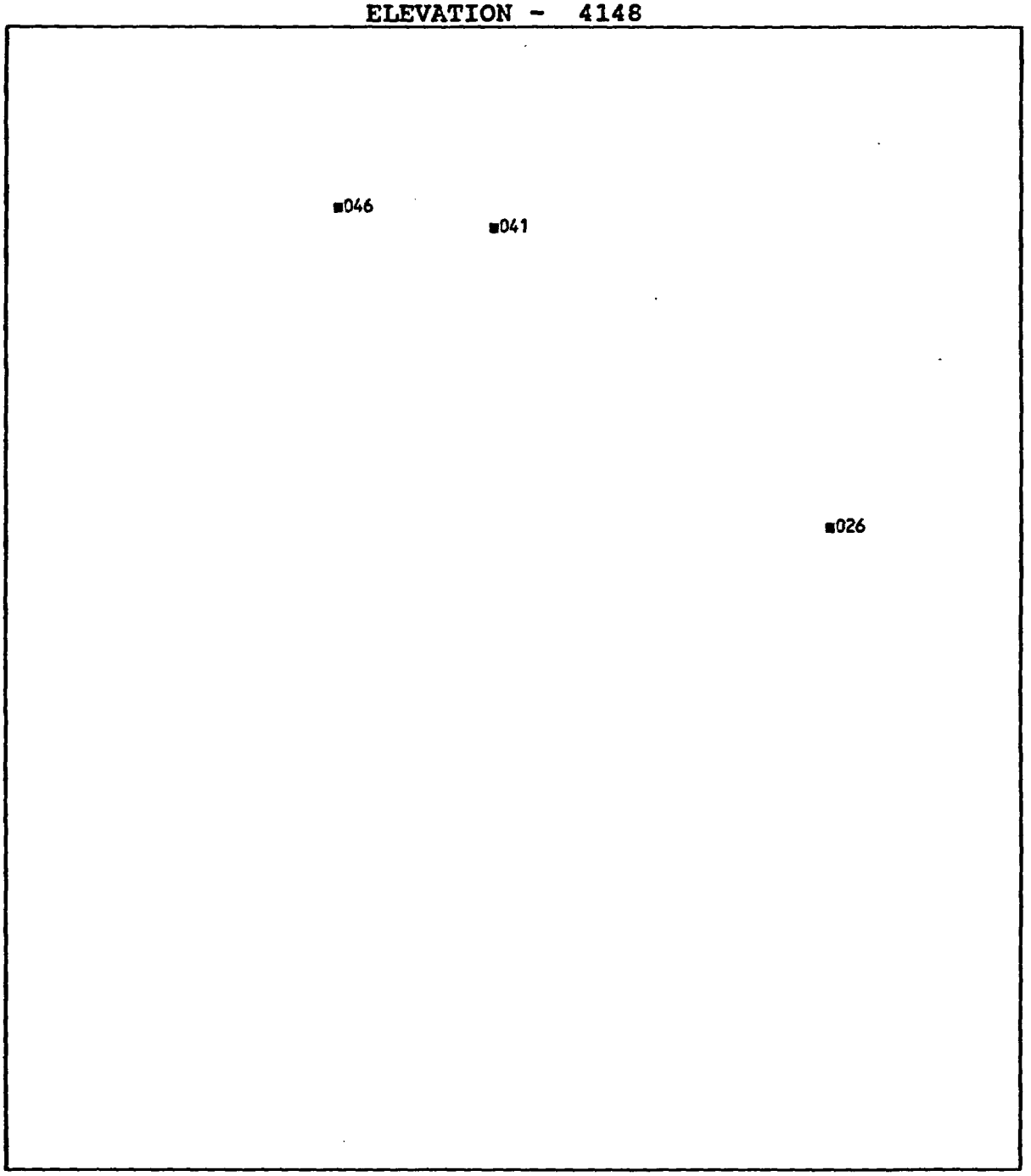
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4147



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
016R1	101	+0.0
024	101.3	+2.4
055R3	100	+2.7
066	102.9	+2.0
105	100.7	+1.7

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

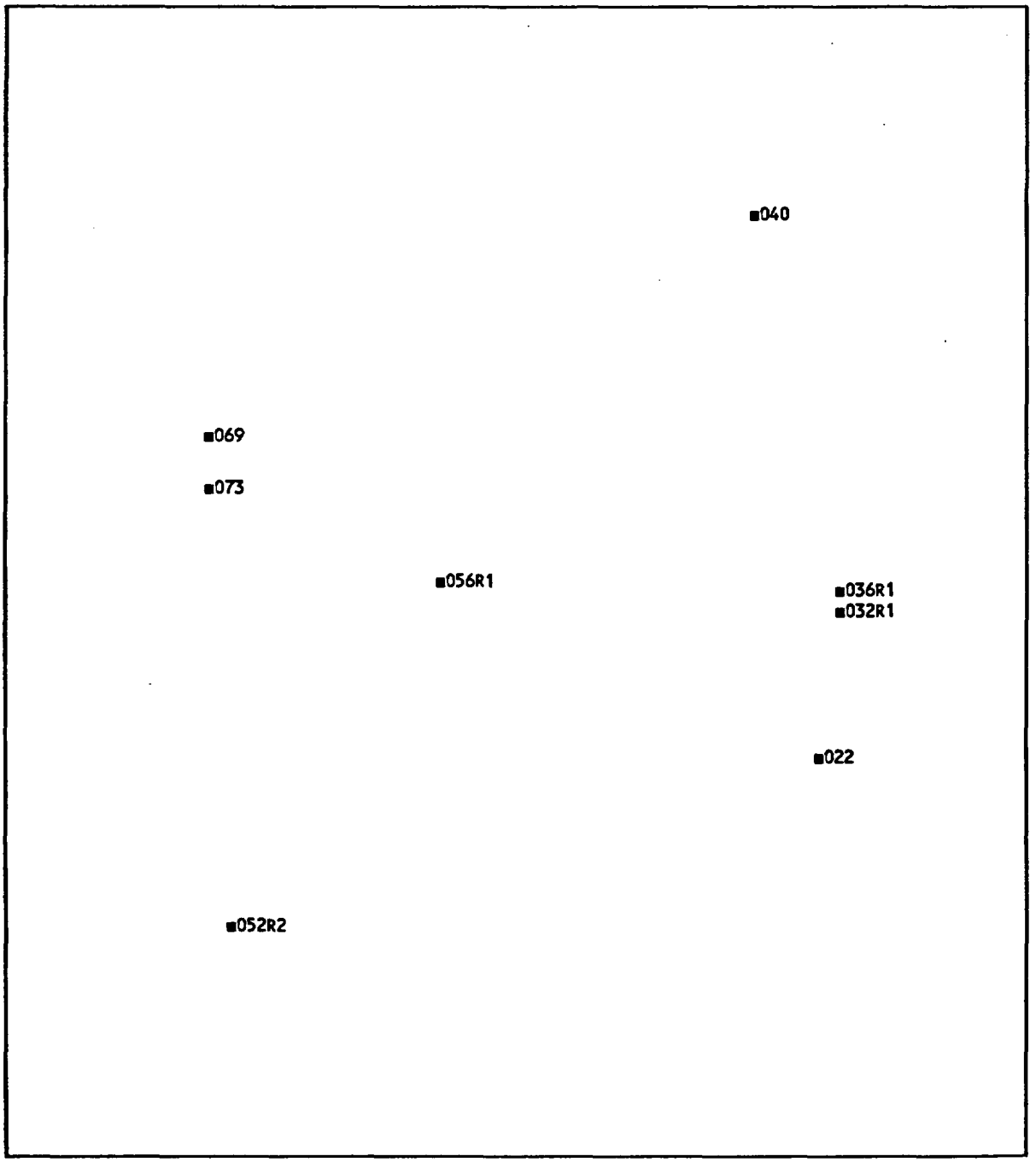
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4148



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
026	100	+1.5
041	100	+3.0
046	100	+1.5

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

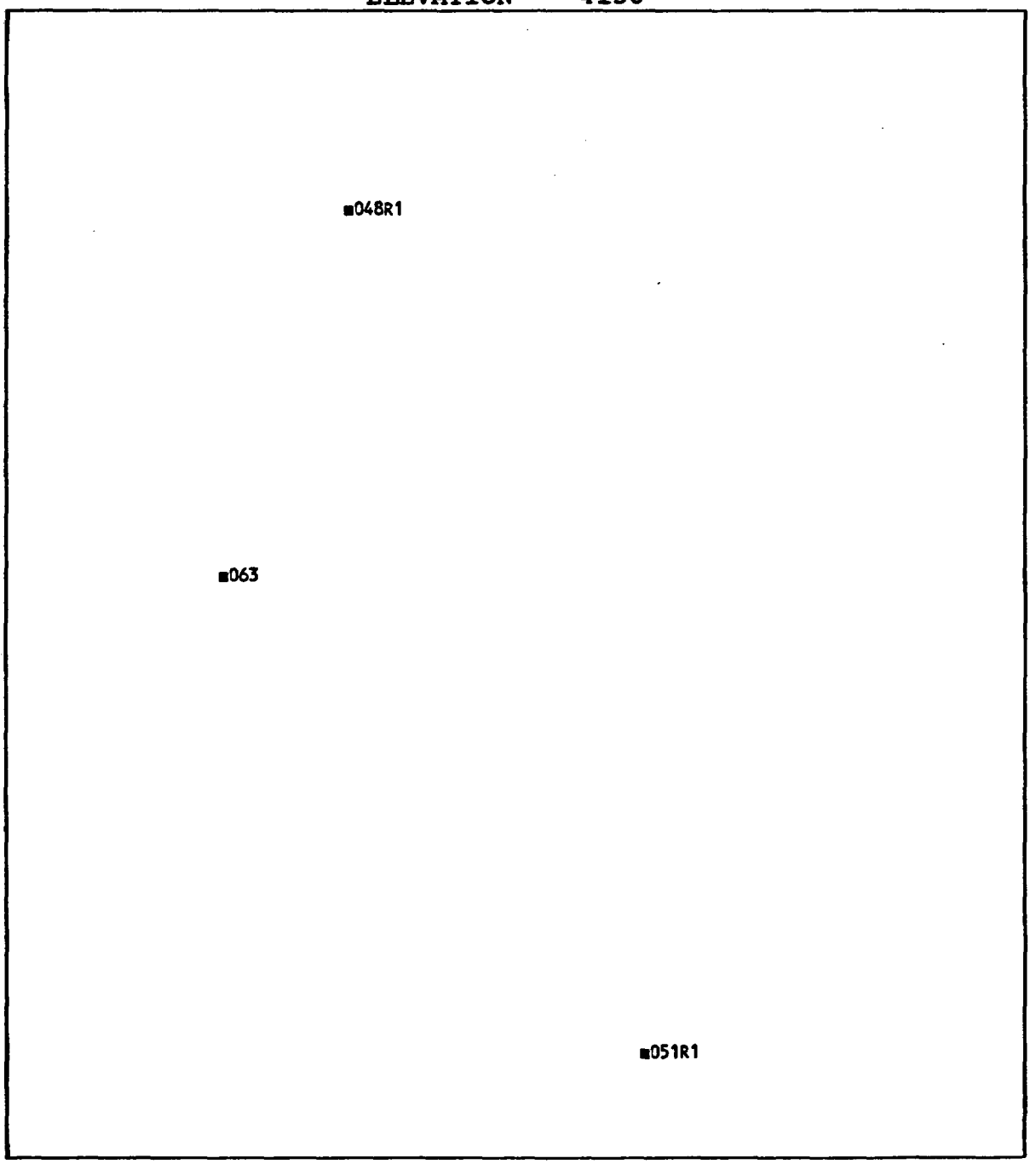
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4149



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
022	102.2	+1.5
032R1	100.4	+0.6
036R1	101.2	+1.7
040	103.7	+1.7
052R2	100.1	+2.5
056R1	104.1	+2.4
069	102	+1.6
073	100.9	+1.2

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

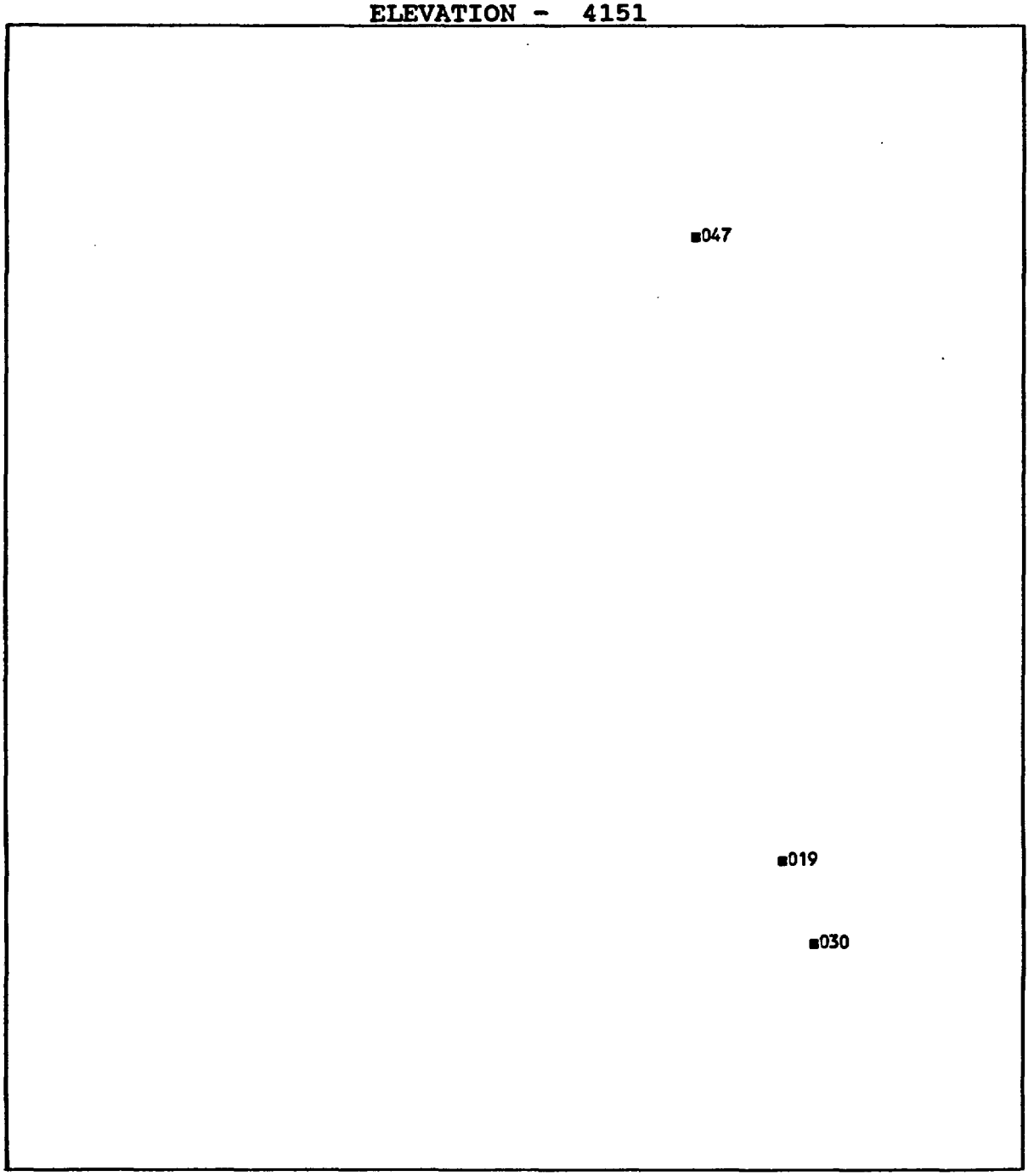
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4150



