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# PROGRAM MANAGER FOR ROCKY MOUNTAIN ARSENAL

U.S. ARMY  
MATERIEL COMMAND

— COMMITTED TO PROTECTION OF THE ENVIRONMENT —

FINAL REPORT  
Feasibility Study  
Soil Volume Refinement Program  
Version 2.0  
Appendices C, D, and E  
*PART 3.*

JUNE 1994  
CONTRACT NO. DAAA05-92-D-0002  
Task #92.14

*A-1*

~~96 1 29 512~~

## EBASCO SERVICES INCORPORATED

James M. Montgomery  
International Dismantling & Machinery  
Greystone Environmental  
Hazen Research  
DataChem BC Analytical

96-00479



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FOR ROCKY MOUNTAIN ARSENAL  
AMXRM-PM COMMERCE CITY, CO 80022

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TECHNICAL SUPPORT FOR  
ENVIRONMENTAL CLEANUP PROGRAMS  
AT ROCKY MOUNTAIN ARSENAL

FINAL REPORT  
Feasibility Study  
Soil Volume Refinement Program  
Version 2.0  
Appendices C, D, and E  
PART 3.

JUNE 1994  
CONTRACT NO. DAAA05-92-D-0002  
Task #92.14

Prepared by:

EBASCO SERVICES INCORPORATED

Prepared for:

Program Manager's Office  
Rocky Mountain Arsenal

THE INFORMATION AND CONCLUSIONS PRESENTED IN THIS REPORT REPRESENT THE OFFICIAL POSITION OF THE DEPARTMENT OF THE ARMY UNLESS EXPRESSLY MODIFIED BY A SUBSEQUENT DOCUMENT. THIS REPORT CONSTITUTES THE RELEVANT PORTION OF THE ADMINISTRATIVE RECORD FOR THIS CERCLA OPERABLE UNIT.

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| REPORT DOCUMENTATION PAGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                             |                                                             | Form Approved<br>OMB No. 0704-0188 |  |
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| 13. ABSTRACT (Maximum 200 words)<br><br>THIS REPORT PRESENTS THE FINDINGS OF THE FEASIBILITY STUDY (FS) SOIL VOLUME REFINEMENT PROGRAM (SVRP). THE SVRP COLLECTED AND ANALYZED SHALLOW SOIL DATA AT RMA FOR USE IN REFINING CONTAMINATED SOIL VOLUME ESTIMATES GENERATED IN THE FS. SAMPLING WAS CONFINED TO THE UPPER 10 FEET OF SOILS, OR TO THE WATER TABLE, WHICHEVER CAME FIRST. SAMPLING DID NOT EXTEND BELOW THE WATER TABLE. THE FOLLOWING APPENDICES ARE CONTAINED IN TWO SEPARATE VOLUMES; APPENDIX A- (DISKETTE), APPENDIX B- BOREHOLE LOGS. APPENDIX C- AUDIT REPORT, APPENDIX D- GEOPHYSICAL CLEARANCE PROGRAM, AND APPENDIX E- STATISTICAL ANALYSIS OF SOIL VERSUS RINSE BLANK DATA.                         |                                             |                                                             |                                    |  |
| 14. SUBJECT TERMS<br><br>ARMY AGENTS, SAMPLING                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                             | 15. NUMBER OF PAGES                                         |                                    |  |
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**APPENDIX C**

# **FEASIBILITY STUDY VOLUME REFINEMENT PROGRAM QUALITY ASSURANCE AUDIT REPORT**

## **INTRODUCTION**

The first Audit for the Feasibility Study Volume Refinement Program (VRP) was performed on March 1 through March 3, 1993 at RMA. The following discussion is on the results of the audit and includes the reported Findings and Observations.

## **PURPOSE**

The purpose of the VRP Quality Assurance (QA) Audit was to provide Ebasco Services Incorporated (EBASCO) management with factual, documented, and objective information upon which they can make decisions concerning the adequacy and effectiveness of the procedures and work activities.

## **SCOPE**

The scope of the VRP QA Audit was to evaluate field activities and operations, such as preparation, set-up, drilling, sampling, sample handling, and documentation occurring at the time of the audit.

## **OBJECTIVES**

The objectives for the VRP QA Audit are as follows:

- Document activities and operations being performed
- Determine compliance or noncompliance with procedures
- Evaluate and assess the adequacy and effectiveness of the procedures
- Determine needs for improvement
- Obtain sufficient evidence to draw conclusions relevant to the objectives

**DETAILS OF AUDIT PLAN**  
**AUDIT PERSONNEL**

The Audit was performed by the following EBASCO personnel:

|                    |              |
|--------------------|--------------|
| Anthony D. Palizzi | Lead Auditor |
| George S. Ballard  | Auditor      |
| Deborah D. Wilson  | Auditor      |

**AUDIT DATES**

The Audit was performed on the following dates:

|                           |                                          |
|---------------------------|------------------------------------------|
| Friday February 26, 1993: | Pre-Audit Briefing                       |
| Monday March 1, 1993 and  |                                          |
| Tuesday March 2, 1993:    | Preparation                              |
|                           | Set-up                                   |
|                           | Drilling, Soil Sampling, Sample Handling |
|                           | Evaluation of findings                   |
| Wednesday March 3, 1993:  | Documentation                            |
| Friday March 13, 1993:    | Post-Audit Briefing                      |

**PROCEDURES**

The following procedures were used to perform the Audit:

- Quality Assurance Management Plan (Final)\*
- VRP Quality Assurance Project Plan (Draft Final)\*
- PMRMA Chemical Quality Assurance Plan:
  - Supplement No. 93-1 (Draft), Packing of Environmental Samples\*
- VRP Work Plan (Draft Final):
  - Technical Plan\*
  - Waste Management Plan\*
  - Data Management Plan\*
- Standard Operating Procedures:
  - NO. 2, Soil Sampling Using Continuous Core Hollow-stem Augers
  - NO. 6, Waste Management\*

**\*NOTE:** Only certain sections of this procedure were evaluated. The evaluation was based on the work being performed at the time of the Audit.

## FINDINGS AND OBSERVATIONS

A list of findings and observations plus Nonconformance Reports (NCR) and Corrective Action (CA) Requests are included in Attachment I.

### DEFINITIONS

**Finding:** A documented result of an audit identifying a nonconformance supported by sufficient evidence to facilitate corrective action taken by the audited organization.

**Observation:** An event examined, or item detected, which does not fall into the category of a nonconformance of finding, but warrants comment.

**Corrective Action:** Measures taken to remedy conditions adverse to quality and preclude repetition.

### FINDINGS:

A total of 27 Findings were documented.

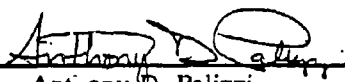
### OBSERVATIONS:

A total of 4 Observations were documented.

## RECOMMENDATION FOR IMPROVEMENTS

Correct and complete to Procedures to accurately reflect current work activities.

### AUTHORIZATIONS

  
Anthony D. Palizzi

  
George S. Ballard

  
Deborah D. Wilson

**ATTACHMENT I**

**NONCONFORMANCES, FINDINGS, OBSERVATIONS,  
AND CORRECTIVE ACTIONS**



## FINDINGS AND OBSERVATIONS

### DEFINITIONS:

**FINDING:** A documented result of an audit which identifies a nonconformance supported by sufficient evidence to facilitate corrective action taken by the audited organization.

**OBSERVATION:** An event examined, or item detected, which does not fall into the category of a nonconformance or finding, but warrants comment.

**CORRECTIVE ACTION:** Measures taken to remedy conditions adverse to quality and preclude repetition.

**STANDARD OPERATING PROCEDURE (SOP) NO. 2, SOIL SAMPLING USING CONTINUOUS CORE HOLLOW-STEM AUGERS**

**STANDARD OPERATING PROCEDURE (SOP) NO.5, GEOPHYSICAL CLEARANCE OF BOREHOLE AND SURFICIAL SOIL SAMPLING LOCATIONS**

**DRAFT FINAL TECHNICAL PLAN FOR FEASIBILITY STUDY VOLUME REFINEMENT PROGRAM Version 3.0**

**DRAFT FINAL QUALITY ASSURANCE PROJECT PLAN FOR FEASIBILITY STUDY VOLUME REFINEMENT PROGRAM Version 3.0**

**DRAFT FINAL QUALITY ASSURANCE MANAGEMENT PLAN**

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### *SOP NO. 2*

### FINDINGS

**Requirement:** SOP 2, page 2, Section 3.1, EQUIPMENT... "The following is a list of borehole sampling equipment for each rig":

Standard 2-foot (ft) core barrels

**Finding:** Standard 5-ft core barrels used

FINDINGS CONTINUED

---

Requirement: SOP 2, page 3, bullet 19, Daily Summary of Activities Form

Finding: Form denotes "Shift Accomplishments"

---

Requirement: SOP 2, page 4, BORE LOG FORM: reviewed for completion and consistency.

Finding: Site type not completed on all Bore Log Forms checked  
Signature and Date was not completed (only initials) on all agent hole Bore Log Forms  
QA/QC signature not completed on all Bore Log Forms  
Color code reported as N/A on agent hole Bore Log Forms

---

Requirement: SOP 2, page 6, Section 3.2.1, DRILLING PROCEDURES... "The following information will be contained on the Bore Log Form at a minimum:..." (see list on page 6).

Finding: The following information was not on the Bore Log Form:

- Task Name
- Task Number
- Air Monitoring Measurements
- Ground Elevation
- Sample Types
- Sample Depths and time
- Drilling Observations
- Other Pertinent Information

---

Requirement: SOP 2, page 7, Section 3.1, EQUIPMENT... "The following is a list of borehole sampling equipment for each rig:

Stainless steel bowls and glass funnels

Finding: Glass funnels not used.

---

FINDINGS CONTINUED

Requirement: SOP 2, page 7, Section 3.1, EQUIPMENT... "The following is a list of borehole sampling equipment for each rig:

Sample bottles (1 liter amber wide-mouth glass containers with teflon-lined lids.

Finding: 250 milliliter bottles used.

Requirement: SOP 2, page 9, Section 3.1, EQUIPMENT... "The following is a list of borehole sampling equipment for each rig:

Core boxes

Finding: Core boxes not used.

Requirement: SOP 2, page 9, Section 3.1, EQUIPMENT... "The following is a list of borehole sampling equipment for each rig:

Coding forms (Figure 4)... Figure 4 (Coding Form) is exhibited on page 10

Finding: Did not observe any coding forms utilized, or present in the field files.

Finding: Figure is titled "Data Entry Form", and not "Coding Form".

Requirement: SOP 2, page 13, Section 3.2.2, "Detailed sample information is addressed in the Technical Plan."

Finding: SOP 2 is inadequate as the statement does not inform the user "where in the Technical Plan the sample information is found".

### FINDINGS CONTINUED

Requirement: SOP 2, page 14, Section 3.2.2, "Sampling Procedures"

"If a sample for RMA screening is required for the location, collect a total of 50 grams of material from each end of the core using a clean stainless steel putty knife and then place the material in a baggie." AND

Requirement: TECHNICAL PLAN (TP), page 3-35, Section 3.4.3,  
Item 2., "Scrape a minimum of 50 grams of soil from the entire length of the unlined sample or from the ends of the polybutyrate tube sample into a plastic ziploc bag."  
Item 3, "Complete and attach sample tag to plastic bag."

Finding: Samples were taken using different methods. One sample was taken by dumping the core into a stainless bowl, mixing the core, then scooping out the sample. Another sample was taken by scooping soil from the core at random intervals prior to placing it into a bowl.

Finding: Samples were not taken by scraping the entire length.

Finding: The Technical Plan & the SOP do not agree on the sample-taking method.

Finding: Samples were placed in a bottle, not a plastic bag.

Requirement: SOP 2, page 15, Section 3.2.2, "Previous experience... 2-ft continuous sampling runs provide the best core recovery."

Requirement: TP, page 3-34, Borehole Sampling... "Typically, the soil samples will be collected in an unlined core barrel at 2-ft intervals."

Finding: Standard 5-foot (ft) continuous sampling runs are being used.

Requirement: SOP 2, page 20, Section 6.1, FIELD NOTES: The information in the field book will include the following as a minimum: (see list on page 20):

Finding: The following information was not in the field logbooks:

Site and Sample ID numbers  
Description of samples  
Sampling method  
Drilling observations

FINDINGS CONTINUED

Requirement: SOP 2, page 16, Section 3.2.3, "The grout will be composed of Type II...in a ratio of 4.7 pounds... per 94-pound sack... maximum of 8 gallons pre-approved ground water."

Finding: No documentation, or measurements accurate enough to verify the proportions listed in this SOP were accurately followed.

Requirement: SOP 2, page 16, Section 3.2.3, "All PPE and waste generated at the bore hole will be drummed and left at the location until cleared by LSD laboratory."

Finding: PPE not left at the location.

Requirement: SOP 2, page 17, Section 4.0, "All QA/QC samples... with QA/QC identification numbers... analysis."

"Details are provided in the... QAPP."

Finding: No definition of QA/QC identification numbers can be found in this SOP, the QAMP, or the QAPP.

Finding: Statement doesn't identify where in the QAPP the details are provided.

*SOP NO. 5*

*FINDINGS*

---

Requirement: SOP 5, page 15, Section 5.3, FIELD PROCEDURES: "At a minimum, the heading for each data sheet...." (see list on page 15)

Finding: The following information was not included on the data sheet:

Site identification

Location

**TECHNICAL PLAN (TP):**

**FINDINGS**

**Requirement:** TP, page 3-46, Section 3.5.3, QA/QC Samples, "The field duplicate sample... by splitting the soil sample from the core barrel into two separate sample containers."

**Requirement:** SOP 2, page 15, Section 3.2.2, "If a duplicate... divide the sample in half lengthwise in the core barrel...sample bottle."

**Finding:** Instructions are unclear. Field duplicate samples are being taken using different methods. In one case, the entire core is placed in a bowl, mixed, and then each sample is scooped out. In the second case, the sample is scraped from the length of the core, mixed in a bowl, and a sample taken, the process is then repeated for the duplicate.

**Requirement:** TP, page 3-46, Section 3.5.3, QA/QC Samples,... "Approximately three liters of... and collected in sample containers."

**Requirement:** SOP 2, page 17, Section 4.1, Field Rinsate Samples... "Approximately three liters of... and collected in a large decontaminated stainless steel bowl."

**Finding:** Instructions are conflicting.

**Finding:** Rinsate samples are not collected in a bowl prior to taking the sample.

**Requirement:** TP, page 3-50, Section 3.6.1:  
"Position 6 contains an alpha character ... sample type."  
"These... are:" blank, D, R, T, and A.

**Finding:** Rinse blank samples were taken and recorded without the "R" designation, and RMA laboratory samples were missing the "A" designation.

**FINDINGS CONTINUED**

Requirement: TP, page 51-52, Section 3.6.4, LOGBOOKS: "The information in the field logbooks will include the following as a minimum": (see list on page 51)

Finding: The follow' - information does not match SOP 2 and was not included in the field logbook:

Sample location details

Date and Time of sample collection

Sample depth intervals



*QUALITY ASSURANCE MANAGEMENT PLAN (QAMP)*

*FINDINGS*

Requirement: QAMP, Section A-3, page 1, Subsection 2.1.1.1, "Specialized training requirements needed..."

Finding: Certain personnel working on site have not received Quality Assurance Training.

## **OBSERVATIONS**

---

**Requirement:** TP, page 3-46, Section 3.5.2, "All soil samples will be preserved by cooling to 4° C in ice chests with blue ice." Several places in the TP and the SOP indicate placing samples in ice chests with blue ice.

**Observation:** TP, page 3-35, item 5, on the list, "Cool to 4 degrees Celsius (°C)". This should be changed to include "in ice chests with blue ice." as stated above to prevent potential confusion, and add consistency to the TP.

---

**Requirement:** SOP 2, page 14, bullet 3, "Seal, label, and store..."

**Observation:** This should read, "Custody seal, and sample tag..."

---

**Requirement:** SOP 2, page 4, Bore Log Form: "Sample number", "Site ID", and "Site Type"

**Observation:** Sample number should be Sample Tag Number  
Site ID and Site Type should be further defined to match what is mentioned in the Data Management Plan.

---

**Requirement:** Field Files

**Observation:** The following information was not observed in the Field Files:

Health and Safety Notes  
Geophysical Clearance Information  
Survey Information

---

## NONCONFORMANCE REPORT FORM

Page 1 of 1

NCR No.: NCRVRP001

Audit/Surveillance No.: AUDVRP001

### NONCONFORMANCE

1. Project: Feasibility Study Volume Refinement Program, Task 92-14
2. Responsible Organization/Department: Ebasco Services Incorporated (EBASCO)
3. Requirements (Document, Section No., Page, etc.):

STANDARD OPERATING PROCEDURE (SOP) NO. 2, SOIL SAMPLING USING CONTINUOUS CORE HOLLOW-STEM AUGERS

#### 4. Nonconformance Description:

The work activities being performed are not in accordance with the procedures. Details of the Findings for NCRVRP001 are listed on Attachment I.

5. Issued By: Print Name: Anthony D. Palizzi

Signature/Date: [Signature] 5/14/93

6. QA Manager Signature/Date: \_\_\_\_\_

### MANAGEMENT RESPONSE

7. Use-As-Is: \_\_\_\_\_ Repair/Rework: \_\_\_\_\_ Revise: \_\_\_\_\_ Continue Work: \_\_\_\_\_ Stop Work: \_\_\_\_\_

8. Responsible Management Signature/Date: \_\_\_\_\_

9. Comments:

10. Corrective Action Request Needed (QA Manager): Yes: \_\_\_\_\_ No: \_\_\_\_\_

11. QA Manager Signature/Date: \_\_\_\_\_

12. Corrective Action Request Needed (Management): Yes: \_\_\_\_\_ No: \_\_\_\_\_

13. Responsible Management Signature/Date: \_\_\_\_\_

### DISTRIBUTION

14. QA Manager: \_\_\_\_\_ Program Manager: \_\_\_\_\_ Responsible Management/Department: \_\_\_\_\_

NOTE: All appropriate signatures/dates must be obtained prior to disposition.  
NCRVRP001

EBASCO Rev.:12/18/92

ATTACHMENT I

NCRVRP001

**STANDARD OPERATING PROCEDURE (SOP) NO. 2, SOIL SAMPLING USING  
CONTINUOUS CORE HOLLOW-STEM AUGERS**

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**SOP NO. 2**  
**FINDINGS**

---

Requirement: SOP 2, page 2, Section 3.1, EQUIPMENT... "The following is a list of borehole sampling equipment for each rig":

Standard 2-foot (ft) core barrels

Finding: Standard 5-ft core barrels used

---

Requirement: SOP 2, page 3, bullet 19, Daily Summary of Activities Form

Finding: Form denotes "Shift Accomplishments"

---

Requirement: SOP 2, page 4, BORE LOG FORM: reviewed for completion and consistency.

Finding: Site type not completed on all Bore Log Forms checked  
Signature and Date was not completed (only initials) on all agent hole Bore Log Forms  
QA/QC signature not completed on all Bore Log Forms  
Color code reported as N/A on agent hole Bore Log Forms

---

FINDINGS CONTINUED

---

Requirement: SOP 2, page 6, Section 3.2.1, DRILLING PROCEDURES... "The following information will be contained on the Bore Log Form at a minimum..." (see list on page 6).

Finding: The following information was not on the Bore Log Form:

Task Name  
Task Number  
Air Monitoring Measurements  
Ground Elevation  
Sample Types  
Sample Depths and time  
Drilling Observations  
Other Pertinent Information

---

Requirement: SOP 2, page 7, Section 3.1, EQUIPMENT... "The following is a list of borehole sampling equipment for each rig:

Stainless steel bowls and glass funnels

Finding: Glass funnels not used.

---

Requirement: SOP 2, page 7, Section 3.1, EQUIPMENT... "The following is a list of borehole sampling equipment for each rig:

Sample bottles (1 liter amber wide-mouth glass containers with teflon-lined lids.

Finding: 250 milliliter bottles used.

---

Requirement: SOP 2, page 9, Section 3.1, EQUIPMENT... "The following is a list of borehole sampling equipment for each rig:

Core boxes

Finding: Core boxes not used.

