PHASE I
REMEDIAL DESIGN

Cushing, Oklahoma, Refinery Site

Prepared For

MAY 1994

FLUOR DANIEL
WILLIAMS BROTHERS

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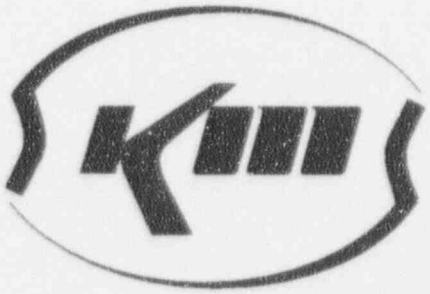

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SECTION 1
INTRODUCTION

Kerr-McGee Corporation (KMC) owns a refinery site near the city of Cushing, in Payne County, Oklahoma. The refinery opened around 1912 and was purchased by Kerr-McGee in 1956. During the early 1960's, in addition to petroleum processing, Kerr-McGee processed uranium fuel and thorium metal in several buildings on-site. The processing area was decommissioned and the licenses under which nuclear processing was performed were terminated in 1966.

KMC continued to operate the refinery until 1972, at which time it was decommissioned. Several refinery units were auctioned, and additional radioactive decommissioning was performed to prepare the property for sale. KMC retained two portions of the property for crude oil storage and transmission activities, which continue today.

In May 1990, KMC entered into a Consent Order with the Oklahoma State Department of Health, addressing the investigation and remediation of the Cushing refinery site. The Consent Order divided the site work into radiological and non-radiological cleanups. The non-radiological cleanup is being performed in a manner similar to the Federal Superfund Remedial Investigation/Feasibility Study (RI/FS) process.

Phase One of the non-radiological cleanup addressed five acidic hydrocarbon sludge pits located on site. The Phase I Remedial Investigation and Feasibility Study were completed and reviewed by the Oklahoma Department of Environmental Quality (ODEQ) and the local citizens. The ODEQ issued a record of decision (ROD) for the acidic sludge pits requiring neutralization, excavation, and placement in on-site engineered disposal cells. This report is the Remedial Design (RD) that will govern the remediation of the acidic hydrocarbon sludges.

This document has been prepared to serve both as the RD for the ODEQ and as preliminary construction specifications for the contractor performing the acidic sludge cleanup. The following technical information is included in this document:

- Record-of-Decision criteria.
- Generic treatment process description.
- Quality control and assurance requirements.
- Property line air monitoring requirements.
- Post-closure monitoring requirements.
- Construction drawings and specifications.

All work will be performed in accordance with a Health and Safety Plan which, at a minimum, will comply with the Site Health and Safety Plan generated by KMC for general site work.

SECTION 2
SITE DESCRIPTION AND BACKGROUND

- *Site Description*
- *Previous Studies*

SITE DESCRIPTION

The Cushing Refinery site is located approximately two miles north of the city of Cushing, Oklahoma. Since refinery operations began in 1912, the site has had numerous owners and has been used for a number of petroleum refining, storage, and related activities. Figure 2-1 has been included to provide a brief summary of its industrial and regulatory history. Data for the figure were extracted from the Phase I Remedial Investigation Report prepared for KMC in April 1993.

From its founding until 1951, the refinery used a sulfuric acid/clay treatment process to process lube oil feed stocks. After treatment, the spent clay, acid, and suspended asphaltene sludges were disposed of in five pits on the site. The pits were constructed as unlined, earthen excavations in native soils. Pits 1, 2, and 3 were constructed on the northwest portion of the site. Pit 4 was located on the northeast portion of the site while Pit 5 was on the southern half of the site. In the feasibility study, the pits were projected to contain an estimated 400,000 cubic yards of waste material comprised of approximately 60 percent hydrocarbons (asphaltic materials), 20 percent clay, and up to 20 percent sulfuric acid. Recent analysis of waste pit borings indicate a total waste volume of 310,000 cubic yards. This figure has been used as the design basis.

Previous studies revealed that a portion of Pit 4 contains some radiological waste within the acidic hydrocarbon sludge. As a result, this document contains a plan for neutralization and segregation of that radiologically contaminated material found in Pit 4. Portions of the site contain radiological wastes, but remediation of these locations is not contained within this phase of the total remediation project. Several storage tanks and operational buildings are still being used for current site operations.

Topographic features of the site include numerous swales and creek channels, with one major channel, Skull Creek, crossing the site. Construction within the Skull Creek floodplain is not being considered and is, therefore, not a concern. Previous studies have shown that the site is underlain by approximately 150 feet of clay, mudstone, sandstone lenses, and shale. Shallow groundwater is a concern at the site, and it has been addressed in the Remedial Design.

PREVIOUS STUDIES

Several studies were performed in compliance with the Consent Order governing site cleanup. The following lists brief summaries of those reports prepared for the first phase of the non-radiological cleanup. The first two are public record and available on request, while the second two are internal studies enabling Kerr-McGee to continue with the final design.

- Phase I Remedial Investigation Report, April 1993

  The report includes description of site hydrogeology, characterization of acidic hydrocarbon waste, discussion of the nature and extent of contamination, and discussion of the fate and transport of contamination. The report is accompanied by five volumes of Appendices containing technical data and information, including soil boring logs, monitoring well installation data, waste characterization data, surface water and sediment data, and groundwater data.

- Cushing, Oklahoma, Refinery Site Feasibility Study on Remediation of Acidic Hydrocarbon Sludges, October 1993.

  The study developed a list of potential alternatives for remediation of the waste sludges. A screening process narrowed the list to five alternatives which would meet remediation objectives. The alternatives were then evaluated using a point system for EPA's 9 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund) evaluation criteria. These remediation alternatives were submitted to the Oklahoma State Department of Health (now ODEQ) to select the final alternative to be implemented.

- Other Industrial Waste Disposal Cell Site Characterization
  Kerr-McGee Cushing Refinery Site, Cushing, Oklahoma

  The investigation developed a characterization of the rock formations underlying three study areas at the refinery site. These three areas were evaluated for siting waste disposal cells for the remediation project. As a result of the investigation, one area was deleted from further consideration.

- Disposal Cell Option Evaluation

  The study evaluated the economic options of constructing one or two disposal cells for disposal of the treated waste. The evaluation considered only construction and transport costs related to construction and filling of the disposal cells. Costs for neutralization and pulverization were considered to be the same for either option and were therefore not included in the evaluation. The study findings yielded the conclusion that construction of two cells was more cost efficient. As a result of this evaluation, Kerr-McGee has proceeded with the design of two disposal cells.

FIGURE
SITE HISTORY
CUSHING REF

1915 - Oil refining operations commence at the Cushing Refinery. Lube stocks are refined using sulfuric acid and clay treatment. Spent acid sludge is placed in five pits on the site.

1956 - Kerr-McGee Corporation purchases Cushing Refinery Site. Pits 1, 2, 3, and 5 are full. Desalter and wax bottoms are disposed of in Pit 4.

6/81 - Kerr-McGee provides U.S. EPA notification that corrosive wastes (D002) and wastes similar to listed refinery wastes (K049-K052) remain at the refinery site.

5/85 - Kerr-McGee installs 38 groundwater monitoring wells around Pits 1 through 4.

9/86 - Kerr-McGee collects random core samples from Pits 1 through 4 for analyses.

9/87 - Kerr-McGee collects and analyzes surface water, sediment, and sludge samples from Pit 5 and surrounding area according to sampling plan proposed by the TAT in 6/87.

10/89 - Cushing Refinery Site is proposed for inclusion on the National Priorities List (Superfund) pursuant to Section 105(a)(8)(A) of SARA.

3/90 - Kerr-McGee collects and analyzes groundwater samples from 41 monitoring wells at the Cushing site.

9/90 - Kerr-McGee begins field work associated with the Phase I Work Plan to fill data gaps.

12/90 - Kerr-McGee submits final Phase I RI Work Plan to Oklahoma State Department of Health.

8/93 - ODEQ issues Record-of-Decision (ROD). The State selects neutralization and stabilization of the wastes and placement of the treated waste in a constructed on-site disposal cell as the final treatment alternative.

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E 2-1
Y TIME LINE
FINERY SITE

1951 - Phenol unit replaces sulfuric acid treatment unit. Acid sludge is no longer produced.

1972 - Cushing Refinery is decommissioned by Dewey Enterprises.

3/84 - FIT performs inspection of the site area in Section 22, T18N, R5E (site area north of Deep Rock Road).

5/86 - FIT performs site assessment of the site area in Section 22, T18N, R5E (site area north of Deep Rock Road). Surface water, sediment, soil, sludge, and groundwater samples were collected and analyzed.

6/87 - TAT performs site assessment of the site area which contains Pit 5. A sampling plan is developed.

5/88 - TAT performs an investigation of the site area which contains Pit 5. Sludge, soil, surface water, and sediment samples were collected and analyzed.

6/88 - Kerr-McGee provides U.S. EPA additional information regarding previous petroleum related activities performed, and wastes remaining at the site.

1/90 - Kerr-McGee installs ten additional groundwater monitoring wells at the Cushing Site.

5/90 - Kerr-McGee enters into Consent Order with Oklahoma State Department of Health.

8/90 - Burns & McDonnell prepares interim RI/FS which summarizes investigations and identifies data gaps.

2/91 - Cushing Refinery Site is dropped from list of proposed Superfund sites.

3/93 - Kerr-McGee submits Draft Feasibility Study to the Oklahoma Department of Environmental Quality (ODEQ) for approval.

4/93 - Kerr-McGee completes Phase I Remedial Investigation.

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SECTION 3
REMEDIAL ACTION DESCRIPTION

- *Criteria*
- *Design and Construction of Disposal Cells*
- *Treatment Process*

CRITERIA

The ODEQ has stipulated the following criteria for treatment of the acidic sludges as set forth in the Record-of-Decision.

1. Excavation and/or treatment of acidic sludge shall be conducted so as to minimize emissions of dust and sulfur dioxide. As proscribed by the Oklahoma Clean Air Act, average emission levels at the site boundary shall not exceed 150 micrograms per cubic meter ($\mu g/m^3$) PM-10 dust over a 24-hour period. PM-10 dust particles are those particles, microscopic in size, that can be inhaled into the lungs. Average emission levels for sulfur dioxide (at the site boundary) shall not exceed 1300 $\mu g/m^3$ [0.5 parts per million (ppm)] over a 3-hour averaging period, or 365 $\mu g/m^3$ (0.14 ppm) over a 24-hour period. These standards also apply at site boundary. If exceedances of the standards occur during remedial actions, a modification of the work will be required.

2. To avoid large pieces of unneutralized waste in the material for disposal, acidic sludges shall be broken or ground such that at least 90 percent of the neutralized particles by weight shall not exceed 1/2 inch, and not more than 0.5 percent of the particles by weight shall exceed 3 inches. Agglomerates of finer neutralized particles shall be acceptable.

3. The pH for the final neutralized product shall be within a range of 9.0 plus or minus 2.0 standard pH unit arter placement in the disposal cell.

4. The final product shall meet at least 25 pounds per square inch (psi) unconfined compressive strength or demonstrate that a lesser psi is acceptable by applying the California Bearing Ratio Test.

5. The toxicity characteristic leachate procedure (TCLP) shall be used to judge stabilization of the waste for both organics and inorganics.

The final criteria, which is the result of preceding studies, is that the disposal cell will be designed with a liner and cap system which will provide protection against the potential migration of any contaminants to groundwater.

DESIGN AND CONSTRUCTION OF DISPOSAL CELLS

From previous evaluations, it was determined that the anticipated treated waste could most economically be disposed of in two cells: Disposal Cell A, which will be located at the southeast section of the property, and Disposal Cell B, which will be located at the northwest section of the property. Disposal Cell A has been sized to handle the projected treated waste quantities from Pit 5. Disposal Cell B has been sized to handle the projected treated waste quantities from Pits 1, 2, 3, and 4. It should be noted that Pit 4 contains low levels of radioactive contamination which may require segregation subsequent to neutralization. Adequate capacity has been designed for Cell A to allow Kerr-McGee to place waste from other locations into the disposal cell if Kerr-McGee and ODEQ agree.

Design Basis

Disposal cells were designed for two potential disposal capacities. The first design capacity is for disposal of anticipated treated waste volumes plus additional waste disposal from other smaller pits on-site. The quantities were calculated based upon pit areas and expected depth of waste which was indicated by numerous borings within the waste. The second design capacity allows for additional waste disposal from other smaller pits on-site as well as a bulking factor for the treated waste. Previous testing of the Cushing waste sludge indicated bulking factors would be very small to negligible. However, from past experiences with other acidic sludges, bulking factors of 25 percent are possible. The capacity and approximate size for each disposal cell are shown in Table 3-1.

Table 3-1
Disposal Cell Capacities and Approximate Sizes

Disposal Cell	*Cell Volume, Yd^3*		*Average Dimensions, Ft.*		*Average Depth, Ft.*	
	Anticipated	*Max.*	*Anticipated*	*Max.*	*Anticipated*	*Max.*
A	240,000	300,000	1050 x 450	1250 x 500	24	24
B	160,000	200,000	500 x 625	500 x 770	21	21

The quantity of material to be excavated was calculated to provide all of the soil required for cap placement, topsoil and soil layer for cap cover, and minimal backfill for Pits 1, 2, 3, 4, and 5. Backfill quantities were calculated by determining the minimum backfill required to bring excavated pits to grade to prevent any ponding of water.

The disposal cell design will consist of an *in situ* liner (a minimum of five feet of existing clay, mudstone and shale) overlain by the treated waste. The treated waste will be covered with a two foot thick compacted clay cap and one foot of native soil. The finished disposal cell will be graded to contour and vegetated.

Cell design assumptions include:

- Clay for the disposal cell cap and liner will be obtained on-site and will meet State permeability requirements of 10^{-7} cm/sec or less.
- The *in situ* liner will be constructed by scarifying the top 12 inches and recompacting.
- Side slopes for the disposal cell liner will be 3:1 (three feet horizontal for each one foot vertical).
- Side slopes for the disposal cell cover will be a minimum of 5:1.

Soil permeability testing performed on clay to be used for both the *in situ* liner and the clay cap have showr, a permeability of less than 10^{-6} cm/sec.

Groundwater Diversion

Groundwater monitoring wells indicate that there is a minor, perched water table at both proposed cell disposal locations. ODEQ requires that a passive groundwater drainage system be installed to divert potential groundwater away from the disposal cell. For Disposal Cell A, the drain will be approximately 600 feet long and will be constructed on the south side of the disposal cell. For Disposal Cell B, the drain will be approximately 2,100 feet long and will be constructed along the north, east, and west sides of the disposal cell. The drain system will divert groundwater away from the disposal cells and lower the groundwater elevation to five feet below the bottom of the treated waste.

The passive groundwater drainage system consists of a 24-inch wide trench with Class A aggregate encased in a permeable geotextile fabric. The depth varies slightly, but always extends to five feet below the bottom of the in-place, treated waste. The system will be drained by a 6-inch diameter, high density polyethylene pipe which includes cleanouts for maintenance. For the drain at Disposal Cell B, the pipes will exit the ground approximately 1,200 feet to the south. For the drain at Disposal Cell A, the pipes exit the ground approximately 200 feet to the west. The outlets have been set at elevations to prevent any inundation from floodwaters after rehabilitation.

Leachate Evaluation

In 1993, the ODEQ ran the Hydrologic Evaluation of Landfill Performance (HELP) model. ODEQ modeled a six inch topsoil cover, a 2 foot thick uncompacted clay cap, the treated waste, and a 3 foot thick compacted clay liner. The ODEQ model presented "worst-case" assumptions regarding soil and waste properties and precipitation. This model generated 7.49 inches per year of leachate through the liner. Even with this quantity of leachate generation, ODEQ determined that groundwater qualit, would not exceed drinking water criteria in the underlying aquifer.

For the Phase I Remedial Design, anticipated leachate productions from the constructed disposal cells were estimated by using the (HELP) computer program for modeling leachate seepage. HELP modeling was performed for two disposal cell liner and cover configurations. Results were compared with the original model results developed by ODEQ. The ODEQ modeling was based upon State regulations and consisted of "worst case scenarios" for comparison.

The first disposal cell design for which the model was run employed a six inch topsoil cover, a 2 1/2 foot thick compacted clay cap, the treated waste, and a 3 foot thick compacted clay liner. Leachate generation averaged 0.08 inches per year through the liner, which was the same quantity that infiltrated the clay cap.

The second disposal cell design for which the model was run employed a six inch topsoil cover, a 2 1/2 foot thick compacted clay cap, the treated waste, and a 5 foot thick *in situ*

liner (consisting of the native clays and mudstones that underlie the disposal cells). Leachate generation averaged 0.081 inches per year through the liner, which was the same quantity that infiltrated the clay cap.

It became apparent that the disposal cell cap is the key factor in minimizing the generation of leachate. Consequently, the cap design was the focus of a discussion between KMC, Fluor Daniel Williams Brothers, and ODEQ. KMC and ODEQ agreed that the cap design should maintain the low permeability of the compacted clay cap. ODEQ approved a design of 2 feet of compacted clay with a permeability of 10^{-8} cm/sec, covered with one foot of soil. The additional six inches of soil covering the compacted clay is intended to minimize dehydration and cracking of the compacted clay cap.

Because of the thickness of underlying mudstones and the proximity of the groundwater diversion trenches, leachate generated in the disposal cell is far more likely to discharge to the trenches than to the underlying aquifer. An evaluation was performed to determine the potential impact to surface waters if all leachate generated were to discharge through the discharge pipes to surface waters.

The peak daily leachate generated by the HELP model was diluted into Skull Creek, assumed a minimum flow of 1 cubic foot per second. The concentration of various compounds that would be necessary to raise clean water above maximum drinking water concentrations were calculated. The results were then compared with the concentration of those compounds resulting from leachate tests performed on untreated waste. The results are shown in Table 3-2, and conclude that surface water will not be adversely impacted even if all leachate generated by the waste discharges immediately to Skull Creek.

Sequencing of Waste Treatment/Placement and Disposal Cell Construction

The final sequencing of disposal cell construction will be determined by both KMC and the contractor. Regardless of the sequencing order, the contractor will need to adhere to certain construction requirements. For example, construction of Disposal Cell A will begin at the north end and progress southward in three phases. Construction of Disposal Cell B will begin at the west end and progress eastward in three phases. The phases of the disposal cell preparation and the pit excavations are indicated in the Excavation and Fill Sequencing Plan included in the Construction Drawings in Appendix B to this document.

Since the actual volume of waste to be disposed of is uncertain, it will be necessary to carefully monitor generated waste quantities versus available disposal cell volume. Table 3-3 references the volumes and preliminary order of excavation that was prepared for the Construction Drawings. The pit volumes shown in Table 3-3 are excavated volumes and do not include treatment or bulking factors. A representative flow diagram for disposal cell construction is shown in Figure 3-1.

Table 3-2
Disposal Cell Leachate Dilution for Discharge into Skull Creek

Parameter	*Oklahoma Water Quality Standard*	*Dilution Factor (1)*	*Max. Leachate Concentration to Meet Water Quality Std. (2)*	*TCLP Concentration Pit 5 Raw Waste*
Metals				
Arsenic	190 ug/L	3142	596,980 ug/L	349 ug/L
Chromium (total)	50 ug/L	3142	157,100 ug/L	368 ug/L
Selenium	5 ug/L	3142	15,710 ug/L	100 ug/L
Silver	0.49 ug/L	3142	1,540 ug/L	BDL (3)
Organics				
Benzene	2,200 ug/L	3142	6,912,400 ug/L	BDL (3)
Pentachlorophenol	1 ug/L (4)	3142	3,142 ug/L	BDL (3)
General Water Quality				
Sulfate	494 ug/L (5)	3142	1,552,148 ug/L	N/A

NOTES:

(1) Per ODEQ water quality standards, a flow of 1 cfs (86,400 cubic feet per day) was used as minimum base flow for Skull Creek. Peak daily leachate from Cells A (16.2 cubic feet per day) and B (11.3 cubic feet per day) combined for the 5-foot, *in situ* liner was 27.5 cubic feet per day. The dilution factor is 86,400/27.5, or 3142 parts of stream water to one part of leachate.

(2) An upstream contaminant concentration of zero was assumed.

(3) Below detection limit.

(4) Federal primary drinking water standard.

(5) Yearly mean standard. The maximum concentration possible is 2090 mg/L at 30 degrees Celsius.

Table 3-3
Approximate Quantities Table
(Conceptual Sequence)

Excavation Order	*Filling Order*	*Phase A Pit Volume (Total Vol) Yd³*		*Phase B Pit Volume (Total Vol) Yd³*		*Phase C Pit Volume (Total Vol) Yd³*	
A,Y	*Cell*	*Min.*	*Max.*	*Min.*	*Max.*	*Min.*	*Max.*
3	B	12,400 (12,400)	15,000 (15,500)	- -	- -	- -	- -
2	B	30,900 (43,300)	38,600 (54,100)	32,100 (75,400)	40,000 (94,100)	- -	- -
1	B	- -	- -	27,700 (103,100)	34,500 (128,600)	- -	- -
4	B	- -	- -	- -	- -	57,300 (160,400)	71,400 (200,000)
5	A	55,200 (55,200)	69,000 (69,000)	97,440 (152,640)	121,800 (190,800)	28,180 (180,820)	35,230 (226,030)
Others On-Site	A	- -	- -	- -	- -	59,180 (240,000)	73,970 (300,000)

It is anticipated that initially Pits 2 and 3 will be treated simultaneously to obtain the best treated waste results. Pit 3 includes a large volume of grease and water and Pit 2 consists of hard acidic sludge. Grease and water from Pit 3 may be combined with Pit 2 waste during the neutralization process. Final details of this activity will be established by KMC.

Stormwater runoff will be controlled to prevent the release of contaminated water into free running surface waters. Stormwater runoff in the decontamination areas will be diverted to the stormwater holding ponds. Stormwater falling within the treatment areas will be pumped to the stormwater ponds or used in the neutralization treatment process.

TREATMENT PROCESS

Treatment of acidic waste sludge requires neutralization prior to excavation and subsequent placement in the disposal cell. Individual activities presently envisioned for completion of the waste treatment portion of the remedial project are illustrated in Figure 3.1 and include:

- Waste sampling and classification
- Waste treatment and verification
- Excavation and placement of treated waste
- Final treatment and verification (if required)
- Final compaction.

The following narrative provides a brief description of the actions and/or technical approaches for each of these activities.

Waste Sampling and Classification

Representative waste areas will be sampled and analyzed to determine the pH and acidity of the waste material. These tests will form the basis for determining the quantity of neutralizing agents to be added to the waste. At a minimum, waste will be treated to bring the pH to greater than 2.0 units prior to excavation.

Large debris (such as timbers and pipes) discovered mixed in with the contaminated waste will be separated and classified as contaminated debris. This debris will also be decontaminated prior to final disposition in accordance with General Demolition and Disposal Specification 000.230.00230.

Waste Treatment and Verification

Material with a pH of less than 2.0 will require treatment prior to excavation. The waste treatment process will be performed by incorporating required quantities of neutralizing agents into the waste. After in place treatment, and prior to excavation, verification analysis will be performed to confirm that the waste has a pH greater than 2.0 units. During

excavation, a layer of treated material will be left in place, thereby minimizing the release of sulfur dioxide.

Water required for the treatment process will be obtained from various sources depending upon location of the waste being treated. For treatment of Pit 5, water will be obtained from the freshwater pond located to the southeast of Pit 5. For treatment of Pits 1, 2 and 3, water can be obtained from either the stormwater pond or from a 2-inch, non-potable water line located in the staging area. Water for treatment of Pit 4 waste will have to be obtained from a rural water line located along the east property line. Additional water sources may be obtained from the sedimentation ponds, depending upon weather conditions.

Excavation and Placement of Treated Waste

The treated waste will be excavated in discrete lifts. The discrete lift depth will be such that a layer of treated waste remains between the untreated waste and bottom of lift excavation. This procedure will minimize excavation of any corrosively hazardous material and minimize sulfur dioxide emissions. Treated waste will be placed in 8-inch, loose lifts in the disposal cell.

Final Treatment

Additional treatment may be conducted in the waste disposal cells if testing reveals that the final treatment criteria have not been met. This may consist of further addition of neutralizing agents and mixing. The mixing process may also consist of pulverization which will reduce waste aggregate particle size by breaking or grinding.

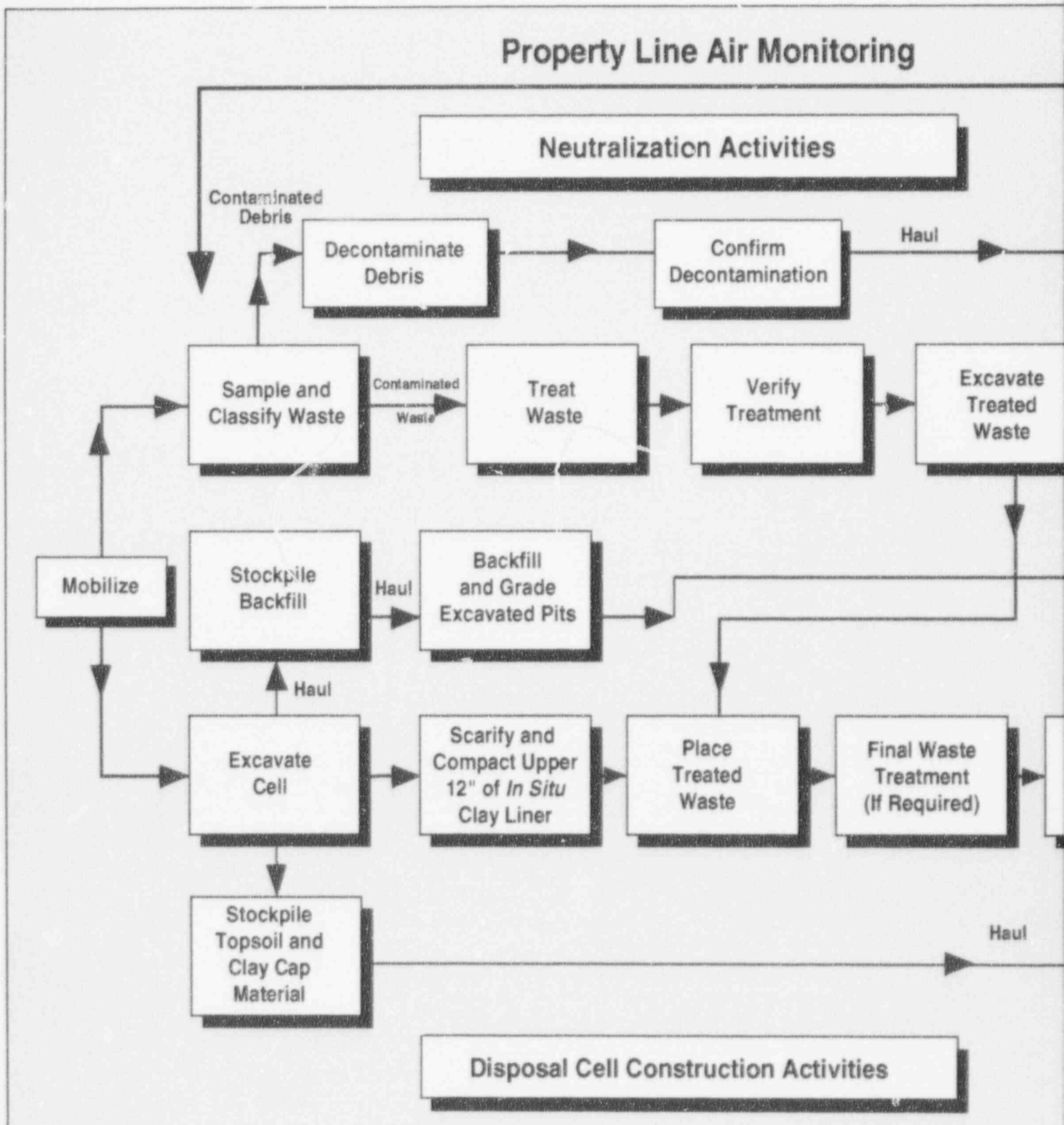
Treatment Verification

Treatment verification will confirm that all treatment criteria have been met. Verification testing will consist of pH analysis, particle size evaluation, and toxicity characteristic leaching procedure (TCLP) analysis. Verification testing may take place in the waste pit or the disposal cell.

Final Compaction

After confirmation that the treated waste has met all pH and particle size criteria, it will be compacted to at least 25 pounds per square inch unconfined compressive strength. If testing reveals that the 25 pounds per square inch criteria has not been met, it must be demonstrated that the lesser strength is acceptable by applying the California Bearing Ratio Test. Once this requirement is met, the final actions necessary to complete Phase 1 activities for that disposal cell may proceed as shown in Figure 3-1.

FIGU
REMEDIAL A
FLOW



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RE 3-1
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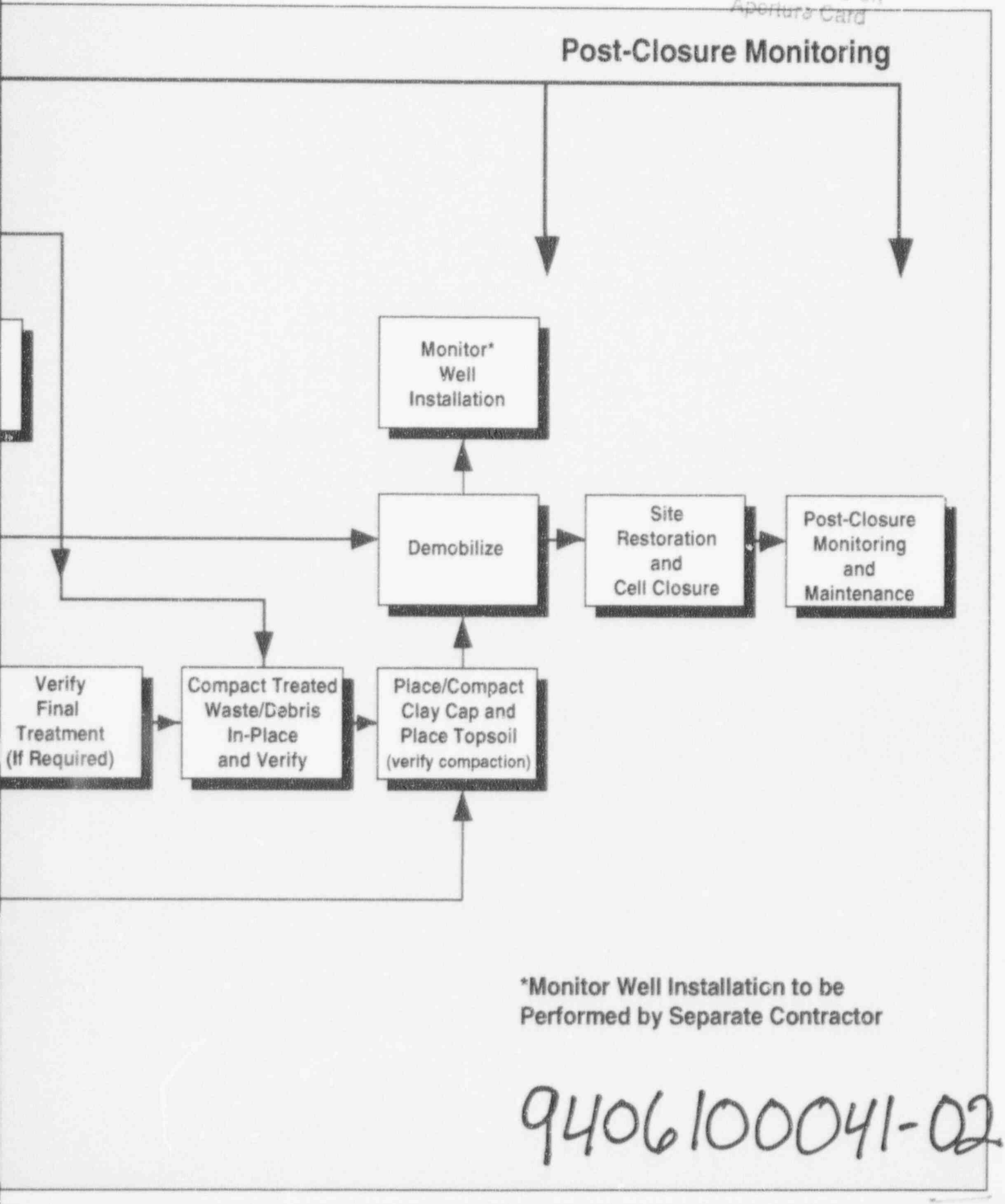
DIAGRAM



*Monitor Well Installation to be
Performed by Separate Contractor

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SECTION 4
QUALITY ASSURANCE AND QUALITY CONTROL PLAN

- *Purpose and Objectives*
- *Project Organization and Responsibilities*
- *QA/QC Definitions*
- *Treatment Process QA/QC Procedures*
- *Disposal Cell Construction QA/QC Procedures*
- *Audits*

PURPOSE AND OBJECTIVES

The purpose of this Quality Assurance and Quality Control (QA/QC) Plan is to define the quality objectives and requirements of the Phase I Remedial Design the procedures to be followed in meeting those requirements and the organization responsible for ensuring proper implementation of this plan.

The project quality objectives are:

- Meet client quality requirements.
- Comply with the requirements of the ROD.
- Comply with relevant regulatory body requirements.

PROJECT ORGANIZATION AND RESPONSIBILITIES

This plan addresses the organization and responsibilities associated with testing, sampling, chemical analyses, inspection, chain of custody, and documentation. The overall organization of this project includes representatives from KMC, construction management (Kerr-McGee or subcontractor), construction contractor, and potentially additional subcontractor personnel depending on the contracting approach selected by KMC.

For on-site work, the actual team will consist of a combination of the following personnel (The Site Construction Manager and Environmental/Laboratory Manager or their designees will be on-site at all times remediation activities are in progress):

- Site Construction Manager

  The Site Construction Manager, as the designee of the Owner, will be responsible for coordination of on-site activities. The Site Construction Manager will maintain a general site log and be responsible for the receipt of daily reports and subcontractor submitted analyses.

- Environmental/Laboratory Manager

  The QA/QC Manager will report to the Site Construction Manager and will be responsible for on-site sampling and analysis coordination during waste treatment activities. This includes review of analyses received from the subcontractor for conformance with specifications, designation of sampling locations for contaminated and treated waste materials, and review of analytical results and their report to the Site Construction Manager. Management of the laboratory will include responsibility for the coordination of sampling and laboratory services, and will assure the availability and maintenance of the sampling and analytical equipment. These responsibilities include assisting the

QA/QC Manager to validate the analytical data and regularly review laboratory procedures and documentation.

- Laboratory Technician(s) (Number Depends on Waste Treatment Production Rate)

  The laboratory technician(s) will report to, and are under direction of, the Environmental/Laboratory Manager. Their responsibilities include obtaining samples and analyzing waste material, uncontaminated material, and treated waste material. Responsibilities also include maintaining appropriate documentation and records of laboratory activities.

- Soils Technician(s) (Number Depends on Rate of Construction)

  The Soils Technician(s) responsibilities will include performance of field testing and sampling required for construction of the disposal cells. This testing will be limited to soils and clays with regards to density testing, thickness testing and permeability testing. The technician will be required to perform all sampling and testing as indicated in the Construction Specifications and as stipulated in the QA/QC plan.

- Quality Assurance/Quality Control Manager

  The QA/QC Manager will report to the Site Construction Manager, will be responsible for adhering to QA/QC guidelines as defined in this QA/QC plan, and will confirm that the QA/QC procedures are completed. Strict adherence to these procedures is critical to the collection of acceptable data. The QA/QC Manager will also assist the Environmental/Laboratory Manager in the performance of data QA/QC reviews and data validation reviews. The QA/QC Manager will be on-site as necessary to verify compliance with this QA/QC plan as well as perform planned QA/QC audits.

QA/QC DEFINITIONS

Data collection efforts will adhere to the QA/QC procedures prescribed in the construction specifications and documented in the QA/QC Plan. These procedures have been developed to assure precision, accuracy, completeness, representativeness, and comparability of data taken during collection. The preceding terms are defined below:

- Precision

  The QA/QC aim in testing precision is to demonstrate the reproducibility of data. The precision of analytical and field measurements will be evaluated and reported along with the analytical method reference number in a manner consistent with previously published data on precision.

- Accuracy

  Accuracy is the relationship of the reported data to the "true" value. Accuracy will be reported with the data and will be consistent with published analytical methods.

- Completeness

  Completeness is a measure of the amount of valid data obtained from a measurement program, compared to the amount that would be obtained under correct, normal conditions. Exceptions to the number of samples required in the construction specifications or changes to the recommended number of samples identified in the specifications will be documented.

- Representativeness

  Data should be representative of the actual conditions at the sampling location. Considerations for evaluating the representativeness of the data include, but are not limited to:

  - The location being sampled

  - The methods used to obtain environmental samples at the site

  - The appropriateness of the analytical method to the type of sample obtained.

- Comparability

  Data will be reported in units consistent with State or equivalent Federal regulations, methods, and guidelines. Comparability between data bases will be achieved by using standardized sampling and analysis methods and data formats. Deviation from the standard method will be noted and data will be qualified for comparative purposes.

TREATMENT PROCESS QA/QC PROCEDURES

Decontamination

The objective for equipment and debris decontamination is to prevent contaminated material from being transported from exclusion zones into uncontaminated areas.

The General Decontamination and Disposal Specification 000.230.02230 addresses the decontamination of debris removed from exclusion zones and heavy equipment used within exclusion zones. The specification also addresses the disposal of decontaminated debris and other solid wastes. The construction contractor is responsible for operating decontamination equipment and completing proper decontamination. The QA/QC Manager or his designee is responsible for verifying that decontamination has been completed according to the design specification.

Sampling and Analysis

Analytical testing of decontaminated debris or equipment will not typically be required. However, the contractor is required to retain equipment and debris from radiologically contaminated areas for radiological screening by KMC. The contractor may be required to perform additional decontamination if excess radiological contamination remains on equipment and debris after screening by KMC. KMC will assume responsibility for the

disposition of debris that can not be adequately decontaminated radiologically. The Site Construction Manager will advise the contractor where to stockpile such debris.

Inspection

The QA/QC Manager or his designee will perform visual inspections to verify compliance with the requirements of the decontamination specification. He will ensure that the contractor has removed waste that may be dislodged from debris or equipment prior to transporting the debris or equipment to the decontamination area. He will also ensure that the contractor has extricated removable contamination from debris and equipment with a high pressure steam or water sprayer before removing equipment or debris from the contamination reduction zone.

Documentation

The construction contractor will document decontamination of equipment and debris in the contractor daily reports. The QA/QC Manager will document decontamination inspections. KMC health physics technicians will document surveys of equipment or debris removed from radiologically contaminated areas. Decontamination water will be handled in accordance with the Treated Waste Excavation, Placement, and Compaction Specification 000.230.02230.

A copy of all documentation will be maintained by the Site Construction Manager in the site office. The certification of completion report will contain separate QA sections that summarize information collected and corrective action taken during the project.

Waste Characterization

The objectives for characterization of waste is to identify waste material requiring treatment, to minimize treatment of material that does not require treatment, and to determine the quantity of treatment reagent required. This characterization will include the waste pits identified on the drawings and other wastes that may be designated for treatment by the Site Construction Manager or KMC.

A sampling grid will be established for each waste pit or areas to be treated. Samples of waste will be collected and submitted to the field laboratory for analysis. Analytical results for samples obtained from each grid area will be transmitted from the Laboratory Technician to the Environmental/Laboratory Manager, who will calculate the amount of treatment reagent necessary to neutralize the amount of acid present in the waste volume. Appendix C presents the method that will be used to calculate treatment reagent requirements. Adjustments to these calculations may be made by the Environmental/Laboratory Manager in conjunction with the Site Construction Manager based on previous sampling and analysis results.

The Environmental/Laboratory Manager will provide the Site Construction Manager and construction contractor the results of the treatment reagent quantity calculations for the designated grid area.

Sampling and Analysis

A 50-foot grid will be established over each area to be characterized. Each 50 X 50-foot area will be sampled. A minimum of five samples of waste will be obtained from each grid area. The five samples from each grid area will be spaced uniformly throughout the area and will represent the full vertical lift to be treated. These five samples will be composited for analysis. Sampling of the waste areas will be completed according to the procedures described in Appendix C of this document.

Waste samples from the grid area will be analyzed for pH and acidity as described in Appendix C of this document. This sampling and analysis process will continue for each waste layer to be characterized.

Inspection

The QA/QC Manager or his designee will verify that sampling is conducted according to the above procedures. He will ensure that analyses are performed in accordance with procedures presented in Appendix C, and that the data have been transmitted to the Site Construction Manager and construction contractor. He will also verify that the appropriate amount of treatment reagent has been applied to the specific grid area for mixing.

Documentation

Field data collected from the field analysis will be summarized, validated, and reported by the Environmental/Laboratory Manager to site management. The QA/QC Manager, or the Environmental/Laboratory Manager, or their designee, will review field generated data prior to its release to verify that it reasonably reflects known conditions.

Field data recording sheets, instrument output, and calculation sheets results will be retained in the project files. The Environmental/Laboratory Manager and the QA/QC Manager will assess data to assure QA/QC objectives are met.

A copy of all documentation will be maintained by the Site Construction Manager in the site office. The certification of completion report will contain separate QA/QC sections that summarize information collected and corrective action taken during the project.

Corrective Action

If results indicate unacceptable conditions or data, the Owner, Site Construction Manager, and QA/QC Manager are responsible for developing and initiating corrective action procedures. Corrective action procedures may include, but are not limited to:

- Re-analyzing the samples, if holding time criteria permit
- Re-sampling and analyzing
- Evaluating and amending sampling and analytical procedures

- Replacing equipment
- Accepting data while acknowledging a level of uncertainty.

Corrective action will be documented and a corrective action report will be attached to the certification of completion report.

Waste Treatment

The objective for waste treatment verification is to document that waste has been treated to meet waste treatment criteria. Samples of treated waste will be analyzed prior to excavation. Treated waste from Pit 4 will require sampling and analytical procedures in addition to those described herein to determine the radionuclide concentration. Radiological analyses will be performed by KMC health physics personnel. The QA/QC for air monitoring will be covered in Section 5.

Sampling and Analysis

The treated waste layer will be sampled for pH, alkalinity, and sieve analysis as described in Appendix C. This sampling and analysis process will continue for each treated waste layer based on the same 50-foot grid and sampling strategy described in the waste characterization sampling and analysis procedures. Results of pH analyses will be used to verify adequate waste neutralization; alkalinity analysis will be used to determine remaining buffer capacity. Calculations of the amount of reagent used for future waste layers may be modified based on the results of alkalinity tests.

If pH tests indicate that the treated waste sample remains acidic, an acidity test will be performed. The acidity test will determine the amount of reagent necessary to complete neutralization of the waste. The application and blending of additional reagents constitutes waste re-treatment.

Additional treated waste sampling procedures will be performed by KMC in Pit 4. Treated waste will be analyzed for radiological contamination. Radiological analyses will determine the disposition of radiologically contaminated waste.

If the Construction Contractor believes adequate waste pulverization has been achieved, a sieve analysis will be performed by the Laboratory Technician(s) to determine if the treatment criteria has been achieved.

Toxicity Characteristic Leaching Procedure (TCLP) analysis will be performed on one sample per 20,000 cubic yards of treated waste. TCLP for metals and organic analyses will be performed by an independent laboratory using Method 1311 provided in SW-846. This analytical procedure will confirm that the waste is adequately stabilized.

Inspection

The QA/QC Manager will inspect treated waste to determine if the area has been consistently treated with the method described by the construction contractor, referencing the submittal described in Paragraph 1.3.A of Waste Treatment Specification 000.230.02210. If additional treatment is necessary and a treatment area does not exhibit sufficient bearing capacity to complete waste treatment, the Site Construction Manager may direct the partially treated layer to be transported to the disposal cell to complete waste treatment.

Documentation

Field data collected from the field analysis will be summarized, validated, and reported by the Environmental/Laboratory Manager to site management. The QA/QC Manager, or his designee, and Environmental/Laboratory Manager will review field generated data prior to its release to verify that it reasonably represents known conditions.

