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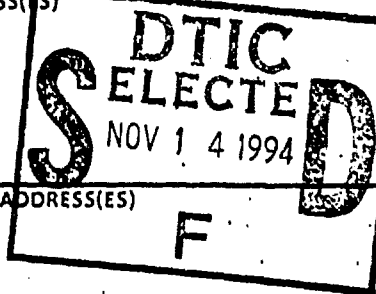


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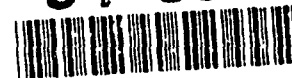
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12a. DISTRIBUTION/AVAILABILITY STATEMENT APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED		13. ABSTRACT (Maximum 200 words) PLANNED IMPROVEMENTS TO THE NORTH BOUNDARY RECHARGE SYSTEM CONSIST OF A LINE OF FIVE RECHARGE TRENCHES EXTENDING ALONG THE EASTERN HALF OF THE SYSTEM ABOUT 45 FEET NORTH OF THE BENTONITE BARRIER. THESE GRAVEL FILLED TRENCHES WILL BE CONSTRUCTED TO EXTEND TO THE DENVER FORMATION SURFACE. VOLUMES 1 AND 2 OF THIS IMPLEMENTATION DOCUMENT CONTAIN: 1. MOU BETWEEN THE ARMY AND SHELL CONCERNING SHELL'S PARTICIPATION IN THE IRA'S 2. CONSTRUCTION WORK PLANS 3. COST ESTIMATES 4. TASK SPECIFIC HEALTH AND SAFETY PLAN 5. ENGINEERING SPECIFICATIONS. ENGINEERING DRAWINGS ARE FOUND IN VOLUME 3.	
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**IMPLEMENTATION DOCUMENT
FOR
RECHARGE TRENCH PROJECT FOR THE
NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA**

**VOLUME 1 GENERAL AND
VOLUME 2 ENGINEERING SPECIFICATIONS**

JANUARY 1990

**Prepared by
MK-Environmental Services
Denver, Colorado 80203**

**Prepared for
Shell Oil Company
Denver, Colorado 80203**

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**Rocky Mountain Arsenal
Information Center
Commerce City, Colorado**

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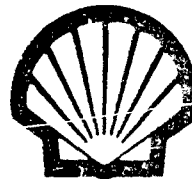
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Ac

**Rocky Mountain Arsenal
Information Center
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Shell Oil Company

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IMPLEMENTATION DOCUMENT FOR INTERIM RESPONSE ACTION
FOR THE RECHARGE TRENCH PROJECT FOR THE
NORTH BOUNDARY SYSTEM IMPROVEMENTS AT
THE ROCKY MOUNTAIN ARSENAL

Section 1.0

INTRODUCTION

The Interim Response Action (IRA) for the Groundwater Recharge Trench Project for the North Boundary System Improvements is being conducted as part of the IRA Process for the Rocky Mountain Arsenal (RMA) in accordance with the June 5, 1987 report to the court United States v. Shell Oil Company and the Federal Facility Agreement effective February 17, 1989.

The Decision Document for the subject IRA became final on April 28, 1989 and the lead role for detailed engineering and construction was transferred from the Army to Shell on May 1, 1989. The detailed design incorporates the concepts proposed in the Final Decision Document and is based on the additional data developed during the preliminary engineering site investigation. The conceptual design was issued as a Preliminary Engineering Design Package on August 14, 1989 for review and comment by the parties. Comments from this review were discussed and resolved at a meeting of the Parties on September 7, 1989. A construction cost estimate and schedule have been prepared and are included. The cost of construction is estimated to be \$680,000.00 and the basis of the estimate is given in Section 4. The deadline for completion of this project (an "IRA Deadline" under the Federal Facility Agreement) is December 11, 1990, subject to extension as described in Section XXVI of the Federal Facility Agreement. Intermediate dates shown in this document comprise the "Schedule" (as defined in the Federal Facility Agreement) are not "Deadlines" under the Federal Facility Agreement.

As outlined in the Final Decision Document for this IRA, the Recharge Trench Project will consist of extending the existing Recharge Trench System at the North Boundary Containment. The Improvements of the Existing Groundwater Treatment System will be considered separately.

Planned improvements to the North Boundary System recharge system consist of construction of a line of recharge trenches extending along the eastern half of the system, located about 45 feet north of the existing soil-bentonite barrier. The planned trenches included four 400-foot trenches west of First Creek, and one 200-foot trench east of First Creek. These gravel-filled trenches will be constructed to extend, as nearly as practical, to the Denver Formation surface. Flows into each trench will be metered, with remote readouts being provided in the treatment plant. A new recharge piping system will not be necessary, the existing piping will be extended to feed the additional trenches..

Piezometers will be installed in each end of each trench as well as between each set of trenches to allow an accurate determination of the effectiveness of the trenches on the groundwater table near the soil-bentonite slurry wall. The new piezometers located outside the trenches near the slurry wall will be equipped so as to provide remote water level readouts in the treatment plant. Piezometers will also be installed to monitor the western half of the system.

MEMORANDUM OF UNDERSTANDING BETWEEN
THE DEPARTMENT OF THE ARMY AND SHELL OIL COMPANY
WITH RESPECT TO
RESPONSE ACTION WORK CONDUCTED PURSUANT TO THE
FEDERAL FACILITY AGREEMENT

I. PARTIES

This Memorandum of Understanding ("MOU") specifies the cooperative undertakings which are to occur between the Army (a potentially responsible party under CERCLA) and Shell (a potentially responsible party under CERCLA) with respect to any Scope of Work developed pursuant to the Federal Facility Agreement now or hereafter attached as an exhibit to this MOU.

II. PURPOSE

The purpose of this MOU is to provide an appropriate basis pursuant to the Federal Facility Agreement for Shell to participate in the expeditious (a) assessment, selection, design and implementation of an IRA or (b) operation and maintenance of any Response Action Structure.

III. DEFINITIONS

The following terms, used in the MOU, shall have the meanings indicated:

(a) "Army" means the United States Department of the Army, and any successors or assigns thereof, and any agency, office or other subdivision thereof; and includes the officers, members, employees and agents of the Army when acting within the scope of their authority.

(b) "Arsenal" means the United States property known as the Rocky Mountain Arsenal and described more particularly on Exhibit A hereto.

(c) "CERCLA" means the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986.

(d) "Contractor" means any commercial party not a part of Shell with which Shell contracts for the performance of Response Action work pursuant to this MOU. Unless otherwise indicated, the term also includes a subcontractor retained by a prime Contractor or another subcontractor.

(e) "Federal Facility Agreement" means the Federal Facility Agreement for Rocky Mountain Arsenal, effective February 17, 1989, including all exhibits thereto (and any amendments or modifications thereof or supplements thereto).

(f) "Financial Manual" means the document identified in paragraph 7.4 of the Settlement Agreement.

(g) "Force Majeure" means any event arising from causes beyond the control of an Organization that causes a delay in or prevents the performance of any obligation under this MOU. "Force Majeure" includes, but is not limited to: acts of God; fire; war; insurrection; civil disturbance; explosion; unanticipated breakage or accident to machinery, equipment or lines of pipe, despite diligent maintenance; adverse weather conditions which could not be reasonably anticipated; unusual delay in transportation; earthquake; restraint by court order or order of public authority; inability to obtain, at reasonable cost and after exercise of reasonable diligence, any necessary authorizations, approvals, permits or licenses as a result of the action or inaction of any governmental agency or authority other than the Army; delays caused by compliance with applicable statutes or regulations governing contracting, procurement or acquisition procedures, despite the exercise of reasonable diligence; and insufficient availability of appropriated funds, if the Army shall have made timely request for such funds as part of the budgetary process. "Force Majeure" also includes any strike or labor dispute, whether or not within the control of the Organization affected thereby, but shall not include increased costs or expenses of Response Actions, whether or not anticipated at the time such Response Actions were initiated.

(h) "IRA" means an Interim Response Action identified in Section XXII of the Federal Facility Agreement.

(i) "Lead Party" means the Organization that is designated with responsibility, in accordance with Section XLIII of the Federal Facility Agreement, for conducting a Response Action, or any part thereof.

(j) "MOU" or "Memorandum of Understanding" means to this entire document and any amendments or modifications hereof and supplements hereto, and all documents incorporated herein by reference.

(k) "NCP" means the National Oil and Hazardous Substances Pollution Contingency Plan, 50 Fed. Reg. 47912 (1985) (effective February 18, 1986), and all amendments thereto which are not inconsistent with CERCLA and which are effective and applicable to any activity undertaken pursuant to this MOU.

(l) "Organization" means the Army, EPA or Shell.

(m) "Party" means the Army or Shell; "Parties" means the Army and Shell.

(n) "Response Action" has the same meaning as "Respond" or "Response" as defined in Section 101(25) of CERCLA, 42 U.S.C. § 9601(25).

(o) "Scope of Work" means a document identified in Part VI by which any Response Action work for which Shell is the Lead Party shall be conducted.

(p) "Settlement Agreement" means the "Settlement Agreement Between the United States and Shell Oil Company Concerning Rocky Mountain Arsenal," effective February 17, 1989, including all exhibits thereto (and any amendments or modifications thereof or supplements thereto).

(q) "Shell" means (a) Shell Oil Company and its successors and assigns, (b) the divisions thereof, including Shell Chemical Company, (c) Julius Hyman & Co., and (d) Shell Chemical Corporation; and includes the officers, employees and agents of Shell when acting within the scope of their authority.

All other capitalized terms used in this MOU shall have the same meaning as in the Federal Facility Agreement or the Settlement Agreement or the meaning specified in an executed Scope of Work.

IV. SCOPE OF MOU

This MOU, the Federal Facility Agreement and the Settlement Agreement constitute the entire understanding between the Army and Shell with respect to Shell's assisting the Army in the Response Action work described in an executed Scope of Work, except for any subsequently executed Scope of Work which the Parties may execute with respect to such Response Action work; constitute the sole conditions controlling Shell's participation in such Response Action work; and with respect to such Response Action work, supersede any other agreement(s) between the Parties. In the event a conflict between the provisions of the Federal Facility Agreement and the Settlement Agreement and this MOU, the provisions of the Federal Facility Agreement and the Settlement Agreement shall govern.

V. OPERATION OF MOU

By their execution of this MOU, each of the Parties acknowledges and agrees as follows:

(a) The provision of the Response Action work pursuant to this MOU is a reasonable and appropriate contribution to the assessment, selection, design and implementation of Response Actions that are protective of the present and future public health and the environment.

(b) The Army's actions under this MOU are not inconsistent with the NCP.

(c) Shell's actions under this MOU, to the extent certified by the Army pursuant to Subpart VI.E., are consistent with the NCP.

(d) This MOU does not operate to establish or to excuse any Shell or Army liability under any law, the Federal Facility Agreement or the Settlement Agreement, except to the extent provided in this MOU.

(e) This MOU does not operate to render Shell or any of its Contractors a CERCLA response action contractor.

(f) This MOU does not operate to expand or limit any of the rights and obligations of the Army as Lead Agency or Shell as Lead Party under any law or the Federal Facility Agreement.

(g) Unless otherwise provided in a Scope of Work, upon acceptance of the Response Action work pursuant to Subpart VI.E, title to any Response Action Structure including all related systems and facilities constructed as a part of that Response Action work shall pass to the United States.

(h) The Army shall be solely responsible for obtaining necessary permits, if any, and for establishing substantive compliance with all permitting requirements pursuant to Section 121(e) of CERCLA, 42 U.S.C. 9621(c), for any activities conducted pursuant to this MOU. However, Shell shall provide any necessary technical support necessary for the Army to obtain such permits.

(i) This MOU has no precedential or controlling effect with respect to any matter which is not expressly the subject of this MOU.

(j) This MOU does not create or impose any obligations or responsibilities on the Parties or relieve them of any obligations or responsibilities, except to the extent expressly provided herein.

VI. SHELL'S PERFORMANCE OF RESPONSE ACTION WORK

A. Development of Scope of Work: Pursuant to Section XLIII of the Federal Facility Agreement, the Army and Shell shall develop Scopes of Work by which Response Action Work for which Shell is the Lead Party shall be conducted. A Scope of Work shall include any required data or specifications for the Response Action work to be performed, a projected schedule for completion and a statement as to the appropriate limits of insurance to be maintained by Shell pursuant to Part VII.

B. Incorporation into this MOU: Any Scope of Work developed pursuant to Subpart VI.A and executed by the Army and Shell, and all the terms and conditions therein are incorporated by reference into this MOU.

C. Performance of Work: Upon execution of the Scope of Work by the Army and Shell, Shell shall immediately commence, in consultation and cooperation with the Army, as provided in the Consent Decree, to perform the Response Action work described in the Scope of Work.

D. Hiring of Contractor: Subject to the approval of the Army, Shell may hire at its sole expense, subject to Part VII, a Contractor to perform any Response Action work described in a Scope of Work. A Contractor may be terminated by Shell with the approval of the Army, which approval shall not be unreasonably withheld. Any disagreement with respect to such termination not resolved informally shall be resolved in accordance with the provisions of Part XIII.

E. Acceptance of Work: 1. If Shell performs the Response Action work in accordance with the specifications set forth in the applicable Scope of Work, the Army shall accept Shell's work pursuant to this MOU. The Army shall act promptly to accept Shell's work, and acceptance shall not be unreasonably withheld. Should the Army decline acceptance, it shall promptly notify Shell in writing, stating with specificity the factual, technical and legal bases for such nonacceptance.

2. If Shell concludes that the Army is in error for treating Shell's performance as incomplete or unacceptable for any other reason, Shell shall give notice in writing, within ten business days of the receipt of the Army's written notification, that Shell disagrees. Any such disagreement, if not resolved informally, shall be resolved in accordance with the provisions in Part XIII.

VII. SHELL INSURANCE OBLIGATIONS

Shell shall maintain such insurance or self-insurance as is required by statute or regulation to cover any claims which may reasonably be anticipated to be made as a result of Response Action work done pursuant to any Scope of Work attached as an exhibit to this MOU. At a minimum, Shell shall, at its sole option, procure insurance, maintain insurance or self-insure sufficiently to cover the following:

1. Worker's compensation and occupational disease insurance in amounts sufficient to satisfy applicable state law;
2. Employer's liability insurance in the minimum amount of \$100,000 per occurrence; and
3. Comprehensive general liability insurance for bodily injury, death or loss of or damage to property of third persons in the minimum amount of \$100,000 per occurrence.

Upon this MOU becoming effective, Shell shall promptly provide the Army with an affidavit that Shell is in compliance with the minimum requirements of this Part. Upon the signing of a Scope of Work, Shell shall promptly provide the Army with an affidavit that Shell is in compliance with this Part as to that Scope of Work. Upon request, Shell shall discuss with the Army the manner in which Shell will fulfill its obligations under this Part.

VIII. ARMY SUPPLEMENTATION OF SHELL INSURANCE

If the Response Action work being performed is an Army-Only Response Action, as defined in the Settlement Agreement, the Army shall release, defend, indemnify and hold harmless Shell from all losses, fines, penalties, claims, suits, liabilities, judgments, or expenses (including expenses of litigation or settlement) (collectively hereinafter in this Part VIII, "claim") with respect to any death or injury to any person or loss of or damage to property to the extent that these result from the construction, operation, collapse, rupture or failure of any Response Action Structure, or any part thereof, after the Army's acceptance pursuant to Subpart VI.E. or the operation, collapse, rupture, failure or ineffectiveness of the Response Action Structure as a result of the construction, operation, collapse, rupture or failure of the Response Action work when such claim is not compensated by insurance or self-insurance, to the extent provided below:

(a) Shell is not in material breach of this MOU with respect to the Scope of Work pursuant to which such Response

Action work was performed or such Response Action Structure was constructed;

(b) Any claim which is within the deductible amounts of Shell's insurance shall not be subject to this Part;

(c) Shell shall not be reimbursed for any claims (including expenses incidental to such claims) to the extent that they result, in whole or in part, from willful misconduct or recklessness by Shell;

(d) The Army may discharge its obligations under this Part by making payments directly to Shell or directly to any party to whom Shell may be liable upon obtaining a release from that party, which release provides adequate protection for Shell.

(e) If insurance coverage maintained in accordance with Part VII is reduced below the minimums specified in that Part without the Army's knowledge or approval, the liability of the Army under this MOU shall not be increased by reason of such reduction;

(f) To the extent that any claim against Shell may reasonably be expected to involve indemnification under this Part, Shell shall:

(1) promptly notify the Army of such claim against Shell;

(2) furnish evidence or proof of any claim covered by this Part in the manner and form reasonably requested by the Army; and

(3) immediately furnish the Army with copies of all pertinent papers received by Shell.

(g) To the extent that the amount of the claim is not determined to be in excess of the limits set forth in Part VII or to the extent that the amount of the claim cannot reasonably be determined to be or not to be in excess of these limits, Shell and the Army shall conduct a joint defense or settlement. Once it is determined that the amount of the claim is in excess of the limits set forth in Part VII, the Army shall direct and control such defense or settlement, with assistance by Shell as is acceptable to both Parties, and Shell shall execute any authorizations which the Army reasonably requires in connection with such settlement.

(h) Reimbursement for any claims under this Part shall not exceed appropriations available during the time that

such claims are represented by final judgments or by settlements approved in writing by the Department of Justice. This agreement to reimburse Shell for certain claims shall not be interpreted as implying that Congress shall, at a later date, appropriate funds sufficient to meet any deficiencies. During all times that claims remain unreimbursed due to lack of appropriated funds, the Army shall exert its best efforts to obtain appropriations for such reimbursement.

**IX. TREATMENT OF COSTS INCURRED
BY SHELL PURSUANT TO THIS MOU**

Any costs incurred by Shell pursuant to this MOU are Reimbursable Costs and shall be governed by the Settlement Agreement and the Financial Manual.

X. DELAY OR PREVENTION OF PERFORMANCE

A. As provided in the Consent Decree, if a Party is rendered unable, wholly or in part, by Force Majeure to carry out its obligations under this MOU, then upon that Party's giving written notice as provided in Subpart XI.C., the obligations of that Party, so far as they are affected by the event of Force Majeure therein specified, shall be suspended during the continuance of such cause, but for no longer period, and such cause shall be remedied so far as possible with all reasonable dispatch.

B. The settlement of a strike or other labor dispute shall be entirely within the discretion of the Party involved with such strike or labor dispute, and the requirement that any event of Force Majeure shall be remedied with all reasonable dispatch shall not require the settlement of a strike or labor dispute by acceding to the demands of the opposing party when such course is inadvisable in the discretion of the Party involved with such strike or labor dispute.

C. When circumstances are occurring or have occurred that delay the completion of any obligation, and a Party believes such circumstances constitute an event of Force Majeure, such Party shall notify the other Organizations in writing within 15 days after the notifying Party obtains information indicating that a delay will occur. Such notice shall include a detailed explanation of the reason(s) for and anticipated duration of the delay, the measures taken and to be taken to prevent or minimize the delay, and a schedule for implementation of such measures. Failure to provide notice in accordance with this paragraph within the required 15-day period shall constitute a waiver of any claim of Force Majeure with respect to any event of Force Majeure for which notice was not timely given.

D. If the Organizations cannot agree whether a delay is or was attributable to an event of Force Majeure, any Organization may invoke Dispute Resolution pursuant to Section X of the Settlement Agreement.

E. Scope of Work Modification: If performance of this MOU is delayed because any Party finds it necessary to make modifications to address an unanticipated occurrence which may cause a delay of more than two weeks, such modifications shall be developed and implemented by Shell in consultation and cooperation with the Army. Any disputes not resolved informally shall be resolved pursuant to the provisions of Part XIV. Further, if Shell anticipates the delay resulting from any such modifications will necessitate the extension of a Deadline, it shall request such an extension in accordance with Section XXVI of the Federal Facility Agreement.

F. Unaffected Activities: To the extent that the unanticipated occurrence does not necessitate delay in any discrete portion(s) of the activities provided in Part VI, such portion(s) of the activities shall proceed as originally provided in the MOU irrespective of the need for modification of other parts of the MOU.

XI. SHELL ACCESS TO ROCKY MOUNTAIN ARSENAL

Shell and its Contractors shall be afforded access to all relevant portions of the RMA in order to perform its obligations under the MOU pursuant to the terms and conditions of the Access and Use Agreement attached as Exhibit E to the Settlement Agreement until such time as the Army and Shell execute an applicable superseding agreement.

XII. DISPUTE RESOLUTION AND JUDICIAL REVIEW

A. Dispute Resolution: Any dispute which arises in connection with this MOU may be submitted for resolution pursuant to Section X of the Settlement Agreement. Prior to any such submission, Shell and the Army shall meet and attempt to resolve the dispute informally.

B. Judicial Review: 1. Judicial review of issues arising in connection with this MOU shall be obtained pursuant to Section XI of the Settlement Agreement.

2. The pendency of any dispute shall not affect the responsibility of the United States or Shell to continue their involvement in the assessment, selection, design and implementation of Response Actions, or discrete portions of Response Actions, not subject to such dispute.

XIII. GENERAL

A. Term: This MOU shall continue in effect as to a specific Scope of Work until the Army, pursuant to Subpart VI.E., accepts Shell's work pursuant to this MOU, and the reimbursement or payment has been made pursuant to Part IX.

B. Modification: Any provision of this MOU or of any Scope of Work may be modified at any time by both Parties' agreement. Any modification must: (1) be in writing; (2) show the date signed by the Parties; (3) specify that it is intended to modify this MOU; (4) state the provisions of the MOU to be modified; (5) state the new provisions; and (6) state when the new provisions are to be effective.

C. Effect of Execution: This MOU shall become effective on the later of its execution by the Parties or the entry of the Consent Decree. A Scope of Work shall become effective, final and binding upon its execution.

IN WITNESS WHEREOF, I have hereunder set my hand as an authorized representative of the United States Department of the Army.

Date: 1/23/89

Lewis D. Walker
Lewis D. Walker
Deputy for Environment, Safety
and Occupational Health

IN WITNESS WHEREOF, I have hereunder set my hand as an authorized representative of Shell Oil Company.

Date: _____

R.G. Dillard
Vice President

XIII. GENERAL

A. Term: This MOU shall continue in effect as to a specific Scope of Work until the Army, pursuant to Subpart VI.E., accepts Shell's work pursuant to this MOU, and the reimbursement or payment has been made pursuant to Part IX.

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IN WITNESS WHEREOF, I have hereunder set my hand as an authorized representative of the United States Department of the Army.

Date: _____

Lewis D. Walker
Deputy for Environment, Safety
and Occupational Health

IN WITNESS WHEREOF, I have hereunder set my hand as an authorized representative of Shell Oil Company.