---

FINDINGS CONTINUED

---

Requirement: SOP 2, page 9, Section 3.1, EQUIPMENT... "The following is a list of borehole sampling equipment for each rig:

Coding forms (Figure 4)... Figure 4 (Coding Form) is exhibited on page 10

Finding: Did not observe any coding forms utilized, or present in the field files.

Finding: Figure is titled "Data Entry Form", and not "Coding Form".

---

Requirement: SOP 2, page 13, Section 3.2.2, "Detailed sample information is addressed in the Technical Plan."

Finding: SOP 2 is inadequate as the statement does not inform the user "where in the Technical Plan the sample information is found".

---

Requirement: SOP 2, page 14, Section 3.2.2, "Sampling Procedures"

"If a sample for RMA screening is required for the location, collect a total of 50 grams of material from each end of the core using a clean stainless steel putty knife and then place the material in a baggie." AND

Requirement: TECHNICAL PLAN (TP), page 3-35, Section 3.4.3,  
Item 2., "Scrape a minimum of 50 grams of soil from the entire length of the unlined sample or from the ends of the polybutyrate tube sample into a plastic ziploc bag."  
Item 3., "Complete and attach sample tag to plastic bag."

Finding: Samples were taken using different methods. One sample was taken by dumping the core into a stainless bowl, mixing the core, then scooping out the sample. Another sample was taken by scooping soil from the core at random intervals prior to placing it into a bowl.

Finding: Samples were not taken by scraping the entire length.

Finding: The Technical Plan & the SOP do not agree on the sample-taking method.

Finding: Samples were placed in a bottle, not a plastic bag.

---

FINDINGS CONTINUED

---

Requirement: SOP 2, page 15, Section 3.2.2, "Previous experience... 2-ft continuous sampling runs provide the best core recovery."

Requirement: TP, page 3-34, Borehole Sampling... "Typically, the soil samples will be collected in an unlined core barrel at 2-ft intervals."

Finding: Standard 5-foot (ft) continuous sampling runs are being used.

---

Requirement: SOP 2, page 20, Section 6.1, FIELD NOTES: The information in the field book will include the following as a minimum: (see list on page 20).

Finding: The following information was not in the field logbooks:

- Site and Sample ID numbers
- Description of samples
- Sampling method
- Drilling observations

---

Requirement: SOP 2, page 16, Section 3.2.3, "The grout will be composed of Type II...in a ratio of 4.7 pounds... per 94-pound sack... maximum of 8 gallons pre-approved ground water."

Finding: No documentation, or measurements accurate enough to verify the proportions listed in this SOP were accurately followed.

---

Requirement: SOP 2, page 16, Section 3.2.3, "All PPE and waste generated at the bore hole will be drummed and left at the location until cleared by LSD laboratory."

Finding: PPE not left at the location.

---

FINDINGS CONTINUED

---

Requirement: SOP 2, page 17, Section 4.0, "All QA/QC samples... with QA/QC identification numbers... analysis."

"Details are provided in the... QAPP."

Finding: No definition of QA/QC identification numbers can be found in this SOP, the QAMP, or the QAPP.

Finding: Statement doesn't identify where in the QAPP the details are provided.

---



# NONCONFORMANCE REPORT FORM

Page 1 of 1

NCR No.: NCRVRP002

Audit/Surveillance No.: AUDVRP001

## NONCONFORMANCE

1. Project: Feasibility Study Volume Refinement Program, Task 92-14
2. Responsible Organization/Department: Ebasco Services Incorporated (EBASCO)
3. Requirements (Document, Section No., Page, etc.):

STANDARD OPERATING PROCEDURE (SOP) NO.5, GEOPHYSICAL CLEARANCE OF BOREHOLE AND SURFICIAL SOIL SAMPLING LOCATIONS

### 4. Nonconformance Description:

The work activities being performed are not in accordance with the procedures. Details of the Findings for NCRVRP002 are listed on Attachment I.

5. Issued By: Print Name: Anthony D. Palizzi

Signature/Date: [Signature] 3/16/93

6. QA Manager Signature/Date: \_\_\_\_\_

## MANAGEMENT RESPONSE

7. Use-As-Is: \_\_\_\_\_ Repair/Rework: \_\_\_\_\_ Revise: \_\_\_\_\_ Continue Work: \_\_\_\_\_ Stop Work: \_\_\_\_\_

8. Responsible Management Signature/Date: \_\_\_\_\_

9. Comments: \_\_\_\_\_

10. Corrective Action Request Needed (QA Manager): Yes: \_\_\_\_\_ No: \_\_\_\_\_

11. QA Manager Signature/Date: \_\_\_\_\_

12. Corrective Action Request Needed (Management): Yes: \_\_\_\_\_ No: \_\_\_\_\_

13. Responsible Management Signature/Date: \_\_\_\_\_

## DISTRIBUTION

14. QA Manager: \_\_\_\_\_ Program Manager: \_\_\_\_\_ Responsible Management/Department: \_\_\_\_\_

NOTE: All appropriate signatures/dates must be obtained prior to disposition.  
NCRVRP0012

EBASCO Rev.:12/18/92

ATTACHMENT I

NCRVRP002

DRAFT FINAL TECHNICAL PLAN FOR FEASIBILITY STUDY VOLUME  
REFINEMENT PROGRAM Version 3.0

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*SOP NO. 5*  
*FINDINGS*

---

Requirement: SOP 5, page 15, Section 5.3, FIELD PROCEDURES: "At a minimum, the heading for each data sheet...." (see list on page 15)

Finding: The following information was not included on the data sheet:

Site identification  
Location

---

FINDINGS CONTINUED

---

Requirement: TP, page 51-52, Section 3.6.4, LOGBOOKS: "The information in the field logbooks will include the following as a minimum": (see list on page 51)

Finding: The following information does not match SOP 2 and was not included in the field logbook:

Sample location details

Date and Time of sample collection

Sample depth intervals

---

## NONCONFORMANCE REPORT FORM

Page 1 of 1  
NCR No.: NCRVRP003  
Audit/Surveillance No.: AUDVRP001

### NONCONFORMANCE

1. Project: Feasibility Study Volume Refinement Program, Task 92-14
2. Responsible Organization/Department: Ebasco Services Incorporated (EBASCO)
3. Requirements (Document, Section No., Page, etc.):

DRAFT FINAL TECHNICAL PLAN FOR FEASIBILITY STUDY VOLUME REFINEMENT PROGRAM Version 3.0

#### 4. Nonconformance Description:

The work activities being performed are not in accordance with the procedures. Details of the Findings for NCRVRP003 are listed on Attachment I.

5. Issued By: Print Name: Anthony D. Palizzi

Signature/Date: [Signature] 7/18/93

6. QA Manager Signature/Date: \_\_\_\_\_

### MANAGEMENT RESPONSE

7. Use-As-Is: \_\_\_\_\_ Repair/Rework: \_\_\_\_\_ Revise: \_\_\_\_\_ Continue Work: \_\_\_\_\_ Stop Work: \_\_\_\_\_

8. Responsible Management Signature/Date: \_\_\_\_\_

9. Comments:

10. Corrective Action Request Needed (QA Manager): Yes: \_\_\_\_\_ No: \_\_\_\_\_

11. QA Manager Signature/Date: \_\_\_\_\_

12. Corrective Action Request Needed (Management): Yes: \_\_\_\_\_ No: \_\_\_\_\_

13. Responsible Management Signature/Date: \_\_\_\_\_

### DISTRIBUTION

14. QA Manager: \_\_\_\_\_ Program Manager: \_\_\_\_\_ Responsible Management/Department: \_\_\_\_\_

NOTE: All appropriate signatures/dates must be obtained prior to disposition.  
NCRVRP0043

EBASCO Rev.:12/18/92

ATTACHMENT I

NCRVRP003

**DRAFT FINAL TECHNICAL PLAN FOR FEASIBILITY STUDY VOLUME  
REFINEMENT PROGRAM Version 3.0**

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**TECHNICAL PLAN  
FINDINGS**

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Requirement: TP, page 3-46, Section 3.5.3, QA/QC Samples, "The field duplicate sample... by splitting the soil sample from the core barrel into two separate sample containers."

Requirement: SOP 2, page 15, Section 3.2.2, "If a duplicate... divide the sample in half lengthwise in the core barrel...sample bottle."

Finding: Instructions are unclear. Field duplicate samples are being taken using different methods. In one case, the entire core is placed in a bowl, mixed, and then each sample is scooped out. In the second case, the sample is scraped from the length of the core, mixed in a bowl, and a sample taken, the process is then repeated for the duplicate.

---

Requirement: TP, page 3-46, Section 3.5.3, QA/QC Samples,... "Approximately three liters of... and collected in sample containers."

Requirement: SOP 2, page 17, Section 4.1, Field Rinsate Samples... "Approximately three liters of... and collected in a large decontaminated stainless steel bowl."

Finding: Instructions are conflicting.

Finding: Rinsate samples are not collected in a bowl prior to taking the sample.

---

Requirement: TP, page 3-50, Section 3.6.1:  
"Position 6 contains an alpha character ... sample type."  
"These... are:" blank, D, R, T, and A.

Finding: Rinse blank samples were taken and recorded without the "R" designation, and RMA laboratory samples were missing the "A" designation.

---

FINDINGS CONTINUED

---

Requirement: TP, page 51-52, Section 3.6.4, LOGBOOKS: "The information in the field logbooks will include the following as a minimum": (see list on page 51)

Finding: The following information does not match SOP 2 and was not included in the field logbook:

Sample location details  
Date and Time of sample collection  
Sample depth intervals

---

ATTACHMENT I

NCRVRP004

DRAFT FINAL QUALITY ASSURANCE PROJECT PLAN FOR FEASIBILITY  
STUDY VOLUME REFINEMENT PROGRAM Version 3.0

DRAFT FINAL QUALITY ASSURANCE MANAGEMENT PLAN

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QAMP  
FINDINGS

---

Requirement: QAMP, Section A-3, page 1, Subsection 2.1.1.1, "Specialized training requirements needed..."

Finding: Certain personnel working on site have not received Quality Assurance Training:

---

## **FEASIBILITY STUDY VOLUME REFINEMENT PROGRAM QUALITY ASSURANCE AUDIT REPORT**

### **INTRODUCTION**

The second Audit for the Feasibility Study Volume Refinement Program (VRP) was performed on May 26 through May 28, 1993 at RMA. The following discussion is on the results of the audit and includes the reported Findings and Observations.

### **PURPOSE**

The purpose of the VRP Quality Assurance (QA) Audit was to provide Ebasco Services Incorporated (EBASCO) management with factual, documented, and objective information upon which they can make decisions concerning the adequacy and effectiveness of the procedures and work activities.

### **SCOPE**

The scope of the VRP QA Audit was to evaluate field activities and operations, such as preparation, set-up, drilling, sampling, sample handling, and documentation occurring at the time of the audit.

### **OBJECTIVES**

The objectives for the VRP QA Audit are as follows:

- Document activities and operations being performed
- Determine compliance or noncompliance with procedures
- Evaluate and assess the adequacy and effectiveness of the procedures
- Determine needs for improvement
- Obtain sufficient evidence to draw conclusions relevant to the objectives



## **DETAILS OF AUDIT PLAN**

### **AUDIT PERSONNEL**

The Audit was performed by the following EBASCO personnel:

Anthony D. Palizzi    Lead Auditor  
George S. Ballard    Auditor

### **AUDIT DATES**

The Audit was performed on the following dates:

Wednesday May 26, 1993 through May 28, 1993

### **PROCEDURES**

The following procedures were used to perform the Audit:

Quality Assurance Management Plan (Final)\*  
VRP Quality Assurance Project Plan (Draft Final)\*  
PMRMA Chemical Quality Assurance Plan:  
    Supplement No. 93-1 (Draft), Packing of Environmental Samples\*  
VRP Work Plan (Draft Final):  
    Technical Plan\*  
    Data Management Plan\*  
    Standard Operating Procedures:  
        NO. 1, Topographic Surveying  
        NO. 2, Soil Sampling Using Continuous Core Hollow-Stem Augers  
        NO. 3, Surficial Soil Sampling

\*NOTE:    Only certain sections of this procedure were evaluated. The evaluation was based on the work being performed at the time of the Audit.

### **FINDINGS AND OBSERVATIONS**

A list of findings and observations plus Nonconformance Reports (NCR) and Corrective Action (CA) Requests are included in Attachment I.

## DEFINITIONS

**Finding:** A documented result of an audit identifying a nonconformance supported by sufficient evidence to facilitate corrective action taken by the audited organization.

**Observation:** An event examined, or item detected, which does not fall into the category of a nonconformance of finding, but warrants comment.

**Corrective Action:** Measures taken to remedy conditions adverse to quality and preclude repetition.

## FINDINGS:

A total of 7 Findings were documented.

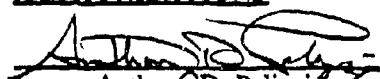
## OBSERVATIONS:

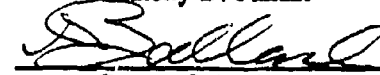
None.

## RECOMMENDATION FOR IMPROVEMENTS

Administer appropriate corrective action to Findings.

## AUTHORIZATIONS

  
Anthony D. Palizzi

  
George S. Ballard

ADP/adp

**ATTACHMENT I**

**NONCONFORMANCES, FINDINGS, AND OBSERVATIONS,**

## FINDINGS AND OBSERVATIONS

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**AS REQUIRED BY THE QUALITY ASSURANCE MANAGEMENT PLAN (QAMP), A FOLLOW-UP ON CORRECTIVE MEASURES TAKEN TO REMEDY NONCONFORMANCES NOTED ON THE PREVIOUS AUDIT HAS RESULTED IN THE FOLLOWING NONCONFORMANCES:**

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**Requirement:** QAMP, Section A-3, paragraph 1.0, first sentence... "All levels of ... management are responsible to ensure EBASCO and subcontractor personnel are trained...", and QAPP, Section A-3, paragraph 1.1, "All training... to the requirements of the QAMP and QAPP."

**Finding:** Several personnel working on the project have not received the required QAMP and QAPP training. Quality Assurance has provided the names to management, and no action has been taken by management to secure the training.

---

**Requirement:** QAMP, Section B-2, paragraph 3.3.10... "Procedure changes are submitted... using the Procedure Change Request (PCR)..."

**Finding:** No evidence that all of the current proposed changes to the affected SOPs have been submitted on the PCR as required.

---

**Requirement:** QAMP, Section B-5, paragraph 3.15.1.3, steps 1.) and 2.), "Nonconforming... dispositions" (see paragraph 3.15.1.6) "are proposed and approved by responsible management....", and items 7. and 8. of the NCR instructions on the back of the NCR form. "(7.) (the disposition); "(8.) Responsible Manager Signature/ Date: \_\_\_\_\_"

**Finding:** Responsible management had not completed this portion of the NCR process by the time of the follow-up audit.

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## *FINDINGS CONTINUED*

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Requirement: QAMP, Section B-5, paragraph 3.15.1.3, steps 1.) and 2.), "Nonconforming... dispositions" (see paragraph 3.15.1.6) "are proposed and approved by responsible management and the QA Manager.", and items 10. and 11. of the NCR instructions on the back of the NCR form. "(10.) Corrective Action Request Needed (QA Manager) Yes:\_\_\_\_ No:\_\_\_\_ "(11.) QA Manager Signature and Date:\_\_\_\_\_"

Finding: QA Management had not completed this portion of the NCR process by the time of the follow-up audit.

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Requirement: QAPP, Section B-5, paragraph 1.2.2... "The QA Manager or his designee and an EBASCO chemist attends each laboratory audit..."

Finding: No evidence the QA Manager or a designee has attended any of the several laboratory audits already conducted by the EBASCO chemist.

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***FINDINGS CONTINUED***

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**QUALITY ASSURANCE PROJECT PLAN (QAPP) - VRP**

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Requirement: QAPP, Section A-9, paragraph 1.1, third sentence "These QA reports are provided at a minimum on a monthly basis."

Finding: QA Management had not provided management any reports by the time of the audit.

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Requirement: QAPP, Section B-5, paragraph 1.2.1. "For the VRP, field surveillance is conducted twice per month during field activities."

Finding: No surveillances have been conducted.

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## NONCONFORMANCE REPORT FORM

Page 1 of 1

NCR No.: NCRVRP005

Audit/Surveillance No.: AUDVRP002

### NONCONFORMANCE

1. Project: Feasibility Study Volume Refinement Program, Task 92-14
2. Responsible Organization/Department: Ebasco Services Incorporated (EBASCO)
3. Requirements (Document, Section No., Page, etc.):

FOLLOW-UP FROM PREVIOUS AUDIT, AUDVRP001.

#### 4. Nonconformance Description:

Details of the Findings for NCRVRP005 are listed on Attachment I.

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5. Issued By: Print Name: Anthony D. Palizzi

Signature/Date: [Signature] 6/17/93

6. QA Manager Signature/Date: [Signature] 7/7/93

### MANAGEMENT RESPONSE

7. Use-As-Is: \_\_\_\_\_ Repair/Rework: \_\_\_\_\_ Revise: \_\_\_\_\_ Continue Work: \_\_\_\_\_ Stop Work: \_\_\_\_\_

8. Responsible Management Signature/Date: \_\_\_\_\_

9. Comments:

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10. Corrective Action Request Needed (QA Manager): Yes: \_\_\_\_\_ No: \_\_\_\_\_

11. QA Manager Signature/Date: \_\_\_\_\_

12. Corrective Action Request Needed (Management): Yes: \_\_\_\_\_ No: \_\_\_\_\_

13. Responsible Management Signature/Date: \_\_\_\_\_

### DISTRIBUTION

14. QA Manager: \_\_\_\_\_ Program Manager: \_\_\_\_\_ Responsible Management/Department: \_\_\_\_\_

NOTE: All appropriate signatures/dates must be obtained prior to disposition.  
NCRVRP001

EBASCO Rev. 12/18/92

**TECHNICAL SUPPORT FOR ROCKY MOUNTAIN ARSENAL  
EBASCO TEAM INTERNAL CORRESPONDENCE**

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DATE: 07/07/93 REF: RMA2-92.14-GEN-M-035

TO: Jim Bush

OFFICE LOCATION: Denver

FROM: Anthony Palizzi *AP*

OFFICE LOCATION: Denver

SUBJECT: Feasibility Study Volume Refinement Program Quality Assurance Audit Report,  
Number 2

The second Audit for the Feasibility Study Volume Refinement Program (VRP) was performed on May 26 through May 28, 1993 at RMA. The following discussion is on the results of the audit and includes the reported findings and observations.

**PURPOSE**

The purpose of the VRP Quality Assurance (QA) Audit was to provide Ebasco Services Incorporated (EBASCO) management with factual, documented, and objective information upon which they can make decisions concerning the adequacy and effectiveness of the procedures and work activities.

**SCOPE**

The scope of the VRP QA Audit was to evaluate field activities and operations, such as preparation, set-up, drilling, sampling, sample handling, and documentation occurring at the time of the audit.

**OBJECTIVES**

The objectives for the VRP QA Audit are as follows:

- o Document activities and operations being performed
- o Determine compliance or noncompliance with procedures
- o Evaluate and assess the adequacy and effectiveness of the procedures
- o Determine needs for improvement
- o Obtain sufficient evidence to draw conclusions relevant to the objectives



## NONCONFORMANCE REPORT FORM

Page 1 of 1

NCR No.: NCRVRP006

Audit/Surveillance No.: AUDVRP002

### NONCONFORMANCE

1. Project: Feasibility Study Volume Refinement Program, Task 92-14
2. Responsible Organization/Department: Ebasco Services Incorporated (EBASCO)
3. Requirements (Document, Section No., Page, etc.):

### FEASIBILITY STUDY VOLUME REFINEMENT PROGRAM QUALITY ASSURANCE PROJECT PLAN

#### 4. Nonconformance Description:

Details of the Findings for NCRVRP006 are listed on Attachment I.