Field data recording sheets, instrument output, and worksheets for calculating results will be retained in the on-site project files. This raw data will be appropriately identified and included in a separate appendix to the certification of completion report. The Environmental/Laboratory Manager and the QA/QC Manager will assess data to assure QA/QC objectives are met.

A copy of all documentation will be maintained by the Site Construction Manager in the site office. The certification of completion report will contain separate QA sections that summarize information collected and corrective action taken during the project.

Waste Excavation, Placement, and Compaction

The objective for waste excavation, placement, and compaction verification is to document that treated waste is compacted to a minimum unconfined compressive strength of 25 pounds per square inch (psi) throughout the treated waste lift. An additional quality assurance objective is to provide independent and verifiable data to calculate the quantity of treated waste excavated and placed by the construction contractor.

Treated Waste Excavation, Placement, and Compaction Specification 000.230.02220 addresses the following work:

- Excavation of treated waste from areas shown on the drawings as directed by the Owner.
- Placement and compaction of treated waste in the disposal cell designated by the Owner.
- Control of surface runoff and groundwater.

The specification requires that waste treatment adequacy be verified prior to placement of new material. Special waste handling requirements may apply to the waste in a portion of

Pit 3 and Pit 4. Based on analytical results, the Site Construction Manager will direct the construction contractor to perform one of the following activities:

- Excavate and transport treated waste to the disposal cell for final placement and compaction if treated waste meets both the neutralization and pulverization treatment criteria.

- Retreat waste that does not meet the neutralization treatment criteria.

- Perform additional pulverization in place, or transport to the disposal cell and perform additional pulverization If the treated waste meets the neutralization treatment criteria but not the pulverization criteria.

- Place grease, water, and emulsified waste from Pit 3 on the surface of Pit 2 prior to treatment. Analysis and treatment will then proceed as described in the preceding sections.

- Excavate and place radiologically contaminated treated waste (Option 2 level contamination) in the radioactive materials storage area designated by KMC.

- Excavate and place radiologically contaminated treated waste (Option 1 level contamination) in the disposal cell for final placement and compaction.

Sampling and Analysis

The QA/QC Manager or his designee must verify that compacted treated material has an unconfined compressive strength of at least 25 psi throughout each compacted lift. Sieve analysis and unconfined compressive strength tests will be performed by a Laboratory Technician of each compacted layer of treated waste. Test locations will be selected to be representative of the area tested.

Treated waste will be sampled using the same 50 foot grid system used in determining reagent additions. Samples will be collected from five representative locations in each 50 x 50 foot section. Since larger particles have a tendency to rise to the tope of the treated material, it is essential that the samples be a composite to the full depth of the treated material. After compositing the five samples, approximately 60 pounds of material will be available for screening. The actual procedure will be performed as described in Appendix C.

Unconfined compressive strength will be measured midway through each compacted lift and will be measured with a penetrometer in accordance with manufacturer's instructions.

Inspection

The QA/QC Manager or his designee will monitor the work of the construction contractor to verify that the work conforms to the design specification. The QA/QC Manager or his designee will inspect side slopes for excavation and backfilling operations to ensure that

they are not steeper than 2:1 (two feet horizontal to one foot vertical) and that excavations outside of exclusion zones are barricaded in accordance with applicable OSHA regulations. Side slopes where treated waste lifts have been excavated may be steeper than 2:1.

The QA/QC Manager or his designee will inspect newly compacted areas to ensure that the construction contractor has protected them from damage due to traffic, erosion, or settlement, and that such areas are restored if damaged.

The QC/QC Manager or his designee will inspect excavations to ensure that the construction contractor implements controls to prevent or control surface water flow into excavations and accumulation of water in excavations. He will inspect the disposal cell area to verify that the construction contractor has implemented measures to prevent run-off ponding. He will verify that the construction contractor has installed measures for the control and prevention of erosion and siltation for areas subject to earthwork.

The QA/QC Manager or his designee will inspect excavated areas in the waste pits to ensure that the construction contractor maintains a sufficient layer (minimum of 2 inches) of neutralized waste over waste during excavation of neutralized or treated waste to control adverse air emissions.

The QA/QC Manager or his designee will verify that non-contaminated material is kept separate from neutralized or treated waste material to avoid mixing treated waste with non-contaminated material.

The QA/QC Manager or his designee will inspect and approve the subgrade, or previously compacted treated waste layer, before the construction contractor may place excavated neutralized or treated waste in the designated disposal cell. He will inspect treated waste placement to verify that treated waste is placed in even, loose, lifts not exceeding eight inches in thickness, and that the maximum thickness of the compacted lift does not exceed six inches.

The QA/QC Manager or his designee will verify that radiologically contaminated and neutralized waste excavated from Pit 4 is placed in the area designated by KMC.

Documentation

Inspection records and test results will be recorded in a log book specifically designated for that particular test. For example, all compaction tests will be recorded in a log book entitled Compaction Testing, and will include information describing the conditions under which the test was performed, the date of the test, test results, and action taken as a result of unsatisfactory test results.

In addition to the documentation maintained by the Site Construction Manager, the construction contractor must maintain and submit the following quality control documentation:

- A complete and organized set of the project record documentation, including any documentation submitted as a basis for payment, plus a complete set which will be required at Contract Closeout. Project record documentation shall be referenced by treatment and placement area or item of work and shall be in chronological or numerical order.

- Cross-sections of the disposal cell and waste pit areas, prepared and signed by an independent surveyor licensed in the State of Oklahoma, showing ground surface after all selective demolition and site clearing has been completed by the construction contractor and accepted by KMC. Section lines shall be spaced no more than 50 feet apart. Elevation shots shall be taken along section lines at breaks in grade and no more than 50 feet apart.

- Reduced field notes and sketches, prepared and signed by an independent surveyor, licensed in the State of Oklahoma, adequately defining the actual excavation limit, or as required, to show the horizontal or vertical break between waste and non-contaminated material layers, which shall be used for record and basis of payment.

- Cross-sections of the disposal cell and former waste pit areas, prepared and signed by an independent surveyor licensed in the State of Oklahoma, after excavation of treated material has been completed.

- The location of radioactively contaminated material placed in the disposal cell, on Construction Drawings.

A copy of all documentation will be maintained by the Site Construction Manager in the site office. The certification of completion report will contain separate QA sections that summarize information collected and corrective action taken during the project.

Reagents

The quality assurance objective associated with the testing and acceptance of reagents is to assure that the reagents are adequate and effective for their intended purpose and do not excessively increase the volume of treated waste.

Neutralization of the acidic waste will require significant quantities of a neutralizing reagent. For portions of the waste pits, the application of additional treatment reagent(s) may be required to improve the material handling properties of the waste. Lime and cement kiln dust have been used to successfully treat the waste in bench- and full-scale studies. The construction specifications provide the construction contractor flexibility in the choice of treatment reagents, subject to approval from KMC. The construction contractor must provide a description and analysis of the proposed treatment reagents with an analysis of the reagents. The definition of treatment reagent and the associated requirements are prescribed in Waste Treatment Specification 000.230.02210.

Sampling and Analysis

The construction contractor will be required to submit the following information on proposed treatment reagents for approval prior to use of the reagents:

- The mineral composition, measured by X-ray diffraction, for each reagent proposed to complete treatment of the acidic sludge. Analyses must also quantify the neutralizing and buffering property of the reagent so that reagent requirements can be calculated from waste acidity using stoichiometric equations.

- Sample neutralization calculations for an assumed acid content of 10% sulfuric acid, by weight.

- A certificate of chemical analysis from the manufacturer or supplier shall be provided for each bulk shipment of treatment reagents demonstrating that the shipment does not contain more than the maximum allowable concentration of leachable heavy metals or organics based on TCLP analysis. Manufacturer or supplier shall certify that reagents are free of listed hazardous wastes. Copies of an original certificate are acceptable for multiple shipments provided that the manufacturing process remains consistent and applicable to each shipment.

Inspection

The QA/QC Manager or his designee will inspect each bulk shipment of treatment reagent. Inspections will be performed to verify that the material is free of excess moisture and other contamination, and that bulk material does not contain foreign material including, but not limited to, rocks, organic materials and trash. He will also insure that reagents are off loaded in a safe manner and that emissions control are adequate.

If bulk material is deemed unacceptable upon visual examination by the QA/QC Manager or his designee, the material shall be removed from the site and replaced with acceptable material at the construction contractor's expense. QA/QC Manager will also ensure that bulk materials are off loaded in a safe manner and that emission controls are adequate.

Documentation

Throughout the project and at project closeout, the construction contractor is required to submit the following quality control documentation:

- Certificate of reagent analysis verifying the composition of the material and that the material does not contain heavy metals.

- Certificate of analysis by EPA Method 1311, verifying the bulk material does not contain excessive leachable heavy metals or organics.

- Weight Tickets - Contractor shall submit a copy of the truck weight ticket certification for each bulk shipment of material required for execution of the work for record and basis of payment.

A copy of all documentation will be maintained by the Site Construction Manager in the site office. The certification of completion report will contain separate QA sections that summarize information collected and corrective action taken during the project.

DISPOSAL CELL CONSTRUCTION QA/QC PROCEDURES

Field testing for compaction, clay permeability, soil layer thickness, topsoil quality, and related activities shall be performed by a qualified technician or qualified sub-contractor with certified personnel. Field tests and testing requirements shall be performed as stipulated in the Construction Specifications and will comply with QA/QC procedures as stipulated in this section of the Quality Assurance/Quality Control Plan. Checklists have been prepared to aid in sampling, inspection, and testing.

Soil Compaction

This procedure applies to the inspection and testing of all soil compaction work performed during Phase I of the Remediation Project. It does not apply to the compaction of treated waste. Testing will be performed in accordance with Earthwork Specification 000.210.02200. Locations of testing and sampling points will be marked on Construction Drawings for future reference and documentation.

Sampling and Analysis

A minimum of 20 compaction tests will be performed per lift of *in situ* liner and compacted clay. The tests will be distributed evenly over the disposal cell and will include a minimum of six (6) test locations evenly spaced along the liner slopes when applicable. The clay lifts shall be compacted at 97 to 100% of optimum moisture. Lift thickness and compaction requirements are stipulated in the above-referenced specification on earthwork.

Inspections

Inspections will be performed by the QA/QC Manager or his designee to ensure compliance with criteria stipulated in Earthwork Specification 000.210.02200. The QA/QC Manager will direct the inspection and testing of all soil compaction work. He will also review all results submitted by testing personnel, assure that failing tests are backed up with acceptable tests after corrective work has been performed, and ensure completion of Soil Compaction Inspection Checklists.

Documentation

The QA/QC Manager will maintain soil test and inspection results, will ensure that compaction test locations are adequately documented, and will compile the Soil Compaction Inspection Checklists.

A copy of all documentation will be maintained by the Site Construction Manager in the site office. The certification of completion report will contain separate QA sections that summarize information collected and corrective action taken during the project.

☐ Rework Required

SOIL COMPACTION INSPECTION CHECKLIST

Location	Material Source
Drawing No.	Specification No.

This form is to be completed by the Inspector on a daily basis whenever this work is being performed.

	Acceptable		*Accepteble*
SURFACE PREPARATION	☐	MOISTURE CONTROL	☐
FILL MATERIAL APPROVED	☐	LIFT PREPARATION	☐
LIFT THICKNESS	☐	FINISH GRADING	☐
COMPACTION METHOD	☐	TESTING COMPLETE AND ACCEPTABLE RESULTS	☐

REMARKS

INSPECTOR	DATE

Instructions for Completing Inspection Checklist

1. Describe physical locations of compaction test.
2. List applicable Construction Drawings and Specifications.
3. Determine if item is or is not acceptable.
4. Document pertinent conversation with contractors or testing agency and explain/clarify an of the above attributes.
5. Sign and date when completed.

Clay Permeability

This procedure applies to permeability testing conducted during Phase I of the Remediation Project. Testing will be performed in accordance with the methods referred to in Earthwork Specification 000.210.02200. Location of testing and sampling points will be marked on Construction Drawings for later reference and documentation.

Sampling and Analysis

For the *in situ* liner, one shelby tube sample shall be obtained for permeability testing for every five compaction tests. The shelby tube sample shall be obtained within five (5) feet of the location of the compaction test. Bore holes shall be backfilled according to Earthwork Specification 000.210.02200.

For the clay cap stockpile, one grab sample shall be obtained and tested for every 5,000 cubic yards of stockpiled clay. Samples will also be taken for every obvious visual change of clay material (i.e., red clay to tan clay). All clays tested for cap material shall demonstrate a permeability of 10^{-8} cm/sec or less (utilizing ASTM procedures) when compacted to optimum moisture content and at least 95% maximum dry density.

Permeability analysis performed on clay cap stockpile will ensure that, when compacted to 95 percent Modified Proctor Density at optimum moisture + 0 -3 percent, permeability will be less than 10^{-8} cm/sec.

Because the clay cap will be placed slightly dry of optimum moisture, *in situ* permeability test may not yield representative results. Therefore, for the compacted clay cap, permeability will be evaluated on the basis of compaction and moisture contented as measured with a nuclear densimeter.

Inspections

Inspections will be performed by the QA/QC Manager or his designee to ensure compliance with criteria stipulated in the above-referenced specification on earthwork. The QA/QC Manager will direct the inspection and testing of soil permeability. He will also review all results submitted by testing personnel, assure that failing tests are backed up with acceptable tests after corrective work has been performed, and ensure completion of Clay Permeability Inspection Checklists.

Documentation

The QA/QC Manager will maintain permeability test and inspection results, will ensure that permeability sample and test locations are adequately documented, and will compile the Clay Permeability Inspection Checklists.

A copy of all documentation will be maintained by the Site Construction Manager in the site office. The certification of completion report will contain separate QA sections that summarize information collected and corrective action taken during the project.

☐ Rework Required

CLAY PERMEABILITY INSPECTION CHECKLIST

Location	Material Source
Drawing No.	Specification No.

This form is to be completed by the Inspector on a daily basis whenever this work is being performed.

	Acceptable		*Acceptable*
SAMPLE OBTAINED *IN SITU*	☐	TESTING FREQUENCY	☐
SAMPLE OBTAINED STOCKPILE	☐		
SAMPLE OBTAINED VISUAL CHANGED	☐		
TESTING COMPLETE AND ACCEPTABLE RESULTS	☐		

REMARKS

INSPECTOR	DATE

Instructions for Completing Inspection Checklist

1. Describe physical locations of compaction test.
2. List applicable Construction Drawings and Specifications.
3. Determine if item is or is not acceptable.
4. Document pertinent conversation with contractors or testing agency and explain/clarify an of the above attributes.
5. Sign and date when completed.

In Situ Liner Thickness

This procedure applies to the inspection and testing of the thickness of the *in situ* liner constructed during Phase I of the Remediation Project. Testing will be performed in accordance with the methods referred to in Earthwork Specification 000.210.02200. Location of all testing and sampling points will be marked on Construction Drawings for later reference documentation.

Sampling and Analysis

Borings will be drilled on a grid pattern of 100-ft x 100-ft within each disposal cell. Borings will be advanced to a depth of 5 feet prior to scarification and compaction. The cuttings will be evaluated for suitability as *in situ* liner material. Borings will be advanced until a total of five foot of acceptable material is reached. After confirmation, the borehole will be backfilled with a cement/bentonite grout or similar hole plugging material.

Inspections

Inspections will be directed by the QA/QC Manager or his designee to ensure compliance with criteria stipulated in the above-referenced specification for earthwork. The QA/QC Manager or his designee will direct the inspection and testing of the *in situ* liner. He will review all results submitted by testing personnel, assure that failing tests are backed up with acceptable tests after corrective work has been performed, and ensure completion of *in situ* Liner Thickness Inspection Checklists.

Documentation

The QA/QC Manager will maintain clay thickness test and inspection results, will ensure that borehole locations and pluggings are adequately documented, and will compile the *In Situ* Liner Thickness Inspection Checklists.

A copy of all documentation will be maintained by the Site Construction Manager in the site office. The certification of completion report will contain separate QA sections that summarize information collected and corrective action taken during the project.

☐ Rework Required

IN SITU LINER THICKNESS INSPECTION CHECKLIST

Location	Material Source
Drawing No.	Specification No.

This form is to be completed by the Inspector on a daily basis whenever this work is being performed.

	Acceptable		*Acceptable*
GRID PATTERN	☐	MOISTURE CONTROL	☐
BORING METHOD	☐	LIFT PREPARATION	☐
CLAY THICKNESS	☐	FINISH GRADING	☐
COMPACTION METHOD	☐	TESTING COMPLETE AND ACCEPTABLE RESULTS	☐

REMARKS

INSPECTOR	DATE

Instructions for Completion of Inspection Checklist

1. Describe physical locations of compaction test.
2. List applicable Construction Drawings and Specifications.
3. Determine if item is or is not acceptable.
4. Document pertinent conversation with contractors or testing agency and explain/clarify an of the above attributes.
5. Sign and date when completed.

Topsoil Stockpiling

This procedure applies to the inspection of topsoil for use during Phase I of the Remediation Project. Testing will be performed in accordance with the methods referred to in Topsoil Removal, Stockpiling, and Importing Specification 00.210.02115.

Sampling and Analysis

The following criteria will be used in performing the inspection of topsoil for suitability and shall be consolidated into the actual attachments used for the project in the form of acceptance criteria.

Topsoil shall be inspected at a rate of at least one sample for every 1,000 cubic yards prior to stockpiling. Imported topsoil shall be inspected at a rate of at least one sample for every 500 cubic yards delivered. Topsoil shall additionally be inspected at a rate of at least one sample for every 5,000 square yards prior to placement on the disposal cells or backfilled waste pits.

Topsoil shall appear naturally friable and free of objectionable material and generally free of stones or other foreign objects larger than one inch.

Inspections

Inspections will be performed by the QA/QC Manager or his designee to ensure compliance with criteria stipulated in the above-referenced specification on topsoil. The QA/QC Manager will direct all topsoil inspection. He will review all results submitted by testing personnel, assure that failing tests are backed up with acceptable tests after corrective work has been performed, and ensure completion of Topsoil Inspection Checklists.

Documentation

The QA/QC Manager will maintain topsoil inspection results, will ensure that topsoil stockpile locations are adequately documented, and will compile the Topsoil Inspection Checklists.

A copy of all documentation will be maintained by the Site Construction Manager in the site office. The certification of completion report will contain separate QA sections that summarize information collected and corrective action taken during the project.

☐ Rework Required

TOPSOIL INSPECTION CHECKLIST

Location	Material Source
Drawing No.	Specification No.

This form is to be completed by the Inspector on a daily basis whenever this work is being performed.

	Acceptable		*Acceptable*
STOCKPILE TOPSOIL	☐	FINISH GRADING	☐
IMPORTED TOPSOIL	☐	TESTING PREPARATION ACCEPTABLE RESULTS	☐
TOPSOIL PLACEMENT	☐		
INSPECTION FREQUENCY	☐		

REMARKS

INSPECTOR	DATE

Instruction for Completing Inspection Checklist

1. Describe physical locations of compaction test.
2. List applicable Construction Drawings and Specifications.
3. Determine if item is or is not acceptable.
4. Document pertinent conversation with contractors or testing agency and explain/clarify an of the above attributes.
5. Sign and date when completed.

Clay Cap Construction

This procedure applies to the inspection of clay cap placement conducted during Phase I of the Remediation Project. Inspections will be performed in accordance with the methods referred to in Earthwork Specification 000.210.02200. Locations of the inspection survey points will be marked on Construction Drawings for later reference and documentation.

Sampling and Analysis

Final grade elevations of both compacted treated waste and the clay cap shall be surveyed on a grid pattern of 100-ft x 100-ft over the entire cell. The surveyed elevations will be subtracted to determine the clay cap thickness. Clay cap shall be acceptable if the thickness is no less than twenty-four inches.

Inspections

Inspections will be performed by the QA/QC Manager or his designee to ensure compliance with criteria stipulated in the above-referenced specification on earthwork. The QA/QC Manager will direct inspection and surveying work performed for clay cap construction. He will review all results submitted by testing personnel, assure that failing tests are backed up with acceptable tests after corrective work has been performed, and ensure completion of Clay Cap Inspection Checklists.

Documentation

The QA/QC Manager will maintain clay permeability test and inspection results, will ensure that permeability sample and test locations are adequately documented, and will compile the Clay Cap Inspection Checklists.

A copy of all documentation will be maintained by the Site Construction Manager in the site office. The certification of completion report will contain separate QA sections that summarize information collected and corrective action taken during the project.

☐ Rework Required

CLAY CAP INSPECTION CHECKLIST

Location	Material Source
Drawing No.	Specification No.

This form is to be completed by the Inspector on a daily basis whenever this work is being performed.

	Acceptable		*Acceptable*
GRID PATTERN	☐	MOISTURE CONTROL	☐
SURVEY ELEVATION TREATED WASTE	☐	LIFT PREPARATION	☐
SURVEY ELEVATION CLAY CAP	☐	FINISH GRADING	☐
COMPACTION METHOD	☐	TESTING COMPLETE AND ACCEPTABLE RESULTS	☐

REMARKS

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INSPECTOR	DATE

Instruction for Completing Inspection Checklist

1. Describe physical locations of compaction test.
2. List applicable Construction Drawings and Specifications.
3. Determine if item is or is not acceptable.
4. Document pertinent conversation with contractors or testing agency and explain/clarify an of the above attributes.
5. Sign and date when completed.

Passive Groundwater Drainage System

This procedure applies to the installation of the passive groundwater drainage system constructed during Phase I of the Remediation Project. Inspections will be performed in accordance with the methods referred to in Excavation, Backfill, and Compaction for Underground Piping Specification 000.210.02224.

Sampling

Visual observation of the construction of the passive groundwater drainage system will be continuous. Spot surveys will be made for flow line elevations at all changes of grade in the drain system and at 100-foot intervals along the drain pipe. Surveyed elevation for the drain collection system will be acceptable if they are no greater than design elevations and up to plus 0.5 foot deeper as indicated on the Construction Drawings. Survey elevations for the drain pipe will be acceptable if they are within ± 0.1 foot of design elevations.

Items that will be noted during the observation of construction include:

- Geotextile overlapped and placed according to the specifications and manufacturers recommendations.
- Suitable aggregate, drainpipe sand bedding, slopewalls constructed to elevations as shown in Construction Drawings.
- All construction as indicated on the Construction Drawings and Specifications.
- Sand bedding compacted to the satisfaction of the QA/QC Manager or his designee.

Inspections

Inspections will be performed by the QA/QC Manager or his designee to ensure compliance with the criteria stipulated the in above-referenced specification. the QA/QC Manager will direct the inspection and survey of the passive groundwater drainage system. He will review all results submitted by survey personnel, assure that inadequate results are backed up with acceptable surveys after corrective work has been performed, and assign completion of Passive Groundwater Drainage System Inspection Checklists.

Documentation

The QA/QC Manager will maintain drainage system inspection results, will ensure that survey locations are adequately documented, will ensure that finished grade elevations allow free drainage along the trench, and will compile the Passive Groundwater Drainage System Inspection Checklists.

A copy of all documentation will be maintained by the Site Construction Manager in the site office. The certification of completion report will contain separate QA sections that summarize information collected and corrective action taken during the project.

☐ Rework Required

PASSIVE GROUNDWATER DRAINAGE SYSTEM INSPECTION CHECKLIST

Location	Material Source
Drawing No.	Specification No.

This form is to be completed by the Inspector on a daily basis whenever this work is being performed.

	Acceptable		*Acceptable*
GEOTEXTILE INSTALLATION	☐	SLOP WALL CONSTRUCTION	☐
AGGREGATE PLACEMENT	☐	BULKHEAD CONSTRUCTION	☐
DRAIN PIPE BEDDING PLACEMENT	☐	FINISH GRADING	☐
FLOWLINE ELEVATIONS	☐	TESTING COMPLETE AND ACCEPTABLE RESULTS	☐

REMARKS

INSPECTOR	DATE

Instruction for Completing Inspection Checklist

1. Describe physical locations of compaction test.
2. List applicable Construction Drawings and Specifications.
3. Determine if item is or is not acceptable.
4. Document pertinent conversation with contractors or testing agency and explain/clarify an of the above attributes.
5. Sign and date when completed.

Rehabilitation/Final Grading

This procedure applies to the rehabilitation of excavated pits and final grading work conducted during Phase I of the Remediation Project. Inspections will be performed in accordance with methods referred to in Earthwork Specification 000.210.02200. Disposal cell and former waste pit areas, as well as areas that has been used to stockpile topsoil or backfill, shall be inspected. Anomalies will be marked on Construction Drawings for reference and documentation.

Sampling and Analysis

Final grade will be checked by surveying on a 100-ft x 100-ft grid pattern for all excavated or backfilled areas. Surveys should be coordinated with survey work being performed for clay cap inspection. Where minor grading has been performed in areas otherwise undisturbed and final grade is not critical, survey will not be required.

Final grades will be acceptable if they generally conform to the Construction Drawings. Rehabilitation grades will be acceptable if grading is smooth and gentle with no sharp breaks or turns.

Inspections

Inspections shall be performed on a daily basis as needed during final grading work. Inspections will be performed by the QA/QC Manager or his designee to ensure compliance with criteria stipulated in the above-referenced specification on earthwork.

The QA/QC Manager will direct the inspection and survey of final grading work. He will review all results submitted by surveying personnel, assure that surveys are backed up with acceptable surveys after corrective work has been performed, and ensure completion of Rehabilitation/Final Grading Inspection Checklists.

Documentation

The QA/QC Manager will maintain inspection results, will ensure that survey locations are adequately documented, and will compile the Rehabilitation/Final Grading Inspection Checklists.

A copy of all documentation will be maintained by the Site Construction Manager in the site office. The certification of completion report will contain separate QA sections that summarize information collected and corrective action taken during the project.

☐ Rework Required

REHABILITATION/FINAL GRADING INSPECTION CHECKLIST

Location	Material Source
Drawing No.	Specification No.

This form is to be completed by the Inspector on a daily basis whenever this work is being performed.

	Acceptable		*Acceptable*
FINAL GRADE SURVEY	☐	FINISH GRADING	☐
GRID PATTERN	☐	TESTING COMPLETE AND ACCEPTABLE RESULTS	☐
FINAL APPEARANCE	☐		

REMARKS

INSPECTOR	DATE

Instruction for Completing Inspection Checklist

1. Describe physical locations of compaction test.
2. List applicable Construction Drawings and Specifications.
3. Determine if item is or is not acceptable.
4. Document pertinent conversation with contractors or testing agency and explain/clarify an of the above attributes.
5. Sign and date when completed.

AUDITS

A system audit of field procedures will be conducted by the QA/QC Manager and the Environmental/Laboratory Manager as necessary. At least one unscheduled field audit will be performed within each six-month period by the QA/QC Manager during the course of the remedial action. The Owner or his designee and the Project QA/QC Manager will ensure that the audit is performed in accordance with approved procedures. The audit will include a review of sampling methodology and sample chain-of-custody documentation, field data, reporting methods, and field data files.

Copies of the audit report will be issued to the Site Construction Manager, the Environmental/Laboratory Manager, the construction contractor, the Project Manager, and the Vice President of KM Environmental Operations. Should a need for corrective action be indicated, the Site Construction Manager will determine appropriate actions, will implement the actions, and will issue a QA/QC Audit Compliance Report on the measures he has taken. The QA/QC Audit Compliance Report will be sent to the same distribution list as the Audit Report.

SECTION 5
AIR MONITORING PLAN

- *Objectives*
- *Emissions Criteria*
- *Air Monitoring Equipment and Locations*
- *Monitoring Procedures*

OBJECTIVES

The objectives of the air monitoring plan are as follows:

- Provide guidelines and procedures for air monitoring while maintaining operational flexibility.

- Provide guidelines for response actions to be implemented during construction activities to avoid exceeding emission criteria.

- Provide guidelines for selection of air monitoring equipment and monitoring locations.

- Provide procedural guidelines for documentation of compliance with emission criteria specified in the Record of Decision (ROD).

EMISSIONS CRITERIA

As stipulated in the ROD, "excavation and/or treatment of acidic sludge shall be conducted so as to minimize emissions of dust and sulfur dioxide." During remediation activities, air quality levels must comply with limits for two parameters, particulate matter (PM-10) and SO_2. Work practices will be modified as necessary to maintain compliance. Emission levels for PM-10 and SO_2 are as follows:

- Particulate Matter (PM-10) - Average emission levels at the site boundary (property line) shall not exceed 150 micrograms per cubic meter over a 24 hour averaging period. Federal National Ambient Air Quality Standards (NAAQS) also limit the annual arithmetic mean to 50 micrograms per cubic meter.

- Sulfur Dioxide - The ROD limits SO_2 emissions to 0.5 ppm over a three hour averaging period. Federal NAAQS regulations specify limits of 0.14 ppm over a 24 hour average and an annual arithmetic mean of 0.03 ppm.

AIR MONITORING EQUIPMENT AND LOCATIONS

Two monitoring systems will be employed during the pit remediation project to ensure compliance with emission criteria:

- Fixed property line monitors, and
- Portable exclusion zone monitors.

Fixed Property Line Monitors

Fixed monitors will typically operate 24 hours per day. Four fixed units will be employed, one of which will be upwind of the construction activities to provide background data. The units will be located as shown on Construction Drawing 832100-10T-02, General Site and

Topo Map, contained in Appendix B. The four monitors will be relocated as shown in the Drawing as work progresses from pit to pit.

Real time SO_2 monitoring will be coupled with real time or standard high-volume samplers for 24-hour time weighted average PM-10 measurements. Minimum detection levels for SO_2 at the perimeter monitors will be less than 0.03 ppm. Minimum detection levels for PM-10 will be 10 micrograms per cubic meter.

Exclusion Zone Monitors

Portable instruments will be used to monitor SO_2 and PM-10 as an indication of emission conditions which may necessitate work practice modifications. Monitoring locations will be in the predominant downwind direction from the pit remediation work. Locations will be selected based on planned work areas and on daily meteorologic conditions.

The portable SO_2 analyzer will have a minimum level of detection for SO_2 of 0.1 ppm. Direct reading hand-held PM-10 analyzers such as the MIE Miniram or the Environmental Devices Model HD1001 will be used. The minimum level of detection for the PM-10 monitor will be 10 micrograms per cubic meter. Should direct monitoring of PM-10 prove ineffective, an analyzer measuring total particulates will be employed. Results from the hand-held particulate analyzer will be correlated with readings from the fixed PM-10 property line monitors.

MONITORING PROCEDURES

The following information and procedures provide quality assurance/quality control and data management requirements for the emission monitoring program.

Exclusion Zone

Monitoring within or near the exclusion zone will be continuous during waste treatment activities. Monitoring will be performed by a qualified monitoring technician. Readings taken by the technician will be recorded at regular intervals as field activities dictate, however, three hours is to be the maximum time between recorded readings during treatment activities.

Corrective action will be implemented if emission levels for particulates or SO_2 indicate that property boundary emission criteria may be exceeded. The monitoring location, i.e. distance of the monitors from the treatment process will determine the action levels for particulate (PM-10) or SO_2.

A proposed approach to specify exclusion zone action levels has been developed using SO_2 dispersion modelling for the Cushing site. The approach will be implemented to set action levels during initial waste treatment at the site and will be correlated with readings from the fixed property line monitors to ensure emission criteria are met.

Dispersion modelling, performed by Radian Corp. for KMC, is reflected in Table 5-1 as a series of action level SO_2 concentrations. Distance from the exclusion zone monitor to the actual remediation activity is shown along the top row of the table. Possible SO_2 readings from the portable analyzer are shown on the far-left column of the table. The intersection

of the exclusion zone monitor distance and SO_2 concentration column and row, respectively, shows the projected distance downwind from the treatment area where the SO_2 concentration will be 0.5 ppm or less. For example, if the exclusion zone monitor is 33 feet downwind of treatment activities and shows an SO_2 concentration of 2 ppm, the projected distance downwind for 0.5 ppm SO_2 levels is 323 feet.

The table assumes "Class D air stability" or moderate straight-line winds. Other charts generated for air stability classes A, B, and C show shorter distances to achieve the 0.5 ppm concentration. Use of the Class D chart is, therefore, the most conservative approach.

Response action levels will be developed daily in the field based on Table 5-1 and the distance to the nearest potential receptor off-site. Air quality readings will result in one of the three following conditions:

- Level 1-A No action required, readings within acceptable range, maintain normal monitoring.

- Level 1-B Treatment activities to be modified, readings above established action levels, increase the level of surveillance.

- Level 1-C Treatment activities cease, non-compliance appears imminent, re-evaluate activities to reduce emissions.

Property Boundary

Monitoring at the property line will typically be maintained on a 24 hour basis. This will provide required data to document compliance with emission criteria as previously discussed. The monitoring will also allow response activities if emission levels indicate potential to exceed emission criteria.

Monitoring will be performed by a qualified monitoring technician. At a minimum, a summary of readings for each 15 minute period during the day will be obtained from the four SO_2 monitors. Data will be recorded at the conclusion of work each day. If high-volume samplers are used for PM-10 monitoring, samples will be collected daily and submitted for analysis. If continuous real-time PM-10 analyzers are used, data will be collected at the same frequency as for SO_2.

Response activities for potential non-compliance will be developed in the field. The response actions will be divided into three conditions:

- Level 2-A No action required, readings within acceptable range, maintain normal monitoring.

- Level 2-B Waste treatment activities to be modified, readings above action levels, increase surveillance.

- Level 2-C Treatment activities cease, non-compliance imminent, re-evaluate work activities to reduce emissions.

Table 5-2 has been developed to supplement initial action and alert level decisions. An 80 percent emission level has been provided which corresponds to Level 2-B alert status. These initial figures may be modified as actual monitoring data become available.

Meteorological Monitoring

A fixed, meteorologic tower will be located on-site in close proximity to the work area. The tower will be used to support wind speed and direction sensors. A temperature sensor will be installed in a location unaffected by site activities and not in direct sunlight. Signals from the sensors will be transmitted to a multi-channel data logger which will store and compile the incoming data. Monitoring will be performed on a continuous basis with hourly averages of each parameter generated and stored. Data will be down-loaded for hard copy reporting at regular intervals as specified.

Quality Assurance/Quality Control for Monitor Units

Monitoring units will be maintained and calibrated in accordance with manufacturers specifications. Daily equipment checks will be performed. A minimum of one back-up unit will be available on-site for each type of perimeter and exclusion zone analyzer unit in the event of a unit failure.

Monitoring Data Management

A qualified monitoring technician will be responsible for documenting the air monitoring data. This will include the collection, reporting, and storage of all air emission data and visual observations which occur during the construction activities. An air monitoring logbook will be prepared for this phase of the remediation project. The daily air monitoring activities will be recorded in the logbook and should include the following information:

- Alert Condition(s) and corresponding times
- Corrective action(s) taken.

Reports will be forwarded to the Site Construction Manager, Environmental/Laboratory Manager and the Quality Assurance/Quality Control Manger.

TABLE 5-1

Allowed Distance (feet) from Remediation Location to Site Boundary as a Function of Monitored Concentration and Distance from Remediation Location and Monitor Location -- D Stability Class

Monitored Conc. (ppm)	*Distance from Remediation Source (ft/meters)*									
	33/10	*66/20*	*98/30*	*131/40*	*164/50*	*197/60*	*230/70*	*263/80*	*295/90*	*328/100*
5	594	630	697	777	852	928	1016	1122	1225	1328
4.5	563	598	651	727	802	878	957	1052	1154	1254
4	528	563	616	672	746	822	901	976	1076	1175
3.5	488	524	576	626	683	759	838	913	986	1085
3	442	478	530	580	627	686	765	840	913	983
2.5	388	423	476	526	573	621	679	754	826	896
2	323	357	409	459	506	554	604	651	721	791
1.5	261	286	325	374	421	468	518	565	611	655
1	179	203	238	273	307	348	397	445	490	535
0.5	33	66	98	131	164	197	230	263	295	328

TABLE 5-2

Action and Exceedance Levels

Reading Interval (Hours)	*Dust Levels*		*Sulfur Dioxide Levels*			
	ug/m³ / Time Interval		*ppm/Time Interval (for 3-hr Criteria)*		*ppm/Time Interval (for 24-hr Criteria)*	
	80%	*Exceedance*	*80%*	*Exceedance*	*80%*	*Exceedance*
0.25	11,520	14,400	4.80	6.00	10.75	13.44
0.50	5,760	7,200	2.40	3.00	5.38	6.72
1.00	2,880	3,600	1.20	1.50	2.69	3.36
1.50	1,920	2,400	0.80	1.00	1.79	2.24
2.00	1,440	1,800	0.60	0.75	1.34	1.68
2.50	1,152	1,440	0.48	0.60	1.07	1.34
3.00	960	1,200	0.40	0.50	0.90	1.12
3.50	823	1,029	n/a	n/a	0.77	0.96
4.00	720	900	n/a	n/a	0.67	0.84
4.50	640	800	n/a	n/a	0.60	0.75
5.00	576	720	n/a	n/a	0.54	0.67
5.50	524	655	n/a	n/a	0.49	0.61
6.00	480	600	n/a	n/a	0.45	0.56
6.50	443	554	n/a	n/a	0.42	0.52
7.00	411	514	n/a	n/a	0.34	0.48
7.50	384	480	n/a	n/a	0.36	0.45
8.00	360	450	n/a	n/a	0.34	0.42
24.00	120	150	n/a	n/a	0.11	0.14

SECTION 6
POST-CLOSURE MONITORING PLAN

- *Functions and Objectives*
- *Routine Inspection and Maintenance*
- *Groundwater Quality Monitoring*

FUNCTIONS AND OBJECTIVES

The Post Closure Monitoring Plan consists of two major functions which are to be performed over specific periods of time. These two functions involve:

- Routine inspection and maintenance of the site
- Groundwater quality monitoring at the site.

The objectives are:

- Provide functional guidelines and procedures for monitoring site conditions and groundwater quality for compliance with State and Federal regulations.
- Provide guidelines for inspection and corrective actions.
- Provide procedural guidelines for documenting compliance with State and Federal regulation for post-closure monitoring.

ROUTINE INSPECTION AND MAINTENANCE

Subsequent to closure of the disposal cells, it will be necessary to ensure that they are maintained and that the modified terrain does not develop erosion features. To accomplish these goals, routine inspections and maintenance activities will be performed on a periodic basis.

Inspection and Maintenance Period and Schedule

Post-closure monitoring will be preformed for a minimum of eight years. Consequently, inspection and maintenance, being part of the post-closure process, will also be performed for a minimum of eight years. Inspection results during that period may indicate a need for continued monitoring beyond the initial eight years.

Routine inspections will begin the first month following the final construction inspection. They will continue every three months for the first year, and every six months for the remainder of the post-closure program. Maintenance, if determined to be required by inspection, will be performed during the same period and as soon as is reasonably possible.

Inspection and Maintenance Activities

There will be two major concerns addressed during the inspection process: The physical condition of the disposal cells and the physical condition of the groundwater monitoring facilities. The inspections will provide for a complete evaluation of both and will recommend appropriate maintenance action if needed.

Disposal Cells

The disposal cells will be inspected for obvious anomalies or conditions which appear unacceptable. These include, but are not limited to, excessive settling, excessive erosion features, or damage from vehicular traffic. Excessive settling is any settling that results in ponding of water either on or adjacent to the cell. Excessive erosion features are rills and/or small gullies in excess of 3 inches deep, or any obvious washout of topsoil and vegetative cover either on or in close proximity to the cell. The final cover will also be inspected for excessive scrub growth (weeds, bushes, saplings) or damage to the final vegetative cover.

Where repair is required, clean fill material and top soil will be used for restoration to grade. The repaired area will be slab sodded. Where excessive scrub growth is existent, it will be cleared, relayered with clean top soil, and slab sodded.

Overall maintenance of the disposal cell will consist of routine mowing to maintain a 4-inch stand of grass. The mowing should be performed routinely to minimize scrub growth. Fertilizer and water may be applied, as necessary, for the first year to encourage strong vegetative growth.

Groundwater Monitoring Facilities

Groundwater monitor wells and related equipment will be inspected for physical damage which may be caused by mowing or other activities. Damage to the facilities will be noted and repaired as soon as is reasonably possible.

GROUNDWATER QUALITY MONITORING

Subsequent to disposal cell closure, groundwater monitoring wells will be installed and periodically sampled to detect migration of waste constituents in groundwater during the post-closure monitoring period.

Sampling Schedule

The initial sample event will begin occurring within 30 days following the closure of each cell and final inspection. Groundwater sampling and analysis will be performed quarterly for the first year after cell closure. Continued sampling and analysis will be performed semi-annually for the remainder of the post-closure monitoring period.

Groundwater Sampling

Groundwater samples will be obtained from groundwater monitor wells (reference Drawing 832100-10T-04) and, if flowing, the outflow drain pipes for the passive groundwater drainage system. For each location, results from the first five sample events will form the background (baseline) data with which to compare future sampling results. All sampling and analysis will be performed in accordance with the procedures and specifications stipulated in the Sampling and Analysis Plan for the Kerr-McGee Refining Corporation, Cushing, Oklahoma, March 29, 1991.

Groundwater will be sampled for the parameters listed in Table 6-1. These constituents, herein referred to as "general water quality parameters," proved to be the only reliable indicators of impact from the acid waste pits during the Phase I Remedial Investigation. The treated waste contains low concentrations of organic compounds and extremely low levels of heavy metals. Both organic and inorganic analysis of leachate indicates that these compounds will not be identified in the groundwater around the disposal cells. However,

certain ions (such as sulfates) exist in the treated waste in significant concentrations. For this reason, the general water quality parameters are anticipated to be the most reliable indicators of leachate impact to groundwater.

REPORTING

Routine Inspection and Maintenance

The attached checklist summarizes visual observations to be made during inspection of the disposal cells and the groundwater monitoring facilities. It will provide the basis for both the field record and the report of routine inspections. Observations included in inspection reports will include noting the performance of maintenance recommended as a result of the previous inspection. Completed checklists will be submitted to the Oklahoma Department of Environmental Quality (ODEQ) within 30 days of the inspection.

Groundwater Quality Monitoring

Groundwater analytical results will be submitted to the ODEQ within 30 days of receipt of the data. A report on the baseline data will be submitted to the ODEQ within 60 days of receipt of the fifth set (1 year following closure) of analytical data. Subsequent groundwater quality monitoring reports will be submitted within 30 days of receipt of the data from semi-annual groundwater sampling events.

Groundwater quality monitoring reports will include groundwater elevation data, a potentiometric surface map, field parameter forms, chain of custody logs, groundwater analytical results, and a comparison of recent data with historical and baseline data. If data indicates a groundwater impact from the treated wastes, KMC will propose additional monitoring or a groundwater assessment program to assess the extent and severity of impact.

TABLE 6-1
PARAMETERS AND ANALYTICAL METHODS

Parameter	*EPA-600 Analytical Method*
pH	Field Measured
Conductivity	Field Measured
pH	150.1
Total Petroleum Hydrocarbon	413.1
Bicarbonate	SM 403
Sodium	273.1
Sulfate	375.3
Inorganic Chloride	325.5
Potassium	258.1
Calcium	215.1 or 215.2
Magnesium	242.1

SM - Standard Methods, 40 CFR Part 300.

EPA Methods - Methods for Chemical Analysis of Water and Wastes, US EPA, March 1983 (EPA-600)

☐ Rework Required

ROUTINE MAINTENANCE INSPECTION CHECKLIST

Location	Disposal Cell A or B

This form is to be completed by the inspector on a daily basis whenever this work is being performed.

DISPOSAL CELL INSPECTION

	Yes	No
VEGETATION HEALTHY	☐	☐
EXCESSIVE SCRUB GROWTH	☐	☐
EXCESSIVE SETTLEMENT	☐	☐
EXCESSIVE EROSION	☐	☐
MOWING REQUIRED	☐	☐
DRAINPIPE SLOPEWALLS - DAMAGED	☐	☐

MONITOR WELLS INSPECTION

	Yes	No
CONCRETE PAD DAMAGED	☐	☐
PROTECTOR PIPE & BUMPER DAMAGED	☐	☐
LOCKED	☐	☐
PAINTING REQUIRED	☐	☐

REMARKS

INSPECTOR	DATE

Instruction for Completing Inspection Checklist

1. Describe location of inspection.
2. List applicable construction drawing and specifications.
3. Identify damage or anomalies.
4. Document completion of inspection by determining yes or no for all items.
5. Sign and date when completed.