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
048R1	100	+1.5
051R1	100	+1.4
063	100.2	+0.9

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

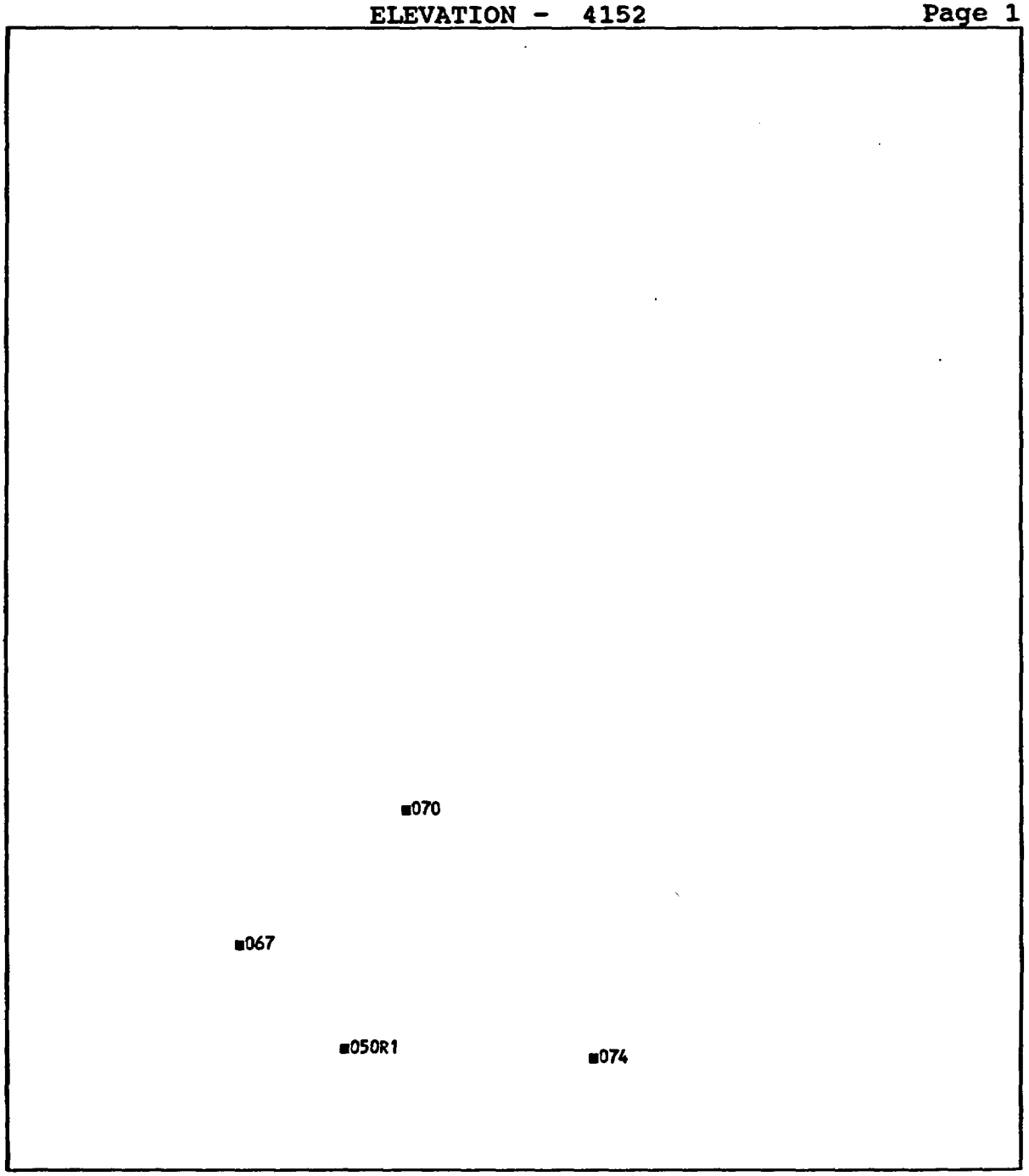
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4151



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
019	101.9	+0.7
030	103.8	+0.5
047	100.1	+1.4

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

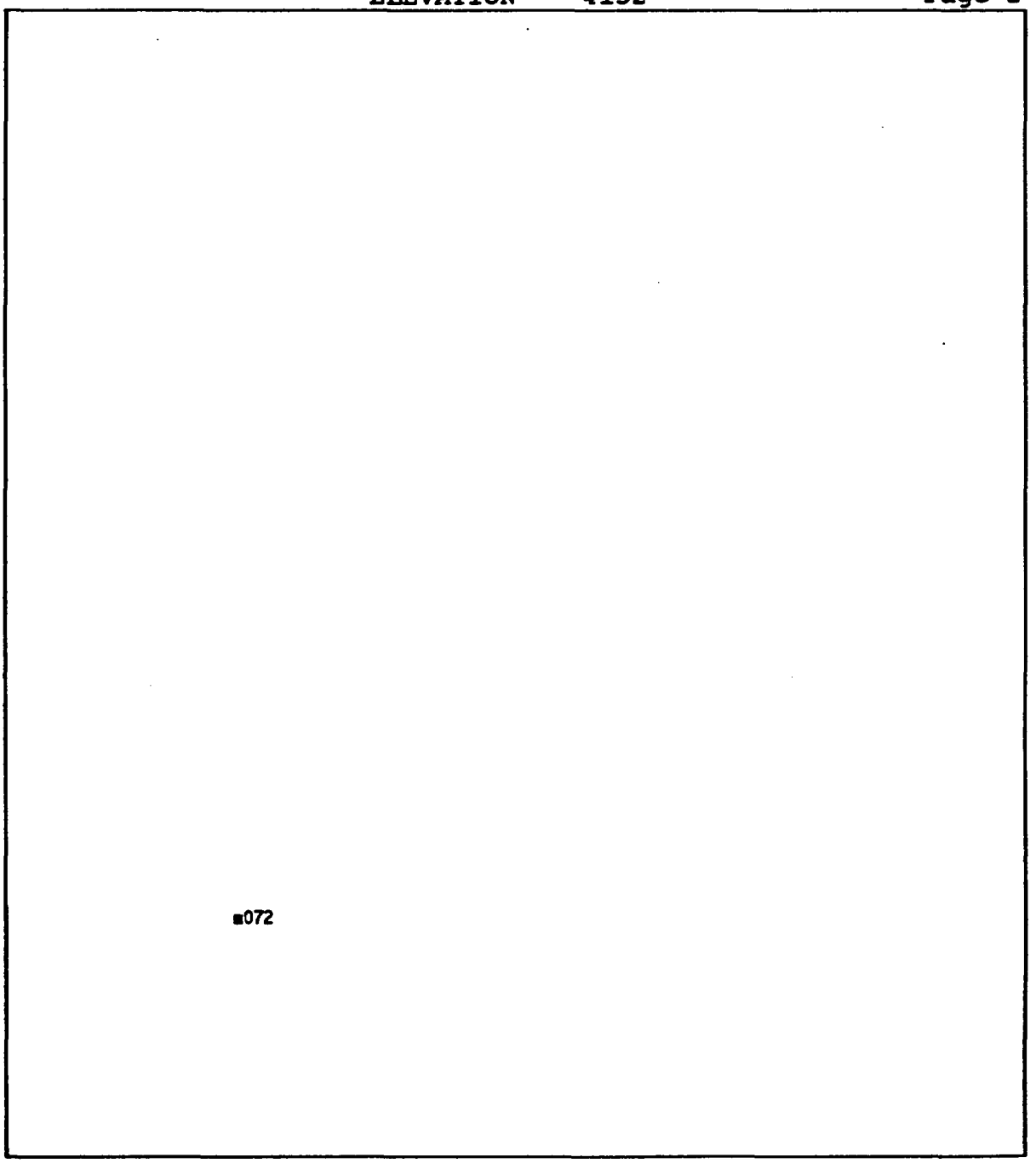
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4152



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
050R1	100.2	+2.3
067	103.6	+1.3
070	100.1	+3.0
074	100	+1.9

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

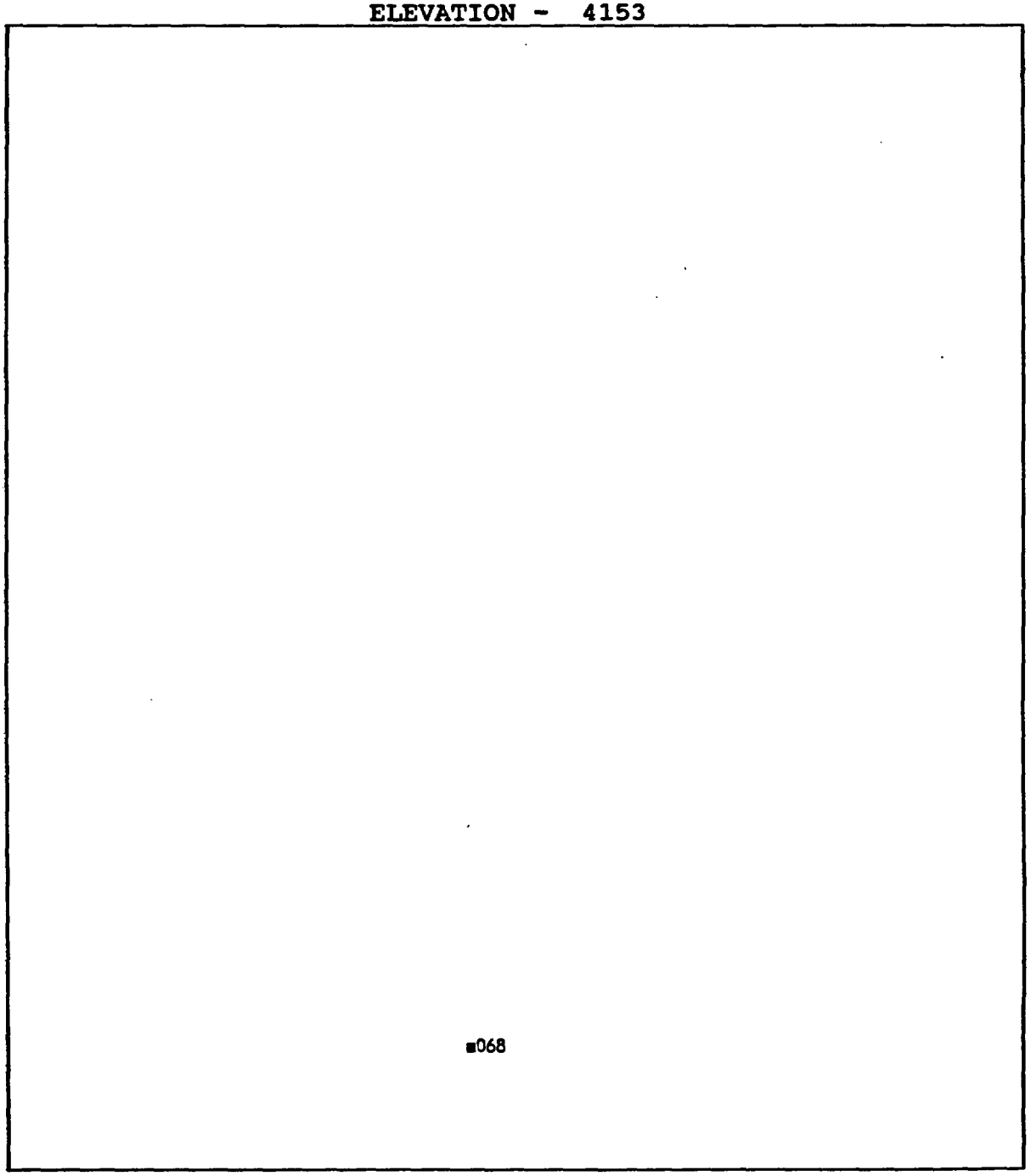
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4152



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
072	101.6	+2.6

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

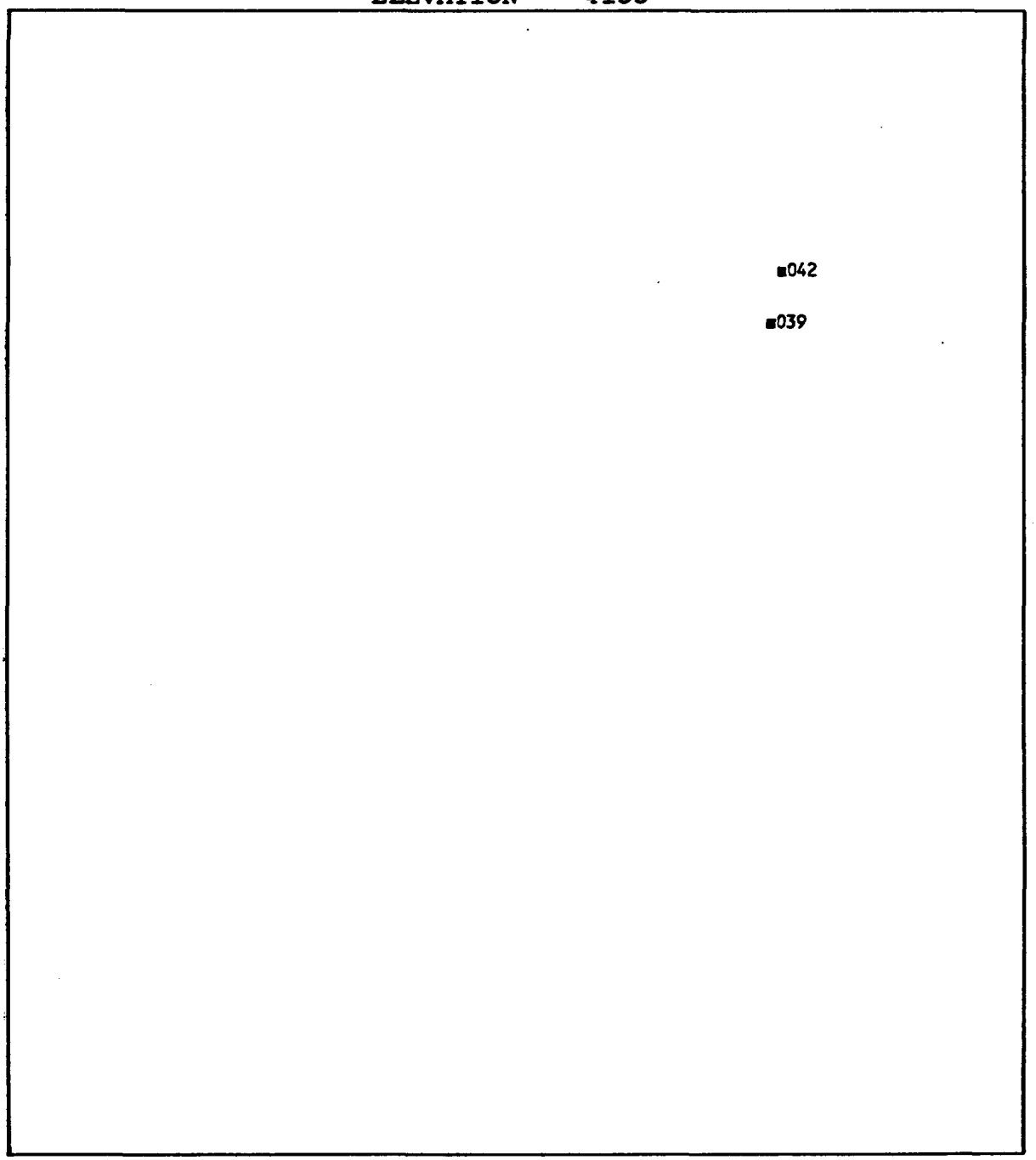
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4153