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5. Issued By: Print Name: Anthony D. Palizzi

Signature/Date: Anthony D. Palizzi 6/17/93

6. QA Manager Signature/Date: Anthony D. Palizzi 7/5/93

### MANAGEMENT RESPONSE

7. Use-As-Is: \_\_\_\_\_ Repair/Rework: \_\_\_\_\_ Revise: \_\_\_\_\_ Continue Work: \_\_\_\_\_ Stop Work: \_\_\_\_\_

8. Responsible Management Signature/Date: \_\_\_\_\_

9. Comments:

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10. Corrective Action Request Needed (QA Manager): Yes: \_\_\_\_\_ No: \_\_\_\_\_

11. QA Manager Signature/Date: \_\_\_\_\_

12. Corrective Action Request Needed (Management): Yes: \_\_\_\_\_ No: \_\_\_\_\_

13. Responsible Management Signature/Date: \_\_\_\_\_

### DISTRIBUTION

14. QA Manager: \_\_\_\_\_ Program Manager: \_\_\_\_\_ Responsible Management/Department: \_\_\_\_\_

NOTE: All appropriate signatures/dates must be obtained prior to disposition.  
NCRVRP001

EBASCO Rev. 12/18/92

# **FEASIBILITY STUDY VOLUME REFINEMENT PROGRAM QUALITY ASSURANCE AUDIT REPORT**

## **INTRODUCTION**

The third Audit for the Feasibility Study Volume Refinement Program (VRP) was performed on August 12, 1993. This Audit was conducted as a follow up to the first two Audits performed March 1 through March 3, 1993 and May 26 through May 28 at RMA. The following discussion describes the results of the Audit and includes one Procedure Change Request.

## **PURPOSE**

The purpose of the VRP Quality Assurance (QA) Follow-up Audit was to provide Ebasco Services Incorporated (EBASCO) management with factual, documented, and objective information concerning Nonconformance responses generated as a result of the first two Audits.

## **SCOPE**

The scope of the VRP QA Follow-up Audit was to review the results of the first two Audits and evaluate the responses to the six Nonconformance Report Forms generated to determine if appropriate corrective actions were implemented. The first two Audits evaluated field activities and operations, such as preparation, set-up, drilling, sampling, sample handling, and documentation occurring at the time of the audit.

## **OBJECTIVES**

The objectives for the VRP QA Follow-up Audit are as follows:

- \* Review Nonconformance Report Forms generated as a result of the first two Audits
- \* Review Procedure Change Requests generated in response to the Nonconformance Reports
- \* Determine if appropriate corrective actions have been implemented

## AUDIT PERSONNEL

The Audit was performed by the following EBASCO personnel:

Anthony D. Palizzi    Lead Auditor  
George S. Ballard    Auditor

## AUDIT DATE

The Follow-up Audit was performed on August 12, 1993.

## PROCEDURES

The following procedures were used to perform the Audit:

Quality Assurance Management Plan (Final)\*  
VRP Quality Assurance Project Plan (Draft Final)\*  
PMRMA Chemical Quality Assurance Plan:  
    Supplement No. 93-1 (Draft), Packing of Environmental Samples\*  
VRP Work Plan (Draft Final):  
    Technical Plan\*  
    Waste Management Plan\*  
    Data Management Plan\*  
    Standard Operating Procedures:  
        No. 2, Soil Sampling Using Continuous Core Hollow-stem Augers  
        No. 6, Waste Management\*

\*NOTE: Only certain sections of this procedure were evaluated. The evaluation was based on the work being performed at the time of the Audit.

## FINDINGS AND OBSERVATIONS

The Procedure Change Request generated is included in Attachment I.

## DEFINITIONS

Finding:        A documented result of an audit identifying a nonconformance supported by sufficient evidence to facilitate corrective action taken by the audited organization.

Observation:   An event examined, or item detected, which does not fall into the category of a nonconformance of finding, but warrants comment.

Corrective

Action: Measures taken to remedy conditions adverse to quality and preclude repetition.

RECOMMENDATION FOR IMPROVEMENTS

The Nonconformance responses have been reviewed and the appropriate corrective action implemented. The first and second QA Audits performed for the Feasibility Study Volume Refinement Program have been closed out.

## PROCEDURE CHANGE REQUEST FORM

PCR No.: 005

Page 1 of 1

Procedure No. Feasibility Study Volume Refinement Program Quality Assurance Project Plan

Procedure Change Requested: Yes

### DESCRIPTION

1. Current Description: (Include SOP No., Page(s), Paragraph No., etc.)

1. QAPP, Section B-5, paragraph 1.2.2: "The QA Manager or his designee and an EBASCO chemist...attend each laboratory audit..."
2. QAPP, Section B-5, paragraph 1.2.1: "For the VRP field surveillance is conducted twice per month during field activities."

2. Recommended Change:

1. Change to: "The QA Manager will designate an EBASCO chemist..."
2. Change to: "No field surveillance will be conducted for the VRP."

3. Initiator Signature/Date:

Anthony D. [Signature] 8/4/93

4. QA Manager Signature/Date:

Anthony D. [Signature] 8/4/93

5. Responsible Project Manager:

[Signature] 8/9/93

6. Reason For Change: NCRVRP006

### RESOLUTION

7. Is change implemented? Yes: X No:
8. If yes, attach procedure and mark Procedure Change Notice.

### APPROVAL

9. QA Manager Signature/Date:

[Signature] 8-9-93

10. Program Manager Signature/Date:

[Signature] 8-12-93

NOTE: All appropriate signatures/dates must be obtained prior to disposition.

EBASCO Rev. No.: 12/18/92

**FEASIBILITY STUDY VOLUME REFINEMENT PROGRAM**

**PROCEDURE CHANGE REQUEST FORMS**

## PROCEDURE CHANGE REQUEST FORM

PCR No.: 001

Page 1 of 5

Procedure No. SOP 2, Soil Sampling using Continuous Core Hollow Stem Augers

Procedure Change Requested: Yes

### DESCRIPTION

#### 1. Current Description: (Include SOP No., Page(s), Paragraph No., etc.)

1. SOP 2, page 2, Section 3.1, EQUIPMENT... "The following is a list of bore hole sampling equipment for each rig":
2. SOP 2, page 3, Bullet 19... "Daily Summary of Activities Form"
3. SOP 2, page 7, Bullet · Stainless steel bowls and glass funnels
4. SOP 2, page 7, Bullet · Sample bottles (1 liter amber...)
5. SOP 2, page 12, Bullet · Air monitoring measurements

#### 2. Recommended Change:

1. Add "5 Ft. Core Barrel" to the list of equipment.
2. Delete reference to form.
3. Delete "and glass funnels", and add the word (Optional) after bowls.
4. Delete "1 liter", and replace with "250 ml".
5. Delete entire bullet.

3. Initiator Signature/Date: Def. B. 7-21-93 4. QA Manager Signature/Date: Anthony Salas 7/19/93 5. Responsible/Project Manager: James A. Davis 7/21/93

6. Reason For Change: NCRVRP001

### RESOLUTION

7. Is change implemented? Yes: X No:
8. If yes, attach procedure and mark Procedure Change Notice.

### APPROVAL

9. QA Manager Signature/Date: Anthony Salas 7/21/93

10. Program Manager Signature/Date: Mark H. 7/22/93

NOTE: All appropriate signatures/dates must be obtained prior to disposition.

EBASCO Rev. No.: 12/18/92

## PROCEDURE CHANGE REQUEST FORM

PCR No.: 001

Page 2 of 5

Procedure No. SOP 2, Soil Sampling using Continuous Core Hollow Stem Augers

Procedure Change Requested: Yes

### DESCRIPTION

#### 1. Current Description: (Include SOP No., Page(s), Paragraph No., etc.)

6. SOP 2, page 13, paragraph 3.2.2, second sentence, "... is addressed in the Technical Plan."
7. SOP 2, page 15, first bullet, "Commence... coring. Previous experience... recovery."
8. SOP 2, page 15, second bullet, "If a sample for RMA screening is required, collect a total of 50 grams of material from each end of the core using a clean stainless-steel putty knife and then place the material in an approved sample bottle."

#### 2. Recommended Change:

6. Change to read "... is addressed in section 3.4.3 of the Technical Plan."
7. Add to end of sentence: "recovery ,but when better than 85% recovery is expected, a 5 foot core sample barrel may be used at the discretion of the rig geologist and field operations leader."
8. Change to the following: "If a sample for RMA screening is required, collect approximately 50 grams of material from the entire length of the unlined sample core using a clean stainless-steel putty knife, then place the material in an approved sample bottle, and in a sealable plastic bag." These methods will be the only methods used for collecting soil samples by the sampling personnel.

3. Initiator Signature/Date: Anthony D. [Signature] 7-21-93

4. QA Manager Signature/Date: Anthony D. [Signature] 7/19/93

5. Responsible Project Manager: [Signature] 7/21/93

6. Reason For Change: NCRVRP001

### RESOLUTION

7. Is change implemented? Yes: X No:
8. If yes, attach procedure and mark Procedure Change Notice.

### APPROVAL

9. QA Manager Signature/Date: Anthony D. [Signature] 7/21/93

10. Program Manager Signature/Date: Michael [Signature] 7/22/93

NOTE: All appropriate signatures/dates must be obtained prior to disposition.

EBASCO Rev. No.: 12/18/92



## PROCEDURE CHANGE REQUEST FORM

PCR No.: 001

Page 3 of 5

Procedure No. SOP 2, Soil Sampling using Continuous Core Hollow Stem Augers  
Procedure Change Requested: Yes

### DESCRIPTION

#### 1. Current Description: (Include SOP No., Page(s), Paragraph No., etc.)

9. SOP 2, page 15, sixth bullet, "Place the scraped material in a baggie, seal, label, attach sample tag, and store it in a cooler with blue ice to be sent to the LSD laboratory for clearance."
10. SOP 2, page 15, seventh bullet, "If a duplicate is required, divide the sample in half lengthwise in the core barrel to ensure a completely representative duplicate and then place each half in a separate sample bottle."

#### 2. Recommended Change:

9. Change to: "Place the scraped material in a sample bottle, attach sample tag, then place in a sealable plastic bag, and store it in a cooler with blue ice to be sent to the LSD laboratory for clearance."
10. Change to: "If a duplicate is required, scrape the entire length of the core barrel to ensure a completely representative duplicate and then place into a separate sample bottle. Repeat the procedure and place the collected material into a second sample container."

3. Initiator Signature/Date: Conf. L. Reedman 7-21-93

4. QA Manager Signature/Date: Anthony D. [Signature] 7/19/93

5. Responsible Project Manager: James A. [Signature] 7/21/93

6. Reason For Change: NCRVRP001

### RESOLUTION

7. Is change implemented? Yes: X No:       
8. If yes, attach procedure and mark Procedure Change Notice.

### APPROVAL

9. QA Manager Signature/Date: Anthony D. [Signature] 7/21/93

10. Program Manager Signature/Date: Michael [Signature] 7/22/93

NOTE: All appropriate signatures/dates must be obtained prior to disposition.

EBASCO Rev. No.: 12/18/92

## PROCEDURE CHANGE REQUEST FORM

PCR No.: 001

Page 4 of 5

Procedure No. SOP 2, Soil Sampling using Continuous Core Hollow Stem Augers

Procedure Change Requested: Yes

### DESCRIPTION

#### 1. Current Description: (Include SOP No., Page(s), Paragraph No., etc.)

11. SOP 2, page 16, second bullet, "The grout will be composed of Type II portland cement and bentonite powder in a ratio of 4.7 pounds of powder per 94-pound sack of cement mixed with a maximum of 8 gallons of pre-approved water. All materials will combined in an above-ground rigid container or mixer and either mechanically or manually blended on site to product a thick, lump-free mixture."
12. SOP 2, page 16, fourth bullet, "All PPE and waste generated at the bore hold will be drummed and left at the location until cleared by the LSD laboratory."

#### 2. Recommended Change:

11. Change to: "The grout will be composed of Type I or Type II portland cement and bentonite powder in a ratio of approximately 4.7 pounds of powder per 94-pound sack of cement mixed with approximately 5 to 8 gallons of pre-approved water. A measuring cup and 5 gallon bucket will be used in the field, and noted in the log book. All materials will combined in an above-ground rigid container or mixer and either mechanically or manually blended on site to product a thick, lump-free mixture."
12. Change to: "All PPE and waste generated at the bore hold will be drummed and left at the location until cleared by the LSD laboratory if there is an indication of a detection of Army Materials by the Minicam. Otherwise, all drums may be brought out of the field to a designated holding area."

3. Initiator Signature/Date:

*David B. Smith* 7-21-93

4. QA Manager Signature/Date:

*Anthony J. Salas* 7/19/93

5. Responsible Project Manager:

*James A. B. B. B.* 7/21/93

6. Reason For Change: NCRVRP001

### RESOLUTION

7. Is change implemented? Yes: ☒ No: ☐

8. If yes, attach procedure and mark Procedure Change Notice.

### APPROVAL

9. QA Manager Signature/Date:

*Anthony J. Salas* 7/21/93

10. Program Manager Signature/Date:

*Michael R. B. B.* 7/20/93

NOTE: All appropriate signatures/dates must be obtained prior to disposition.

EBASCO Rev. No: 12/18/92

## PROCEDURE CHANGE REQUEST FORM

PCR No.: 001

Page 5 of 5

Procedure No. SOP 2, Soil Sampling using Continuous Core Hollow Stem Augers

Procedure Change Requested: Yes

### DESCRIPTION

#### 1. Current Description: (Include SOP No., Page(s), Paragraph No., etc.)

13. SOP 2, page 17, section 4.0, second sentence: "All QA/QC samples are labeled with QA/QC identification numbers and sent..."
14. SOP 2, page 17, section 4.0, last sentence: "Details are provided..."
15. SOP 2, page 17, section 4.1, third sentence: "Approximately 3 liters of distilled water will be rinsed over a decontaminated core barrel (with the polybutyrate liner in place if appropriate) and collected in a large decontaminated stainless steel bowl."

#### 2. Recommended Change:

13. Delete "QA/QC identification" and replace with "sample tag". Should read: "... are labeled with sample tag numbers and sent..."
14. Delete sentence.
15. Change to: "Approximately 3 liters of distilled water will be poured through a decontaminated core barrel (with the polybutyrate liner in place if appropriate) and other tools used for sample collection then into sample bottle(s)."

3. Initiator Signature/Date: [Signature] 7-21-93

4. QA Manager Signature/Date: [Signature] 7/19/93

5. Responsible Project Manager: [Signature] 7/21/93

6. Reason For Change: NCRVRP001

### RESOLUTION

7. Is change implemented? Yes: X No:
8. If yes, attach procedure and mark Procedure Change Notice.

### APPROVAL

9. QA Manager Signature/Date: [Signature] 7/21/93

10. Program Manager Signature/Date: [Signature] 7/22/93

NOTE: All appropriate signatures/dates must be obtained prior to disposition.

EBASCO Rev. No.: 12/18/92

## PROCEDURE CHANGE REQUEST FORM

PCR No.: 002

Page 1 of 1

Procedure No. SOP 1, Topographic Surveying  
Procedure Change Requested: Yes

### DESCRIPTION

1. Current Description: (Include SOP No., Page(s), Paragraph No., etc.)

1. SOP 1, page 4, section 3.3, second paragraph: "The minimum relative accuracy for surveying will be 1.0 foot horizontally and 0.01 foot vertically."
2. SOP 1, page 4, section 3.4, Vertical Control, first sentence, "Elevations... shall be surveyed to within +/- 0.01 foot..."

2. Recommended Change:

1. Change "... 0.01 foot vertically" to 0.1 foot vertically.
2. Change "+/- 0.01 foot..." to +/- 0.1 foot..."

3. Initiator Signature/Date:

Dan L. M. 7/21/93

4. QA Manager Signature/Date:

Anthony D. 7/19/93

5. Responsible Project Manager:

James A. B. 7/21/93

6. Reason For Change: To reflect current operations.

### RESOLUTION

7. Is change implemented? Yes: X No:       
8. If yes, attach procedure and mark Procedure Change Notice.

### APPROVAL

9. QA Manager Signature/Date:

Anthony D. 7/21/93

10. Program Manager Signature/Date:

Michael H. 7/21/93

NOTE: All appropriate signatures/dates must be obtained prior to disposition.

EBASCO Rev. No.: 12/18/92

## PROCEDURE CHANGE REQUEST FORM

PCR No.: 003

Page 1 of 1

Procedure No. SOP 5, Geophysical Clearance of Sampling Locations

Procedure Change Requested: Yes

### DESCRIPTION

1. Current Description: (Include SOP No., Page(s), Paragraph No., etc.)

1. SOP 5, page 1, section 1.0, last paragraph, first sentence: "The... will be used to investigate..."
2. SOP 5, page 13, section 5.1, first sentence: "The... will be used to clear..."

2. Recommended Change:

1. Change to: "The... may be used according to the work plan to investigate..."
2. Change to: "The... may be used according to the work plan to clear..."

3. Initiator Signature/Date: Douglas E. Munk 7-21-93 4. QA Manager Signature/Date: Anthony DeLuca 7/19/93 5. Responsible Project Manager: James A. Burt 7/21/93

6. Reason For Change: To reflect current operations.

### RESOLUTION

7. Is change implemented? Yes: ☒ No: ☐
8. If yes, attach procedure and mark Procedure Change Notice.

### APPROVAL

9. QA Manager Signature/Date: Anthony DeLuca 7/21/93  
10. Program Manager Signature/Date: Muel Ann 7/22/93

NOTE: All appropriate signatures/dates must be obtained prior to disposition.

EBASCO Rev. No.: 12/18/92

## PROCEDURE CHANGE REQUEST FORM

PCR No.: 004

Page 1 of 2

Procedure No. VRP Technical Plan, Section 3.0 of VRP Final Work Plan, Version 3.0

Procedure Change Requested: Yes

### DESCRIPTION

1. Current Description: (Include SOP No., Page(s), Paragraph No., etc.)

1. References to Rig Shift Report, and Shift Accomplishments Form.
2. Tech Work Plan, page 3-31, section 3.4.2, first paragraph, first sentence, "After sampling locations have been staked and prior to any sampling activities, all borehole locations and surficial soil sampling sites will be geophysically cleared for sub surface hazards."
3. Tech Work Plan, page 3-31, section 3.4.2, third paragraph, second sentence, "The surficial soil...."
4. Tech Work Plan, page 3-35, third paragraph, "Typically, the soil samples will be collected in an unlined core barrel at 2-ft intervals."

2. Recommended Change:

1. Delete all mentions of both documents in the entire Technical Work Plan.
2. Delete: "and surficial soil sampling sites" from the sentence.
3. Delete the second sentence in this paragraph.
4. Change to: "Typically, the soil sample will be collected in an unlined core barrel at sampling intervals specified in the Work Plan, section 2.0, Table 2.0, and section 3, Table 3.3-3. When recovery is poor, a 2-ft core barrel will be used. When core recovery is typically better than 85%, a 5-ft core barrel may be used at the discretion of the rig geologist and the Field Operations Leader."

3. Initiator Signature/Date:

Philip B. M. 7/21/93

4. QA Manager Signature/Date:

Anthony J. R. 7/21/93

5. Responsible Project Manager:

James A. B. 7/21/93

6. Reason For Change: NCRVRP003

### RESOLUTION

7. Is change implemented? Yes: X No:
8. If yes, attach procedure and mark Procedure Change Notice.

### APPROVAL

9. QA Manager Signature/Date:

Anthony J. R. 7/21/93

10. Program Manager Signature/Date:

Michael A. 7/22/93

NOTE: All appropriate signatures/dates must be obtained prior to disposition.

EBASCO Rev. No.: 12/18/92

## PROCEDURE CHANGE REQUEST FORM

PCR No.: 004

Page 2 of 2

Procedure No. VRP Technical Plan, Section 3.0 of VRP Final Work Plan, Version 3.0

Procedure Change Requested: Yes

### DESCRIPTION

#### 1. Current Description: (Include SOP No., Page(s), Paragraph No., etc.)

5. Tech Work Plan, page 3-36, item number "2. Scrape a minimum of 50 grams of soil from the entire length of the unlined sample or from the ends of the polyoutyrate tube sample into a plastic ziploc bag."
6. Tech Work Plan, page 3-47, section 3.5.3, fifth sentence, "The field duplicate samples will be collected from bore holes by splitting the soil sample from the core barrel into two separate sample containers."
7. Tech Work Plan, page 3-51, seventh sentence, "These... and corresponding characters are:

#### 2. Recommended Change:

5. Change to: "2. Scrape approximately 50 grams of soil from the entire length of the unlined sample core into a sample bottle, complete and attach sample tag to sample bottle."
6. Change to: "The field duplicate samples will be collected from bore holes by scraping the entire length of the sample interval of the core and placing the collected material into a sample container. The procedure will than be repeated and the collected material placed into a second sample container."
7. Delete characters and references "R - Equipment Rinsate Sample" and "A - RNA laboratory sample for Army Material screening" from the list.