APPENDIX A
DESIGN SPECIFICATIONS

SPECIFICATION LIST

KERR-MCGEE CUSHING REMEDIAL DESIGN

DEMOLITION (SURFACE)

This document has been revised as indicated below and described in the revision record on the following page. Please replace all pages of this document and destroy the superseded copies.

Issue History

Revision No.	Originator	Originator's Initials	Date	Pages
A	M. Holmes	MAH	3/3/94	1-5
B	M. Holmes	MAH	3/28/94	1-5
C	M. Holmes	MAH	5/24/94	1-5

New Issue: _____

Revised Sheets Only Attached: _____

Entire Document Re-issued: X

Client:

Issued for Construction:

Project Manager: _____

Date: _____

Fluor Daniel Williams Brothers:

Issued for Construction:

Project Manager: M J Blaker

Date: 5-26-94

DEMOLITION (SURFACE)

DETAILS OF REVISIONS

This document has been revised as follows:

Revision No.	Date	Description
A	3/3/94	Preliminary Issue
B	3/28/94	Bid Issue
C	5/24/94	Construction Issue

DEMOLITION (SURFACE)

1.0 GENERAL

1.1 Summary

A. Scope of Specification

This specification prescribes the removal of existing buildings, structures, abandoned pipelines, and other similar facilities to the extent indicated on the Construction Drawings or elsewhere in the contract documents, and prescribes the proper disposal of the resulting materials and debris.

B. Related Specifications

The following specifications prescribe items of related Work:

- 000.220.01000: General Requirements
- 000.210.02110: Clearing and Grubbing
- 000.210.02115: Topsoil Removal and Stockpiling
- 000.210.02270: Erosion Control

Coordinate Work prescribed by this specification with Work prescribed by the above listed specifications.

1.2 References

The publications listed below form part of this specification. Each publication shall be the latest revision and addendum in effect on the date this specification is issued for construction unless noted otherwise. Except as modified by the requirements specified herein or the details of the Construction Drawings, Work included in this specification shall conform to the applicable provisions of these publications.

A. OSHA (Occupational Safety and Health Administration)

1. OSHA Constructions Industry Standards: Title 29, Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction.

2. API Requirements for Tank Demolition

2.0 PRODUCTS

Not applicable

3.0 EXECUTION

3.1 Preparation

A. Protection

1. Existing Facilities

Protect existing facilities that are to remain in place, that are to be reused, or that are to remain the property of the owner using temporary covers, shoring, bracing, and supports. Repair to the original condition, or replace with new, those items designated by Owner to remain or to be reused that are damaged during performance of the work. Protect structural elements from being overloaded. Provide new supports, braces, or reinforcement for existing facilities weakened by demolition and removal work.

2. Weather Protection

Protect from the weather, at all times, facilities and equipment designated by Owner to remain in place. Maintain temporary coverings to ensure their effectiveness and to prevent their displacement.

3. Protective Barriers

DEMOLITION (SURFACE)

Before starting demolition operations, erect protective barriers around trees and shrubs designated by Owner that are to remain. Barriers shall consist of 4 feet high woven wire fabric fencing supported by steel or wood posts spaced 6 feet on center (maximum). Erect barriers at or outside of the tree or shrub drip line. Do not use the areas within protective barriers for traffic, storage, or any other purpose. Upon completing demolition work, remove and dispose of protective barriers.

B. Dust Control

1. Existing Buildings

Provide dust proof barricades to prevent the intrusion of dust or inclement weather into interiors of existing buildings exposed by the work. Construct barricades using substantially braced framing covered with a suitable polyethylene sheeting material. Remove and properly dispose of barricades when no longer needed (as determined by the owner and construction manager).

2. Airborne Contaminants

During demolition work covered by this specification, take appropriate measures to protect personnel from being injured by airborne contaminants such as asbestos fibers and metal dusts. Such measures shall comply with the requirements of OSHA Construction Industry Standards pertaining to airborne contaminants, and the approved Site Health and Safety Plan.

3. The use of water will not be permitted when it will result in hazardous or objectionable conditions such as pollution, flooding, or unsafe areas.

3.2 Buildings and Structures

General

Buildings and other structures and related appurtenances designated to be removed or demolished shall be completely removed as indicated on the drawings or elsewhere in the contract.

3.3 Utilities and Related Appurtenances

A. General

It is not anticipated that any utility service lines will need to be removed.

B. Abandonment of Utilities

Purge, clean, fill, or terminate utility pipelines that are to be abandoned in a manner conforming to the requirements of the nationally recognized code covering the specific utility; and as indicated on the drawings, in these specifications, and elsewhere in the contract documents. Bring conflicts between code requirements and the contract documents to the attention of the Owner, for resolution.

C. Disconnecting Utilities

When demolition or abandonment work requires the disruption or interruption of service or disconnection of a service connection, coordinate such work with the affected utility supplier to ensure that proper measures are taken to protect the utility from damage. Owner shall also be informed of these interruptions.

3.4 Explosives

Using explosives will not be permitted.

3.5 Burning

Burning debris and rubbish on the owner's property will be permitted. The Owner will designate areas for burning debris. When permitted, burning shall strictly comply with applicable Federal, State, and local regulations.

DEMOLITION (SURFACE)

3.6 Salvage

Owner reserves the right to keep identified materials and equipment scheduled to be demolished or removed. Remove other such materials and equipment from the site.

3.7 Safety Requirements

Perform demolition in accordance with applicable requirements of the OSHA Construction Industry Standards.

3.8 Cleanup

Project site materials, rubbish and other debris will be disposed of on-site as directed by the owner.

3.9 Regulations

Local regulations regarding hauling and disposal shall apply.

4.0 ATTACHMENTS

Not applicable

End of Specification

CLEARING AND GRUBBING

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New Issue: _____

Revised Sheets Only Attached: _____

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Project Manager: _____

Date: _____

Fluor Daniel Williams Brothers:

Issued for Construction:

Project Manager: M J Blaker

Date: 5-26-94

CLEARING AND GRUBBING

DETAILS OF REVISIONS

This document has been revised as follows:

Revision No.	Date	Description
A	3/3/94	Preliminary Issue
B	4/18/94	Bid Issue
C	5/24/94	Construction Issue

CLEARING AND GRUBBING

1.0 GENERAL

1.1 Summary

A. Scope of Specification

This specification prescribes the complete removal and proper disposal of trees, brush, roots, fences, pavements, surface rocks and boulders, and other objects resting on or protruding through the surface of areas to be cleared or cleared and grubbed that are designated on the Construction Drawings or elsewhere in these specifications or other contract documents, except such items that are designated to remain or are designated for demolition according to Demolition (Surface) Specification 000.210.02050.

B. Related Specifications

The following specifications prescribe items of related Work:

- 000.210.02050: Demolition
- 000.220.01000: General Requirements

Coordinate Work prescribed by this specification with Work prescribed by the above listed specifications.

2.0 PRODUCTS

Not applicable

3.0 EXECUTION

3.1 Protection

A. General

Avoid damage to the site and to existing facilities, trees, and shrubs designated by the owner to remain. Cleared and grubbed material shall be decontaminated and disposed in accordance with Specification 000.230.02230, if necessary.

B. Monuments

1. Protect benchmarks, baseline monuments, property corners, and other temporary or permanent survey markers in the vicinity of the work from destruction or disturbance. Accurately restore at the earliest practical date any markers destroyed or disturbed.

2. Within the area to be cleared, properly relocate survey markers that interfere with the work, or witness the markers and then restore them after completing the work. Perform survey marker relocation or restoration work under the direct supervision of a registered land surveyor.

C. Protective Barriers

Before starting clearing operations, erect protective barriers around trees, shrubs, and other facilities designated by Owner to remain. Barriers shall consist of 4 feet high woven wire fabric fencing supported by steel or wood posts spaced 6 feet on center (maximum). Erect barriers at or outside of the tree or shrub drip line. Do not use the area within protective barriers for traffic, storage, or any other purpose. After clearing and grubbing work is complete, remove and dispose of protective barriers.

3.2 Clearing

Remove trees, brush, stumps, rubbish, and other debris and vegetation resting on or protruding through the surface of areas to be cleared and grubbed. In areas to be cleared only, cut off flush with or below the surface vegetation that is protruding through the ground surface.

CLEARING AND GRUBBING

3.3 Grubbing

In areas to be grubbed, remove the following materials to a depth of no less than 12 inches below the original ground surface: roots; stumps; and other debris, brush, and refuse embedded in or protruding through the ground surface. Rake, disk, or plow the area to a depth of no less than 6 inches, and remove to a depth of 12 inches all roots and other debris thereby exposed.

3.4 Solid Waste Disposal

Cleared and grubbed material will be disposed either by burning, salvage, or land disposal.

A. Burning

Burning on the Owner's property, at a location approved by the owner, will be permitted for biodegradable solid waste; waste such as wood, roots, weeds, and grass. Burning shall strictly comply with applicable Federal, State and local regulations.

B. Salvage

Owner reserves the right to keep cleared and grubbed material stockpiled, at a location designated by the owner, material the owner wishes to keep.

C. Land Disposal

Non-biodegradable cleared and grubbed material such as concrete, steel, boulders, and fencing may be placed in the on-site disposal cell upon approval by the Owner. Otherwise, remove from the site. Off site disposal of solid waste shall strictly comply with applicable Federal, State, and local regulations.

3.5 Smoothing of Terrain

After clearing and grubbing have been completed, eliminate stump holes, depressions, ridges, and other irregular surface features by grading and backfilling to achieve a surface suitable for subsequent construction operations. Shape the resulting surface for positive drainage of surface runoff. Backfill as necessary by filling holes and depressions with suitable material obtained within the Work area and by compacting to a density equal to or greater than that of the surrounding undisturbed soil. Areas to be excavated immediately after clearing and grubbing is complete need not be smoothed.

4.0 ATTACHMENTS

Not applicable

End of Specification

TOPSOIL REMOVAL, STOCKPILING AND IMPORTING

This document has been revised as indicated below and described in the revision record on the following page. Please replace all pages of this document and destroy the superseded copies.

Issue History

Revision No.	Originator	Originator's Initials	Date	Pages
A	M. Holmes	MAH	3/3/94	1-4
B	M. Holmes	MAH	4/8/94	1-4
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TOPSOIL REMOVAL, STOCKPILING AND IMPORTING

DETAILS OF REVISIONS

This document has been revised as follows:

Revision No.	Date	Description
A	3/3/94	Preliminary Issue
B	4/8/94	General Revision per client Comments
C	5/24/94	Construction Issue

TOPSOIL REMOVAL, STOCKPILING AND IMPORTING

1.0 GENERAL

1.1 Summary

A. Scope of Specification

This specification prescribes the requirements for removal and for stockpiling of topsoil for later use. Also prescribed are requirements for imported topsoil if required.

B. Related Specifications

The following specifications prescribe items of related Work:

- 000.210.02110: Clearing And Grubbing
- 000.220.01000: General Requirements
- 000.210.02200: Earthwork
- 000.210.02270: Erosion control

Coordinate Work prescribed by this specification with Work prescribed by the above listed specifications.

C. Terminology

The following term is defined as stated, unless otherwise indicated:

1. Topsoil

Natural, friable, fertile, fine, loamy soil and generally representative of agriculturally productive soil in the vicinity of the jobsite. Topsoil shall be free from objectionable material that would hinder plant growth or maintenance and shall not contain more than 5 percent by volume of stones, or other foreign objects larger than 1 inch in any dimension.

2. Imported Topsoil

Soil which has been obtained from offsite or has been generated on site which meets the definition of topsoil.

1.2 References

The publications listed below form part of this specification. Each publication shall be the latest revision and addendum in effect on the date this specification is issued for construction unless noted otherwise. Except as modified by the requirements specified herein or the details of the Construction Drawings, Work included in this specification shall conform to the applicable provisions of these publications.

A. ASTM (American Society for Testing and Materials)

1. ASTM D2488: Standard practice for description and identification of soils (visual manual procedure).

2.0 PRODUCTS

Not applicable.

3.0 EXECUTION

3.1 Preparation

Before topsoil removal operations begin, clear and grub according to Clearing and Grubbing Specification 000.210.02110.

3.2 Removal

Remove materials only to such depth that it meets the definition of topsoil. Avoid mixing topsoil

TOPSOIL REMOVAL, STOCKPILING AND IMPORTING

with subsoil or other undesirable materials.

3.3 Stockpiling

Place the removed topsoil in stockpiles. Topsoil stockpiles shall be separate from other stockpiled materials. Stockpiles shall be neatly shaped and free draining, with sides sloped at 4 horizontal to 1 vertical or flatter and other surfaces sloped 2 percent or greater, or as otherwise shown on the drawings. Conserve acceptable topsoil from the site sufficiently to cover areas requiring planting.

3.4 Importing

Topsoil required to be imported shall be done on an as needed basis. Imported topsoil shall be approved by the owner and shall be placed where required as soon as reasonably possible after receiving. Short term stockpiling of imported topsoil will need to be approved by the owner. Pending owner's approval, consideration for generating topsoil by placing 12 inches of soil and blending top 6 inches with required additions to meet topsoil definition will be acceptable.

3.5 Erosion Control

Subsequent to stockpiling measures for control, prevention and abatement of erosion on accumulation of silt for the stockpile areas shall be installed as required by Erosion Control Specification 000.210.02270.

3.6 Erosion Control

A. Grass Cover

Stockpiles or areas of stockpiles that will not be disturbed for more than 60 days shall be planted with grass in accordance with Erosion Control Specification 000.210.02270. Stockpiles that will not be disturbed for more than one year shall be seeded with permanent grass. Stockpiles that will be relocated or disturbed in less than one year shall be seeded with temporary grass mixtures.

B. Straw Bale Dike

A straw bale dike shall be constructed around the perimeter of each stock pile prior to stockpiling any topsoil. Straw bale dikes shall be adjusted to accommodate stockpiles that become larger than anticipated.

4.0 ATTACHMENTS

Not applicable.

End of Specification

EARTHWORK

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EARTHWORK

DETAILS OF REVISIONS

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EARTHWORK

1.0 GENERAL

1.1 Summary

A. Scope of Specification

This specification prescribes the requirements for excavation, backfill and disposal cell construction required to achieve the site finished grades indicated on the Construction Drawings or otherwise required by the contract documents. Also prescribed are the requirements for the removal, replacement, and disposal of unsuitable materials; the disposal of surplus materials; and the furnishing, placement, and compaction of borrow material.

B. Related Specifications

The following specifications prescribe items of related Work:

- 000.210.02050: Demolition
- 000.210.02110: Clearing And Grubbing
- 000.210.02115: Topsoil Removal, Stockpiling and Importing
- 000.210.02270: Erosion Control
- 000.220.01000: General Requirements
- 000.230.02220: Treated Waste Excavation, Placement and Compaction

Coordinate Work prescribed by this specification with Work prescribed by the above listed specifications.

C. Terminology

The following terms are defined as stated, unless otherwise indicated:

1. Soil Classification Symbols: Symbols based on the Unified Soil Classification System as determined per ASTM D2487 or ASTM D2488 (such as GW, SW, and CH).

2. Satisfactory Fill Material: Soil classified per ASTM D2487 or ASTM D2488 as one of the following:

   - Gravel (GW, GP, GM, GC)
   - Sand (SW, SP, SM, SC)
   - Inorganic lean clay (CL)
   - Inorganic silt (ML)
   - Gravel-silt, gravel-clay, sand-silt, sand-clay mixture containing 5 to 12 percent fines (e.g., GW-CL, SP-ML)

   Satisfactory fill material shall be free from frozen lumps, refuse, stones or rocks larger than 3 inches in any dimension, or other material that might prevent proper compaction or cause the completed fill or embankment to have insufficient bearing capacity for the expected superimposed loads.

3. Unsatisfactory Fill Material: Soil having insufficient strength or stability to carry the loads that will be superimposed on the completed fill without excessive settlement or loss of stability; material containing refuse, frozen lumps, large rocks, debris, or other materials that could cause the fill not to compact; and organic soils (Pt, CH, OL).

4. Cohesive Materials: Soils classified per ASTM D2487 or ASTM D2488 as GC, SC, ML, CL, MH, CH, or materials classified as GM or SM when their fine fraction (material passing a No. 40 sieve) has a plasticity index of 4 or greater.

5. Cohesionless Materials: Soils classified per ASTM C2487 or ASTM D2488 as GW, GP, SW, SP, and materials classified as GM or SM when their fine function (material passing a No. 40 sieve) is nonplastic or has a plasticity index less than 4.

6. Modified Proctor Density: The maximum dry density achieved per ASTM D1557 when testing a sample of material representative of that to be compacted in the field.

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7. Optimum Moisture Content: The moisture content at which the Modified Proctor Density is achieved.

8. Inspection and Testing Agency: The company, partnership, or corporation retained to perform the inspections and tests required to determine and verify compliance of the work with the requirements of this specification.

9. Soils Engineer: The registered professional engineer (or designated representative) who is responsible for evaluating the suitability of the soil and rock materials involved in the work, and for verifying the compliance of the soil related work to the requirements of the specifications.

10. Rock: Solid, homogenous, interlocking crystalline material with firmly cemented, laminated, or foliated masses, or conglomerate deposits that cannot be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also sandstones, shales and large boulders, buried masonry, or other concrete masses (except sidewalks and other pavements and slabs) larger than 1/2 cubic yard in volume.

11. Proof-Rolling: Applying test loads over the surface of a designated area to locate and permit the timely correction of deficiencies in subsurface soils that are likely to adversely affect the performance of the disposal cell.

1.2 References

The publications listed below form part of this specification. Each publication shall be the latest revision and addendum in effect on the date this specification is issued for construction unless noted otherwise. Except as modified by the requirements specified herein or the details of the Construction Drawings, Work included in this specification shall conform to the applicable provisions of these publications.

A. Applicable Codes

1. ASTM (American Society for Testing and Materials)

   a. ASTM D1557: Test Methods for Moisture-Density Relations of Soil and Soil-Aggregate Mixtures using 10-pound Rammer and 18-inch Drop.

   b. ASTM D2487: Standard Test Method for Classification of Soils for Engineering Purposes.

   c. ASTM D2488: Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

   d. ASTM C33: Concrete Aggregate

   e. ASTM C150: Portland Cement

2. OSHA (Occupational Safety and Health Administration)

   a. OSHA Construction Industry Standards, Title 29, Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction.

B. Kerr-McGee Reference Documents

1. Other industrial waste disposal cell site characterization
   Kerr-McGee Cushing Refinery Site

2. Phase I - Remedial Investigation Report
   Kerr-McGee Cushing Refinery Site

3. Phase I - Remedial Design
   Cushing, Oklahoma Refinery Site

1.3 Submittals

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A. **Excavation Safety Plan**

When required by the contract documents, an Excavation Safety Plan shall be submitted for review and approval no less than 10 days before the scheduled date for start of excavation operations. The plan shall indicate the systems, methods, and techniques to be used to ensure that excavation sidewalls will be properly guarded to protect personnel, and existing facilities and structures in the vicinity of the work.

B. **Water Control Plan**

When required by the contract documents, a Water Control Plan shall be submitted for review and approval no less than 10 days before the scheduled date for the start of earthwork operations. The plan shall indicate the methods and techniques to be used for control of water (both surface runoff and groundwater) during Work.

1.4 **Quality Assurance**

A. **General**

An inspection and testing agency will be retained by the Owner, or the Construction Manager to perform field and laboratory testing and soil evaluations to verify compliance of the work with the requirements of this specification and to ensure the achievement of the intents and purposes of the work. The performance or lack of performance of such tests and inspections shall not be construed as granting relief from the requirements of these specifications or the other contract documents.

B. **Earthwork**

Earthwork shall be performed in accordance with Quality Assurance and Quality Control Plan as contained in Phase I Remedial Design document for the Cushing, Oklahoma Refinery Site.

1.5 **Site Conditions**

A. **Existing Geotechnical Conditions**

Existing site geotechnical conditions have been investigated by Kerr-McGee. The reports containing the findings, conclusions, and recommendations resulting from this investigation are by this reference made a part of these specifications. The information contained in the reports shall not be construed as a guarantee of the depth, extent, or character of materials actually present.

2.0 **PRODUCTS**

2.1 **Materials**

A. **Borrow**

Borrow material shall meet the requirements specified herein for satisfactory fill materials.

B. **Portland Cement**

Portland Cement shall be according to ASTM C150, Type I or II.

C. **Sand**

Sand shall be fine aggregate per ASTM C33.

2.2 **Mixtures**

A. **Lean Concrete**

A mixture containing 1 part (by volume) Portland cement, 2 parts sand, and water. The amount of water shall be the minimum necessary to produce a mixture with a consistency suitable for proper placement.

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3.0 EXECUTION

3.1 Examination

A. General

Before starting work, thoroughly examine the site to ascertain conditions under which the work must be performed.

B. Existing Facilities to Remain

Take protective measures to prevent existing facilities within the work area that are not designated for removal from being damaged by the work.

C. Survey Monuments

Locate and protect from damage survey monuments within the work area. Properly relocate or witness any monument that must be disturbed by the work. After completion of the work, restore monument.

3.2 Preparation

A. Preceding Work

Before start of earthwork covered by this specification, complete required preceding work such as:

- 000.210.02050: Demolition
- 000.210.02110: Clearing And Grubbing
- 000.210.02115: Topsoil Removal, Stockpiling and Importing

B. Erosion and Siltation Control, Prevention, and Abatement

Before starting earthwork operations on any particular area of the project site, install measures for the control, prevention, and abatement of erosion and accumulation of silt for that area as required by the Construction Drawings and by Erosion Control Specification 000.210.02270.

C. Slope Stabilization

1. Stabilize the sides of excavations and any other steeply sloped bank as necessary to prevent slope failure or any other earth movement that might injure personnel, or damage existing buildings, structures, or other facilities in the vicinity of the work. The stabilization method employed shall comply with all pertinent requirements of the OSHA Construction Industry Standards and all other applicable Federal, State, and local codes and regulations.

2. Remove sheeting, bracing, and shoring systems employed for slope stabilization as the progress of the work eliminates their need, unless they are permitted or required to remain by other provisions of these specifications or the other contract documents. Carefully remove such systems in a manner that will prevent subsidence or other soil movement that might damage any existing or newly constructed structure or other facility.

D. Existing or Complete Utilities

Use care in moving machinery and equipment over existing or newly installed pipes and utilities during construction so as not to cause damage to completed work. Do not use power-driven equipment to excavate closer than 2 feet from any existing utility or structure. For work immediately adjacent to, or for excavation exposing an existing utility or other structure, use manual or light equipment excavation methods until the obstruction is cleared. Support uncovered pipes and other existing work affected by the excavation until they are properly supported by backfill.

E. Structures and Surfaces

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Protect newly backfilled areas and adjacent structures, slopes, or grades from damage. Repair and re-establish damaged grades and slopes. Protect existing streams, ditches, and other stormwater facilities from silt accumulation and erosion.

3.3 Construction Layout

Unless otherwise stipulated elsewhere in the contract documents, the work covered by this specification shall include the performance of calculations, and the setting of marks and stakes necessary to ensure that the work conforms to the required lines, grades, and dimensions. Relate such layout to the elevation datum, and control reference lines identified on the Construction Drawings or elsewhere in the contract documents.

3.4 Excavation

A. General

1. Remove soil, rock, and other materials as necessary to achieve the finished grades, subgrades, or other limits of excavation indicated. Utilize satisfactory materials resulting from excavation work in the construction of fills and for the replacement of removed unsuitable materials.

2. Stockpile excavated satisfactory materials that are needed for construction of required fills, or for replacement of unsuitables at locations indicated on the Construction Drawings or elsewhere in the contract documents.

3. After pit excavation is completed per Treated Waste Excavation Placement, and Compaction Specification 000.230.02220, recompact materials that are to remain but have been loosened or otherwise disturbed by the excavation operations, to a firm, stable condition, and to a density equal to or greater than the surrounding undisturbed material.

B. Rock Excavation

1. Remove rock encountered in areas requiring excavation using mechanical methods (such as ripping, wedging, or impact) to reduce the rock to manageable sized fragments .

2. Except as otherwise shown, required, or specified, excavate rock within disposal cell liner to a depth of no less than 60 inches below the indicated finished grade. Backfill undercut areas with satisfactory clay placed and compacted in accordance with the requirements for clay liner and cap as indicated in 3.7.

3.5 Ditches, Swales and Channels

Construct new and modified ditches, swales, and channels to conform with the lines, grades, and cross sections indicated on the Construction Drawings or otherwise required by the contract documents. Trim and dress roots, stumps, rock, and other foreign materials exposed by the work to conform with the required surface. Do not overexcavate. Backfill to grade any excessive excavation using either satisfactory materials thoroughly compacted to the density required for fills or place stone or cobble to form an erosion resistant ditch lining.

3.6 Fills

A. General

Construct fills by placing and compacting satisfactory materials in successive, uniform, horizontal lifts of not greater than 8 inches loose thickness. Compact each lift to the specified density before placing materials for the overlying lift.

B. Large Rocks and Boulders

Rocks and boulders exceeding the maximum size allowed in satisfactory fill material may be incorporated into deep fills subject to the following size and depth limitations:

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Depth Below Finished Grade (feet)	Maximum Size Allowable (Inches)
3 to 5	6
Over 5	12

Carefully place oversized rocks and boulders incorporated into fills pursuant to this provision so that no voids are created.

C. Compaction

1. Compact materials placed in fills to no less than 92 percent of Modified Proctor Density (ASTM D1557), except that the top 12 inches of subgrade beneath structurally loaded areas (such as slabs, pavements, foundations, and railroads) shall be compacted to no less than 95 percent of Modified Proctor Density.

2. Adjust the moisture content as necessary to achieve a condition suitable for compaction. For cohesive materials, the moisture content at the time of compaction shall be within 2 percentage points of optimum.

3.7 In Situ Liner and Clay Cap

A. General

1. Liner shall be in situ with a minimum depth of 60 inches from top of final grade to bottom of liner. Depths shall be verified as indicated in 3.7(C).

2. All clays used for disposal cell construction shall have a permeability of 10^{-6} cm/sec or less at 95% standard product density and optimum moisture, a liquid limit of no less than twenty percent (20%), a plastic limit no less than 10 percent (10%), and at least thirty percent (30%) of said soil shall pass a 200-mesh sieve.

3. Before placing the first layer of treated waste, scarify the surface of the bottom of the disposal cell to a depth of no less than 12 inches and then re-compact at optimum moisture content or 2 to 3% less optimum as approved by owner.

4. Objectionable sandstone on unsuitable liner material shall be removed and disposed of as backfill or treated waste as necessary as approved by owner.

B. Cap

1. Construct cap by placing satisfactory clay in successive uniform horizontal lifts of not greater than 8 inches loose thickness. Compact each lift before placing clay for the overlying lift. Clay shall be compacted to 95% Modified Proctor Density at optimum moisture or 2 or 3% less of optimum as approved by Owner. Lifts shall be added until cap thickness is 2 foot thick. Thickness shall be verified as indicated in 3.7(C).

2. Cell cap shall be constructed to grade as shown on Construction Drawings and then all sharp breaks in grade shall be rounded to give a smooth appearance. After rounding, thickness of cell cap shall not be less than 3 foot, (2' clay and 12 inches cover soil).

C. Verification

1. Clay liner depth shall be verified by boring with a 3" auger to a depth of 5 foot. Borings shall be performed on a 100' x 100' grid over the entire cell liner as excavation warrants. Boreholes will be refilled with cement/bentonite grout, hole plug or equivalent.

2. Clay cap thickness shall be verified through surveying on a 100' x 100' grid. Elevations will be shot on compacted treated waste, in place and after final clay cap is in place. The difference between the two elevations shall not be less than two feet.

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3.8 Surface Drainage

Conduct excavation, fill, and backfill operations in such a manner and sequence that proper drainage is maintained at all times in and around the work area. Promptly remove surface waters that become impounded. Remove and replace with satisfactory materials, or stabilize (by drying, or by approved mechanical or chemical amendment methods) materials that become loosened due to exposure to the elements. Waters that have become contaminated shall be handled as stipulated in Treated Waste Excavation, Placement, and Compaction Specification 000.230.02220.

3.9 Soft or Yielding Subgrades

If an area of soft or yielding subgrade is detected during the performance of Work prescribed by this specification, report this condition immediately to the Construction Manager for determination of appropriate corrective action.

3.10 Proof-Rolling

Proof-roll areas required on the construction drawings, or elsewhere in the contract documents, to be proof-rolled with a 15 ton (minimum gross weight), pneumatic-tired roller. Cover the designated areas with a minimum of 2 passes using the roller. Where the width of the area to be proof-rolled is more than 25 percent of the length of the area, make the second pass of the roller in a direction perpendicular to that of the first pass. Proof-rolling operations shall be supervised by the Construction Manager or the designated representative. Correct deficiencies detected by proof-rolling in accordance with the instructions of the Owner.

3.11 Finish Grading

Trim and finish-grade the surface of areas involved in work covered by this specification to generally conform to the Construction Drawings. The resulting surface shall be reasonably smooth and free of ruts, ridges, depressions, and other significant irregularities. Finish ditches so that no ponding occurs. Leave areas designated to be grassed in a condition suitable for subsequent topsoiling, and seeding or sodding operations.

4.0 ATTACHMENTS

Not applicable

End of Specification

EXCAVATION, BACKFILL, AND COMPACTION FOR UNDERGROUND PIPING

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EXCAVATION, BACKFILL, AND COMPACTION FOR UNDERGROUND PIPING

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EXCAVATION, BACKFILL, AND COMPACTION FOR UNDERGROUND PIPING

1.0 GENERAL

1.1 Summary

A. Scope of Specification

This specification prescribes the excavation, bedding, backfilling, and compaction required for installing underground piping, haul road culverts, and the passive groundwater drainage system.

B. Related Specifications

The following specifications prescribe items of related work:

- 000.210.02110: Clearing And Grubbing
- 000.210.02115: Topsoil Removal, Stockpiling and Importing
- 000.210.02270: Erosion Control
- 000.220.01000: General Requirements

C. Terminology

The following terms are defined as stated unless otherwise indicated:

1. Satisfactory Clean Backfill/fill Material - Soil classified per ASTM D2487 or ASTM D2488 as one of the following:

   - gravel (GW, GP, GM, GC)
   - sand (SW, SP, SM, SC)
   - inorganic lean clay (CL)
   - inorganic silt (ML)
   - a gravel-silt, gravel-clay, sand-silt, sand-clay mixture containing 5 to 12 percent fines (e.g., GW-CL, SP-ML)

   Satisfactory clean backfill/fill material shall be free from frozen lumps, refuse, rocks larger than 3 inches in any dimension, or other material that might cause damage to the pipe, prevent proper compaction, or cause the completed backfill/fill to have insufficient bearing capacity for the expected superimposed loads.

2. Unsatisfactory Material - Soil or other material having insufficient strength or stability to carry the loads that will be superimposed on the completed backfill without excessive consolidation or loss of stability; material containing refuse, frozen lumps, large rocks, debris, or other materials that could damage the pipe or cause the backfill not to compact; and organic soils (Pt, OH, OL).

3. Select Backfill Material - Satisfactory backfill material containing no stones or hard particles larger than 1/2 inch in any dimension.

4. Cohesive Material - Soils classified per ASTM D2487 or ASTM D2488 as GC, SC, ML, CL, or materials classified as GM or SM when their fine fraction (material passing No. 40 sieve) has a plasticity index of 4 or greater.

5. Rock - Solid homogenous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, that cannot be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also sandstone, shale and large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume.

6. Unyielding Subgrade - Rock or soil containing large stones (over 3 inches in any dimension) that if allowed to remain at the trench bottom, would likely cause uneven or point loading on the pipe.

7. Unstable Subgrade - Material in the trench bottom that lacks sufficient firmness to maintain the alignment of the pipe, or to prevent joints in the pipe from separating during backfilling. This may be material that is otherwise satisfactory but has been disturbed or is saturated with water.

8. Modified Proctor Density - The maximum dry density achieved per ASTM D1557 when testing a sample of material representative of that to be compacted in the field.

9. Optimum Moisture Content - The amount of moisture requirement for maximum soil density.

10. Relative Density - The degree of compactness of a free draining granular soil with respect to the loosest and densest conditions of the soil as determined by ASTM D4253 and ASTM D4254.

11. Soils Engineer - The registered professional engineer (or designated representative) who is responsible for evaluating the suitability of the soil and rock materials involved in the work, and for verifying the compliance of the soil related work with the requirements of the specifications.

12. Soil Classification Symbols - Where used in this specification, symbols for soil classification (e.g., GW, SW, CH) shall be understood to be the soil classification group symbol based on the Unified Soil Classification System as determined per ASTM D2487 or ASTM D2488.

13. Topsoil - Dark-colored, fine-grained, silty, or sandy material with a high content of well-decomposed organic matter, representative of agriculturally productive soils in the vicinity, that is free from appreciable quantities of hard clods, stiff clay, gravel, brush, large roots, and other deleterious materials.

14. Pipe Embedment Zone - The area of the trench in the immediate vicinity of the installed pipe, including special foundations when required (see pipe bedding details on the drawings), where special materials and construction techniques are required by this specification to ensure proper installation of the pipeline.

15. Load-bearing Subgrade - The soil lying beneath and up to 5 feet outside of the edge of pavements and structures (either existing or to be constructed), and the soil lying within such other limits of load-bearing subgrade as may be indicated on the drawings or elsewhere in the contract documents.

1.2 References

A. Applicable Codes

The publications listed below form part of this specification. Each publication shall be the latest revision and addendum in effect at the time of the project's execution unless noted otherwise. Ex ept as modified by the requirements specified herein or the details of the drawings, all Work included in this specification shall conform to the applicable provisions of these publications.

1. ASTM (American Society for Testing and Materials)

a. ASTM C33: Standard Specification for Concrete Aggregate

b. ASTM D1557: Test Methods for Moisture-Density Relations of Soil and Soil-Aggregate Mixtures using 10-pound Rammer and 18-inch Drop.

c. ASTM D2487: Standard Test Method for Classification of Soils for Engineering Purposes.

d. ASTM D2488: Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

e. ASTM D4253: Standard Test Methods for maximum Index Density of Soils using a Vibratory Table.

f. ASTM D4254: Standard Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.

g. ASTM D1682: Standard Test Methods for Tensil Strength and Elongation of Geotextile.

h. ASTM D751: Standard Test Methods for Puncture Strength of Geotextile.

i. COECW02215: Standard Test Method for Pore Size of Geotextile.

j. ASTM D1505: Standard Test Method for Density.

k. ASTM D1238: Condition E - Standard Test Method for Melt Index.

l. ASTM D638: Standard Test Method for Flex Modules and Tensile Strength.

m. ASTM D1963: Condition C - Standard Test Method for Environmental Stress Crack Resistance.

n. ASTM D2837: Standard Test Method for Hydrostatic Design Basis.

o. ASTM C76: Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.

2. OSHA (Occupational Safety and Health Administration)

a. OSHA Constructions Industry Standards, Title 29, Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction.

1.3 Submittals

A. Trenching Safety Plan

When required by the contract documents, a trenching safety plan shall be submitted for review and approval no less than 10 days before the scheduled start date for trenching. The plan shall indicate the systems, methods, and techniques to be used to ensure that all trench sidewalls will be properly guarded for the protection of personnel and existing facilities and structures in the vicinity of the work.

B. Water Control Plan

When required by the contract documents, a Water Control Plan shall be submitted for review and approval, no less than 10 days before the scheduled date for the start of earthwork operations. The plan shall indicate the methods and techniques to be used for control of water (both surface runoff and groundwater) during the work.

1.4 Quality Assurance

A testing and inspection agency will be retained by the Owner, or the Construction Manager to perform field and laboratory testing and soil evaluations to verify compliance of the work with the requirements of this specification and to ensure the achievement of the intents and purposes of the work. The performance or lack of performance of such tests and inspections shall not be construed as granting relief from the requirements of these specifications or the other contract documents.

1.5 Site Conditions

Existing site geotechnical conditions have been investigated by Kerr-McGee. The report containing the findings, conclusions and recommendations resulting from this investigation is by this reference made a part of these specifications. A copy of the report is included in the contract documents. The data contained in the report shall not be construed as a guarantee of the depth, extent, or character of materials actually present.

2.0 PRODUCTS

2.1 Materials

A. Granular Bedding Material

Well-graded sand (SW or SW-SM), gravel (GW or GW-GM), or manufactured aggregate containing no particles larger than 1/2 inch, and free from roots, debris, or any other substance that

EXCAVATION, BACKFILL, AND COMPACTION FOR UNDERGROUND PIPING

would harm the pipe or might impair the performance of the material as bedding for the pipe.

B. Plastic Marking Tape

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6-inches wide with minimum thickness of 0.004 of an inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in Table 1 and shall bear a continuous printed inscription describing the specific utility.

Table 1. Tape Color

Red: Electric
Yellow: Gas, Oil, and Dangerous Materials
Orange: Telephone, Teiegraph, Television, Police, and Fire Communications
Blue:: Water Systems
Green:: Sewer Systems

C. High Density Polyethylene Pipe (HDPE)

The drain pipe system for the passive groundwater drainage system shall be made of high density polyethylene resin which meets the following requirements:

1. The pipe supplied shall be high density, high molecular weight, polyethylene pipe. The pipe shall conform to ASTM D3350 with minimum cell classification values 345434C. All fitting supplied shall be made form polyethylene resin which meets this specification.

2. The HDPE pipe shall conform to minimum physical property requirements listed in Table 1.

TABLE 1

MINIMUM PHYSICAL PROPERTY REQUIREMENTS

PHYSICAL PROPERTY	TEST METHOD	ACCEPTABLE MINIMUM TEST RESULTS
Density	ASTM D1505	No less than 0.955 gms/ccm
Melt Index	ASTM D1238 Condition E	no greater than 0.15 gms/10 minutes
Flex Modulus	ASTM D638	110,000 psi < 160,000 psi
Tensile Strength	ASTM D638	3,200 psi < 3,500 psi
Environmental Stress Crack Resistance	ASTM D1693 Condition C	< 5,000 hrs
Hydrostatic Design Basis	ASTM D2837	1,600 psi @ 23° C

3. The HDPE drain pipe shall be solid wall pipe. The O.D. shall be 6.625 inches, the SDR shall be 26. No holes will be drilled in this pipe. The pipe shall be joined by butt fusion.

4. The perforated HDPE pipe shall have an O.D. of 6.625 inches, and the SDR shall be 26. Three holes 120 degrees apart on 3/8 inch OD shall be drilled on 4 inch centers. The pipe shall be joined by butt fusion.

EXCAVATION, BACKFILL, AND COMPACTION FOR UNDERGROUND PIPING

D. Reinforced Concrete Pipe (RCP)

1. RCP shall be Class III, Wall B (Class V under railroads) except as otherwise noted on the Construction Drawings and shall conform to the requirements of ASTM.

2. Joint material for RCP shall be rubber gasket conforming to the requirements of ASTM 443.

3. Flared end sections shall be Class I.

E. Geotextile Fabric

1. The geotextile shall be of nonwoven needle punched construction and consist of long chain polymeric fibers composed of polypropylene, polyethylene or polyamide. The fibers must be oriented into a multi-directional stable network whereby they retain their positions relative to each other and allow the passage of water as specified. The fabric should be free of any chemical treatment or coating which reduces permeability and shall be inert to chemicals commonly found in soil.

2. The geotextile fabric shall conform to the minimum physical property requirements listed in Table 2.

TABLE 2

MINIMUM PHYSICAL PROPERTY REQUIREMENTS

PHYSICAL PROPERTY	TEST METHOD	ACCEPTABLE MINIMUM TEST RESULTS
Tensile Strength, wet	ASTM D1682	120 lbs
Elongation, wet	ASTM D1682	40%
Coefficient of Water Permeability	Constant Head (50 mm)	0.10 cm\sec
Puncture Strength	ASTM D751	65 lbs
Pore Size - EOS	Corps of Engineers CW-02215	40 (may sieve size) U.S. Standard Sieve

3.0 EXECUTION

3.1 Preparation

A. Preliminary Site Examination

Prior to excavating, thoroughly investigate the line of the proposed trench to ascertain the existence and location of any underground structures or other items that might interfere with the pipe installation. Notify Owner or Site Manager of any obstructions that will prevent installation of the pipe or appurtenance as indicated on the drawings.

B. Construction Layout

Unless otherwise stipulated elsewhere in the contract documents, the work covered by this specification shall include the performance of all calculations, and the setting of all marks and stakes necessary to ensure that the work conforms to the required lines, grades, and dimensions.

C. Stripping and Stockpiling Topsoil

Strip topsoil in areas to be excavated and stockpile separately from other excavated materials. Protect topsoil stockpiles from contamination during progress of the work until their materials have been used in finish operations.

D. Erosion and Siltation Control, Prevention, and Abatement

EXCAVATION, BACKFILL, AND COMPACTION FOR UNDERGROUND PIPING

Before starting earthwork operations in any particular area of the project site, install measures for the control, prevention, and abatement of erosion and siltation for that area as required by the drawings and by Erosion Control Specification 000.210.02270.

E. Trenching Safety

Before the start of trenching, plan for and assemble materials and equipment required to stabilize trench walls as necessary to ensure the safety of personnel working in the trench, and to protect from damage existing facilities and structures in the vicinity of the work. The systems, methods, and techniques used shall meet or exceed all applicable requirements of the OSHA Construction Industry Standards, and all other local, State, and Federal codes and regulations.

3.2 Protection

A. Slope Stabilization

1. Stabilize the sides of excavations as necessary to prevent slope failure or any other earth movement which might injure personnel or damage existing buildings, structures, or other facilities in the vicinity of the work. The stabilization method employed shall comply with all pertinent requirements of the OSHA Construction Industry Standards, and all other applicable Federal, State, and local codes and regulations.

2. Remove sheeting, bracing, and shoring systems employed for slope stabilization as the progress of the work eliminates their need, unless they are permitted or required to remain by other provisions of these specifications or the other contract documents. Carefully remove such systems to prevent subsidence or other soil movement that might damage any existing or newly constructed structure or other facility.

B. Existing or Complete Utilities

Carefully move machinery and equipment over existing or newly installed pipes and utilities during construction so as not to damage completed work. Do not use power-driven equipment to excavate closer than 2 feet from any existing utility or structure. For work immediately adjacent to, or for excavation exposing an existing utility or other structure, use manual or light equipment excavating techniques. Start manual or light equipment excavation before reaching the obstruction and continue until the obstruction is uncovered, or until clearance for the new pipe or utility is ensured. Support uncovered pipes and other existing work affected by the excavation until they are properly supported by backfill. Report immediately to the construction manager any damage to existing utility lines or other subsurface facilities.

C. Structures and Surfaces

Protect newly backfilled areas and adjacent structures, slopes, or grades from damage. Repair and re-establish damaged grades and slopes. Protect existing streams, ditches, and other stormwater facilities from silt accumulation and erosion.

3.3 Control of Water

A. General

Prevent or control water flow into excavations, or water accumulation in excavations, to ensure that the bottoms and sides of all excavations remain in a firm and stable condition throughout construction operations.

B. Surface Waters

Plan and conduct excavation operations so as to minimize the disruption of stormwater drainage in the vicinity of the work. Provide diversion ditches, dikes, and other suitable measures to control and direct runoff around and away from the excavation. Protect the sides of excavations from erosion and sloughing caused by stormwater runoff. Promptly remove stormwater accumulations in excavations. The systems and equipment for control of surface water shall be of sufficient capacity to accommodate the runoff rate that can be expected from the 2 year (50 percent annual chance) rainfall event, with no significant

disruption of the construction schedule, or damage to existing features or facilities in the vicinity of the work.

C. Groundwater

When the bottom of the trench must be carried to an elevation below the groundwater piezometric surface, or to such proximity to the piezometric surface that the excavation bottom will become soft due to its being saturated by groundwater, take measures to lower the piezometric surface sufficiently to maintain the stability of the excavation bottom. Design the groundwater control system using accepted professional methods of design and engineering consistent with the best modern practice. The system shall include trenches and sumps with pumps, well points, and such other equipment, appurtenances, and related earthwork necessary to achieve the groundwater control needs of the work. Carefully design and operate the system to avoid damage to existing structures and other facilities in the vicinity of the work.