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
068	104.3	+1.4

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

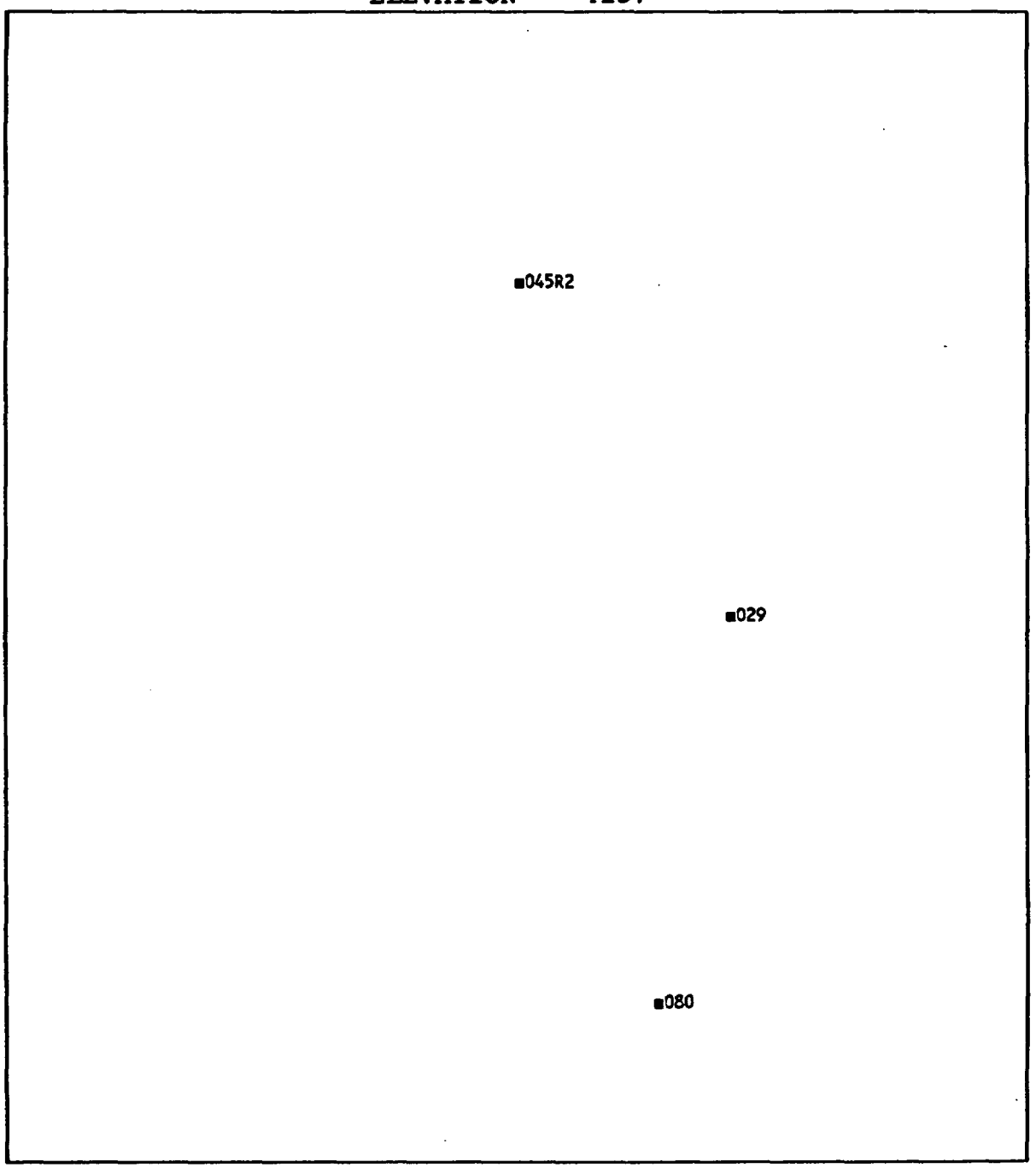
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4155



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
039	101.9	+1.5
042	101.2	+1.0

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

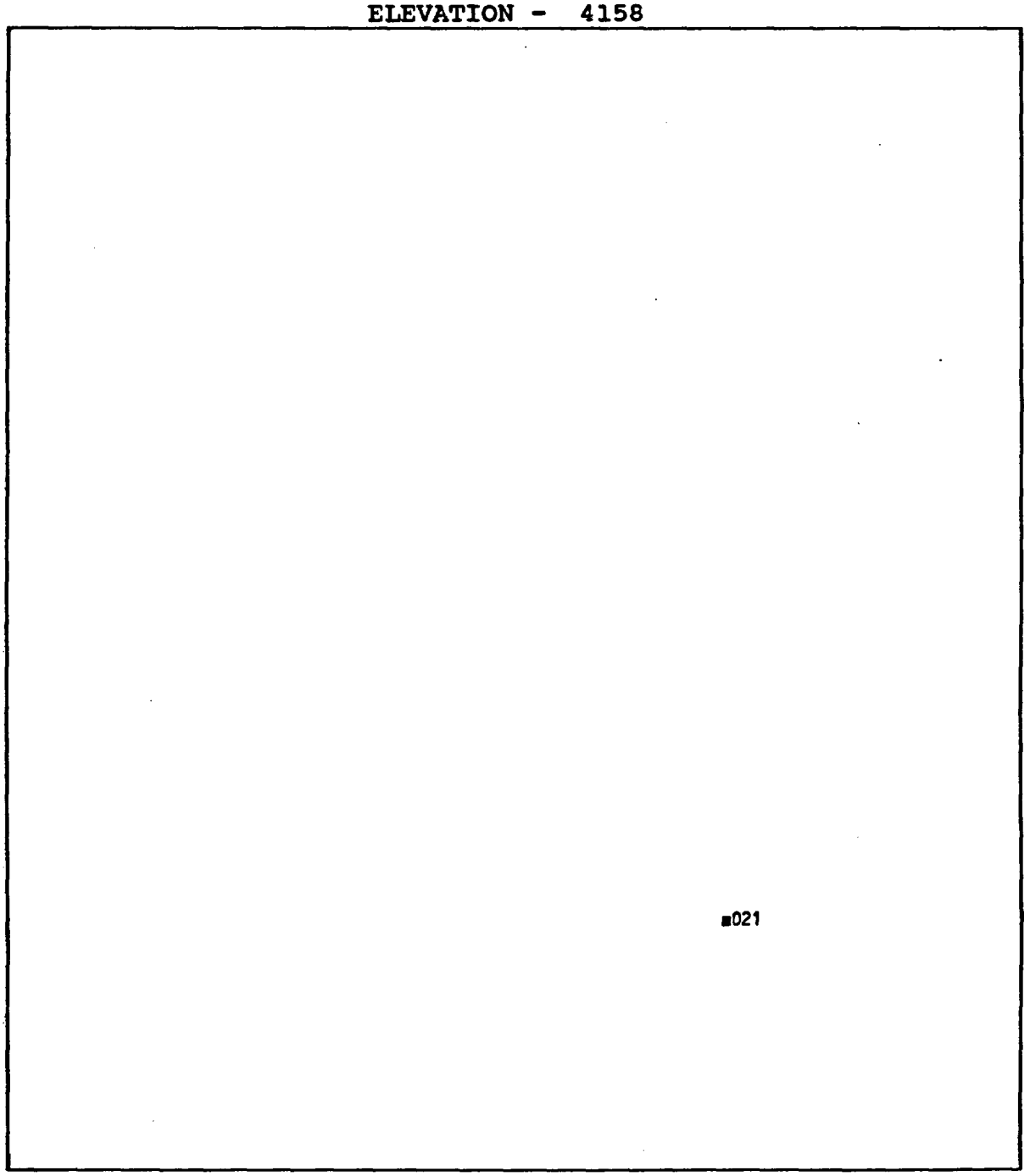
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4157



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
029	102.5	+1.4
045R2	100.8	+1.4
080	102.1	+1.4

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

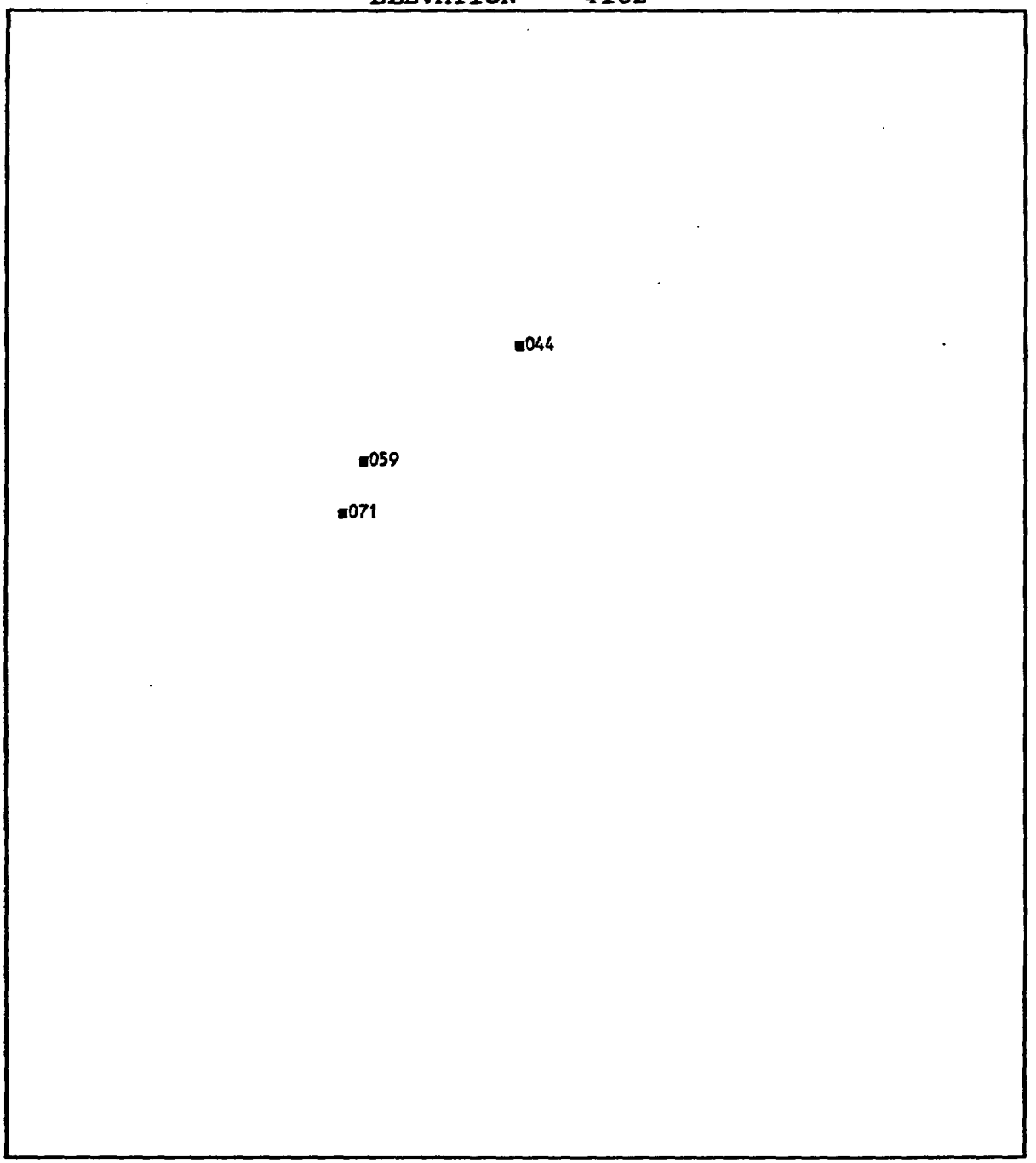
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4158