3. Initiator Signature/Date:

4. QA Manager Signature/Date:

5. Responsible Project Manager:

6. Reason For Change: NCRVRP003

### RESOLUTION

7. Is change implemented?

Yes: 5

No:     

8. If yes, attach procedure and mark Procedure Change Notice.

### APPROVAL

9. QA Manager Signature/Date:

10. Program Manager Signature/Date:

NGTE: All appropriate signatures/dates must be obtain prior to disposition.

EBASCO Rev. No.: 12/18/92

## PROCEDURE CHANGE REQUEST FORM

PCR No.: 005

Page 1 of 1

Procedure No. Feasibility Study Volume Refinement Program Quality Assurance Project Plan

Procedure Change Requested: Yes

### DESCRIPTION

#### 1. Current Description: (Include SOP No., Page(s), Paragraph No., etc.)

1. QAPP, Section B-5, paragraph 1.2.2: "The QA Manager or his designee and an EBASCO chemist...attend each laboratory audit..."
2. QAPP, Section B-5, paragraph 1.2.1: "For the VRP field surveillance is conducted twice per month during field activities."

#### 2. Recommended Change:

1. Change to: "The QA Manager will designate an EBASCO chemist..."
2. Change to: "No field surveillance will be conducted for the VRP."

3. Initiator Signature/Date: [Signature] 8/4/93

4. QA Manager Signature/Date: [Signature] 8/4/93

5. Responsible Project Manager: [Signature] 8/9/93

6. Reason For Change: NCRVRP006

### RESOLUTION

7. Is change implemented? Yes: X No:
8. If yes, attach procedure and mark Procedure Change Notice.

### APPROVAL

9. QA Manager Signature/Date: [Signature] 8-9-93

10. Program Manager Signature/Date: [Signature] 8-12-93

NOTE: All appropriate signatures/dates must be obtained prior to disposition.

EBASCO Rev. No.: 12/18/92



APPENDIX D

Table D-1 shows that 57 boreholes were relocated due to the possible presence of subsurface hazards. Seven drilling locations were moved because surface metal such as railroad tracks, metal fences, or pipes, was effecting the induction readings and thus possibly masking buried hazards. The other 50 boreholes were relocated because of possible buried hazards such as underground utilities, culverts, or buried debris.

In addition to EMI, GPR surveys were used to clear eight borehole locations. These boreholes were located close to cultural features such as concrete walls or pads, railroad tracks, or buildings. EMI surveys at these locations also indicated the presence of underground utilities very near the staked location. GPR was used to further delineate the location of the utilities and to ensure clearance at the drilling location. GPR surveys were conducted in these areas using either a 100 megahertz (MHz) bistatic, 300 MHz, or 500 MHz antennas. At a particular site, choice of antenna was based on its ability to penetrate to a depth of at least 10 ft. All antennas used were shielded to reduce interference from nearby buildings or power lines.

| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| A-1      | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-2      | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-3      | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-4      | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-5      | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-6      | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-7      | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-8      | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-9      | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-10     | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-11     | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-12     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-17     | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-18     | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-19     | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-20     | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-21     | yes                                              | yes      | no  | yes                  |                             |          |
| A-22     | yes                                              | yes      | no  | yes                  |                             |          |

BD Geophysical data indicates buried debris near staked location.

CS Conductive soils.

DR Location moved to facilitate drill rig.

GPR Ground penetrating radar

SM The presence of surface metal is effecting geophysical data.

UGU Geophysical data indicates possible presence of underground utilities near staked location

| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| A-23     | yes                                              | yes      | no  | yes                  |                             |          |
| A-24     | yes                                              | yes      | no  | yes                  |                             |          |
| A-25     | yes                                              | yes      | no  | yes                  |                             |          |
| A-26     | yes                                              | yes      | no  | yes                  |                             |          |
| A-27     | yes                                              | yes      | no  | yes                  |                             |          |
| A-28     | yes                                              | yes      | no  | yes                  |                             |          |
| A-29     | yes                                              | yes      | no  | yes                  |                             |          |
| A-30     | yes                                              | yes      | no  | yes                  |                             |          |
| A-31     | yes                                              | yes      | no  | yes                  |                             |          |
| A-32     | yes                                              | yes      | no  | yes                  |                             |          |
| A-33     | yes                                              | yes      | no  | yes                  |                             |          |
| A-34     | yes                                              | yes      | no  | yes                  |                             |          |
| A-35     | yes                                              | yes      | no  | no                   | 1 meter<br>north            | UGU      |
| A-36     | yes                                              | yes      | no  | no                   | 2 meters<br>north           | UGU      |
| A-37     | yes                                              | yes      | no  | yes                  |                             |          |
| A-38     | yes                                              | yes      | no  | yes                  |                             |          |
| A-39     | yes                                              | yes      | no  | yes                  |                             |          |

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UGU Geophysical data indicates possible presence of underground utilities near staked location

| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| A-40     | yes                                              | yes      | no  | yes                  |                             |          |
| A-41     | yes                                              | yes      | no  | yes                  |                             |          |
| A-42     | yes                                              | yes      | no  | yes                  |                             | BD       |
| A-43     | yes                                              | yes      | no  | yes                  |                             | BD       |
| A-44     | yes                                              | yes      | no  | yes                  |                             | BD       |
| A-45     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-46     | yes                                              | yes      | no  | yes                  |                             | CS & BD  |
| A-47     | yes                                              | yes      | no  | yes                  |                             | BD       |
| A-48     | yes                                              | yes      | no  | yes                  |                             | BD       |
| A-49     | yes                                              | yes      | no  | no                   | 5 meters<br>west            | UGU      |
| A-50     | yes                                              | yes      | no  | yes                  |                             |          |
| A-51     | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-52     | yes                                              | yes      | no  | no                   | 3 ft south                  | CS & SM  |
| A-53     | yes                                              | yes      | no  | yes                  |                             | CS       |
| A-54     | yes                                              | yes      | no  | yes                  |                             |          |
| A-56     | yes                                              | yes      | no  | yes                  |                             |          |
| A-57     | yes                                              | yes      | no  | yes                  |                             |          |
| A-58     | yes                                              | yes      | no  | yes                  |                             |          |

BD Geophysical data indicates buried debris near staked location.

CS Conductive soils.

DR Location moved to facilitate drill rig.

GPR Ground penetrating radar

SM The presence of surface metal is effecting geophysical data.

UGU Geophysical data indicates possible presence of underground utilities near staked location

| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| A-59     | yes                                              | yes      | no  | yes                  |                             |          |
| A-60     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-61     | yes                                              | yes      | no  | yes                  |                             |          |
| A-62     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-63     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-64     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-65     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-66     | yes                                              | yes      | no  | yes                  |                             |          |
| A-67     | yes                                              | yes      | no  | yes                  |                             |          |
| A-68     | yes                                              | yes      | no  | yes                  |                             |          |
| A-69     | yes                                              | yes      | no  | yes                  |                             |          |
| A-70     | yes                                              | yes      | no  | yes                  |                             |          |
| A-71     | yes                                              | yes      | no  | yes                  |                             |          |
| A-72     | yes                                              | yes      | no  | yes                  |                             |          |
| A-73     | yes                                              | yes      | no  | yes                  |                             |          |
| A-74     | yes                                              | yes      | no  | yes                  |                             |          |
| A-75     | yes                                              | yes      | no  | yes                  |                             |          |
| A-76     | yes                                              | yes      | no  | yes                  |                             |          |

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UGU Geophysical data indicates possible presence of underground utilities near staked location

| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| A-77     | yes                                              | yes      | no  | yes                  |                             |          |
| A-78     | yes                                              | yes      | no  | yes                  |                             |          |
| A-79     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-80     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-81     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-82     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-83     | yes                                              | yes      | no  | yes                  |                             |          |
| A-84     | yes                                              | yes      | no  | yes                  |                             |          |
| A-85     | yes                                              | yes      | no  | yes                  |                             |          |
| A-86     | yes                                              | yes      | no  | yes                  |                             |          |
| A-87     | yes                                              | yes      | no  | yes                  |                             |          |
| A-88     | yes                                              | yes      | no  | yes                  |                             |          |
| A-89     | yes                                              | yes      | no  | yes                  |                             |          |
| A-90     | yes                                              | yes      | no  | yes                  |                             |          |
| A-91     | yes                                              | yes      | no  | yes                  |                             |          |
| A-92     | yes                                              | yes      | no  | yes                  |                             |          |
| A-93     | yes                                              | yes      | no  | yes                  |                             |          |
| A-94     | yes                                              | yes      | no  | yes                  |                             |          |

BD Geophysical data indicates buried debris near staked location.

CS Conductive soils.

DR Location moved to facilitate drill rig.

GPR Ground penetrating radar

SM The presence of surface metal is effecting geophysical data.

UGU Geophysical data indicates possible presence of underground utilities near staked location

| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| A-95     | yes                                              | yes      | no  | yes                  |                             |          |
| A-96     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-97     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-98     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-99     | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-100    | yes                                              | yes      | no  | yes                  |                             |          |
| A-101    | yes                                              | yes      | no  | yes                  |                             |          |
| A-102    | yes                                              | yes      | no  | no                   | 1 meter<br>south            | UGU      |
| A-103    | yes                                              | yes      | no  | yes                  |                             | UGU      |
| A-104    | yes                                              | yes      | no  | no                   | 2 meters<br>west            |          |
| A-105    | yes                                              | yes      | no  | yes                  |                             |          |
| A-106    | yes                                              | yes      | no  | no                   | 1 meter<br>south            | UGU      |
| A-107    | yes                                              | yes      | no  | yes                  |                             |          |
| A-108    | yes                                              | yes      | no  | yes                  |                             |          |
| A-109    | yes                                              | yes      | no  | yes                  |                             |          |
| A-110    | yes                                              | yes      | no  | yes                  |                             |          |

BD Geophysical data indicates buried debris near staked location.

CS Conductive soils.

DR Location moved to facilitate drill rig.

GPR Ground penetrating radar

SM The presence of surface metal is effecting geophysical data.

UGU Geophysical data indicates possible presence of underground utilities near staked location



| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| A-111    | yes                                              | yes      | no  | yes                  |                             |          |
| A-112    | yes                                              | yes      | no  | no                   | 3 meters<br>east            | SM       |
| A-113    | yes                                              | yes      | no  | yes                  |                             |          |
| A-114    | yes                                              | yes      | no  | no                   | 5 meters<br>southwest       | UGU      |
| A-115    | yes                                              | yes      | no  | no                   | 1.5 meters<br>north         | BD       |
| A-116    | yes                                              | yes      | no  | no                   | 4 meters<br>east            | UGU      |
| A-117    | yes                                              | yes      | no  | yes                  |                             |          |
| A-118    | yes                                              | yes      | no  | no                   | 5 meters<br>east            | UGU      |
| A-119    | yes                                              | yes      | no  | no                   | 5 meters<br>east            | UGU      |
| A-120    | yes                                              | yes      | no  | yes                  |                             |          |
| A-121    | yes                                              | yes      | no  | yes                  |                             |          |
| A-122    | yes                                              | yes      | no  | yes                  |                             |          |
| A-123    | yes                                              | yes      | no  | yes                  |                             |          |
| A-124    | yes                                              | yes      | no  | no                   | 3 meters<br>south           | BD       |

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CS Conductive soils.

DR Location moved to facilitate drill rig.

GPR Ground penetrating radar

SM The presence of surface metal is effecting geophysical data.

UGU Geophysical data indicates possible presence of underground utilities near staked location

| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| A-125    | yes                                              | yes      | no  | yes                  |                             |          |
| A-126    | yes                                              | yes      | no  | yes                  |                             |          |
| A-127    | yes                                              | yes      | no  | no                   | 8 meters<br>north           | UGU      |
| A-128    | yes                                              | yes      | no  | yes                  |                             |          |
| A-129    | yes                                              | yes      | yes | yes                  |                             |          |
| A-130    | yes                                              | yes      | no  | yes                  |                             |          |
| A-131    | yes                                              | yes      | no  | yes                  |                             |          |
| A-132    | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-133    | yes                                              | yes      | no  | yes                  |                             | SM       |
| A-134    | yes                                              | yes      | no  | no                   | 1 meter<br>south            | SM & UGU |
| A-135    | yes                                              | yes      | no  | yes                  |                             |          |
| A-136    | yes                                              | yes      | no  | yes                  |                             |          |
| A-137    | yes                                              | yes      | no  | no                   | 1 meters<br>north           | UGU      |
| A-138    | yes                                              | yes      | no  | yes                  |                             |          |
| A-139    | yes                                              | yes      | no  | yes                  |                             |          |
| A-140    | yes                                              | yes      | no  | no                   | 3 meters<br>south           | BD       |

BD Geophysical data indicates buried debris near staked location.

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GPR Ground penetrating radar

SM The presence of surface metal is effecting geophysical data.

UGU Geophysical data indicates possible presence of underground utilities near staked location

| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| A-141    | yes                                              | yes      |     | no                   | 3 meters<br>south           | UGU      |
| A-142    | yes                                              | yes      | no  | yes                  |                             |          |
| A-143    | yes                                              | yes      | no  | yes                  |                             |          |
| A-144    | yes                                              | yes      | no  | no                   | 4 meters<br>south           | UGU      |
| A-145    | yes                                              | yes      | no  | yes                  |                             |          |
| A-146    | yes                                              | yes      | no  | no                   | 2 ft east                   | SM       |
| A-147    | yes                                              | yes      | no  | yes                  |                             |          |
| A-148    | yes                                              | yes      | no  | no                   | 3 meters<br>north           | UGU      |
| A-149    | yes                                              | yes      | no  | yes                  |                             |          |
| A-150    | yes                                              | yes      | no  | yes                  |                             |          |
| A-151    | yes                                              | yes      | no  | yes                  |                             |          |
| A-152    | yes                                              | yes      | no  | yes                  |                             |          |
| A-153    | yes                                              | yes      | no  | yes                  |                             |          |
| A-154    | yes                                              | yes      | no  | no                   | 2 meters<br>south           | UGU      |
| A-155    | yes                                              | yes      | no  | yes                  |                             |          |
| A-156    | yes                                              | yes      | no  | no                   | 5 ft north                  | UGU      |

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DR Location moved to facilitate drill rig.

GPR Ground penetrating radar

SM The presence of surface metal is effecting geophysical data.

UGU Geophysical data indicates possible presence of underground utilities near staked location

| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| A-157    | yes                                              | yes      | no  | no                   | 6 ft south                  | BD       |
| A-158    | yes                                              | yes      | no  | yes                  |                             |          |
| A-159    | yes                                              | yes      | no  | no                   | 5 meters<br>east            | BD       |
| A-160    | yes                                              | yes      | no  | yes                  |                             |          |
| A-161    | yes                                              | yes      | no  | yes                  |                             |          |
| A-162    | yes                                              | yes      | yes | yes                  |                             |          |
| A-163    | yes                                              | yes      | no  | yes                  |                             |          |
| A-164    | yes                                              | yes      | no  | yes                  |                             |          |
| A-165    | yes                                              | yes      | no  | yes                  |                             |          |
| A-166    | yes                                              | yes      | no  | yes                  |                             |          |
| A-167    | yes                                              | yes      | yes | yes                  |                             |          |
| A-168    | yes                                              | yes      | yes | yes                  |                             |          |
| A-169    | yes                                              | yes      | yes | yes                  |                             | UGU      |
| A-170    | yes                                              | yes      | no  | yes                  |                             |          |
| A-171    | yes                                              | yes      | no  | yes                  |                             |          |
| A-172    | yes                                              | yes      | no  | yes                  |                             |          |
| A-173    | yes                                              | yes      | no  | yes                  |                             |          |
| A 174    | yes                                              | yes      | no  | yes                  |                             |          |

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| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 31                                            | EM 31-DL | GPR |                      |                             |          |
| A-175    | yes                                              | yes      | no  | no                   | 2 meters<br>north           | UGU      |
| A-176    | yes                                              | yes      | no  | yes                  |                             | UGU      |
| A-177    | yes                                              | yes      | no  | no                   | 5 ft<br>northwest           | UGU      |
| A-178    | yes                                              | yes      | no  | yes                  |                             |          |
| A-179    | yes                                              | yes      | no  | yes                  |                             |          |
| A-180    | yes                                              | yes      | no  | yes                  |                             |          |
| A-181    | yes                                              | yes      | no  | yes                  |                             |          |
| A-182    | yes                                              | yes      | no  | yes                  |                             |          |
| A-183    | yes                                              | yes      | no  | no                   | 1 meter<br>north            | BD       |
| A-185    | yes                                              | yes      | no  | yes                  |                             |          |
| A-186    | yes                                              | yes      | no  | yes                  |                             |          |
| A-187    | yes                                              | yes      | no  | yes                  |                             |          |
| A-188    | yes                                              | yes      | no  | yes                  |                             |          |
| A-189    | yes                                              | yes      | no  | yes                  |                             |          |
| A-190    | yes                                              | yes      | no  | yes                  |                             |          |
| A-191    | yes                                              | yes      | no  | yes                  |                             |          |

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| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| A-192    | yes                                              | yes      | no  | yes                  |                             |          |
| A-193    | yes                                              | yes      | no  | yes                  |                             |          |
| A-194    | yes                                              | yes      | no  | yes                  |                             |          |
| A-195    | yes                                              | yes      | no  | yes                  |                             |          |
| A-196    | yes                                              | yes      | no  | yes                  |                             |          |
| A-197    | yes                                              | yes      | no  | yes                  |                             |          |
| A-198    | yes                                              | yes      | no  | yes                  |                             |          |
| A-199    | yes                                              | yes      | no  | yes                  |                             |          |
| A-200    | yes                                              | yes      | no  | yes                  |                             |          |
| A-201    | yes                                              | yes      | no  | no                   | 2 ft east                   | SM       |
| A-202    | yes                                              | yes      | no  | yes                  |                             |          |
| A-203    | yes                                              | yes      | no  | yes                  |                             |          |
| A-204    | yes                                              | yes      | no  | yes                  |                             |          |
| A-205    | yes                                              | yes      | no  | yes                  |                             |          |
| A-206    | yes                                              | yes      | no  | yes                  |                             |          |
| A-207    | yes                                              | yes      | no  | yes                  |                             |          |
| A-208    | yes                                              | yes      | no  | yes                  |                             |          |
| A-209    | yes                                              | yes      | no  | yes                  |                             |          |

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| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| A-210    | yes                                              | yes      | no  | yes                  |                             |          |
| A-211    | yes                                              | yes      | no  | yes                  |                             |          |
| A-212    | yes                                              | yes      | no  | yes                  |                             |          |
| A-213    | yes                                              | yes      | no  | yes                  |                             |          |
| A-214    | yes                                              | yes      | no  | yes                  |                             |          |
| A-215    | yes                                              | yes      | no  | yes                  |                             |          |
| F-1      | yes                                              | yes      | no  | yes                  |                             |          |
| F-2      | yes                                              | yes      | no  | no                   | 10 ft west                  | BD       |
| F-3      | yes                                              | yes      | no  | yes                  |                             |          |
| F-4      | yes                                              | yes      | no  | yes                  |                             |          |
| F-5      | yes                                              | yes      | no  | yes                  |                             |          |
| F-6      | yes                                              | yes      | no  | yes                  |                             |          |
| F-7      | yes                                              | yes      | no  | yes                  |                             |          |
| F-8      | yes                                              | yes      | no  | yes                  |                             |          |
| F-9      | yes                                              | yes      | no  | yes                  |                             |          |
| F-10     | yes                                              | yes      | no  | yes                  |                             |          |
| F-11     | yes                                              | yes      | no  | yes                  |                             |          |
| F-12     | yes                                              | yes      | no  | yes                  |                             |          |