D. Disposal of Removed Water

Convey water removed by the water control systems to an existing stormwater drainage facility with sufficient capacity to accommodate the flow rates involved without damage.

E. System Removal

After completing construction operations needing water control, remove materials, equipment, and other facilities used for that purpose, and clean up and restore affected areas as required.

3.4 Excavation

A. General

Carefully excavate trenches to the minimum depths and widths necessary for installing the pipeline and associated appurtenances in accordance with the requirements of this specification, and the lines and grades indicated on the Construction Drawings or elsewhere in the contract documents. In the pipe embedment zone, the trench sidewalls shall be as nearly vertical as practical. From the top of the pipe embedment zone to the surface, the trench sidewalls shall be either sloped sufficiently to prevent sloughing or cave-in, or shall be properly supported. Stockpile excavated materials in an orderly manner a sufficient distance from the trench sidewalls to avoid endangering the stability of the bank.

B. Unstable Subgrade

When soft, yielding, or otherwise unstable soil conditions are encountered at the required trench bottom elevation, over excavate the trench to a depth of no less than 12 inches below the required pipe bottom elevation, and backfill with granular bedding material. If conditions are so severe that over excavating and backfilling will not achieve a stable condition, notify the site manager immediately so that appropriate corrective measures may be identified.

C. Unyielding Subgrade

Whenever rock, stone, masonry, or other hard, unyielding material is encountered at or above the required trench bottom elevation, remove it to provide a clearance of no less than 6 inches below and on each side of pipes and associated fittings, valves, and other appurtenances. Backfill the overexcavated area with granular bedding material.

D. Previous Excavations

In the event that the trench passes over a sewer or through any other previous excavation, carefully compact the bottom of the trench to a density equal to or greater than that of the native soil adjacent to the previous excavation. Perform this compaction carefully to avoid damaging the previously installed facility.

3.5 Bedding

EXCAVATION, BACKFILL, AND COMPACTION FOR UNDERGROUND PIPING

A. For HDPE Piping

After the excavation reaches the required trench bottom elevation and any unsatisfactory subgrade conditions are corrected as specified, prepare the bottom of the trench for placement of the pipe by spreading in the trench a layer of loose granular bedding material (approximately 2 inches thick) to attain a level just above the required grade of the outside bottom of the pipe. Carefully shape the surface of this layer of loose material to ensure that uniform and continuous support is provided to the bottom quadrant of each pipe section along its entire length. In the prepared trench bottom, excavate small depressions (bell holes) of the minimum size, if necessary, to allow removing the pipe handling slings, to allow assembly of pipe joints, and to avoid the development of bearing loads on the pipe bells or flanges.

B. For Haul Road Culverts

After the excavation reaches the required trench bottom elevation and any unsatisfactory subgrade conditions are corrected as specified, prepare the bottom of the trench for placement of the pipe by spreading in the trench a layer of loose granular bedding material (approximately 6 inches thick) to attain a level just above the required grade of the outside bottom of the pipe. Carefully shape the surface of this layer of loose material to ensure that uniform and continuous support is provided to the bottom quadrant of each pipe section along its entire length. In the prepared trench bottom, excavate small depressions (bell holes) of the minimum size, if necessary, to allow removing the pipe handling slings, to allow assembly of pipe joints, and to avoid the development of bearing loads on the pipe bells or flanges.

3.6 Pipe Laying and Assembly

A. The type, class and size of pipe used shall be as shown on the Construction Drawings. The pipe shall be laid and maintained to the required line and grade with the necessary fittings and other appurtenances placed at the required locations. Installation shall commence at the lowest point for each segment of the route.

B. Place the pipe, pipe assemblies, and fittings on the prepared trench bottom, embedding the bottom of the pipe into the loosely placed bedding materials true to the required line and grade. Ensure that the barrel of each pipe section is uniformly supported along its entire length, and that no point loads are developed on bells, flanges, or elsewhere. Assemble joints in accordance with the applicable piping system requirements.

C. The pipe shall be inspected for defects and cracks before being carefully lowered into the trench. Any defective, damaged or unsound pipe or any pipe that has had its grade disturbed after laying shall be taken up and replaced. Open ends shall be protected with a stopper to prevent earth or other materials from entering the pipe during construction. The interior of the pipe shall be free from dirt, excess water and other foreign materials as the pipe laying progresses, and left clean at the completion of the installation.

D. RCP shall be laid with the groove or bell end upstream. Damaged bituminous coating on CSP shall be repaired by applying bituminous material conforming to AASHTO M190.

3.7 Grade Survey

Spot surveys will be made for flowline elevations for the passive groundwater drainage system. Surveyed elevation shots will be made at all change of grades in the drain collection system (trench) and at 100 foot intervals along the drain pipe (HDPE). Surveyed elevations will be acceptable if they meet the following:

A. Trench - Elevations shall be no shallower than shown on the Construction Drawings but may be up to 0.5 foot over excavated.

B. HDPE - Elevations shall be as shown on plans ± 0.1 foot.

3.8 Haunching

After placing the pipe and assembling joints in accordance with the applicable system installation specifications, carefully fill bell holes with bedding material and place compact bedding material under the sides of the pipe to the pipe spring line. Take care during placement and compaction

of this material to ensure sound support is developed for the sides of the pipe while avoiding either vertical or lateral displacement of the pipe from its intended position. Place haunching area material and compact to the required density in uniform lifts of not over 6 inches loose thickness using manual or mechanical tamping techniques.

3.9 Initial Backfill

A. Place and compact clean select backfill from the spring line of the pipe to the top of the pipe embedment zone in uniform horizontal lifts of not over 6 inches loose thickness. Bring up the level of backfill uniformly on opposite sides of the pipe along the full length of each pipe section. Take care not to damage the pipe or any protective coating it may have.

B. When installing high density polyethylene (HDPE) pipe, polyvinyl chloride (PVC) pipe, corrugated metal pipe (CMP), or any other flexible type pipe, give special attention to proper compaction of the materials in the pipe haunch area and sides to ensure that adequate side support of the pipe is developed while avoiding any vertical or lateral displacement of the pipe. For flexible type pipe, the material directly above the pipe in the pipe embedment zone shall be only lightly compacted to avoid distorting the pipe. Compacted density requirements do not apply to materials in this area directly over flexible type pipe.

3.10 Final Backfill

Place and compact satisfactory clean backfill material in 8 inch maximum loose thickness lifts to restore the required finished surface grade. During final backfill for plastic or other non-ferrous pipelines, install plastic marking tape above the pipeline at a depth of 1 to 2 feet below the required finished grade.

3.11 Compaction

A. Equipment

Compact bedding and backfill materials using vibratory or impact type compaction equipment suitable for use in confined areas, and operated at the frequency and amplitude recommended by the equipment manufacturer for the type of material and lift thickness involved in the work.

B. Moisture Content

1. At the time of compaction, the moisture content of the material shall be such that the specified compacted density will be obtained and the completed backfill will be in a firm and stable condition. Adjust the moisture content as necessary to achieve a condition suitable for compactions.

2. For cohesive materials, the moisture content at the time of compaction shall be within 2 percentage points of optimum.

C. Compacted Density

1. Pipe Embedment Zone

Compact bedding and backfill material placed in the pipe embedment zone compacted to a density of no less than 92 percent of Modified Proctor Density or, if a free-draining granular material, to a density of no less than 70 percent relative density.

2. Final Backfill

a. Except in areas of load bearing subgrade, compact final backfill composed of satisfactory materials from the original trenching to a density equal to or greater than that of the existing undisturbed material immediately adjacent to the trench. Where the excavated material is unsatisfactory for use as backfill and, therefore, imported materials are used, compact the backfill to no less than 90 percent of Modified Proctor Density.

b. In areas of load bearing subgrade, compact final backfill materials to a

density of no less than 92 percent of Modified Proctor Density, with the top 12 inches compacted to no less than 95 percent of Modified Proctor Density.

3.12 Geotextile Placement

Excavate trench to the design dimensions as shown in the Construction Drawings. Line the trench with geotextile fabric allowing for 6 inch overlaps. Place aggregate in lifts to design depth. Close geotextile fabric and cover by placing native soil over the closed drain.

3.13 Restoration and Clean Up

A. General

After completing backfill placement and compaction, restore vegetative cover and other features, surfaces, and structures disturbed during the work, except as otherwise indicated. Return restored features and facilities to a condition equal or superior to that which existed before the work began.

B. Clean Up

Remove off the jobsite and properly dispose of surplus piping materials, soils, temporary structures, and other debris resulting from the work. Leave the site in a neat and clean condition, ready to receive topsoil, seeding, or whatever final surface treatment is indicated.

4.0 ATTACHMENTS

Not applicable.

End of Specification

AGGREGATE PAVEMENT BASE

This document has been revised as indicated below and described in the revision record on the following page. Please replace all pages of this document and destroy the superseded copies.

Issue History

Revision No.	Originator	Originator's Initials	Date	Pages
A	M. Holmes	MAH	3/3/94	1-5
B	M. Holmes	MAH	3/22/94	1-6
C	M. Holmes	MAH	5/24/94	1-6

New Issue: _____

Revised Sheets Only Attached: _____

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Client:

Issued for Construction:

Project Manager: _____

Date: _____

Fluor Daniel Williams Brothers:

Issued for Construction:

Project Manager: M L Blaker

Date: 5-26-94

AGGREGATE PAVEMENT BASE

DETAILS OF REVISIONS

This document has been revised as follows:

Revision No.	Date	Description
A	3/3/94	Preliminary Issue
B	3/22/94	Issued for
C	5/24/94	Construction Issue

AGGREGATE PAVEMENT BASE

1.0 GENERAL

1.1 Summary

A. Scope of Specification

This specification prescribes the requirements for the construction of haul roads to the lines, grades, thicknesses, and cross sections shown on the Construction Drawings.

B. Related Specifications

The following specifications prescribe items of related work:

- 000.220.01000: General Requirements
- 000.210.02110: Clearing and Grubbing
- 000.210.02270: Erosion Control
- 000.210.02115: Topsoil Removal, Stockpiling and Importing

1.2 References

The publications listed below form part of this specification. Each publication shall be the latest revision and addendum in effect on the date this specification is issued for construction unless noted otherwise. Except as modified by the requirements specified herein or the details of the drawings, Work included in this specification shall conform to the applicable provisions of these publications.

A. ASTM (American Society for Testing and Materials)

1. ASTM C 117 Standard Test Method for Materials Finer than Number 200 Sieve in Mineral Aggregates by Washing

2. ASTM C 131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

3. ASTM C 136 Standard Method for Sieve Analysis of Fine and Coarse Aggregates

4. ASTM D 698 Test Methods for Moisture-Density Relations of Soil and Soil-Aggregate Mixtures using 5.5 pound Rammer and 12 inch Drop

5. ASTM D 1557 Test Methods for Moisture-Density Relations of Soil and Soil-Aggregate Mixtures using 10 pound Rammer and 18 inch Drop

6. ASTM D 1883 Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils

7. ASTM D 4318 Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

8. ASTM E 329 Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as used in Construction

1.3 Submittals

A. Product Data

Before delivery of materials, submit for approval certified laboratory test data for the aggregates to be used in the work.

1. Gradation (ASTM C 136 and C 117)
2. Bearing ratio (ASTM D 1883)
3. Atterbeg limits (ASTM D 4318)
4. Percent of wear (ASTM C 131)

B. Test Results

AGGREGATE PAVEMENT BASE

Submit results of the tests required during the performance of the work.

1.4 Quality Assurance

An inspection and testing agency may be retained by the owner to perform field and laboratory testing and soil evaluations to verify compliance of the work with the requirements of this specification, and to ensure the achievement of the intents and purposes of work. The performance or lack of performance of such tests and inspections shall not be construed as granting relief from the requirements of these specifications or the other contract documents.

2.0 PRODUCTS

Materials for aggregate base shall consist of durable and sound crushed gravel, crushed stone, or slag. They shall be free from organic matter, lumps of clay, clay coatings, or other objectionable matter; and shall conform to one of the following grades:

Percents by Weight Passing Sieves

Sieve:	Grade 1:	Grade 2:	Grade 3:
2 inch	100	--	--
1- 1/2 inch	70-100	100	--
1 inch	45-80	60-100	100
1/2 inch	30-60	30-65	40-70
No. 4	20-50	20-50	20-50
No. 10	15-40	15-40	15-40
No. 40	5-25	5-25	5-25
No. 200	0-10	0-10	0-10

The aggregate shall have a soaked California Bearing Ratio of at least 80 percent when tested in accordance with ASTM D 1883, and a percentage of wear (except slag) not exceeding 45 when tested in accordance with ASTM C 131. Slag shall be an air-cooled, blast furnace product having a dry weight of not less than 65 pounds per cubic foot and shall consist of angular fragments reasonably uniform in density and quality, and free from thin and elongated pieces, dirt, and other objectionable materials. That portion of the material passing the No. 40 sieve shall have a liquid limit of no more than 25 and a plasticity index of not more than 5 when tested in accordance with ASTM D 4318.

3.0 EXECUTION

3.1 Preparation

Before placing the graded aggregate base course, clean the underlying subgrade of all foreign substances. Correct ruts and soft yielding spots that appear in the underlying course, areas showing inadequate compaction, and excessive deviations in the surface.

3.2 Inspection

Examine the surface of the areas on which the graded aggregate base is to be placed. The surface shall be smooth, firm, clean, and frost free. Correct conditions detrimental to proper and timely completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.3 Application

A. Limitations on Application

Do not construct graded aggregate base course when weather conditions will detrimentally affect the quality of the base course.

B. Placing and Spreading

Place and spread the aggregate in layers of uniform thickness. When a compacted layer 6 inches or less in thickness is required, place material in a single layer. When a compacted layer in excess of 6 inches is required, place material in layers of equal thickness. Do not exceed 6 inches or have less than 3 inches in thickness for any compacted layer. Place

AGGREGATE PAVEMENT BASE

layers so that when compacted, they will be true to grades required with the least possible surface disturbance. Where the base course is constructed in more than 1 layer, lightly scarify the surface of each previously placed and compacted layer to a depth of 1 to 2 inches immediately before the placement and spreading of materials for the subsequent course. Maintain water content of the material during the placing period as required to obtain the compaction specified. Make adjustments, as required, in placing procedures or equipment to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory base course.

C. Compaction and Finishing

1. Compact to a dry density of not less than 95 percent of maximum dry density determined by ASTM D 1557.

2. Roll the material with a self-propelled, three-wheel roller weighing no less than 10 tons, or with approved vibratory equipment. Begin the rolling at the edges of the layers. On the final layer, the outside wheel of the roller shall cover equal parts of the material and the shoulder. The roller shall run forward and backward along the edge until the shoulder and coarse material are bound together firmly. When the sides have been rolled, the rolling shall progress gradually toward the center, parallel with the centerline of the roadway, uniformly lapping each preceding track at least 18 inches and covering thoroughly the entire surface with the rear wheel. Continue rolling until the required density is achieved and the entire surface is well keyed and does not creep or wave ahead of the roller.

3. Compact inaccessible areas with smaller mechanical equipment or hand tampers. If the mixture is excessively moistened by rain, aerate it by means of blade graders, or other approved equipment, until the moisture content of the mixture is satisfactory. Finish the surface of the layer by blading or rolling with a smooth roller or a combination thereof. The completed surface shall be firm, even, and true to line and grade.

3.4 Field Quality Control

A. Smoothness Test

The surface of the completed aggregate base shall not deviate more than 1 inch from the specified cross section. Correct deviations by loosening, adding, or removing material; reshaping; watering; and compacting.

B. Thickness Test

The average thickness determined by computing the average of the depth measurement, shall not underrun the specified thickness by more than 1/2 inch. Measure the thickness of the base course at intervals such that there will be a depth measurement for at least each 500 square yards of complete base course. Take depth measurements by making test holes, at least 3 inches in diameter, through the base course. Where base course deficiency is more than 1/2 of an inch, correct by scarifying, adding mixture of proper gradation, reblading, and recompacting. Where the measured thickness is more than 1/2 of an inch thicker than specified, consider it as the specified thickness plus 1/2 of an inch for determining the average.

3.5 Adjustment and Cleaning

A. Adjustment

When correcting deficiencies for smoothness and thickness, remove material in a manner that does not disturb or mix material from the underlying course into the layer. Feather edges of the new material so that the joint between new and original material is invisible.

B. Cleaning

Remove all debris, rubbish, and excess material from the jobsite.

3.6 Protection and Maintenance

AGGREGATE PAVEMENT BASE

After construction of haul roads has been completed, protect and maintain the base throughout until the project is complete. Maintenance shall include fixing washouts, regrading periodically, clean up mud and debris that may fall. The haul roads are to receive water periodically for dust suppression. Areas of aggregate base course damaged by freezing, rainfall, or other weather conditions shall be corrected to meet the specified requirements.

4.0 ATTACHMENTS

Not applicable.

End of Specification

EROSION CONTROL

This document has been revised as indicated below and described in the revision record on the following page. Please replace all pages of this document and destroy the superseded copies.

Issue History

Revision No.	Originator	Originator's Initials	Date	Pages
A	M. Holmes	MAH	3/3/94	1-6
B	M. Holmes	MAH	4/18/94	1-6
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EROSION CONTROL

DETAILS OF REVISIONS

This document has been revised as follows:

Revision No.	Date	Description
A	3/3/94	Preliminary Issue
B	4/18/94	Bid Issue
C	5/24/94	Construction Issue

EROSION CONTROL

1.0 GENERAL

1.1 Summary

A. Scope of Specification

This specification prescribes the requirements for the construction and maintenance of erosion and sedimentation control facilities and the implementation of erosion control practices as defined herein and indicated on the Construction Drawings.

B. Related Specifications

The following specifications prescribe items of related Work:

- 000.210.02110: Clearing And Grubbing
- 000.210.02200: Earthwork
- 000.220.01000: General Requirements
- 000.220.02900: Landscape Development

Coordinate Work prescribed by this specification with Work prescribed by the above listed specifications.

C. Terminology

1. Construction Sequence Schedule: An orderly listing and time frame for all land-disturbing activities along with the planned erosion and sediment control measures to be constructed and maintained for the duration of those activities.

2. Level Spreader: An erosion control feature constructed at the end of a diversion ditch to spread the concentrated flow and slow the erosive velocity.

3. Check Dams: Small drainageway flow retarder, usually of stone, constructed in swales and channels to slow the stormwater flow and reduce erosion until permanent stabilization measures are in place.

4. Straw Bail Dike: Flow retarder, made of a continuous line of staked in place straw bales. To reduce erosion until permanent stabilization measures are in place.

1.2 References

The publications listed below form part of this specification. Each publication shall be the latest revision and addendum in effect on the date this specification is issued for construction unless noted otherwise. Except as modified by the requirements specified herein or the details of the drawings, Work included in this specification shall conform to the applicable provisions of these publications.

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

1. AASHTO T194 Determination of Organic Matter in Soils by Wet Combustion

B. ASTM (American Society for Testing and Materials)

1. ASTM D1682 Ultraviolet Stability, Tensile Strength, and Grab Elongation of Geotextile Fabric

2. ASTM D751 Diaphragm Bursting Strength, and Tension Test of Geotextile Fabric

C. Corps of Engineers Guide

1. Specification Number CW02215 - equivalent opening size of geotextile fabric - #100 sieve minimum, #40 sieve maximum.

1.3 Submittals

Contractor shall submit the following to the construction manager for approval, when requested:

EROSION CONTROL

A. Construction sequence schedule is required for projects with land-disturbing activities of one or more acres.

B. Certification from grass seed supplier indicating seed purity, germination, and weed presence in percent.

C. Manufacturers label from silt fence fabric, and mulch netting, indicating product name and manufacturer.

2.0 PRODUCTS

2.1 Topsoil

Topsoil shall be natural, friable, fertile, fine, loamy soil and generally representative of agriculturally productive soil in the vicinity of the jobsite. Topsoil shall be free from subsoil and objectionable material that would hinder plant growth or maintenance and shall not contain more than 5 percent by volume of stones, or other foreign objects larger than 1 inch in any dimension.

2.2 Mechanical Mulches

A. Woven jute netting, with approximately 1 inch square openings, shall be as manufactured by Sullivan Industries, Ludlow Manufacturing Co., or approved equal.

B. Gravel or crusher-run stone.

2.3 Organic Mulches

A. Straw from oats, wheat, barley, or rye. B.Hay from pangola, alfalfa, bermuda, or prairie grass.

2.4 Fertilizer

Fertilizer shall be uniform in composition, free-flowing, and suitable for application with approved equipment. Deliver to the site in bags or other convenient containers, each fully labeled, including the following information:

- Name and address of manufacturer.
- Name brand or trademark.
- Number of net pounds or ready mixed material in the package.
- Chemical composition or analysis and guarantee of analysis.

Use of liquid fertilizer is subject to the approval of the construction manager prior to its use.

2.5 Lime

Lime shall be ground limestone containing no less than 85 percent of total carbonates and ground to such fineness that 50 percent will pass through a #100 sieve and 90 percent will pass through a #20 sieve.

2.6 Silt Fence

The fabric material shall contain stabilizers and inhibitors to make the fibers resistant to deterioration due to exposure to ultraviolet light and heat.

2.7 Erosion Control Matting

Erosion control matting can be used in conjunction with seeding and temporary erosion control and shall be approved by the owner prior to installation. The matting shall be a machine produced matt of curled and barbed Aspen wood excelsior or equal. Fiber shall be evenly distributed through a photodegradable plastic mesh without the inclusion of chemical additives.

3.0 EXECUTION

Schedule and conduct construction operations in such a manner and sequence that erosion on the project site is minimized. Coordinate the installation of temporary erosion control features with the

EROSION CONTROL

construction of the permanent erosion control features to the extent necessary to ensure effective and continuous control of erosion throughout the period of Work.

3.1 Construction Access

The construction entrances, site access roads, and temporary construction parking areas shall be stabilized with crusher-run stone. These items shall be installed and maintained by Contractor for the duration of the Work.

3.2 Sediment Pond, Traps and Principle Storm Water Detention Basins

These facilities, as indicated on the drawings, shall be constructed before any major site clearing or grading takes place.

3.3 Tree Preservation and Protection

Trees shall remain and be protected as indicated by the Owner.

3.4 Dust Control

Contractor shall make every effort to control dust for the duration of the Work. This effort shall include minimizing the area of disturbed soil exposed at any one time, and installing temporary or permanent surface stabilization measures immediately after completing a land grading unit of the overall Work. For disturbed areas not subject to traffic, temporary or permanent vegetation shall be installed according to the drawings. For other areas subject to traffic, dust control measures shall include mulching, sprinkling water, spraying adhesive or calcium chloride and surface roughening by tillage. The measures implemented shall be maintained until all disturbed areas have been stabilized with vegetation.

3.5 Temporary and Permanent Vegetative Cover Seeding

Protective cover for areas disturbed by the grading operation shall be established within 30 days after completion of a unit of the work.

A. Permanent grass mixtures of seed, fertilizer and lime shall be placed as specified. Permanent seed mixtures shall be placed in quantities as shown in the table below or as recommended by the Payne County Extension Agent.

PLANT	PER ACRE	PER 1000 SQ FT.	PLANTING DATE	DEPTH OF SEEDING
Bermuda Grass	10 Lbs	0.25 Lbs	4/1 - 8/15	0-1/2 Inch
Bluestream	40 Lbs	0.90 Lbs	9/1 - 11/1	0-1/2 Inch
Lovegrass	5 Lbs	0.10 Lbs	4/1 - 6/30	0-1/2 Inch

B. Temporary grass mixtures shall be placed in the quantities as shown below.

PLANT	PER ACRE	PER 1000 SQ FT.	PLANTING DATE	DEPTH OF SEEDING
Annual Ryegrass	40 Lbs	0.9 Lbs	9/15 - 11/30	1/4 Inch
Elbon Rye	2 Bu	3.0 Lbs	8/15 - 11/30	2 Inches
Wheat	2 Bu	3.0 Lbs	8/15 - 11/30	2 Inches
Oats	3 Bu	2.5 Lbs	8/15 - 11/30	2 Inches
Sorghum	60 Lbs	1.4 Lbs	3/1 - 9/15	2 Inches
Sudan Grass	40 Lbs	9.0 Lbs	4/1 - 9/15	2 Inches

3.6 Mulching

Surface mulch, organic or mechanical, shall be placed along with or immediately after the grass seed, fertilizer, and lime has been put in place. Refer to the drawings for areas to be mulched, the proper material, and installation methods to be used. Follow manufacturer's recommendations for anchoring netting or matting.

3.7 Riprap

EROSION CONTROL

Riprap, when required, shall be as shown on the Construction Drawings.

3.8 Temporary Inlet Protection

Temporary sediment-trapping construction for inlet protection shall be incorporated as shown on the Construction Drawings at the same time as the storm drain piping installation, until the drainage area is permanently stabilized with vegetation or paved surfacing.

3.9 Temporary Straw Bale Dikes

Temporary straw bale dikes, if required, shall be installed as indicated on the Construction Drawings.

3.10 Silt Fence

Silt fencing shall be erected where stipulated by specifications.

3.11 Surfacing Of Slopes

The surface of slopes shall be left rough textured or scarified prior to topsoil placement.

3.12 Topsoil Replacement

Replacement of topsoil is required in all areas to be grassed. Topsoil that is placed on slopes shall be left rough textured or scarified prior to the placement of grass seed mixture.

3.13 Maintenance

All sediment and erosion control facilities shall be checked after each rainfall and maintained, as required, in order for them to continue to perform efficiently.

4.0 ATTACHMENTS

Not applicable

End of Specification

GENERAL REQUIREMENTS

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GENERAL REQUIREMENTS

DETAILS OF REVISIONS

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A	3/3/94	Preliminary Issue
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C	5/24/94	Construction Issue

GENERAL REQUIREMENTS

1.0 GENERAL

1.1 Summary

A. Scope of Specification

This specification prescribes the general requirements for specifications. These general requirements are complementary to general conditions of the Contract contained in the RFQ (Request for Quotation) and are not intended to duplicate or contradict the General Conditions. Contradictions shall be brought to the attention of the Owner.

B. Terminology

Terminology is covered in the General Conditions; additions are as follows, and apply wherever such terms are used:

1. Engineer: Engineering Division of Fluor Daniel Williams Brothers.

2. Construction Manager (Agent): Kerr McGee.

3. Contractor: Appropriate individual, partnership, company, or corporation as established by work assignments set forth by the Owner as Construction Manager, and becomes contractually obligated to Agent and Owner.

4. Trade: Workmen or Mechanics with special skills, or firms that hire them, as applicable.

5. Any: The term "any" in the Contract Documents shall be interpreted as "any and all" whenever more than 1 item would be applicable for completion of the Work of the Project; for example, "any other general expenses."

6. Shop Drawings: Drawings, diagrams, schedules, and other data specifically prepared for the work by the Contractor to illustrate some portion of the work.

7. Product Data: Illustrations, standards, schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate a material, product, or system for some portion of the work.

8. Samples: Physical examples which illustrate materials, equipment, or workmanship, and establish standards by which the work will be judged.

1.2 References

The publications listed below form part of this specification. Each publication shall be the latest revision and addendum in effect on the date this specification is issued for construction unless noted otherwise. Except as modified by the requirements specified herein or the details of the Construction Drawings, Work included in this specification shall conform to the applicable provisions of these publications.

A. ACI (American Concrete Institute)

B. AISC (American Institute of Steel Construction)

C. AISI (American Iron and Steel Institute)

D. AMCA (Air Moving & Conditioning Association, Inc.)

E. ANSI (American National Standards Institute)

F. AREA (American Railroad Engineering Association)

G. Applicable State Department of Highways Specification

H. ASSHTO (American Association of State Highway and Transportrtion Officials)

I. ASTM (American Society for Testing and Materials)

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J. AWI (American Wood Institute)

K. AWPB (American Wood Preservers Bureau)

L. AWS (American Welding Society)

M. AWWA (American Water Works Association)

N. BOCA (Building Official Code Administration)

O. CBM (Certified Ballast Manufacturers)

P. CRSI (Concrete Reinforcing Steel Institute)

Q. CSI (Construction Specifications Institute)

R. ETL (Electric Testing Laboratories)

S. FM (Factory Mutual)

T. FS (Federal Specifications)

U. IPCEA (Insulated Power Cable Engineers Association)

V. MSHA (Mine Safety and Health Administration)

W. NCBC (North Carolina Building Code)

X. NEC (National Electric Code)

Y. NEMA (National Electric Manufacturers Association)

Z. NFPA (National Fire Protection Association Codes)

AA. NRMCA (National Ready Mixed Concrete Association)

BB. OSHA (Occupational Safety and Health Administration Standards)

CC. PCA (Precast Concrete Institute)

DD. SBC (Standard Building Code)

EE. SDI (Steel Deck Institute)

FF. SJI (Steel Joist Institute)

GG. SMACNA (Sheet Metal and Air Conditioning Contractors National Association)

HH. SSPC (Steel Structures Painting Council Specifications)

II. UBC (Universal Building Code)

JJ. UL (Underwriters Laboratories)

KK. U.S. Department of Commerce, Bureau of Standards for Lumber

1.3 System Description

The intent of the contract documents is to include the items necessary for the proper execution and completion of the work.

A. The contract documents are complementary, and what is required by any one shall be as binding as if required by all.

GENERAL REQUIREMENTS

B. Work not covered in the specifications and Construction Drawings will not be required, unless it is consistent therewith and is reasonably inferable therefrom as being necessary to produce intended results.

C. Written interpretations of specifications and Construction Drawings are valid only when issued by the Engineer.

D. Words and abbreviations which have well-known technical or trade meanings are used in the specifications and Construction Drawings in accordance with such recognized meanings.

E. Where custom built equipment is specified, and an independent testing laboratory label or listing is not applicable to the completed product, components used in the construction and assembly of such equipment must be labeled or listed by an independent testing laboratory acceptable to the local governing authorities, where such label or listing is applicable to the components. These labels shall be securely affixed to the components in a conspicuous location.

F. The Mechanical and Electrical Drawings are diagrammatic, intending to show general locations and arrangements of piping, wiring, equipment, and specialties and not necessarily showing the required offsets, connections, or appurtenances. Accurately lay out work in cooperation with other trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum practical accessibility for operation, maintenance, and headroom.

G. Drawing scale is selected for convenience in presentation and not for establishment of dimensions.

1. Use drawing dimensions for performance of work.

2. Verify actual dimensions at the site to determine that sufficient space exists and that no interference will be caused.

1.4 Submittals

A. Filing of Drawings

The Contractor shall file necessary Construction Drawings with the Insurance Authority and Local Authorities, if their approval is required. Copies of these Construction Drawings bearing the stamp of approval of the authorities having jurisdiction shall be submitted to the Construction Manager prior to starting the Work.

B. Record Documents and Samples

The Construction Manager shall maintain at the site one record copy of all Construction Drawings, specifications, addenda, change orders, and other modifications, in good order and marked currently to record all changes made during construction; and shall maintain at the site reviewed shop drawings, product data, and samples. These shall be available to the Engineer and shall be delivered for the Owner upon completion of the work.

C. Shop drawings, product data, and samples shall comply with individual specification section requirements and as follows:

1. Shop drawings shall be one reproducible sepia for return with remarks noted.

2. Product data shall be submitted in a quantity of 6 copies.

3. Submit samples in a quantity of 3; one to be retained by the Architect/Engineer, one to be retained at the construction site, and one to be returned by the Engineer to the originator after approval.

4. Approval indicates conformance to contact documents (not performance, code compliance, dimensions, or quantities) and does not constitute approval to vary from contract documents. Resubmit disapproved shop drawings, product data, and samples for approval in same manner as for first submittal.

5. No portion of the work requiring shop drawings, product data or sample approval shall be started until Engineer approval is obtained in writing.

GENERAL REQUIREMENTS

2.0 PRODUCTS

2.1 General

A. Substitution for items described in the contract documents will be as follows:

1. Where "Approved Substitute" is omitted for the item, product, material, system, or equipment, provide exactly as specified. No substitution will be considered or approved.

2. Where "Approved Substitute" is included for an item, product, material, system, or equipment, substitution may be submitted for approval. Proposed substitution shall be:

a. Accompanied by certified data.

b. Available in quantity sufficient to prevent delay of the work.

c. Provided in same range of colors, textures, gages, dimensions, capacities, functions, types, and finishes.

d. Equal to specified item in strength, durability, efficiency, serviceability, ease, and cost of maintenance.

e. Compatible with design without design modifications by the Engineer or additional cost.

3.0 EXECUTION

3.1 Field Quality Control

A. Workmanship contemplated under this work shall be first class in every respect. Finishes shall be free from imperfections not in conformity with first-class work.

B. Factory assemblies shall conform to the first-class standards of the trades concerned.

C. Defective materials shall not be built in and, if built in, shall be removed at the Contractor's expense. Where, in the opinion of the Construction Manager or Owner, doubt exists as to the quality or effectiveness of the work, the work shall be reinstalled as directed.

3.2 Daily Cleanup

A. Maintain the premises and Project site in a reasonable neat and orderly condition, free from accumulations of waste materials and rubbish during the entire construction period.

B. Remove crates, cartons, trash and flammable waste materials from the work areas by the end of each working day.

C. Do not dispose of trash or debris by burning on Project site.

D. Clean and leave free from rubbish, construction debris, and dirt; dust electrical closets, pipe and duct shafts, chases, furred spaces and similar spaces which are generally unfinished, roof drains and roof areas.

E. Clean and restore any finished surface which is defaced in any way.

F. Provide and maintain runner strips of nonstaining kraft building paper on finished floors.

4.0 ATTACHMENTS

Not applicable

End of Specification

LANDSCAPE DEVELOPMENT

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Issue History

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LANDSCAPE DEVELOPMENT

DETAILS OF REVISIONS

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LANDSCAPE DEVELOPMENT

1.0 GENERAL

1.1 Summary

A. Scope of Specification

1. Work includes permits, licenses, labor, materials, equipment, transportation and services necessary to furnish and install vegetative cover. Prepare soil and related elements as specified. Such Work includes but is not limited to the following:

   a. Placing, mixing, and testing topsoil, amendments, and fertilizers.

   b. Planting vegetative cover as specified.

   c. Maintaining vegetative cover for period specified herein.

B. Related Specification

The following specifications prescribe items of related work:

- 000.220.01000: General Requirements
- 000.210.02270: Erosion Control
- 000.210.02115: Topsoil Removal, Stockpiling and Importing

1.2 Submittals

A. Warranty

1. Submit 1-year warranty for materials and workmanship on prescribed forms as required by Contract Documents. Coordinate demonstrations and trial runs of equipment for Owner and complete such demonstrations before final acceptance.

2. Whenever required by the specifications, or whenever called for the Owner the Contractor shall furnish for review full information concerning the materials to be used in the work. Samples of materials shall be submitted for review when so directed. Machinery, equipment, materials, and articles installed or used without such review shall be at the risk of subsequent rejection.

B. Operation Manuals

Submit bound operation manuals for items of equipment for which the manufacturer has printed instructions. Manuals shall be assembled and submitted as indicated for maintenance manuals or may be included therewith.

C. Warranties

Whenever warranties are required for periods in excess of 1 year in Contract Documents, bind, label, and transmit warranties as described for other manuals above.

D. Substitution

If it is desired to use materials or products of manufacturer's names different from those specified, the party requesting the substitution shall make written application as described herein. The burden of proving the equality of the proposed substitution rests on the party making the request. To be acceptable, the proposed substitution shall meet or exceed expressed requirements of Contract Documents and shall be submitted upon the general contractor's letterhead.

Request for substitutions shall be submitted to the Owner at the earliest date possible in order to afford him ample time to process the request. Requests for substitution shall be accompanied by such technical data as the party making the request desires to submit. The Owner will consider reports from reputable independent testing laboratories, verified experience records from previous users, and other written information valid under the circumstances. Requests for substitution shall completely and clearly indicate in what

respects the materials or products differ from those indicated and from those in the contract documents. Requests for substitution shall be accompanied by the manufacturer's printed recommendations clearly describing the installation, use and care, as applicable, of the proposed substitutions.

Requests for substitutions shall be accompanied by a complete schedule of changes in Contract Documents, if any, which must be made to permit the use of the proposed substitution. If a proposed substitution is approved by the Owner, an addendum shall be issued to General Contractor. Unless substitutions are received and approved as described above, the Contractor shall be responsible for furnishing materials and products in strict accordance with Contract Documents, with the following exception:

Exception: In the event that specified item cannot be delivered to the jobsite and incorporated into the work at such times and in such quantities as to cause no delay, then the contractor may request a substitution. If the substitution provides a cost savings, the contractor will be adjusted by change order with Owner receiving the benefit of the net savings.

1.3 **Quality Assurance**

A. Work Schedule

Provide for review by the Owner proposed schedule for Work on area by area, operation by operations basis, including beginning and completion dates. Submit revised schedules if progress of work must be adjusted.

B. Guarantee, Periodic Inspections, and Replacements

1. Vegetative Cover Guarantee

One year. During this guarantee period, the Contractor shall replant at no additional cost, those areas that show a poor stand of vegetative cover with the same materials as originally specified. Replacement made within 6 months after the beginning of the guarantee period shall not extend the guarantee period of this planting; those replacements made 6 months or more after the beginning of the guarantee period shall be maintained and guaranteed for a period of 6 months from the time of the replacement.

2. Maintenance Period

The maintenance period for vegetative cover and related materials shall be as noted in Phase I Remedial Design Document drawings. The Contractor shall adhere to specified note as indicated.

3. Inspections of Maintenance

a. During guarantee period, the Owner shall make periodic visits to site (especially during times of unusually severe weather conditions) to inspect vegetative cover installed and guaranteed by Contractor.

b. If insufficient maintenance or other damaging condition continues, the Owner may request that the Contractor inspect site and make their determination of situation at Contractor's expense.

c. If Owner concurs with the Contractor after inspection, Owner may then file written notice with the Contractor, that unless proper maintenance or other necessary work has been completed by a reasonable given date, and sustained thereafter, the terms of vegetative guarantee will become null and void for all or stated portions of Work; and a new guarantee period shall be established.

d. Materials Specified as Requiring Approval: Secure representative sample(s) and arrange for the Owner to inspect; if disapproved, resubmit additional sample(s) until approved, keep approved sample for reference until near end of project before incorporating it in work. Sample approval does not ensure approval of material installed.

LANDSCAPE DEVELOPMENT

e. Replacement: Make the replacements required under the guarantee at no cost to Owner. Make replacements during earliest favorable weather and season following original specifications, unless directed otherwise by the Owner.

f. Satisfaction of Guarantee: Near end of guarantee period, the Owner shall determine whether vegetative covers are in satisfactory condition. When all are acceptable, Contractor shall be notified and shall be eligible for final payment.

C. Intent of Contract Documents

1. The intent of Contract Documents is to include items necessary for the proper execution and completion of Work. Contract Documents are complementary, and what is required by one shall be as binding as though required by all. Work not covered in the specifications and Construction Drawings shall not be required, unless it is consistent with them and is reasonably inferable from them as being necessary to produce the intended results.

2. Detailed Construction Drawings shall take precedence over small scale drawings,. In case of discrepancy, either in the figures, in the Construction Drawings or in the specifications, the matter shall be promptly submitted to the Owner, who will promptly make a determination in writing. Adjustment by the Contractor without this determination shall be at his own risk and expense.

D. Drawings

1. Work shall conform to the Construction Drawings, all of which form a part of these specifications.

2. In the event there are changes in the Construction Drawings or specifications, Contractor shall be notified by the Owner. The Contractor shall then confirm receipt of this change in writing for the Owner.

E. Final Approval

When approval of materials, procedures, and final appearance is required, the responsibility of clarification and performance rests on the Owner.

1.4 Product Delivery and Handling

A. Delivery

1. Deliver materials and products in the manufacturer's original, unopened packaging. Clearly identify each package with contents and the manufacturer's name and address. Make deliveries in sufficient time to prevent construction delays.

2. Notify the Owner in advance when the material is to be delivered and the manner of shipment.

3. Furnish with material an itemized list of the actual quantity and sizes.

B. Storage and Handling

1. Store and handle materials and products in the manufacturer's original, unopened packages, and in a way to prevent damage caused by vandalism, weather, or work performed under this specification or by other trades.

2. The Owner shall provide suitable protection for material and equipment on the site and shall maintain storage space in a safe and orderly condition. Owner assumes no liability for loss or damage to materials or equipment due to improper storage, lack of protection from the elements, or from other cause. Flammable materials shall be enclosed in safe UL and NFPA approved containers.

1.5 Site Conditions

A. Protective Devices

LANDSCAPE DEVELOPMENT

Provide barricades, lights, signs, and similar devices necessary to protect public from dangerous conditions resulting from work, and to protect work from trespass.

B. Outdoor Toilet Facilities

Provide portable unit for workers, or make other approved arrangements.

C. Water and Electricity

The Owner has the responsibility to coordinate with Contractor to ensure and maintain an adequate supply of water and electricity required for the job.

D. Preservation of Existing Vegetation

The Contractor shall preserve and protect existing vegetation such as trees, shrubs, and grass on or adjacent to the site unless otherwise specified by the Owner. The Contractor shall be responsible for unauthorized cutting or damaging of trees and shrubs, including damage due to careless operation of equipment, stockpiling of materials, or tracking on grass area by equipment.

2.0 Materials

A. Topsoil

1. Source of Topsoil

   Offsite Locations: Use well-drained sites not previously stripped.

2. Characteristics

   Natural, friable, fertile, fine, loamy soil representative of topsoils in jobsite vicinity, and that produce heavy growth.

3. Cleanliness

   Free from subsoil, objectionable weeds, litter, sods, stiff clay, stones larger than 1 inch in diameter, stumps, roots, trash, toxic substances, or any matter harmful to plant growth or a hindrance to installation or maintenance.

4. Hydrogen Ion Content

   The pH range appropriate for plant materials specified; general range 5.5 to 6.5.

5. Conditions

   Not frozen or muddy when delivered or spread.

6. Depth

   Depth of topsoil shall depend on depth required to fine grade, site to finish grade but in no case less than 4 inches.

B. Soil Conditioning Materials

1. Aluminum Sulfate

   Unadulterated, in manufacturer's original, unopened container, labeled with analysis and net weight. Use to acidify soil (lower pH).

2. Limestone

   Raw, ground agricultural limestone, containing at least 90 percent calcium carbonate; 90 percent shall pass No. 10 sieve and 50 percent shall pass No. 50 sieve. Use to decrease acidity of soil (raise pH).

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3. Peat

Domestic or imported material consisting of at least 50 percent partially decomposed vegetable matter of nature occurrence, brown in color, clean, low in mineral and woody content, mildly acid, and either granulated or shredded.

C. Commercial Fertilizers

Conforming to applicable Federal and State laws; uniform in composition, dry, free-flowing, and delivered to site in original, unopened containers, each bearing manufacturer's guaranteed analysis. Minimum analysis of complete fertilizers shall be as specified on drawings.

D. Grass Seed

1. General Requirements

Fresh, clean, disease and pest-free, new-crop seed conforming to Federal and State laws including regulations of Oklahoma Department of Agriculture; each type individually bagged or packaged and tagged to show name, net weight, origin, analysis, and lot number.

2. Seed Mixture

The seed mixture shall be as recommended by the Soil Survey of Payne County, Oklahoma and as stipulated in Erosion Control Specification 000.210.02220.

E. Sod

Sod shall contain at least 85 percent permanent grass suitable to the climate in which it is to be placed; not more than 15 percent nursing grass; not more than 10 percent weed and undesirable grasses, and shall be of good texture, free from obnoxious roots, stones, and foreign materials. The sod shall be cut into 12 inch squares or twelve 1 inch wide strips, uniformly 3/4 of an inch to 1- 1/2 inches thick with clean cut edges. The sod shall be nursery grown. It shall be well rooted 2 year old growth of permanent and desirable grasses, indigenous to general location of the project site. The sod shall be virtually free from weeds and undesirable grasses.

3.0 EXECUTION

3.1 Subgrade Preparation

Before the placement of topsoil, objectionable material shall be removed from the subgrade to a depth of not less than 12 inches; this requirement includes fill embankments.