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
021	102	+0.9

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

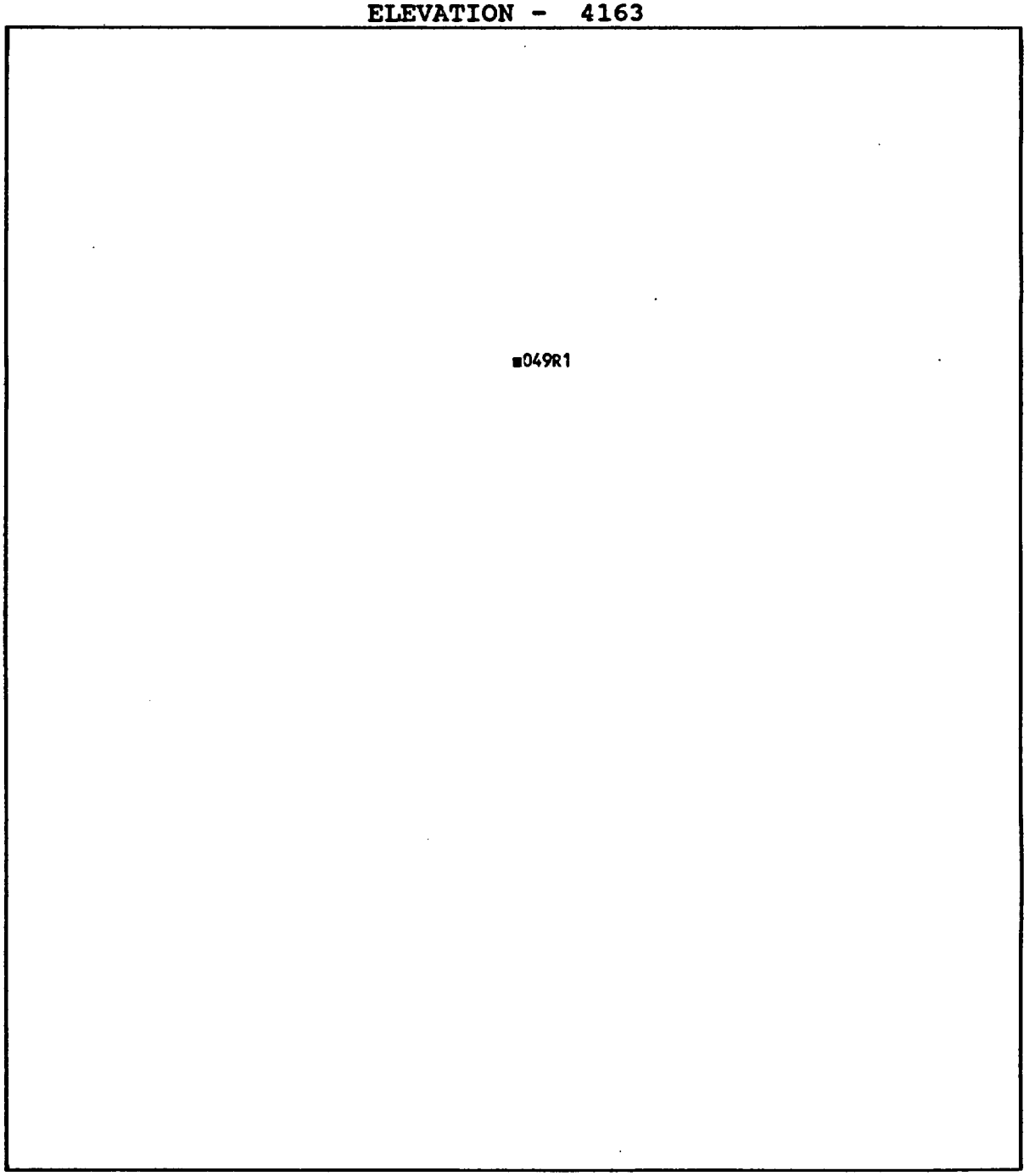
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4162



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
044	102.5	+1.3
059	103.5	+3.0
071	104.3	+1.2

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

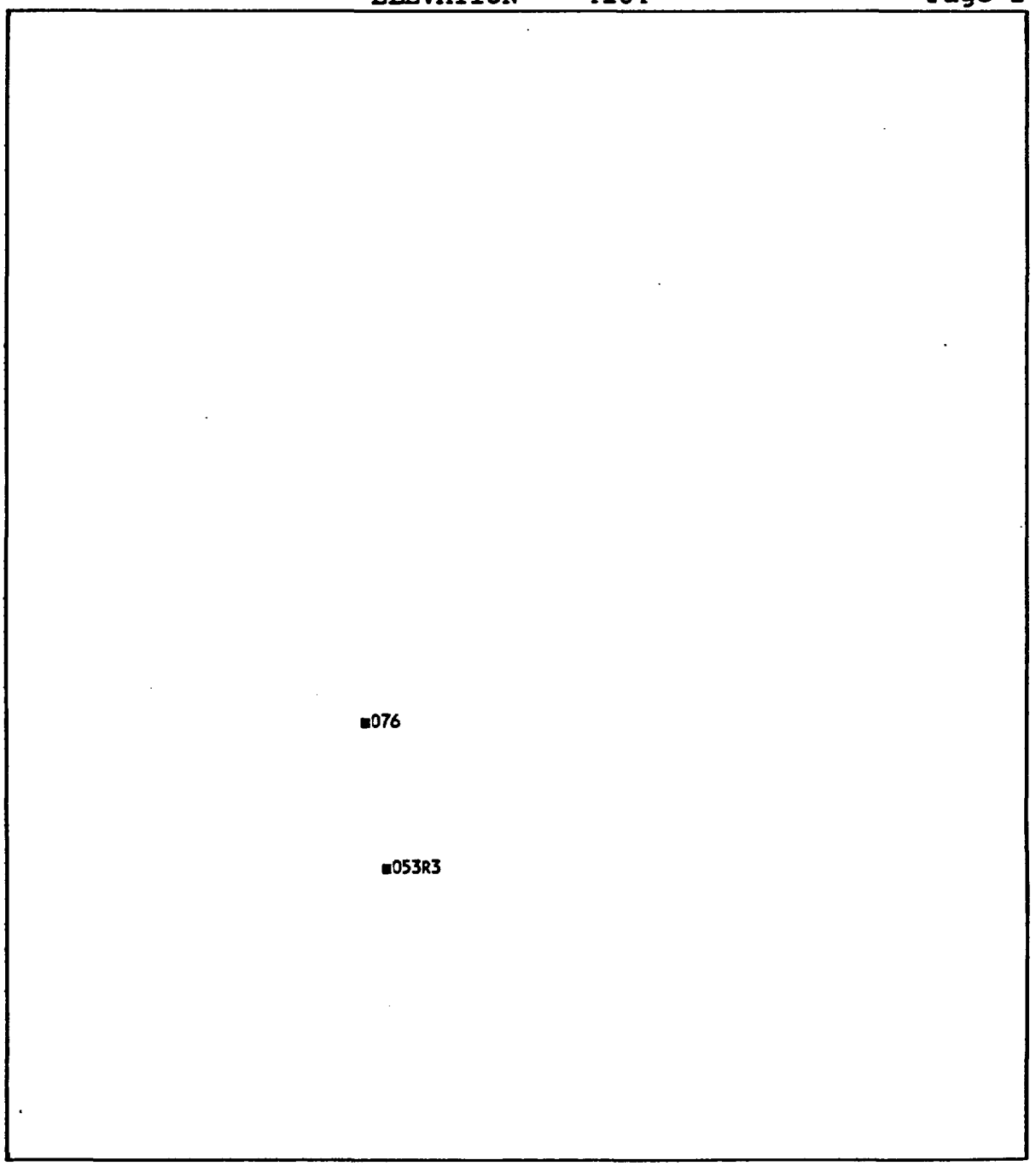
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4163



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
049R1	101.9	+3.0

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

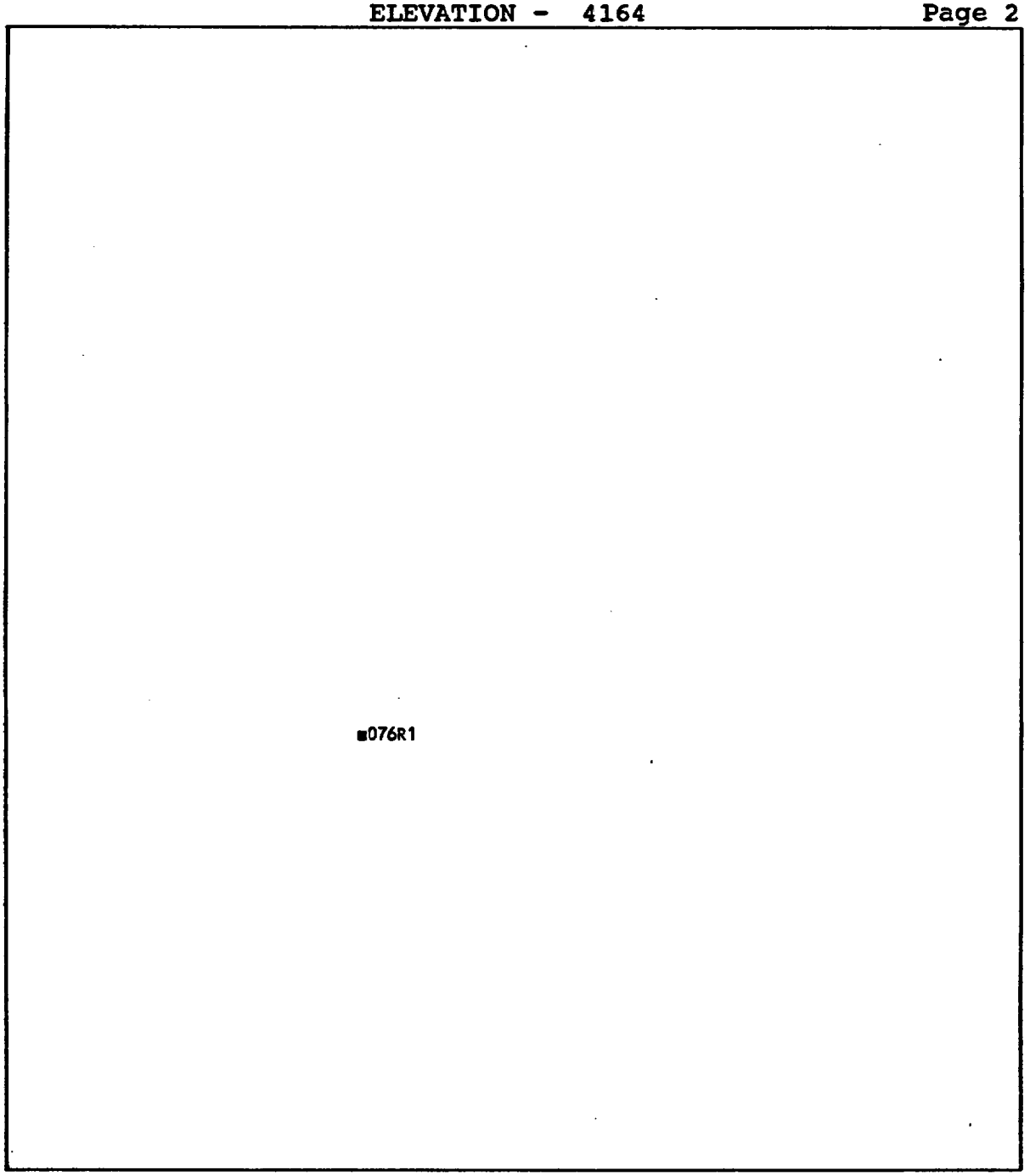
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4164



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
053R3	103	+1.9
076	101.4	+3.5

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

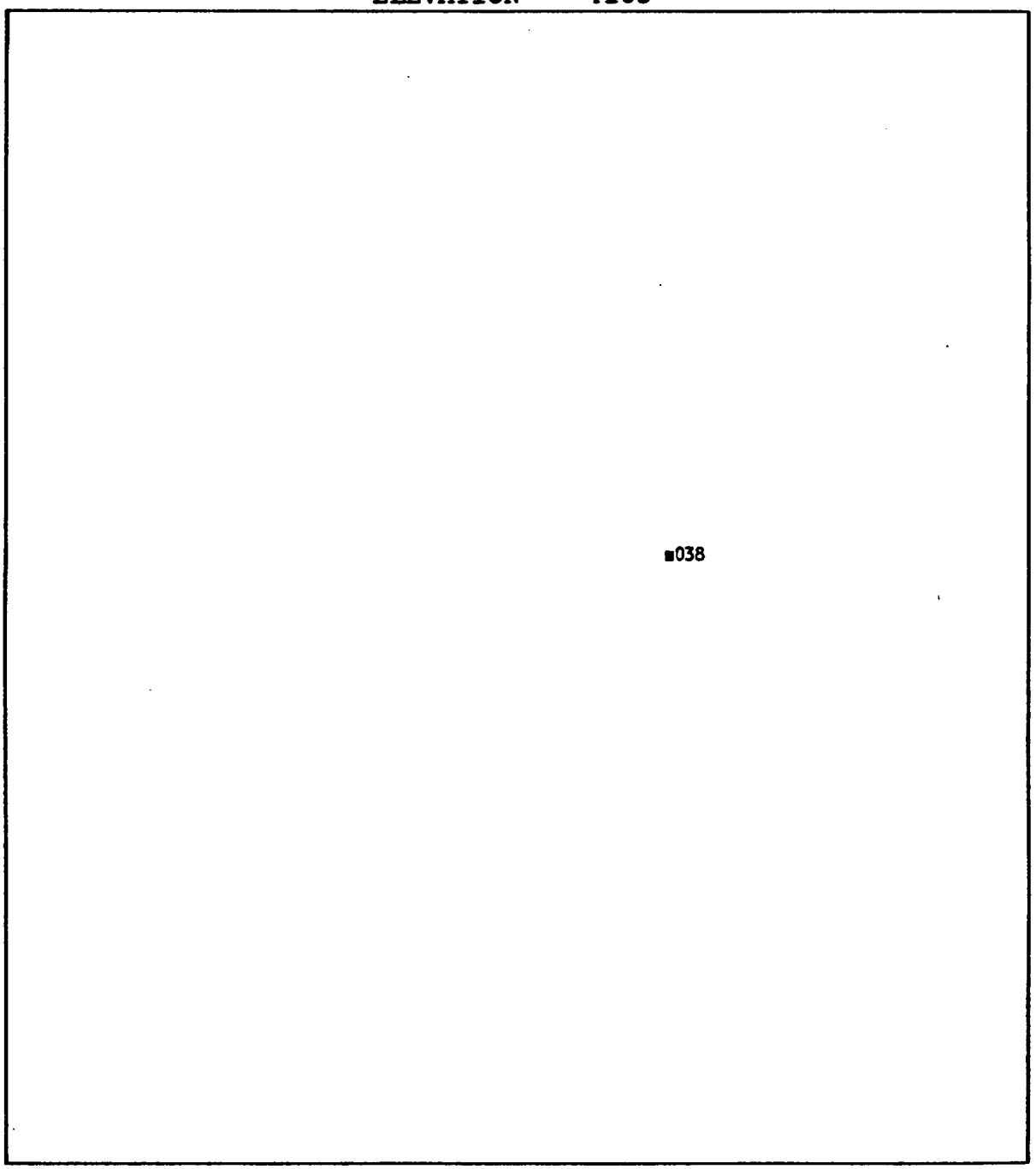
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4164