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| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| F-13     | yes                                              | yes      | no  | yes                  |                             |          |
| F-14     | yes                                              | yes      | no  | yes                  |                             |          |
| F-15     | yes                                              | yes      | no  | yes                  |                             |          |
| F-16     | yes                                              | yes      | no  | yes                  |                             |          |
| F-17     | yes                                              | yes      | no  | yes                  |                             |          |
| F-18     | yes                                              | yes      | no  | yes                  |                             |          |
| F-19     | yes                                              | yes      | no  | yes                  |                             |          |
| F-20     | yes                                              | yes      | no  | yes                  |                             |          |
| F-21     | yes                                              | yes      | no  | yes                  |                             |          |
| F-22     | yes                                              | yes      | no  | yes                  |                             |          |
| F-23     | yes                                              | yes      | no  | yes                  |                             |          |
| F-24     | yes                                              | yes      | no  | yes                  |                             |          |
| F-25     | yes                                              | yes      | no  | yes                  |                             |          |
| F-26     | yes                                              | yes      | no  | yes                  |                             |          |
| F-27     | yes                                              | yes      | no  | yes                  |                             |          |
| F-28     | yes                                              | yes      | no  | yes                  |                             |          |
| F-29     | yes                                              | yes      | no  | yes                  |                             |          |
| F-30     | yes                                              | yes      | no  | yes                  |                             |          |

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| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| F-31     | yes                                              | yes      | no  | yes                  |                             |          |
| F-32     | yes                                              | yes      | no  | yes                  |                             |          |
| F-33     | yes                                              | yes      | no  | yes                  |                             |          |
| F-34     | yes                                              | yes      | no  | yes                  |                             |          |
| F-35     | yes                                              | yes      | no  | yes                  |                             |          |
| F-36     | metal<br>detector                                | yes      | no  | yes                  |                             | DR       |
| F-37     | yes                                              | yes      | no  | yes                  |                             |          |
| F-38     | yes                                              | yes      | no  | yes                  |                             |          |
| F-39     | yes                                              | yes      | no  | yes                  |                             |          |
| F-40     | yes                                              | yes      | no  | yes                  |                             |          |
| F-41     | yes                                              | yes      | no  | yes                  |                             |          |
| F-42     | yes                                              | yes      | no  | yes                  |                             |          |
| F-43     | yes                                              | yes      | no  | yes                  |                             |          |
| F-44     | yes                                              | yes      | no  | yes                  |                             |          |
| F-45     | yes                                              | yes      | no  | yes                  |                             |          |
| F-48     | yes                                              | yes      | no  | yes                  |                             |          |
| F-49     | yes                                              | yes      | no  | no                   | 5 ft north                  | UGU      |

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| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| F-50     | yes                                              | yes      | no  | no                   | 2 meters<br>south           | UGU      |
| F-51     | yes                                              | yes      | no  | yes                  |                             |          |
| F-52     | yes                                              | yes      | no  | no                   | 8 meters<br>northwest       | Culvert  |
| F-53     | yes                                              | yes      | no  | no                   |                             |          |
| F-54     | yes                                              | yes      | no  | yes                  |                             |          |
| F-55     | yes                                              | yes      | no  | no                   | 1 meter<br>north            | BD       |
| F-56     | yes                                              | yes      | no  | yes                  |                             |          |
| F-57     | yes                                              | yes      | no  | yes                  |                             |          |
| F-58     | yes                                              | yes      | no  | no                   | 1 meter<br>southeast        | UGU      |
| F-59     | yes                                              | yes      | no  | yes                  |                             |          |
| F-60     | yes                                              | yes      | no  | no                   | 2 ft south                  | UGU      |
| F-61     | yes                                              | yes      | no  | yes                  |                             |          |
| F-62     | yes                                              | yes      | no  | no                   | 5 meters<br>east            | UGU      |
| F-63     | yes                                              | yes      | no  | no                   | 2 meters<br>northeast       | UGU      |

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| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| F-64     | yes                                              | yes      | no  | yes                  |                             |          |
| F-65     | yes                                              | yes      | no  | yes                  |                             |          |
| F-66     | yes                                              | yes      | no  | no                   | 2 meters<br>west            | UGU      |
| F-67     | yes                                              | yes      | no  | no                   | 6 ft east                   | UGU      |
| F-68     | yes                                              | yes      | no  | yes                  |                             |          |
| F-69     | yes                                              | yes      | no  | yes                  |                             |          |
| F-70     | yes                                              | yes      | no  | yes                  |                             |          |
| F-71     | yes                                              | yes      | no  | yes                  |                             |          |
| F-72     | yes                                              | yes      | no  | yes                  |                             |          |
| F-73     | yes                                              | yes      | no  | yes                  |                             |          |
| F-74     | yes                                              | yes      | no  | yes                  |                             |          |
| F-75     | yes                                              | yes      | no  | yes                  |                             |          |
| F-76     | yes                                              | yes      | no  | yes                  |                             |          |
| F-77     | yes                                              | yes      | no  | yes                  |                             |          |
| F-78     | yes                                              | yes      | no  | yes                  |                             |          |
| F-79     | yes                                              | yes      | no  | yes                  |                             |          |
| F-80     | yes                                              | yes      | no  | yes                  |                             |          |
| O-1      | yes                                              | yes      | no  | yes                  |                             |          |

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UGU Geophysical data indicates possible presence of underground utilities near staked location

| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| O-2      | yes                                              | yes      | no  | yes                  |                             |          |
| O-3      | yes                                              | yes      | no  | yes                  |                             |          |
| O-4      | yes                                              | yes      | no  | yes                  |                             |          |
| O-5      | yes                                              | yes      | no  | yes                  |                             |          |
| O-6      | yes                                              | yes      | no  | yes                  |                             |          |
| O-7      | yes                                              | yes      | no  | yes                  |                             |          |
| O-8      | yes                                              | yes      | no  | no                   | 2 meters<br>north           | BD       |
| O-9      | yes                                              | yes      | no  | yes                  |                             |          |
| O-10     | yes                                              | yes      | no  | yes                  |                             |          |
| O-11     | yes                                              | yes      | no  | yes                  |                             |          |
| O-12     | yes                                              | yes      | no  | yes                  |                             |          |
| O-13     | yes                                              | no       | no  | no                   | 3 meters<br>southwest       | UGU      |
| O-14     | yes                                              | no       | no  | yes                  |                             |          |
| O-15     | yes                                              | no       | no  | yes                  |                             |          |
| O-16     | yes                                              | no       | no  | yes                  |                             |          |
| O-17     | yes                                              | no       | no  | no                   | 2 meters<br>west            | SM       |

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| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| O-18     | yes                                              | no       | no  | yes                  |                             |          |
| O-19     | yes                                              | no       | no  | no                   | 3 meters<br>north           | SM       |
| O-20     | yes                                              | yes      | no  | yes                  |                             |          |
| O-21     | yes                                              | yes      | no  | yes                  |                             |          |
| O-22     | yes                                              | yes      | no  | yes                  |                             |          |
| O-23     | yes                                              | yes      | no  | yes                  |                             |          |
| O-24     | yes                                              | yes      | no  | yes                  |                             |          |
| O-25     | yes                                              | yes      | no  | yes                  |                             |          |
| O-26     | yes                                              | yes      | no  | yes                  |                             |          |
| O-27     | yes                                              | yes      | no  | yes                  |                             |          |
| O-28     | yes                                              | yes      | no  | yes                  |                             |          |
| O-29     | yes                                              | yes      | no  | yes                  |                             |          |
| O-30     | yes                                              | yes      | no  | yes                  |                             |          |
| O-31     | yes                                              | yes      | no  | yes                  |                             |          |
| O-32     | yes                                              | yes      | no  | yes                  |                             |          |
| O-33     | yes                                              | yes      | no  | yes                  |                             |          |
| O-34     | yes                                              | yes      | no  | yes                  |                             |          |
| O-35     | yes                                              | yes      | no  | yes                  |                             |          |

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|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| O-36     | yes                                              | yes      | no  | yes                  |                             |          |
| O-37     | yes                                              | yes      | no  | yes                  |                             |          |
| O-38     | yes                                              | yes      | no  | yes                  |                             |          |
| O-39     | yes                                              | yes      | no  | yes                  |                             |          |
| O-40     | yes                                              | yes      | no  | yes                  |                             |          |
| O-41     | yes                                              | yes      | no  | yes                  |                             |          |
| O-42     | yes                                              | yes      | no  | no                   | 5 meters<br>south           | UGU      |
| O-43     | yes                                              | yes      | no  | no                   | 3 meters<br>south           | UGU      |
| O-44     | yes                                              | yes      | no  | no                   | 3 meters<br>south           | UGU      |
| O-45     | yes                                              | yes      | no  | yes                  |                             |          |
| O-46     | yes                                              | yes      | no  | yes                  |                             |          |
| O-47     | yes                                              | yes      | no  | yes                  |                             |          |
| O-48     | yes                                              | yes      | no  | no                   | 4 meters<br>northeast       | BD       |
| O-49     | yes                                              | yes      | no  | yes                  |                             |          |
| O-50     | yes                                              | yes      | no  | yes                  |                             |          |
| O-51     | yes                                              | yes      | no  | yes                  |                             |          |

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| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| O-52     | yes                                              | yes      | no  | yes                  |                             |          |
| O-53     | yes                                              | yes      | no  | yes                  |                             | DR       |
| O-54     | yes                                              | yes      | no  | yes                  |                             |          |
| O-55     | yes                                              | yes      | no  | yes                  |                             |          |
| O-56     | yes                                              | yes      | no  | yes                  |                             |          |
| O-57     | yes                                              | yes      | no  | no                   | 2 meters<br>south           | BD       |
| O-58     | yes                                              | yes      | no  | yes                  |                             |          |
| O-59     | yes                                              | yes      | no  | yes                  |                             |          |
| O-60     | yes                                              | yes      | no  | no                   | 2 meters<br>east            | BD       |
| O-61     | yes                                              | yes      | no  | yes                  |                             |          |
| O-62     | yes                                              | yes      | no  | yes                  |                             |          |
| O-63     | yes                                              | yes      | no  | yes                  |                             |          |
| O-64     | yes                                              | yes      | no  | yes                  |                             |          |
| O-65     | yes                                              | yes      | no  | yes                  |                             |          |
| O-67     | yes                                              | yes      | no  | yes                  |                             |          |
| O-68     | yes                                              | yes      | yes | yes                  |                             |          |
| O-69     | yes                                              | yes      | no  | yes                  |                             | DR       |

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|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| O-70     | yes                                              | yes      | yes | no                   | 1 meter<br>north            | UGU      |
| T-1      | yes                                              | yes      | no  | yes                  |                             |          |
| T-2      | yes                                              | yes      | no  | yes                  |                             |          |
| T-3      | yes                                              | yes      | no  | yes                  |                             |          |
| T-4      | yes                                              | yes      | no  | yes                  |                             |          |
| T-5      | yes                                              | yes      | no  | yes                  |                             |          |
| T-6      | yes                                              | yes      | no  | no                   | 1 meter<br>south            | BD       |
| T-7      | yes                                              | yes      | no  | yes                  |                             |          |
| T-8      | yes                                              | yes      | no  | yes                  |                             |          |
| T-9      | yes                                              | yes      | no  | yes                  |                             |          |
| T-10     | yes                                              | yes      | no  | yes                  |                             |          |
| T-11     | yes                                              | yes      | no  | yes                  |                             |          |
| T-12     | yes                                              | yes      | no  | yes                  |                             |          |
| T-13     | yes                                              | yes      | no  | yes                  |                             |          |
| T-14     | yes                                              | yes      | no  | yes                  |                             |          |
| T-15     | yes                                              | yes      | no  | yes                  |                             | CS       |
| T-16     | yes                                              | yes      | no  | yes                  |                             | CS       |

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SM The presence of surface metal is effecting geophysical data.

UGU Geophysical data indicates possible presence of underground utilities near staked location



| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| T-17     | yes                                              | yes      | no  | no                   | 5 ft south                  | BD       |
| T-18     | yes                                              | yes      | no  | yes                  |                             |          |
| T-19     | yes                                              | yes      | no  | yes                  |                             |          |
| T-20     | yes                                              | yes      | no  | yes                  |                             |          |
| T-21     | yes                                              | yes      | no  | yes                  |                             |          |
| T-24     | yes                                              | yes      | no  | yes                  |                             |          |
| T-25     | yes                                              | yes      | no  | yes                  |                             |          |
| T-26     | yes                                              | yes      | no  | yes                  |                             |          |
| T-27     | yes                                              | yes      | no  | yes                  |                             |          |
| T-28     | yes                                              | yes      | no  | no                   | 1 meter<br>north            | BD       |
| T-29     | yes                                              | yes      | no  | yes                  |                             |          |
| T-30     | yes                                              | yes      | no  | yes                  |                             |          |
| T-31     | yes                                              | yes      | no  | yes                  |                             |          |
| T-32     | yes                                              | yes      | no  | yes                  |                             |          |
| T-33     | yes                                              | yes      | no  | no                   | 2 meters<br>north           | BD       |
| T-34     | yes                                              | yes      | yes | no                   | 2 meters<br>east            | UGU      |

BD Geophysical data indicates buried debris near staked location.

CS Conductive soils.

DR Location moved to facilitate drill rig.

GPR Ground penetrating radar

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| Borehole | Geophysical Instrument Used<br>to clear borehole |          |     | Drilled as<br>staked | Staked<br>location<br>moved | Comments |
|----------|--------------------------------------------------|----------|-----|----------------------|-----------------------------|----------|
|          | EM 38                                            | EM 31-DL | GPR |                      |                             |          |
| T-35     | yes                                              | yes      | no  | yes                  |                             |          |
| T-36     | yes                                              | yes      | no  | yes                  |                             | DR       |
| T-37     | yes                                              | yes      | no  | yes                  |                             |          |

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APPENDIX E

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### STATISTICAL ANALYSES OF SOIL VERSUS RINSE BLANK DATA

Various statistical methods can be used to determine whether a correlation exists between the contaminant concentrations observed in soil samples from borings drilled immediately before and after the collection of the rinse blanks. The simplest method is the construction of scatter plots that give a visual impression of how strongly the values of x are related to the values of y with which they are paired. Scatter plots were prepared for pairings of the maximum contaminant concentration in soil samples from preceding borings (x) to contaminant concentrations in the rinse blank (y), and for pairings of the rinse blank concentrations (x) to maximum contaminant concentrations in soil samples from the following boring (y). Examination of these scatter plots do not readily indicate any correlation (Figure E-1).

Numerical measures of how strongly the soil contaminant levels and rinse blank levels are related, also known as correlation coefficients, were also developed. Two types of correlation coefficients were calculated: Pearson's correlation coefficient and Spearman's Rank correlation coefficient (Table 2.6-3). The Pearson's correlation coefficient, r, is given by:

$$r = \frac{\sum (x - \bar{x})(y - \bar{y})}{(n-1)s_x s_y}$$

where: x = maximum contaminant concentration in soil sample from preceding boring or in the rinse blank, depending on whether correlation of previous bore to rinse blank, or rinse blank to subsequent bore, is being evaluated

$\bar{x}$  = sample mean for x values

y = maximum contaminant concentration in rinse blank or in soil sample from boring immediately after rinse blank

Table E-1 Statistical Correlation Between Soil and Rinse Blank Contaminant Concentrations

| Contaminant | Previous Boring Max. Conc. to Rinse Blank |                          |                 |                         | Following Boring Max. Conc. to Rinse Blank |                         |                 |                         |
|-------------|-------------------------------------------|--------------------------|-----------------|-------------------------|--------------------------------------------|-------------------------|-----------------|-------------------------|
|             | Pearson's                                 |                          | Spearman's Rank |                         | Pearson's                                  |                         | Spearman's Rank |                         |
|             | n                                         | Correlation Coefficient  | n               | Correlation Coefficient | n                                          | Correlation Coefficient | n               | Correlation Coefficient |
| Aldrin      | 11                                        | -0.24 weak, negative     | 5               | -0.30 weak, negative    | 11                                         | 0.996 strong, positive  | 5               | 0.40 weak, positive     |
| Arsenic     | 57                                        | -0.38 weak, negative     | 48              | -0.12 weak, negative    | 57                                         | -0.32 weak, negative    | 47              | -0.29 weak, negative    |
| Chlordane   | 6                                         | -0.35 weak, negative     | 3               | 1.00 strong, positive   | 6                                          | -0.10 weak, negative    | 3               | 0.50 weak, positive     |
| CL6CP       | 6                                         | -0.26 weak, negative     | 1               | (a)                     | 6                                          | 1.16 not valid          | 1               | (a)                     |
| Dieldrin    | 17                                        | -0.16 weak, negative     | 15              | -0.29 weak, negative    | 17                                         | -0.16 weak, negative    | 16              | -0.04 weak, negative    |
| Endrin      | 11                                        | -0.30 weak, negative     | 6               | 0.77 moderate, positive | 11                                         | -0.43 weak, negative    | 5               | 0.20 weak, positive     |
| Isodrin     | 9                                         | -0.21 weak, negative     | 2               | (a)                     | 9                                          | 0.43 weak, positive     | 2               | (a)                     |
| Mercury     | 19                                        | -0.13 weak, negative     | 3               | -1.00 strong, negative  | 19                                         | 0.004 weak, positive    | 4               | -0.80 strong, negative  |
| MPA         | 15                                        | -0.57 moderate, negative | 1               | (a)                     | 15                                         | -0.41 weak, negative    | 1               | (a)                     |
| PPDDE       | 7                                         | -0.29 weak, negative     | 1               | (a)                     | 7                                          | -0.21 weak, negative    | 2               | (a)                     |
| PPDDT       | 8                                         | 1.07 not valid           | 2               | (a)                     | 8                                          | 0.79 moderate, positive | 2               | (a)                     |

(a) - Insufficient number of ranked pairs to determine correlation coefficient.

$\bar{y}$  = sample mean for y values  
 $n$  = number of sample pairs  
 $s_x$  = standard deviation for x values  
 $s_y$  = standard deviation for y values

Pearson's correlation coefficient does not depend on the unit of measurement for either variable. It is a measure of the extent to which the variables are linearly related. For purposes of this study, results less than CRLs were assigned values of zero.

Spearman's Rank correlation coefficient is a measure of the two variables' linear or nonlinear relationship. Unlike the Pearson's correlation coefficient, the Spearman's Rank correlation coefficient is not very sensitive to outlying points. Spearman's Rank correlation coefficient is determined by assigning a rank to each x and y variable from the lowest value to the highest, i.e., the lowest x value receives a rank of 1 while the next highest number receives a rank of 2, and so on. If either the rinse blank or associated soil concentration was below the CRL, the pair was not included in the calculation of the Spearman's Rank correlation coefficient. The rank pairs were used to develop a correlation coefficient using a modified Pearson's method. The Spearman's Rank correlation coefficient,  $r_s$ , is given by:

$$r_s = \frac{\sum [x \text{ rank} - (\frac{n+1}{2})] [y \text{ rank} - (\frac{n+1}{2})]}{n(n-1) (n+1) / 12}$$

where: x rank = rank of contaminant concentration in soil sample from boring preceding rinse blank or in rinse blank

y rank = rank of contaminant concentration in rinse blank or from boring immediately after rinse blank

n = number of ranked pairs

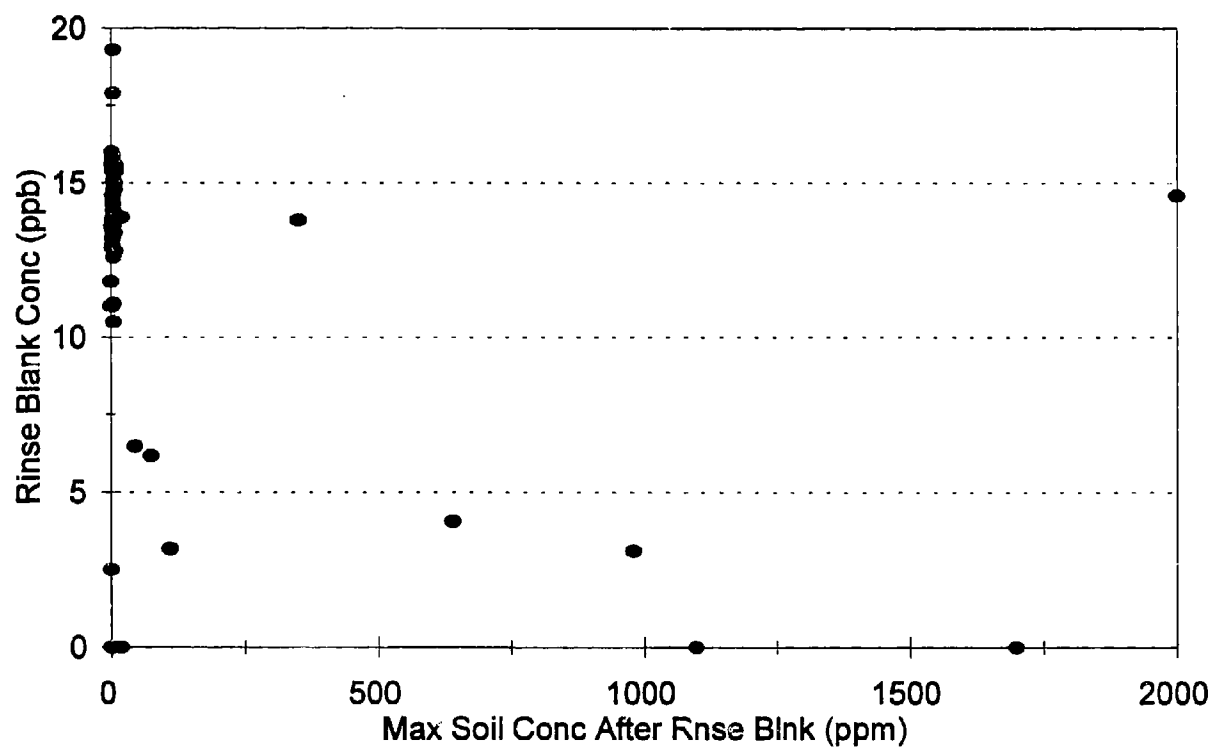
The elimination of pairs with less than CRL values reduced the number of Spearman's Rank correlation coefficients that could be calculated. If a contaminant had less than 3 pairs, the Spearman's Rank correlation coefficient was not determined. Coefficients determined for less than 5 pairs are also suspect.