Date: 2/15/89

R. G. Dillard
R.G. Dillard
Vice President

SCOPE OF WORK

Shell will perform the following activities as lead party for design and implementation of the North Boundary Containment System Improvements Interim Response Action:

1. Perform the preliminary investigation and engineering required to develop a Preliminary Engineering Design Package for review and approval by the Army.
2. Perform detailed design of the selected system, based on the agreed specifications, which will be in conformance with the selected alternatives set forth in the Final Decision Document including the following:
 - a. New recharge trenches along the eastern half of the system on the north side of the soil-bentonite barrier.
 - b. Reconfiguration of existing sumps and piping to allow for operation of only two carbon adsorbers and use of the third adsorber as a spare unit;
 - c. Replacement of existing cartridge filters in the pre- and post-filtration systems with bag filters to attempt to obtain increased solids removal efficiency and improved reliability;
 - d. Enlargement of existing virgin and spent carbon storage tanks for increased storage capacity;
 - e. Replacement of existing carbon adsorber effluent septa with stainless steel well screen to attempt to reduce carbon fines carry over;

- f. Conversion of existing spent carbon blowcase for operation as a virgin carbon definer/blowcase;
- g. Enlargement of existing carbon definer/blowcases and increase of defining water flowrate to attempt to improve removal of fines from virgin carbon;
- h. Conversion of the exiting wastewater sump to a continuous flow clarifier for improved handling of wastewaters from carbon defining and loading operations, and for reduction of carbon fines carryover into the plant influent;
- i. Reconfiguration of existing piping to allow for "discharge-to-waste" of treated water following carbon addition for reduction of carbon fines carryover during adsorber start-up;
- j. Addition of a bag filtration system to the discharge of the wastewater clarifier for removal of suspended solids prior to discharge into the influent sump;
- k. Reconfiguration and/or replacement of existing carbon transfer piping, such as replacement of short radius elbows with long radius elbows, to attempt to reduce carbon fines generation during transfer operations;
- l. Enlargement of existing treatment building for accommodation of enlarged carbon storage vessels and access to storage and adsorption vessels;

- m. Cleaning and/or replacement of pre-filter and adsorber influent piping for removal of scale and carbon fines buildup;
 - n. Addition of flowmeters and flow control valves to the discharge piping of each well extraction manifold for control of groundwater contribution from each manifold;
 - o. Replacement of existing carbon adsorber influent plate septa with stainless steel well screen for improvement of flow distribution across the carbon bed;
 - p. Wells found during construction and acting as contaminant migration pathways from the alluvial aquifer to the Denver Formation will be closed under the Abandoned Wells IRA by the appropriate Army contractor.
 - q. A full evaluation of the existing dewatering system south of the soil-bentonite barrier will be made to determine if the dewatering capacity meets all requirements. If additional dewatering capacity is needed, such capacity will be implemented as part of this IRA.
- 3. Prepare draft and final Implementation Document and implement the final North Boundary System Improvements Implementation Document for review and approval by the Army.
 - 4. Perform all work in connection with construction of North Boundary System Improvements as described more fully in the North Boundary System Improvements

Implementation Document (as defined below), including the following:

- a. Procurement of all required materials and subcontractors.
- b. Supervisory and construction labor to manage subcontracts and install wells, piping and treatment systems, recharge trench addition, and required roads and utilities.
- c. Testing and supervision of startup of the North Boundary System Improvements upon completion of construction.
- d. Site cleanup and final grading of any disturbed areas in preparation for reseeding by the Army.
- e. All activities described in this paragraph 4 shall be performed in accordance with the construction work plan, basis of the estimated cost, schedule, technical specifications, engineering drawings, and health and safety plan to be set forth in the North Boundary System Improvements Implementation Document.
- f. The term "North Boundary System Improvements Implementation Document" means the following documents, both of which are hereby incorporated herein by reference:
 - 1) Final Implementation Document for IRA to extract, treat and recharge groundwater in the North Boundary System area. This document to be prepared by MK-Environmental Services for Shell and any amendments or

modifications thereof and supplements thereto; and

- 2) Prior to issuance of the documents described in 4.f.(1), but only prior to issuance of that documents, Draft Implementation Documents for the IRA to extract, treat and recharge groundwater in the North Boundary System to be prepared by MK-Environmental Services for Shell.
5. As set forth in the Final Decision Document, the Draft Implementation Document must be completed by January 15, 1990. For construction reasons this Draft Implementation Document will be issued in two sections. The first section will cover the improvements to the recharge trenches and will be issued about November 21, 1989. The second section will cover the improvements to the remainder of the system and will be issued by January 15, 1990. To allow sufficient time for Army issuance by this milestone, Shell will submit forty (40) complete copies of the Draft Implementation Document to the Army five (5) working days prior to the above deadline.

The Army will issue the Draft Implementation Document to the other Organizations, Department of Interior and the State by January 15, 1990, and require comments within thirty (30) days of the date of issuance. Within five (5) working days after the end of the 30 day comments period, the Army will submit copies of all comments received to Shell for review and inclusion in the Final Implementation Document as appropriate.

Shell shall submit thirty (30) complete copies of the Final Implementation Document to the Army as a deliverable within twenty (20) working days of receipt of comments by Shell on the Draft Implementation Document. The Army shall issue the Final Implementation Document to the other Organizations, Department of Justice and the State no later than five (5) working days after receipt from Shell.

6. During performance of construction of this Interim Response Action, Shell shall submit a monthly letter progress report to the Army summarizing work performed versus work planned, highlighting major items completed, and updating the schedule of construction until the Interim Response Action is completed. Monthly letter reports shall be submitted to the Army within ten (10) working days after the end of each monthly reporting period. At the close of the project, a letter will be provided to the Army summarizing the work completed.

IN WITNESS WHEREOF, I have hereunder set my hand as an authorized representative of the United States Department of the Army.

Date

11/4/89

Donald Campbell
Deputy Program Manager

IN WITNESS WHEREOF, I have hereunder set my hand as an authorized representative of Shell Oil Company.

Date

11/2/89

C.K. Hahn
Manager, Denver Site Project

Section 3

CONSTRUCTION WORK PLAN

1. Survey: Area will be staked to locate and define the limits of excavation and location of facilities.
2. Soil Investigation: Prior to the beginning of the construction work the areas to be excavated will be investigated for contaminants as outlined in the Health and Safety Plan.
 - A. Recharge Trenches: One hole in each area will be drilled to one foot below planned excavations and tested at five foot increments to investigate volatile organic levels.
 - B. Pipeline Trenches: One hole every 500 feet will be drilled to approximately one foot below planned excavations in the alignment of each pipeline and tested every five feet of depth to investigate the presence of volatile organic substances.
 - C. Should findings warrant further investigations, additional testwork will be specified and implemented.
3. Recharge Trenches: Excavation of each of these units will be performed in two phases as discussed below:
 - A. Bench: Upper 3 to 4 feet of existing soil, will be excavated down to establish a lower working platform to minimize vertical trenching and create an area to stockpile potentially contaminated soils from the vertical trench excavation.

- B. Vertical Trench Excavation: The remaining depth of excavation will be trenched with a 30" to 36" wide bucket to the elevations selected in the field by the geologist.

Note: Potentially contaminated soil will be stockpiled on one side of the benched platform to isolate the soil removed during the trenching operation. Personnel working on this side of the trench will decontaminate their clothing prior to leaving this area or crossing the trench if contaminant levels are found to warrant these measures.

4. Dust Control: During the period when earth moving and excavation operations are in progress a water truck will be on site and the surfaces will be sprayed to maintain the surface soil moisture content and control the evolution of dust.
5. Recharge Trench: Will be excavated using standard equipment. Gravel filling will follow excavation as closely as possible, i.e., gravel fill must not flow into area where excavation is taking place.
6. Geological Services: An onsite geologist will monitor the construction work to establish depth of excavation along the length of each trench and log information for future reference.
7. Health & Safety: An onsite health and safety officer will monitor the work and test the excavations with an OVA and PID to ensure worker's safety and identify any volatile organic compounds that may be encountered.
8. Reporting: Attached is a copy of the Daily Construction Report Form on which the daily activities are recorded and a copy of the Daily Personnel Log which is used to record the names of all personnel who have visited the site.

9. Organization: An organization chart for the construction of the North Boundary System Improvements/IRA Recharge Trench Project is attached.
10. Air Monitoring: A specific air monitoring program has not been selected as of the date of issue. The program will be finalized shortly and all parties will be notified.

Day _____ Date _____

Work Summary : _____

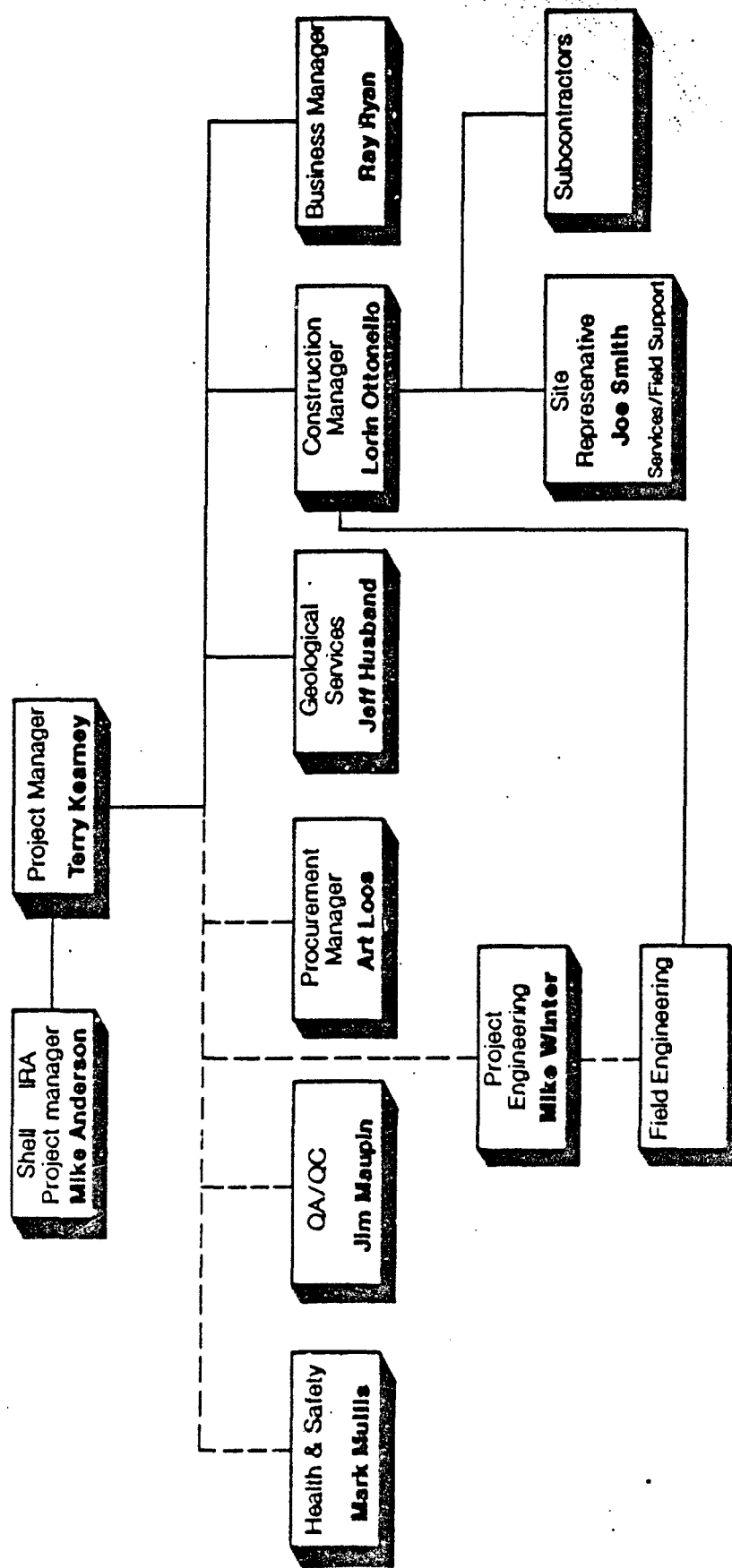
Extra Work/Delays :

Title

Day _____ Date _____

[illegible]

ORGANIZATION CHART **RECHARGE TRENCH PROJECT** **THE NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA**



Section 4

RECHARGE TRENCH PROJECT FOR THE NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA BASIS OF THE CONSTRUCTION COST ESTIMATE

The attached construction cost estimate has been prepared for implementation of the Recharge Trench Project for the North Boundary System Improvements Interim Response Action (IRA). Included in the estimated costs are the recharge trenches, roads, site grading, and utility distribution systems as defined in the engineering specifications enclosed in Volume II and the engineering drawings enclosed in Volume III. The subject specifications and drawings were completed in January 1990 and were subsequently issued in January 1990 as part of this Implementation Document.

Labor costs are based on the prevailing non-union wage rates in Adams County, Colorado. Equipment hourly rates are based on standard "Blue Book" equipment operating costs. Prices for permanent materials and major equipment are based on previous estimates and current estimating manuals. Since the recharge trench will be excavated as directed by the Engineer, no allowance has been included for any blasting of the bedrock.

Indirect costs for construction management, Contractor's overhead and fee, and Health and Safety Program are also included in the estimate. The estimate has been prepared on the basis of direct hire construction work with Morrison-Knudsen acting as construction manager for Shell Oil Company. Miscellaneous work may be subcontracted.

For the development of health and safety supplies costs as well as labor productivity estimates, it was assumed that all excavation of trenches greater than 5 feet deep will be performed with Level C personnel protection. All other work will be performed with Level D personnel protection.

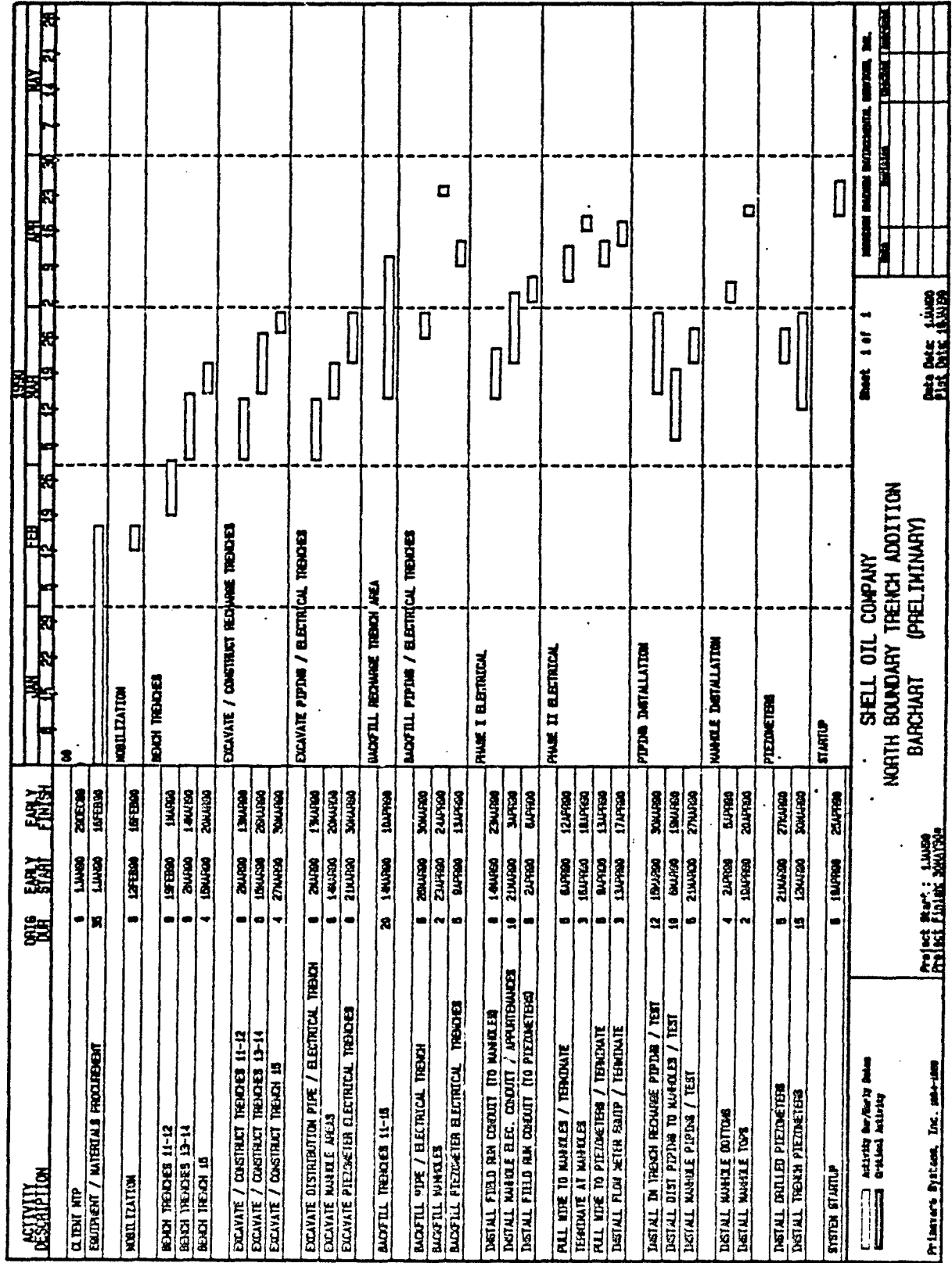
This estimate is based on on preparing a working bench for each trench. Potentially contaminated material will be placed in the working bench during evacuation. The potentially contaminated material will be spread over the recharge trench in the bench area upon completion of the trench backfill. Clean spoil material will be placed over the potentially contaminated material to grade level. The potentially contaminated material will never leave the excavation.

All equipment and personnel will be decontaminated before leaving a bench area. Water used for decontamination will discharge into the recharge trench. The decontamination water will never leave the bench areas.

NORTH BOUNDARY SYSTEM IMPROVEMENTS
RECHARGE TRENCH PROJECT

ESTIMATE BREAKDOWN

1.	Mobilization	\$ 7800
2.	Recharge trench with piezometers	151,080
3.	Distribution piping and electrical	153,045
4.	Drilled piezometers	42,000
5.	Health and safety	117,020
6.	Construction management	154,486
7.	Fees	<u>54,569</u>
	Total Project	\$680,000



Prismac Systems, Inc. 800-441-1000

1.0 PURPOSE

The purpose of the Task Specific Health and Safety Plan (TSHSP) is to establish specific requirements for the protection of personnel during construction of the North Boundary System Improvements. The TSHSP contains related background information and specific procedures necessary to maintain the health and safety of MK-ES employees and subcontractors while performing the work. This plan will make use of data generated through previous site assessment efforts and available toxicological information integrated with generally accepted remedial hazardous waste work practices and construction protocols.

The TSHSP has been designed to provide a level of detail which will inform all personnel of the current information and procedural requirements when cross-referenced to the MK-Environmental Services' Rocky Mountain Arsenal Health and Safety Plan (Project 1680 Document No. 870911.10) September, 1987. The project plan has established provisions for medial surveillances, detection of unexploded ordnance, surety monitoring, personnel training, and of routine field operations at RMA.

2.0 RESPONSIBILITIES

The Onsite Health and Safety Officer (OHSO) will report to the Technical Team Manager to facilitate project continuity, however, he will also have reporting responsibility to the Project Industrial Hygiene Manager.

2.1 Technical Team Manager

The Technical Team Manager has full responsibility for implementing and executing an effective program of employee protection and accident prevention. This individual may delegate authority to expedite and facilitate any application of

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the program. It is recognized that strong support and active participation by the Project Manager is an essential element in a successful safety and health program.

2.2 Industrial Hygiene Manager

The Industrial Hygiene Manager has overall project responsibility for development and implementation of the project. This individual will be consulted when any changes to this plan or modification of any procedure is required or requested or when any new activity is proposed. Authorization for any personnel to conduct work activities on this project must be cleared through this individual first. All medical authorizations and training records will be maintained by the Project Industrial Hygiene Manager.

2.3 Onsite Health and Safety Officer

The Onsite Health and Safety Officer (OHSO) will be responsible for monitoring worker exposures to chemical toxicants. The OHSO will conduct both general air survey monitoring with direct reading instrumentation and personal monitoring by air sampling pumps. As data is received and evaluated, the OHSO in conjunction with the Project Industrial Hygienist shall modify the general safety and health plan to fit current worker protection needs.

The OHSO is also responsible for the establishment and execution of all decontamination and emergency procedures. Further, he will ensure the integrity and accuracy of all documentation reflecting activities of health and safety relevance.

With the determination of unsafe work conditions, the OHSO is authorized to stop work. Resolution of all onsite health and safety problems will be coordinated through the Technical Team Manager with assistance from the Project Industrial Hygienist.

3.0 HAZARD CHARACTERIZATION

A comprehensive hazard assessment has been conducted which is designed to assist in identifying the chemical and physical hazards associated with the construction of the North Boundary System Improvements. For the purposes of this TSHSP, a distinction has been made between these two types of hazards, allowing for a detailed discussion of their relevance to the task.

3.1 Chemical Hazard Assessment

In any discussion regarding the chemical compounds found at RMA, it is important to understand that the concurrent chemical hazards which may be encountered are directly related to the following:

- The chemical and physical properties of the compounds which have migrated to the point of excavation.
- The concentration of contaminant and the individual's susceptibility/hypersensitivity to the contaminant.

In order for those compounds present to represent a hazard to site workers, there must first be contact through inhalation, skin, or ingestion at a concentration high enough to cause health effects. Therefore, a compound must satisfy two requirements before it can be considered a hazard: 1) it must be present in sufficient concentration; 2) worker contact must be possible. While conducting construction activities in support of this project, the chemical exposure component will be controlled mainly by eliminating worker contact through the use of personal protective equipment (PPE).

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Soils analysis of the identified construction area and its surroundings have not shown concentrations sufficiently high to warrant an inhalation concern based on contaminants reaching their respective Permissible Exposure Limits (PEL). Analytical data suggests that the contaminated groundwater plume in the area to be excavated contains several volatile and semivolatile organic compounds in part or fractional part per billion concentrations.

Dermal (skin) contact followed by inadvertent ingestion of contaminated soil and water is the more feasible exposure pathway. Detailed information regarding compounds which may potentially pose the greatest health hazards is presented below. The health significance and selection of these compounds was based upon research and factors which relate to worker exposure potential. The most significant among these include:

- Availability of reliable analytical data representative of the contaminated groundwater plume.
- Relative concentration of target compounds in the soil within and surrounding the identified site of work.
- Chemical/physical characteristics of contaminants present.
- Existing in-field and laboratory analytical techniques necessary for compound identification.

Unexploded Ordnances (UXO) have been encountered in several areas of RMA, historic information has identified those locations. All locations of proposed soil intrusive activities lay outside areas to be avoided.

There are three general classes of agents known to have been stored at RMA. They are nerve agents, including GB and VX; choking agents such as phosgene; and blistering agents such as

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the mustard gases and Lewisite. From gathering historical information, no agent presence is expected in the areas of proposed work.

An Army biologic agent named TX (anti-crop) was also manufactured at the Rocky Mountain Arsenal. According to Army documents this agent is non-pathogenic to man or animal and no allergic type of reactions have ever been recorded after more than 20 years of direct contact of personnel with the anti-crop agent.

3.1.1 Organic Contaminants

The groundwater and soils of the North Boundary area are contaminated with a variety of organic and inorganic compounds. They are present in the parts per billion (ppb) range or fractions thereof. Several of the compounds that may be present are moderately to highly toxic via ingestion. Thus, eating food, smoking, chewing tobacco or gum are strictly forbidden in the active working area, i.e., exclusion and/or contamination reduction zones. The contaminants present are listed below with a brief synopsis of each chemical.

- Benzene is considered a suspected human carcinogen with a Permissible Exposure Limit (PEL) of 1 ppm for inhalation as a time-weighted average (TWA). Benzene's vapor pressure is 75 mmHg at 20°C. It has an aromatic sweet odor at 82 ppm, which is the odor threshold. As an acute poison, benzene produces narcotic effects with symptoms of eye, nose and respiratory irritation, headache, nausea, giddiness, abdominal pain and a staggered gait.
- Carbon Tetrachloride has been evaluated by the International Agency for Research on Cancer (IARC), this organization concluded the chemical does cause cancer. Carbon tetrachloride has a PEL established of 2 ppm and a

vapor pressure 91 mmHg at 20°C. Its odor is characterized by an ether-like quality at 250 ppm, which is the odor recognition threshold. The compound causes both intense eye and skin irritation, drowsiness, dizziness, and vomiting if personnel are subjected to acute overexposure.