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
076R1	100.7	+2.3

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

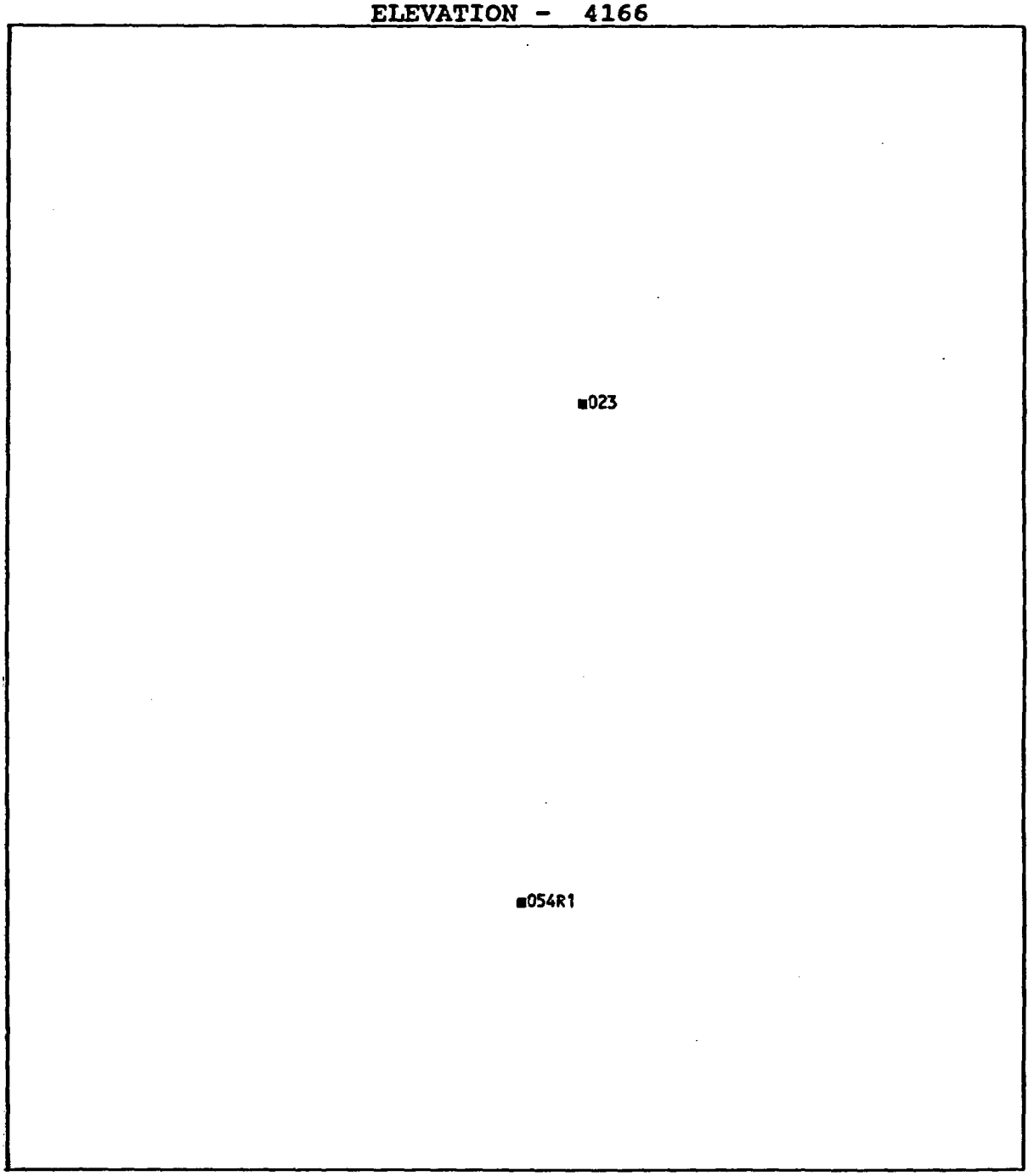
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4165



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
038	105.4	+0.4

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

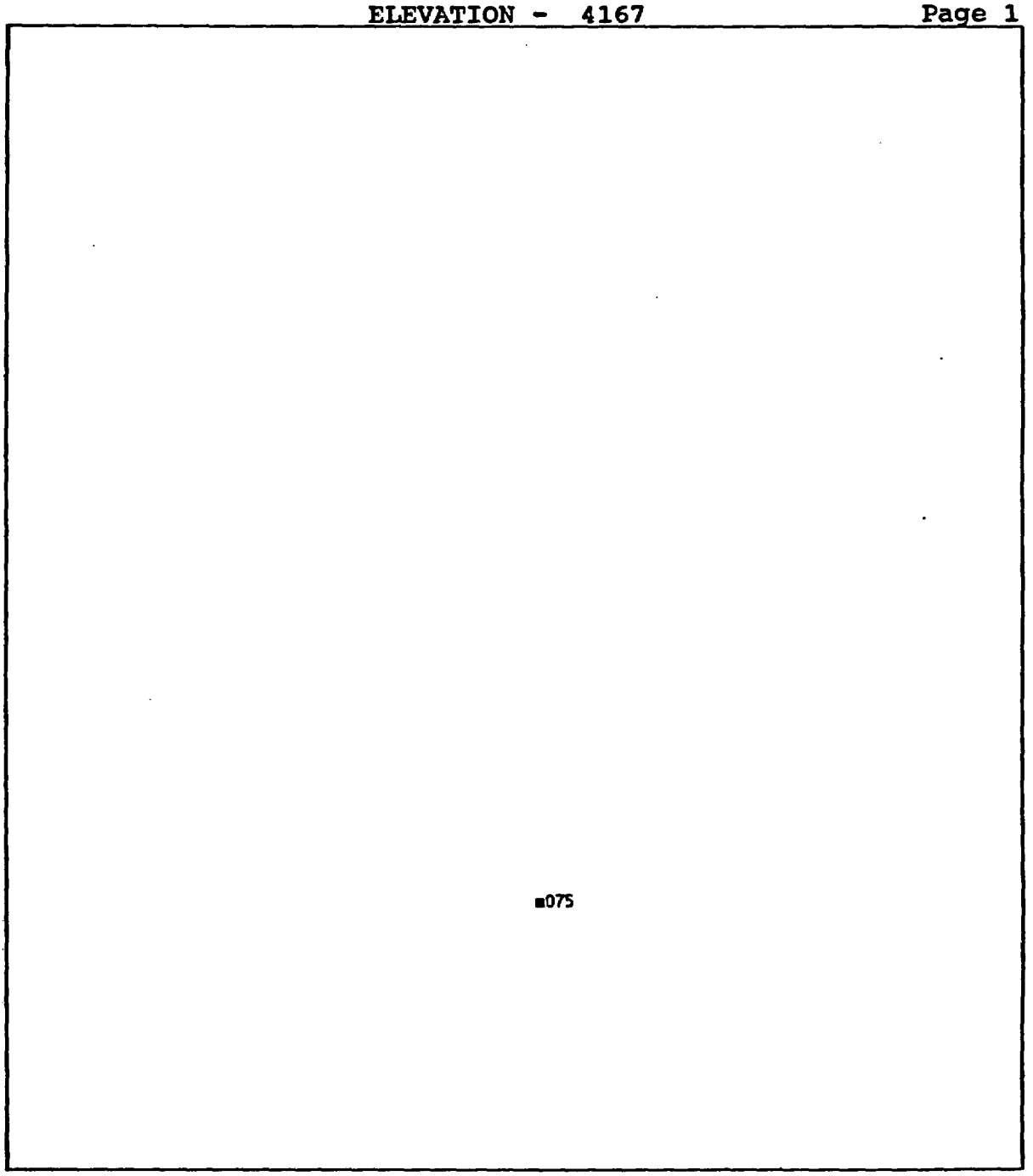
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4166



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
023	101.1	+0.6
054R1	105.4	+1.6

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

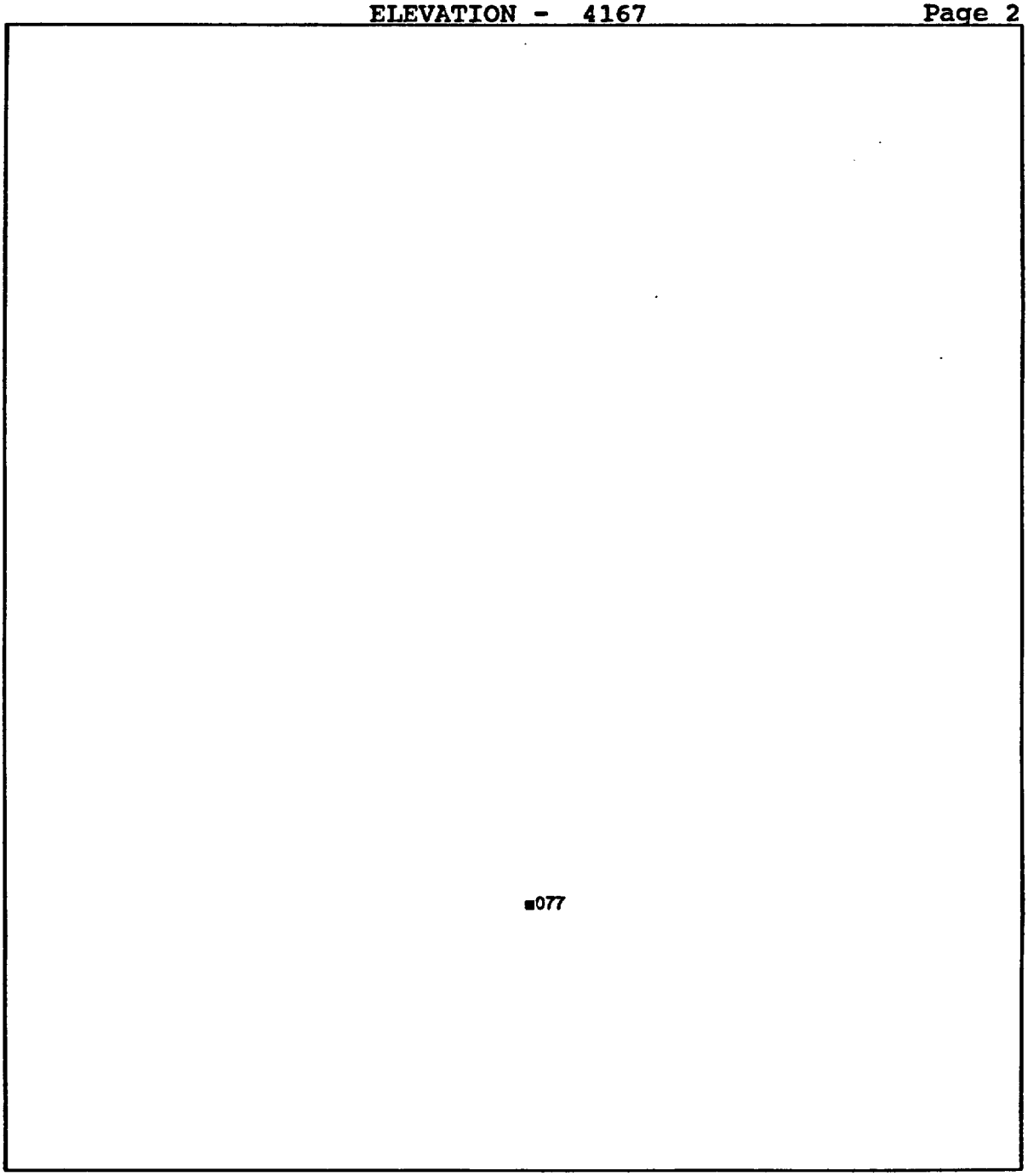
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4167



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
075	100	+1.6

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

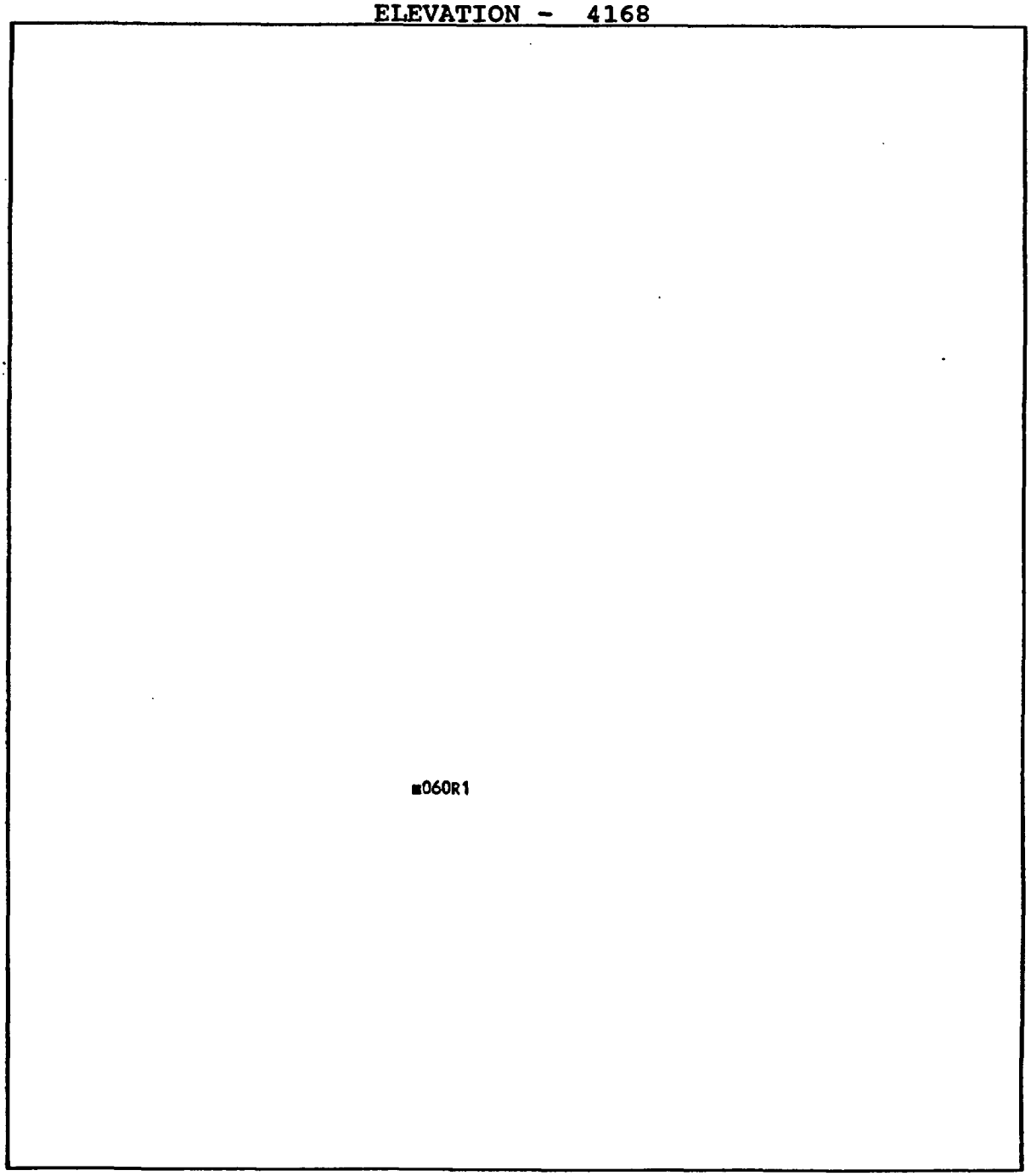
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4167