The value of the correlation coefficients for both methods vary between -1 and 1. A positive value indicates a positive relationship between the variables, i.e., when x increases y increases. A negative value indicates a negative relationship, i.e., when x decreases y increases.

When the correlation coefficient equals 1, the strongest positive relationship exists between x and y, while -1 indicates the strongest negative relationship. A rule of thumb is to assume that a strong relationship exists if the correlation coefficient is  $> +0.8$  or  $< -0.8$ , a weak relationship if the correlation coefficient is between  $+0.5$  and  $-0.5$ , and moderate otherwise (Devore and Peck 1986).

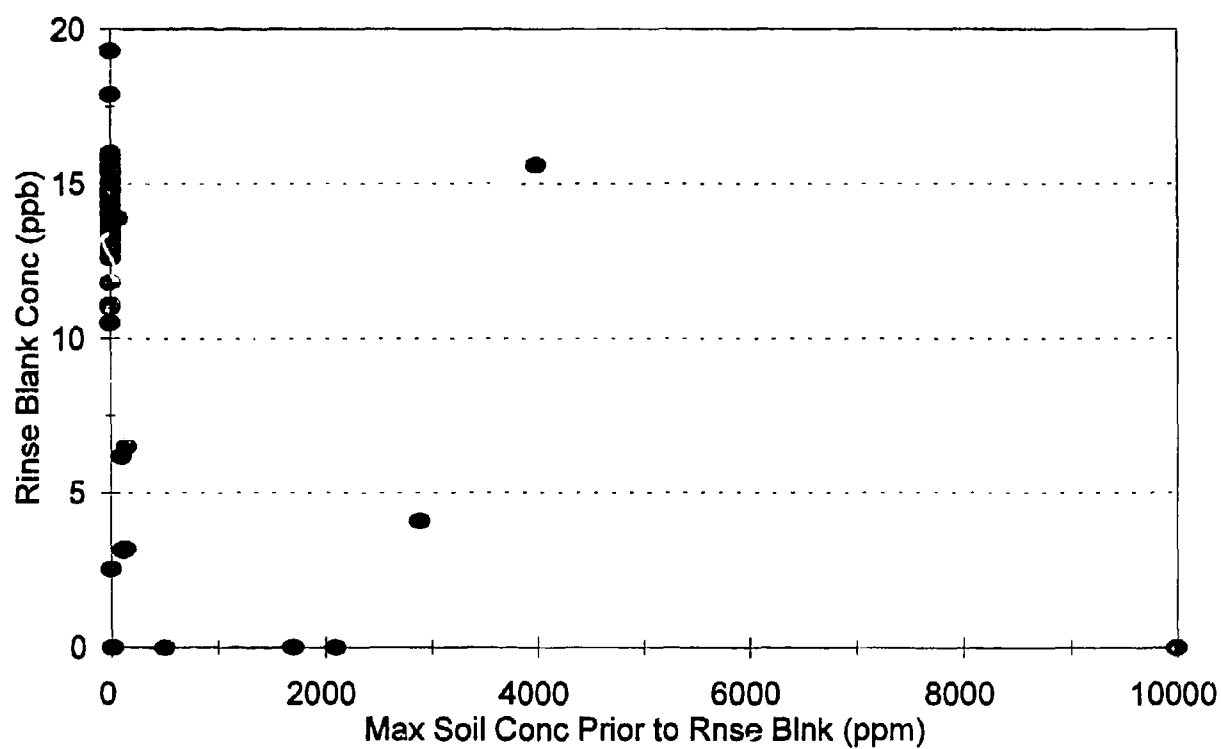
For the most part, the calculated correlation coefficients indicate weak negative relationships between the rinse blank concentrations and soil concentrations. The few strong positive relationships (aldrin in subsequent bore to rinse blank, chlordane in previous bore to rinse blank) were isolated incidents not confirmed by both Pearson's and Spearman's Rank tests. In fact, for chlordane the two tests contradict each other. Mercury, by way of contrast, showed strong negative correlations under Spearman's Rank test for both cases (prior to rinse and rinse to subsequent bores). In general, these correlation analyses indicate that rinse blank detections are not related to prior subsequent sample concentrations and not indicative of failures in the decontamination procedures.