- Chlorobenzene has an established PEL of 75 ppm and a vapor pressure of 8.8 mmHg at 20°C. Its odor is characterized by a mild aromatic aroma some associate with almonds. Symptoms of overexposure are drowsiness, eye, nose, and skin irritation and liver damage.
- Chloroform is also a suspected human carcinogen with a recently reduced PEL of 2 ppm. Chloroform has a vapor pressure of 160 mmHg at 20°C. With an odor threshold of 280 ppm, the chemical has a characteristic sweet pleasant smell. Symptoms associated with acute exposure are dizziness, headache, fatigue, nausea and mental dullness. Chloroform also causes eye and skin irritation.
- p-Chlorophenylmethyl sulfide (CPMS) does not have an established PEL. CPMS has a vapor pressure of 0.11 mmHg at 25°C. Not much information exists on the chemical except it was tested for both skin and eye irritation on rabbits. It produced no skin irritation but did produce positive corneal responses, which were reversible.
- p-Chlorophenylmethyl sulfoxide (CPMSO) does not have an established PEL. CPMSO has a vapor pressure of 8×10^{-4} mmHg at 25°C. In rabbits, sulfoxide produced mild skin irritation, eye lesions of the iris and conjunctivae (which were reversible) but corneal opacity was not reversible within 21 days.

- p-Chlorophenyl methylsulfone (CPMSO₂) does not have an established PEL. Its vapor pressure is 5×10^{-4} mmHg at 25°C, making exposure to this chemical by inhalation unlikely. The compound was only found in groundwater analysis. Studies have shown CPMSO₂ to be a mild skin irritant. Other symptoms associated with acute exposure levels are depression, anorexia, and weakness.
- Dibromochloropropane (DBCP) is considered a carcinogen and has a PEL of 1 ppb. DBCP's vapor pressure is 0.8 mmHG at 21°C, and its odor threshold is 0.03 ppm. Symptoms of overexposure to DBCP include drowsiness, nausea, vomiting, as well as eye, nose and throat irritation.
- 1,2 Dichloroethane (Ethylene Dichloride) is considered to be a potential human carcinogen with a PEL of 1 ppm and a Short-Term Exposure Limit (STEL) of 2 ppm, not to be exceeded during any 15 minute excursion. The vapor pressure is 62 mmHg at 20°C. 1,2 Dichloroethane has a chloroform-like aroma and an odor threshold of 87 ppm. Breathing the chemical can irritate the nose, throat, and lungs causing a cough, shortness of breath, and difficulty in breathing. Overexposure can cause nausea, vomiting, headaches, increasing drowsiness, and then loss of consciousness.
- Dicyclopentadiene (DCPD) has a recently established PEL of 5 ppm. DCPD's vapor pressure is 2.2 mmHg at 25°C and its odor threshold is 0.011 ppm. Some studies indicate DCPD is an eye irritant.
- Dieldrin has an established PEL of 0.25 mg/m³ with a "Skin" notation and a vapor pressure of 1.8×10^{-7} mmHg at 20°C. NIOSH recommends that dieldrin be treated as a potential human carcinogen. Dieldrin does not have an odor threshold, but some sources report the compound has a mild

chemical odor. Symptoms of Dieldrin overexposure include headache, dizziness, nausea, vomiting, sweating, limb tremors, and convulsions.

- Diisopropyl Methyl Phosphonate (DIMP) does not have an established PEL. DIMP has a vapor pressure of 0.28 mmHg at 25°C and in some studies has been shown to be an eye and skin irritant.
- 1,4-Dithiane has no established PEL. Its vapor pressure is 0.8 mmHg at 25°C. There is very limited information concerning health effects related to Dithiane overexposure.
- Endrin has a PEL of 0.1 mg/m³ with "skin" notation. Its vapor pressure is reportedly 2×10^{-7} mmHg at 20°C. Endrin has no established odor threshold but the smell emitted is a mild chemical odor. Symptoms associated with overexposure to Endrin are headache, dizziness, abdominal discomfort, nausea, vomiting, insomnia, weakness, and anorexia.
- Isodrin does not have a PEL, but it has a vapor pressure of 10^{-6} mmHg at 25°C. Symptoms of overexposure to Isodrin are headache, dizziness, nausea, weakness, and confusion.
- Methyl chloroform (1,1,1 Trichloroethane) has a PEL of 350 ppm and a vapor pressure of 100 mmHg at 20°C. Methyl chloroform has a mild chloroform-like smell and an odor threshold of 390 ppm. Overexposure to methyl chloroform vapor may cause headache, dizziness, drowsiness, unconsciousness, irregular heart beat, and death. Methyl chloroform liquid splashed in the eyes may cause irritation. Dermatitis may result from repeated skin contact with the liquid.

- 1,4 Oxathiane does not have an established PEL. The chemical's vapor pressure is 3.9 mmHg at 20°C. There is no established odor threshold for this chemical. Animal studies have shown 1,4 Oxathiane to be a skin and eye irritant.
- Tetrachloroethene has an established PEL of 25 ppm. Its vapor pressure is 14 mmHg at 20°C. The odor threshold is 47 ppm and the smell is said to resemble ether or chloroform. The chemical is an eye, nose and throat irritant. Other symptoms of overexposure are a flushed face, vertigo, dizziness, headache and nausea.
- Trichloroethene (TCE) has a PEL of 50 ppm. NIOSH recommends that TCE be treated as a potential human carcinogen. The vapor pressure of TCE is 58 mmHg at 20°C with an odor threshold of 200 ppm. Symptoms of overexposure include headache, vertigo, tremors, nausea, vomiting, dermatitis and eye irritation.
- Xylene has a 100 ppm PEL and a 150 ppm STEL. Xylene has three isomers with different vapor pressures. Ortho, meta, and para have vapor pressures of 7, 9, and 9 mmHg at 20°C, respectively. All isomers have an aromatic smell and an odor threshold of 20 ppm. Xylene vapor may cause irritation of the eyes, nose, and throat. Liquid xylene may be irritating to the eyes and skin. In addition, breathing high concentrations may cause loss of appetite, nausea, vomiting, and abdominal pain.

3.1.2 Metal Contaminants

Heavy metals were primarily found associated with soils at varying depths, but not in concentrations that would warrant an inhalation concern. To protect personnel from potential dermal or inadvertent ingestion hazards, personnel protective equipment

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(PPE) and site hygiene practices will be utilized respectively. Information concerning metals which may be present in or around the task site is presented below.

- Chromium has an OSHA PEL of 0.5 mg/m^3 for the insoluble salts form. Primarily the health effects associated with chromium result from overexposure to soluble chromic or chromous salts, which cause an allergic skin rash. Insoluble forms of the chemical are known to cause histologic fibrosis of the lungs.
- Copper has a PEL of 1 mg/m^3 and is considered highly irritating to the mucous membranes. Other symptoms in cases where overexposure has occurred include nasal perforation, a metal taste and dermatitis.
- Lead in its inorganic state, as a dust or fume, currently has an established PEL of 0.15 mg/m^3 . As with chromium, the primary health hazard is associated with lead salts. There is limited data concerning the carcinogenicity of organic lead compounds or metallic lead. Symptoms of overexposure to the inorganic form are paleness, malnutrition, constipation, abdominal pain, colic, anemia, tremors and paralysis of the wrist.
- Zinc has a new PEL for zinc oxide dust established at 10 mg/m^3 with a respirable fraction set at 5 mg/m^3 . Zinc primarily affects the respiratory system but produces several systemic effects elsewhere. Symptoms of overexposure to zinc are a dry throat, a sweet metallic taste, cough, chills, fever, headache, blurred vision, back pain, nausea, vomiting, and fatigue.

3.2 Physical Hazard Assessment

Accidents involving physical hazards can directly injure workers. Additional hazards can also be created; for example, increased chemical exposure due to damaged protective equipment, or danger of direct contamination into the bloodstream by a cut or abrasion. Site personnel should constantly look out for potential safety hazards, and should immediately inform their supervisors of any new hazards so that mitigative action can be taken.

Construction projects have their own variety of potential physical hazards, including but not limited to heavy equipment use, excavation/trenching operations, scaffolding, and heat stress disorders related to hard physical labor. These topics merit individual discussion as they apply to the general construction scheduled on the Rocky Mountain Arsenal site.

3.2.1 Heavy Equipment

All motor vehicles that operate as off-highway earth-moving equipment must meet certain requirements for the safety of the operator and surrounding workers. Machines should be maintained in good working order. All vital parts such as motors, chases, blades, bladeholders, tracks, drives, hydraulic and pneumatic mechanisms, and transmissions should be thoroughly inspected each day.

Safe practices to implement while working from or around heavy equipment are detailed below.

- Care will be taken when working on inclined surfaces to insure that machinery will not tip over.
- At no time will a piece of equipment be left unattended while the motor is running.

- All bidirectional machines shall be equipped with a horn which shall be operated as needed when the machine is moving in either direction.
- Seat belts will be required for heavy machinery which have roll-over protective structures (ROPS). Seat belts will not be present in heavy equipment that does not have ROPS.
- At least one 2A portable fire extinguisher shall be mounted on at least one vehicle, and within 100 feet of construction operations.

3.2.2 Trenching/Excavation

There are certain regulatory requirements that OSHA requires for trenching and excavation which will be followed on the North Boundary Improvements. OSHA requires that, in all excavations, employees exposed to danger from moving ground shall be protected by a shoring system, sloping of the ground, or some other equivalent means. Because of the type of soil present, a 1:1 (45°) angle of slope at the sides of the excavation will be used on this project. This is the greatest angle above the horizontal plane at which a material will lie without sliding. If for any reason trenching specifications must be changed, then operations will proceed with adherence to 29 CFR 1926.650 through 653 Subpart P.

If heavy equipment or materials are to be located near (with a radius of the height of the excavating vehicle), or above the trench, the walls must be braced, sheet-piled, or shored safely support the extra weight. In addition, the spoils pile of excavated material must be stored at least two feet from the edge of the excavation, and be retained in an effective manner.

In case of an emergency, workers must be able to exit the trench quickly. If employees are to be in trenches 4-feet deep or more, adequate means of egress must be provided and located so as to require no more than 25 feet of lateral travel.

Areas around trenching activities will be inspected daily, with close attention paid to subsidence or tension cracks, especially after rainstorms. Diversion dikes or ditches shall be constructed as a means of preventing surface water from entering the excavation if deemed necessary by the OHSO. If any questionable area is located that could increase the possibility of a cave-in or slide, then excavation must be stopped until the problem is corrected.

Two separate areas within the recharge/slurry trench are identified, the upper 4-5 foot excavation is the working zone of the trench with the deeper vertical shaft being designated as the deep portion. Under no circumstances are MK-ES employees, vendors, or authorized subcontractors permitted to enter the deep portion of the recharge trench excavation. Consequently, all sampling, visual observations, and real time analytical determinations are to be made from the working trench or ground surface.

3.2.4 Heat Stress

Heat-induced occupational illnesses, injuries, and reduced productivity occur in situations in which the total heat load (environmental plus metabolic) exceeds the capacities of the body to maintain normal body functions without excessive strain. The effects of heat stress may be compounded by the addition of personnel protective clothing over the customary work ensemble. The major limitation with protective clothing is that it decreases the body's natural ability to exchange heat with the environment (the loss of evaporative and convective cooling capacity). Normally, within enclosed environments engineering

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controls can be implemented to reduce the effects of heat upon the human body, but an outdoor work environment reduces this possibility.

Where engineering controls of heat stress are not practical, other solutions exist to keep the level of total heat stress on the worker within limits that will not cause increased risk of a heat-related illness. Some of these solutions may include but are not limited to acclimatization, work schedule adjustment, rest-work regimen, shading, increasing the work crew size and personal cooling devices.

Because heat stress can be so debilitating, it is important that all workers assigned to this task be familiar with its signs and symptoms. Heat disorders are interrelated and seldom occur as distinct entities. The recognizable symptoms of various heat related disorders are discussed below, together with prevention criteria and immediate treatment steps.

Heat Rash - This is also called "prickly heat" and is caused by either constant abrasion to an area of skin by rubbing or chaffing, especially in high friction areas, i.e., arm pits, nape of neck, etc. Rough protective clothing on bare skin aided by a humid environment is another cause of heat rash.

- Treatment

Application of powder or mild drying lotion to the effected area can reduce the discomfort. Another method, if feasible, is to change the type of protective clothing.

- Prevention

Do not use constrictive clothing, and provide a cotton fabric barrier between skin and abrasive protective clothing.

Heat Cramps - This heat disorder is caused by heavy sweating during hot work and ingesting copious amounts of water without replacing salt loss. The water ingested dilutes remaining electrolytes and the excess water enters body muscles, causing painful spasms in hands, feet, legs, arms or stomach. Water intake is very important during hot working conditions but not to the exclusion of everything else.

- Treatment

The pain can be readily alleviated by rest and massaging of affected muscles after electrolyte drink replenishment.

- Prevention

For unacclimatized workers, supplement salt intake at meals. Acclimatized personnel should receive adequate salt intake with meals. Increase the amount of fluid intake with electrolyte replacement beverages like Gatorade, Squincher, etc.

Heat Exhaustion - This heat illness can be caused by lack of acclimatization and failure to replenish lost water during sustained exertion in heat. Characteristic symptoms are listed below:

fatigue	clammy, moist skin	giddiness
nausea	pale complexion	fainting
headache	rapid pulse	low blood pressure

- Treatment

Remove individual to a cooler environment. Have the person to lay down with feet elevated, and give electrolyte replacement beverages.

- Prevention

Acclimatize workers using a breaking-in schedule for 5-7 days. Ample fluid replacement will be available at all times and encouraged during the work day.

Heat Stroke - This is the most severe of all the heat related disorders and can be caused by several separate factors or a combination thereof. It is characterized by dry, hot skin because the body has lost its ability to thermo-regulate the body core temperature (in simple terms the body can no longer sweat): The symptoms and signs of heat stroke are listed below:

red, dry skin	headache	loss of consciousness
fatigue	giddiness	convulsions
nausea	confusion	coma

- Treatment

Immediate and rapid cooling by immersion in chilled water with massage helps revive the victim. Alternatively, wrap victim in a wet sheet and fan vigorously with cool dry air. Death may result if treatment is delayed.

- Prevention

Medical screening of workers, with selection based on health and physical fitness. Personnel can be acclimatized for 5-7 days by graded work and heat exposure. Workers must be monitored during sustained work in severe heat.

In dealing with heat stress disorders during the summer months, the primary means of control is prevention. The OHSO will be present to establish work/rest criteria based on current environmental conditions. The OHSO will also establish a monitoring program if the situation warrants such an action.

This program will include monitoring the following physiological functions:

- Heart Rate

Count the radial pulse during a 30-second period as early as possible in the rest period.

If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same duration.

If the heart rate still exceeds 110 beat per minute at the next rest period, again shorten the following work cycle by one-third.

- Oral Temperature

Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).

If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the duration of the rest period.

If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, again shorten the following work cycle by one-third.

Do not permit a worker to wear a semi-impermeable or impermeable garment when his/her temperature exceeds 100.6°F (38.1°C). Refer to Table 3.2.4-1 for suggested frequency of physiological monitoring.

TABLE 3.2.4-1

SUGGESTED FREQUENCY OF PHYSIOLOGICAL MONITORING FOR FIT
AND ACCLIMATIZED WORKERS

<u>Adjusted temperature (b)</u>	<u>Normal work ensemble (c)</u>	<u>Impermeable Ensemble</u>
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5° - 90°F (30.8°-32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5° - 87.5°F (28.1°-30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5° - 82.5°F (25.3°-28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5° - 77.5°F (22.5°-25.3°C)	After each 150 minutes of work	After each 120 minutes of work

Source: Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (NIOSH, OSHA, USCG, EPA).

- a) For work levels of 250 kilocalories/hour.
- b) Calculate the adjusted air temperature (ta adj) by using this equation: $ta\ adj\ ^\circ F = ta\ ^\circ F + (0.13 \times \% \text{ sunshine})$. Measure air temperature (ta) with a standard mercury in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinctive shadow; 0 percent sunshine = no shadows).
- c) A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

3.2.3 Scaffolding

Construction Requirements

The following scaffolding construction requirements are summarized from 29 CFR 1926.451, which will be adhered to in its entirety. The following general requirements apply to all scaffolds. Tubular welded frame scaffolds, mobile scaffolds and Boatswain's chairs are planned for use on this project, but any other scaffolds used will closely follow the regulation cited above.

- Guardrails, toeboards, midrails, screen, planking, and rope will follow the OSHA requirements.
- Scaffold footing will be sound. No unstable objects will support scaffolds. Uprights of scaffolds will be plumb and securely braced.
- Any scaffold parts and accessories weakened from any cause will be immediately repaired or replaced.
- Safe access will be provided. Slippery conditions on scaffolds will be eliminated as soon as possible.

The main requirements for tubular welded frame scaffolds are:

- Bracing, leg bases and vertical alignment will follow 29 CFR 1926.451(d).
- Panels or frames will be spaced according to the loads imposed.
- To prevent movement, the scaffold will be secured to the building or structure.

Mobile scaffolds moved manually will follow the requirements highlighted below:

- Mobile scaffold height limitations, bracing, planking, vertical alignment, footing and casters will comply with 29 CFR 1926.451(c).
- All casters will have a positive locking device to hold the scaffold in place.
- A ladder which will be provided for proper access will not tend to tip the scaffold.
- Employees will not ride on manually propelled scaffolds unless conditions specified in 29 CFR 1926.451(e)(7) exist.

Boatswain's chairs have the following unique requirements.

- The employee will be protected by a safety belt and lifeline in accordance with 29 CFR 1926.104.
- The other requirements of 29 CFR 1926.451(1) will be followed.

If man lifts, personnel hoists or bucket trucks are used to move workers and/or materials onto scaffold or roofs, the provisions of 29 CFR 1926.552 will be followed.

Safety Rules

Certain basic safety rules for working on scaffolds will greatly reduce the chance of injury (Morrison-Knudsen Co., Inc. Safety and Health Training Manual, 1972).

- Inspect the scaffold before using it (esp. hand rails and toeboards).
- While climbing vertical ladders to reach a scaffold, be especially cautious. When getting on or off the scaffold platform, hold onto the siderail extension.
- Use a rope or hoist to raise or lower material, rather than carrying it on the ladder.
- Keep scaffolds free from waste (grease, soil, or other wet substances) or other material which could cause trips or falls.
- Never jump from the scaffold to the ground.

4.0 FIELD HEALTH AND SAFETY GUIDELINES

4.1 Task Specific Site Briefing

Prior to initiating the field effort, it will be the responsibility of the OHSO to conduct a pretask safety briefing which adequately addresses each of the following areas:

- A review of pertinent analytical data reflecting the chemical characteristics of the soil and groundwater.
- The health significance of the contaminants so identified.
- Applicable safety rules pertaining to trench wall stability and the placement of superimposed loads.
- Delegation of individual responsibilities, i.e., operation of environmental monitoring instrumentation, backup and emergency response personnel.

- Rationale supporting the chosen level of personal protective equipment.
- Safety criteria for scaffolding forms used.
- Equipment and personnel decontamination requirements.
- Equipment mobilization and logistical considerations.
- Emergency response procedures.
- Discussion and resolution of anticipated problems of health and safety significance.

4.2 Initial Level of Protection

The objective of personal protective equipment (PPE) specified for use during earthwork and construction activities in areas of disturbed native soils is to shield individuals from the chemical hazards associated with inadvertent skin or respiratory contact. Based upon the available information relating to compounds detected in the groundwater and the surrounding soils as well as their likelihood for skin contact, the following level of dermal protection has been specified:

- * Nitrile rubber outer gloves
- Latex rubber inner gloves
- * Polyurethane/polyvinylchloride work boots with steel toes
- Outer garment, Tyvek polyethylene-coated
- Undergarment, cotton work coveralls
- Hard hats
- Safety glasses with side shields

* Duct taped to outer protective garment at ankle and wrist.

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Air purifying respirators with a full face-piece designed to provide protection against concurrent respiratory hazards, will be used in conjunction with combination cartridges (MSA Ultratwin, equipped with GMS-H combination cartridges, or equivalent) certified for use against particulates (HEPA), organic vapors and acid gases, if environmental or personnel monitoring conducted during task work indicates an action level has been reached.

The action level signifies a concentration or criteria at which appropriate field action must be taken by personnel. This action can be in the form of upgrading to respiratory protection, a dermal protection increase or evacuation of the construction area. A table of action guidelines to follow appears in Table 4.2-1. Personnel must be and remain during the course of their work period on-site, clean shaven to the degree that will insure a proper face-to-face piece seal can be obtained with a full-face respirator.

Upgrading to a different level of protection will be conducted at the option of the OHSO. Downgrading of levels and variance of personal protective equipment used will be determined by the OHSO on a case-by-case basis.

TABLE 4.2-1

CRITERIA FOR FIELD TEAM ACTION

1) Combustible/Explosive Environments

- GT 50% LEL - In borehole or excavation, suspend operations. Vent, blanket, monitor continuously.
- GT 25% LEL - Above borehole or excavation, evacuate personnel.
- 10 - 25% LEL - In borehole or excavation, monitor LEL and O₂ continuously.
- LT - 10% LEL - In borehole or excavation, acceptable conditions, monitor as normal.

2) Organic Vapors in the Breathing Zone

- GT 10 ppm with FID - Level B (supplied air) mandatory if sustained for 5 min. continuous monitoring, send personal sample for analysis.
- GT 1 ppm & LT 10 ppm with FID - Monitor as normal, Level C protection required. Personal sampling initiated at discretion of OSHO.
- Initial Action Level - 1 ppm sustained for 5 minutes, immediately upgrade to Level C.

3) Semivolatile Organic Compounds

Need based upon environmental conditions favoring dust deposition. Filtration sampling utilizing personal and high-volume samplers equipped with size selective classifier (cyclone) to be used at the discretion of the OHSO.

GT - Greater Than
LT - Less Than
LEL- Lower Explosive Limit
FID- Flame Ionization Detector

4.3 Field Monitoring Instrumentation

Environmental monitoring instrumentation chosen for use during the excavation phase of this field effort has been based upon the sensitivity of the instrument to contaminants thought present and the associated health significance of contaminant(s) in the immediate environment. Although historic analytical information has shown levels not significant enough to pose a health threat, environmental conditions could cause changes which need to be monitored on a continuous basis. As such, instrumentation which is to be available throughout the course of the task will include the following:

- A precalibrated, flame ionization organic vapor detector capable of conducting real time quantitative/qualitative contaminant analyses and possessing an ionization energy of at least 12.7 eV (Foxboro OVA, Model 128GC or equivalent).
- Combustible gas indicator equipped with a remote sensing, sample line and possessing O₂, % LEL and H₂S detection capabilities (MSA, Model 361 or equivalent).
- Variable flow, belt-mounted personal sampling pumps to be used in conjunction with sample media appropriate for the contaminant of interest or passive/diffusion type organic vapor dosimeters (3M, Model 3510 or equivalent).

4.4 Air Monitoring Protocols

Although no air emissions are expected with the current analytical information gathered for the work area, personnel air sampling will be conducted to document any aberrations.

Potential contaminants which will be monitored include but are not limited to, endrin, chloroform, and lead. Sampling will be conducted when site conditions are expected to present the most

air emissions, which will be during trenching and native soil disturbance operations.

Only OSHA and NIOSH approved sampling methodologies will be utilized for collection of the chemicals. The samples will be sent in with all appropriate documentation under chain-of-custody (COC) procedures and processed with quality assurance protocols adhered to.