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
077	100	+1.5

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

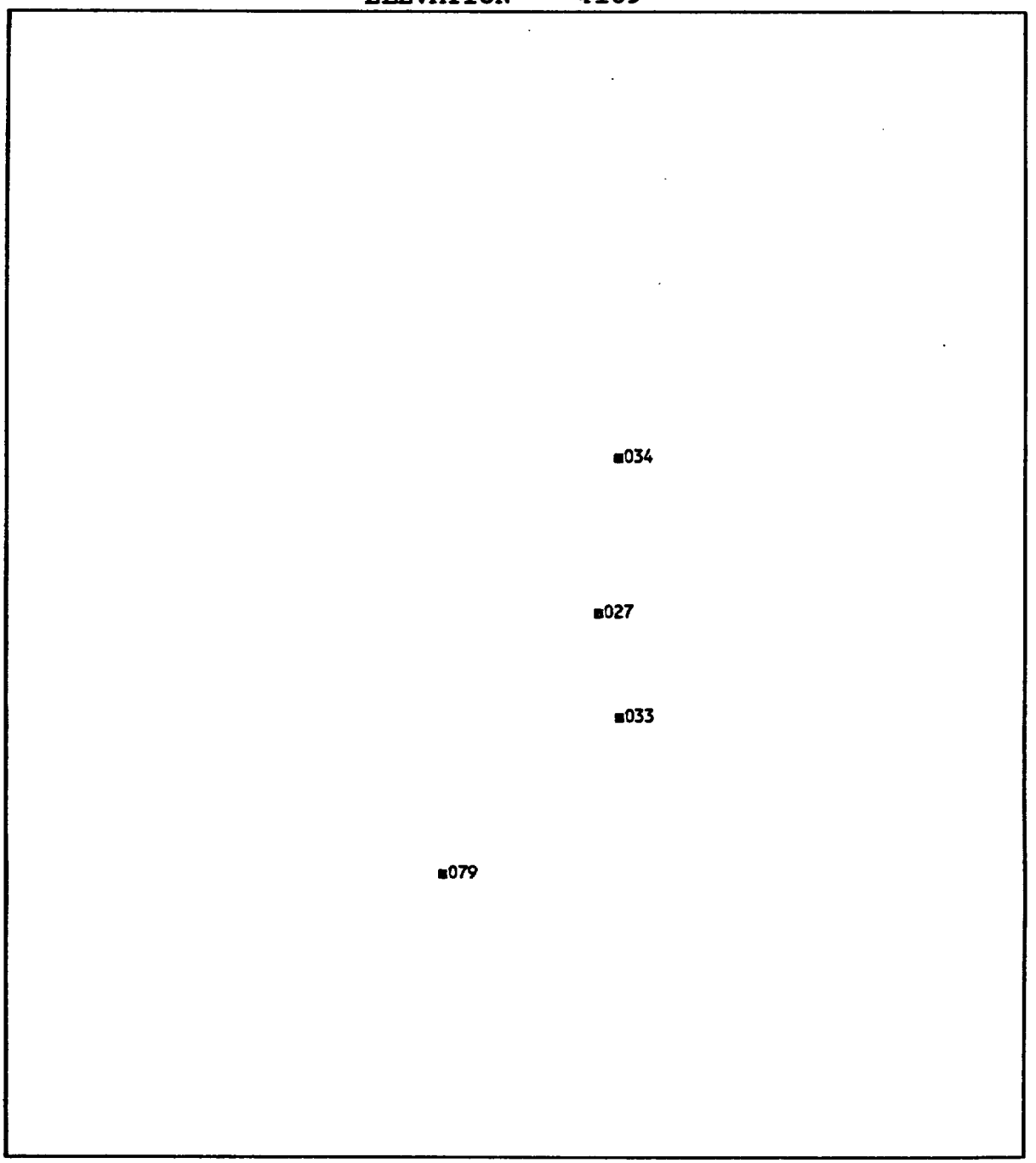
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4168



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
060R1	100.3	+1.3

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

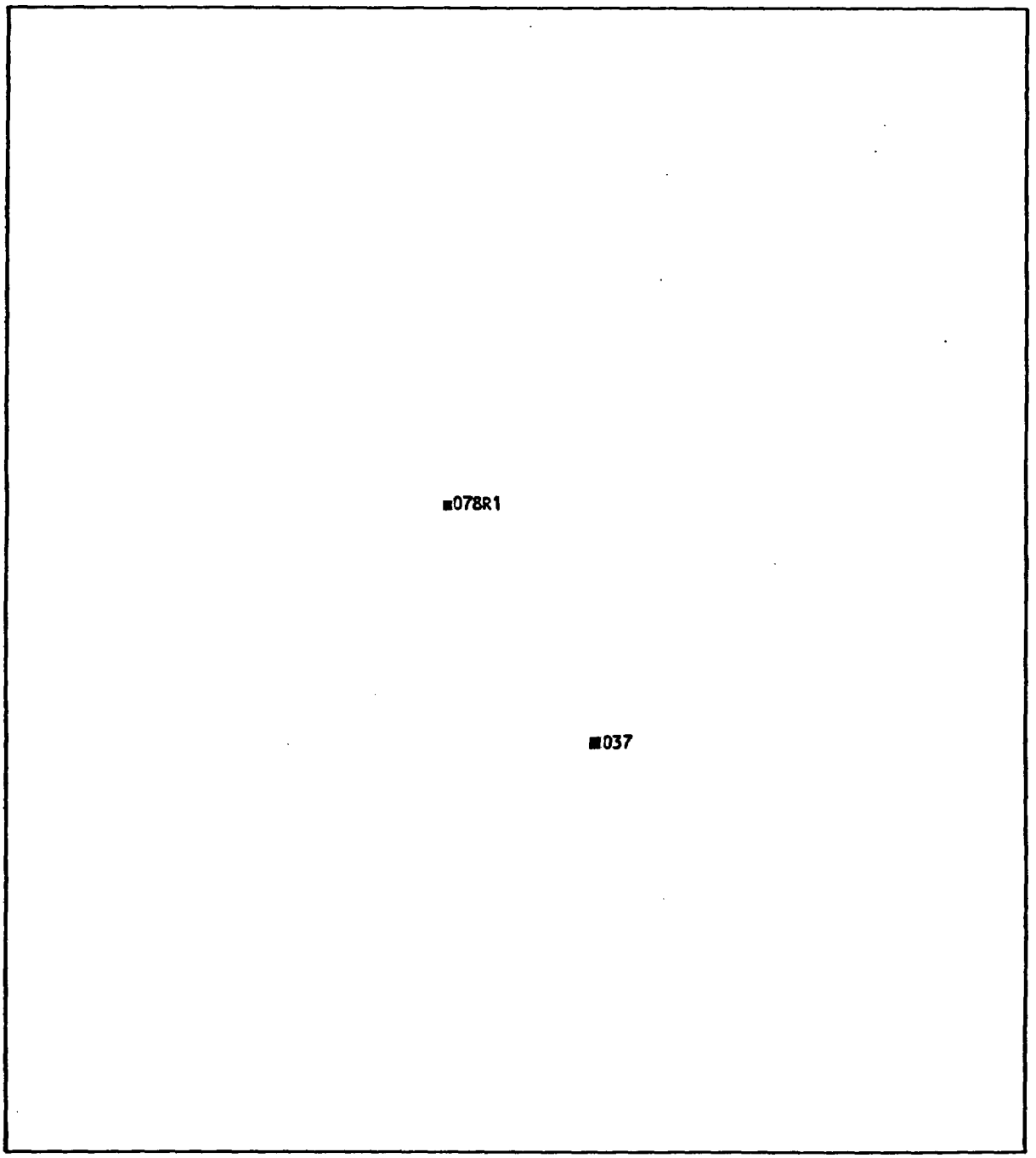
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4169



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
027	102	+2.0
033	100.9	+3.0
034	104.4	+1.5
079	100.9	+2.5

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

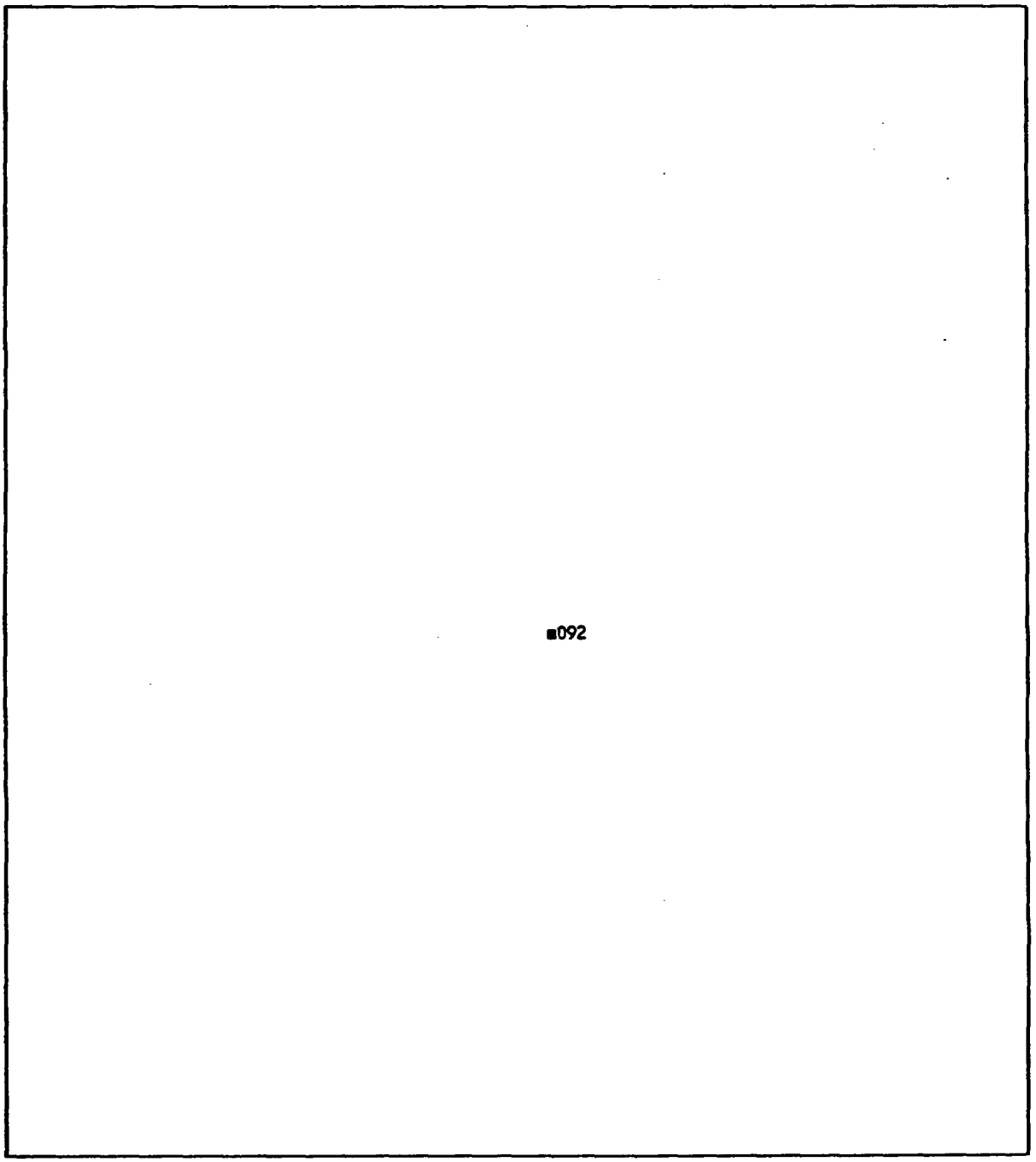
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4172



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
037	100.3	+1.9
078R1	101.3	+2.4

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

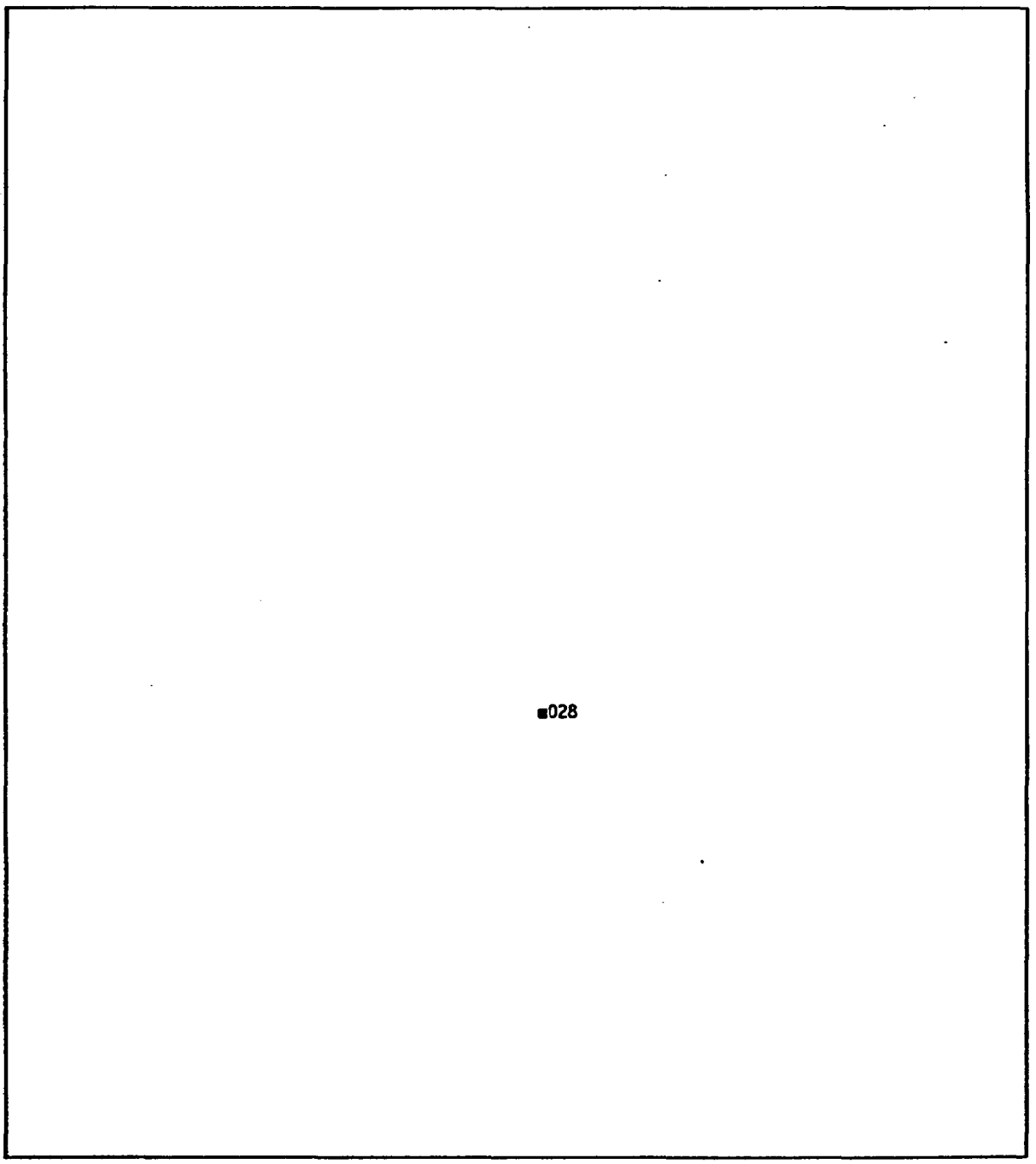
GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4176



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
092	100.7	+2.0

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

GREEN RIVER
RADON BARRIER - MOISTURE DENSITY
ELEVATION - 4177



TEST NO.	PERCENT COMPACTION	MOISTURE % OF OPT
028	101.1	+0.8

BEDDING MATERIAL

BEDDING MATERIAL

- The bedding material was obtained from the approved Hasting's Borrow Source. M-K Engineers and Jacob's Engineering had both investigated the source prior to approval.