3.2 Installation

1. Vegetative Cover

a. Topsoil Spreading

Spread topsoil on newly graded areas not occupied by pavement, structures, bedding plants, ground cover, or other construction. The topsoil shall be taken from the stockpiles and spread in 4 inch layers unless otherwise noted on the plans. The topsoil shall be graded smoothly to the proper elevations and left in a condition suitable for seeding operations.

b. Seed Bed Preparation

After the areas to be seeded have been brought to the proper grades, the areas shall be thoroughly tilled to a depth of at least 3 inches by disking, harrowing, or other approved methods. If a crust is formed over the prepared surface as a result of a rain, the surface shall again be made suitable for planting.

LANDSCAPE DEVELOPMENT

- Fertilizer

  - 1,000 lbs/acre on flat areas
  - 850 lbs/acre on sloped areas

- Lime

  - 3,000 lbs/acre on flat areas
  - 3,500 lbs/acre on sloped areas

c. Fertilizer Distribution

Fertilizer shall be distributed uniformly on areas to be fertilized and shall be incorporated into the soil to a depth of at least 3 inches by disking, harrowing, or other approved methods. The incorporation of fertilizer may be a part of the tillage operation specified above.

d. Lime Distribution

Lime shall be distributed uniformly on areas to be fertilized at the rate of [ ] tons to 1 acre and shall be incorporated in the soil to a depth of 3 inches by disking, harrowing, or other approved methods, immediately following or simultaneously with the incorporation of the fertilizing or seeding.

e. Planting

No seed shall be sown during high winds or until the surface is in proper condition and suitable for working. Small grass seeds shall be properly mixed and sown in a mixture by a method approved by Landscape Architect to ensure uniform distribution over the area. Immediately after sowing small grass seed, the area shall be rolled with an approved form of handroller so the soil about the seed is compacted.

(1) Hydro-Seeding: Hydro-seeding may be used provided proper seed bed preparation has been completed. Mix and apply seed, mulch, fertilizer, and water using standard methods.

f. Mulching

Mulch as required to prevent erosion and to retain moisture for seed germination and growth during summer months. Apply mulch at a rate of 2 tons per acre. Use sufficient amount of binding material to hold mulch in place.

3.3 Field Quality Control

A. Punch List Inspection(s)

After work has been substantially completed, the Contractor shall notify the Owner that Work is ready for punchlist inspection. The Owner, within reasonable time, shall check work and prepare punch list stating observed deficiencies of work that need correction before acceptance of work inspection. Punchlist is for Contractor's convenience and shall not relieve him of any obligations of Contractor. The Contractor is expected to review contract documents and technical specifications and to inspect Work to determine that requirements shall have been met before inspection(s).

B. Inspection(s) for Acceptance of Work

Within a reasonable time after receipt by the Contractor, the Owner shall inspect, to determine substantial completion of work before guarantee period begins. Items on punchlist shall also have been attended to before acceptance inspection(s). If work is unacceptable and additional inspection is required, Contractor shall reimburse Owner for additional expenses charged by the Owner for re-inspection. If applicable under terms of Contract, Owner shall deduct such amount from payment to Contractor.

C. Acceptance of Work

After inspection, Contractor shall be notified of acceptance of Work in writing by the Owner

but exclusive of possible future replacement of vegetative cover.

D. **Inspection for Final Approval**

1. Final Inspection

At the conclusion of the Guarantee Period, a final inspection of Work included in this Contract shall be made by the Owner. At that time, as determined by the Owner, vegetative cover found not to be in a healthy growing condition, or otherwise in such condition as to impair or destroy the symmetrical or other desired appearance, shall be removed from the site and replaced by Contractor at no cost to Owner.

2. Standard for Acceptance

The vegetative cover bed shall be free from high spots or depressions and shall drain properly; and vegetative cover shall be healthy and dense enough generally to exclude view of soil if viewed from above; scattered bare spots not larger than 4 inches square in area shall not total more than 3 square feet in any 100 square feet.

E. **Inspection and Acceptance**

After vegetative cover has reached standard for acceptance, notify the Owner and request inspection. If Work is not accepted, continue interim maintenance until Work has been accepted.

F. **Inspection of Materials and Work**

- Interim Inspections: During progress of construction
- Punchlist Inspection: Upon substantial completion of Work
- Inspection for Final Approval: At end of guarantee period

3.4 **Adjustment and Cleaning**

A. **Maintenance**

1. General

Maintenance shall include watering, fertilizing and mowing as necessary to keep the vegetative cover in a healthy, growing condition and to keep the areas neat and attractive throughout the construction and maintenance periods.

2. Maintenance Period

Maintenance period shall be stipulated in the Phase I Remedial Design Document.

B. **Clean-Up**

1. The Contractor shall to the satisfaction of Owner, remove debris from his operations each evening of every workday. Brick bats, rock, wood debris, metal objects, and similar materials uncovered during excavation operations shall be disposed of, leaving the completed work in a neat, policed manner.

2. During course of planting, excess and waste materials shall be continuously and promptly removed, and measures taken to prevent damage to existing structure, plants, and grass.

3. After planting in an area has been completed, the area shall be thoroughly cleaned up. Debris, rubbish, subsoil, and waste materials shall be cleaned up and removed from the property.

4. Grass areas that have been injured by the Work shall be reseeded and the entire area, when completed, shall be neat and clean to the satisfaction of the Owner.

5. The Contractor shall periodically, or as directed during the progress of this work, remove and properly dispose of debris, and keep the premises reasonably clear of hazardous obstructions. Upon completion of his work, Contractor shall remove

temporary construction facilities and unused materials provided for Work, put the premises in a neat and clean condition, and do cleaning required by the specifications. Trash burning on the site shall be subject to prior approval of the Owner and existing local and State regulations.

6. Protection

The Contractor shall protect plants and grass from damage at all times.

4.0 ATTACHMENTS

Not applicable.

End of Specification

TEMPORARY FACILITIES

This document has been revised as indicated below and described in the revision record on the following page. Please replace all pages of this document and destroy the superseded copies.

Issue History

Revision No.	Originator	Originator's Initials	Date	Pages
A	M. Holmes	MAH	3-31-94	1-6
B	M. Holmes	MAH	5-24/94	1-6

New Issue: _____

Revised Sheets Only Attached: _____

Entire Document Re-issued: X

Client:

Issued for Construction:

Project Manager: _____

Date: _____

Fluor Daniel Williams Brothers:

Issued for Construction:

Project Manager: M T Blaker

Date: 5-26-94

TEMPORARY FACILITIES

DETAILS OF REVISIONS

This document has been revised as follows:

Revision No.	Date	Description
A	3-31-94	Issued for Approval
B	5-24-94	Construction Issue

TEMPORARY FACILITIES

1.0 GENERAL

1.1 Summary

A. Scope of Specification

This specification prescribes requirements for the establishment, maintenance, and removal of temporary office and construction facilities as required herein for the entire duration of the project.

1.2 Submittals

Submit the following items. Submittals are for the record or approval, as indicated.

- Layout of the Personnel Decontamination Facility for approval.
- Layout of Project Site Manager's office space for approval.
- Layout of Testing Lab office space for approval.
- Layout of any additional space requirements for approval.

2.0 PRODUCTS

2.1 Materials

Temporary construction facilities may be of used or new origin. If used facilities are provided, they shall be water tight (if designed to be so), clean and in good, usable condition.

3.0 EXECUTION

3.1 General

A. Transportation

Contractor shall be responsible for transportation of temporary construction facilities to and from the site including special permits, fees or escorts required for oversize loads.

B. Set-up

Contractor shall be responsible for labor, material and equipment required for proper set-up of temporary construction facilities.

1. Install concrete footings and slabs necessary for proper set-up and construction of temporary facilities.
2. Install blocking required for stability of mobile structures.
3. Install tie-downs on mobile structure not anchored to a concrete footing or slab.
4. Install skirting around construction facilities plumbed with hot and/or cold water.

C. Dismantling

Contractor shall be responsible for labor, material and equipment required to dismantle temporary construction facilities.

1. Remove blocking and tie-downs used in the set-up of temporary construction facility.
2. Remove concrete footing and/or slab used in the construction of temporary facilities.
3. Police the area occupied by the temporary facility and restore the area to its original or intended final condition.

D. Utilities

Contractor shall be responsible for costs and arrangements for service required in procuring and maintaining for the duration of the project the utility services listed below. Contractor shall be responsible for installation and removal of temporary utility lines, meters and other equipment that may be required to procure and maintain the utility. Unless otherwise specified herein,

TEMPORARY FACILITIES

Contractor shall also be responsible for payment of periodic usage charges levied by the utility companies for the duration of the project.

1. Electrical service for construction facilities as specified herein.

2. Potable water service for construction facilities as specified herein.

3. Telephone service and equipment for construction facilities as specified herein.

3.2 Contractor's Office Facilities

Contractor shall provide an on-site office facility for the entire duration of the project.

A. Office Space

Contractor's office space shall be of size to promote the proper control and execution of the project.

1. Space provided shall be ample to properly store and view the contract documents.

2. Space shall be provided for storage of first aid equipment and materials.

B. Telephones

Contractor shall provide at least one telephone in his office facility.

3.3 Personnel Decontamination Facility

Contractor shall provide and make operational a personnel decontamination facility prior to commencement of clearing, grubbing, demolition or remediation work. General requirements and layout of a typical decontamination facility are as follows:

A. The facility shall provide an organized process by which levels of contamination are reduced.

B. Each level of decontamination shall be performed at separate stations to prevent cross-contamination.

C. Stations shall be arranged in order of decreasing contamination, preferably in a straight line.

D. Separate doorways to and from the Exclusion Zone shall be provided. Signs denoting the doorway purpose (ENTRY ONLY and EXIT ONLY) shall be posted as appropriate for the final arrangement of the facility.

E. A separate doorway shall be provided from the "clean" zone inside the facility to the Support Zone outside the facility. Contractor shall provide fencing as shown on the drawings at the Support Zone doorway to prevent entrance to the Exclusion Zone from this doorway.

F. Dressing stations and lockers for personal protective equipment shall be provided.

G. The facility shall be equipped with showers plumbed for hot and cold water to assist in the decontamination process.

H. Water used in the decontamination process shall be collected in a single header and routed to the stormwater holding pond. This line is strictly for routing and disposal of decontamination water and shall not be connected to sanitary sewer lines.

I. Air handling unit(s) equipped with heating and cooling units shall be provided for the office space.

J. The facility shall be provided with lighting normal for this type of facility.

3.4 Toilet Facilities

TEMPORARY FACILITIES

Contractor shall provide and maintain temporary toilet facilities on the site for the entire duration of the project.

A. Contractor shall be responsible for janitorial services, pumping and disposal of sewage. All portable toilets shall be regularly maintained and shall be in compliance with applicable health and local regulations. As a minimum, the toilets shall be cleaned and pumped twice a week.

B. After work is completed, the portable toilets shall be removed from the site and their areas properly cleaned and disinfected.

C. Installation of septic tanks and lateral field lines will not be permitted.

3.5 Project Site Manager's Office Space

Contractor shall provide office space for Project Site Manager's personnel which meets or exceeds the minimum requirements below:

A. Office space (minimum 300 square feet) shall be provided for the entire duration of the project.

1. Shall include a conference room which will accommodate 10 persons. Shall be separated from the remaining office space by a full height partition with access from within the overall space and from the exterior.

2. Shall have at least one full height partitioned office (minimum 70 square feet).

B. Office shall be physically separate from Contractor's office space. Project Site Manager shall hold keys to the exterior doors.

C. Contractor shall provide two (2) telephone lines, including telephone equipment, for the entire duration of the project. One of the furnished telephone lines shall be suitable for "FAX" transmission. Project Site Manager shall be responsible for payment of local and long distance charges levied by the telephone company for these two lines only.

D. The office space shall be provided with lighting normal for this type of use.

E. Air handling units equipped with heating and cooling units shall be provided for the office space.

F. Office space shall include the following furniture:

1. Three (3) standard size desks.

2. Three (3) desk chairs on rollers.

3. Fourteen (14) chairs for conference room and visitor use.

4. A table(s) suitable for seating 10 persons in conference.

5. Drawing table or fabricated counter-top (minimum 6 feet long and 3 feet wide) for viewing drawings.

6. Equivalent of a four (4) drawer filing cabinet (may consist of 2 each 2 drawer cabinets).

7. Four (4) trash cans.

G. Contractor shall provide janitorial services twice a week.

3.6 Testing Lab Office Space

Contractor shall provide office space (for Testing Lab personnel) which meets or exceeds the minimum requirements below:

A. Office space (minimum 120 square feet) shall be provided for the entire duration of the

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project.

B. Office space shall be physically separate from Contractor's office space. Testing Lab shall hold keys to the exterior door(s).

C. The office space shall be provided with lighting normal for this type of use.

D. Air handling units equipped with heating and cooling units shall be provided for the office space.

E. The office space shall be equipped with a minimum twelve (12) linear feet of counter-top space. A stainless steel sink shall be installed at some location in the counter-top and plumbed with hot and cold water. Contractor shall install a drain line from this sink to the stormwater holding ponds.

F. The Testing Lab office space shall be provided with the following furniture:

1. Three (3) chairs.

2. Equivalent of a four (4) drawer filing cabinet (may consist of 2 each 2 drawer cabinets).

3. Two (2) trash cans.

G. Contractor shall provide janitorial services twice a week.

4.0 **ATTACHMENTS**
Not applicable.

End of Specification

WASTE TREATMENT

This document has been revised as indicated below and described in the revision record on the following page. Please replace all pages of this document and destroy the superseded copies.

Issue History

Revision No.	Originator	Originator's Initials	Date	Pages
A	M. Holmes	MAH	3/3/94	1-8
B	R. Franke	RKF	4/5/94	1-9
C	M. Holmes	MAH	5/24/94	1-9

New Issue: _____

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Client:	Fluor Daniel Williams Brothers:
Issued for Construction:	Issued for Construction:
Project Manager: _____	Project Manager: W L Blaker
Date: _____	Date: 5-26-94

WASTE TREATMENT

DETAILS OF REVISIONS

This document has been revised as follows:

Revision No.	Date	Description
A	3/3/94	Preliminary Design
B	04/05/94	Response to Kerr McGee Comments. Minor wording changes per Kerr McGee mark-up. Changed definition of contaminated material to include visually contaminated. Increased amount of reagent stockpile to 3 days supply. Included sulfur dioxide as an air monitoring parameter. Included Owners's representative with reference to Owner. A Note was added to clarify that waste is to be treated (neutralized and pulverized) in the waste pit whenever possible. A suggested pulverization method was added. The ASTM method for sieve analysis was added.
C	05/24/94	Construction Issue

WASTE TREATMENT

1.0 GENERAL

1.1 Summary

A. Scope of Specification

This specification prescribes the treatment requirements for waste at the locations shown on the Construction Drawings or as indicated by the Owner or Owner's representative. Waste treatment shall be performed by pulverizing the Waste and blending into the Waste a material that will neutralize the acid present in the waste such as lime, fly ash, cement, or other approved material. All work shall be performed in strict accordance with the Contractor's health and safety plan to prevent injury or illness to workers and the general public and to prevent contamination of non-contaminated areas.

The Contractor will be provided flexibility in choosing waste treatment method(s) provided that the waste is adequately neutralized in place to avoid excavation of a corrosively hazardous material. The Contractor may complete Pulverization of the Neutralized Waste following excavation and placement of the Neutralized Waste in the selected disposal cell.

B. Work Not Included

Decontamination of debris encountered during or equipment used in the performance of this work is not included in the scope of this specification.

Excavation, transportation, placement, and compaction of Neutralized Waste is not included in the scope of this specification.

C. Related Specifications

The following specifications prescribe items of related Work:

- 000.210.02200: Earthwork
- 000.230.02220: Treated Waste Excavation, Placement, and Compaction
- 000.230.02230: Decontamination

Coordinate Work prescribed by this specification with Work prescribed by the above listed specifications.

D. Related Technical Requirements and Reports

- Phase I Remedial Design Document, Cushing, Oklahoma refinery site for information concerning emission monitoring that will be performed during the remediation work.
- Contractor's Site Specific Health and Safety Plan
- Kerr-McGee Remedial Investigation and Feasibility Study Reports
- Kerr-McGee Full Scale Pilot Demonstration - A copy of the Kerr-McGee Full Scale Pilot Demonstration Final Report is included as Appendix B in the Cushing, Oklahoma Refinery Site Feasibility Study. This report presents details on reagents and equipment used during the pilot demonstration, sludge characteristics, sludge volumes, as well as other information pertinent to waste treatment.

E. Terminology

The following terms are defined as stated, unless otherwise indicated:

1. Waste - Soil or sludge material within the excavation limits indicated on the Construction Drawings or as encountered during performance of the work shall be deemed waste if it is a hydrocarbon sludge with a Ph of less than 2 or soil or material which is visually stained. This does not include soil which has been impacted from free oil.

2. In Situ Waste Treatment - Introducing and uniformly mixing in place the treatment reagents with the waste.

WASTE TREATMENT

3. Ex Situ Waste Treatment - Following In Situ Waste Treatment and excavation, uniformly mixing the in situ treated waste, if required, so as to meet the treatment criteria.

4. Treated Waste - Waste, as defined above, which, after waste treatment, has been Neutralized and Pulverized, to meet the following treatment criteria:

   a. Neutralization

      The Ph of the In Situ Neutralized Waste product shall be within a range of 9.0 plus or minus 2.0 standard pH units.

   b. Pulverization

      Pulverized Waste material shall be blended at the completion of In Situ or Ex Situ Waste Treatment such that it meets the following requirements:

      * Minimum passing 0.5 inch sieve...90 percent
      * Minimum passing 3.0 inch sieve...99.5 percent

      Excluding agglomerates of treated waste.

5. Treatment Reagent: A material approved for treatment of Waste such as:

   a. Quicklime (Calcium oxide): A white caustic substance obtained by calcining limestone in a kiln or furnace.

   b. Hydrated Lime (Calcium hydroxide): A dry powder obtained by treating quicklime with enough water to satisfy its affinity for water under the conditions of its hydration.

   c. Lime Slurry: A suspension of hydrated lime solids in water.

   d. Fly Ash: A finely divided residue that results from the combustion of powdered coal, containing varying amounts of carbon, silica, alkalies, sulfur, and other components.

   e. Cement Kiln Dust: A finely divided residue that results from the production of cement in a kiln, containing varying amounts of calcium, carbon, silica, and other components.

   f. Other treatment reagents will be considered if submitted by Contractor for approval.

1.2 References

The publications listed form part of this specification. Each publication shall be the latest revision and addendum in effect on the date this specification is issued for construction unless noted otherwise. Except as modified by the requirements specified herein or the details of the Construction Drawings, work included in this specification shall conform to the applicable provisions of these publications.

* X-Ray Diffraction Method for Mineral Percentage
* EPA Method 1310 - Concentration of Leachable Heavy Metals
* Particle Size Analysis - Reference Section A and Appendix C of Phase I Remedial Design Document

1.3 Submittals

Submit the following items. Submittals are for the record or approval, as indicated.

A. **Proposed Treatment Equipment** - Contractor shall submit manufacturer's literature containing performance specifications for all of the proposed treatment equipment.

B. **Proposed Treatment Reagents** - Contractor shall submit manufacturer's literature or other technical data for all of the proposed treatment reagents, for approval. This data shall contain at a minimum; 1) a mineral percentage compositional breakdown, as measured by the

WASTE TREATMENT

X-ray diffraction mineral percentage method, of each reagent proposed to complete treatment of the acidic sludge; 2) the chemical composition of the material so that reagent requirements can be calculated from waste acid content using stoichiometric equations. Provide sample neutralization calculations for an assumed acid content of 10% sulfuric acid, by weight.

Contractor shall submit manufacturer's literature, Material Safety Data Sheet (MSDS), or other technical data for the proposed treatment reagents, for approval.

C. **Treatment Method** - Contractor shall submit a detailed description of the proposed treatment method consistent with Paragraph 3.0, Execution, for approval. If field conditions warrant alteration of the proposed treatment method, the Contractor shall submit a detailed description of the alternative treatment method, for approval.

D. **Quality Certification** - required by manufacturer or supplier.

1.4 **Quality Assurance**

The following quality control documentation shall be provided for the items listed below. In addition, Contractor shall submit one complete set of the documentation required below at Contract Closeout.

A. **Treatment Reagents** - The following certificates of analysis shall be provided for the record on each day's total bulk shipment. Tests shall be performed and results supplied in certificate form prior to shipment of the material to the work site.

1. Certificate of analysis by the X-ray diffraction mineral percentage method verifying the composition of the material.

2. Certificate of analysis by EPA Method 1310 verifying the bulk material does not contain more than the maximum allowable concentration of leachable heavy metals or organics. Copies of original certificate will be acceptable for multiple shipments provided that the manufacture process remains consistent and applicable to each shipment.

B. **Weight Tickets** - Contractor shall submit a copy of the truck weight ticket certification for each bulk shipment of material required for execution of the work.

1.5 **Product Delivery and Handling**

A. **Delivery** - Contractor shall transport, handle and store bulk shipments of materials required under this section as follows:

1. Treatment Reagents shall be delivered to the jobsite with the manufacture's name and certified weight provided.

2. Truck beds shall be dry and free of dirt, grease, oil, or other deleterious material.

3. Bulk materials shall be protected during shipment by watertight covers to protect the material from the elements and to prevent loss of material.

4. Bulk shipments shall not be off-loaded at the site until the Owner or Owner's representative has visually inspected the material and has received and approved any test certificates required herein.

5. Approved bulk materials shall be off-loaded in free draining areas designated on the Construction Drawings or as directed by the Owner or Owner's representative to prevent water damage to the material from ponded water. If off-loaded on the ground, Contractor shall take measures to prevent stockpiled bulk material from becoming mixed with the supporting and surrounding ground surface.

6. Approved bulk materials shall be off-loaded making effort mitigation dust emissions by utilizing appropriate dust control measures.

7. Bulk material shall not be off-loaded during rainfall events or periods of high winds. The Owner or Owner's representative will determine if high wind conditions exist.

8. Contractor shall stage shipments of bulk materials so that large stockpiles of material will not be present on the project site at any one time. Contractor shall not stockpile more reagents than can normally be used in three days, except as approved by the Owner or Owner's representative. Any material that is not used during the performance of the day's work shall be covered to prevent damage by the elements and loss of material.

B. **Inspection** - Each bulk shipment of treatment reagents will be subject to inspection by the Owner or Owner's representative.

Treatment reagents will be visually inspected to verify that the material is free of excess moisture and other contamination.

Bulk material shall not contain foreign material, including, but not limited to, rocks, organic materials and trash.

If the bulk material is deemed unacceptable upon visual examination by the Owner or Owner's representative, the material shall be removed from the site and replaced with acceptable material at the Contractor's expense.

C. **Storage and Handling** - Materials shall be stored at the location shown in the Construction Drawings and in a manner that prevents their degradation.

Bulk material deposited at the work site shall be protected by watertight covers.

Contractor will not be paid for excess bulk materials delivered or remaining on the site after all remediation work is complete. Removal of excess bulk materials delivered or remaining on the site after all remediation work is complete shall be at the Contractor's expense.

1.6 Site Conditions

A. **Existing Conditions**

Take precautions to prevent damage to equipment caused by debris encountered during waste treatment work.

B. **Environmental Requirements**

Contaminated surface water runoff shall be contained on the work site or channeled to a stormwater treatment area to avoid hazards to surrounding properties and waterways.

C. **Sequencing and Scheduling**

Work within right-of-ways shall be coordinated with the appropriate governing authority and shall be performed in a manner which does not interfere with surrounding traffic or operations.

2.0 PRODUCTS

2.1 General

Waste treatment products shall consist of Treatment Reagents such as hydrated lime (calcium hydroxide) in dry or slurry (wet) form, fly ash, portland cement, or other approved agents.

2.2 Materials

A. **Treatment Reagents** - Treatment Reagents shall consist of a dry powder, pellet, or slurry. A slurry shall be obtained by treating the reagent with enough water to satisfy its affinity for water under the conditions of its hydration.

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A certificate of chemical analysis from the manufacturer or supplier shall be provided for each bulk shipment of treatment reagents. I shall certify that the shipment does not contain more than the maximum allowable concentration of leachable heavy metals or organics based on TCLP analysis.

B. Water - Water used for dust control or as otherwise required herein shall be obtained from potable water sources. If temporarily stored, the container shall be relatively free from deleterious amounts of acid, alkali, salt and organic materials. Contaminated water contained on site may be used for dust control or as otherwise required herein following Neutralization and approval from the Owner or Owner's representative.

2.3 Equipment

Contractor shall provide all machinery, tools, and equipment necessary to obtain the specified results.

3.0 EXECUTION

3.1 General

During remedial operations, the respirable dust and sulfur dioxide levels will be monitored at several locations along the property boundary. If the concentration of PM-10 dust or sulfur dioxide exceeds the limits stated in the Phase I Remedial Design Document, Contractor shall cease the operation causing the excessive PM-10 dust or sulfur dioxide until the contractor provides the means or methods to control the dust or sulfur dioxide emissions.

Neutralization of Waste shall be completed in situ when possible.

Pulverization of Waste may be completed in situ or ex situ.

3.2 Waste Treatment

NOTE!!! Waste treatment should be completed in the waste pit to the extent practical and in all cases the pH of contaminated material must be greater than 2.0 before excavation. If complete waste treatment is not feasible or additional pulverization is necessary, the additional treatment or pulverization may be completed after placement in the waste pit and before final compaction.

The method tested to achieve pulverization of the treated waste was to use a road bed tiller. Two passes over a 12 inch lift of treated waste using the road bed tiller operating at a speed not exceeding 0.5 foot per second and a rotor speed of the tiller blades a minimum 290 revolutions per minute has been an effective pulverization method in similar situations.

A. In Situ Waste Treatment

1. Neutralization of Waste shall be performed using the equipment and treatment reagents specified in the Contractor's submittal described in Paragraph 1.3.A and B.

2. Neutralization of Waste shall be performed according to the method described in the Contractor's submittal described in Paragraph 1.3.C.

3. Waste areas shall be Neutralized in place and excavated in layers. As each layer is treated and excavated, the underlying layer will be analyzed by the Owner or Owner's representative to determine if waste is present and if additional treatment is necessary. Contractor shall maintain a sufficient layer (minimum of 2 inches) of Neutralized Waste over Waste during excavation of Neutralized Waste to control adverse air emissions from Waste.

4. Based on the testing results, Contractor will be provided information from the Owner or Owner's representative concerning the estimated amount of treatment reagents necessary to complete Neutralization of the Waste layer. The designated amount of treatment reagents will be applied according to the Contractor's submittal described in Paragraph 1.3.C.

5. Treatment and excavation of waste shall continue until non-contaminated material is encountered in the surrounding or supporting strata. If static groundwater is encountered, the Contractor shall control groundwater according to Treated Waste

Excavation, Placement, and Compaction Specification 000.230.02220, to the extent necessary so that treatment can continue without interference from groundwater.

6. If dry treatment reagent is used, it shall be applied in such a manner as to reduce dusting. Treatment Reagent should be applied only to such areas as can be mixed into the waste during the same day as application to prevent wind dispersal.

7. Contractor shall spread water over the work area as needed during all phases of the remediation work to control dust migration from the work area or to provide moisture to complete the neutralization reaction.

8. Continue waste treatment as described by Contractor under Paragraph 1.3.C until the Treatment Reagent has been sufficiently blended with the waste to meet the pH treatment standard under Paragraph 1.1.E.4.a. Continue with mixing and the application of the required amount of water and Treatment Reagent until a thorough and uniform mix has been obtained.

9. The pH of the Treated Waste will be tested and approved by the Owner or Owner's representative before excavation under Treated Waste Excavation, Placement and Compaction Specification 000.230.02220.

10. A sieve analysis of the Treated Waste will be performed by the Owner or Owner's representative before excavation under Treated Waste Excavation, Placement and Compaction Specification 000.230.02220.

11. If Waste Treatment (Neutralization and Pulverization) has been accomplished and accepted by the Owner or Owner's representative, Contractor shall excavate, transport, place, and compact the Neutralized waste in the designated disposal cell in accordance with the requirements of Treated Waste Excavation, Placement and Compaction Specification 000.230.02220.

12. If Neutralization has been accomplished and accepted by the Owner or Owner's representative, Contractor shall excavate and complete Ex Situ Waste Treatment in accordance with the requirements of Paragraph 3.2.B.

B. Ex Situ Waste Treatment

1. Waste areas that will not support spreading, mixing, and excavation equipment, may, at the discretion of the Owner or Owner's representative, be treated by this method.

2. If Neutralization has been accomplished and accepted by the Owner or Owner's representative, Contractor shall excavate and place Neutralized waste in accordance with the requirements of Treated Waste Excavation, Placement, and Compaction Specification 000.230.02220.

3. Following excavation and placement of Neutralized waste and prior to compaction of the Treated Waste, Contractor shall pulverize the Neutralized Waste such that it meets the Particle Size Analysis specified in Paragraph 1.1.E.4.b.

4. A sieve analysis of the Treated Waste will be performed by the Owner or Owners representative before compaction under Treated Waste Excavation, Placement, and Compaction Specification 000.230.02220.

5. If Waste Treatment is accepted by the Owner or Owner's representative, compaction shall be completed according to Treated Waste Excavation, Placement, and Compaction Specification 000.230.02220.

3.3 Safety Precautions

Contractor shall perform Waste Treatment in accordance with the Contractor's Site Health and Safety Plan.

4.0 ATTACHMENTS

None

End of Specification

TREATED WASTE EXCAVATION, PLACEMENT, AND COMPACTION

This document has been revised as indicated below and described in the revision record on the following page. Please replace all pages of this document and destroy the superseded copies.

Issue History

Revision No.	Originator	Originator's Initials	Date	Pages
A	M. Holmes	MAH	3/3/94	1-8
B	R. Franke	RKF	4/05/94	1-8
C	M. Holmes	MAH	5/24/94	1-8

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Revised Sheets Only Attached: _____

Entire Document Re-issued: X

Client:

Issued for Construction:

Project Manager: _____

Date: _____

Fluor Daniel Williams Brothers:

Issued for Construction:

Project Manager: M J Blaker

Date: 5-26-94

TREATED WASTE EXCAVATION, PLACEMENT, AND COMPACTION

DETAILS OF REVISIONS

This document has been revised as follows:

Revision No.	Date	Description
A	3/3/94	Preliminary Issue
B	4/5/94	Response to Kerr McGee comments. Minor wording changes per Kerr McGee mark-up. Changed definition of contaminated material to include visually contaminated. Clarified that Owner may require contractor to procure independent surveyor, at Owner's discretion. Included sulfur dioxide as an air monitoring parameter. Included Owners's representative with reference to Owner.
C	5/24/94	Construction Issue

TREATED WASTE EXCAVATION, PLACEMENT, AND COMPACTION

1.0 GENERAL

1.1 Summary

A. Scope of Specification

This Specification prescribes the requirements for the following:

- The excavation required for Treated Waste from areas shown on the Construction Drawings, directed by the Owner or Owner's representative, or as specified herein.
- The placement and compaction of Treated Waste in the disposal cell designated by the Owner or Owner's representative.
- The control of surface runoff and groundwater for the safe and efficient execution of the work.

B. Work Not Included

Placement and compaction of backfill material in excavated waste pit areas is not included in this Specification.

C. Related Specifications

The following specifications prescribe items of related Work:

- 000.210.02115: Topsoil Removal, Stockpiling and Importing
- 000.230.02230: Decontamination
- 000.220.01000: General Requirements
- 000.230.02210: Waste Treatment
- 000.210.02200: Earthwork

Coordinate Work prescribed by this Specification with Work prescribed by the above listed specifications.

D. Related Technical Requirements and Reports

- Phase I Remedial Design Document, Cushing, Oklahoma refinery site for information concerning emission monitoring that will be performed during the remediation work.
- Contractor's Site Specific Health and Safety Plan
- Kerr-McGee Remedial Investigation and Feasibility Study Reports
- Kerr-McGee Full Scale Pilot Demonstration - A copy of the Kerr-McGee Full Scale Pilot Demonstration Final Report is included as Appendix B in the Cushing, Oklahoma Refinery Site Feasibility Study. This report presents details on reagents and equipment used during the pilot demonstration, sludge characteristics, sludge volumes, as well as other information pertinent to waste treatment.

E. Terminology

The following terms are defined as stated, unless otherwise indicated:

1. Waste - Soil or sludge material within the excavation limits indicated on the Construction Drawings or as encountered during performance of the work shall be deemed waste if it is a hydrocarbon sludge with a pH of less than 2 or soil material which is visually stained. This does not include soil which has been impacted from free oil.
2. In Situ Waste Treatment - Introducing and uniformly mixing in place the treatment reagents with the waste.
3. Ex Situ Waste Treatment - Following In Situ Waste Treatment and excavation, uniformly mixing the in situ treated waste, if required, so as to meet the Pulverization treatment criteria.

TREATED WASTE EXCAVATION, PLACEMENT, AND COMPACTION

4. Treated Waste - Waste, as defined above, which, after waste treatment, has been Neutralized and Pulverized, as defined below, to meet the following treatment criteria:

   a. Neutralization

      The pH of the In Situ Neutralized Waste product shall be within a range of 9.0 plus or minus 2.0 standard pH units.

   b. Pulverization

      Pulverized Waste material shall be blended at the completion of In Situ or Ex Situ Waste Treatment such that it meets the following requirements:

      - Minimum passing 0.5 inch sieve...90 percent
      - Minimum passing 3.0 inch sieve...99.5 percent

      Excluding agglomerates of treated waste.

5. Potentially Radiologically Contaminated Area - Areas identified by Kerr-McGee that may contain radiological contamination.

6. Radiological Contamination - Sludge identified by Kerr-McGee that contains a greater concentration of uranium or thorium above background levels.

7. Treatment Reagent: A material approved for treatment of Waste such as:

   a. Quicklime (Calcium oxide): A white caustic substance obtained by calcining limestone in a kiln or furnace.

   b. Hydrated Lime (Calcium hydroxide): A dry powder obtained by treating quicklime with enough water to satisfy its affinity for water under the conditions of its hydration.

   c. Lime Slurry: A suspension of hydrated lime solids in water.

   d. Fly Ash: A finely divided residue that results from the combustion of powdered coal, containing varying amounts of carbon, silica, alkalies, sulfur, and other components.

   e. Cement Kiln Dust: A finely divided residue that results from the production of cement in a kiln, containing varying amounts of calcium, carbon, silica, and other components.

   f. Other treatment reagents will be considered if submitted by Contractor for approval.

1.2 References

None

1.3 Quality Assurance

Contractor or Owner, at Owner's discretion, shall procure an independent surveyor licensed in the State of Oklahoma to prepare surveys for project records and basis of Contractor payments. Surveys for project records and basis of payment shall be provided directly to Owner with a copy sent directly to Contractor's office. Contractor shall submit, under written transmittal, a complete and organized set of the project record documentation listed below at Contract Closeout. Any documentation submitted in part as a basis for payment shall be in addition to the complete set required at Contract Closeout. Project record documentation shall be referenced per area or item of work and shall be in chronological or numerical order.

The following project record documentation will be prepared and signed by an independent surveyor licensed in the State of Oklahoma.

TREATED WASTE EXCAVATION, PLACEMENT, AND COMPACTION

1. Cross-sections showing ground surface after all selective demolition and site clearing has been completed by the Contractor and accepted by the Owner. Sections lines shall be spaced no more than 50 feet apart. Elevation shots shall be taken along section lines at breaks in grade and no more than 50 feet apart.

2. Reduced field notes and sketches adequately defining the actual or specified excavation limit or as required to show the horizontal or vertical break between waste and non-contaminated material layers for record and basis of payment.

3. Cross-sections of the entire project site after excavation of treated material has been completed. Cross-sections shall be taken along the same section lines established for Paragraph 1.3.A.1.

1.4 Site Conditions

Existing site geological conditions have been investigated by Kerr-McGee and documented in the reports referenced in Paragraph 1.1.D. The information contained in the reports shall not be construed as a guarantee of the depth, extent, or character of materials actually present.

2.0 PRODUCTS

None

3.0 EXECUTION

3.1 General - General requirements of this section are as follows:

A. Air Emissions Control

During remedial operations, respirable dust and sulfur dioxide will be monitored at several locations along the property boundary. If the maximum allowable concentration of respirable dust or sulfur dioxide exceeds the limits stated in the Phase I Remedial Design Document, Contractor shall cease the operation causing the excessive air emissions and shall provide means or methods to control air emissions.

B. Preparation

1. Preliminary Site Examination

   Notify Owner or Owner's representative of any obstructions that will prevent accomplishment of the work as indicated on the Construction Drawings or in these specifications.

2. Stripping and Stockpiling

   Strip and stockpile Non-contaminated Material near areas to be excavated separately from excavated Treated Materials. Protect Non-contaminated Material stockpiles from contamination during performance of the work.

3. Erosion and Siltation Control, Prevention, and Abatement

   Before starting earthwork operations on any particular area of the project site, install measures for the control, prevention, and abatement of erosion and siltation for that area as required by the Construction Drawings and by Specification 000.210.02200, Erosion Control.

4. Waste Treatment and Testing

   * Prior to excavation, waste must be treated in accordance with Specification 000.230.02210, Waste Treatment. Prior to excavation, the area to be excavated will be tested by the Owner or Owner's representative to verify adequate waste treatment.

   * Owner or Owner's representative will screen Potentially Radiologically Waste for Radiological Contamination prior to waste excavation.

TREATED WASTE EXCAVATION, PLACEMENT, AND COMPACTION

C. Protection

1. Slope Stabilization

- Unless otherwise indicated on the Construction Drawings, or directed by the Owner or Owner's representative, Contractor shall perform all excavation and backfilling operations using side slopes not steeper than 3:1 (3 feet horizontal to 1 foot vertical). Vertical cuts exceeding 4 feet will not be allowed unless properly shored or braced per OSHA standards.

- For excavations outside of fenced exclusion zones, Contractor shall provide barricades conforming to applicable OSHA regulations around open holes and depressions occurring as part of the work. Open holes and depressions outside the temporary fence limits shall also be provided with warning lights which will operate from dusk to dawn. The Contractor shall also protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by operations under this Specification.

2. Protection and Restoration of Surface

Protect newly compacted areas from damage due to traffic, erosion, or settlement.

D. Control Of Water

Prevent or control water flow into excavations, or water accumulation in excavations, to ensure that the bottoms and sides of excavations remain firm and stable throughout construction operations. Groundwater levels fluctuate with climatic conditions and Contractor shall make his own assessment of the extent of rain water and groundwater to be encountered, and the equipment required to support Contractor's schedule for completion of the work.

1. Surface Waters

Plan and conduct excavation operations so as to minimize the disruption of stormwater drainage in the vicinity of the work. Provide diversion ditches, dikes, and other suitable measures to control and direct runoff around and away from the excavation. Protect the sides of excavations from erosion and sloughing caused by stormwater runoff. Promptly remove stormwater accumulations in excavations and dispose of water according to Paragraph 3.1.D.3. The systems and equipment for controlling surface water shall be of sufficient capacity to accommodate the runoff rate expected from the 2 year (50 percent annual chance) rainfall event, with no significant disruption of the construction schedule, or damage to existing features or facilities in the vicinity of the work.

2. Groundwater

When the bottom of the excavation must be carried to an elevation below the groundwater piezometric surface, or to such proximity to the piezometric surface that the excavation bottom will become soft due to its being saturated by groundwater, take measures to lower the piezometric surface sufficiently to maintain the stability of the excavation bottom. Design the groundwater control system using accepted professional methods of design and engineering consistent with the best modern practice. The system may include trenches and sumps with pumps, well points, or such other equipment, appurtenances, and related earthwork necessary to achieve the groundwater control needs of the work. Carefully design and operate the system to avoid damage to existing structures and other facilities in the vicinity of the work.

3. Disposal of Removed Water

Rain water runoff or groundwater accumulated in depressions created by the remediation work shall be removed from the area and disposed by any of the following methods:

- Distribute over other areas within the remediation limits. Contractor shall take care to ensure that any distributed runoff does not hamper remediation operations in progress or migrate outside the remediation limits.

- Temporarily store water in a manner approved by the Owner or Owner's representative and later distribute within the remediation limits for dust control or to facilitate waste treatment or as needed to achieve proper compaction of backfilled material within the remediation limits.

- Convey water removed by the water control systems to an existing stormwater drainage facility that has sufficient capacity to accommodate the flow rates involved without damage. Owner or Owner's representative will secure permits or other approvals required from authorities having jurisdiction for such stormwater discharge.

- Other procedures which may be submitted by the Contractor and approved by the Owner or Owner's representative.

4. System Removal

After completing construction operations needing water control, remove materials, equipment, and other facilities used for that purpose, and clean up and restore affected areas as required.

3.2 Excavation

A. Treated Waste

Maintain a sufficient layer (minimum of 2 inches) of Neutralized Waste over Untreated Waste during excavation of Neutralized or Treated Waste to control adverse air emissions from Waste.

B. Non-contaminated Material Excavations

Excavate Non-contaminated Material separately from Neutralized or Treated Material. Maintain separation between excavated Neutralized or Treated Waste and Non-contaminated Material to avoid mixing of Neutralized or Treated Waste and Non-contaminated Material.

For requirements governing stockpiling of Non-contaminated Material and backfilling of excavated waste pits, see Earthwork Specification 000.210.02200.

3.3 Placement

A. Treated Waste

Contractor shall not place excavated Neutralized or Treated Waste in the designated disposal cell until the subgrade or previously compacted Treated Waste layer has been inspected, tested, and approved by the Owner or Owner's representative.

Place Neutralized or Treated waste in even loose lift layers not exceeding 8 inches in depth. The maximum compacted lift shall not exceed 6 inches thick.

Maintain drainage of the disposal cell area to prevent runoff ponding and possible delay of work during Neutralized or Treated Waste placement and compaction operations.

B. Radiologically Contaminated Waste

Place excavated Radiologically Contaminated Waste in the stockpile area designated by Owner or Owner's representative.

3.4 Compaction

Contractor shall not compact treated material until the lift has been inspected, tested, and approved by the Owner or Owner's representative. Additional Ex Situ Treatment under Waste Treatment Specification 000.230.02210 may be required prior to waste compaction.

The treated waste shall be placed in an eight inch loose lift and compacted.

Small, portable rammers or vibratory plate compactors shall be utilized within 5 feet of debris disposed in the cell. Self-propelled or towed compaction equipment shall be utilized elsewhere

within the disposal cell.

Compact backfill material at a moisture content suitable for that material using appropriate compaction equipment. When water must be added, distribute it uniformly over the surface of the layer, and thoroughly incorporate it into the Treated Waste by manipulation (plowing, discing, raking, or blading) to achieve a uniform distribution of moisture throughout the material. When the moisture content is excessive, defer compaction until the material has dried to a suitable moisture content. Natural drying may be accelerated by manipulation to increase the rate of evaporation, or by blending in a dry material. If drying is accomplished by blending in a dry material, take care not to exceed the specified maximum layer thickness for compaction. Remove any excess material from the layer before compaction.

The unconfined compressive strength of treated material shall be a minimum of 25 psi throughout the compacted lift following compaction.

3.5 Testing

Observation and testing of all earthwork shall be supplied by the Owner or Owner's representative.

A. Waste Compaction Testing

Unconfined compressive strength of compacted treated material will be measured in accordance with manufacture's instructions for a penetrometer and in accordance with the Phase I Remedial Design Document.

B. Frequency And Location Of Testing

Field sieve analysis and unconfined compressive strength tests will be performed for each 5,000 square feet, or fraction thereof, of each compacted layer of treated waste.

Field sieve analysis and unconfined compressive strength test locations will be determined by the Owner or Owner's representative and located to be representative of the area tested.

4.0 ATTACHMENTS

None

End of Specification

GENERAL DECONTAMINATION AND DISPOSAL

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Client:	Fluor Daniel Williams Brothers:
Issued for Construction:	Issued for Construction:
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Date: _____	Date: 5-26-94

GENERAL DECONTAMINATION AND DISPOSAL

DETAILS OF REVISIONS

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A	3/3/94	Preliminary Issue
B	4/5/94	Response to Kerr McGee Comments. Minor wording changes per Kerr McGee mark-up. Changed definition of contaminated material to include visually contaminated. Included Owners's representative with reference to Owner.
C	5/24/94	Construction Issue

GENERAL DECONTAMINATION AND DISPOSAL

1.0 GENERAL

1.1 Summary

A. Scope of Specification

This specification describes decontamination of debris removed from within an exclusion zone and decontamination of heavy equipment when exiting an exclusion zone. In addition this specification governs disposal of solid wastes. The intent of this specification is to prevent contaminated material from being transported from a zone of exclusion to non contaminated areas.