5.0 MEDICAL SURVEILLANCE REQUIREMENTS

All regular MK-ES employees and subcontractors who will be performing field work in areas either suspected or known to be contaminated where the potential exists for exposure according to 29 CFR 1910.120, will be required to participate in MK-ES' medical surveillance program. For all site personnel, a release for work will be verified by the OHSO before an employee or subcontractor can begin onsite activities.

The physical exam will be administered prior to the onset of any field work and upon termination of employment or field involvement. Episodic examinations may also be administered, at the discretion of the OHSO.

5.1 Objectives

The medical surveillance program has been designed specifically to address those activities associated with invasive operations conducted at the Rocky Mountain Arsenal. All physical examinations falling under the program will be administered by the RMA Project Medical Consultant (PMC) or the licensed physician, so authorized by the PMC. Further detail regarding the administrative aspects of MK-ES' medical surveillance program may be found in Appendix III of the General Health and Safety Plan for Project 1680.

In general, the principal objectives of the medical surveillance program are to:

- Provide respirator certification as required under 29 CFR 1910.134.
- Determine an individual's ability to perform work while wearing protective equipment.
- Determine required acceptable substance abuse screen results.
- Assist in evaluating the adequacy of the personal protective equipment prescribed.
- Establish a physiological baseline necessary to assess the degree and/or effects of exposure to hazardous materials.
- Provide data for future epidemiological studies and evaluations.

5.2 Scope

All baseline examinations, unless otherwise specified by the PMC, will at the minimum address the following physiological and biochemical parameters:

- Comprehensive review of medial history.
- Complete physical exam with emphasis on cardiovascular and pulmonary system.
- Complete blood count (CBC).
- SMAC-22 biochemical profile.
- Pulmonary Function Testing.
- Resting Electrocardiogram or Treadmill.
- Methemoglobin

- Creatinine clearance.
- Blood lead
- Urine arsenic
- Urine mercury
- Urine cadmium
- Complete urinalysis
- SGPT/G6PD
- Chest X-ray, PA and Lateral
- Baseline audiogram
- Substance abuse
- Cholinesterase profile

Exit examinations will cover all of the above with the exception of the chest X-ray, treadmill and substance abuse. The scope of all episodic exams will be based upon consultation with the PMC and the particular event which precipitated them.

5.3 Abnormal Results

In general, whenever any medical test yields an abnormal result, the test will be repeated. The Project Industrial Hygienist will be advised of this situation and may stipulate additional tests under the advice of the project medical consultant or, if required, modify the test frequency.

Whenever medical monitoring substantiates and/or indicates a potential problem, the site worker may no longer work onsite until a medical release is obtained from the project medical consultant. MK-ES' medical surveillance program also contains special provisions relative to the monitoring of cardiac related problems, heavy metal screening, and an individual's suitability for respirator use. The results of all medical monitoring will be made available to the individual worker with results kept strictly confidential, and to project health professionals.

5.4 Medical Information Disclosure and Confidentiality

The personal medical information obtained through MK-ES' medical surveillance program shall be treated as strictly confidential, and may be released only through adherence to the corporate "Disclosure of Medical Information" guidelines, further described in the RMA General Health and Safety Plan.

Consistent with this policy, all personnel will be requested to complete a "Medical Record Release Authorization" form and submit it to the examining physician with a completed medical history questionnaire at the time of the exam. With this release, the examining physician will be able to inform each employee and project management of an individual's physical status and ability to perform work on the project site with or without any specified work restrictions.

A personal copy of the questionnaire and/or medical exam may be requested from the examining physician by completing a "Request for Personal Medical Records" form. The form may be obtained from and submitted to the Project Manager, OHSO, Project Industrial Hygienist, and/or PMC.

6.0 PERSONNEL TRAINING REQUIREMENTS

Prior to the onset of North Boundary Improvements construction activities, all MK-ES employees and subcontractors will have attained a level of training necessary according to 29 CFR 1910.120. This training is mandatory for personnel conducting intrusive activities at a hazardous waste site. In addition, supervisors are required to have 8 more hours of training to manage employees at hazardous waste sites. In order that personnel have an appropriate level of training for this project, a brief highlight of each training course is given, along with the main topics of necessary knowledge and skills needed for compliance with safety and health protocols.

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6.1 Basic Hazardous Waste Training

A comprehensive health and safety training program will be required which includes 40 hours of classroom training. For the purposes of this project, training must, at a minimum, include:

- Notification of the variety of potential chemical and physical hazards site workers may encounter.
- Worker awareness of the purpose and limitations of safety equipment.
- Instruction of workers to identify, avoid, escape, and properly respond to emergency situations.
- Familiarization of site workers with survey instrumentation and what the responses may reflect.
- Determination of the appropriate levels of protection for worker health and safety.
- Define decontamination protocols that are required for personnel and equipment.
- Delineation of required work zones to be utilized.

Affected personnel will include all MK-ES employees and subcontractors assigned to this task who will be conducting work in areas known or suspected to be contaminated. This may also include any personnel assigned to the project who will return to the site on an intermittent basis, i.e., senior project management, lower-tier subcontractors, inspectors, etc. Identification of individuals so affected will be the responsibility of the OHSO.

6.2 Refresher Training

A refresher course is to be given annually from the anniversary date of the original 40 hour training, and is to consist of 8 hours of classroom instruction. The topics of review should coincide with those given during basic training.

6.3 Supervisor Training

All regular personnel assuming a supervisory or management role, i.e., director of the activities of one or more employees whose tasks will be conducted in areas of known or suspected contamination, will have successfully completed the 40 hour health and safety course coupled with an additional 8 hours of training related to the supervision of field activities.

The supervisors' course of instruction will focus on the health and safety elements necessary for the safe and efficient completion of the field effort and all support activities. Some specific elements may include:

- Task specific, work practice observation techniques.
- Documentation and records review procedures.
- Emergency response and first aid.
- Accident report preparation.
- Elements of accident investigation.

6.4 Weekly "Tailgate" Training

Throughout the course of the field effort, a number of modifications to this TSHSP may be warranted. These changes will be communicated to all contractors and discussed with workers

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during the weekly safety meetings held by the OHSO. In addition to this type of information, general safety problems encountered during the project will be addressed and discussed during these meetings.

6.5 Hazard Communication Program Training

To protect the health and safety of MK-ES employees and subcontractors, a Hazard Communication Program (HCP) has been developed for chemicals used in constructing the North Boundary Improvements. The HCP applies to all employees which may be exposed to hazardous substances as a result of normal work conditions or as the result of a reasonably foreseeable emergency.

Chemicals and other hazardous substances brought onto this construction project by MK-ES or its subcontractors will be covered by four components: the written hazard communication program (SOP 1370.01.05), Material Safety Data Sheets (MSDS), container labeling, and training. The written hazard communication program will be accessible to workers, and will list the chemicals present on the work site, specify how container labeling will be done, describe how MK-ES will be handled and detail what will be covered in employee training. Labeling on containers will identify the hazardous chemical, display the relevant hazard warning and specify the name and address of the chemical manufacturer. Material Safety Data Sheets will be obtained from the chemical manufacturer or distributor by the company bringing the chemical onto the construction project. This information will be filed with the MK-ES written hazard communication program for MK-ES employee and subcontractor reference. Workers who may be exposed to hazardous chemicals will be trained about the requirements of the hazard communication regulation, hazardous chemical locations and areas of use, hazards of work place chemicals, methods of protection

from chemical injury, and the components of the hazard communication program discussed above.

7.0 SITE CONTROL

The purpose of site control is to minimize the migration of contamination from the work area. This will be handled by the establishment of work zones to protect the public from unknowingly coming into contact with site hazards, and to protect the site facilities from vandalism. This section will discuss the physical barriers to be used in site control as well as explain the administrative procedures which will be enforced.

7.1 Work Zone Establishment

Three work zones will be established by the OHSO or his/her designee at each site or task location scheduled to be conducted in a contaminated area. The zones will be communicated to the field crew. These zones, Exclusion (Hot), Decontamination, and Support, will serve two functions. First, they will help to minimize the potential for spreading contamination to clean areas. Second, they will physically delineate high hazard areas where dermal and respiratory protection may be required.

The Exclusion zone will include all areas where active or contaminated soil/water handling activities are occurring. The zone will also include areas in and adjacent to any excavation/embankment areas. According to the OHSO, workers in these areas may require specific dermal or respiratory protection. The actual boundaries of these zones will vary somewhat as the work progresses. The following factors will be considered by the OHSO in the actual determination of the boundaries:

- Physical and topographical features of the site.
- Rate of progress (trenching).

- Weather conditions.
- Perimeter and personnel air sampling results.
- Physical and chemical characteristics of the contaminants of concern.
- Activities occurring within the Exclusion zone.
- Results of real-time monitoring with flame/photoionization organic vapor analyzers and a combustible gas detector.

As with the Exclusion zone boundaries, the Decontamination zone boundaries will vary. In general, the zone will encompass all areas between the Exclusion zone and the Support or clean area. In order to control the flow of people and equipment in the Decontamination zone, access control points will be established. All entrances and exits will be through these points.

The Support zone will include all required facilities and maintenance areas that are kept free of contaminated equipment and clothing. No entrance of equipment or personnel into the Support zone will be permitted until full decontamination procedures have been implemented. Personnel in this area may wear normal work clothing.

Non-essential access to both the hot zone and contamination reduction corridor must be strictly controlled. Only personnel who are essential to the completion of the task or those who are responding to an emergency situation will be allowed access to these areas. Such individuals must adhere to the prescribed level of protection that is currently in use.

Once designated, the hot line, which represents the outermost boundary of potential contamination, will be conspicuously identified through the use of traffic cones, flags, barrier tape, ropes, or other suitable means.

7.2 Visitor Control

All site visitors (including vendors and state or federal agency employees) will be required to inform the MK-ES OHSO of their presence prior to entering the site. This procedure will ensure that the OHSO has been able to communicate potential site hazards, site rules, emergency procedures, and personal protective equipment requirements to all visitors before they enter the site.

In an effort to secure certain work areas and/or activities from unauthorized visitors, areas or activities so designated may need to be completely fenced. Examples of such may include all open excavations, and stockpile areas for contaminated soils. Designation of such areas activities will be left to the discretion of the OHSO. Specific control provisions will be established in conjunction with project management prior to initiation of the field effort.

Based on the number of personnel potentially involved in this task, it may prove to be somewhat difficult to control the personnel continuously entering and exiting the site. However, this type of control will be necessary to ensure that all personnel have received the appropriate training and medical certifications. Therefore, all personnel scheduled to enter the Exclusion zone will be recorded in a register at the work site or another convenient location. Furthermore, an "Approved Employee List" will enable task management to determine if the personnel have been cleared for work by the PMC. If the personnel requesting entrance to a site do not appear on the list, the

MK-ES Safety Officer must be contacted before they can be permitted access to the site.

8.0 ENVIRONMENTAL MONITORING TECHNIQUES

Prior to initiating any excavation or material handling component related to this task, instrumentation readings will be taken relative to background and recorded in the task health and safety log. Local background levels, as established with the chosen organic vapor analyzer, should be determined prior to and during the operation of excavating and/or sampling equipment. This establishes a means of assessing the interfering influence of diesel exhaust or other environmental factors which may contribute to background flux.

The site of any required excavation will initially be scarified by the excavator to approximately six to twelve inches in depth. The contents of the bucket will then be field surveyed with the chosen organic vapor analyzer. Prior to overburden placement, subsequent buckets will be randomly sampled at a frequency dictated by the results of previous evaluations. Monitoring with a combustible gas indicator will be conducted within the excavation as a means of assessing H_2S , % LEL and O_2 concentration. All such monitoring will be conducted from the surface or bench trench (shallow) using extendable and/or remote sampling probes.

Survey monitoring will immediately forewarn personnel of a potential hazard in the event that saturated soils immediately surrounding the slurry wall are heavily contaminated and consequently, would vent their volatile fraction when physically disturbed by excavation equipment. This venting process can result in elevated airborne contamination concentrations of health of health and safety significance at both the source (trench) and within worker breathing zones. In addressing this potential, the use of remote sampling probes, increasing the

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distance of personnel work stations relative to the source of contamination, upgrading the level of protection, and in some instances, evacuation of personnel will be considered.

Observed values taken from the source of contamination, i.e., excavated sludge and/or drill cuttings and the worker's breathing zone, are to be recorded in health and safety log format consistent with the requirements of the general plan.

Supplemental assessment of organic vapor and H₂S migration will be periodically determined within the cab of the excavator and at the hot line. The frequency of such surveying will primarily be dependent upon values generated by the excavated soil and the proximity of a worker's breathing zone to the source of contamination. Contaminant values taken from an individual's breathing zone which are in excess of established action levels (Table 3.2-1) will trigger the collection and laboratory analysis of personal/area samples and/or an upgrade in the existing level of protection. Samples may also be collected for documentation of air emissions present at the site of excavation. Personal or area industrial hygiene air samples will be collected using a low flow rate and charcoal tubes for chloroform or any other compound as determined by the Industrial Hygienist. The Hygienist will also specify when sampling of endrin will be needed. Other compounds will be sampled as the need arises.

9.0 DECONTAMINATION

To prevent the spread of contaminants to areas other than the work zone, decontamination procedures will be followed for both personnel and equipment.

9.1 Personnel Decontamination

Personnel decontamination protects workers from hazardous substances that may contaminate and eventually permeate the protective clothing, respiratory equipment, and other equipment

used onsite. It further protects all field personnel by minimizing the transfer of contaminants into the clean areas and preventing the uncontrolled transportation of contaminants from the task site.

Throughout the course of the construction process, personnel decontamination will typically be accomplished in four steps: contaminant removal from the outer layers of the PPE, proper doffing procedures, proper personal hygiene, and laundering of work clothes. Each phase is discussed in the following sections.

9.1.1 Contaminant Removal

This phase of the decontamination process will remove contamination from the outer surface of the PPE while the worker is still wearing any required respiratory protection. In order to provide suitable facilities for this phase, a personnel decontamination station will be constructed in the contamination reduction zone established at the site of the construction. All personnel in the Decontamination and hot zones must pass through these facilities before entering the Support zone. These stations will be equipped with temporary water supplies, hoses, brushes, containers, and associated equipment. The decon area will be monitored daily by the OHSO to ensure that equipment is functioning properly. The actual process of contaminant removal will be as follows:

- Removal of gross contamination by spraying affected areas with water to physically strip the contaminants from clothing, boots, gloves, etc.
- Scrubbing outer layers of reusable PPE with a biodegradable detergent and water solution to further remove trace contamination.

- Spraying the outer layer of reusable PPE with clean water to remove biodegradable detergent and water solution.

All wash and rinse water generated will be discharged to the excavation, thereby eliminating the need for traditional treatment or containment steps.

9.1.2 Doffing Procedures

Once the outer layers of PPE have been successfully decontaminated, they will be removed in a manner which will avoid the transfer of trace contamination onto work clothing.

The following is a sequential, step-by-step listing of the doffing procedures to be implemented during the closure which is based on the anticipated PPE:

- Tape Removal - All tape used to seal openings either around the ankles and wrists or on the suit zipper will be removed and deposited into a container lined with plastic.
- Respiratory Protection Removal - If this protection is required during decontamination, it will be removed at this point.
- Chemically-Resistant Coverall Removal - With the assistance of a helper, any chemically-resistant coveralls in use will be removed. This procedure will entail removing the coveralls in an "INSIDE-OUT" manner, beginning with the collar of the suit and ending with the ankles. All of these coveralls will be placed into a container also lined with plastic.

- Outer Boot-Cover Removal - This step will entail removing any chemically-resistant boot covers being used. If no boot covers are in use, the footwear being used will be thoroughly cleaned to remove all visible contamination during the contaminant removal phase. All boot covers will be disposed of in the same manner as the chemical-resistant coveralls, or be segregated for additional decontamination and further use if there is no evidence of chemical or physical degradation.
- Outer-Glove Removal - Chemically-resistant gloves will be removed and placed into a container with a plastic liner. Those gloves that do not exhibit evidence of chemical degradation will be segregated for additional decontamination and further use.
- Inner-Glove Removal - The final step in the process is to remove the vinyl gloves worn inside the chemical-protective gloves.

The above procedure will be closely monitored by the OHSO throughout the project to ensure that it remains effective. If, during the course of this field effort, the PPE requirements change or it is determined that the procedure is not effective, the OHSO will revise the procedure. Changes will be discussed during the weekly safety meetings.

9.1.3 Proper Personal Hygiene

In order to supplement the effectiveness of the contaminant removal and PPE doffing procedures, proper personal hygiene will be used to further reduce the potential for contamination. The following hygiene rules will be implemented throughout the duration of the task:

- Hands and face must be thoroughly washed with soap and water upon leaving the work area and before eating, drinking, or any other activities that increase the probability of ingestion of hazardous materials.
- All personnel working in a Decontamination or Exclusion zone will be required to shower at the completion of the work shift or before leaving the Arsenal. All showers will be taken at Building 316A.
- No food, chewing gum, chewing tobacco, or cigarettes will be permitted within the Decontamination or Exclusion zones of the work site.
- If any site personnel comes into direct contact with waste material, the affected body part will be washed immediately with soap and water.
- All work clothing which becomes contaminated will remain on site for decontamination or disposal, depending on the type and amount of contamination.

9.1.4 Laundering of Work Coverall

The final phase of personal decontamination will be the laundering of employee work clothes. A cotton coverall worn underneath protective clothing will be laundered offsite at a facility notified of possible chemical contaminants. This will also allow MK-ES to make certain that potentially contaminated clothing is not reused until appropriately laundered.

9.2 Equipment Decontamination

This section of the Health and Safety Operating Procedure addresses the decontamination procedures for all equipment used during the construction process. This equipment ranges from
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personal air sampling pumps to the backhoe used to excavate the trenches. Due to the anticipated duration of this field effort, a number of different levels of decontamination will have to be established. These levels will include the procedures required to remove equipment from the site, from the hot zone for major repair, from the hot zone for routine maintenance, to transport vehicles between excavation sites, and from the Exclusion zone for temporary down time.

9.2.1 Transportation of Vehicles Out of the Hot Zone

This section will lay the groundwork for the requirements of all other levels of decontamination. The procedures described below will be required anytime a piece of equipment is removed from the hot zone.

The decontamination equipment will be capable of supplying hot water under high pressure in combination with a commercial biodegradable detergent. The high-pressure hot water stream will impact all exposed surfaces of vehicles used within the confines of the hot zone.

In addition to vehicle decontamination, all tools and other equipment being transferred between the hot zone established at the construction site and Building 316A will be decontaminated. This cleaning will be conducted by using a hand-held, high pressure, hot-water wand to remove contamination on large pieces of equipment. Scrub brushes will be made available for smaller, hard-to-clean equipment.

This level of decontamination for vehicles and equipment will be limited to removing visible contamination. No further effort will be made to detect (i.e., wipe test) or remove tract contamination unless specifically advised.

9.2.5 Equipment Removal from the Site

The following decontamination procedure will be followed whenever any piece of equipment used in the hot zone established for this field effort is to be removed from the site of construction.

- The equipment will be initially decontaminated as described previously. The following steps will also be taken if necessary.
- All exposed metal surfaces will be washed with a water solution containing commercial biodegradable detergent to remove residual contamination.
- All equipment which contains enclosed machinery (i.e., water pumps) that has been in direct contact with waste must be dismantled, or the enclosed machinery made accessible, so that the equipment can be washed with a decon solution.
- Following the detergent wash, the equipment will be rinsed with hot water under high-pressure.
- All equipment will be inspected by the OHSO prior to being removed from the site. No equipment which is visibly contaminated, or which yields readings above background on a flame or photoionization detector, will be removed from the site. Wipe samples may be taken and analyzed prior to releasing any equipment from the site.
- No rubber hose, or other porous material, which comes in direct contact with contaminated soil or water and cannot be adequately decontaminated, will not be permitted to leave the site. If the material cannot be adequately decontaminated, the article will be disposed of with other expendable items (i.e., gloves, PPE

9.2.2 Removal of Equipment for Major Repairs

All equipment, in need of major repairs, being removed from the hot zone will go through decontamination as described above and will be inspected by the OHSO prior to the beginning of maintenance operations. In addition, if it is necessary to bring in an outside contractor to perform the repairs, the piece of equipment in question will be subjected to additional scrutiny to ensure that personnel unfamiliar with site hazards and/or unqualified medically, are not exposed to hazardous materials. If, during this inspection, there is evidence of surface contamination, the piece of equipment will be decontaminated as per the procedure outlined in "Equipment Removal from the Site."

9.2.3 Removal of Equipment for Routine Maintenance

During the course of the construction effort, equipment may require routine maintenance. Most of this maintenance will be performed within the hot zone to minimize the flow of equipment from contaminated to established clean areas. However, there may be equipment that will have to be serviced outside of the hot zone. Any equipment that must be removed from the hot zone for routine maintenance will be decontaminated as per Section 9.2.1 and inspected by the Health and Safety Officer to determine if PPE will be required for the maintenance operations.

9.2.4 Decontamination for Temporary Down Time

If equipment is being removed from the hot zone to be taken out of service and stored onsite, it will be decontaminated as per the paragraphs above. No equipment which has entered the hot zone will be taken out of service or stored onsite for an extended period of time until all visible contamination has been removed. Additionally, the OHSO must be notified before equipment is taken to a "dirty storage" or laydown area.

suites) in a DOT approved container to be ultimately shipped under appropriate federal standards for disposal.

10.0 GENERAL CONSTRUCTION SAFETY REQUIREMENTS

All construction industry standards from 29 CFR Part 1926 will be adhered to during all phases of construction.

10.1 Invasive Operations

- Prior to the onset of any invasive operations, i.e., excavation or sample retrieval, an effort shall be made to determine whether underground conveyances or utilities will be encountered and, if so, where such utilities are located.
- Under no circumstances will an excavation or borehole be left open unless it is conspicuously barricaded and marked.
- Dust suppression/airborne capture techniques will be employed as needed and/or stipulated by the OHSO.

10.2 Equipment

- Under no circumstances will welding repairs be permitted in the hot zone. All hot work will be conducted in predesignated areas only.
- No personnel will be permitted within the swing radius of the excavator without notifying the operator of his/her presence.

- The excavator must be inspected by a competent person prior to each use. Any deficiencies shall be repaired or defective parts replaced before continued use.
- An accessible fire extinguisher of 5BC rating or higher shall be available at the excavator operator's station.
- Except where electrical transmission lines have been de-energized and grounded, or other equipment has been used to prevent physical contact with the lines, the excavator shall be operated proximate to power lines in accordance with the following:
 - 1) Lines rated at 50 kV or Less - Minimum clearance shall be 10 ft.
 - 2) Lines over 50 kV - Minimum clearance is 10 feet plus 1 foot for each additional 30 kV.

11.0 EMERGENCY RESPONSE PLAN

Because of the nature of the work being conducted in support of this task, it is impossible to foresee and establish rigid procedures for all types of emergency situations. Therefore, this plan will be primarily based on general information which will be supplemented by the establishment of an Emergency Management Team (EMT).

11.1 Emergency Management Team

This team will be responsible for all technical guidance concerning emergency response throughout the duration of this work. The remainder of this Emergency Response Plan (ERP) will discuss the responsibilities of the EMT and the basic information and procedures which have been integrated with an established RMA Emergency Response Plan.