- The bedding material was placed to a depth of 6 inches on top of the radon barrier material. The equipment used was as follows: Belly Dump Trucks for hauling; Caterpillar D-6 and D-3 Dozers, Caterpillar 120G Grader, and a John Deere 690A Track-Hoe for placing; Caterpillar D-6 and D-3 Dozers, and a John Deere Track-Hoe with a tamping plate for applying compaction.

- The required durability test frequency for bedding material was one set of tests initially prior to delivery of any material to the site, one set of tests for the first-third and second-third quantities produced, and one set of tests after completion of production activities. Western Engineers, Inc. was the commercial testing lab used to perform the required durability tests.

- As required, four representative samples of select bedding material were submitted to Western Engineers, Inc. for durability testing in accordance with the American Society for Testing and Materials (ASTM) as follows: ASTM C-127 for saturated surface dry specific gravity; ASTM C-127 for absorption; ASTM C-88 for soundness after 5 cycles; and ASTM C-131 for abrasion after 100 revolutions. The specific gravity tests produced an average result of 2.59 and a low of 2.58. The absorption tests produced an average result of 1.37% and a high of 1.53%. The soundness tests on the coarse fraction produced an average result of 4.78% loss and high of 9.29% loss, while the fine fraction produced an average result of 6.32% loss and a high of 10.06% loss. The abrasion tests produced an average result of 5.9% loss and a high of 6.3% loss.

- The bedding material individual durability test results were not required to meet a specified value, however, the Design Specifications did require the results to meet a score of 50 or better for each sample.

- Each of the four samples tested for durability scored above 50, with an average score of 62, a low score of 59, and a high score of 66.

- The bedding material was required by the Design Specifications to have no more than 3 percent of clay lumps and friable particles in accordance with ASTM C-142.

- From the four samples sent to Western Engineers, Inc., to be tested for durability and clay lumps and friable particles, the second one-third and final one-third samples failed the percent clay lumps and friable particles requirement at 3.54% and 3.15% respectively. After review of the test result data, it was determined that the tests had not been performed properly. The MK-Ferguson Quality Assurance Department at the Albuquerque Project Office initiated a Quality Deficiency Report (QDR) based on the errant test results. The QDR questioned the validity of the test data and required retesting of each one-third quantity in accordance with MK-F QA/QC work Procedure No. 4, Revision 2, Section 5.1.2.1 and Work Procedure No. 3, Revision 0, Section 5.5.

- Two bedding material retest samples for each of the failing one-third quantities were sent to Western Engineers, Inc. and two retest samples for each of the one-third quantities were sent to Professional Service Industries, Inc. (PSI). All ten retest samples passed the percent clay lumps and friable particles requirement, with an average result of .85%, a low result of .31% and a high result of 1.33%. The QDR generated by the MK-Ferguson Quality Assurance Department was closed upon knowledge of the results.

- The specified gradation test frequency for the bedding material was one test upon delivery of the material to the disposal cell, one test for the first-third and second-third quantities placed, and one test near completion of placement operations.

- As required, four gradation tests were taken with all four tests passing the design specifications. Considering that 4,718 cubic yards of bedding material was placed, the average equalled one gradation test for every 1,180 cubic yards of material placed.

- Five additional information only gradation tests were taken during production which passed the specified gradation limits. These tests were taken at one-third production increments prior to acquiring durability samples.

- A tolerance of .1 feet was specified for the 6 inch depth of bedding material which allowed depth check reading to be between .4 feet to .6 feet. Sixty (60) passing depth checks were taken with at least one depth check for every 100 foot by 50 foot area. The depth checks complimented a documented engineering survey.

- All areas that were found to be outside of the depth tolerances were reworked as specified and reverified by additional depth checks until passed.

- Compaction of the bedding was continually monitored to assure that the specified techniques were employed. The 2.1 slopes received compaction by use of a John Deere 690A Trackhoe with a Tamping Plate and the 5:1 slopes received two passes with either a Caterpillar D-3 or D-6 Dozer.

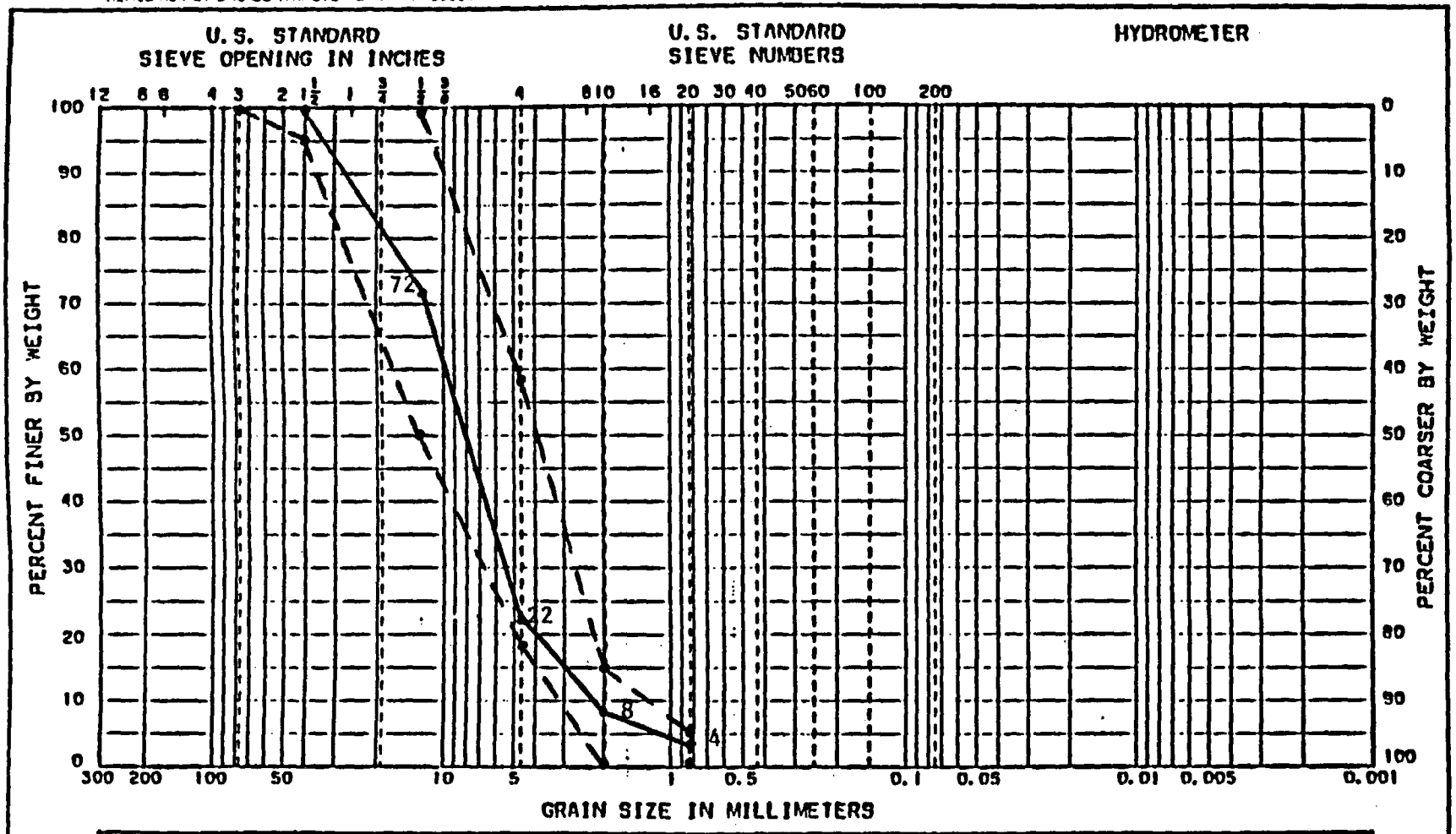
- All tests and inspections were performed in strict accordance with the specification requirements.

- The following pages contain an average gradation summary and plots of the cell embankment identifying depth check locations.

SELECT BEDDING MATERIAL

MK-FERGUSON
A MORRISON KNUDSEN COMPANY
REMEDIAL ACTIONS CONTRACTOR-UMTRA PROJECT

---- SPECIFIED LIMIT ——— ACTUAL AVERAGE VALUE



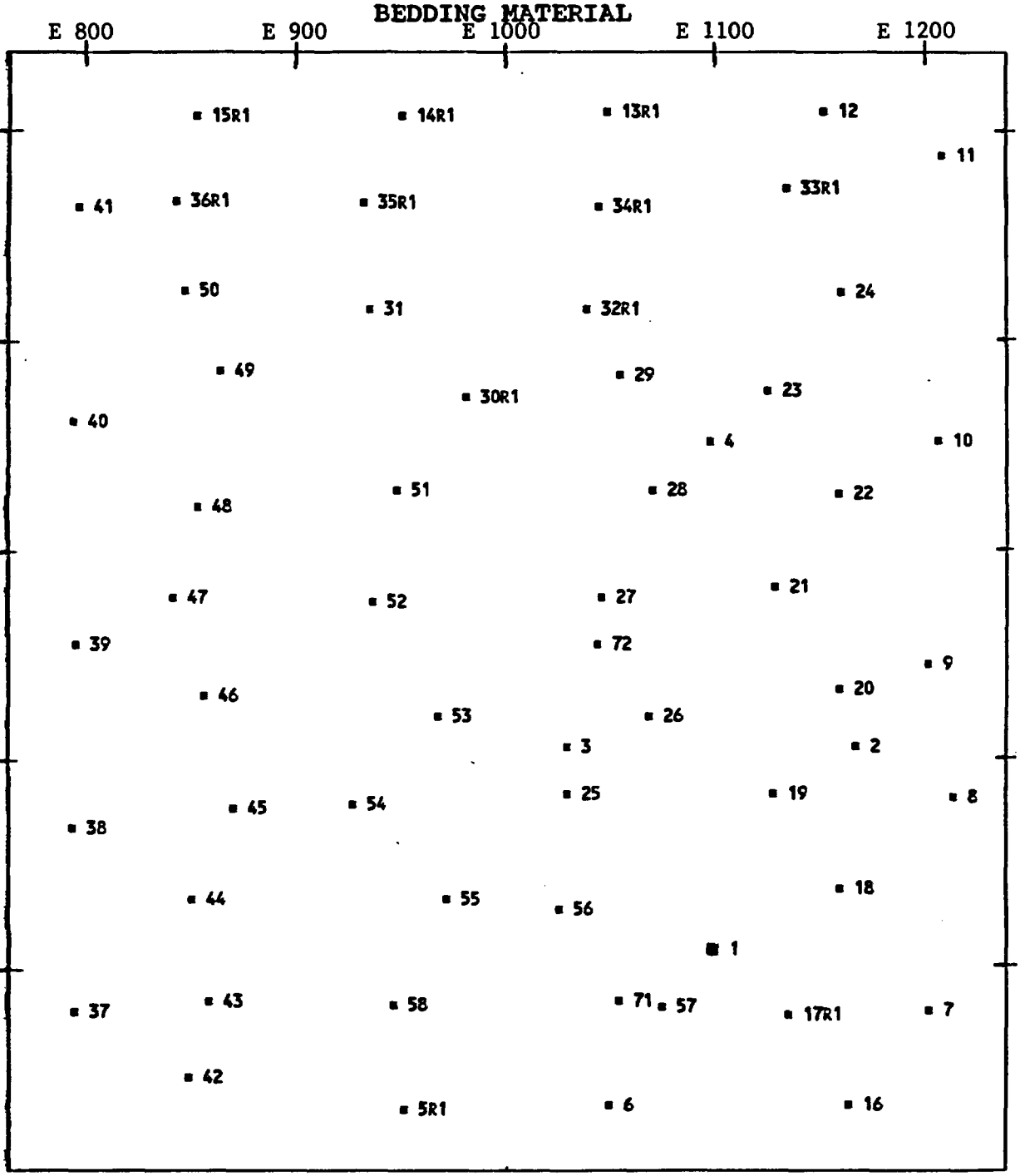
GRAIN SIZE ANALYSIS

SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI

PROJECT
JOB NO.
AREA
HOLE NO.
DATE

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

GREEN RIVER DEPTH CHECKS
BEDDING MATERIAL



TEST NO.	AVERAGE DEPTH	TEST NO.	AVERAGE DEPTH	TEST NO.	AVERAGE DEPTH	TEST NO.	AVERAGE DEPTH	TEST NO.	AVERAGE DEPTH
1	.60	13R1	.58	25	.59	37	.59	49	.56
2	.52	14R1	.55	26	.46	38	.58	50	.60
3	.60	15R1	.51	27	.59	39	.59	51	.57
4	.45	16	.57	28	.51	40	.56	52	.52
5R1	.59	17R1	.45	29	.53	41	.58	53	.53
6	.50	18	.51	30R1	.58	42	.45	54	.51
7	.46	19	.53	31	.59	43	.57	55	.40
8	.58	20	.49	32R1	.46	44	.57	56	.59
9	.49	21	.44	33R1	.55	45	.59	57	.60
10	.59	22	.52	34R1	.51	46	.59	58	.57
11	.54	23	.47	35R1	.57	47	.53	71	.59
12	.55	24	.45	36R1	.55	48	.58	72	.57

RIPRAP TYPE A

TYPE A RIPRAP

- The riprap material was obtained from the approved Fremont Junction Borrow Source. M-K Engineers performed an in-depth investigation of the source prior to approval.

- The Type A Riprap was placed on top of the bedding material to a depth of 6 inches around the perimeter of the cell and to a depth of 12 inches on the upper 5:1 slopes. The equipment used during construction was as follows: End Dumps with Pup Trailers for hauling to the site and a Volvo 6 x 6 low ground pressure unit for hauling and dumping onto the cell embankment; and a Komatsu PC 200 LC Backhoe and a Caterpillar D-6 Dozer for spreading.

- The required durability test frequency for the Type A Riprap was one set of tests initially prior to delivery of any material to the site, one set of tests for the first-third and second-third quantities produced, and one set of tests after completion of production activities. Western Engineers, Inc. and Professional Service Industries, Inc. were the commercial testing laboratories used to perform the required durability tests.

- As required, four representative samples of Type A Riprap were acquired and sent to the laboratory for durability testing in accordance with ASTM as follows: ASTM C-127 for saturated surface dry specific gravity; ASTM C-127 for absorption; ASTM C-88 for soundness after 5 cycles; and ASTM C-131 for abrasion after 100 revolutions. The specific gravity tests produced an average result of 2.61 and a low of 2.40. The absorption test results had an average result of 1.46% and a high value of 3.12%. The soundness test results had an average of .70% loss and a high value of .93% loss. The abrasion test results had an average result of 6.9% loss and a high value of 7.3% loss.