B. Work Not Included

Personnel decontamination is not included in the scope of this specification. Refer to the site health and safety plan for personnel decontamination procedures.

Demolition and clearing and grubbing is not included in the scope of this specification.

C. Related Specifications

- 000.210.02050: Demolition
- 000.210.02110: Clearing and Grubbing
- 000.230.02210: Waste Treatment

Coordinate Work prescribed by this specification with Work prescribed by the above listed specifications.

D. Related Technical Requirements and Reports

- Contractor's Site Specific Health and Safety Plan
- Kerr-McGee Remedial Investigation and Feasibility Study Reports

E. Terminology

The following terms are defined as stated, unless otherwise indicated:

1. Contaminated Debris - Demolished structures, equipment, or other solid wastes soiled with waste.
2. Waste - Soil or sludge material within the excavation limits indicated on the Construction Drawings or as encountered during performance of the work shall be deemed waste if it is a hydrocarbon sludge with a pH of less than 2 or soil or material which is visually stained. This does not include soil which has been impacted from free oil.
3. Decontamination - Removal of waste from debris, materials, or equipment.
4. Potentially Radiologically Contaminated Area - Areas identified by Kerr McGee that may contain radiological contamination.
5. Radiological Contamination - Sludge identified by Kerr McGee that contains uranium or thorium above background concentration.
6. Removable Contamination - Contamination that can readily be removed from surfaces by contact, wiping, brushing, or washing.
7. Solid Wastes - non-hazardous material or material that has been made non-hazardous, including ash from burning non hazardous materials and decontaminated debris that can be disposed in a municipal landfill.

1.2 System Description

A. Performance Requirements

Water used for decontamination shall be collected and shall not be allowed to drain freely and leave the site. When possible, the collected water shall be used in treating acidic

GENERAL DECONTAMINATION AND DISPOSAL

sludge as described in Specification: 000.230.02210, Waste Treatment.

1.3 Submittals

A. Decontamination Water Control Plan

A Decontamination Water Control Plan shall be submitted for review and approval no less than 10 days before the scheduled date for the start of waste treatment operations. The plan shall indicate the methods and techniques to be used for control of decontamination water during Work. Decontamination operations shall not begin until the contractor obtains written approval of the Decontamination Water Control Plan from the Owner or Owner's representative.

1.4 Quality Assurance

The Owner or Owner's representative, will perform visual inspections to verify compliance of the work with the requirements of this specification and to ensure the achievement of the intents and purposes of the work. The performance or lack of performance of such tests and inspections shall not be construed as granting relief from the requirements of these specifications or the other contract documents.

2.0 PRODUCTS

Not applicable

3.0 EXECUTION

3.1 Debris and Equipment Decontamination

A. Preparation

Remove loose Waste that may be dislodged from debris or equipment prior to transporting the debris or equipment to the decontamination area.

B. Inspection

The Owner or Owner's representative may inspect any debris or equipment prior to being transported to the decontamination area.

C. Performance

Wash Removable Contamination from debris and equipment with a high pressure steam or water sprayer.

D. Field Quality Control

The Owner or Owner's representative will visually inspect Washed Contaminated Debris and equipment to determine if Decontamination has been accomplished.

Segregate equipment used in, and debris from, Potentially Radiologically Contaminated Areas to be screened for radiological contamination by the Owner or Owner's representative following decontamination. Additional decontamination may be required if radiological contamination is detected on equipment and debris during the screening by the Owner or Owner's representative. If radiological contamination cannot be removed from debris, the Owner or Owner's representative will assume responsibility for final disposition of Radiologically Contaminated Debris. The Owner or Owner's representative will direct the contractor regarding stockpiling Radiologically Contaminated Debris following the radiological screening.

3.2 Solid Waste Disposal

Contaminated Debris will be decontaminated as described in Paragraph 3.1 of this specification. The resulting Solid Waste will be disposed either by burning, salvage, or land disposal.

A. Burning

GENERAL DECONTAMINATION AND DISPOSAL

Burning on the Owner's property will be permitted for biodegradable solid waste; waste such as wood, roots, weeds, and grass. Burning shall strictly comply with applicable federal, state, and local regulations.

B. Salvage

Owner reserves the right to keep decontaminated materials and demolished structures or equipment.

C. Land Disposal

Non biodegradable solid waste such as concrete and steel, may be placed in the on site disposal cell upon approval by the Owner or Owner's representative. Otherwise, remove solid wastes from the site or burn in accordance with Paragraph 3.2.A of this specification. Off site disposal of solid waste shall strictly comply with applicable federal, state, and local regulations.

3.3 Safety Requirements

Decontaminate in accordance with Contractor's Approved the Site Health and Safety Plan and applicable OSHA requirements.

3.4 Cleanup

Remove from the project site, in accordance with Paragraph 3.2 of this specification, materials, rubbish, ashes, and other debris resulting from the work; leave the site clean and safe.

3.7 Regulations

Local regulations regarding hauling, disposal, and burning apply.

4.0 ATTACHMENTS

None

End of Specification

APPENDIX B
CONSTRUCTION DRAWINGS

KERR - McGEE

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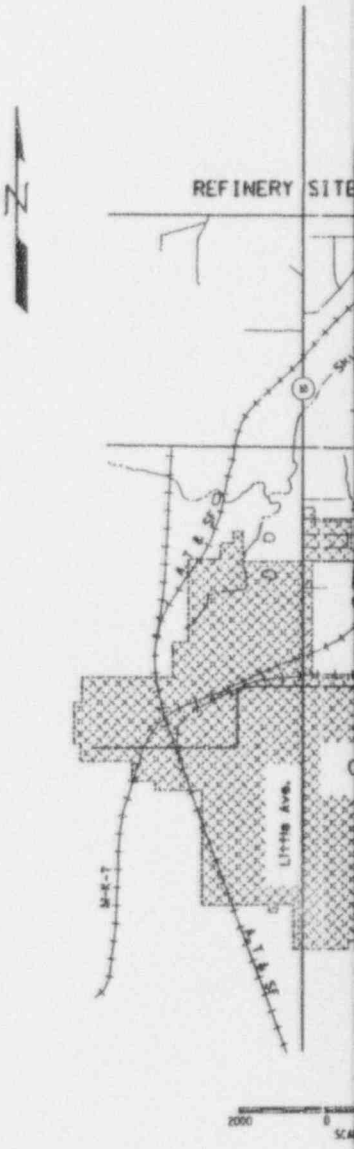
LEGEND

- DISPOSAL CELL LOCATIONS
- NEW HAUL ROADS
- EXISTING ROADS
- ALTERNATE HAUL ROAD
- CONTAMINATION REDUCTION AREA
- ACID SLUDGE PIT
- ACIDIC STORMWATER COLLECTION AND TREATMENT AREA
- BURIED DEBRIS
- ASBESTOS LANDFILL
- SKULL CREEK
- PETROLEUM STORAGE TANKS
- EXISTING MONITOR WELLS
- NEW MONITOR WELLS AND IDENTIFICATION NUMBER (MW-1)
- NEW PIEZOMETERS AND IDENTIFICATION NUMBER (P-1)
- POWER POLES
- STANDPIPE
- PROPOSED PROPERTY LINE AIR MONITORING LOCATIONS
- LIMITS OF CONSTRUCTION (SEE NOTE 1 DWG. 832100-10T-02)
- TREATMENT STAGING AREAS - GENERAL LOCATIONS
- PASSIVE UNDERGROUND DRAINAGE SYSTEM
- DRAINLINE PIPE - HIGH DENSITY POLYETHYLENE (HDPE)
- TOP OF SLOPE
- TOE OF SLOPE
- CUSHING CITY LIMITS
- STATE HIGHWAY (33)
- STRAW BALE DIKE
- RAILROAD
- 870 CONTOUR ELEVATIONS
- PROPERTY LINE
- SLOPE INDICATOR
- EXCLUSION ZONE
- FENCE
- C.R.L. CONSTRUCTION REFERENCE LINE
- GAS LINE
- SOIL MATERIAL
- CREEK FLOWLINE



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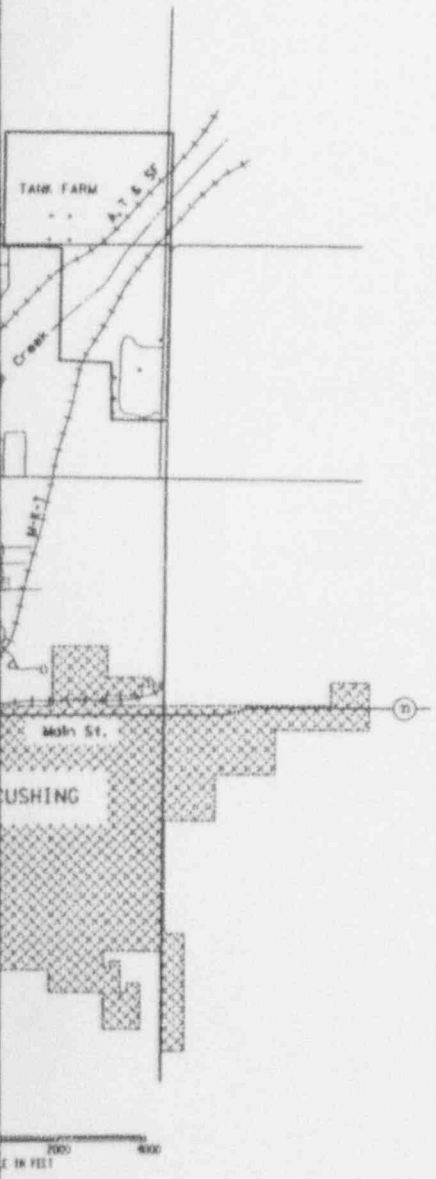


ARED BY:
EL WILLIAMS BROTHERS
ST 6TH STREET
OKLAHOMA 74121
61-9500

INDEX OF DRAWINGS

NUMBER	DESCRIPTION
832100-10T-01-C	COVER SHEET
832100-10T-02-C	GENERAL SITE AND TOPO PLAN
832100-10T-03-C	EXCAVATION AND FILL SEQUENCING PLAN
832100-10T-04-C	PLOT PLANS DISPOSAL CELLS A & B
832100-10U-01-C	FINAL GRADING PLAN, DISPOSAL CELL A, & PIT 5
832100-10U-02-B	FINAL GRADING PLAN, DISPOSAL CELL B, & PITS 1,2,3, AND 4
832100-10P-01-C	CROSS SECTIONS, DISPOSAL CELL A
832100-10P-02-C	CROSS SECTIONS, DISPOSAL CELL B
832100-10T-05-C	HAUL ROADS AND EROSION CONTROL PLAN
832100-10T-06-B	TREATMENT STAGING AREAS
832100-10P-03-C	MISCELLANEOUS SECTIONS AND DETAILS SHT. 1

GENERAL NOTES:

1. CLEARING AND GRUBBING OPERATIONS SHALL BE RESTRICTED TO THE LIMITS OF CONSTRUCTION AREAS AND SHALL BE PERFORMED ON AN AS NEEDED BASIS. REFER TO THE GENERAL SITE AND TOPO DWG. NO. 832100-10T-02 FOR LIMITS OF CONSTRUCTION.

2. CLEARING AND GRUBBING DEBRIS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL BE DISPOSED OF IN ACCORDANCE WITH LOCAL AND STATE REGULATIONS.

3. HANDLING OF STORMWATER RUNOFF WITHIN THE LIMITS OF CONSTRUCTION SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL BE CONTROLLED AS STIPULATED IN THE SPECIFICATIONS.

4. FENCING REQUIREMENTS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL BE CONSTRUCTED SO AS TO COMPLY WITH ALL FEDERAL AND STATE REGULATIONS.

5. HAUL ROAD CONSTRUCTION FROM DISPOSAL CELL "B" TO PIT "4" WILL NEED TO BE COORDINATED WITH OWNER.

6. TOPSOIL AND SOIL LAYERS SHALL BE STRIPPED AND STOCKPILED TO BE UTILIZED FOR FINAL COVER AS STIPULATED IN TOPSOIL REMOVAL, STOCKPILING AND IMPORTING SPECIFICATION 000.210.02115.

7. PROPERTY LINE AIR MONITORING WILL BE PERFORMED AS STIPULATED IN THE AIR MONITORING PLAN, SECTION 5.

8. CONTRACTORS ACCESS TO THE PROPERTY SHALL BE FROM CONTROLLED ACCESS POINTS. ACCESS TO AND EGRESS FROM THE EXCLUSION ZONE SHALL BE CONTROLLED THROUGH DECONTAMINATION AREAS ACCORDING TO THE HEALTH AND SAFETY PLAN.

9. KERR McGEE SHALL PROVIDE AREAS OUTSIDE LIMITS OF CONSTRUCTION REQUIRED FOR CONTRACTOR FACILITIES AND/OR PARKING AS NEEDED.

10. EXISTING INFORMATION SHOWN ON THE DRAWINGS (CONTOURS, ELEVATIONS, STRUCTURES, AND UTILITIES) ARE APPROXIMATE. THE CONTRACTOR SHALL VERIFY EXISTING CONDITIONS AND REPORT ANY DISCREPANCIES TO THE OWNER FOR RESOLUTION.

11. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING THE EXISTING STORMWATER DRAINAGE SYSTEMS WITHIN LIMITS OF CONSTRUCTION OR INSTALLATION OF ADEQUATE TEMPORARY SYSTEMS UNTIL ALL R/W WORK HAS BEEN COMPLETED.

12. APPROVED BULK MATERIALS SHALL BE OFF-LOADED ONLY IN DESIGNATED AREAS AND IN ACCORDANCE WITH SPECIFICATION 000.230.02210.

13. NOTIFY OWNER OF ANY OBSTRUCTIONS THAT WILL PREVENT ACCOMPLISHMENT OF THE WORK. CONTAMINATED DEBRIS ENCOUNTERED DURING WASTE TREATMENT OR EXCAVATION SHALL BE DECONTAMINATED AND DISPOSED ACCORDING TO SPECIFICATION 000.230.02230.

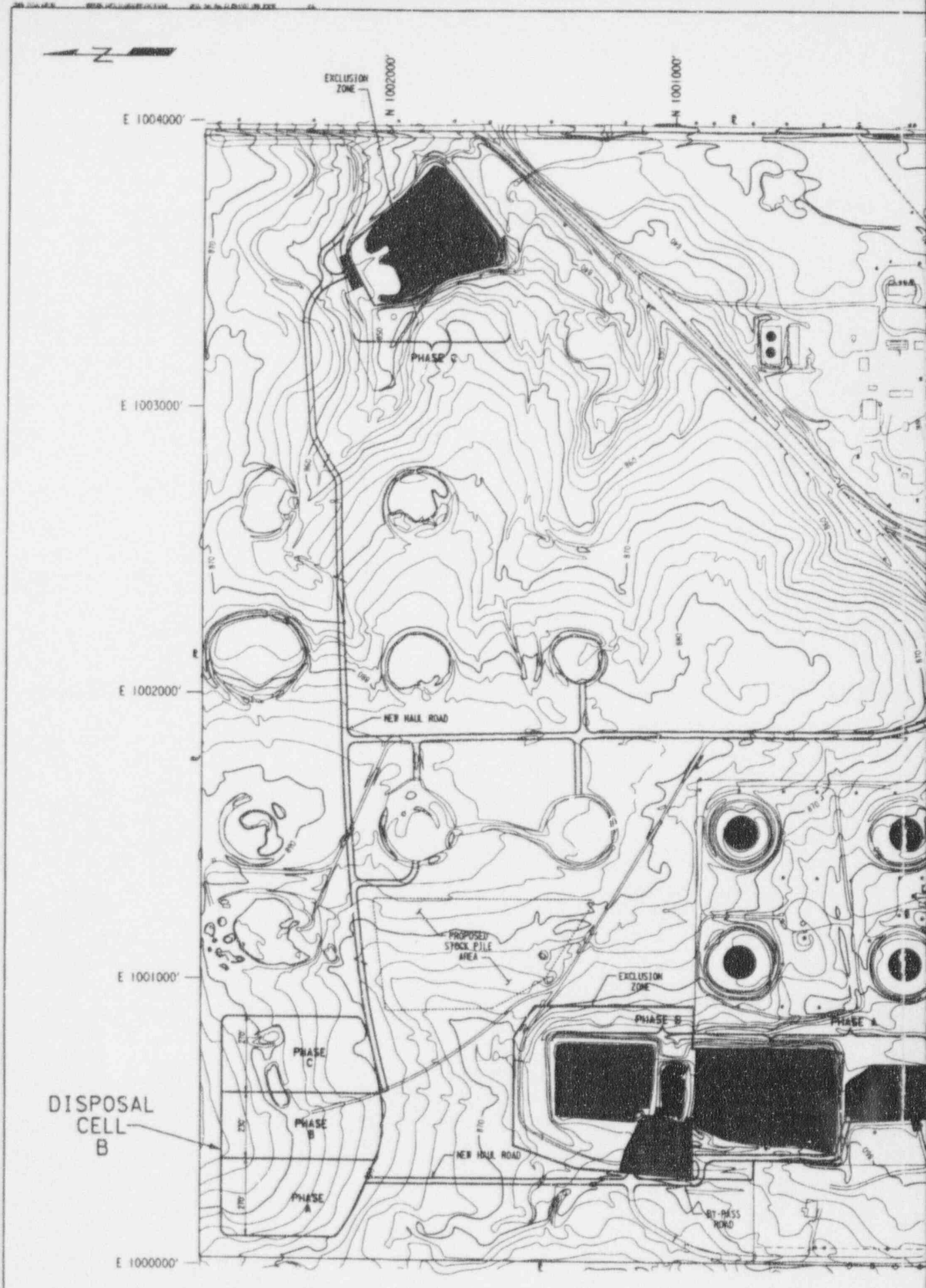
14. PIT AREAS SHOWN ON DRAWINGS ARE APPROXIMATE LOCATION OF WASTE AREAS AND ARE APPROXIMATE LIMITS OF EXCAVATION. WASTE PRESENT IN THESE AREAS OR AREAS DESIGNATED BY THE OWNER SHALL BE TREATED ACCORDING TO SPECIFICATION 000.230.02210.

15. SANDSTONE OR OTHER UNSUITABLE LINER MATERIAL ENCOUNTERED WITHIN THE PROPOSED IN SITU LINER SHALL BE REMOVED. WHEN UNSUITABLE MATERIAL HAS BEEN REMOVED, THE VOID SHALL BE BACKFILLED AND COMPACTED WITH SUITABLE CLAY MATERIAL AS STIPULATED IN EARTHWORK SPECIFICATION 000.210.02200.

16. CLAY CAPS SHALL BE PLACED IN 8 INCH LOOSE LIFTS AND COMPACTED TO 95% STANDARD PROCTOR DENSITY AT OPTIMUM MOISTURE CONTENTS OF LESS AS STIPULATED IN EARTHWORK SPECIFICATION 000.210.02210. BOTTOM 12 INCHES OF DISPOSAL CELL SHALL BE SCARIFIED AND RECOMPACTED TO 95% STANDARD PROCTOR DENSITY AT OPTIMUM MOISTURE CONTENT.

17. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE IN PLACE PRIOR TO COMMENCEMENT OF EARTHWORK OPERATION IN THAT AREA AND SHALL REMAIN IN PLACE UNTIL THE AREA IS STABILIZED BY PERMANENT VEGETATIVE COVER.

JOB NO.	DRAWING NO.	CAD NUMBER	REV
832100	832100-10T-01	210T01	C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EXCLUSION ZONE
N 1002000'
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PHASE C
NEW HAUL ROAD
PROPOSED STOCK PILE AREA
EXCLUSION ZONE
PHASE B
PHASE A
PHASE C
PHASE B
PHASE A
NEW HAUL ROAD
BY-PASS ROAD
DISPOSAL CELL B

APPROXIMATE QUANTITIES TABLE
(CONCEPTUAL SEQUENCE)

EXCAVATION ORDER	FILLING ORDER	PHASE A PIT VOLUME (TOTAL VOL.) YD³		PHASE B PIT VOLUME (TOTAL VOL.) YD³		PHASE C PIT VOLUME (TOTAL VOL.) YD³	
PIT	CELL	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
3	B	12,400 (12,400)	15,500 (15,500)	- -	- -	- -	- -
2	B	30,900 (43,300)	38,600 (54,100)	32,100 (75,400)	40,000 (94,100)	- -	- -
1	B	- -	- -	27,700 (103,100)	34,500 (128,600)	- -	- -
4	B	- -	- -	- -	- -	57,300 (160,400)	71,400 (200,000)
5	A	55,200 (55,200)	69,000 (69,000)	97,440 (152,640)	121,800 (190,800)	28,180 (180,820)	35,230 (226,030)
OTHERS ON-SITE	A	- -	- -	- -	- -	55,180 (240,000)	73,970 (300,000)

GENERAL NOTES:

1. PIT PHASES SHOWN ARE FOR INITIAL ESTIMATES ON VOLUME REFERENCES. ACTUAL ORDER OF EXCAVATION MAY BE MODIFIED BY THE OWNER.
2. DISPOSAL CELL PHASES ARE SHOWN IN PROPOSED ORDER OF CONSTRUCTION, MAY BE MODIFIED AT TIME OF CONSTRUCTION.
3. CLOSE APPROXIMATION OF VOLUMES SHOULD BE MAINTAINED THROUGH EACH PHASE TO MONITOR AVAILABLE CAPACITY OF THE DISPOSAL CELL.
4. VOLUMES SHOWN IN TABLE ARE ANTICIPATED WASTE QUANTITIES. BULKING FACTORS HAVE BEEN INCLUDED. WASTE QUANTITIES ARE FROM PIT WASTE AND ALSO INCLUDED WASTE MATERIAL FROM OTHER MINOR LOCATIONS ON SITE.
5. TREATED WASTE SHALL BE EXCAVATED ACCORDING TO SPECIFICATION BAR 230.02228.
6. SEE NOTES 8, 9, 10, 12, 13 AND 14 ON COVER SHEET, DRAWING NO. 832100-10T-01.

9406100041-04

FLUOR DANIEL WILLIAMS BRO.HERS

KERR - McGEE CORPORATION

DOCUMENT TITLE:
EXCAVATION AND FILL SEQUENCING PLAN

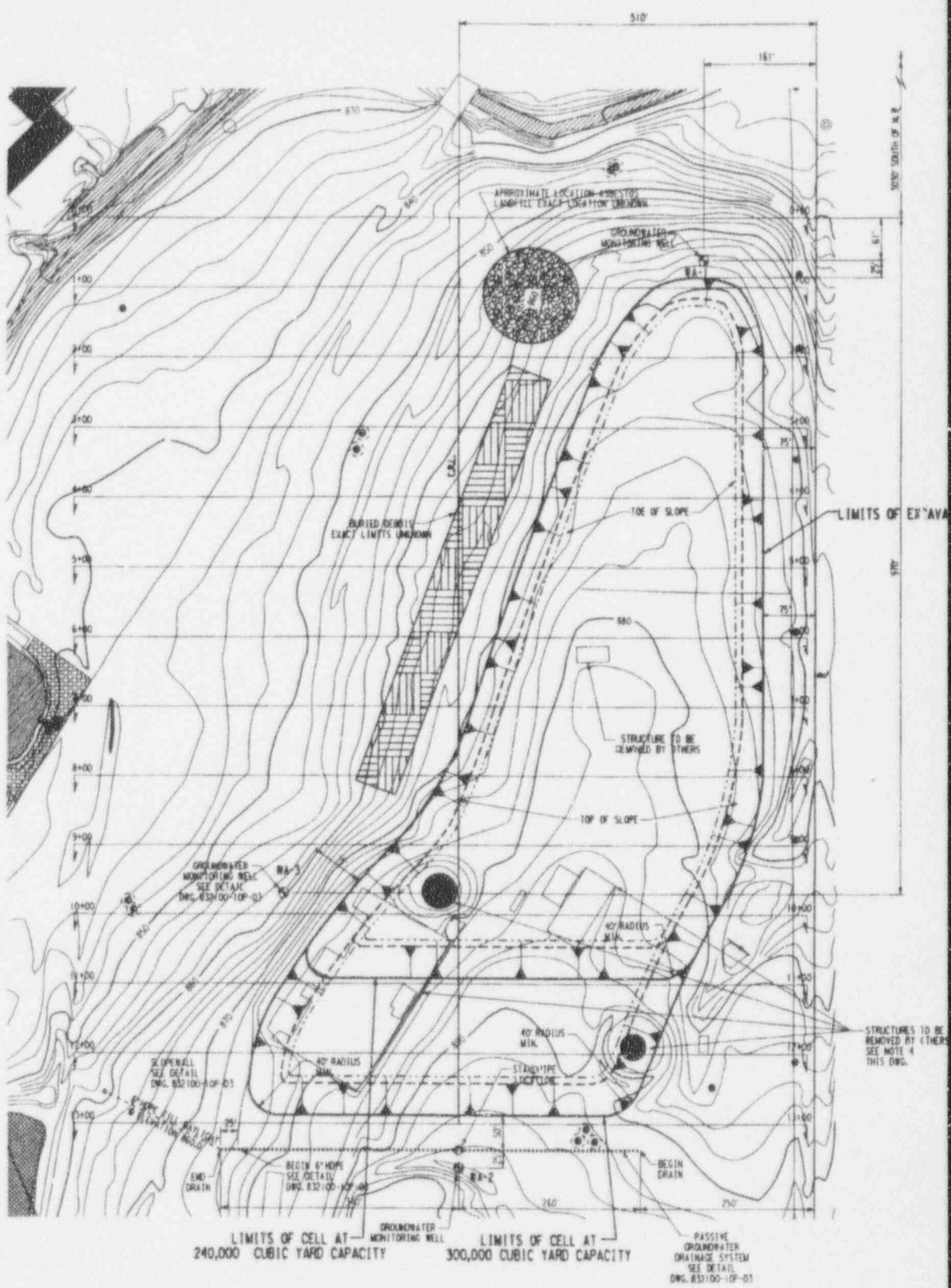
FOR CUSHING REMEDIAL DESIGN - PHASE I — CUSHING, OKLAHOMA

SCALE	JOB NO.	DRAWING NO.	CAD NUMBER	REV
1" = 200'	832100	832100-10T-03	210T03	C

NO.	REVISIONS DESCRIPTION	DRAWN	DATE	CHK.	DATE	APPR.	DATE
B	GENERAL REVISIONS PER CLIENT COMMENTS	MRS	04/01/94				
C	REVISED NOTES 2 AND 4, QUANTITIES TABLE	MLF	05/25/94				

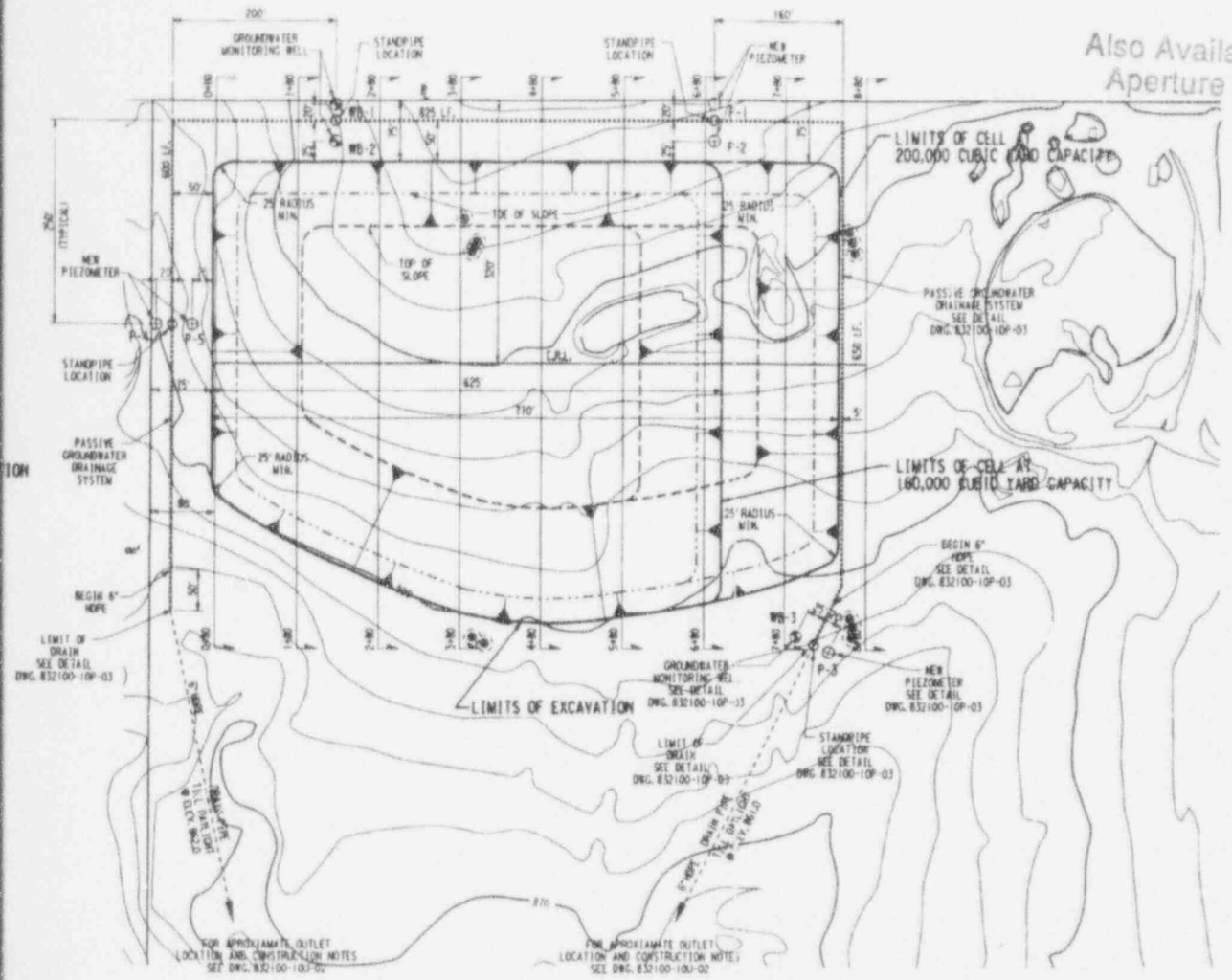
APPROVALS	BY	DATE
DRAWN	MRS	02/25/94

CURRENT DRAWING STATUS				
ISSUED FOR	SIGNATURE	DATE	REV.
INFORMATION	ENGR.		
	DRFT.		
BID	ENGR.		
	DRFT.		
CUSTOMER APPROVAL	ENGR. M.E.	05/02/94	A
	DRFT.		
CONSTRUCTION	ENGR. M.C.	6/14/94	C
	DRFT.		



DISPOSAL CELL A PLOT PLAN

FOR CROSS SECTIONS SEE DWG. 832100-10P-07



LEGEND - THIS DWG. ONLY

——— EXISTING CONTOURS
CONTOURS INTERVAL = 2 FT.

DISPOSAL CELL B PLOT PLAN

FOR CROSS SECTIONS
SEE DWG. 832100-10P-08

GENERAL NOTES:

1. EXCAVATION SHOULD NOT DISTURB BURIED DEBRIS OR BURIED ASBESTOS LANDFILL. IF ENCOUNTERED, WORK SHALL CEASE AND KERR-MCGEE IS TO BE NOTIFIED IMMEDIATELY.
2. EXISTING MONITOR WELLS SHOULD BE MAINTAINED UNLESS REMOVAL BECOMES NECESSARY.
3. DEPTH OF NEW MONITOR WELLS AND PIEZOMETERS SHALL BE AS SHOWN ON DETAIL INFORMATION.
4. NOTIFY OWNER OF ANY OBSTRUCTIONS THAT WILL PREVENT ACCOMPLISHMENT OF THE WORK. ENCOUNTERED CONTAMINATED DEBRIS SHALL BE DECONTAMINATED AND DISPOSED ACCORDING TO SPECIFICATION 000.230.02232. STRUCTURES THAT MUST BE REMOVED TO COMPLETE THE WORK SHALL BE DISMANTLED OR DEMOLISHED ACCORDING TO DEMOLITION (SURFACE) SPECIFICATION 000.210.02050.
5. EXISTING GROUNDWATER MONITORING WELLS WHICH ARE TO BE REMOVED SHALL BE ABONDONED AND PLUGGED.
6. CELL CAP AND LINER ELEVATIONS VARY, REFER TO CROSS SECTIONS FOR RESPECTIVE DESIGN ELEVATIONS.
7. SEE NOTES 10, 11, 13, AND 17 ON COVER SHEET, DRAWING NO. 832100-10T-01.
8. THE PROPOSED EXCAVATION LIMITS SHOWN ON THE DRAWINGS SHALL BE USED BY THE CONTRACTOR AS A BASE TO SUBMIT UNIT RATES FOR THE DIFFERENT ITEMS OF WORK REQUIRED IN THE CONTRACT DOCUMENTS.

REVISIONS								APPROVALS		
NO.	DESCRIPTION	DRAWN	DATE	CHD.	DATE	APPR.	DATE		BY	DATE
B	GENERAL REVISION PER CLIENT COMMENTS	BRS	04/04/94					DRAWN	BRS	02-15-94
C	REVISED NOTES 4,5 AND 8	MLK	05/20/94							

CURRENT DRAWING STATUS			
ISSUED FOR	SIGNATURE	DATE	REV
INFORMATION	CHKR.		
	DRFT.		
BIDS	CHKR.		
	DRFT.		
CUSTOMER APPROVAL	CHKR. M.B	05/20/94	C
	DRFT.		
CONSTRUCTION	CHKR. M.B	05/20/94	C
	DRFT.		

FLUOR DANIEL WILLIAMS BROTHERS

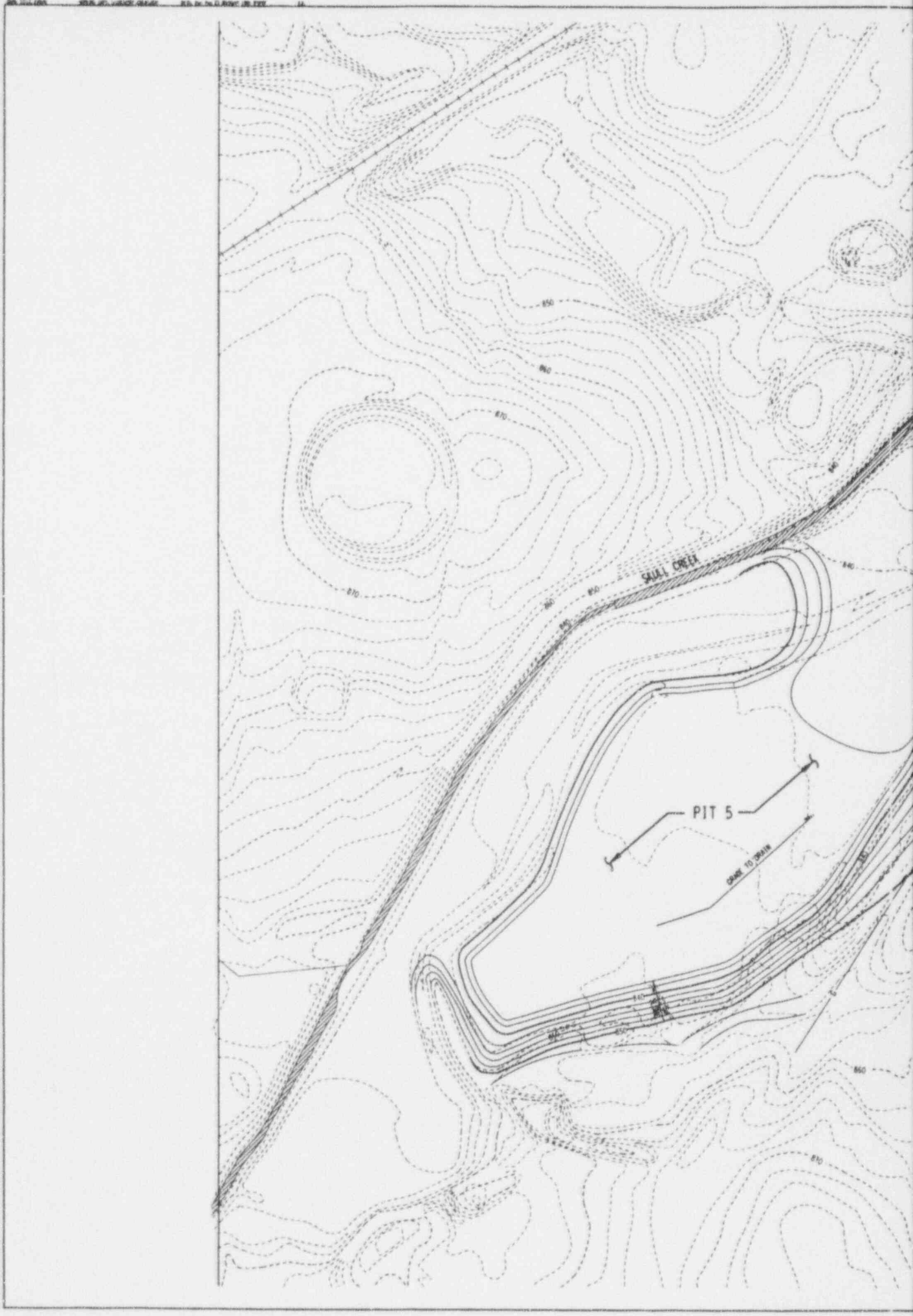
KERR - McGEE CORPORATION

DOCUMENT TITLE:
PLOT PLANS
DISPOSAL CELLS A & B

FOR CUSHING REMEDIAL DESIGN - PHASE I — CUSHING, OKLAHOMA

SCALE	JOB NO.	DRAWING NO.	CAD NUMBER	REV.
1" = 100'	832100	832100-10T-04	210T04	C

9406100041-05


SKULL CREEK
PIT 5
CRANE TO DRAIN
850
860
870
840
880
890
900
910

GENERAL NOTES:

1. CONTOURS SHOWN ARE APPROXIMATE. FINAL CONTOURS WILL DEPEND ON DISPOSAL CELL SIZE AND ACTUAL WASTE QUANTITIES AND BACKFILL QUANTITIES GENERATED.
2. FINAL CONTOURS SHALL BE ROUNDED GIVING A SMOOTH APPEARANCE.
3. LOCATION OF GAS LINE IS APPROXIMATE WELL NEED TO BE FIELD VERIFIED AND CLEARLY MARKED.
4. FINAL CONTOURS SHOWN ON DISPOSAL CELL A ARE FOR MAXIMUM CELL SIZE. CONTOURS ON THE SOUTH END WILL NEED TO BE GRADED SOMEWHAT DEPENDING UPON FINAL DISPOSAL CELL SIZE.
5. IF ADDITIONAL CONTAMINATED MATERIAL IS FOUND TO BE PRESENT OUTSIDE THE EXCAVATION LIMITS SHOWN, IT SHALL BE TREATED, EXCAVATED, TRANSPORTED, BACKFILLED, AND COMPACTED PER THE DIRECTION OF THE OWNER. PAYMENT FOR TREATED AREAS AND AREAS BACKFILLED WITH CLEAN FILL SHALL BE BASED ON MEASURED QUANTITIES AND AT THE UNIT RATES SUBMITTED ABOVE.

LEGEND - THIS DRG. ONLY

---- EXISTING TOPOGRAPHY
—— PROPOSED FINAL GRADE
CONTOUR INTERVAL = 2 FT.

9406100041-06

REVISIONS								APPROVALS			CURRENT DRAWING STATUS				
NO.	DESCRIPTION	DRAWN	DATE	DES.	DATE	APPR.	DATE		BY	DATE	ISSUED FOR	SIGNATURE	DATE	REV.
D	GENERAL REVISION PER CLIENT COMMENTS	MRS	04/04/94					DRAWN	MRS	01-08-94	INFORMATION	ENGR.		
C	ADDED NOTE 5	MLK	05/20/94									DRFT.		
											BIDS	ENGR.		
												DRFT.		
											CUSTOMER APPROVAL	ENGR. MLK	05/20/94	1
												DRFT.		
											CONSTRUCTION	ENGR. MLK	6/20/94	C
												DRFT.		