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The EMT will consist of individuals actively involved in the project. The individuals selected for the team include:

- MK-ES Onsite Health and Safety Officer (OHSO)
- One field crew member
- MK-ES Construction Manager

The following is a brief description of the responsibilities assigned to the identified EMT member:

- MK-ES OHSO
 - Responsible for the overall direction of the EMT and the execution of the ERP.
 - Responsible for the notification of appropriate individuals/agencies in the event of an emergency.
 - Responsible for maintaining a log of activities, data, decisions, notifications, and other pertinent information during each emergency.
 - Responsible for selecting the proper personal protective equipment for site and emergency response personnel.
 - Responsible for selecting and training onsite personnel to respond to emergency situations.
 - Responsible for notifying the local hospital in accordance with established protocol of an emergency situation that requires medical attention.

- MK-ES Construction Manager
 - Responsible for the health and safety of site personnel during an emergency.
 - Provides technical input on the emergency situation from a site operations standpoint.
 - Arranges and provides for personnel and materials needed to mitigate an emergency situation. Is responsible for maintaining all site emergency response equipment that requires routing maintenance.

This Emergency Management Team will meet at least once every two weeks throughout the duration of the project to discuss upcoming construction activities and potential emergency situations. Problems in responding to these situations will be discussed and specific solutions will be developed and communicated to task employees and emergency agencies identified in this ERP.

11.2 Communication

At least one telephone will be located on-site in one of the site vehicles and will be available for emergency communications. Another cellular mobile telephone may also be installed in the construction manager's vehicle.

11.3 Personal Injury Response Plan

Physical injuries can range from a sprained ankle to a compound fracture, or from a minor cut to massive bleeding. Depending on the seriousness of the injury, first aid treatment may be given at the site by the OHSO. For more serious injuries, additional assistance may be required at the site or the victim may have to be treated at a medical facility. The OHSO will assess the

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seriousness of the injury and consult by phone with the Project Medical Consultant, if necessary. If hospitalization is required, the OHSO will, in accordance with RMA notification protocol, arrange for an ambulance. If soiled clothing cannot be removed, the injured person will be wrapped in blankets for transportation to the hospital.

If personnel, including unauthorized personnel, have skin contact with contaminated soil or water, the affected area shall be flushed with water and any wet or soiled clothing removed. These personnel should be observed by the OHSO to ascertain whether there are any acute symptoms resulting from the exposure. If there is any visible manifestation of exposure such as skin irritation, the affected project personnel shall be referred to the Project Medical Consultant to verify that the symptoms were not the result of a delayed or acute exposure, a secondary response to exposure such as skin infection, or occupational dermatitis. All episodes of obvious chemical contamination are to be reviewed by the Project Industrial Hygienist to determine whether changes are needed in work practices or procedures.

11.4 Emergency Response Protocol and Contacts

In the event of an onsite emergency, notify the appropriate response team listed. The mobile telephone located in one of the support vehicles should be used for this purpose.

Remote field operators will familiarize themselves with the location of the RMA firehouse (origin of emergency response) prior to onset of operations. Daily submittal of field activities and anticipated location(s) to the RMA fire department will be required.

If the emergency involves an accident or injury to an individual the RMA Fire Department will be contacted immediately as first responder and the initial transport agency. Appropriate first
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aid should be administered until help arrives. Where the victim is transported to depends on if warfare agent contamination is present or not. The RMA Fire Department makes all determinations of this type and is ultimately responsible for where and how the individual is transported. If agent contamination is present, then the victim will be transported to Fitzsimons Army Hospital according to the RMA Fire Department. Fitzsimons has on file a Memorandum of Understanding (MOU) between itself and the RMA Fire Department to admit, decontaminate, and treat personnel working at the Arsenal. This facility does not have the capabilities to treat cardiac arrest cases. If the scenario occurred that a person had a heart attack and agent exposure, according to the RMA Fire Department the individual would be taken immediately to Fitzsimons and appropriate care provided which may include air lifting them to Aurora Presbyterian once agent decontamination has been completed.

1. Fire Department/Ambulance..... 289-0223
2. Fitzsimons Emergency Room..... 361-8350 or 361-8031
3. AMI Presbyterian Aurora Hospital. 360-3133
4. Reed Ambulance Service (backup)... 758-1333
5. Project Industrial Hygienist
Karen Lewis..... 860-8621
6. Onsite Health and Safety Officer
(OSHO) Mark Mullis..... 288-0930 (Bldg. 316A)
7. MK-ES Construction Manager
Lorin Ottenello 288-0930 (Bldg. 316A)
8. Technical Team Manager
Terry Kearney..... 860-8621
9. Project Medical Consultant
R. Burtan..... 758-1482

12.0 REFERENCES

29 CFR 1910; General Industry Standards, Occupational Safety and Health Administration, 1989.

29 CFR 1926; Construction Industry Standards, Occupational Safety and Health Administration, 1987.

Documentation of the Threshold Limit Values and Biological Exposure Indices Fifth Edition, American Conference of Governmental Industrial Hygienists, 1986. Supplemental Documentation, 1988.

Documents compiled for TX information, maintained in MK-Environmental Services Library, 1970 through 1973, HAZ 0143. Specific Document: Fort Detrick Response to Comments on the Environmental Impact Statement by the Surgeon General, U.S. Public Health Service on the Disposal of Anticrop Material at Rocky Mountain Arsenal, March 1971.

Hazardous Substance Fact Sheet, U.S. Environmental Protection Agency, Office of Toxic Substances, July 1988.

NIOSH Pocket Guide to Chemical Hazards, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, September 1985.

Occupational Health Guidelines for Chemical Hazards, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health and U.S. Department of Labor, Occupational Safety and Health Administration, January 1981. Supplemental Documentation, 1988.

Standard Operating Procedure 1370.01.05: Hazard Communication Program for Rocky Mountain Arsenal, Morrison-Knudsen Engineers, May 1989.

Threshold Limit Values and Biological Exposure Indices for 1988-1989, American Conference of Governmental Industrial Hygienists, 1989.

RMA REMEDIATION PROJECT
IRA FINAL DETAILED DESIGN
RECHARGE TRENCH PROJECT FOR THE
NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA
SPECIFICATION SCHEDULE

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A DIVISION OF MK-FERGUSON

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SPECIFICATION 22-3227

NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

RECHARGE TRENCH PROJECT

TRENCH PIEZOMETERS

CLIENT: SHELL OIL COMPANY

PROJECT: NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

LOCATION: ROCKY MOUNTAIN ARSENAL, COMMERCE CITY, CO

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

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SPECIFICATION 22-3227
NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA
RECHARGE TRENCH PROJECT
TRENCH PIEZOMETERS

1. GENERAL

- A. This specification covers all piezometers located within the recharge trenches. Two piezometers shall be located in each trench as shown on the drawings.
- B. Generally, the required work and materials include furnishing and placing or driving the piezometer screen and conductor pipe, concrete around the upper 3 feet of the conductor pipe, and a concrete surface pad.
- C. The Contractor will provide all required equipment, labor, and materials. MK-ES will provide professional assistance in the field.
- D. MK-ES Health and Safety procedures are set forth in the task-specific Health and Safety Plan. The Contractor will be required to follow and employ these procedures.

2. REFERENCE STANDARDS

- A. Organizations whose standards are referenced herein include the following:
 - 1) ASTM - American Society for Testing and Materials
- B. Any reference to the above standards shall be the edition in effect as of the date of this specification unless stated otherwise.

3. MATERIALS

- A. Cement shall meet the requirements of ASTM C150 Type II.
- B. Casing and Piezometer Screen: The well point shall be 1-1/4" diameter, 36 inches in length. The slotted casing above the well point shall be 1 1/4" diameter type 304 stainless steel, 10 slot (0.010"), threaded to the well point. It shall be of stainless steel with Number 60

gauze. The blank casing above the slotted casing will be 1-1/4" stainless steel pipe, threaded to the slotted casing. The protective casing shall be Schedule 40 steel pipe.

4. TRENCH PIEZOMETER CONSTRUCTION

- A. See MK-ES Drawing 34-006 for design details of trench piezometers.
- B. The construction procedure and design of the piezometer may vary, depending upon the method used to place gravel in the trench. Unless otherwise directed, the wellpoint will be placed on the bottom of the trench and gravel backfilled around it or driven into place.
- C. Capping of Piezometers
 - 1) Each piezometer shall be equipped with a 4-inch diameter steel pipe casing embedded into the concrete as shown in the drawings. Locking covers to prevent unwarranted access to the piezometer shall be installed.
 - 2) Any piezometer that will be left uncompleted for a period of greater than eight hours, shall be capped by the Subcontractor with a watertight cap and equipped with some type of "vandal proof" cover satisfying the Engineer and applicable state or local regulations.
 - 3) The top of the piezometer shall be protected from the inflow of surface water by a concrete cap and apron as shown on the drawings.

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SPECIFICATION 34-0202

NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

RECHARGE TRENCH PROJECT

SITE PREPARATION AND GRADING

CLIENT: SHELL OIL COMPANY

PROJECT: NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

LOCATION: ROCKY MOUNTAIN ARSENAL, COMMERCE CITY, CO

MK-ENVIRONMENTAL SERVICES
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SPECIFICATION SECTION 34-0202
NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA
RECHARGE TRENCH PROJECT
SITE PREPARATION AND GRADING

1. SCOPE

- A. This specification and other Contract Documents cover the furnishing of all equipment, labor, materials, and performance of work for site preparation, grading, and incidental items as required by applicable drawings and as specified herein.
- B. Generally, required items of work include:
 - 1) Established line and elevation control.
 - 2) Grading of recharge trench sites.
 - 3) Locating and protecting existing underground pipelines.
 - 4) Incidental items.

2. RELATED WORK

- A. The following related work is covered in other specifications:
 - 1) Excavating and backfilling for five recharge trenches, manholes, and underground piping; maintaining temporary roads during subsequent activities; finish grading.

3. GENERAL PROCEDURES

- A. Reference Points: Carefully maintain bench marks, monuments and other reference points. Replace them as the Engineer directs if they are disturbed or destroyed.
- B. Soil Investigation: Refer to Drawing 34-002 which notes, in part, the U.S. Army Engineer source of "Information for the topography, boreholes, wells, and bedrock". A

copy of each listed report is available for review at the Engineer's office in downtown Denver.

- C. Inspector: The services of a qualified Inspector will be provided by the Engineer to determine by observation and testing the quality of work and materials during site preparation and grading. He will judge the adequacy of site preparation, acceptability of available fill material, and the correct placement and compaction of fill. Work procedures require his approval as they are successively performed. Any work found unsatisfactory shall be corrected in an approved manner at the Contractor's expense.

4. INSPECTION

- A. All materials and the work shall be subject to inspection by the Engineer. The Engineer shall be provided access to all parts of the work and shall be furnished with such information and assistance as is required to make a complete and detailed inspection.
- B. The Engineer may direct that portions of the work be removed or uncovered. After examination, said portions of the work shall be restored to the standard required by these specifications.
- C. Do not proceed with the work until lines, grades, and/or structure locations have been established. Any work performed contrary to the drawings, specifications, or instructions of the Engineer, beyond the line and grades shown on the drawings, or any extra work done without authorization of the Engineer, may be ordered removed or replaced, at the Contractor's expense.

5. GRADING

- A. General: Perform necessary grading to achieve final elevations closely approximating those shown by the drawings. Surfaces shall be well-compacted, reasonably smooth, and free from irregularities, with uniform transitions made to adjacent areas.
- B. Ditches and Swales: Finish to drain readily. Take measures to prevent erosion of freshly graded areas by appropriate means before vegetation is re-established. Repair and reestablish areas of settlement or erosion to required elevations and slopes prior to acceptance of the work.

- C. Road Subgrades: New permanent roads are not required nor provided. New 2" PVC underground pipe shall be installed in a trench that will be cut across a gravel road along First Creek. After the pipe is installed and tested, and the trench is properly backfilled and compacted, restore the road to near original crown, grade, and surface materials.

6. INCIDENTAL ITEMS

- A. Safeguards: Provide, erect, maintain, and later remove temporary safeguards such as barricades, guard rails, signs, lights, and flares for protection of personnel, the public, equipment, and materials, as the Engineer directs and as required by state, federal, and local codes and ordinances.
- B. Existing Underground Lines and Services:
- 1) The Owner will provide the approximate location of existing underground lines and services. The Contractor is responsible for verifying the location of, uncovering, and protecting these items.
 - 2) Do not cut, remove or damage these items unless directed to do so by prior written approval of the Engineer.
 - 3) Lines or services damaged will be repaired or replaced to the Engineer's satisfaction at the Contractor's expense.
- C. Water Removal: Maintain grades to promote water drainage. Provide and operate equipment to keep construction areas free of surface and storm water. Provide necessary diversion ditches or other Engineer approved facilities for removing water. Dispose of surface and storm water as directed by the Engineer so construction and storage areas, streets, roads, and other surfaces are not flooded.
- D. Temporary Roads: Locate and construct temporary roads at locations directed or approved by the Engineer to serve as a means of access during construction activities.
- E. Culverts: Culverts are not required.

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- F. Riprap: Size and placement shall be as shown on the drawings.
- G. Stripping Topsoil: In excavated areas for both the recharge trenches and the pressure manifold, the top 8 to 12 inches of soil shall be separately excavated and stockpiled for later use in providing the top layer of backfill over the trenches.
- H. Finish Grading: Spread soil from on-site stockpiles onto previously stripped areas, including the recharge trench areas, that have been rough graded. Select materials to eliminate large stones, vegetation, and debris. Spread soil smoothly and uniformly, in sufficient quantity to allow for natural settlement, so that final dressing can be performed satisfactorily. Raking or compacting is not required.
- I. Revegetation: Revegetation is not required nor provided under this specification.

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SPECIFICATION 34-0203

NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

RECHARGE TRENCH PROJECT

EXCAVATING AND BACKFILLING

CLIENT: SHELL OIL COMPANY

PROJECT: NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

LOCATION: ROCKY MOUNTAIN ARSENAL, COMMERCE CITY, CO

MX-ENVIRONMENTAL SERVICES
A DIVISION OF MX-FERGUSON

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SPECIFICATION 34-0203

NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

RECHARGE TRENCH PROJECT

EXCAVATING AND BACKFILLING

1. SCOPE

- A. This specification and other Contract Documents cover the furnishing of all equipment, labor, materials and performance of work for all excavating, backfilling and incidental items as required by applicable drawings and as specified herein.
- B. Generally, required items of work include:
 - 1) Excavating for structures and preparing subgrades for trenches and manholes
 - 2) Filling, backfilling and compacting
 - 3) Grading around structures
 - 4) Incidental items

2. RELATED WORK

- A. The following related work is covered in other specifications:
 - 1) Site Preparation and Grading (Specification 34-0202)
 - 2) Piping and Instrumentation (Specification 35-1501)
 - 3) Manholes (Specification 35-1511)

3. GENERAL PROCEDURES

- A. Reference Points: Carefully maintain bench marks, monuments and other reference points. Replace items as the Field Engineer directs if they are disturbed or destroyed.

- B. Soil Investigation: A report of soil conditions investigated on the site is shown on the drawings. Accuracy of this report is not guaranteed in that conditions at the present time and at other locations on the site may vary from those disclosed.
- C. Engineer: The Engineer will determine by observation and testing the quality of work and materials during excavating and backfilling. He will judge: acceptability and advantageous use of available fill and backfill materials; and the correct placement and compaction of fill and backfill to specified densities. Excavating, filling, backfilling and compacting procedures require his approval as they are successively performed. Any work found unsatisfactory shall be corrected in an approved manner.

4. EXCAVATING FOR STRUCTURES

- A. Dimensions: Excavate to required elevations and dimensions, allowing ample space for form and material placement, inspection, and form removal. If the nature of the soil permits and the Engineer gives prior approval, excavation may be made to correct dimensions and used as a concrete form. Degree of slope for open cut earth banks in all excavations over 5 feet deep in which a man enters will be as outlined in the Task-Specific Health and Safety Operating Procedure.
- B. Removing Materials: Excavate all materials encountered, except for existing services and permanent structures. Remove rock, boulders, portions of abandoned structures, and other hard obstructions to a depth at least 6" below planned excavation level in the pressure pipe trench. Soil conditions at bottom of excavation shall be subject to the Engineer's approval. Surfaces shall be level, or sloped as required, clean, and clear of mud or frozen material.
- C. Suitable Bearing: Where unsuitable material is exposed at completion of planned excavation, perform further excavation as directed by the Engineer until suitable bearing is reached. Place and compact fill as specified herein to correct elevations.
- D. Overexcavation: If materials are removed below required elevations, through error or careless excavating, the Contractor shall notify the Engineer who will determine corrective measures. MK-ES Construction Manager shall

determine if the Contractor is due additional compensation.

E. Rock Excavation:

- 1) Rock is defined as stone or hard shale in original ledge, and boulders over 1/2 cu.yd in volume or over 3'-0" in greatest dimension, which require special equipment and/or explosives to remove.
- 2) It is assumed that materials at the job site can be excavated with normal equipment such as a power shovel or bulldozer. If rock is encountered, notify the Engineer for his consideration before proceeding with further excavating.
- 3) The recharge trench shall not be excavated beneath the bedrock surface. When excavating near the expected depth of the bedrock surface, the Contractor shall notify the Engineer. The Engineer will make the judgement of the depth at which the bedrock surface is encountered.

F. Material Storage and Disposal: Select excavated materials which can be reused later shall be classified and stockpiled. The top 4 to 6 feet of excavated material from the recharge trenches shall be stockpiled for later reuse as trench backfill. Dispose of other unsuitable and excess material and debris elsewhere on the Owner's property as directed by the Engineer.

G. Existing Underground Lines and Services:

- 1) The Engineer will provide the approximate location of existing underground lines and services. The Contractor is responsible for verifying the location of, uncovering, and protecting these items.
- 2) Do not cut, remove or damage these items unless directed to do so by prior written approval of the Engineer.
- 3) Lines or services damaged will be repaired or replaced to the Engineer's satisfaction at the Contractor's expense.

5. TRENCH EXCAVATION

- A. General: The recharge trench shall be constructed to the elevations, lines, grades, and cross-sections shown on the drawings and in accordance with these specifications, unless otherwise directed by the Engineer. The Engineer may modify the dimensions and quantities of the work as determined to be necessary. The Contractor shall submit a general work sequence schedule and layout plan of operations to the Engineer for approval a minimum of three (3) weeks prior to the start of construction.
- B. Excavation Phases: Excavation of the trench will be performed in two phases as discussed below:
- 1) Bench: Approximately 3 to 4 ft of existing alluvium will be excavated down to the elevation shown on the drawings and establish a working bench to minimize trench depth and create an area to stockpile potentially contaminated soils from the vertical trench excavation.
 - 2) Vertical Trench Excavation: The remaining depth of excavation will be trenched as required by the drawings and this specification to the elevations required or as specified in the field by the Engineer.
 - 3) Excavated Material: Contaminated soils will be designated by the Field Engineer. Potentially contaminated or contaminated soils will be stored on the working bench. If any contaminated or potentially contaminated soil must be removed from the working bench, it will be drummed by the Contractor in drums provided by the Engineer. The Engineer will be responsible for arranging for characterization, storage, and final disposal of drummed soil as required. Potentially contaminated soil will be stockpiled on one side of the benched platform to isolate the material. Handling procedures shall be in accordance with the project Task-Specific Health and Safety Plan. The height of stockpiled material shall not exceed the existing ground level adjacent to the working platform.

6. FILLING, BACKFILLING AND COMPACTING

- A. Fill and Backfill Materials: Use Engineer approved materials obtained from: stockpiles of excavated

smooth and free from irregularities, with uniform transitions made to adjacent areas. Raking and reseeding will be provided by others.

8. INSPECTION

- A. All materials and each part or detail of the work shall be subject to inspection by the Engineer. The Engineer shall be provided access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.
- B. The Engineer may direct the Contractor to remove or uncover portions of the work. After examination, the Contractor shall restore said portions of the work to the standard required by these specifications.
- C. The Contractor shall not proceed until the lines, grades and/or structure locations have been established. Any work done by the Contractor contrary to the drawings, specifications or instructions of the Engineer, beyond the lines and grades shown on the drawings, or any extra work done without authorization of the Engineer, may be ordered removed or replaced at the Contractor's expense.

9. INCIDENTAL ITEMS

- A. Safeguards: Provide, erect, maintain and later remove temporary safeguards such as barricades, bridges, guard rails, signs, lights and flares for protection of personnel, the public, equipment and materials as the Engineer directs and as required by state and local codes and ordinances.
- B. Retaining Excavations: Provide shoring, sheeting and bracing necessary to retain excavations, maintain banks securely, withstand water pressure, prevent cave-ins, and protect life and property. As backfilling proceeds, remove shoring, sheeting and bracing in a manner to prevent damage or disturbance to the construction and surrounding areas.
- C. Water Removal: Maintain grades to promote water drainage. Provide and operate equipment to keep construction areas free of surface and storm water. Provide necessary diversion ditches or dewatering systems. Dispose of surface and storm water as directed by the Engineer so construction and storage areas,

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streets, roads and other surfaces are not flooded. Do not remove any groundwater from an excavations except for water attached to the in-place soils to be excavated.

- D. Temporary Roads: Maintain temporary roads in operating condition.

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SPECIFICATION 34-0272

NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

RECHARGE TRENCH PROJECT

DRILLED PIEZOMETERS

CLIENT: SHELL OIL COMPANY

PROJECT: NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

LOCATION: ROCKY MOUNTAIN ARSENAL, COMMERCE CITY, CO

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

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SPECIFICATION 34-0272
NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA
RECHARGE TRENCH PROJECT
DRILLED PIEZOMETERS

1. SCOPE

- A. Ten (10) 4-inch diameter drilled piezometers will be constructed along the North Boundary. The piezometers are expected to range in depth from a possible minimum of 15 ft to a possible maximum of 30 ft dependent upon location. The Contractor will furnish equipment, labor and materials, and perform operations as required to construct the wells. Design details are presented on Drawing 34-006.

2. RELATED WORK

- A. The following related work is covered in other specifications:
- 1) Cast-In-Place Concrete (Specification 34-0301)
 - 2) Site Preparation and Grading (Specification 34-0202)

3. REFERENCE STANDARDS

- A. Organizations whose standards are referenced herein include the following:
- 1) ASTM - American Society for Testing and Materials
 - 2) API - American Petroleum Institute

4. CONTRACTOR QUALIFICATIONS

- A. The Contractor shall submit evidence, including drilling experience in the Denver area and a list of available drilling and support equipment to the Engineer, that he is competent to construct wells of the design provided by the Engineer. This evidence should ensure that the Contractor will have sufficient competent, experienced personnel to construct the piezometers. A qualified well driller, having a current State of Colorado drilling

certification and approved by the Engineer, will supervise the construction including well drilling, casing installation, slurry preparation and installation, and well completion activities. The well driller and on-site support personnel shall have completed safety training in accordance with the Task-Specific Health and Safety Plan.

5. DRILLED PIEZOMETER DESCRIPTION

- A. The piezometers will consist of a nominal 10-inch auger borehole (6½-inch hollow-stem) to total depth. The well will be completed with 4-inch Schedule 40 PVC slotted and blank casing with a sand pack, bentonite seal, and cement/bentonite grout seal. A vented well cap, 8-inch steel protective surface casing with locking well cover, and concrete well pad will complete the surface installation.