- The Type A Riprap individual durability test results were not required to meet a specified value, however, the test results were scored for each sample and sent to M-K Engineers for acceptance. After review of the results, M-K Engineers signed for acceptance of the material.

- The average score for the four durability sample results was 85 with a low score of 78, and a high score of 90.

- The specified gradation test frequency for the Type A Riprap was one test upon delivery of the material to the disposal cell, one test for the first and second third quantities placed, and one test near completion of placement activities.

- All gradation tests were performed in accordance with ASTM C-136.

- As required, four gradation tests were taken with all four tests passing the design specifications. Considering that 9,165 cubic yards of Type A Riprap were placed, the average equalled one gradation test for every 2,291 cubic yards of material placed.

- Four additional information only gradation tests were taken during production which passed the specified gradation limits. The gradation tests were taken at one-third production increments prior to acquiring durability samples.

- The required tolerance was 90% to 125% of the specified depth which allowed between .45 feet to .625 feet for the specified 6 inch depth and between .90 feet to 1.25 feet for the specified 12 inch depth. Thirty-nine (39) passing depth checks were taken with at least one depth check for every 100 foot by 100 foot area. The depth checks complimented a documented engineering survey.

- All areas that were found to be outside of the depth tolerances were reworked as specified and reverified by additional depth checks until passed.

- The shape of at least 75 percent of the Type A Riprap, by weight, was required to have the minimum dimension not less than one-third of the maximum dimension. Two dimension analyses were performed during production which satisfied the dimensional requirement. There were no required frequencies for performing dimensional analyses.

- Daily inspections of the Type A Riprap were conducted during excavation, production, stockpiling, transporting, and placement to assure the following: That proper techniques were employed to prevent degradation of the material due to improper handling; that distribution was uniform; that voids were kept as minimal as possible; and that proper gradation was maintained.

- Daily inspections were also conducted to assure that the Type A Riprap was sound stone, resistant to abrasion, and free from cracks, seams and weathering rinds.

- During production, sandstone was extracted from the Type A Riprap to assure that no more than 10% sandstone by volume was present in the final product.

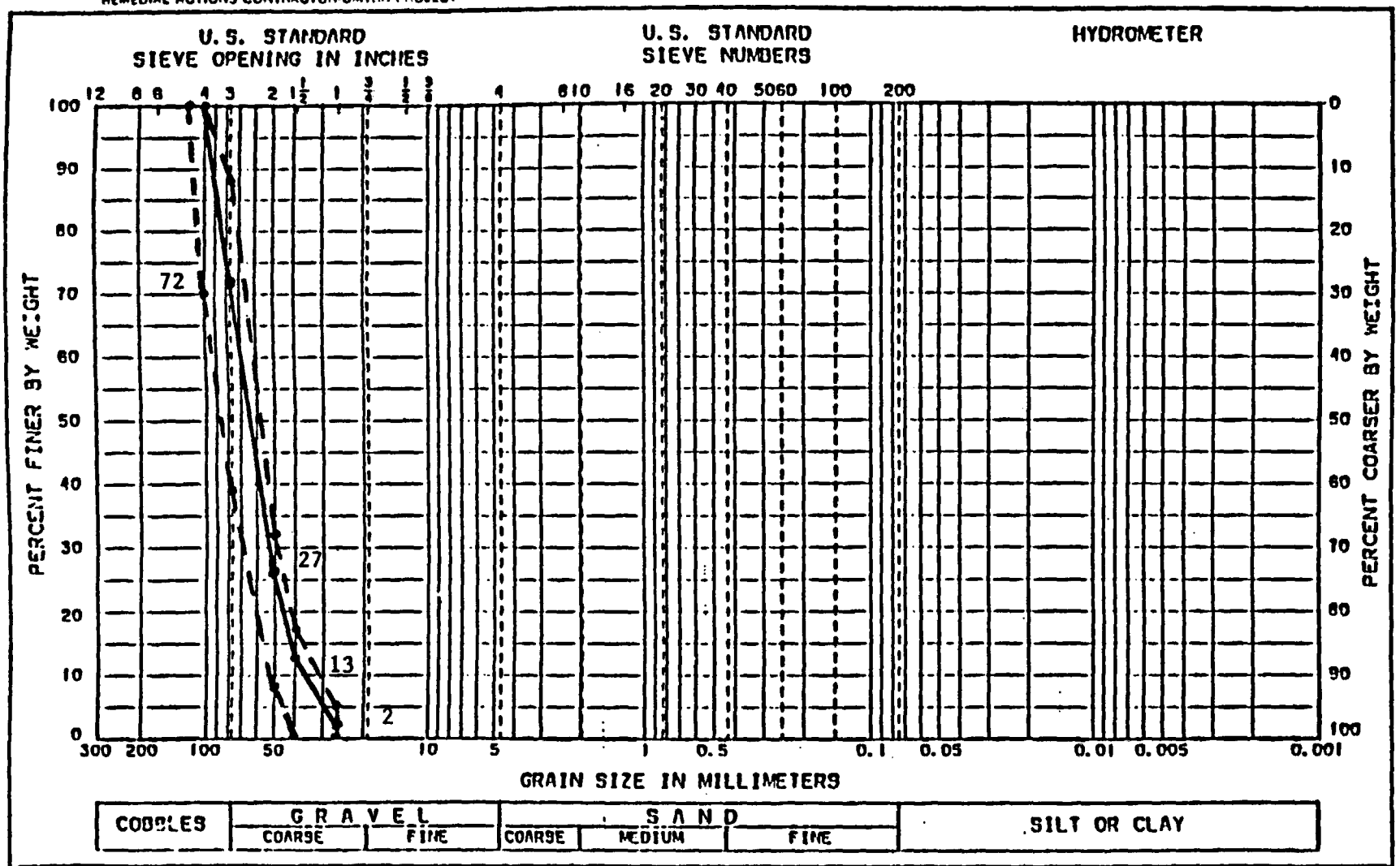
- All tests and inspections were performed in strict accordance with the specification requirements.

- The following pages contain an average gradation summary and plots of the cell embankment identifying depth check locations.

RIPRAP TYPE A

MK-FERGUSON
A MORRISON KNUDSEN COMPANY
REMEDIAL ACTIONS CONTRACTOR-UMTRA PROJECT

----- SPECIFIED LIMIT ——— ACTUAL AVERAGE VALUE



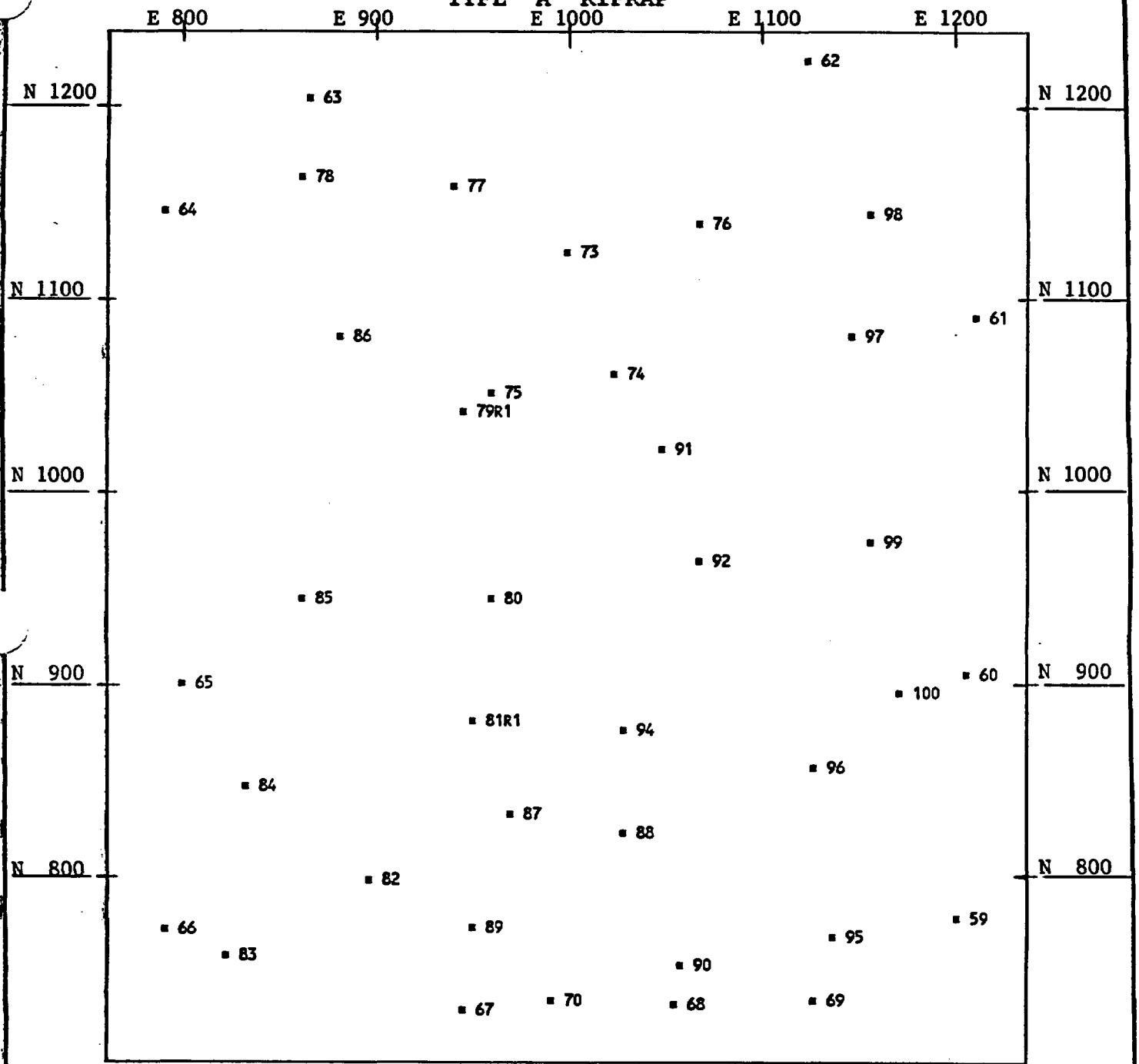
GRAIN SIZE ANALYSIS

SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI

PROJECT
JOB NO.
AREA
HOLE NO.
DATE

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

GREEN RIVER DEPTH CHECKS
TYPE "A" RIPRAP



TEST NO.	AVERAGE DEPTH	TEST NO.	AVERAGE DEPTH	TEST NO.	AVERAGE DEPTH	TEST NO.	AVERAGE DEPTH
59	.59	73	.96	85	.99	98	.91
60	.51	74	1.00	86	.91	99	1.14
61	.50	75	.99	87	1.05	100	.97
62	.57	76	.91	88	1.23		
63	.59	77	.95	89	.91		
64	.53	78	.99	90	1.07		
65	.58	79R1	1.06	91	1.09		
66	.52	80	.96	92	1.01		
67	.49	81R1	1.04	94	.98		
68	.53	82	1.17	95	.92		
69	.45	83	1.01	96	1.01		
70	.45	84	.94	97	.98		

RIPRAP TYPE B

TYPE B RIPRAP

- The Riprap material was obtained from the approved Fremont Junction Borrow Source. M-K Engineers performed an in-depth investigation of the source prior to approval.

- The Type B Riprap was placed around the perimeter of the cell embankment progressing up the 2:1 slope. The primary equipment used during construction was as follows: End Dumps with Pup Trailers for hauling to the site; a Volvo 6 x 6 low ground pressure unit for hauling and dumping onto the cell embankment; and a Komatsu PC 200 LC Backhoe for placement and filling of voids.

- The required durability test frequency for the Type B Riprap was one set of tests initially prior to delivery of any material to the site, one set of tests for the first-third and second-third quantities produced, and one set of tests after completion of production activities. Western Engineers, Inc. and Professional Service Industries, Inc. were the two commercial testing laboratories used to perform the required durability tests.

- As required, four representative samples of Type B Riprap were acquired and sent to the laboratory for durability testing in accordance with ASTM as follows: ASTM C-127 for saturated surface dry specific gravity; ASTM C-127 for absorption; ASTM C-88 for soundness after 5 cycles; and ASTM C-131 for abrasion after 100 revolutions; ISRM method for Schmidt rebound hardness; and ISRM method for splitting tensile strength.

  The specific gravity tests produced an average result of 2.64 and a low result of 2.43. The absorption test results had an average result of 1.40% and a high value of 2.89%. The soundness test results had an average of 1.00% loss and a high value of 1.26% loss. The abrasion test results had an average of 7.23% loss and a high value of 8.11% loss. The

Schmidt rebound hardness test results had an average value of 46.1 and a low value of 31.0. The splitting tensile strength had an average value of 1,496 and a low value of 1,025.

- The Type B Riprap individual durability test results were not required to meet a specified value, however, the test results were scored for each sample and sent to M-K Engineers for acceptance. After review of the results, M-K Engineers signed for acceptance of the material.

- The average score for the four durability sample results was 80 with a low score of 83, and a high score of 90.

- The specified gradation test frequency for the Type B Riprap was one test upon delivery of the material to the disposal cell, one test for the first and second-third quantities placed, and one test near completion of placement activities.

- All gradation tests were performed in accordance with ASTM C-136.

- As specified, four gradation tests were taken with all four tests passing the design specifications. Considering that 15,462 cubic yards of Type B Riprap were placed, the average equalled one gradation test for every 3,866 cubic yards of material placed.

- Four additional information only gradation tests were taken during production which passed the specified gradation limits. The gradation tests were taken at one-third production increments prior to acquiring durability samples.

- An engineering survey was performed for line and grade on the Type B Riprap and was found to be within tolerances.

- The shape of at least 75 percent of the Type B Riprap, by weight, was required to have the minimum dimension not less than one-third of the maximum dimension. One dimensional analyses was performed during production which satisfied the dimensional requirement. There were no required frequencies for performing dimensional analyses.

- Daily inspections of the Type B Riprap were conducted during excavation, production, stockpiling, transporting, and placement to assure the following: That proper techniques were employed to prevent degradation of the material due to improper handling; that distribution was uniform; that voids were kept as minimal as possible; and that proper gradation was maintained.

- Daily inspections were also conducted to assure that the Type B Riprap was sound stone, resistant to abrasion, and free from cracks, seams and weathering rinds.

- During production, sandstone was extracted from the Type B Riprap to assure that no more than 10% sandstone by volume was present in the final product.

- All tests and inspections were performed in strict accordance with the specification requirements.

- An average gradation summary has been provided on the next page.

TYPE B RIPRAP

---- SPECIFIED LIMIT
—— ACTUAL AVERAGE VALUE

MORRISON-KNUDSEN CO., INC.
MECHANICAL ANALYSIS - ROCK