## Arsenic Concentration

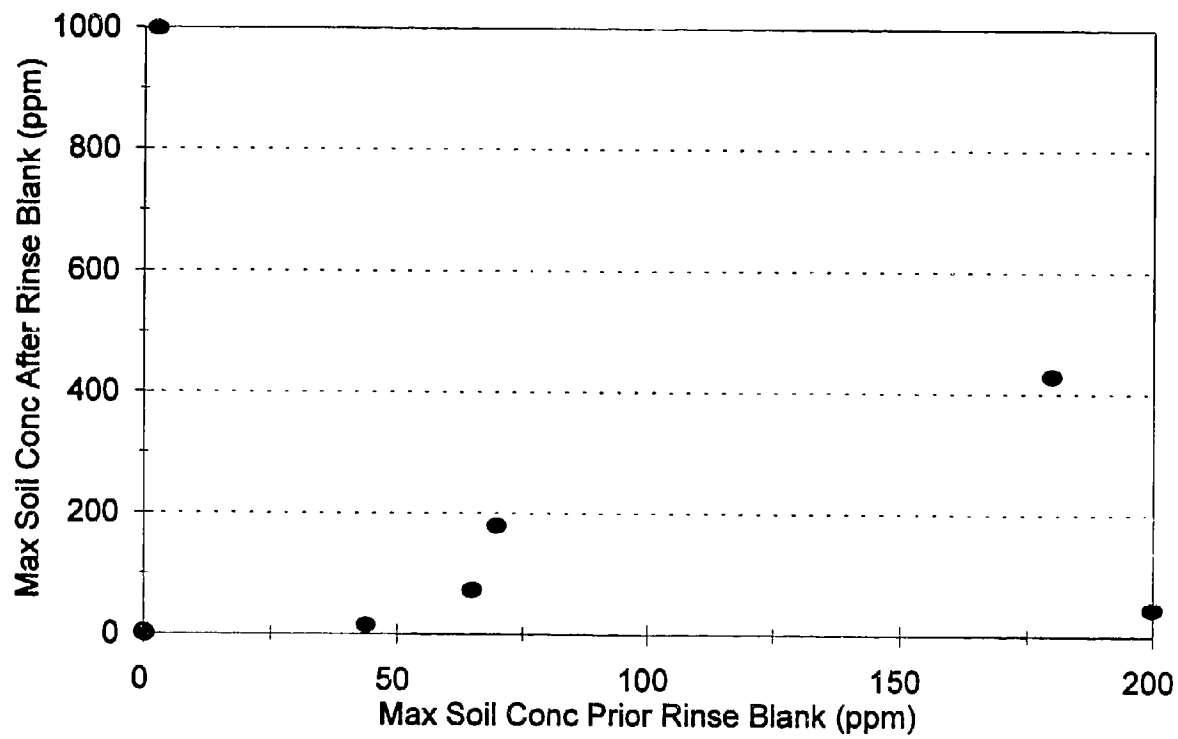




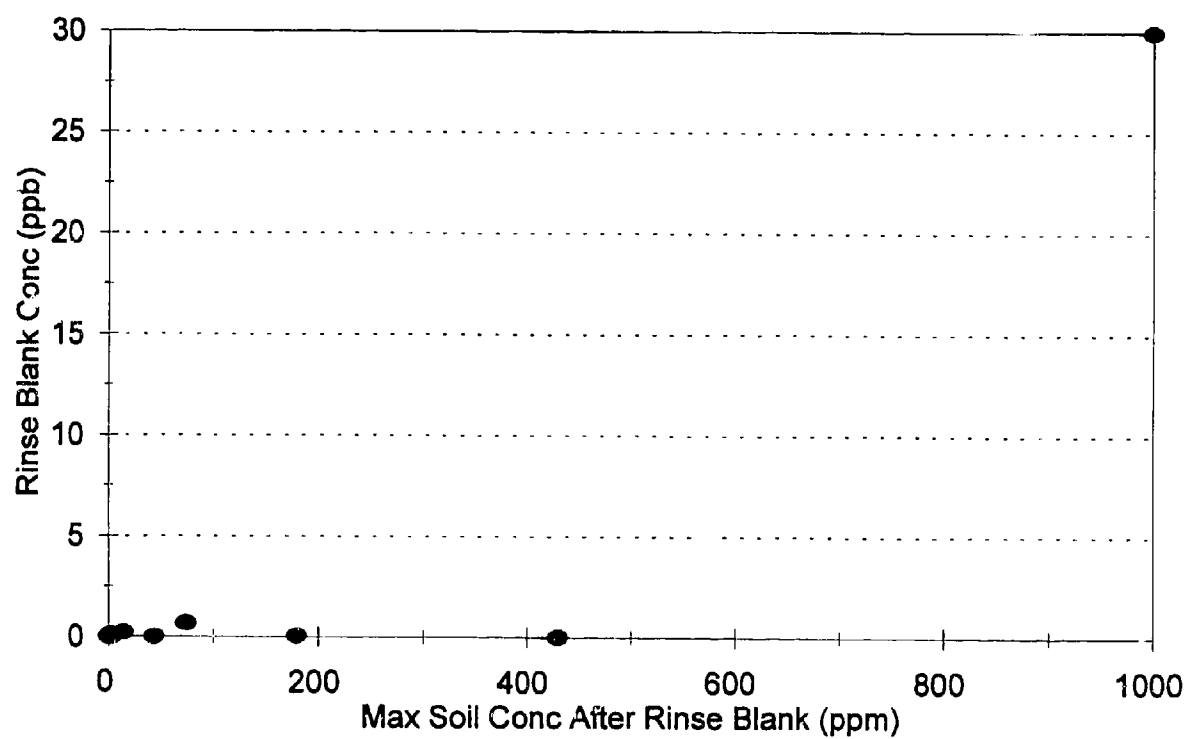
## Arsenic Concentration



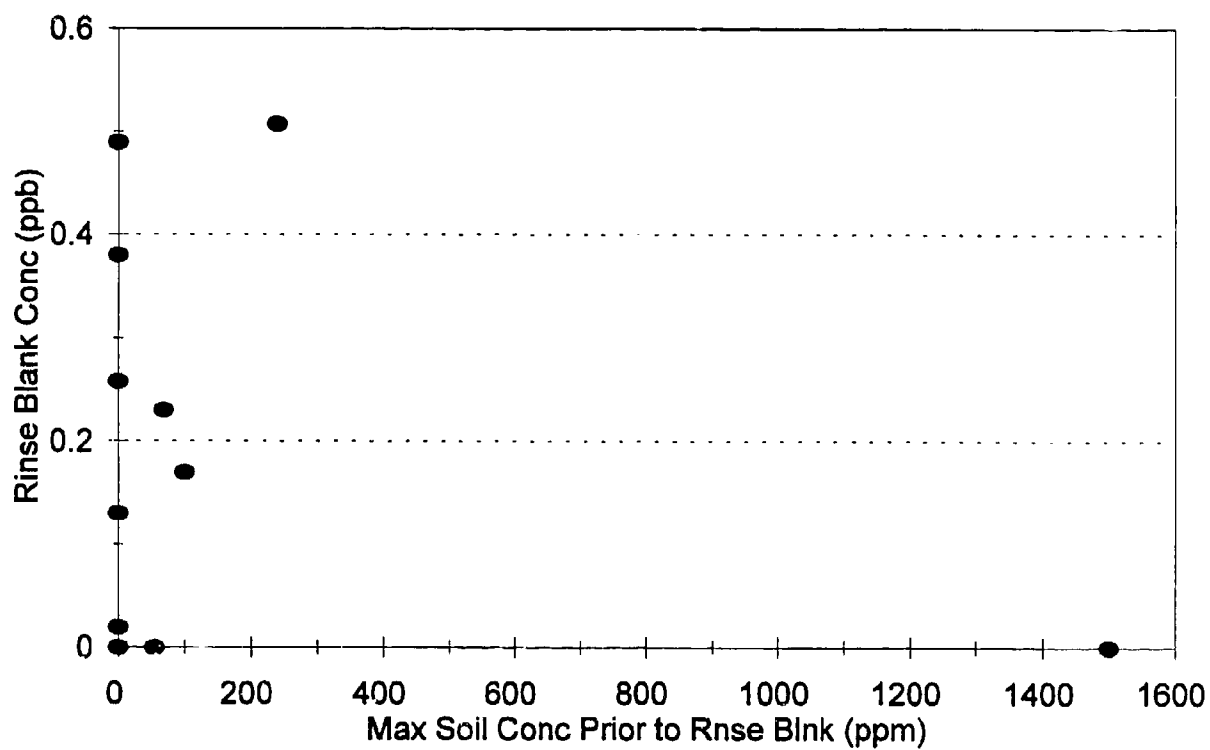
## Aldrin Concentrations



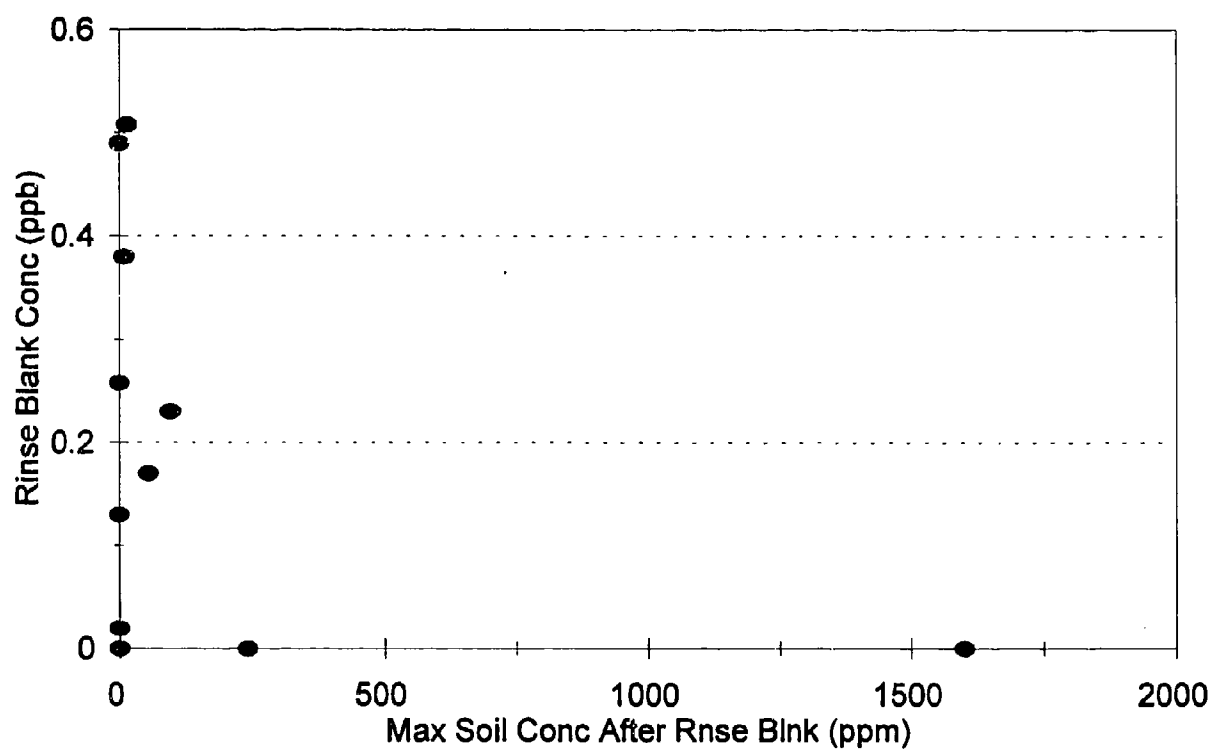
## Aldrin Concentrations



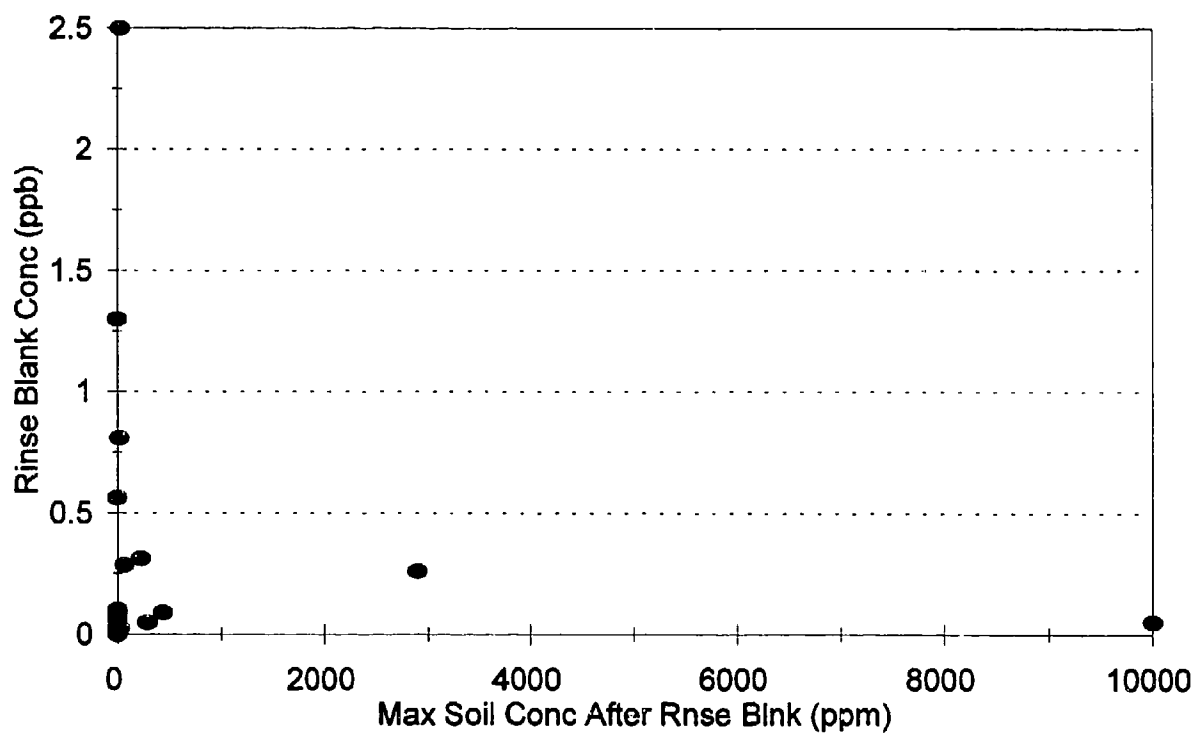
## Endrin Concentrations



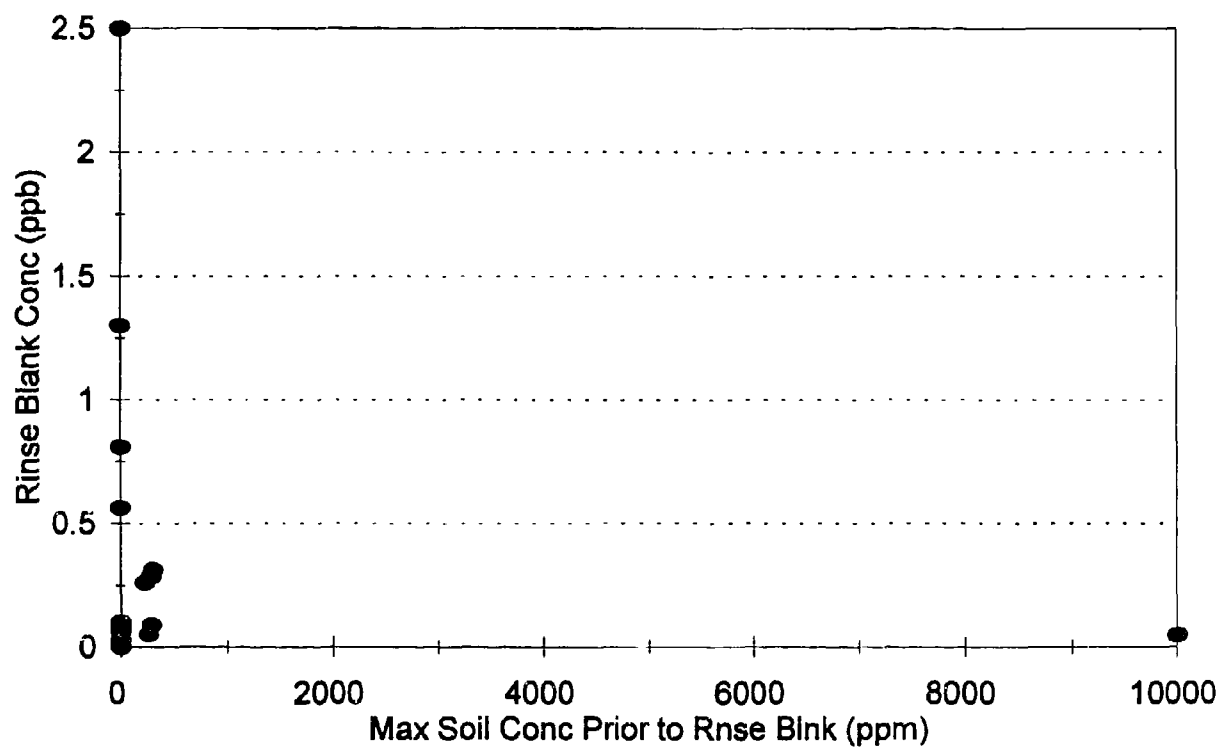
## Endrin Concentrations



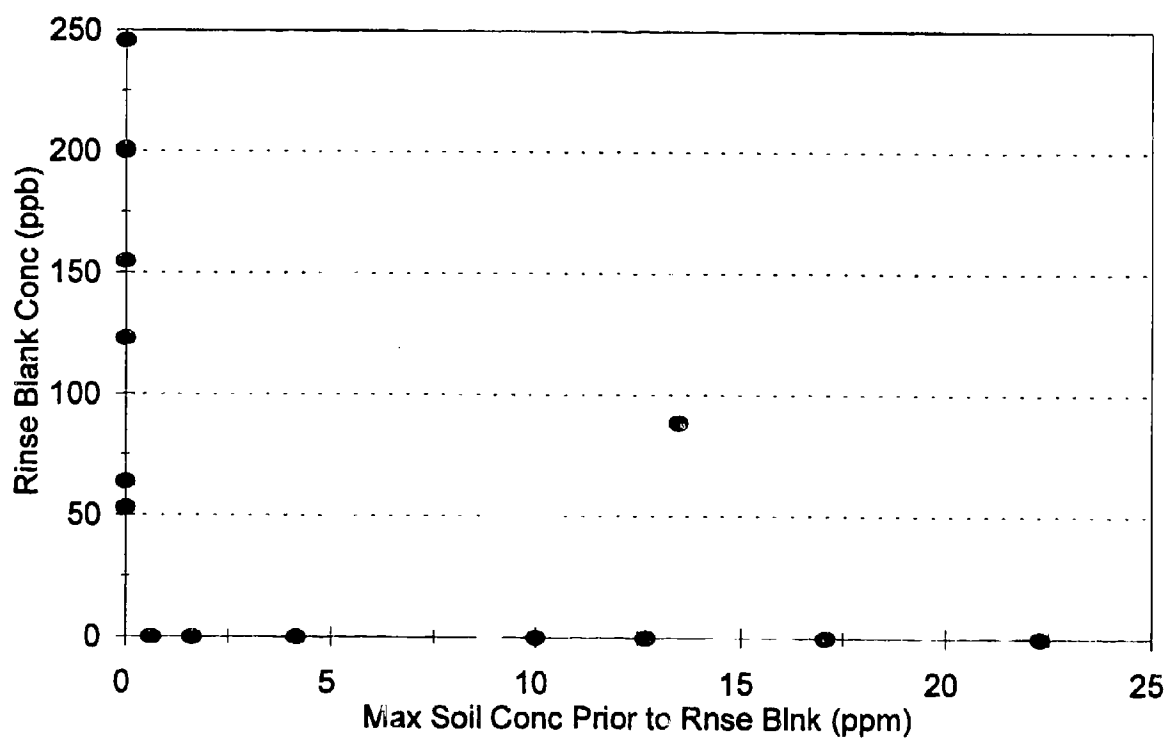
## Dieldrin Concentrations



## Dieldrin Concentrations

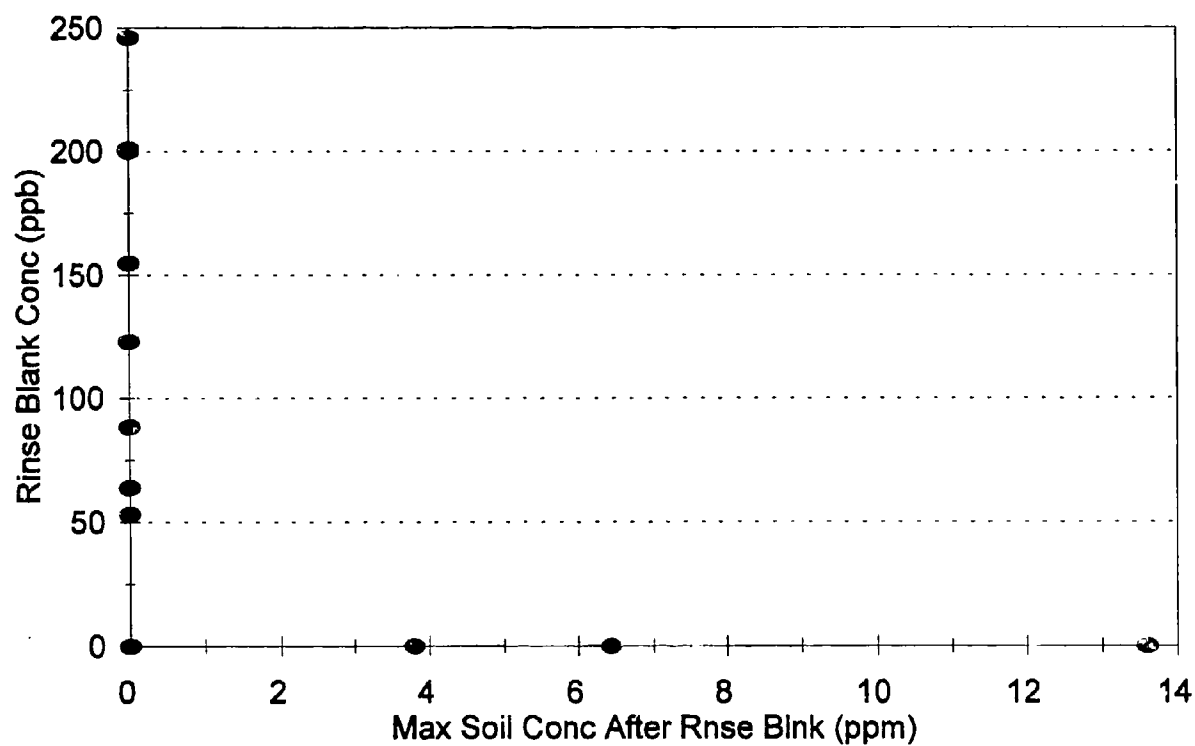


## MPA Concentrations

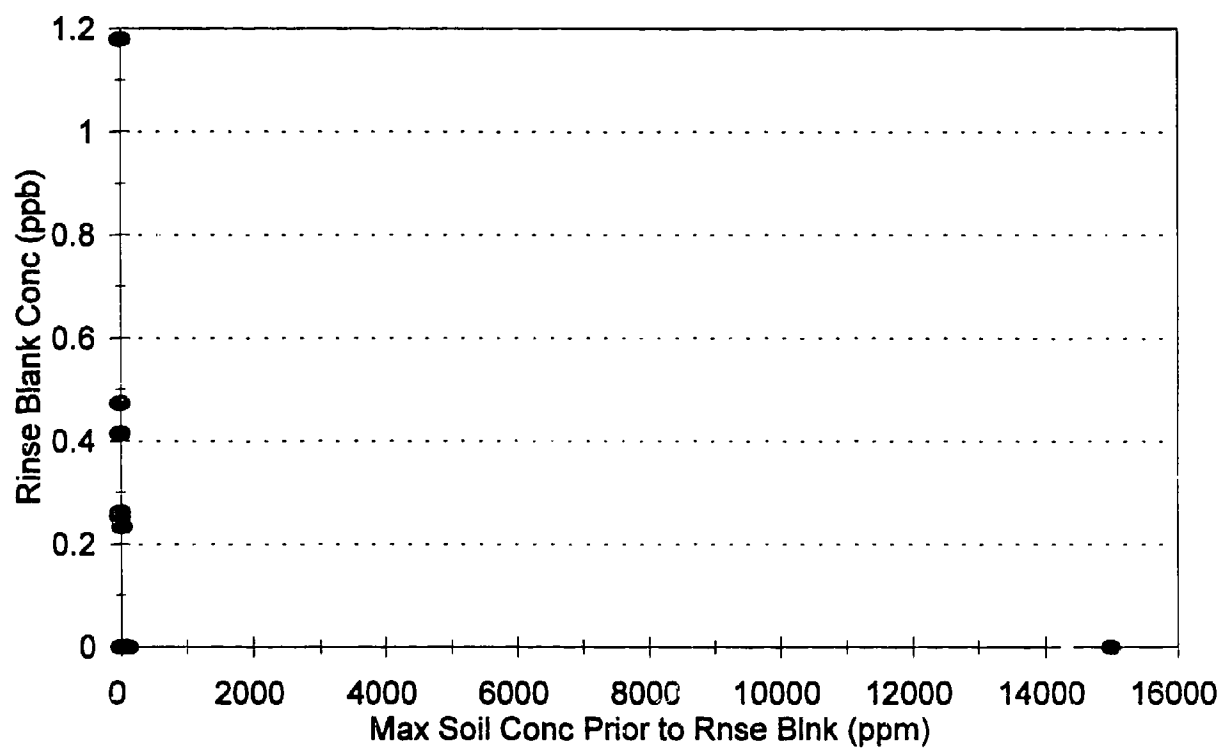




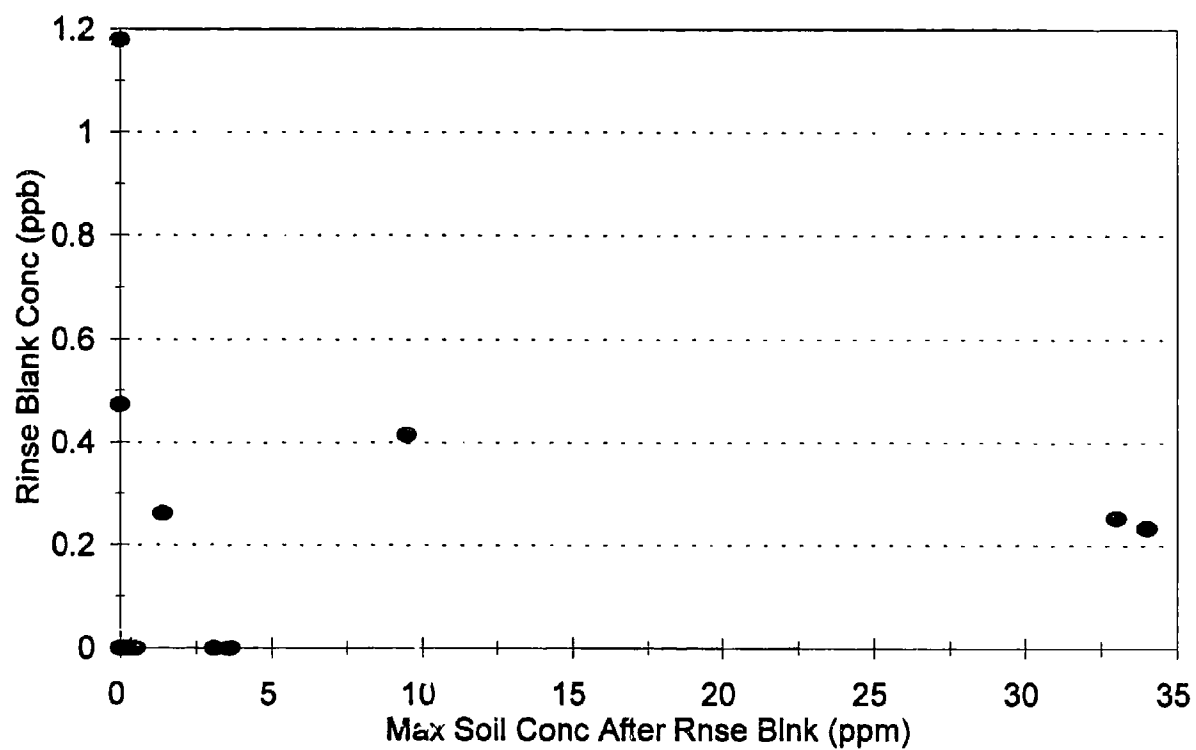