6. MATERIALS

- A. Blank Casing: The well casing will be 4-inch Schedule 40 flush-threaded PVC pipe.
- B. Slotted Casing: The well will be completed with Schedule 40 PVC 20-slot (0.020 inch) commercially manufactured and slotted casing, having a solid one-piece cap or plug.
- C. Sand Pack: The sand pack will consist of washed silica sand. It is anticipated that 10/20 sand will be used. Sand pack characteristics may be changed from well to well by the Engineer dependent upon subsurface geologic conditions, and may even vary within a particular well.
- D. Bentonite: Bentonite used shall be sodium cation base montmorillonite, premium grade Wyoming-type bentonite, which conforms to the most recent applicable API specifications. The Contractor shall furnish to the Engineer a certificate of compliance. Bentonite will be protected from moisture during transit and storage.
- E. Water: A source of water for use during drilling operations will be identified by the Engineer.
- F. Protective Casing: An 8-inch Schedule 40 steel pipe will be used for the surface protective casing. The steel casing shall be 5 ft long, and be buried 3 ft in the ground. The steel casing shall have a metal, lockable cap (MAASS 6LCR or equal).

- G. Cement: Type II Portland cement will be used for applications requiring cement.
- H. Water Level Sensor Casing: The level sensor casing shall consist of a 1½" Schedule 40 PVC pipe.

7. EQUIPMENT

- A. Drilling of the piezometer shall be accomplished by use of a suitable hollow-stem auger well drilling rig. The drilling rig shall have the capabilities of successfully auger drilling and completing a 4-inch well in a nominal 10-inch auger borehole to a depth at least 40 ft. The Contractor shall have the capability of installing the required PVC casing string, sand pack, bentonite seal, and cement/bentonite grout. The Contractor will be required to have the equipment necessary to install the required surface completion.

8. WELL CONSTRUCTION

- A. General: The ten (10) drilled piezometers will be completed approximately as discussed in the following sections. Site-specific geologic conditions may require changes to well construction plans. Modifications to construction specifications must be approved in advance by the Engineer.
- B. Borehole: A nominal 10-inch auger borehole will be drilled to penetrate approximately 1 ft into the Denver Formation. Sufficient depth into the Denver Formation will be specified by the Engineer in the field.
- C. Well String: A well string consisting of, from bottom to top, 4-inch, 20-slot (0.020-inch) Schedule 40 PVC slotted casing with bottom cap or plug and blank casing will be installed. The length of the slotted casing will be dependent upon the depth of the well as shown on the drawings. The 1½" diameter water level sensor casing shall be attached inside the well string as indicated on the drawings.
- D. Sand Pack: The sand pack will extend to 3 ft above the top of the slotted casing. Precautions will be taken during sand pack installation to prevent excessive compaction. Additional sand pack will be added as required to maintain the sand pack approximately 3 ft above the top of the slotted casing and assure the

bentonite seal does not migrate deeply into the sand pack.

- E. Annular Seal: A 2-ft thick bentonite seal will be placed on top of the sand pack. A cement/bentonite grout will be placed from the bentonite seal to 3 ft below finished grade. Well construction operations will be conducted continuously from the beginning of sand pack placement until the cement/bentonite grout reaches desired elevation. Additional cement/bentonite grout will be added as necessary to maintain the grout level at the desired level. The grout shall consist of 20 parts cement to 1 part bentonite with a maximum of 6.5 gallons of water per sack of cement. The sand pack, bentonite seal and cement/bentonite grout shall be tremied into place.

F. Surface Construction:

- 1) Protective Casing: 8-inch steel pipe with a lockable cover and vented well cap, extending from 3 ft in ground to 2 ft above ground and painted yellow shall be installed.
- 2) Well Pad: 48-inch square, 6-inch thick concrete pad centered on well and sloped away from the well for drainage, extending into the borehole annulus to the top of the cement/bentonite grout shall be installed.

- G. Well Drill Cuttings: Well cuttings produced during drilling operations will be considered potentially contaminated. Cuttings will be secured in 55-gallon steel drums provided by the Engineer. The Engineer will arrange for the disposal of well drill cuttings.

- H. Surveying: The tops of all new alluvial monitoring wells will be surveyed by the Engineer.

9. WELL DEVELOPMENT

- A. The wells shall be developed following completion of construction activities. Well development shall be conducted by alternately jetting (air or water) and bailing each well as directed by the Engineer, and shall include jetting of all screened sections of the aquifer. Wells shall be developed for a minimum of two hours, or until discharge water during surging of all screened well sections is essentially free of sand, whichever is least.

Water removed from a well during development shall be visually monitored for sand content and turbidity. A minimum of 15 gallons per foot of saturated alluvial thickness shall be bailed from each well during well development. The total volume of water removed during well development shall be recorded. Water generated during well development activities shall be collected in suitable drums or tanks provided by the Engineer. Disposal shall be arranged by the Engineer.

10. CLEANUP

- A. At completion and before acceptance of this work, clear away equipment, surplus material, and rubbish, leaving the site in a neat, presentable condition acceptable to the Engineer.

11. QUALITY CONTROL

- A. General: The Contractor shall maintain records as required by the Engineer to assure that well construction is being conducted within contract limits. The results of drilling construction and development activities shall be documented to assure they meet specifications. The Contractor shall maintain records of observations, measurements and tests performed. These records shall be furnished to the Engineer no later than 24 hours after the tests, measurements, and/or observations are made.
- B. Well Construction Log: The Engineer shall maintain a well construction log of daily activities. The well construction log shall identify subsurface geologic occurrences encountered during well construction. The depth to the groundwater table and the Denver Formation shall be identified.

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SPECIFICATION 34-0301

NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

RECHARGE TRENCH PROJECT

CAST-IN-PLACE CONCRETE

CLIENT: SHELL OIL COMPANY

PROJECT: NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

LOCATION: ROCKY MOUNTAIN ARSENAL, COMMERCE CITY, CO

MK-ENVIRONMENTAL SERVICES
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SPECIFICATION 34-0301
NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA
RECHARGE TRENCH PROJECT
CAST-IN-PLACE CONCRETE

1. SCOPE

- A. The cast-in-place concrete requirements consist only of the various non-reinforced thrust blocks and supports for piping installed underground, and the concrete caps and aprons at piezometers, and the concrete used in constructing the steel protective posts as shown on the design drawings.
- B. This specification applies only for the above said type of work. In the event that other more extensive cast-in-place concrete becomes necessary, other appropriate specifications would be issued.

2. RELATED WORK

- A. The following related work is covered in other specifications:
 - 1) Excavating and Backfilling (Specification 34-0203).
 - 2) Manholes (Specification 35-1511).
 - 3) Piping and Instrumentation (Specification 35-1501).

3. REFERENCE STANDARD

- A. Organizations whose standards are referenced herein include the following:
 - 1) ACI - American Concrete Institute
 - 2) ASTM - American Society for Testing and Materials
- B. Any references to the above standards shall be the edition in effect as of the date of this specification unless otherwise stated.

4. GENERAL

- A. Shop Drawings: None are required and none will be furnished. Cast-in-place concrete shall be located and sized as required by the design drawings.
- B. Earth Compaction: The earth upon which each of the concrete thrust blocks will bear shall be undisturbed soil.

5. MATERIALS

- A. Concrete: 3,000 psi or commercial dry mix for pouring small quantities.
- B. Portland Cement: ASTM C150, Type II.
- C. Sand: ASTM C144, washed natural sand, free from impurities.
- D. Aggregate: Washed natural aggregate maximum 1/2" size, free from impurities.
- E. Water: Free of deleterious amount of acids, alkalis, and organic materials.

6. FINISH

- A. Trowel finish the concrete aprons at piezometers.

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SPECIFICATION 35-1501

NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

RECHARGE TRENCH PROJECT

PIPING AND INSTRUMENTATION

CLIENT: SHELL OIL COMPANY

PROJECT: NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

LOCATION: ROCKY MOUNTAIN ARSENAL, COMMERCE CITY, CO

MK-ENVIRONMENTAL SERVICES
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SPECIFICATION 35-1501
NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA
RECHARGE TRENCH PROJECT
PIPING AND INSTRUMENTATION

1. SCOPE

- A. This specification and applicable design drawings cover the furnishing, installing, and testing of underground piping and instrumentation to distribute treated effluent from the existing 6" PVC effluent line to the new North Boundary Recharge Trenches. The existing pumps at the Effluent Wet Well have sufficient capacity and pressure capability for the required distribution.
- B. The work includes:
- 1) Connecting to an existing 6" Schedule 80 PVC underground pipeline leading from the North Boundary System Treatment Plant. The existing line is located adjacent to Recharge Trench #10.
 - 2) Install the underground east-west header to supply treated water to the recharge trench via three (3) Recharge Trench Manholes.
 - 3) Piping inside each of the three (3) manholes, plus discharge piping and perforated drain line into each Recharge Trench. This includes discharge piping across (beneath) First Creek to supply Trench #15.
 - 4) Pressure indicators and flowmeters in each manhole.

2. RELATED WORK

- A. Related work is covered in other specifications:
- 1) Excavating and Backfilling (Specification 34-0203)
 - 2) Manholes (Specification 35-1511)
 - 3) Trench Piezometers (Specification 22-3227)

3. REFERENCE STANDARDS

A. The piping components and instruments shall be designed, manufactured, and tested in accordance with applicable standards and references:

- 1) ASTM - American Society for Testing and Materials
- 2) ANSI - American National Standards Institute
- 3) ISA - Instrument Society of America
- 4) Text, Plastic Piping Systems, by David A. Chasis
- 5) National Sanitation Foundation
- 6) AWWA - American Water Works Association

4. GENERAL REQUIREMENTS

A. Codes, Permits and Fees, Tests, and Certificates:

- 1) All work performed under this specification shall meet the requirements of the codes, rules, and/or regulations of the State of Colorado and the Federal Government.
- 2) The U.S. Army shall obtain and pay for all permits and certificates of inspection required for this work by governing authorities.
- 3) Notification shall be given to the U.S. Army of all tests performed during progress of the work and prior to completion, so an Army representative may witness the tests.

B. Coordination and Interferences:

- 1) MK-ES shall be responsible to coordinate the work under this specification with work performed in the same areas by other trades such as the site work, excavating, grading, and trench and manhole construction.
- 2) MK-ES shall also request that the location of any underground utilities be identified by an Army representative.

5. MATERIAL REQUIREMENTS

A. General:

- 1) Refer to Items 1.D.1) and 2), above. The underground effluent pipe and fittings shall be PVC manufactured from a compound that meets the requirements of Type 1, Grade 1, polyvinyl chloride as outlined in ASTM D1784. A Type 1, Grade 1 compound is characterized as having the highest requirements for mechanical properties and chemical resistance.
 - 2) The compound from which PVC pipe is produced shall have a design stress rating of 2,000 psi at 73°F, listed by The Plastic Pipe Institute.
 - 3) Materials from which PVC pipe and fittings are manufactured shall have been tested and approved for conveying potable water, by The National Sanitation Foundation.
 - 4) PVC pipe shall conform to the requirements of ASTM D1785. Fittings shall conform to the requirements of ASTM D2467 for Schedule 80 socket type and ASTM D2464 for Schedule 80 threaded type. All PVC socket and threaded connections shall be joined and installed using the manufacturer's recommended procedure.
 - 5) The PVC pipe and fittings shall be supplied by an approved manufacturer.
- B. The valves shown on Drawings 371-35-001 and 371-35-002 shall be supplied by the manufacturers indicated, or approved equal.
- C. All pipe fittings and nipples located in the manholes shall be threaded galvanized steel Class 150, or Class 3000 forged steel, as indicated on MK-ES Drawing 371-35-002.
- D. The effluent piping flow sensor in the three (3) recharge manholes shall be a 1" or 1½" Halliburton Standard Meter with magnetic pickup, as indicated on the drawings.
- E. The outflow piping from a manhole to a Recharge Trench shall be furnished and installed with materials as indicated on MK-ES Drawing 371-35-002.

6. INSTALLATION AND TESTING OF PVC PIPE

- A. Instruction: Installation workers shall be instructed in the proper handling and joining techniques. Piping shall not be thrown, whipped, or dropped during handling.
- B. Storage: In outside storage, the pipe and fittings shall be covered with light tarpaulin to prevent excessive heat build-up. Loose pipe stacks shall not exceed 3 feet in height.
- C. Excavation, Trenching and Backfill shall be according to the requirements of Specification 34-0203 except as otherwise specified herein or on the drawings. Generally, installations of PVC pipe shall be in open trenches. The trench width below top of pipe barrel shall be the minimum required to provide working space for pipe jointing, bedding, and inspection.
- D. Bedding: PVC pipe shall be bedded on material free from rock particles greater than 1/2-inch diameter in such a way as to support the full barrel length. If natural bedding materials do not meet these requirements or will not provide adequate pipe support, overexcavate and place a minimum of 4 inches of tamped sand to provide pipe support.
- E. Backfilling:
 - 1) After the pipe is bedded and successfully initially tested as described under Section 6.F, the pipe shall be covered with 6 to 8 inches of soil free of rocks, debris, or particles larger than one-half inch. This initial backfill layer shall be tamped to restrain the pipe during high-pressure testing, and to act as a cushion for final backfill.
 - 2) After successfully passing the high-pressure test, the initial soil cover shall be compacted on both sides of the pipe, with special care at the pipe haunches. Material placed at pipe joints shall not be compacted. Final backfill shall not contain any large sharp rocks in the first 18 inches that could penetrate the initial cushioning layer. Afterwards, the remaining backfilling will be accomplished according to Specification 24-0203.
 - 3) Install caution tape as indicated on the drawings.

F. Testing:

- 1) After the pipe is bedded, an initial hydrostatic test shall be conducted at 10% of maximum test pressure, not to exceed 50 psi, to ascertain any initial leakage. Solvent-cemented joints shall have dried a specified period of time dependent on the surface temperature. After a successful initial test, sufficient backfill shall be placed as mentioned above to prevent pipe movement during subsequent high-pressure testing.
- 2) The high test pressure shall be between 1.2 and 1.5 times the maximum operating pressure or the design pressure rating, whichever is lower.
- 3) Maximum operating pressure shall be 60 psig.
- 4) The high-pressure test shall be conducted for a period of not less than 2 hours. To successfully pass the high-pressure test, the volume of water required to maintain the test pressure shall not exceed the amount calculated by the equation:

$$L = \frac{NDP}{7400}$$

where L = makeup water (gal./hr)
N = number of joints in the tested line
D = nominal pipe diameter (in.)
P = average test pressure (psi)

- 5) When testing sections of line having more than one pipe size, the allowable leakage shall be computed by applying the above equation to each section of pipe having a different diameter, then summing the allowable leakages for each pipe section.
- 6) Test records shall be delivered to an Army representation by MK-ES.
- 7) In the event that low temperatures make testing with water impractical, an equivalent air test will be allowed.

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SPECIFICATION 35-1511

NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

RECHARGE TRENCH PROJECT

MANHOLES

CLIENT: SHELL OIL COMPANY

PROJECT: NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

LOCATION: ROCKY MOUNTAIN ARSENAL, COMMERCE CITY, CO

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

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SPECIFICATION 35-1511
NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA
RECHARGE TRENCH PROJECT
MANHOLES

1. SCOPE

- A. This specification covers the furnishing and installing of precast concrete eccentric cone manholes that shall be located to serve the North Boundary System Improvement Recharge Trenches.
- B. The trench and manhole locations are shown on MK-ES, Inc. Drawings 34-003, 34-004, and 34-005.

2. RELATED WORK

- A. Related work is covered under other specifications:
 - 1) Site Preparation and Grading (Specification 34-0202)
 - 2) Excavating and Backfilling (Specification 34-0203)
 - 3) Piping and Instrumentation (Specification 35-1501)

3. REFERENCE STANDARDS

- A. Organizations whose standards are referenced herein include the following:
 - 1) ASTM - American Society for Testing and Materials
- B. Any reference to the above standards shall be the edition in effect as of the date of this specification unless stated otherwise.

4. MATERIALS

- A. Gray Iron Castings (rated for H-20 load): ASTM A48-83, Class 35B.
- B. Grout: Non-shrink, nonmetallic, noncorrosive; Five Star Grout (U.S. Grout Co.), or as approved by the Engineer.

- C. Precast Concrete Units: ASTM C478.
 - D. Aluminum cover.
 - E. Butyl resin mastic as manufactured by Concrete Sealant, KT Snyder (Ramnek), or approved equal.
5. INSTALLATION
- A. Manholes:
 - 1) Excavate earth to a minimum of 8" below required manhole base elevation, then fill and level gravel up to the required manhole base elevation. The gravel shall be as specified for the Recharge Trenches.
 - 2) Set the manhole cylindrical base portion atop the leveled gravel fill on the pre-established centerline.
 - 3) Join the concentric cone to the cylindrical base with cold-applied bituminous joint sealant.

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SPECIFICATION 37-1601

NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

RECHARGE TRENCH PROJECT

ELECTRICAL WORK

CLIENT: SHELL OIL COMPANY

PROJECT: NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

LOCATION: ROCKY MOUNTAIN ARSENAL, COMMERCE CITY, CO

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

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SPECIFICATION 37-1601
NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA
RECHARGE TRENCH PROJECT
ELECTRICAL WORK

1. SCOPE

- A. This specification and applicable drawings cover the furnishing and installing of electrical work as required by the drawings and as specified herein.

2. REFERENCE STANDARDS

- A. All equipment, materials, construction and installation shall be in accordance with the following applicable codes and standards:

- 1) ANSI - American National Standards Institute
- 2) NEMA - National Electrical Manufacturers Association
- 3) NFPA/ - National Fire Protection Association/
NEC National Electrical Code
- 4) Applicable State of Colorado Electrical, Building, Energy, Fire, and Safety Codes
- 5) Local codes

3. RELATED WORK

- A. Several items of work are specified in other specifications and are not included in the work covered by this specification.

- 1) Excavating and Backfilling (Specification 34-0203)
- 2) Manholes (Specification 35-1511)
- 3) Piping and Instrumentation (Specification 35-1501)

4. GENERAL REQUIREMENTS

- A. In the event of any discrepancy between one drawing and another or between the drawings and this specification, the Contractor shall bring such discrepancies to the attention of the Engineer for a ruling.
- B. It shall be the Contractor's responsibility to assure that all requirements of inspection authorities are complied with.
- C. Names of approved manufacturers are listed in this specification to establish a standard of quality. Products of other manufacturers may be used with the approval of the Engineer.

5. REQUIRED ITEMS OF WORK

- A. The work involved shall be in accordance with the following:
 - 1) The drawings for construction and their references.
 - 2) The contents and references of this specification.
 - 3) The installation instructions of the manufacturers of equipment or materials supplied to the Contractor for installation.
- B. All electrical systems, both above grade and below grade, shall be completed as outlined on the drawings and in this specification, and be ready for use.
- C. Labor and materials which are necessary for the completion and satisfactory operation of the electrical installation shall be furnished.

6. WIRE AND CABLE METHODS

- A. General: As required by the drawings, all power and control wiring shall be furnished and installed, unless otherwise specified, and shall meet NEC standards for wire, cable and workmanship.
- B. 600-V Conductors: All single conductor wiring for power installed in conduit for operating at 600 V or below shall be UL approved stranded soft annealed copper, type XHHW or THHN.

- C. Telephone Cable: Cable shall consist of No. 19 AWG solid annealed copper conductors twisted in pairs; each conductor shall have polyethylene insulation. The cable shall have an overall copper shield and polyethylene jacket. Cable shall be Anixter telephone cable Type PE-22 or approved equal.
- D. Twisted-pair signal cable (TSP) shall be constructed of two No. 18 AWG copper signal wires with high-density polyethylene or PVC insulation over each conductor, a tinned 7-strand copper drain wire, an aluminum foil mylar tape over the pair and the drain wire, and an overall jacket of high-density polyethylene or PVC.

7. CONDUIT AND CONDUIT FITTINGS

- A. General: Conduit sizes, type and length shall be furnished and installed as required by the drawings and meet the latest edition of the NEC.

- B. Materials:

- 1) Conduit:

- a) Rigid Galvanized Steel Conduit (RGS) shall conform to ANSI C80.1 and be standard weight, mild rigid steel, hot-dipped galvanized with inside and outside finished with a protective zinc coating. Couplings, elbows and bends shall meet these same requirements. Fittings shall be of the threaded type.
 - b) Flexible Conduit shall be liquid-tight with an integral grounding conductor, per ANSI/UL 360, Anaconda Sealtite type UA or equal.
 - c) PVC-coated Steel Conduit shall conform to NEMA RN-1 and be standard weight, mild rigid steel, hot-dipped galvanized prior to plastic coating. Coating shall be a minimum of 0.040" of polyvinyl chloride bonded to the steel conduit. Couplings, elbows, conduit bodies and fittings shall be PVC coated and meet the same requirements as the coated conduit. Each item mentioned above, such as coupling, etc. shall have a flexible PVC sleeve which extends from each end of the coupling and which will overlap the PVC coating on the conduit when the coupling has been installed on the conduit.

2) Boxes and Fittings:

- a) Exposed Work: All conduit fittings, junction and device boxes shall be cast Type FS or FD with threaded hubs, steel covers and gaskets for use with RGS.
- b) For weatherproof locations, proper sealing gaskets in addition to self-closing hinged lids for receptacle covers shall be provided.
- c) Gasket material for conduit fittings and boxes shall be neoprene or other approved plastic.

C. Installation:

1) Above Grade Conduit System:

- a) Above grade conduit shall be rigid galvanized steel conduit.
- b) Field bends and offsets shall be uniform and symmetrical, without conduit flattening or finish scarring. Field bends shall be made with standard tools and equipment manufactured specifically for conduit bending. Minimum bend radii shall be as required by the NEC, but in no case less than six times conduit diameter.
- c) All conduit ends shall be cut square, properly threaded and reamed. All connections and joints shall be made tight and weatherproof, engaging not less than five threads, and coated with approved thread compound, such as "Kopr-Shield" compound manufactured by Thomas and Betts. All steel conduit joints shall be weatherproof, using suitable metal oxide for joint makeup.
- d) Pull fittings or boxes shall be installed wherever necessary on conduit systems to facilitate pulling wire and cables, and shall be in accessible locations.
- e) Open ends of conduit shall be carefully plugged or capped during construction to prevent the entrance of foreign materials or moisture into the conduit. Before pulling wire or cable into

the conduit system, a swab shall be drawn through the entire length of the conduit to remove any moisture, metal cuttings or other foreign material.

- f) Outside above grade conduit runs that are extended below grade shall be provided with drain-seal fittings in a vertical drop directly above grade.
- g) Conduit connections to flowmeters shall be liquid-tight flexible steel conduit with suitable fittings.
- h) In wet areas indoors and areas subject to washdown, the entire wiring system, boxes, conduit, and fittings must be mounted so that 1/4 inch minimum space exists between system and supporting surface.
- i) At all entrances to panelboards, pull boxes or outlet boxes (without threaded hubs or bases), conduit runs shall be secured in place by a galvanized locknut with an O-ring seal outside the box and a locknut and bushing on the inside. Bushings shall be of the insulating type. NEMA 1 panelboards, pull boxes, etc., shall be secured in place by a galvanized locknut outside the box and a locknut and bushing inside. Bushings shall be of the insulating type.
- j) Exposed conduit shall be rigidly maintained and fastened to structural steel by means of an approved clamp or device made for this purpose. On masonry structures, conduits shall be fastened with one-hold conduit clamps and backstrips with flush anchors. The type of conduit support will depend on the type of construction, and/or details as indicated on drawings. Pull boxes shall be rigidly supported with structural steel supports. It shall remain in the Contractor's scope of work to furnish and install any and all support structures when none are specifically furnished.