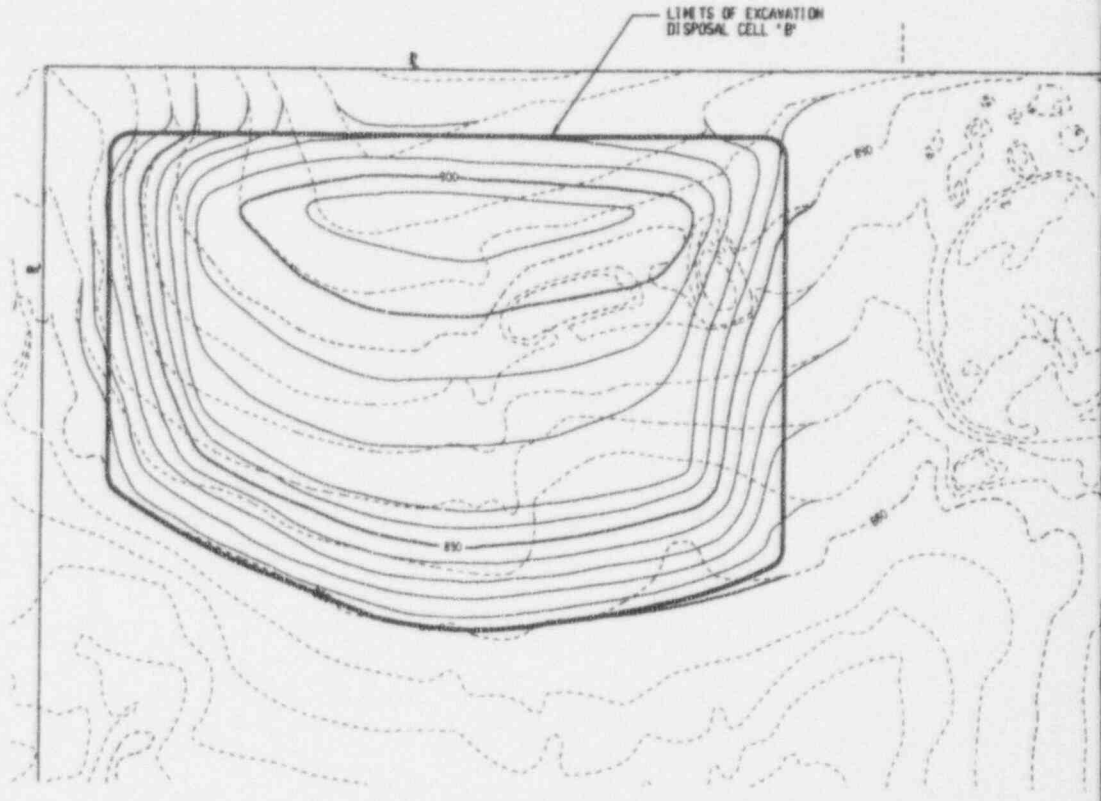
FLUOR DANIEL WILLIAMS BROTHERS

KERR - McGEE CORPORATION

DOCUMENT TITLE:
FINAL GRADING PLAN
DISPOSAL CELL A & PIT 5

FOR CUSHING REMEDIAL DESIGN - PHASE I CUSHING, OKLAHOMA

SCALE	JOB NO.	DRAWING NO.	CAD NUMBER	REV.
1" = 100'	832100	832100-10U-01	210U01	C



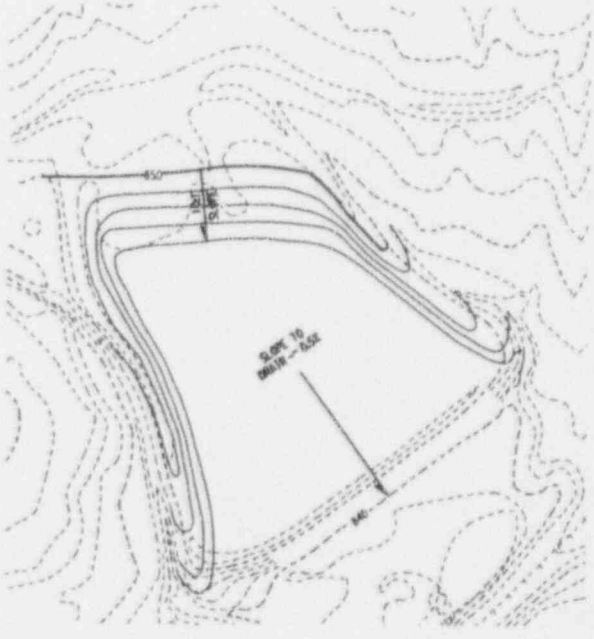
DISPOSAL CELL B PLAN

LEGEND - THIS DWG. ONLY

- - - EXISTING TOPOGRAPHY

—— PROPOSED FINAL GRADE

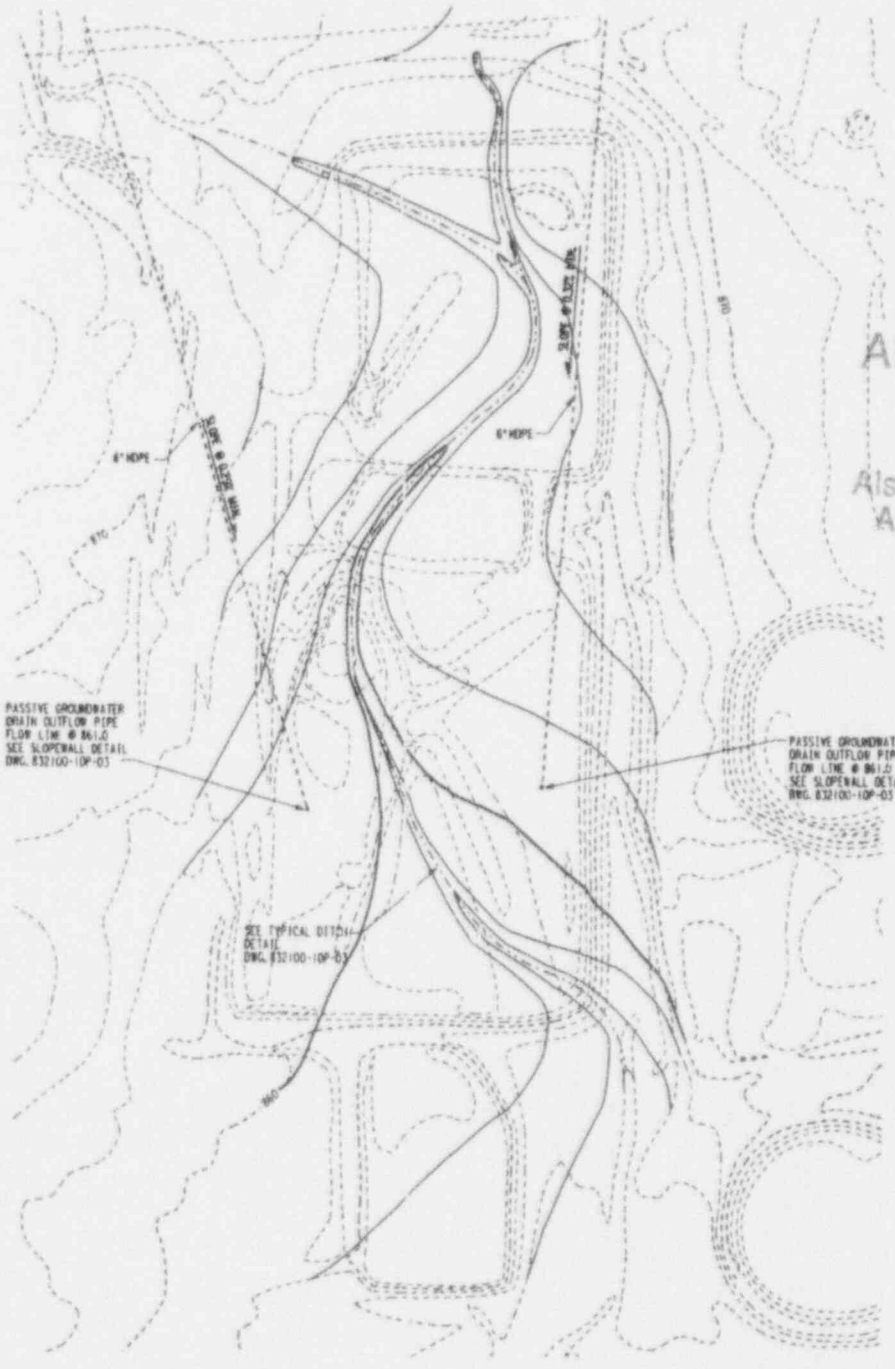
CONTOUR INTERVAL = 2 FT.



PIT 4 PLAN

GENERAL NOTE

1. CONTOURS WILL DEPE WASTE DUM
2. FINAL CON APPEARANC
3. FINAL GRA DRAINAGE.
4. FINAL CON CELL SIZE GRADED ST
5. LOCATION WILL BE D OUTFALL S PIPE FROM



HOWN ARE APPROXIMATE, FINAL CONTOURS
ND ON DISPOSAL CELL SIZE AND ACTUAL
NTITIES AND BACKFILL QUANTITIES GENERATED.

OURS SHALL BE ROUNDED GIVING A SMOOTH

E ON ALL PITS ARE TO BE FOR POSITIVE

OURS SHOWN ON DISPOSAL CELL B ARE FOR MAXIMUM
CONTOURS ON THE EAST END WILL NEED TO BE
NEARLY DEPENDING UPON FINAL DISPOSAL CELL SIZE.

F DRAINPIPE OUTFALL IS APPROXIMATE, ACTUAL LOCATION
TERMINED IN THE FIELD DEPENDING UPON FINAL GRADE.
ULD BE LOCATED SO AS TO PREVENT ANY FLOODING OF
STORMWATER RUNOFF.

PIT 1,2 & 3 PLAN

9406100041-07

REVISIONS							
NO.	DESCRIPTION	DRAWN	DATE	ENGR.	DATE	APPR.	DATE
2	GENERAL REVISION PER C.QUY COMMENTS	BRS	04/04/94				

APPROVALS		
	BY	DATE
DRAWN	BRS	02-01-94

CURRENT DRAWING STATUS				
ISSUED FOR:	SIGNATURE		DATE	REV
INFORMATION	ENGR.			
	DRFT.			
BIDS	ENGR.			
	DRFT.			
CUSTOMER APPROVAL	ENGR.	RLB	03/02/94	1
	DRFT.			
CONSTRUCTION	ENGR.	n/a	5/24/94	0
	DRFT.			

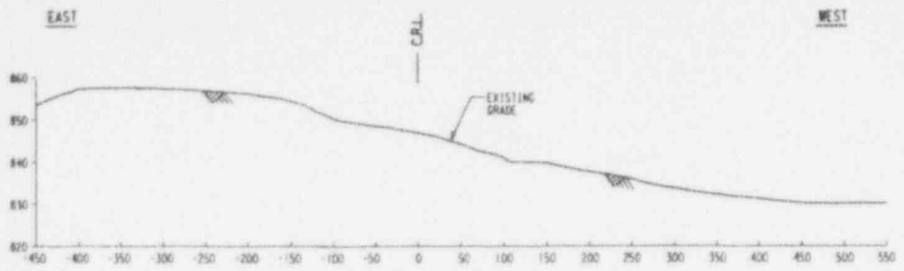
FLUOR DANIEL WILLIAMS BROTHERS

KERR - McGEE CORPORATION

DOCUMENT TITLE:
FINAL GRADING PLAN
DISPOSAL CELL B & PITS 1, 2, 3, AND 4

FOR: CUSHING REMEDIAL DESIGN - PHASE I — CUSHING, OKLAHOMA

SCALE	JOB NO.	DRAWING NO.	CAD NUMBER	REV
1" = 100'	B32100	B32100-10U-02	210U02	B



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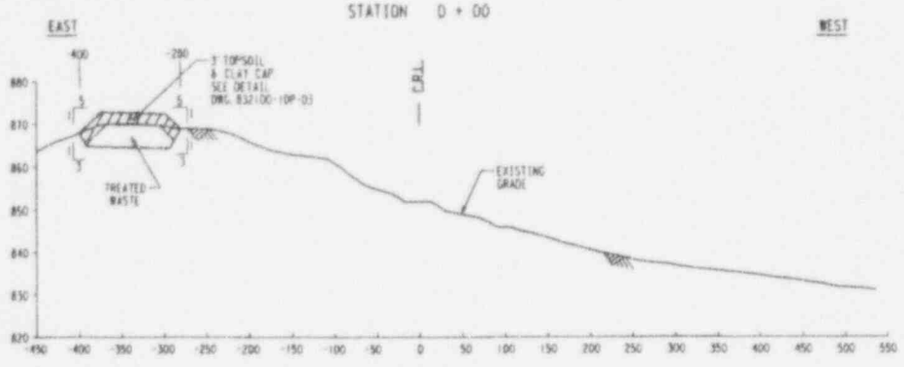

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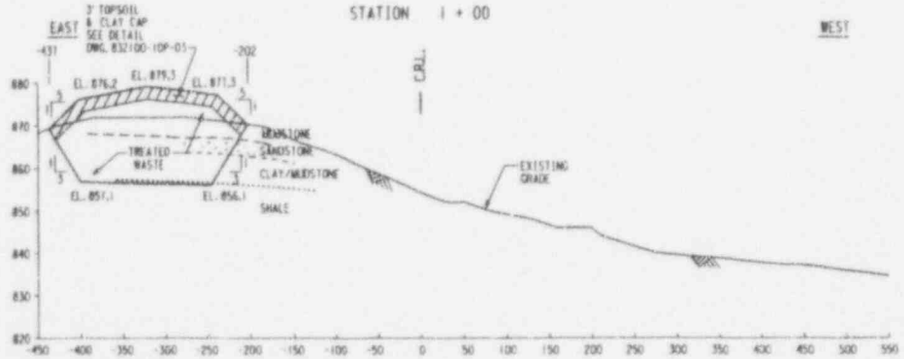

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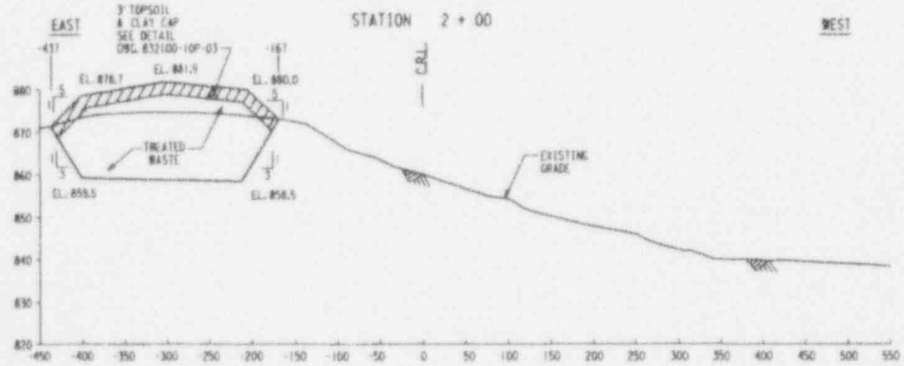

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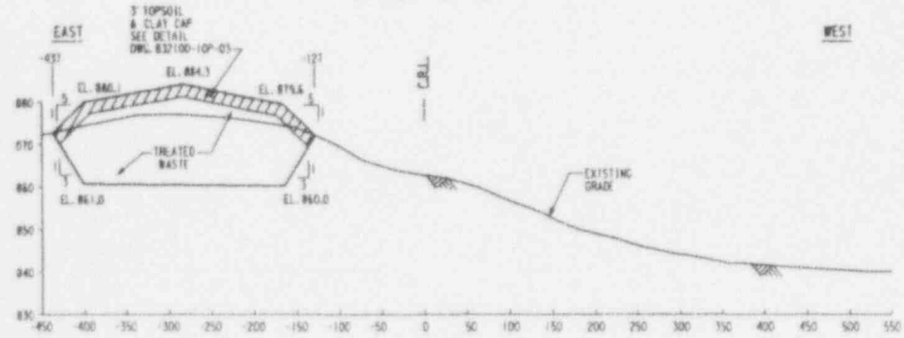

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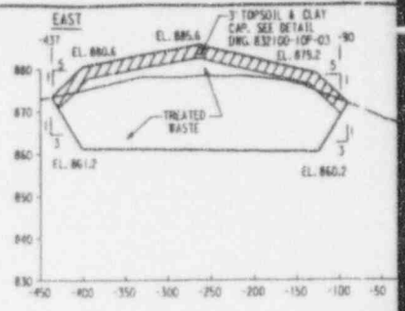

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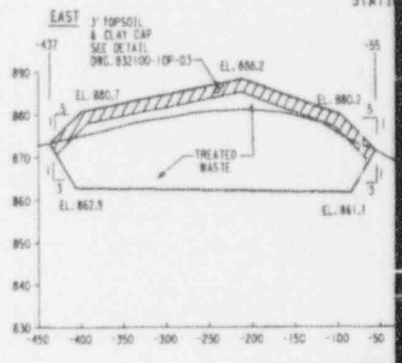

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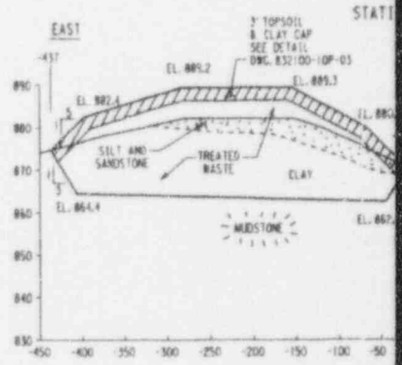

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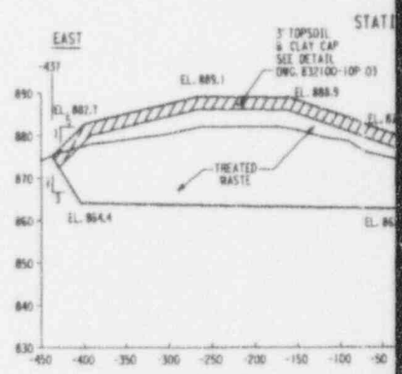

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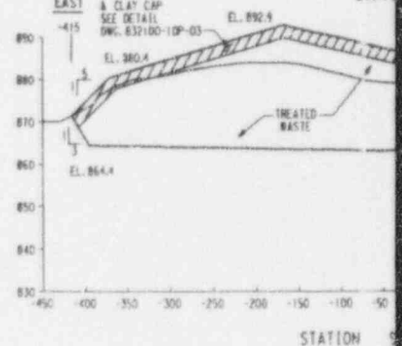

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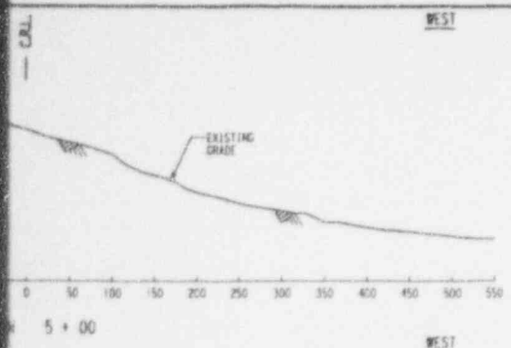

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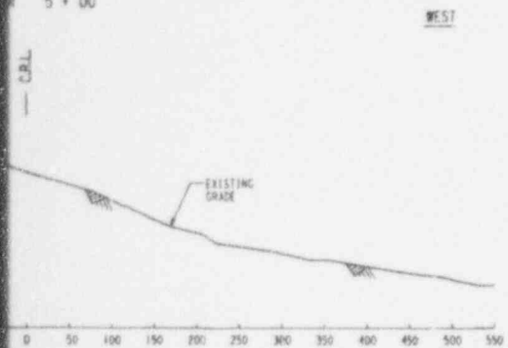

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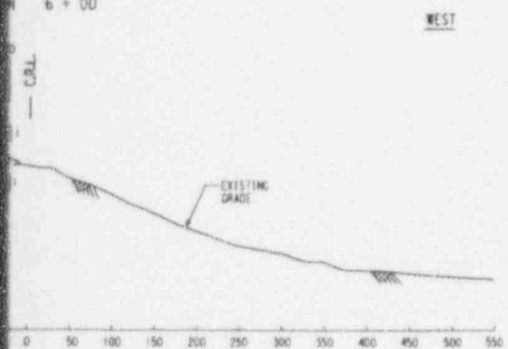

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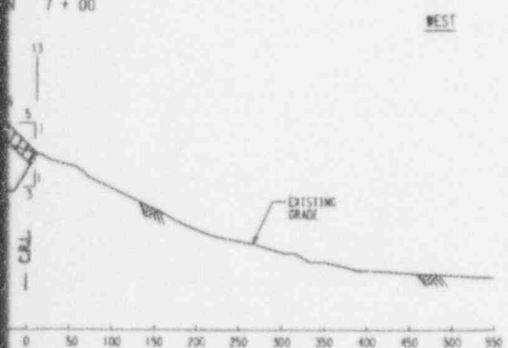

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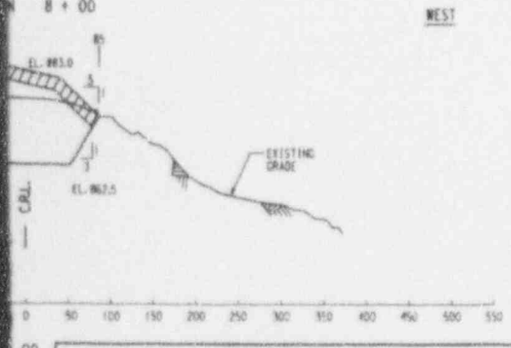

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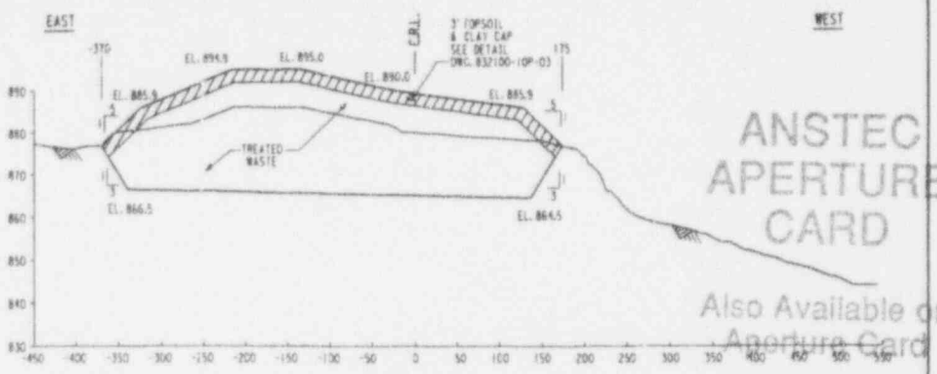

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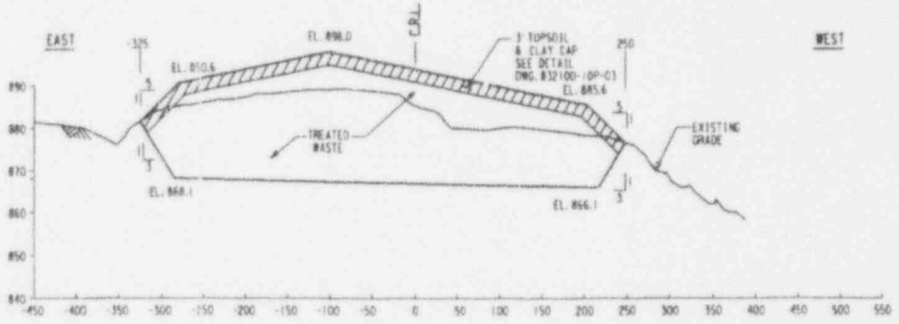

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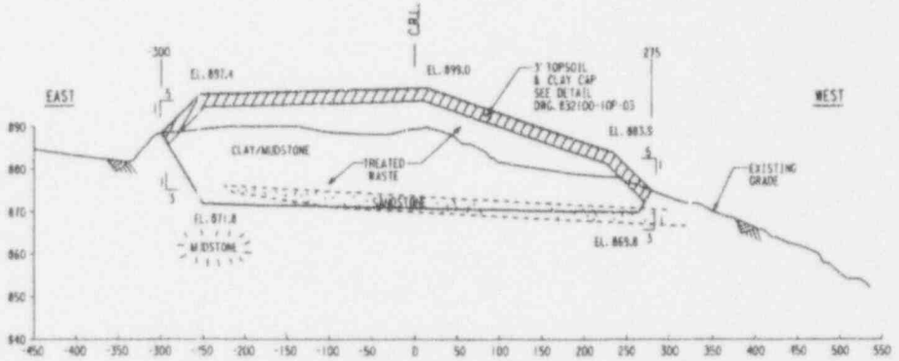

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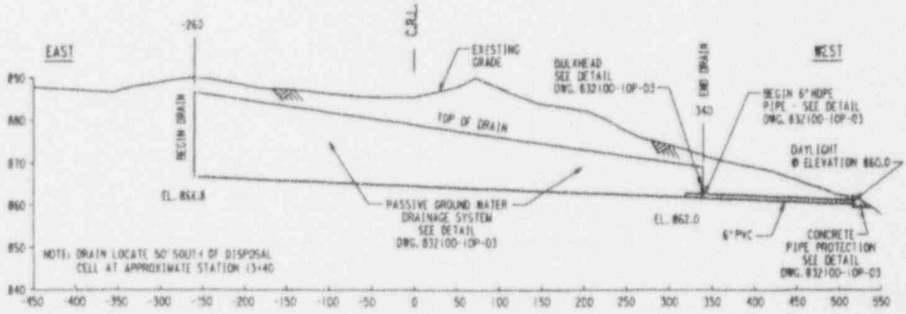


STATION 13 + 00

GENERAL NOTES:

1. LITHOLOGY SHOWN IS REPRESENTATIVE AND SHOULD NOT BE ASSUMED CONTINUOUS THROUGH EACH CROSS-SECTION. BORING LOGS SHOULD BE REFERENCED FOR SPECIFIC LOCATIONS AND GEOLOGICAL FEATURES.

FLUOR DANIEL WILLIAMS BROTHERS

KERR - McGEE CORPORATION

DOCUMENT TITLE:
CROSS SECTIONS
DISPOSAL CELL A

FOR CUSHING REMEDIAL DESIGN - PHASE I — CUSHING, OKLAHOMA

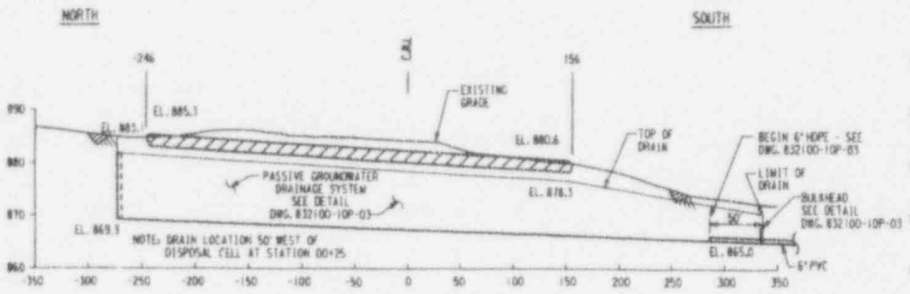
SCALE	JOB NO.	DRAWING NO.	CAD NUMBER	REV
V (1"=20') H (1"=100')	832100	832100-10P-01	210P01	C

NO.	REVISIONS DESCRIPTION	DRAWN	DATE	DES.	DATE	APPR.	DATE
B	GENERAL REVISIONS REVISED PER CLIENT COMMENTS	EDF	03/31/94				
C	REVISED NOTE 1	MLT	05/20/94				

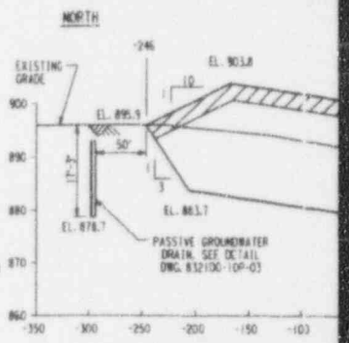
APPROVALS	BY	DATE
DRAWN	BBS	02-09-94

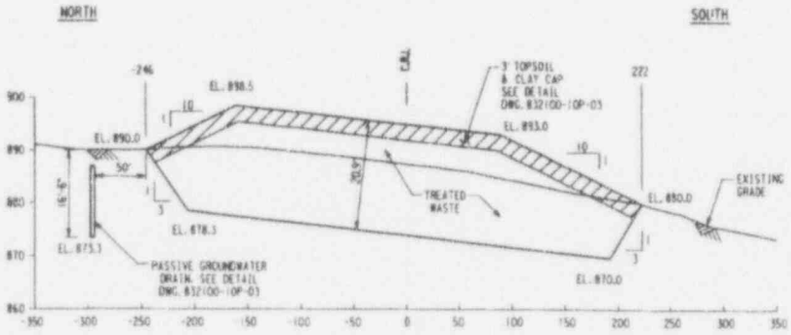
CURRENT DRAWING STATUS				
ISSUED FOR:		SIGNATURE	DATE	REV
INFORMATION	ENGR.			
	DRFT.			
BIDS	ENGR.			
	DRFT.			
CUSTOMER APPROVAL	ENGR. MLB	05/20/94		A
	DRFT.			
CONSTRUCTION	ENGR. MLB	6/24/94		C
	DRFT.			

9406100041-08



STATION 0 + 80





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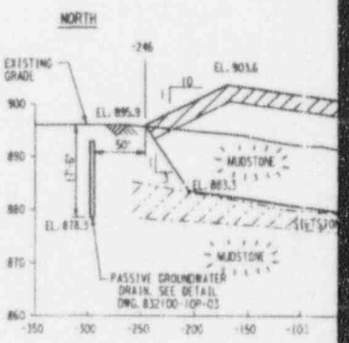

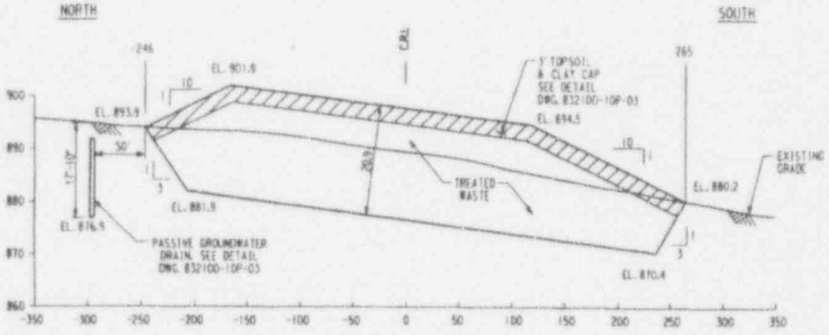

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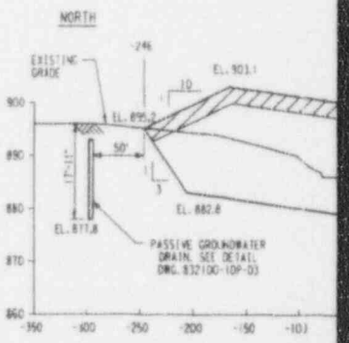
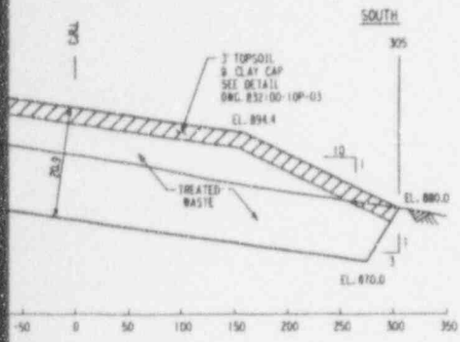
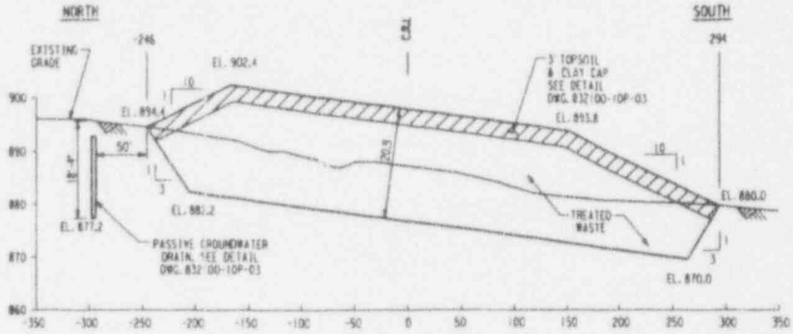
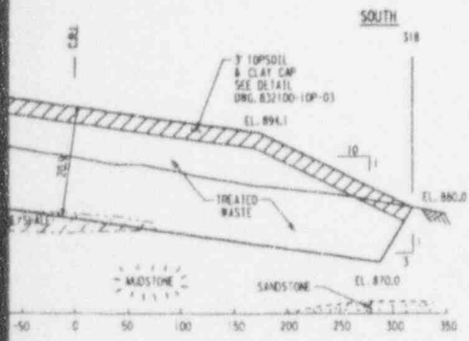




STATION 3 + 80



STATION 6 + 80



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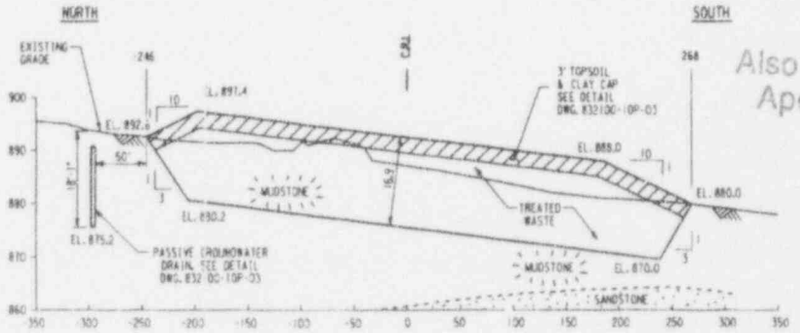

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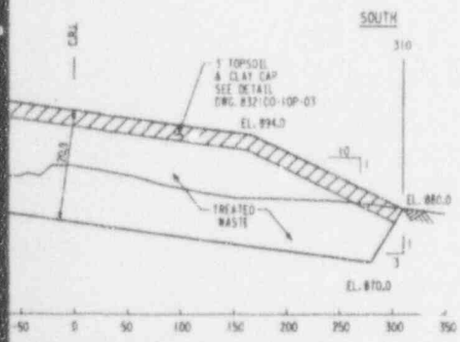

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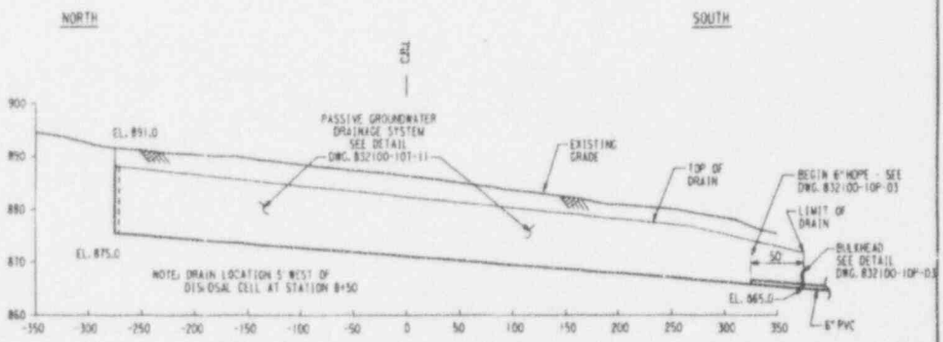

STATION 8 + 80

940610000 41-09

GENERAL NOTES:

1. LITHOLOGY SHOWN IS REPRESENTATIVE AND SHOULD NOT BE ASSUMED CONTINUOUS THROUGH EACH CROSS-SECTION. BORING LOGS SHOULD BE REFERENCED FOR SPECIFIC LOCATIONS AND GEOLOGIC FEATURES.

FLUOR DANIEL WILLIAMS BROTHERS

REVISIONS								APPROVALS			CURRENT DRAWING STATUS				
NO.	DESCRIPTION	DRAWN	DATE	CHK.	DATE	APPR.	DATE		BY	DATE	ISSUED FOR:	SIGNATURE	DATE	REV	
B	GENERAL REVISIONS, REVISED PER CLIENT COMMENTS	RDF	03/31/94					DRAWN	MRS	07-09-94	INFORMATION	ENGR.			
C	REVISED NOTE 1	MLS	05/20/94									DRFT.			
											BIDS	ENGR.			
												DRFT.			
											CUSTOMER APPROVAL	ENGR. M.S	03/02/94	A	
												DRFT.			
											CONSTRUCTION	ENGR. M.S	6/23/94	C	
												DRFT.			

KERR - McGEE CORPORATION

DOCUMENT TITLE:
CROSS SECTIONS
DISPOSAL CELL B

FOR CUSHING REMEDIAL DESIGN - PHASE I — CUSHING, OKLAHOMA

SCALE	JOB NO.	DRAWING NO.	CAD NUMBER	REV
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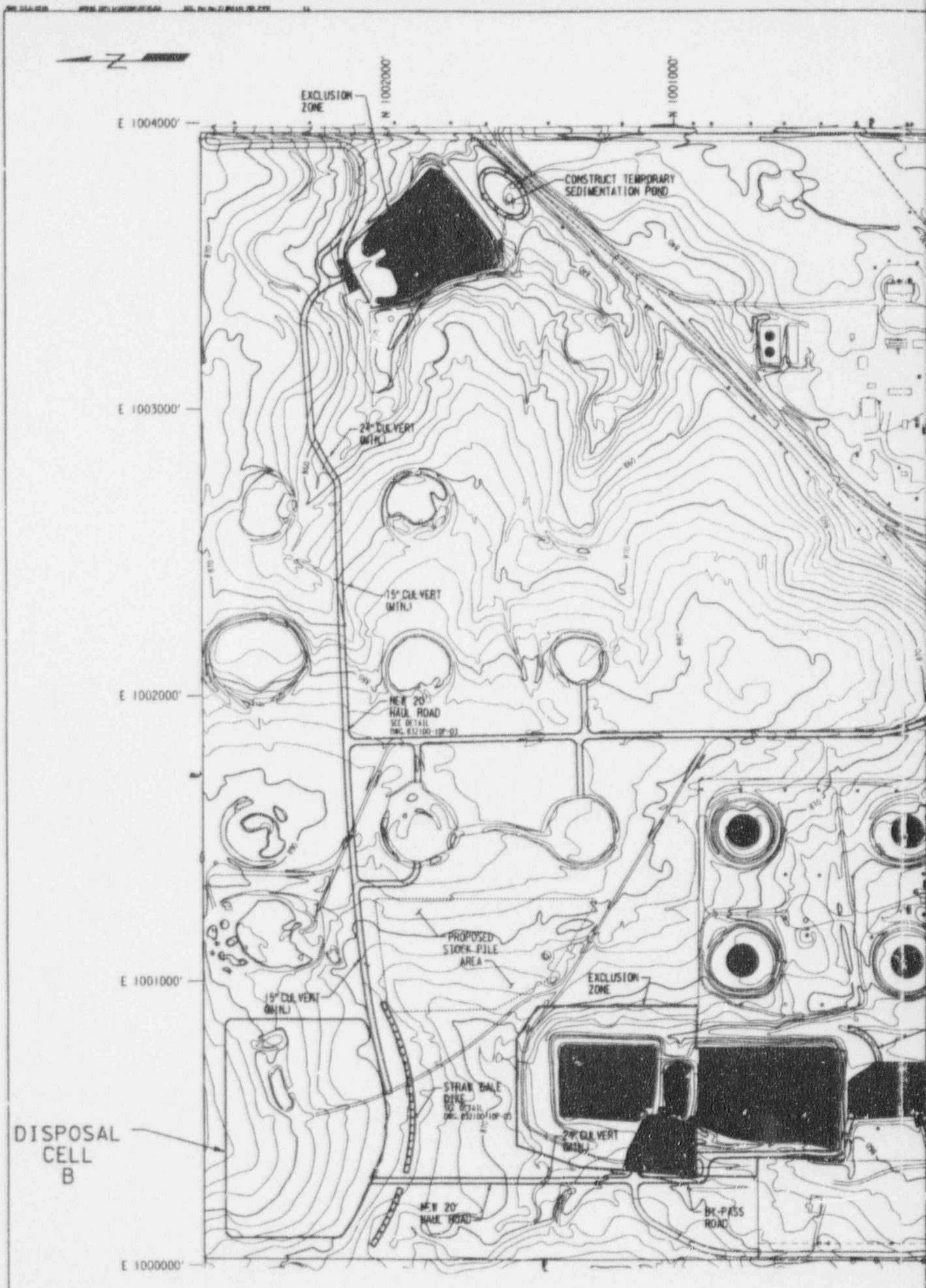

N
N 1002000'
N 1001000'
EXCLUSION ZONE
E 1004000'
CONSTRUCT TEMPORARY SEDIMENTATION POND
E 1003000'
24" CULVERT (MIN.)
15" CULVERT (MIN.)
E 1002000'
NEW 20' HAUL ROAD
SEE DETAIL
DWG. 832100-10F-02
PROPOSED STOCK PILE AREA
EXCLUSION ZONE
E 1001000'
15" CULVERT (MIN.)
STRAW BALE DIKE
SEE DETAIL
DWG. 832100-10F-02
24" CULVERT (MIN.)
DISPOSAL CELL B
NEW 20' HAUL ROAD
BY-PASS ROAD
E 1000000'

GENERAL NOTES:

1. PIT 3 TO BE CONVERTED TO TEMPORARY SEDIMENTATION POND AFTER WASTE EXCAVATION. PIT SHOULD BE BACKFILLED TO APPROXIMATE 2' DEPTH W/24" CORP OUTLET PIPE AND OVERFLOW BERM.
2. SEDIMENTATION POND AT PIT 4 TO BE CONSTRUCTED PRIOR TO FINAL CONTOURING OF PIT 4. APPROXIMATE SIZE TO BE 100' X 200' X 2' WITH 24" CORP OUTLET PIPE AND OVERFLOW BERM.
3. WORK EFFORTS AT CELL A AND AT PIT 5 SHALL BE PERFORMED SO AS TO MINIMIZE EROSION AS STIPULATED IN EROSION CONTROL SPECIFICATION 02B 212 02270.
4. SHOE-FLYS TO BE CONSTRUCTED ALONG HAUL ROADS AS NEEDED TO MINIMIZE WORK SLOW DOWN.
5. CULVERTS SHOWN ARE TEMPORARY AND HAVE BEEN SIZED FOR MINIMAL RUN-OFF CAPACITY. LARGER CULVERTS MAY BE USED AT THE DISCRETION OF THE CONTRACTOR.
6. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE IN PLACE PRIOR TO COMMENCEMENT OF EARTHWORK OPERATION IN THAT AREA AND SHALL REMAIN IN PLACE UNTIL THE AREA IS STABILIZED BY PERMANENT VEGETATIVE COVER.
7. THE CONTRACTOR SHALL INSPECT AND MAINTAIN ALL EROSION AND SEDIMENT CONTROL MEASURES ON A REGULAR BASIS AND AFTER EVERY RAINFALL EVENT.
8. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING THE EXISTING STORMWATER DRAINAGE SYSTEM WITHIN LIMITS OF CONSTRUCTION OR INSTALLATION OF AN ADEQUATE TEMPORARY SYSTEM UNTIL ALL NEW WORK HAS BEEN COMPLETED.
9. TEMPORARY HAUL ROADS ARE TO BE LEFT IN PLACE AFTER CONSTRUCTION UNLESS OTHERWISE DIRECTED BY THE OWNER.

TEMPORARY DIVERSION DITCH

24" CORP TEMPORARY OUTFLOW FOR SEDIMENTATION POND

9406100041-10

REVISIONS							
NO.	DESCRIPTION	DRAWN	DATE	CHK.	DATE	APPR.	DATE
B	GENERAL REVISION PER CLIENT COMMENTS	RKS	04/04/95				
C	REVISED NOTES 6 AND 8	RKS	05/30/95				

APPROVALS		
	BY	DATE
DRAWN	RKS	03-15-95

CURRENT DRAWING STATUS				
ISSUED FOR	SIGNATURE	DATE	REV.
INFORMATION	ENGR.		
	DEPT.		
BIDS	ENGR.		
	DEPT.		
CONSTRUCTION APPROVED	ENGR. M.S.B.	05/02/95	A
	DEPT.		
CONSTRUCTION	ENGR. M.S.B.	6/21/95	C
	DEPT.		

