Department of Energy

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MAY 04 2010

PPPO-02-475-10

Mr. W. Turpin Ballard
U.S. Environmental Protection Agency, Region 4
Federal Facilities Branch
61 Forsyth Street
Atlanta, Georgia 30303

Mr. Edward Winner, FFA Manager
Kentucky Department for Environmental Protection
Division of Waste Management
200 Fair Oaks Lane, 2nd Floor
Frankfort, Kentucky 40601

Dear Mr. Ballard and Mr. Winner:

TRANSMITTAL OF THE REMEDIAL ACTION WORK PLAN FOR THE NORTHWEST PLUME INTERIM REMEDIAL ACTION OPTIMIZATION AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY (DOE/LX/07-0339&D1)

Please find enclosed the certified D1 *Remedial Action Work Plan* (RAWP) *for the Northwest Plume Interim Remedial Action Optimization at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0339&D1, for your review.

On February 11, 2010, the Department of Energy (DOE) submitted a draft RAWP to the Kentucky Department for Environmental Protection (KDEP) and U.S. Environmental Protection Agency (EPA) for review. The reviews were requested in conjunction with DOE's parallel review of the document. This approach was implemented in order to meet DOE's request to accelerate schedule for this project. The enclosed certified D1 RAWP incorporates comments received from EPA and KDEP, as well as DOE comments. A red-lined version and a comment summary table in response to EPA and KDEP comments also are enclosed.

If you have any questions or require additional information, please contact David Dollins at (270) 441-6819.

Sincerely,

Reinhard Knerr
Paducah Site Lead
Portsmouth/Paducah Project Office

Enclosures:

1. Certification Page
2. D1 RAWP for NW Plume IRA Optimization
3. CRS
4. Red-lined D1 RAWP

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AR File/Kevil

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CERTIFICATION

Document Identification: **Remedial Action Work Plan for the Northwest Plume Interim Remedial Action Optimization at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE/LX/07-0339&D1)**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Paducah Remediation Services, LLC
Operator

Dennis Ferrigno, PM, Site Manager — Date Signed: 5-03-10

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

U.S. Department of Energy (DOE)
Owner

Reinhard Knerr, Paducah Site Lead
Portsmouth/Paducah Project Office — Date Signed: 5/4/10

DOE/LX/07-0339&D1
PRIMARY DOCUMENT

Remedial Action Work Plan for the Northwest Plume Interim Remedial Action Optimization at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

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DOE/LX/07-0339&D1
PRIMARY DOCUMENT

Remedial Action Work Plan for the Northwest Plume Interim Remedial Action Optimization at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—May 2010

Prepared for the
U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
PADUCAH REMEDIATION SERVICES, LLC
managing the

Environmental Management Activities at the
Paducah Gaseous Diffusion Plant
under contract DE-AC30-06EW05001

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PREFACE

This *Remedial Action Work Plan for the Northwest Plume Interim Remedial Action Optimization at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0339&D1, was prepared in accordance with requirements under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. The objectives of this plan are to (1) describe the purpose and scope of the changes to the interim remedial action, (2) identify the project organization, (3) present the project working schedule, and (4) identify other key project documents and plans.

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CONTENTS

TABLES

FIGURES

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ACRONYMS

ARAR	applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CQCP	Construction Quality Control Plan
DMIP	Data Management Implementation Plan
DOE	U.S. Department of Energy
DOECAP	DOE Consolidated Audit Program
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
EW	extraction well
FFA	Federal Facility Agreement
H&S	health and safety
HQ	headquarters
IRA	interim remedial action
KAR	*Kentucky Administrative Regulations*
KDFWR	Kentucky Department of Fish and Wildlife Resources
KEEC	Kentucky Energy and Environment Cabinet
KPDES	Kentucky Pollutant Discharge Elimination System
KRS	Kentucky Revised Statues
LDR	land disposal restriction
LLW	low-level waste
MW	monitoring well
NWP	Northwest Plume
NWPGS	Northwest Plume Groundwater System
O&M	operations and maintenance
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
PPE	personal protective equipment
QA	quality assurance
QC	quality control
RAWP	Remedial Action Work Plan
RFD	Request for Disposal
RCRA	Resource Conservation and Recovery Act
RGA	Regional Gravel Aquifer
ROD	record of decision
RSE	Remediation System Evaluation
RWP	radiological work permit
^{99}Tc	technetium-99
TCA	trichloroethane
TCE	trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TRU	transuranic waste
TSCA	Toxic Substance Control Act
TSDF	treatment, storage, and disposal facility
TVA	Tennessee Valley Authority
VOC	volatile organic compound