## MPA Concentrations



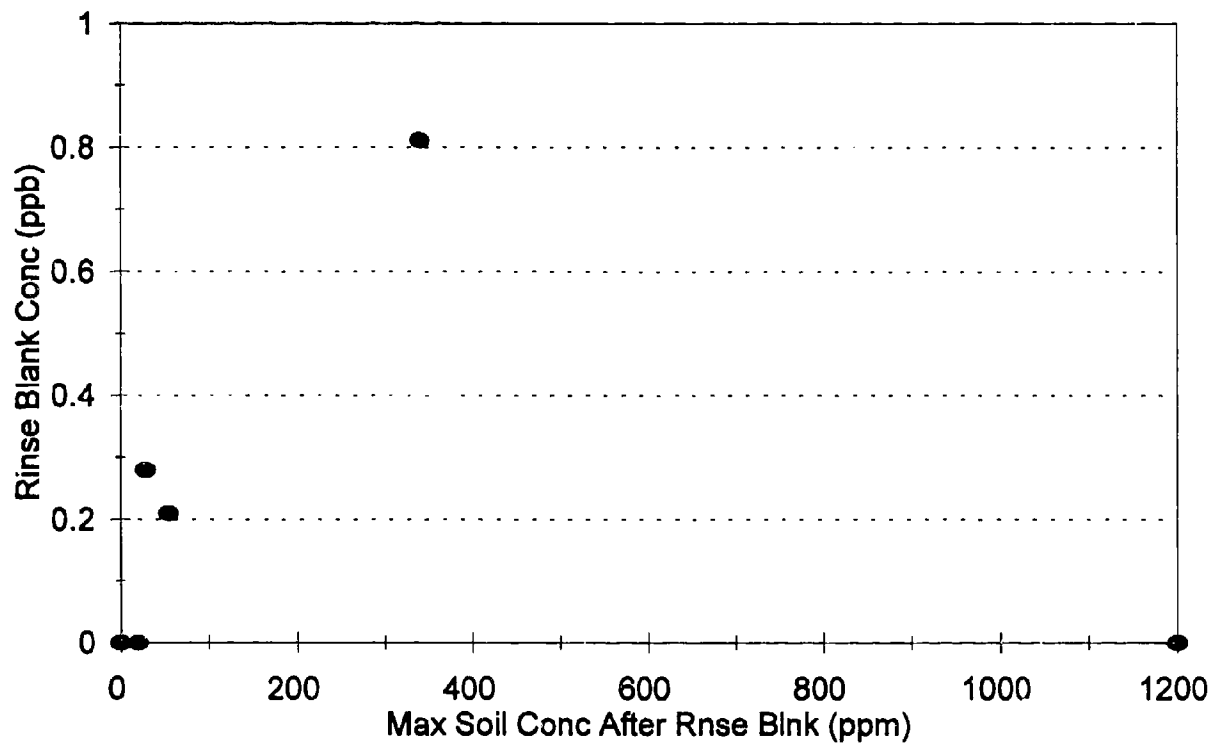
## Mercury Concentrations



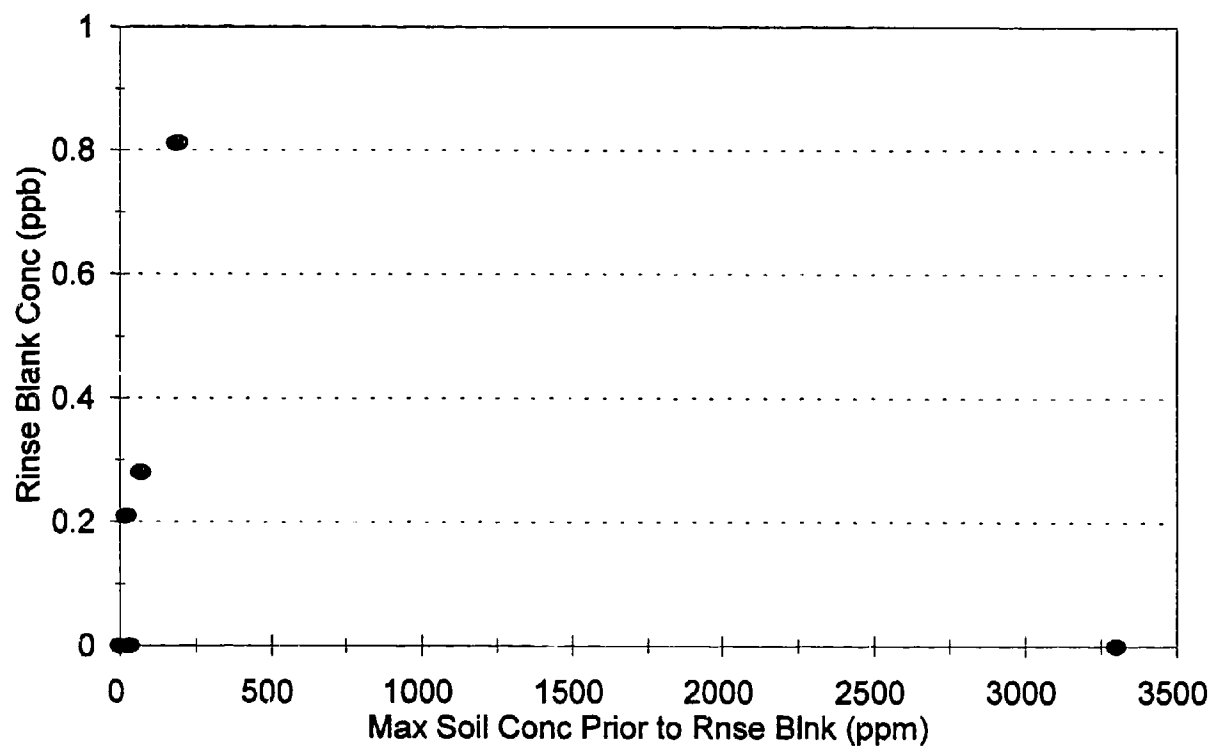
## Mercury Concentrations



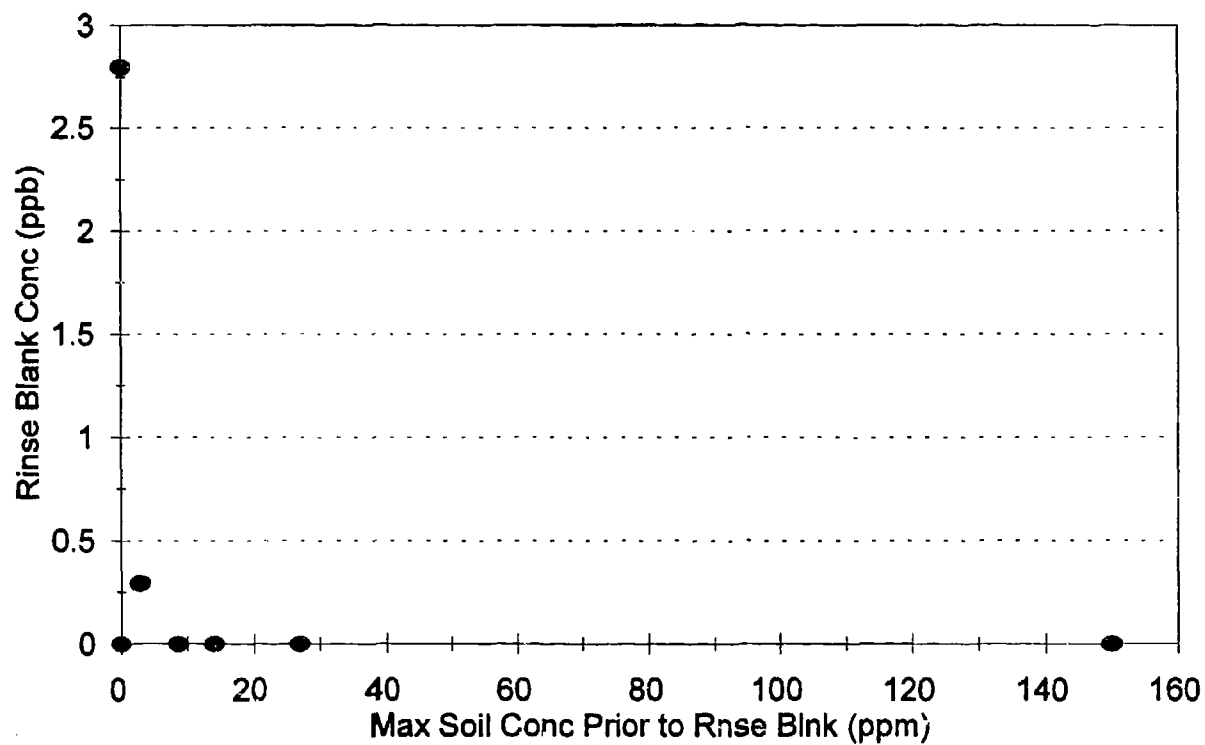
## Chlordane Concentrations



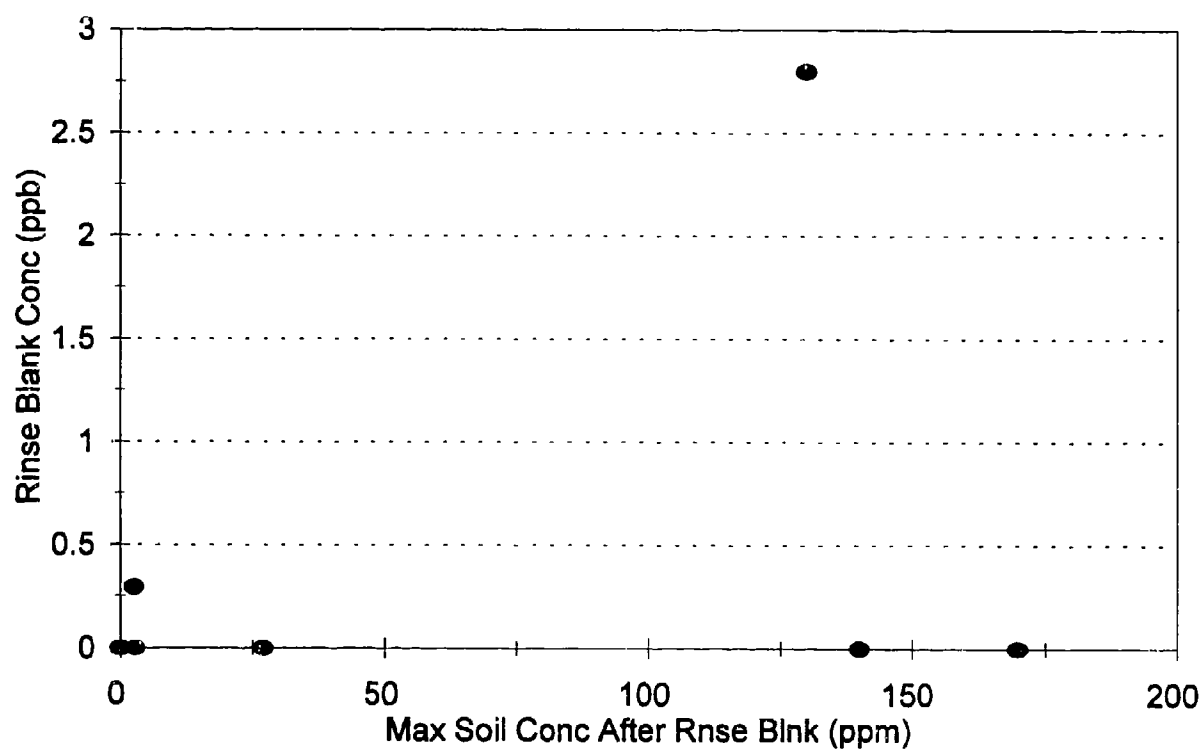
## Chlordane Concentrations



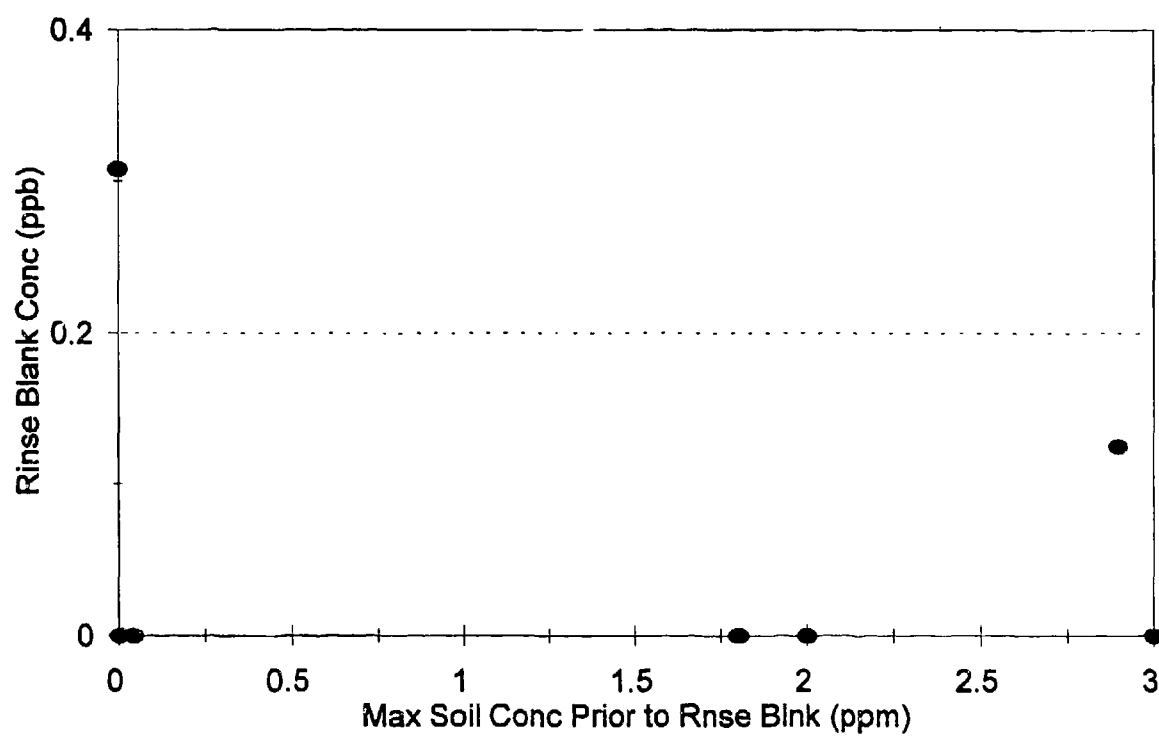
## Isodrin Concentrations



## Isodrin Concentrations

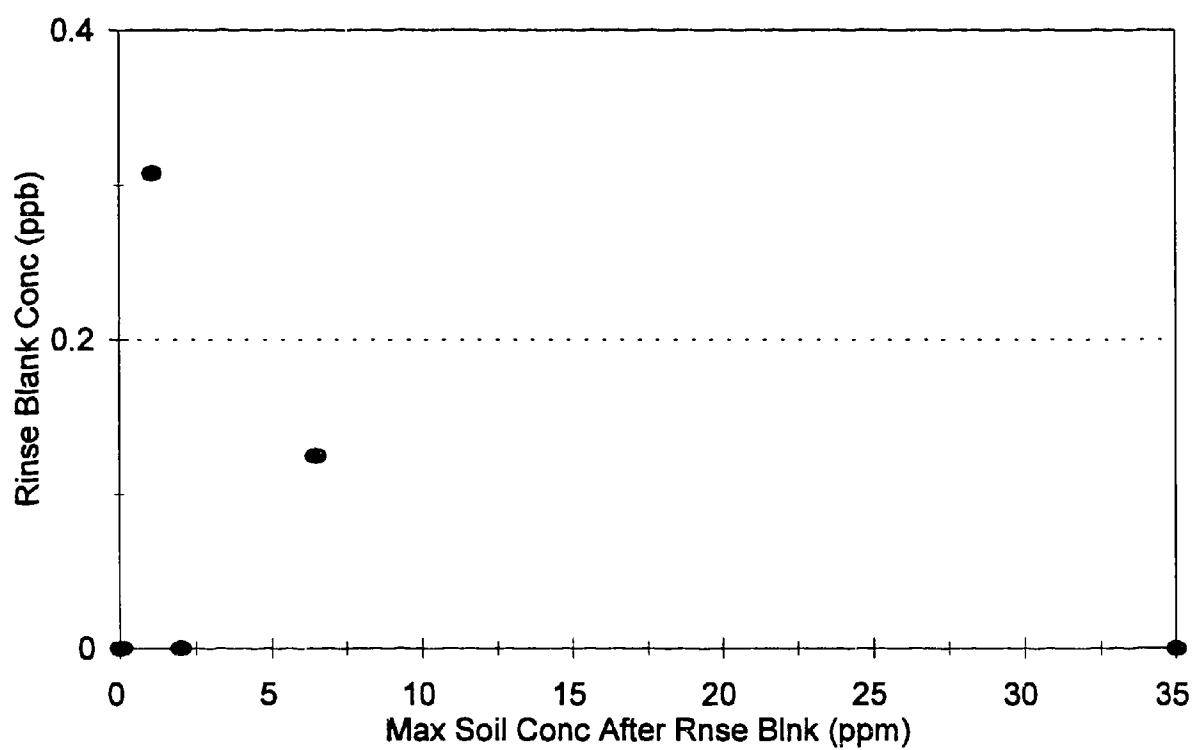


## PPDDE Concentrations

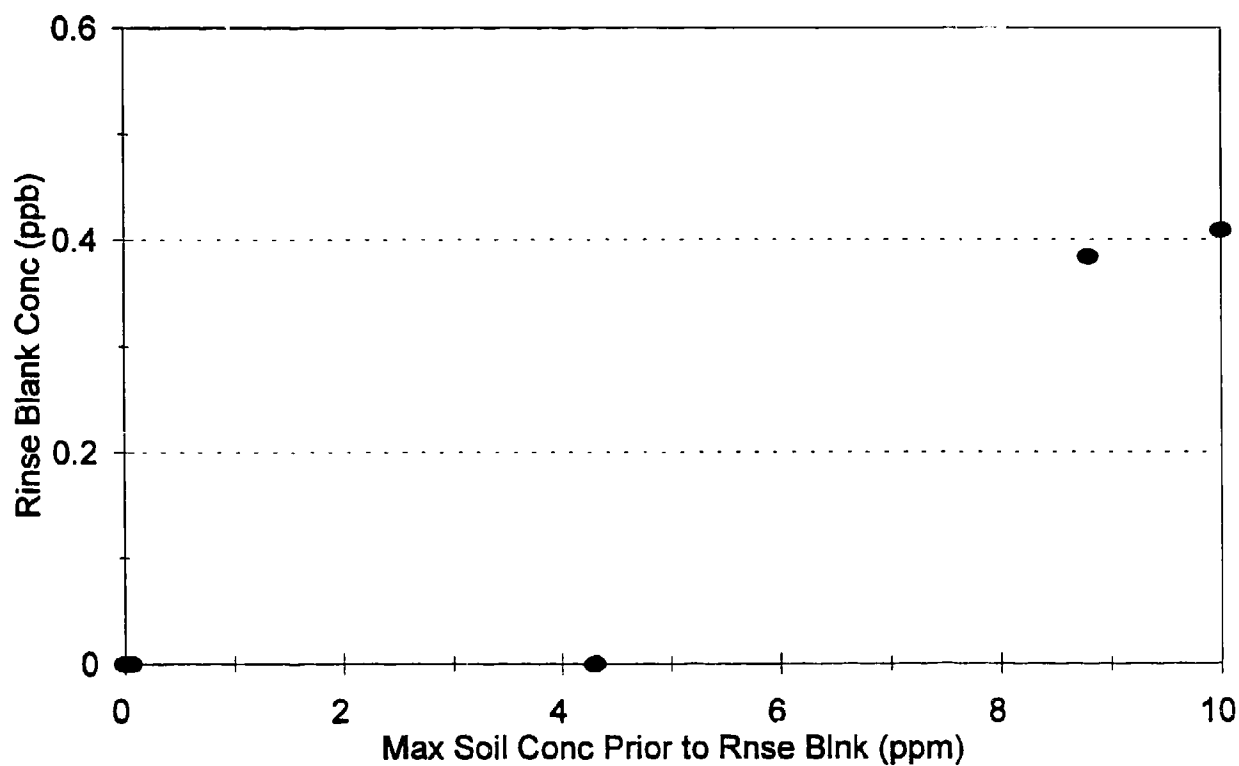




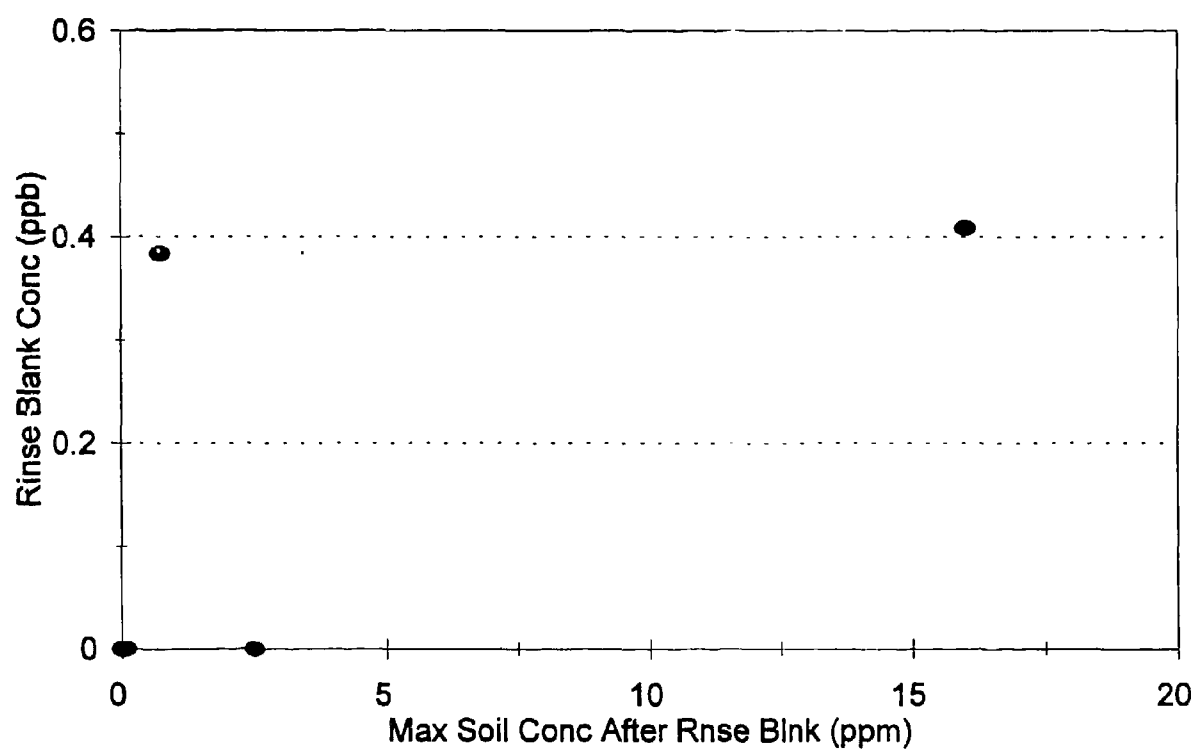
## PPDDE Concentrations



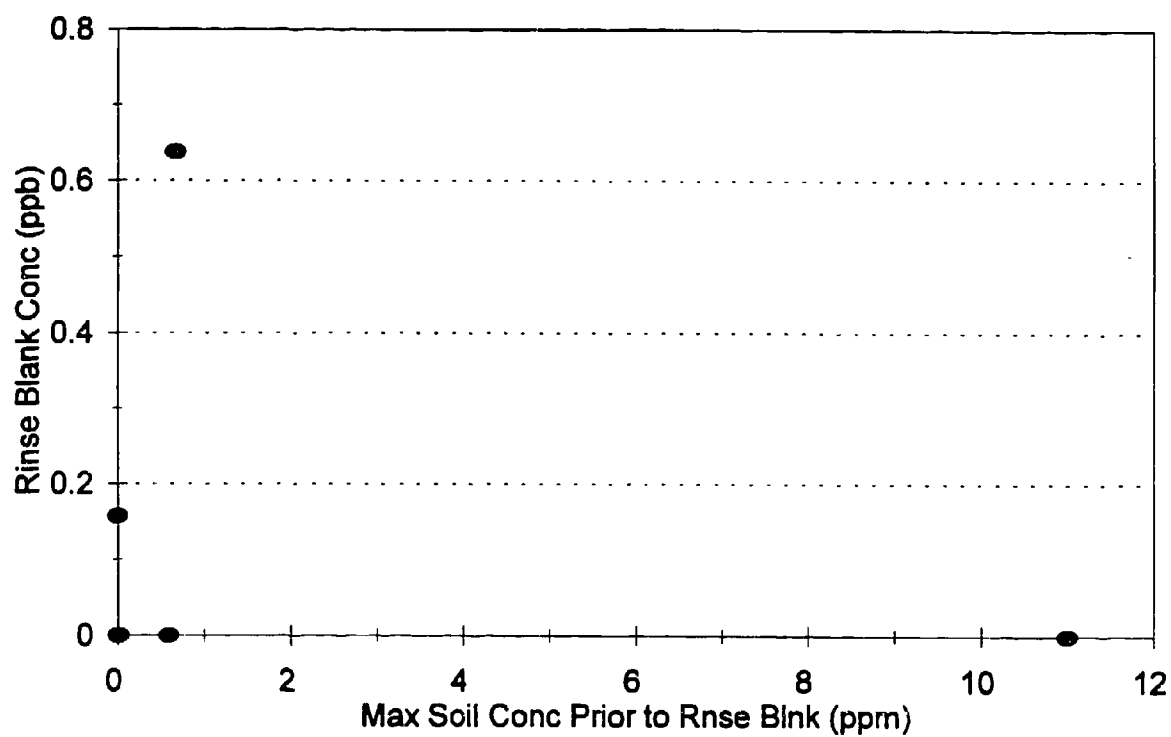
# PPDDT Concentrations



## PPDDT Concentrations



## CL6CP Concentrations



## CL6CP Concentrations