- k) All steel bolts, nut, washers and screws shall be galvanized or cadmium plated.
 - l) Conduit bodies Type "LB," "LR," "LT," etc., shall not be used as splice boxes.
 - m) Conductor supports shall be in accordance with the NEC and the method of support shall be approved in writing by the Engineer.
- 2) Conduit in Contact with Earth:
- a) Conduit in direct contact with earth shall be PVC coated steel conduit.
 - b) Conduits shall be installed on minimum of four-inch sand bedding at the bottom of the trench after the trench has been smoothed and tamped. Refer to the construction drawings for details.
 - c) The installation of PVC-coated conduit shall follow the installation instructions recommended by the manufacturer. Herein are a few extra steps to follow:
 - Care must be taken to minimize damage to the PVC coating during cutting, threading, bending and assembly of components.
 - Exposed metal due to damage of the PVC coating must be touched up with compound recommended by PVC-coated conduit manufacturer.
 - To field cut, use a clamp-type vise, tighten to hold conduit securely. Cut conduit with a hacksaw or power saw.
 - All conduits shall be reamed after cutting. Reamer shall be designed for use on PVC-coated conduit.
 - Use only tools approved or recommended for use on PVC-coated conduit.
 - d) Conduit bending radii shall be as large as possible and shall be not less than eight times

nominal conduit diameter, and free from flats, kinks or damage.

- e) Conduit installation shall follow excavating as closely as possible. Conduit shall be installed in dry trenches maintained free of accumulated water.
- f) Conduit runs shall be kept closed at all times using pipe caps or plugs.
- g) After conduits are in place, backfill and compact fill to a depth above conduits as specified in drawings and applicable specifications. Install a continuous warning strip of red plastic in the excavation and continue backfill per drawings and specifications.
- h) Conduits in the same trench shall have a minimum horizontal and vertical separation of three inches.

8. GROUNDING SYSTEM

- A. All non-current carrying metal parts of electrical equipment and installations shall be connected to the grounding electrode system as required by the NEC. These will include, but not necessarily be limited to, electrical and instrument equipment enclosure, terminal boxes, steel supporting structures, etc.
- B. Equipment remote from the existing main ground grid may be grounded by separate grounding electrodes and conductors. The resistance to ground of the completed system shall be less than 5 ohms.
- C. Copperweld ground rods shall be 3/4 inch x 10 feet. Top of ground rods shall be a minimum of two feet below grade. Additional section of rods shall be driven as required to obtain the required system resistance.
- D. The signal and telephone cable shield shall be terminated as indicated by the instrument manufacturer in the installation instruction manual.
- E. All telephone and signal cable shields must be bonded to maintain electrical continuity at each cable splice.

9. AS-BUILTS

- A. One (1) complete set of drawings issued for this contract shall be maintained exclusively for record purposes by the Contractor and all changes and modifications shall be shown and noted thereon in red color. Supplemental drawings or sketches may be added. Dimensions, clearances, sizes and significant references shall be added.
- B. Drawings shall be kept neat and clean, and shall be available at all times for reference. All sketches, notes and data shall be sufficiently clear to permit photo reproductions when needed.
- C. As-built drawings must be submitted to MK-ES at the completion of the work.

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

SPEC NO.: 38-0108
W.O. NO.: 2127-371-03
DATE: 01/15/90
ISSUE/REV.: 0
PAGE: 1

SPECIFICATION 38-0108

NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

RECHARGE TRENCH PROJECT

SUMMARY OF WORK

CLIENT: SHELL OIL COMPANY

PROJECT: NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

LOCATION: ROCKY MOUNTAIN ARSENAL, COMMERCE CITY, CO

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

SPEC NO.: 38-0108
W.O. NO.: 2127-371-03
DATE: 01/15/90
ISSUE/REV.: 0
PAGE: 2

<u>CONTENTS</u>	<u>PAGE</u>
1. PROJECT DESCRIPTION	3
2. SCOPE OF WORK	4
3. MANUFACTURERS' SPECIFICATIONS AND INSTRUCTIONS	4
4. WORK QUALITY	5
5. FIELD MEASUREMENT AND TEMPLATES	5
6. SPECIAL CONDITIONS	5

SPECIFICATION 38-0108

NORTH BOUNDARY SYSTEM IMPROVEMENTS IRA

RECHARGE TRENCH PROJECT

SUMMARY OF WORK

1. PROJECT DESCRIPTION

A. Project Title: North Boundary System Improvements
Recharge Trench Project.

B. Project Owner: U.S. Department of the Army

C. Project Location and Elevation:

- 1) The project is located along the northern boundary of the Rocky Mountain Arsenal in Sections 23 and 24, Township 2 South, Range 67 West in Adams County, Colorado.
- 2) The surface elevation ranges from about 5135 to about 5150 feet above sea level.

D. General Description of the Project:

- 1) The basic element of the project is construction of five trenches. Four of the trenches will be approximately 400 feet long and one will be about 200 feet long. The trenches will be filled with gravel to within a few feet of the surface where a 4-inch polyethelene drain pipe will be placed and covered with gravel. The drain pipe will be connected through a manhole to a pressure pipe placed in a 4-to-5-foot deep trench. In operation, water will be pumped from an existing treatment plant through the pressure pipe into the drain pipe and the gravel backfill. From the gravel the water will recharge the aquifer.
- 2) Piezometers will be placed within the gravel in the trench and also in a line about 30 feet south of the trenches and 15 feet north of the existing slurry wall to monitor ground water levels after the project is placed in operation.

2. SCOPE OF WORK

- A. The contract work to be performed by the Contractor consists of constructing and completing the project in accordance with the drawings and the specifications and all applicable provisions of the contract documents, the Final Implementation Document, and the Federal Facilities Agreement.
- B. The contract work includes the Contractor furnishing all plant, labor, tools, equipment, appliances, materials, transportation, and services called for in these specifications or in the design drawings, unless specifically excepted. The contract work includes performing all operations necessary for and properly incidental to, the construction and proper completion of the project (unless specifically excepted in these specifications or in the design drawings), as shown and noted in the drawings and as specified in these specifications. Elements of the contract work are classified under respective items contained in the bid schedule. Contract work shall generally include, but not be limited to, the following items:
- 1) Mobilization at "work site"
 - 2) Excavation and backfill of recharge and pressure pipe trenches
 - 3) Installation of drain pipe, pressure pipe, manholes, valving, electrical and instrumentation
 - 4) Installation of piezometers

3. MANUFACTURERS' SPECIFICATIONS AND INSTRUCTIONS

- A. Unless otherwise indicated or specified, all manufactured materials, products, processes, equipment, or the like shall be installed or applied in accordance with the manufacturers' instructions, directions, or specifications. Said installation or application shall be in accordance with the printed instructions furnished by the manufacturer of the material or equipment concerned for use under conditions existing at the work site. Two copies of such instructions shall be furnished to the Engineer and his acceptance thereof shall be obtained before work is begun.

- B. Any deviation from the manufacturers' printed recommendations shall be explained and acknowledged in writing by the particular manufacturer as correct for the circumstances. Contractor will be held responsible for all installations contrary to the manufacturers' recommendations. If any item of material or equipment is found to be installed not in accordance with the manufacturer's recommendations, Contractor shall make all changes necessary to achieve such compliance within the terms of his contract.

4. WORK QUALITY

- A. All contract work shall be erected and installed plumb, level, square, and true, or true to the indicated angle, and in proper alignment and relationship to the work of other trades. All finished work shall be free from defects and damage.

5. FIELD MEASUREMENT AND TEMPLATES

- A. Contractor shall secure all field measurements required for proper and accurate fabrication and installation of the contract work. Exact measurements are the Contractor's responsibility. Contractor shall also furnish or obtain all templates, patterns, and setting instructions required for the installation of all contract work. All dimensions shall be the responsibility of the Contractor in the field. All dimensions and surveying will be subject to verification by the Engineer.

6. SPECIAL CONDITIONS

- A. The Rocky Mountain Arsenal is a Military Reservation and persons admitted to the site are subject to existing safety and security regulations.
- B. U.S. Citizenship is required for access to the site.
- C. Names of each person as shown on a drivers license, including delivery personnel to be admitted to site, must be submitted to the Engineer one week in advance of arrival at the site.
- D. Entry to the site will be through the west entrance to the Rocky Mountain Arsenal on Quebec Street, thence east on December 7th Avenue to D Street and north to the work site. A secondary point of entry is at the southern

MX-ENVIRONMENTAL SERVICES
A DIVISION OF MX-FERGUSON

SPEC NO.: 38-0108
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DATE: 01/15/90
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- . Arsenal boundary during some hours as shown on design drawing 34-001.
- E. No firearms or cameras are permitted on the Arsenal.
- F. Current registration and proof of insurance for each vehicle to be admitted to the Arsenal must be submitted upon arrival at the site.

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

SPEC NO.: 38-3797
V.O. NO.: 2127-371-03
DATE: 01/12/90
ISSUE/REV.: 0
PAGE: 0

SPECIFICATION 38-3797

INSTRUMENT LIST AND DATA SHEETS

CLIENT: SHELL OIL COMPANY

PROJECT: ROCKY MOUNTAIN ARSENAL REMEDIATION PROJECT

INTERIM RESPONSE ACTION FINAL DETAILED DESIGN

NORTH BOUNDARY SYSTEMS IMPROVEMENTS

RECHARGE TRENCH PROJECT

LOCATION: ROCKY MOUNTAIN ARSENAL, COMMERCE CITY, CO

TAG NUMBER	SERVICE/APPLICATION	SPECIFICATION			P&I DRAWING	MTNG CODE	NOTES
		NUMBER	SHEET				
			No.	Rev			
LT-101 thru LT-110	Injection Field Water Table Level Transmitters	38-3797	1	0	--	F	See Data Sheet 1
FT-12 thru FT-16	Turbine Flowmeters (5 each) Haliburton, specified on Dwg. 371-35-002, Detail 1	None	-	-	--	L&F	No Data Sheet Required
PI-12 thru PI-16	Pressure Gauge (5 each) Ashcroft M/N 45B.20357 speci- fied on Dwg. 371-37-002 Detail 1	None	-	-	--	L&F	No Data Sheet Required

NOTES: Requested or specified by

Mounting Code: F - field mounted; L - line mounted; P - panel mounted
R - rack mounted; T - tank mounted; V - vendor mounted

				DRAWN BY CED	APPROVED BY BJJ	MK-ENVIRONMENTAL SERVICES A DIVISION OF MK-FERGUSON INSTRUMENT LIST
				CHECKED BY	SCALE ---	
				CONTRACT NUMBER 2127		
				SHEET NUMBER A		
01/12/90	Construction	0	BJ			Specification 38-3797
10/26/89	Implementation Plan	8	BJ			
DATE	REVISION OR ISSUE	NO.	BY			

TAG NUMBER : LT-101 thru 110 (10 total)
 MANUFACTURER: Drexelbrook
 MODEL NUMBER: Refer to Model Information

SERVICE: Injection Field Water Table Level Transmitters

LEVEL SENSING ELEMENT

Type	Flexible cable w/weight at bottom end
Material	Stainless steel cable w/polypropylene cover
Length	(Refer to Model Information)
Spacer Disc Type	None
Insertion Connection Size Required	1" NPT
Tag	Vendor to attach stainless steel tag ID to each LT

TRANSMITTER

Type	2-wire, loop powered
Calibration	(Refer to Model Information)
Mounting (Integral; Remote)	Integral

SERVICE CONDITIONS

Fluid	Well water
Temperature (Fluid)	60°F (nominal)
Specific Gravity	1.0
Temperature (Ambient)	-20°F to 110°F

MODEL INFORMATION

10 Ea. Mod. Y508-11-8-TESA Deep Well Level Measuring System
 To Include: 408-2200-4 Ramp Capacitance Xmitter; Y-700-5-44 polypropylene sensing element; standard vertical head with TFE boot; NEMA 4X enclosure; integral mounted xmitter; 4-20 mA output; 752-25-3 bottom weight (7/8" O.D. x 4" long); loop surge protector Drexelbrook P/N 377-4-1

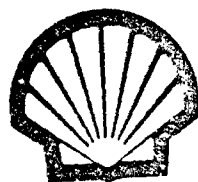
	Probe Length Required from Mounting Thread	Ref. Elevation at Bottom of Probe
LT-101 =	18.75 ft	5129.5
LT-102 =	24.75 ft	5120.5
LT-103 =	17.75 ft	5124.4
LT-104 =	22.75 ft	5119.5
LT-105 =	24.75 ft	5119.5
LT-106 =	19.75 ft	5126.5
LT-107 =	17.15 ft	5134.5
LT-108 =	12.85 ft	5136.0
LT-109 =	20.45 ft	5127.3
LT-110 =	13.65 ft	5137.9

				DRAWN BY CED	APPROVED BY BJJ	MK-ENVIRONMENTAL SERVICES A DIVISION OF MK-FERGUSON
				CHECKED BY	SCALE	
				CONTRACT NUMBER 2127		
01/12/90	Construction	0	BJ	SHEET NUMBER		LEVEL TRANSMITTERS RF FREQUENCY TYPE (DEEP WELL MEASUREMENT)
10/26/89	Implementation Plan	8	BJ	1		
DATE	REVISION OR ISSUE	NO.	BY			

Specification 38-3797

VOLUME 1 GENERAL AND
VOLUME 2 ENGINEERING SPECIFICATIONS

JANUARY 1990



Shell Oil Company

PMH 00-000-71

12/14/89 14:00

5562230

P M-R M A

2002

NORTH BOUNDARY RECHARGE TRENCHES
ROCKY MOUNTAIN ARSENAL, CO

Comments By: CEMRO-ED-CF, Greg Mellama

The Implementation Document has been reviewed, and the following comments are provided:

a. It will be difficult to keep the trenches open during excavation, as there is a relatively high water table and most of the excavated material are sands and sandy gravels.

b. The riprap placed in First Creek should include a rock filled sill on the upstream side to prevent undercutting and unraveling of the rock sill.

RMA 90-0180 2/3

Review Comments

For: ~~John~~ **DAVID** Project Manager, WMRD-20-8A
JRM. David Davis, Industrial Hygienist, WMRD-20-8A
December 8, 1989

Document Reviewed:

Draft Implementation Document
for Recharge Trench Project
for the North Boundary System Improvements
Interim Response Action
Rocky Mountain Arsenal
November 1989
Prepared by AR-Environmental Services
Prepared for Shell Oil Company

VOLUME 1 - GENERALSection 1.1 Construction Work Plan

1. P. 26, 2.6 Soil Investigation

Provide more details regarding testing for contaminants (i.e. location of holes, frequency of testing, parameters and methods (organic vapors by PID or FID, combustible gases by CCI meter, etc.), action levels for determining whether soil is contaminated, etc.).

Section 1.3 Estimated Cost and Basis of the Estimate

2. P. 27

The purpose of the recharge trenches is to inject treated (clean) water back into the aquifer downgradient of the slurry wall. Therefore, leaving contaminated soil in the trenches would seem to at least partially defeat the purpose of treating the water. If any contaminated soil is encountered it should be removed and replaced with clean soil.

Page 11 of the Health and Safety Plan says diversion ditches may be constructed to keep surface runoff out of the trenches. Therefore, decontamination water should not be disposed of in the trenches. The decon water could be disposed of in the same manner as water generated during well development activities (paragraph 3 of spec. section 01-0-72).

3. P. 28

Provide additional breakdown of these costs.

BEST AVAILABLE COPY

Section 2.0 Health and Safety Plan

4. General

The plan needs to include information on the staff organization, qualifications and responsibilities. Page 48 addresses the responsibilities of the OHSO pertaining to the Emergency Management Team but there is no information provided for normal activities.

5. P. 1. 1.0

Clarify whether the referenced "Rocky Mountain Arsenal Health and Safety Plan" is an HK-E document or an RNA document.

6. P. 38. A.1.1

"All wash and rinse water generated will be discharged to the effluent..." See comment #2 above.

VOLUME 2 ENGINEERING SPECIFICATIONS

AND

VOLUME 3 ENGINEERING DRAWINGS

I have no comments on Volumes 2 and 3.

DEC 13 '89 08:11

P.2/3

Comments By: CEMRO-ED-DD, Jim Mueller

1. Section E001. Please define the term "cleanout" somewhere on the drawing.
2. Section E002. The typical loop diagram should be shown as detail 3 on this drawing. *OK*
3. Section E001. The new wiring shown for the flow transducers and the level transmitters require 11 pair or 22 conductors. Verify that 11 pair in the existing 13 pair cable are available for use.
4. Section E001. I believe that lightning protection (gas tube protectors) should be provided on all new conductors to protect the electronic indicators and electronic equipment from lightning surge damage. Is lightning protection already provided flow transducers and level transmitters? *Not shown*
5. Section E001. Detail 3 show a 1" conduit where one line on same drawing near detail arrow shows 1 1/2" C. Coordinate.
6. Section E-001. Junction box JB5 is shown as a Nema wk. Specify junction box JB1, JB2, JB3, JB4. *JB1, JB2, JB3, JB4*
7. Section E001. Specify Nema type for terminal box TX-2. *TX-2*

DEC 13 '89 08:11

P. 2

**CORPS OF ENGINEERS
ENGINEERING REVIEW COMMENTS**

**SHEET 1 OF 2
DATE: 1 Dec. 1989**

Missouri River Division

TO: Don L. Ohnstad

Design Phase: Draft Report

Designed By: A/E for Shell

Submittal: R-998

Project: North Boundary System Imp.

Project Location: Rocky Mt. Arsenal

Comments By: R. J. Waples, P.E.

Branch/Section: CEMRD-EC-EZ

Drawing # or Paragraph #	Item #	Comments	Action
Pg 20, Par 2	1.	Report and Specifications Describe the procedure if organics are found in the excavation areas that violate the Health and Safety Plan.	
Pg 20, Par 3	2.	The Drawings and other sections state that the top 3-4 feet of existing soil shall be removed and stockpiled.	
Pg 27, Par 2	3.	Verify the statement that the decontamination water can not leave the bench area. It would appear that if decon. water is of any significance then it should be discharged on the other side of the slurry wall for treatment before discharge.	
34-0203 Par 5	4.	Specify the minimum bury depth for the treated water for main.	
34-0203 Par 9D	5.	The specifications state that groundwater shall not be removed except for water attached to the in-place soils. If dewatering is required for the trench installation, then the groundwater disposal method and possible treatment will need to be addressed. Clarify in the general part of this report on the excavation procedure. Clarify if sheet piles shall be required to prevent the sands and gravels from washing into the trench excavation.	
35-1501 Par 6E	6.	Verify that 6-8 inches of backfill will provide adequate cover over the pipe to prevent movement during high-pressure testing. Additional backfill between joints could prevent the movement of the pipe.	

12/14/89 14:02 5562230

P H-R M A

OFC 13 '23 29:13

P.1 2 2007

35-1501 Par 6F 7.

Specify the test pressure for the hydrostatic test of the pipe.

Drawings

C-006

8.

The Section A detail indicates that the work bench width may not be adequate for safely stockpiling the contaminated soil in the deep cut areas.

P-001

9.

The Corps of Engrs. do not typically allow the use of flanges on buried fittings.

12/14/89 14:03 5562230

P M-R M A

DEC 13 1989 09:14

MRD

CORPS OF ENGINEERS
ENGINEERING REVIEW COMMENTS

TO:

2008

CEMRD-ED-EA

PLACE & SPECIFICATION

APPROVED BY:

DESIGNED BY:

PROJECT:

PERMANENT

FINAL

AS ADV.

DATE

DIST

N. Boundary Improvement

LOCATION OF BASE:

INVITATION NO.:

BID OPENING DATE:

RMA

COMMENTS BY:

BRANCH OR SECTION:

DATE:

Doug Pendrell

ED-66

12/8/89

DRAWING NUMBER OR
PARAGRAPH NUMBERITEM
NUMBER

COMMENTS

SHEET 1 OF 1

FORWARDED TO:
(NAME, DATE)

1 Past construction activities along the north boundary have experienced some problems due to cemented zones in the overburden. Shell Oil Co should be made aware of this because it could impact trench excavation if encountered. Recommend reviewing the North Boundary Construction Foundation Report (March 1934) that was prepared by the Omaha District.

12/18/89 14:46 3358 7852

PROGRAM MCR

2002

AMXRM-TO (200-1b)

14 December 1989

MEMORANDUM FOR Interim Response Division, ATTN: T. Kilgannon

SUBJECT: Comments on the Implementation Document for Recharge Trench Project for the North Boundary System Improvement Interim Response Action (IRA)

Review of the recharge trench package does not include the Program Manager's (PM) recommendation to provide remote water level instruments in the existing ten recharge trenches like the ones to be installed in the five new recharge trench systems. The Shell response to PM Technical Operations Division comments states that a total of four remote water level instruments would be added to the ten existing recharge trenches. The PM would like to discuss the decision regarding the rationale for the addition of only four remote water level instruments for the existing ten recharge trenches.

David W. Strang
DAVID W. STRANG
Chief, Technical Operations
Division

12-16/89 14:46
12-15-89 16:09

358 7852

PROGRAM MCR

003

P.2/2

MRD DMAHA District		CORPS OF ENGINEERS ENGINEERING REVIEW COMMENTS		TO:	
PLANS & SPECIFICATIONS AND/OR DESIGN REPORT		DESIGNED BY:		PROJECT: COUNTRY STS. IMPROVEMENTS I.R.	
☐ PRELIM ☒ 90% ☒ FINAL ☐ AS-ADV. ☒ AS ☐ DIST		INVITATION NO.:		BID OPENING DATE:	
LOCATION OR BASE: ROCKY MOUNTAIN ARSENAL CO		DATE: 12/11/89		BRIDGE OR SECTION: STRUCTURES AND BRIDGES	
COMMENTS BY: OM PATNET		DATE: 12/11/89		BRIDGE OR SECTION: STRUCTURES AND BRIDGES	
DRAWING NUMBER OR PARAGRAPH NUMBER	ITEM NUMBER	COMMENTS	SHEET L OF L	PHONED TO: (Name/Date)	
DRAWINGS	1	FURNISH NOTES ON THESE			
371-35-001		DRAWINGS INDICATING THE DESIGN			
AND 371-35-002		LOADS USED FOR THIS PROJECT			
DESIGN	2	PLEASE PROVIDE THE DESIGN			
ANALYSIS		COMPUTATIONS TO CHECK THESE		U-4 1/2	
		DRAWINGS. WITHOUT THEM A		12/12	
		COMPLETE CHECK CANNOT BE			
		MADE			
SPECIFICATIONS					
3C-0203	3	SPECIFY ALL REFERENCES OF			
		ASTM WITH APPLICABLE			
		PUBLICATIONS NUMBER/YEAR FOR			
		EXCAVATING AND BACKFILLING			
34-0301	4	FOR CAST-IN-PLACE CONCRETE			
		FURNISH THE APPLICABLE PUBLICATIONS			
		NUMBER/YEAR OF A.C.I., ASTM,			
		ETSI AND ANY OTHER REFERENCES			
		USED FOR THIS SPECIFICATION			

Memo for Record

Jan 11, 1990

Subject: Comments on Implementation Document for Recharge Trench Project North Boundary System Improvements IRA

The subject implementation document arrived in the WES Geotechnical Laboratory early in January 1990 and has been reviewed expeditiously. Comments are as follows:

1) Field measurements by WES in December 1989, after bog recharging was discontinued, indicate that water levels are remaining relatively high where the new trenches are to be placed. Accordingly the overall impression that the trenches will penetrate the aquifer to full depth may be misleading.

2) It will be difficult to excavate the trenches to the depths shown on the plans unless some method is used to keep the saturated sand and gravel from caving into the trench. The percentage of saturated sand and gravel is much greater on this series of trenches than on the series of trenches installed earlier. Also the water table shown on trench and plan profile sheet 3 of 3 is probably low. The water table in this area fluctuates according to the flow in First Creek. If First Creek is high, trenches 14 and 15 will have a higher water table than is shown in the plans. The plans to handle caving sand and gravel below the water table are not included.