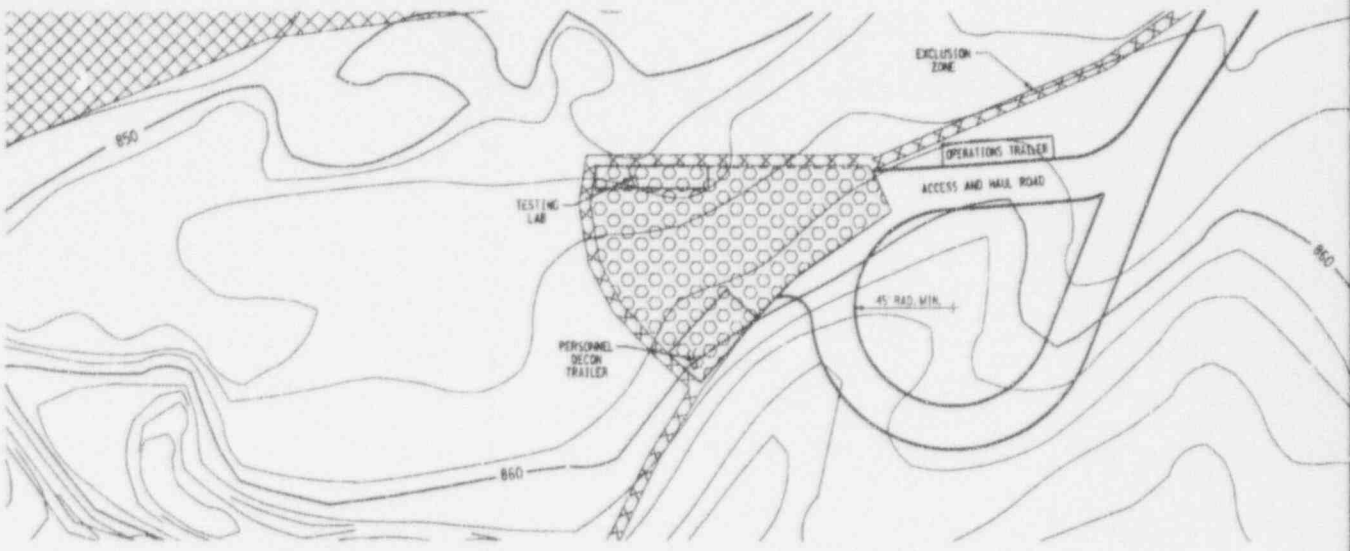
FLUOR DANIEL WILLIAMS BROTHERS

KERR - McGEE CORPORATION

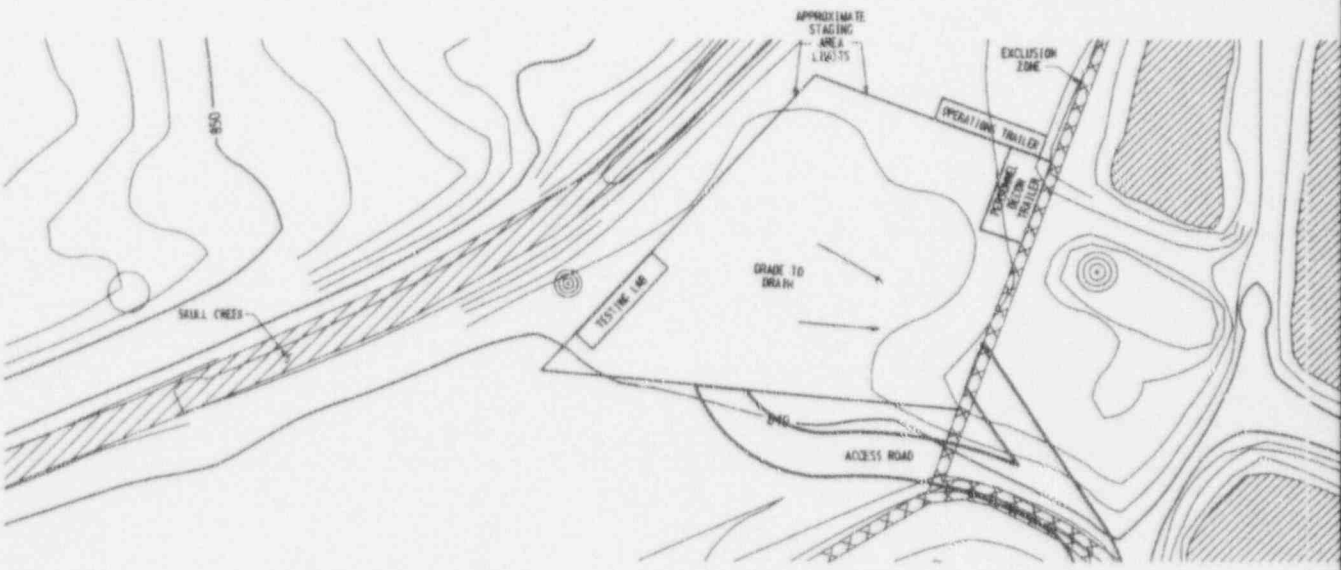
DOCUMENT TITLE:
HAUL ROADS AND EROSION CONTROL PLAN

FOR CUSHING REMEDIAL DESIGN - PHASE I — CUSHING, OKLAHOMA

SCALE	JOB NO.	DRAWING NO.	CAD NUMBER	REV.
1" = 200'	832100	832100-10T-05	210T05	C



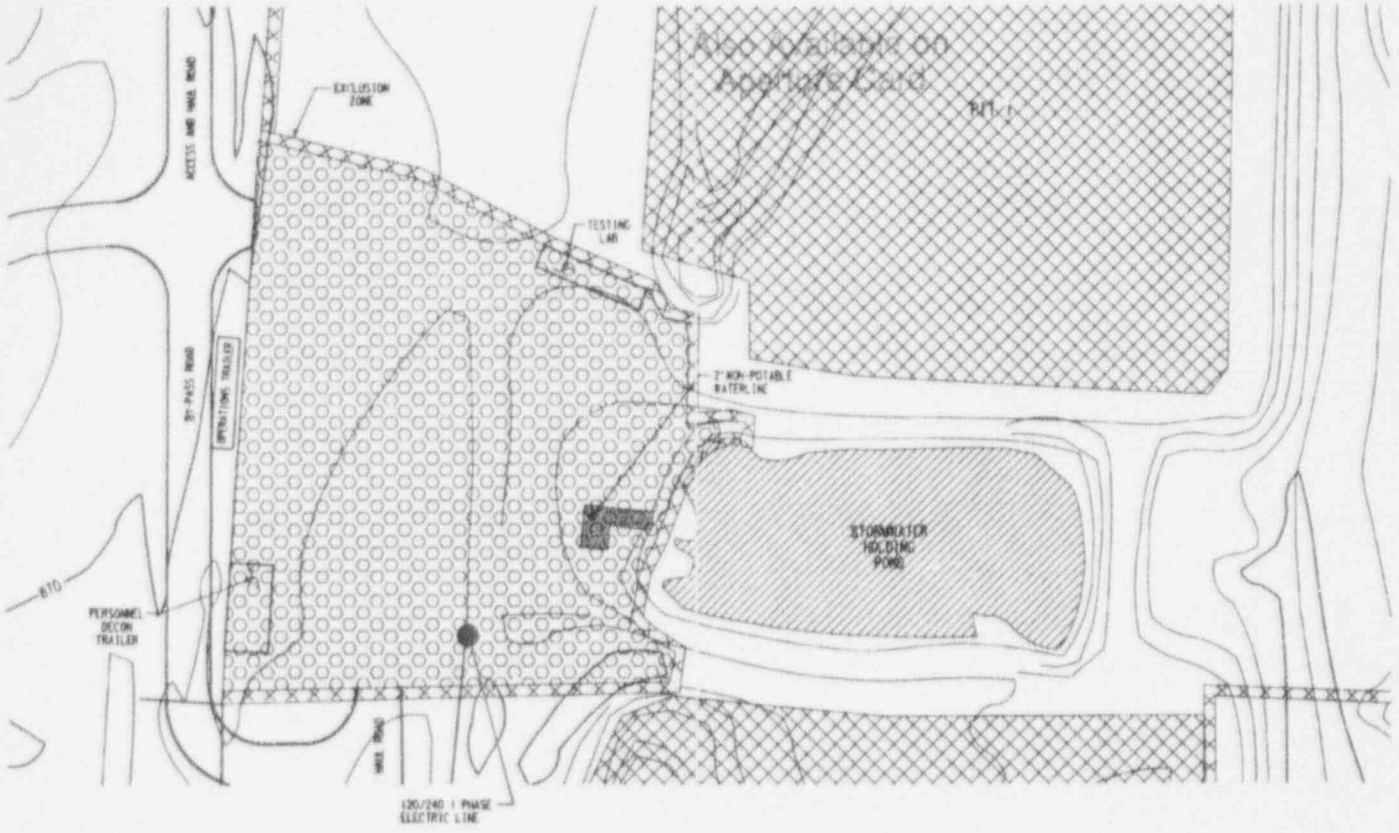
TREATMENT STAGING AREA A



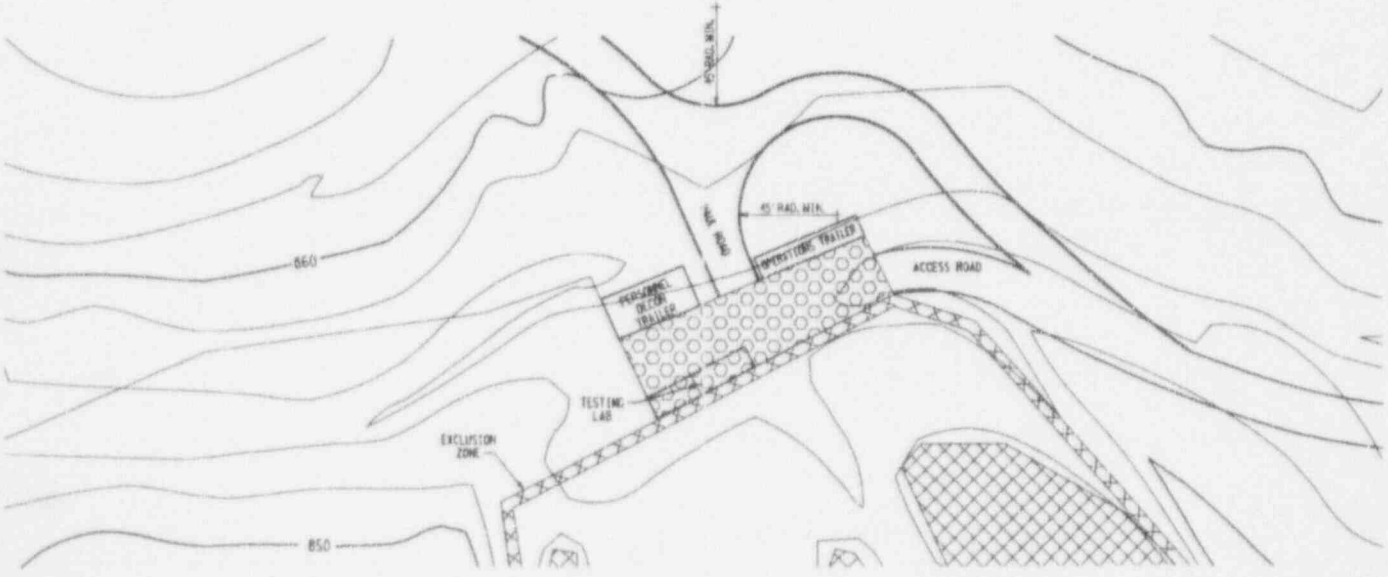
GENERAL NOTES

1. LAYOUTS SHOWN ARE FOR CONCEPTUAL PURPOSES ACTUAL LAYOUT WILL BE AT DISCRETION OF THE CONTRACTOR.
2. FOR STAGING AREA A, ALTERNATE, WATER AND ELECTRIC SOURCES AVAILABLE ON EAST SIDE OF STORMWATER HOLDING PONDS.
3. NO WATER OR ELECTRIC SOURCES AVAILABLE IN STAGING AREA A, WILL NEED TO ACCESS FROM STAGING AREA A, ALTERNATE AREA.
4. NO WATER OR ELECTRIC SOURCES AVAILABLE IN STAGING AREA B-2, RURAL WATER 12 INCH AND ELECTRIC AVAILABLE ALONG EAST PROPERTY LINE.
5. SIZE OF STAGING AREAS SHOWN ARE EXISTING AREAS. ACTUAL AREA REQUIRED MAY BE GREATER AND MAY BE INCREASED AS NEEDED BY THE CONTRACTOR.
6. FENCING SHALL BE CONSTRUCTED AND MODIFIED AS NEEDED BY THE CONTRACTOR.
7. ALL TEMPORARY FACILITIES SHALL BE IN ACCORDANCE WITH TEMPORARY FACILITIES SPECIFICATION 000230.01590.
8. CONTRACTOR TO PROVIDE AND MAINTAIN GRAVEL SURFACE AT STAGING AREAS AS REQUIRED TO PERFORM CONSTRUCTION OPERATION.
9. LOCATION OF WATERLINE SHOWN IS APPROXIMATE, WILL NEED TO FIELD VERIFY BOTH ABOVE AND BELOW GRADE.

TREATMENT STAGING AREA A
ALTERNATE



TREATMENT STAGING AREA B-1



TREATMENT STAGING AREA B-2

9406100041-11

FLUOR DANIEL WILLIAMS BROTHERS

REVISIONS								APPROVALS			CURRENT DRAWING STATUS				KERR - McGEE CORPORATION				
NO	DESCRIPTION	DRAWN	DATE	ENG.	DATE	APPR.	DATE		BY	DATE	ISSUED FOR	STATUS/BY	DATE	REV	DOCUMENT TITLE: TREATMENT STAGING AREAS				
B	GENERAL REVISIONS REVISED PER CLIENT COMMENTS	KDF	04/07/94					DRAWN	BRS	03-11-94	INFORMATION	ENGR.							
												DRFT.							
											BIDS	ENGR.							
												DRFT.							
											CUSTOMER APPROVAL	ENGR. N.S	05/02/94	1	FOR CUSHING REMEDIAL DESIGN - PHASE I			CUSHING, OKLAHOMA	
												DRFT.							
											CONSTRUCTION	ENGR. AGD	5/23/94	B	SCALE: 1" = 40'	JOB NO.: 832100	DRAWING NO.: 83210-10T-06	CAD NUMBER: 210T06	REV: B
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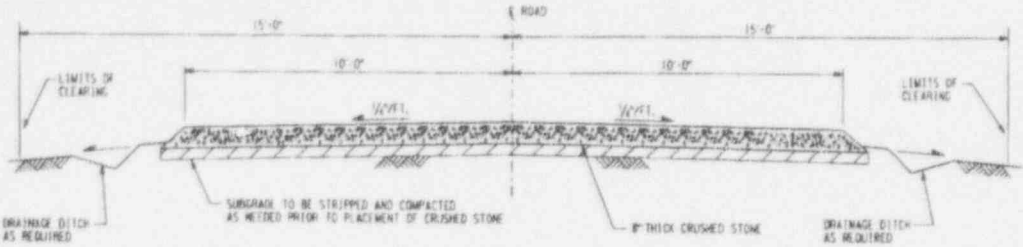
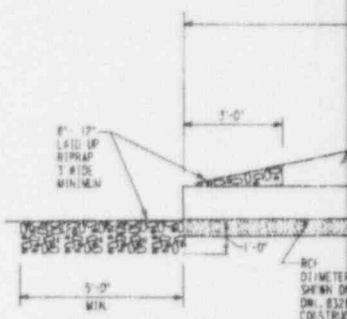


TYPICAL TEMPORARY HAUL ROAD SECTION

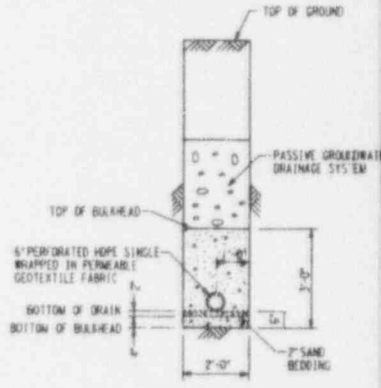


MONITORING WELL TABLE

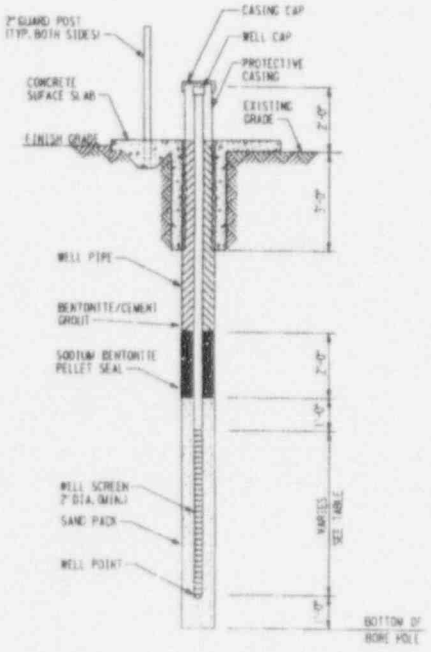
WELL IDENTIFICATION	BOTTOM ELEVATION	LENGTH OF SCREEN (FT)	APPROXIMATE TOTAL DEPTH (FT)
MA-1	848.5'	10'	18.5'
MA-2	861.4'	10'	36.6'
MA-3	848.0'	8'	12.0'
MW-1	872.2'	10'	15.8'
MW-2	877.2'	10'	15.8'
MW-3	867.2'	10'	19.8'

PIEZOMETER TABLE

WELL IDENTIFICATION	BOTTOM ELEVATION	LENGTH OF SCREEN (FT)	APPROXIMATE TOTAL DEPTH (FT)
P-1	874.4'	10'	21.6'
P-2	874.4'	10'	20.6'
P-3	867.2'	10'	19.8'
P-4	864.2'	10'	15.8'
P-5	864.2'	10'	16.8'

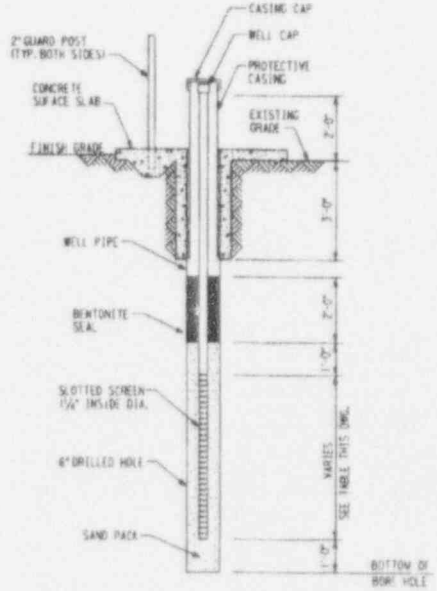


TYPICAL BULKHEAD SECTION



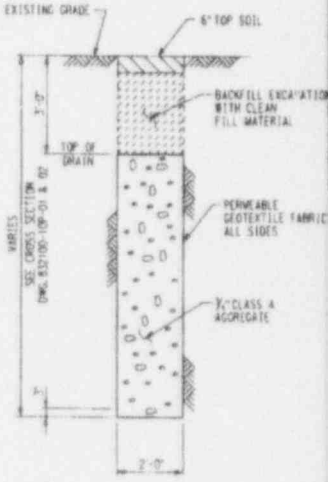
TYPICAL GROUNDWATER MONITORING WELL DETAIL

INSTALLATION SHALL BE PER THE SAMPLING AND ANALYSIS PLAN, KERR MCGEE CORP., CUSHING, OKLA.

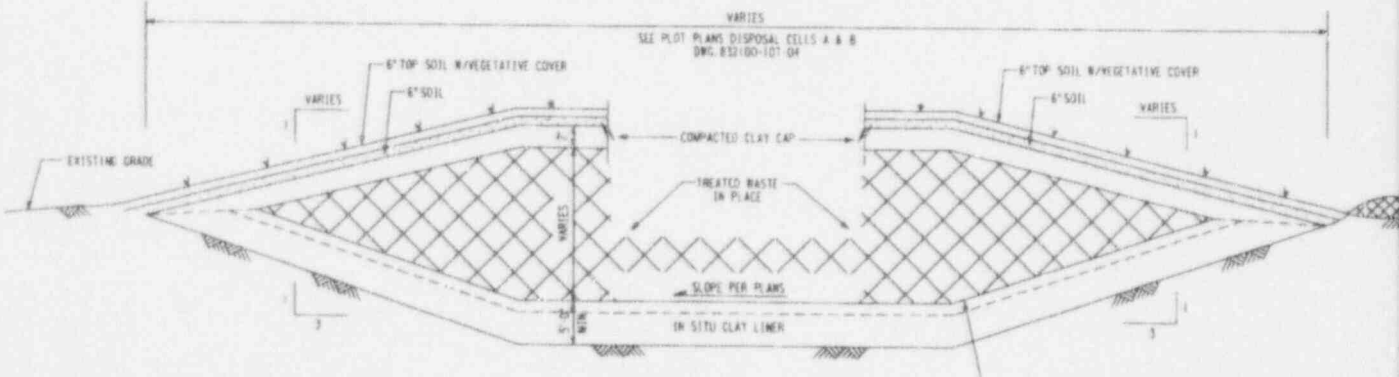


TYPICAL PIEZOMETER WELL DETAIL

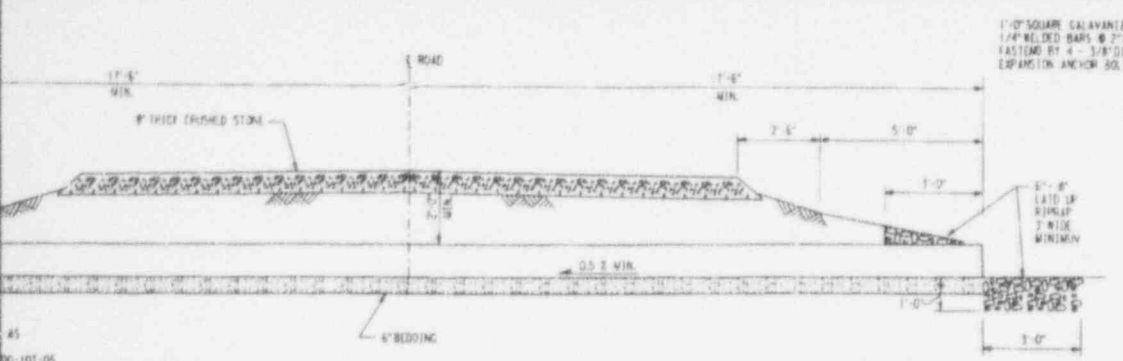
INSTALLATION SHALL BE PER THE SAMPLING AND ANALYSIS PLAN, KERR MCGEE CORP., CUSHING, OKLA.



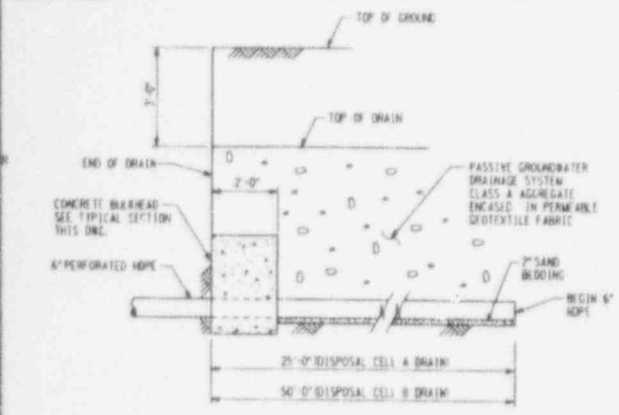
PASSIVE GROUNDWATER DRAINAGE SYSTEM



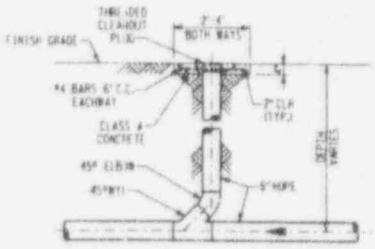
TYPICAL DISPOSAL CELL CROSS SECTION



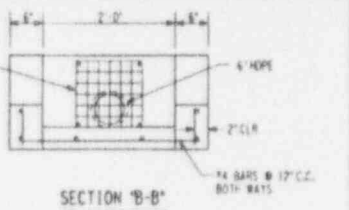
TYPICAL TEMPORARY HAUL ROAD CULVERT



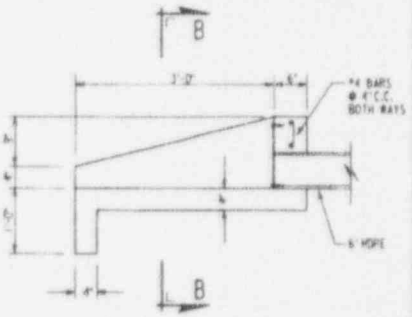
DRAIN PIPE/BULKHEAD DETAIL



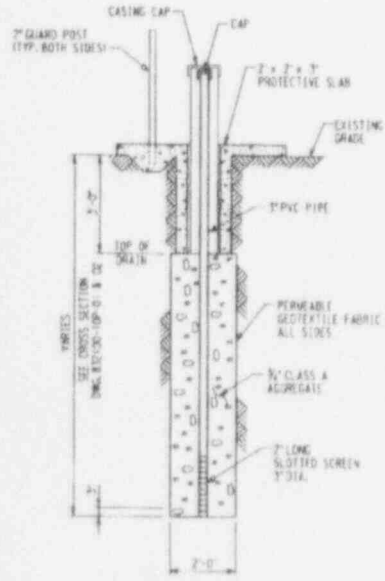
6" HDPE DRAIN LINE CLEANOUT



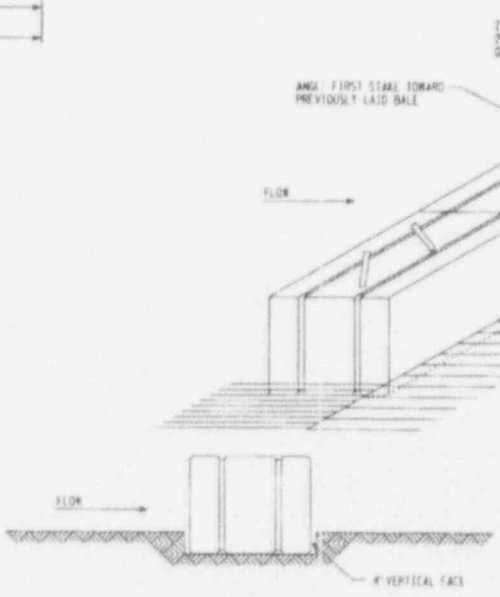
SECTION "B-B"



6" DRAIN PIPE SLOPEWALL DETAIL



STAND PIPE DETAIL



EMBEDDING DETAIL

BALES SHALL BE PLACED IN A ROW WITH ENDS TIGHTLY ABUTTING THE ADJACENT BALES.

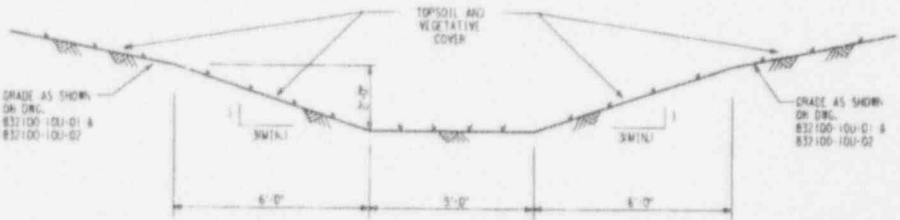
EACH BALE SHALL BE EMBEDDED IN THE SOIL A MINIMUM OF 4".

BALES SHALL BE SECURELY ANCHORED IN PLACE BY STAKES OR RE-BARS DRIVEN THROUGH THE BALES. THE FIRST STAKE IN EACH BALE SHALL BE ANGLED TOWARD PREVIOUSLY LAID BALE TO FORCE BALES TOGETHER.

INSPECTION SHALL BE FREQUENT AND REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.

BALES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFULNESS SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.

STRAW BALE DIKE DETAIL



TYPICAL DITCH DETAIL

GENERAL NOTES:

1. THE BOTTOM OF THE LANDFILL SHALL BE PROOF-ROLLED PRIOR TO PLACEMENT OF THE TREATED WASTE. "SOFT AREAS" SHALL BE EXCAVATED AND BACKFILLED WITH SUITABLE CLAY AND COMPACTED AS STIPULATED IN EARTHWORK SPECIFICATION 000.210.03.07C.
2. THE CLAY CAP SHALL BE COMPACTED TO A MINIMUM DENSITY OF 95% OF STANDARD PROCTOR.
3. SEE TOPSOIL REMOVAL, STOCKPILING AND IMPORTING SPECIFICATION 000.210.02.15 FOR FINAL 1 FOOT COVER.
4. REQUIREMENTS FOR HDPE PIPING AND PERMEABLE GEOTEXTILE FABRIC SHALL BE AS STIPULATED IN EXCAVATION, BACKFILL, AND COMPACTION FOR UNDERGROUND PIPING SPECIFICATION 000.210.12.24.

1' TEMPORARY RUN-OFF DIVERSION DIKE (AS NEEDED DURING FILLING)

EXISTING GRADE

REVISIONS								APPROVALS			CURRENT DRAWING STATUS				
NO.	DESCRIPTION	DRAWN	DATE	CHK.	DATE	APPR.	DATE		BY	DATE	STATUS OF:	SIGNATURE	DATE	REV.	
B	GENERAL REVISION PER CLIENT COMMENTS	WPS	04/06/93					DRAWN	WPS	7-18-91	CADD/M. SYSTEM	ENGR.			
C	GENERAL REVISION PER CLIENT COMMENTS	WLB	05/20/94									DRAFT			
											BIDS	ENGR.			
												DRAFT			
											CUSTOMER APPROVAL	ENGR. N.D.	03/02/94	1	
												DRAFT			
											CONSTRUCTION	ENGR. WLB	11/22/94	C	
												DRAFT			

FLUOR DANIEL WILLIAMS BROTHERS

KERR - McGEE CORPORATION

DOCUMENT TITLE:
MISCELLANEOUS SECTIONS AND DETAILS
SHEET 1

TITLE: CUSHING REMEDIAL DESIGN - PHASE I — CUSHING, OKLAHOMA

SCALE	JOB NO.	DRAWING NO.	CAD NUMBER	REV
NONE	832100	832100-10P-03	210P03	C

9406100041-12

APPENDIX C
SAMPLING AND ANALYSIS PROCEDURES

- *Scope and Application*
- *Untreated Waste Sampling Procedures*
- *Treated Waste Sample Analysis*
- *Untreated Waste Sample Analysis Procedures*

SCOPE AND APPLICATION

The following procedures are to be used in association with the sampling procedures discussed in the Kerr-McGee Sampling and Analysis Plan. The procedures discussed below are additional procedures necessary to complete the QA/QC requirements discussed in the QA/QC Plan.

UNTREATED WASTE SAMPLING PROCEDURES

A reproducible, 50-foot grid system will be established over each waste pit or area to be treated. Temporary stakes or signs may be placed to locate the approximate lines of the grid system.

A minimum of five samples of waste uniformly spaced will be obtained from each grid area. Each sample will consist of approximately 100-grams (g) of waste which will consist of a composite of material taken vertically through the lift to be treated. Waste Treatment Specification 000.230.02210 requires that the construction contractor maintain a protective layer or blanket of treated material over underlying contaminated waste; samples obtained for waste area sampling should not include material from this treated waste layer.

Samples will be collected using a soil sampling device. The sampler will be cleaned between samples by wiping off visible contamination and rising with deionized water.

Each sample will be labeled to indicate the grid location, lift identification and that it is an untested sample.

Samples will remain in the Laboratory Technician's custody at all times. After receipt of the sample in the on-site laboratory, the sample will be logged into a hardbound notebook with prenumbered pages. Data will be entered using only insoluble black ink.

TREATED WASTE SAMPLING PROCEDURES

Sampling for pH and alkalinity analyses will be performed using the same frequency, procedures, and approximate locations as those described for untreated waste sampling procedures. Sampling for alkalinity will be performed as directed by Site Construction Manager.

For Waste Pit 4, sampling for pH and alkalinity analyses will be performed using the same frequency and general procedures as those described in the section for waste characterization of the Kerr-Mc-Gee Sampling and Analysis Plan.

For Waste Pit 4, the 50-foot grid will be divided into nine equal sections (approximately five-meter square areas) and two samples will be obtained from the approximate center of each five-meter grid section.

For radiological contamination screening, a 25 ml sample of treated waste will be obtained from each five-meter grid area. The 25 ml sample will be obtained using a one-inch, soil sample tube. The sample will be obtained from the entire depth of treated waste. The sample of treated waste will be thoroughly mixed (composited over the one foot depth) and a 25 ml sample bottle will be filled and provided to KMC for radiological screening.

UNTREATED WASTE SAMPLE ANALYSIS PROCEDURES

An equal mass (no less than 100g) from each of the five samples obtained from an individual grid area will be composited. One sample from this composite will be analyzed.

Analyses of untreated waste will be performed using the procedures as presented. These procedures are modified EPA methods, as referenced, for pH and acidity analyses. The amount of treatment reagent necessary for a given waste volume is a function of the acidity. The relationship of acidity and reagent need is discussed.

The Environmental/Laboratory Manager will calculate the amount of treatment reagent necessary for a given grid area using the procedures provided.

QA/QC Checks

Sampling personnel will be required to take duplicates and field blanks to assure the overall precision and the effectiveness of the decontamination procedures. To attain this goal, ten percent (10%) of the samples collected per matrix for analysis will be duplicated.

The use of equipment field blanks will determine the effectiveness of the sampling equipment decontamination procedures. To evaluate these procedures, one field blank will be collected each day for each media sampled.

Apparatus and Materials

- pH meter with means for temperature compensation
- Combination electrode
- Magnetic stirrer and flow coated stirring bar
- Balance capable of 0.01g resolution
- Beakers, 100 ml
- Electrode stand
- Buret with stand
- Sieves
- Mixing bucket.

Reagents

- Deionized water
- Stock NaOH solution: purchased 1.00 N or 0.100 N solution
- Reference H_2SO_4 solution: purchased 1.00 N or 0.100 N solution
- Certified pH 2, 7 and 10 buffer solutions.

pH Analysis

This method is an electrometric procedure for measuring pH of extraction fluids from untreated and treated wastes. This procedure is a modification of EPA 9045. The modifications were based on data from similar successful remedial action projects completed for a similar waste type. The modifications are necessary as a result of remediation time constraints.

Interferences

Samples with a true pH greater than 11 may measure incorrectly low. Samples with a true pH less than 1 may measure incorrectly high.

Temperature fluctuations will cause measurement errors. These fluctuations can be automatically corrected with the appropriate pH electrode.

Errors will occur when the electrodes become coated. If an electrode becomes coated with an oily material that will not rinse free, it must be washed with detergent, rinsed several times, placed in 1:10 HCl, and then thoroughly rinsed with water.

Sample Extraction Procedure

Place 10.0g of the composite sample and 50.0ml deionized water into a 100-ml beaker

Add a magnetic stir bar and mix for 10 minutes

Let mixture settle for 5 minutes

Remove liquid extract and place in a 100-ml beaker

Instrument Calibration Procedure

Ensure electrode is clean and free of oily material

Place the electrode into clean, undiluted, certified pH 7.0 buffer solution. Enter this buffer as the first standard on the pH meter.

Rinse electrode with deionized water and return to holding solution

Repeat step 7.2 with second standard buffer. If measuring pH of untreated sludge, a pH 2.0 buffer should be used. If measuring pH of treated sludge, a pH 10.0 buffer should be used.

Rinse electrode with deionized water and return to holding solution

Verify calibration by returning electrode to first buffer solution and reading pH after meter has stabilized

If pH within ± 10 percent of certified value, continue with analysis

pH Measurement Procedure

Remove electrode from holding solution and rinse with deionized water

Place electrode in sample and read pH after meter has stabilized

Rinse electrode with deionized water and repeat above two steps until samples are completed

Return electrode to holding solution

Quality Control

Duplicate extractions and analyses should be performed approximately every 10th sample with a minimum of 10% duplication. A minimum of one duplicate will be performed each day analysis is performed.

Electrodes must be thoroughly rinsed and cleaned, if necessary, between samples.

One pH buffer used for calibration should be analyzed every 10th sample to ensure calibration curve is still valid.

Buffers should be replaced daily and when they are noticeably contaminated.

Extraction Efficiency

Ten (10) samples of untreated waste will be collected from random locations from each waste pit.

Samples will be extracted as per Standard Operating Procedures for pH and Acidity.

Rather than removing all of the extract from the waste at the specified time of analysis, only the volume required for analysis will be removed.

Acidity analyses will be performed at the times specified during remediation activities and at the following times: 1 hour, 2 hours, 5 hours, 1 day, 2 days.

Curve produced will be prepared by plotting volume of titrant used to reach neutralization versus time.

Extraction efficiency will be calculated using the point of maximum titrant volume and 15-minute titrant volume as follows:

$$Efficiency\ (\%) = 100\% \times \frac{minimum\ volume\ (ml)}{maximum\ volume\ (ml)} \times 15\ (Minutes)$$

Subsamples of each of the ten samples will be neutralized in the laboratory using the appropriate amount of lime and kiln dust.

Acidity Analysis

This method is a titrimetric procedure for determining residual acidity of extraction fluids from the Kerr-McGee Phase I, Cushing Refinery Site Remedial Action, untreated wastes. This procedure is based on EPA 305.1

Alkalinity and pH analysis will be as described for untreated waste analysis.

Interferences

Interferences are those associated with pH measurement.

Working NaOH solution may be purchased 0.10 N or prepared from a 1.00 N solutioned using the following procedure.

Working NaOH solution: Dilute stock solution 1:10 by adding 100-ml of stock solution to 900-ml deionized water. Mix thoroughly. Calculate actual Normality of working solution as follows:

- Place 20 ml of Reference H_2SO_4 solution into a 100-ml beaker
- Place a magnetic stir bar into beaker and mix at a slow speed
- Place pH electrode into solution such that electrode and stir bar do not touch
- Titrate Reference H_2SO_4 solution with working NaOH solution to an endpoint of pH 8.2. Record titrant volume
- Repeat steps 5.3.1 to 5.3.5 to obtain a second determination
- Calculate working NaOH Normality by averaging two titrant volumes and using average in the following equation:

$$Normality\ (NaOH) = \frac{normality\ (H_2SO_4)\ x\ volume\ (H_2SO_4)}{volume,\ ml\ (NaOH)}$$

$$= \frac{0.100\ N\ x\ 20\ ml}{volume,\ ml\ (NaOH)}$$

- Record calculated Normality and mark working NaOH solution container with calculated Normality.

Instrument Calibration Procedure

Calibrate pH meter as described in pH standard operating procedure

Acidity Determination Procedure

Place 10.0 ml of waste extract (obtained from pH determination) into a 100-ml disposable beaker. Add 10-15 ml deionized water.

Place magnetic stir bar into beaker and mix at slow speed

Place pH electrode into solution such that electrode and stir bar do not touch

Titrate solution using working NaOH solution to an electrometric endpoint of pH 5.5. Record volume of titrant used.

Calculate acidity of extract as follows:

$$Acidity\ (mg/s\ as\ CaCO_3) = \frac{volume\ of\ titrant,\ ml\ x\ titrant\ normality\ x\ 50{,}000}{volume\ of\ sample\ titrated,\ ml}$$

Convert acidity of extract to solid basis (mg $CaCO_3$ to kg waste) and include extraction efficiency as follows:

$$Acidity\ (mg/Kg\ as\ CaCO_3) = \frac{acidity,\ mg/l\ x\ total\ volume\ extract,\ ml}{weight\ of\ sample\ extracted,\ mg\ x\ ext.\ eff.}$$

Calculate volume of reagent necessary (assume quicklime CaO for the following calculation) required for neutralization (assumes all neutralization from CaOH content of lime):

Weight of CaO (Kg) required to neutralize waste (Kg) =

$$\frac{0.5\ x\ normality\ of\ base\ volume\ of\ titrant,\ ml\ x\ total\ volume\ of\ extract,\ ml\ x\ MOL\ WT\ of\ lime\ X\ \%\ CaOH\ in\ lime}{WT\ samp\ ext.,\ mg\ x\ volume\ of\ ext.\ titrated,\ ml}$$

Convert weight:weight neutralization to volume:volume neutralization requirements:

$$Volume\ of\ lime,\ \% = \frac{WT\ of\ CaOH,\ Kg}{Kg\ waste}\ x\ \frac{density\ of\ waste}{density\ lime}$$

Quality Control

Duplicate extractions and analyses will be performed approximately every 10th sample with a minimum of ten percent duplication. A minimum of one duplicate will be performed each day analysis is performed.

Normality of working solution will be checked each day solution is used and anytime new solution is prepared.

An analysis of deionized water will be performed as a blank, approximately every 20th sample, with a minimum of five percent blank analysis. A minimum of one blank analysis will be performed each day analysis is performed.

Average extraction efficiency will be determined in main laboratory and verified in field laboratory prior to commencing field analysis. Efficiency to be determined from Alkalinity vs. Extraction Time curve which is to be developed. (See curve development guidelines listed under Extraction Efficiency (page C-4) this appendix.

TREATED WASTE SAMPLE ANALYSIS PROCEDURES

Apparatus and Material

Same as Untreated Sample Analysis

Reagents

Same as Untreated Sample Analysis

Alkalinity Analysis

This method is a titrimetric procedure for determining residual alkalinity of extraction fluids from Kerr-McGee Phase I, Cushing Refinery Site Remedial Action, untreated wastes. This procedure is based on EPA 310.1.

Interferences

Interferences are those associated with pH measurement.

Working H_2SO_4 solution may be purchased 0.10 N solution or prepared from a 1.00 N stock solution by the following procedure.

Working H_2SO_4 solution: Dilute stock solution 1:10 by adding 100-ml of stock solution to 900-ml deionized water. Mix thoroughly. Calculate actual Normality of working solution as follows:

- Place 20 ml of Reference NaOH solution into a 100-ml beaker
- Place a magnetic stir bar into beaker and mix at a slow speed
- Place pH electrode into solution such that electrode and stir bar do not touch
- Titrate Reference NaOH solution with working H_2SO_4 solution to an endpoint of pH 5.5. Record titrant volume
- Repeat steps 5.3.1 to 5.3.5 to obtain a second determination
- Calculate working H_2SO_4 Normality by averaging two titrant volumes and using average in the following equation:

$$Normality\ (H_2SO_4) = \frac{normality\ (NaOH)\ x\ volume\ (NaOH)}{volume,\ ml\ (H_2SO_4)}$$

$$= \frac{0.100\ N\ x\ 20\ ml}{volume,\ ml\ (H_2SO_4)}$$

- Record calculated Normality and mark working H_2SO_4 solution container with calculated Normality.

Instrument Calibration Procedure

Calibrate pH meter as described in pH standard operating procedure

Alkalinity Determination Procedure

Place 10.0 ml of waste extract (obtained from pH determination) into a 100-ml disposable beaker. Add 10-15 ml deionized water.

Place magnetic stir bar into beaker and mix at slow speed

Place pH electrode into solution such that electrode and stir bar do not touch

Titrate solution using working H_2SO_5 solution to an electrometric endpoint of pH 5.5. Record volume of titrant used.

Calculate alkalinity of extract as follows:

$$Alkalinity\ (mg/l\ as\ CaCO_3) = \frac{volume\ of\ titrant,\ ml\ x\ titrant\ normality\ x\ 50{,}000}{volume\ of\ sample\ titrated,\ ml}$$

Convert acidity of extract to solid basis (mg $CaCO_3$ to kg waste) and include extraction efficiency as follows:

$$Alkalinity\ (mg/Kg\ as\ CaCO_3) = \frac{alklinity,\ mg/l\ x\ total\ volume\ extract,\ ml}{weight\ of\ sample\ extracted,\ mg\ x\ extractive\ efficiency}$$

Quality Control

Duplicate extractions and analyses will be performed approximately every 10th sample with a minimum of ten percent duplication. A minimum of one duplicate will be performed each day analysis is performed.

Normality of working solution will be checked each day solution is used and anytime new solution is prepared.

An analysis of deionized water will be performed as a blank, approximately every 20th sample, with a minimum of five percent blank analysis. A minimum of one blank analysis will be performed each day analysis is performed.

Average extraction efficiency will be determined in main laboratory and verified in field laboratory prior to commencing field analysis. Efficiency to be determined from Alkalinity vs. Extraction Time curve which is to be developed. (See curve development guidelines listed under Extraction Efficiency (page C-4) this appendix.

Particle Size Analysis

Following waste treatment, samples of the neutralized product will be collected and screened to ensure that particle size criteria are met. Based on Kerr-McGee experience in full-scale sludge treatment demonstrations at the Cushing site, separation of oversize agglomerates of treated material is a key factor in successfully meeting the particle size criteria. Separation of agglomerates has necessitated a modification of the traditional ASTM screening test (ASTM C 136). Breaking of individual oversize particles and determining whether they contain large pieces of untreated waste or are simply agglomerates of smaller treated particles is required. While drying is suggested in the ASTM procedure, it can form hard chunks from the sometimes sticky agglomerates. These are not easily broken. This procedure has been adapted from the ASTM standard to allow testing of moist materials. The requirement for manual sorting also requires that sample sizes be limited.

Screening

Each sample (about 50 pounds) will be weighed (balance readable to 0.1 percent of test load) then poured through an approximately 18 x 18 inch stationary screen with 3 inch by 3 inch openings. Any pieces of waste remaining on the screen will be broken by hand (using rubber gloves) to determine whether they are agglomerates of neutralized material (brown/tan particles) or contain unneutralized black acidic sludge. Broken agglomerates will be dropped through the screen, while any broken particle in which unneutralized waste exceeded the 3 x 3 screen size will be collected in a separate plastic bag.

Weights of materials passing through the screen and the large unneutralized particles in the separate plastic bag will be measured and the sum of the weights should be within 0.3 percent of the initial sample weight. If not, the test will be repeated on another sample. The percentage of oversize unneutralized material will be determined to the 0.1 percent by dividing the oversize weight (excluding the plastic bag) by the total sample weight and multiplying by 100.

$$\textit{Percent plus 3 inch} = \frac{\textit{Oversize Weight} \times 100}{\textit{Initial Weight}}$$

If the plus 3 inch fraction of the material exceeds 0.5 weight percent, the material in the section sampled must be retreated to reduce the particle size.

Following screening on the 3 inch x 3 inch screen, the undersize material will be split down using standard splitting techniques to a roughly 5 pound sample for further testing.

After weighing (balance readable to 0.1 percent of test load), the roughly 5 pound sample will be poured through a standard 8 inch screen having a mesh with 0.5 inch openings. The

same procedure for manual breaking and checking for agglomerates will be employed as was used on the 3 inch screening. Particles containing unneutralized acidic material (black, chunky, SO_2 smell) exceeding the one half inch opening will be collected in a separate plastic bag. Agglomerates of neutralized material will be broken up by hand and dropped through the screen.

When screening is completed, the weight of the plus one half inch unneutralized particles (excluding the plastic bag) will be measured. The fraction of plus one half inch material will be calculated to the nearest 0.1 percent by dividing the oversize weight by the initial sample weight, multiplying by 100, then dividing by the quantity 100 minus the percentage of plus 3 inch material determined earlier (to correct for any plus 3 inch material removed in the previous screening).

$$\textit{Percent Plus 0.5 Inch} = \frac{(\textit{Weight of Plus 0.5 Inch}/\textit{Initial Weight}) \times 100}{(100 - \textit{Percent Plus 3 Inch})/100}$$

Material containing more than 10 weight percent of unneutralized particles over one half inch in size must be retreated to reduce the particle size.