We would welcome an opportunity to discuss these concerns if the overall plan and schedule of construction can still be modified.

STATE OF COLORADO

COLORADO DEPARTMENT OF HEALTH

4210 East 11th Avenue
Denver, Colorado 80220
Phone (303) 320-8333



Roy Romer
Governor

Thomas M. Vernon, M.D.
Executive Director

December 14, 1989

Mr. Donald Campbell
Deputy Program Manager
Rocky Mountain Arsenal
AMXRM-PM, Bldg. 111
Commerce City, Colorado 80022-2180

Re: State Comments and Concerns on the Implementation Document
for Recharge Trench Project for the North Boundary System
Improvements IRA and General State Comments and Concerns on
the North Boundary System Improvements IRA at the Rocky
Mountain Arsenal

Dear Mr. Campbell:

Enclosed please find the State's comments on the above-referenced
document and the State's general comments on the North Boundary
System (NBS) Improvements IRA.

The State believes that the implementation of additional recharge
trenches at the NBS will be beneficial to the overall operation
and performance of this system. The State is pleased with the
early performance of the ten recharge trenches which were in-
stalled at the NBS in 1988. Nonetheless, the State submits these
comments in the spirit of cooperation so that the overall perfor-
mance and effectiveness of the NBS can be increased.

1. Volume I, Page 1, paragraph 2 - This paragraph references a
meeting of the Parties held on September 7, 1989, in which the
Preliminary Engineering Design Package was discussed. Ap-
parently, the Parties' comments were reviewed, discussed and
resolved. Please provide the State with a summary of these dis-
cussions and the corresponding resolutions which were made.

2. Volume I, Page 2, paragraph 3 - The document specifies that
piezometers will be installed inside and outside of each newly
installed trench. The State submitted comments, dated May 17,
1988, on the Proposed Decision Document for the IRA for the NBS
at RMA via construction of Ground Water Recharge Trenches. In
the State's Specific Comment #2 on that document, the State re-
quested that new or existing Denver formation wells also be
monitored to determine the vertical gradient and impact of the

RECEIVED

DEC 20 1989

OLIVE ROBERTS & OWEN

Mr. Campbell
December 14, 1989
Page No. 2

recharge trenches on the Denver units. The State makes this same request at this time.

3. Volume I, Page 16, paragraph (p.) - The document specifies that certain wells found during construction will be closed under the Abandoned Wells IRA. The State submitted comments, dated December 5, 1989, on the Draft Final Report RMA Abandoned Well Closure IRA. In the State's Comment #1 and Comment #8 on that document, the State requested that a subcommittee meeting be held to discuss the closure efforts which have been made and will be made regarding wells in and around the NBS. Please review these previously submitted comments. The State requests that a subcommittee meeting be held to discuss these issues.

4. Volume I, Page 16, paragraph (q.) - The document specifies that a full evaluation of the existing dewatering system of the soil-bentonite barrier will be made. Have the specifics of the planned evaluation been drafted or finalized? Please keep the State informed on this matter.

5. General State Comment on Recharge Trench Installation - The State believes that the proposed recharge trenches constitute waste injection facilities and thereby come under the jurisdiction of Federal U.I.C. regulations. Therefore, the U.I.C. regulations appear to be applicable or relevant and appropriate. Please re-evaluate these regulations and supply the organizations with the Army's interpretation on the applicability of these regulations.

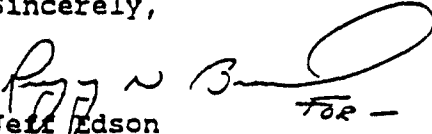
6. General State Comment on NBS Improvements IRA - The State submitted comments, dated November 3, 1989, on the Preliminary Engineering Design Package for NBS Improvements IRA. In the State's General Comment #5 the State suggested that the Army develop and issue a proposed NBS comprehensive monitoring program which would then be reviewed, discussed and finalized by the organizations. Please review this previously submitted comment. The State again makes the request that a comprehensive monitoring program be developed for the NBS.

The State suggests that the NBS comprehensive monitoring program include provisions to monitor the "long-term" performance, permeability and deterioration of the recharge trenches. This monitoring program should also include an evaluation of the dewatering and recharge rates, and flow system response changes caused by temporal variations. The State believes that the U.S. Army Corps of Engineers made similar recommendations in the Corps' August 1989 Final Report on the Start-Up Performance of Groundwater Recharge Trenches at Rocky Mountain Arsenal.

Mr. Campbell
December 14, 1989
Page No. 3

The State looks forward to the continuing improvements which are being made at the North Boundary System. If you have any questions regarding these comments, please contact me.

Sincerely,


Jeff Edson
RMA Project Manager
Hazardous Materials and
Waste Management Division

JE:GB:jmb
C:\WS2000\RMA\CAMPBEL2.LTR

Enclosure

cc: Michael R. Hope, Esq.
John Moscato, Esq.
~~Chris~~ Hahn
Edward J. McGrath, Esq.
Connally Mears
Bruce Ray, Esq.
Major Lawrence E. Rouse
Tony Truschel

MEETING DECEMBER 20, 1989
NORTH BOUNDARY RECHARGE TRENCH PROJECT (EAST)
REVIEW OF COMMENTS ON DRAFT IMPLEMENTATION DOCUMENT

ATTENDEES

<u>Name</u>	<u>Organization</u>
Marty Wilson	MK-ES
Karen S. Lewis	MK-ES
Anthony LaChance	MK-ES
Terry Kearney	MK-ES
George Chadwick	Consultant
Tim Kilgannon	PMRMA
G. Barbieri	PMRMA
Greg Mellema	Corps-Omaha Dist.

01/19/90 - 8048-239
File 371-16-8
371-11-8

MEETING NOTES
NORTH BOUNDARY SYSTEM IMPROVEMENTS
RECHARGE TRENCH PROJECT
DRAFT IMPLEMENTATION DOCUMENT
REVIEW OF COMMENTS

I. COMMENTS BY GREG MELLEMA - COE

COMMENT A:

It will be difficult to keep the trenches open during excavation, as there is a relatively high water table and most of the excavated material are sands and sandy gravels.

RESPONSE A:

Water-level monitoring in January 1990 shows the water table in the area of the proposed trenches has dropped roughly five feet since May 1989, and is still gradually dropping. This is largely the result of a deliberate reduction in use of the recharge capabilities in the vicinity of the proposed trenches. The lower water table will be of significant benefit in facilitating construction of the proposed recharge trenches. It is intended that the trenches be constructed as deep as feasible into the alluvial aquifer, but a minimum of at least three feet below the water table. If necessary to reach the minimum penetration, use of a trench box or widened trench section will be utilized. However, based on the lithology of the aquifer and experience gained from construction the existing 10 recharge trenches, we fully expect that the trenches can generally reach more than three feet below the water table, and in some areas even reach the bedrock surface. Based on the existing water table in the

01/19/90 - 8048-239
File 371-16-8
371-11-8

area, even a penetration of only three feet beneath the water table will expose large areas of permeable aquifer materials to the trenches.

COMMENT B:

The riprap placed in First Creek should include a rock filled sill on the upstream side to prevent undercutting and unraveling of the rock sill.

RESPONSE B:

MK-ES will add a detail or cross-section of the riprap to the drawing.

II. COMMENTS BY CHERYL DAVIS, INDUSTRIAL HYGIENIST - COE

COMMENT NO. 1:

VOLUME 1 - GENERAL, Section 3.0 Construction Work Plan, p. 20, 2.0 Soil Investigation. Provide more details regarding testing for contaminants (i.e., location of holes, frequency of testing, parameters and methods (organic vapors by PID or FID, combustible gases by CGI meter, etc.), action levels for determining whether soil is contaminated, etc.).

RESPONSE:

The details requested in this comment are located in the text of the Implementation Document.

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- Contaminants potentially present:
 Section 2.1.1 Organic Contaminants (H&S Plan).
 Section 2.1.2 Metal Contaminants (H&S Plan).
- Contaminants MK-ES is monitoring for:
 Section 3.4 IH Air Monitoring Protocols (H&S Plan).
- Location of holes:
 Section 3, Construction Work Plan 2.B.
- Frequency of testing:
 Section 3, Construction Work Plan 2.B.
- Parameters and methods:
 Section 3.3 Field Monitoring Instrumentation (H&S Plan).
- Action levels:
 Section 3.2 Initial Level of Protection (H&S Plan).

COMMENT NO. 2 BY CHERYL DAVIS:

Section 4.0 Estimated Cost and Basis of the Estimate, p. 27.
 The purpose of the recharge trenches is to inject treated (clean) water back into the aquifer downgradient of the slurry wall. Therefore, leaving contaminated soil in the trenches would seem to at least partially defeat the purpose of treating the water. If any contaminated soil is encountered it should be removed and replaced with clean soil.

Page 11 of the Health and Safety Plan says diversion ditches may be constructed to keep surface runoff out of the trenches. Therefore, decontamination water should not be disposed of in the

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trenches. The decon water could be disposed of in the same manner as water generated during well development activities (paragraph 9 of Spec., Section 34-0272).

RESPONSE:

Soil will be handled as contaminated in accordance with the Final Decision Document for the North Boundary System Improvements Interim Response Action at the Rocky Mountain Arsenal, April 1989.

The decontamination process in the trench area will be handled by employing a steam cleaner, which will generate a very small amount of water. No water will leave the bench area.

COMMENT NO. 3 BY CHERYL DAVIS:

p. 28. Provide additional breakdown of these costs.

RESPONSE:

Item cost estimates can be provided and viewed at the offices of MK-Environmental Services in Denver, Colorado.

COMMENT NO. 4 BY CHERYL DAVIS:

General. The plan needs to include information on the staff organization, qualifications and responsibilities. Page 46 addresses the responsibilities of the OHSO pertaining to the Emergency Management Team but there is no information provided for normal activities.

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RESPONSE:

Personnel with responsibilities for health and safety issues are detailed in the Health and Safety Plan text under Section 2.0.

COMMENT NO. 5 BY CHERYL DAVIS:

p. 1, 1.0. Clarify whether the referenced "Rocky Mountain Arsenal Health and Safety Plan" is an MK-ES document or an RMA document.

RESPONSE:

The text has been changed to identify the document as requested. The document is a MK-ES document.

COMMENT NO. 6 BY CHERYL DAVIS:

Page 38, 8.1.1. "All wash and rinse water generated will be discharged to the excavation . . ." See Comment No. 2 above.

RESPONSE:

As the response to Comment No. 2 indicates, the steam cleaner works by high pressure steam and does not produce any substantial amount of water.

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III. COMMENTS BY JIM MULLER - COE

COMMENT NO. 1:

Section E001. Please define the term "cleanout" somewhere on the drawing.

RESPONSE:

"Piping Cleanout" will be designated on the drawing.

COMMENT NO. 2:

Section E002. The typical loop diagram should be shown as detail 3 on this drawing.

RESPONSE:

The drawing will be revised.

COMMENT NO. 3:

Section E001. The new wiring shown for the flow transducers and the level transmitters require 11 pair or 22 conductors. Verify that 11 pair in the existing 18 pair cable are available for use.

RESPONSE:

The 11 pair were originally installed with the intention of using them for this work package. To date, no changes in this plan have developed.

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COMMENT NO. 4:

Section E001. I believe that lightning protection (gas tube protectors) should be provided on all new conductors to protect the electronic indicators and electronic equipment from lightning surge damage. Is lightning protection already provided flow transducers and level transmitters?

RESPONSE:

Most of the electrical system is naturally grounded by design creating minimal exposure to lightning. The designers feel the additional expense of the lightning protection is not warranted under these circumstances.

COMMENT NO. 5:

Section E001. Detail 3 shows a 1" conduit where one line on same drawing near detail arrow 3 shows 1 1/2"C. Coordinate.

RESPONSE:

The drawing will be revised.

COMMENT NO. 6:

Section E001. Junction box JB5 is shown as a Nema 4x. Specify junction box JB1, JB2, JB3, and JB4.

RESPONSE:

The drawing notes JB5 specifications are "Typical for 5."

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COMMENT NO. 7:

Section E001. Specify Nema type for terminal box TBX-2.

RESPONSE:

The drawing will be revised. Note: There is no TBX-2. We assume TBX-1 was intended subject.

IV. COMMENTS BY R. J. WAPLES - COE

COMMENT NO. 1 BY R. J. WAPLES:

Page 20, paragraph 2. Report and Specifications. Describe the procedure if organics are found in the excavation areas that violate the Health and Safety Plan.

RESPONSE:

See Response II-1. Personnel protection levels and decontamination procedures will change accordingly.

COMMENT NO. 2 BY R. J. WAPLES:

Page 20, paragraph 3. The drawings and other sections state that the top 3-4 feet of existing soil shall be removed and stockpiled.

RESPONSE:

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Document will be changed to read 3-4 feet.

COMMENT NO. 3 BY R. J. WAPLES:

Page 27, paragraph 2. Verify the statement that the decontamination water cannot leave the bench area. It would appear that if decontamination water is of any significance then it should be discharged on the other side of the slurry wall for treatment before discharge.

RESPONSE:

See Response II-2a and b. Minimal water will be generated during the decontamination operation.

COMMENT NO. 4 BY R. J. WAPLES:

34-0203, paragraph 5. Specify the minimum bury depth for the treated water force main.

RESPONSE:

The documents will be revised.

COMMENT NO. 5 BY R. J. WAPLES:

34-0203, paragraph 9D. The specifications state that groundwater shall not be removed except for water attached to the in-place soils. If dewatering is required for the trench installation, then the groundwater disposal method and possible treatment will need to be addressed. Clarify in the general part of this report on the excavation procedure. Clarify if sheet piles shall be

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required to prevent the sands and gravels from washing into the trench excavation.

RESPONSE:

No dewatering will be performed. The RMA has reduced recharge in this area, thus allowing the water table to drop to minimize the water encountered. No sheet piles will be used, however, a trench box may have to be used. Similar work was performed in this area in early 1989 with minimal problem.

COMMENT NO. 6 BY R. J. WAPLES:

35-1501, paragraph 6E. Verify that 6-8 inches of backfill will be adequate to cover over the pipe to prevent any movement during high-pressure testing. Additional backfill between joints could prevent the movement of the pipe.

RESPONSE:

The procedure has been used previously with success.

COMMENT NO. 7 BY R. J. WAPLES:

35-1501, paragraph 6F. Specify the test pressure for the hydrostatic test of the pipe.

RESPONSE:

The specification will be revised.

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COMMENT NO. 8 BY R. J. WAPLES:

Drawing C-006. The Section A detail indicates that the work bench width may not be adequate for safely stockpiling the contaminated soil in the deep cut areas.

RESPONSE:

Previous experience tells us that the width is adequate. The Construction Manager will maintain necessary width.

COMMENT NO. 9 BY R. J. WAPLES:

Drawing P-001. The Corps of Engineers do not typically allow the use of flanges on buried fittings.

RESPONSE:

The designer has more confidence in the flange connections versus the socket weld and union connection.

V. COMMENTS BY DOUG PENDRELL - COE

COMMENT NO. 1 BY DOUG PENDRELL:

Past construction activities along the North Boundary have experienced some problems due to cemented zones in the overburden. Shell Oil should be made aware of this because it could impact trench excavation if encountered. Recommend reviewing the North Boundary Construction Foundation Report (March 1984) that was prepared by the Omaha District.

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RESPONSE:

The cemented zones are expected to be deeper than planned excavations.

VI. COMMENTS BY DAVID STRANG - RMA-PMO

COMMENT NO. 1 BY DAVID STRANG:

Review of the recharge trench package does not include the Program Manager's (PM) recommendation to provide remote water level instruments in the existing ten recharge trenches like the ones to be installed in the five new recharge trench systems. The Shell response to PM Technical Operations Division comments states that a total of four remote water level instruments would be added to the ten existing recharge trenches. The PM would like to discuss the decision regarding the rationale for the addition of only four remote water level instruments for the existing ten recharge trenches.

RESPONSE:

The four additional level indicators to be installed for the existing 10 recharge trenches will be addressed in the Final Implementation Document. The decision to use only 4 level indicators for the existing 10 recharge trenches is based on two reasons:

One, there are only 4 spare pairs of wires in Manhole No. 8. Running additional wires would be cost prohibitive.

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Two, the hydrologists feel that 4 well placed level indicators will be adequate to measure water table trends in the area.

VII. COMMENTS BY OM PATNET, COE

COMMENT NO. 1 BY OM PATNET:

Drawings 35-001 and 35-002. Furnish notes on these drawings indicating the design loads used for this project.

COMMENT NO. 2 BY OM PATNET:

Please provide the design computations to check these drawings. Without them a complete check cannot be made.

RESPONSES 1 AND 2:

A complete set of design data will be submitted when the design is finalized in the Final Implementation Document.

COMMENT NO. 3 BY OM PATNET:

Specification 34.0203. Specify all references of ASTM with applicable publications number/year for excavating and backfilling.

COMMENT NO. 4 BY OM PATNET:

Specification 34-0301. For cast-in-place concrete furnish the applicable publications number/year of ACI, ASTM, AISI, and any other references used for this specification.

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RESPONSES 3 AND 4:

The designer feels the references are adequate.

VIII. COMMENTS BY WATERWAYS EXPERIMENT STATION

COMMENT NO. 1 BY W.E.S.:

Field measurements by W.E.S. in December 1989, after bog recharging was discontinued, indicate that water levels are remaining relatively high where the new trenches are to be placed. Accordingly the overall impression that the trenches will penetrate the aquifer to full depth may be misleading.

RESPONSE NO. 1:

Refer to response I-A.

COMMENT NO. 2 BY W.E.S.:

It will be difficult to excavate the trenches to the depths shown on the plans unless some method is used to keep the saturated sand and gravel from caving into the trench. The percentage of saturated sand and gravel is much greater on this series of trenches than on the series of trenches installed earlier. Also the water table shown on trench and plan profile sheet 3 of 3 is probably low. The water table in this area fluctuates according to the flow in First Creek. If First Creek is high, trenches 14 and 15 will have a higher water table than is shown in the plans. The plans to handle caving sand and gravel below the water table are not included.

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RESPONSE NO. 2:

Refer to response I-A.

IX. COMMENTS BY THE STATE OF COLORADO

STATE OF COLORADO COMMENT NO. 1:

Volume I, Page 1, paragraph 2 - This paragraph references a meeting of the Parties held on September 7, 1989, in which the Preliminary Engineering Design Package was discussed. Apparently, the Parties' comments were reviewed, discussed and resolved. Please provide the State with a summary of these discussions and the corresponding resolutions which were made.

RESPONSE TO COMMENT 1:

Resolutions and decisions made at the Internal Army meeting held on 7 September 1989 are reflected in the Implementation Document. As a matter of general policy as well as litigation policy, the Army will not provide information regarding internal discussions to the State.

STATE OF COLOPADO COMMENT NO. 2:

Volume I, Page 2, paragraph 3 - the document specifies that piezometers will be installed inside and outside of each newly installed trench. The State submitted comments, dated May 17, 1988, on the Proposed Decision Document for the IRA for the NBS at RMA via construction of Ground Water Recharge Trenches. In the State's Specific Comment #2 on that document, the State

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requested that new or existing Denver formation wells also be monitored to determine the vertical gradient and impact of the recharge trenches on the Denver units. The State makes this same request at this time.

RESPONSE TO COMMENT NO. 2:

The comment references are not for the Proposed Decision Document prepared for this IRA. However, the comment noted monitoring wells in the unconfined and confined aquifers, including the Denver Formation, are monitored to evaluate the vertical gradient and impact of the recharge trench operations on these aquifers.

STATE OF COLORADO COMMENT NO. 3:

Volume I, Page 16, paragraph (p.) - The document specifies that certain wells found during construction will be closed under the Abandoned Wells IRA. The State submitted comments, dated December 5, 1989, on the Draft Final Report RMA Abandoned Well Closure IRA. In the State's Comment #1 and Comment #8 on that document, the State requested that a subcommittee meeting be held to discuss the closure efforts which have been made and will be made regarding wells in and around the NBS. Please review these previously submitted comments. The State requests that a subcommittee meeting be held to discuss these issues.

RESPONSE TO COMMENT NO. 3:

Comments 1 and 8 will be answered in the Final Report on the Rocky Mountain Abandoned Well Closure IRA.

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STATE OF COLORADO COMMENT NO. 4:

Volume I, Page 16, paragraph (q.) - The document specifies that a full evaluation of the existing dewatering system of the soil-bentonite barrier will be made. Have the specifics of the planned evaluation been drafted or finalized? Please keep the State informed on this matter.

RESPONSE NO. 4:

A formal plan will not be prepared to evaluate the existing dewatering system. MK-ES has reviewed the flow records and water table data for the area. The existing dewatering manifolds will be adequate to handle the current water flows. As site conditions change, the day to day operation of the updated facility will determine if future changes are needed in the dewatering system.

STATE OF COLORADO COMMENT NO. 5:

General State Comment on Recharge Trench Installation - The State believes that the proposed recharge trenches constitute waste injection facilities and thereby come under the jurisdiction of Federal U.I.C. regulations. Therefore, the U.I.C. regulations appear to be applicable or relevant and appropriate. Please re-evaluate these regulations and supply the organizations with the Army's interpretation on the applicability of these regulations.

RESPONSE TO COMMENT NO. 5:

It remains the army's policy that UIC regulations are not applicable or appropriate and relevant to the recharge trenches.

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UIC regulations, by definition, are applicable to injection wells, not recharge trenches. Even if the UIC regulations, in general, were applicable to recharge trenches, 40 C.F.R. 144.13(c) exempts from UIC regulations wells used to inject treated groundwater into the same formation from which it was drawn pursuant to CERCLA.

STATE OF COLORADO COMMENT NO. 6:

General State Comment on NBS Improvements IRA - The State submitted comments, dated November 3, 1989, on the Preliminary Engineering Design Package for NBS Improvements IRA. In the State's General comment #5 the State suggested that the Army develop and issue a proposed NBS comprehensive monitoring program which would then be reviewed, discussed and finalized by the organizations. Please review this previously submitted comment. The State again makes the request that a comprehensive monitoring program be developed for the NBS.

The State suggests that the NBS comprehensive monitoring program include provisions to monitor the "long-term" performance, permeability and deterioration of the recharge trenches. This monitoring program should also include an evaluation of the dewatering and recharge rates, and flow system response changes caused by temporal variations. The State believes that the U.S. Army Corps of Engineers made similar recommendations in the Corps' August 1989 Final Report on the Start-Up Performance of Groundwater Recharge Trenches at Rocky Mountain Arsenal.

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RESPONSE TO COMMENT NO. 6:

As previously communicated, we are preparing a draft Operational Monitoring Program plan for the North Boundary Containment/Treatment System (NBCS). This draft is expected to be completed during the second quarter of fiscal year 1990. As CDH requested, the plan will address assessment of the long-term performance of the NBCS, to include recharge trenches operation and the dewatering and recharge subsystems. (Note that we have addressed these topics in the annual assessment reports in the past.)

Questions may be addressed to Tom Brooks, extension 296.

X. Clarification to U.S. EPA Comment No. 7 on the Preliminary Engineering Design Package for the North Boundary System Improvements IRA:

All PVC pipe which isn't usable will be cut up, tested for cleanliness and placed into a sanitary landfill offpost. The previous response was incorrect by stating unusable PVC pipe, once tested for cleanliness, would be disposed of in the sanitary landfill on post.

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