WAC	waste acceptance criteria
WKWMA	West Kentucky Wildlife Management Area
WMC	Waste Management Coordinator
WMP	Waste Management Plan

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EXECUTIVE SUMMARY

The Paducah Gaseous Diffusion Plant (PGDP) is an active uranium enrichment facility owned by the U.S. Department of Energy (DOE). DOE is conducting environmental restoration activities at PGDP in compliance with the requirements of the Commonwealth of Kentucky and the U.S. Environmental Protection Agency (EPA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). PGDP was placed on the National Priorities List in 1994 and DOE, EPA, and the Commonwealth of Kentucky entered into a Federal Facility Agreement in 1998 (EPA 1998).

The Northwest Plume Interim Remedial Action (NWP IRA) Optimization project is intended to increase volatile organic compound mass removal and enhance capture in the vicinity of the current south well field of the NWP IRA System. This action was initiated in response to recommendations that are documented in past system evaluations and assessments. The optimization action also has been described in the FY 2010 Site Management Plan and the 2003 and 2008 CERCLA 5-Year Review Reports.

The well field optimization effort was undertaken utilizing the updated PGDP groundwater flow model coupled with *Brute Force*, a particle tracking optimization code based on sequential MODFLOW-2000 (Harbaugh *et al*. 2000) and MODPATH (Pollack 1994) modeling software. Simulation runs for one, two, three, and four well scenarios were executed for current flow field conditions (with and without anthropogenic recharge). Predicted mass capture was 99.98% and 99.99% for the one and two well scenarios, respectively.

Based on the results of both current and future flow field conditions, the two-well scenario was run to evaluate mass capture at a total extraction rate of 220 gpm, the historical maximum flow rate for the pump-and-treat facility.

The NWP IRA Optimization project includes the design, construction, and startup of two new extraction wells in the vicinity of the current south well field.

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1. INTRODUCTION

In August 1988, volatile organic compounds (VOCs) and radionuclides were detected in private water wells north of the Paducah Gaseous Diffusion Plant (PGDP). The principal contaminants of concern discovered in off-site groundwater in this area were trichloroethene (TCE) and technetium-99 (^{99}Tc). Contaminated groundwater emanating from the northwest portion of PGDP is referred to as the Northwest Plume, and an interim remedial action was identified in the early 1990s in response to contaminants associated with the Northwest Plume (NWP). The *Record of Decision for Interim Remedial Action of the Northwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/06-1143&D4, (ROD) was signed in July 1993 (DOE 1993). As stated in the Declaration for the ROD, "the primary objective of this interim remedial action is to initiate a first phase remedial action, as an interim action to initiate control of the source and mitigate the spread of contamination in the Northwest Plume."

The Northwest Plume Groundwater System (NWPGS) construction was completed in May 1995, with system testing and shakedown through August 27, 1995. The NWP interim remedial action (IRA) System began routine pump-and-treat operations on August 28, 1995. The treatment system is housed in a preengineered metal building located outside the northwest corner of the PGDP security fence.

Two wells make up the south extraction well (EW) field at the PGDP security fence, and two wells comprise the north EW field approximately two miles north of the treatment system. Extracted groundwater is transferred through secondary containment dual-wall piping to the treatment facility. The treatment system is designed to remove TCE and ^{99}Tc using air stripping and ion exchange technologies. Spent ion exchange resin is removed from the vessels and replaced with new resin. Spent resin is shipped off-site as a low-level radiological waste. Off-gas from the air stripper passes through granular activated carbon prior discharge. Treated groundwater is discharged to a U.S. Department of Energy (DOE) permitted Outfall 001.

This Remedial Action Work Plan (RAWP) is intended to provide background information, define the project organization, identify project plans and procedures, and present a project planning schedule for optimization of the NWP IRA.

1.1 PURPOSE OF THE INTERIM REMEDIAL ACTION OPTIMIZATION

The NWP IRA Optimization project is intended to increase VOC mass removal and enhance capture in the vicinity of the current south well field of the NWP IRA System. This action was initiated in response to recommendations documented in past system evaluations and assessments as summarized below.

2003 CERCLA Five-Year Review (October 2003)

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Five-Year Review for 2003 was published in October 2003. In it, the assessors observed the following, "…persistent contaminant levels of approximately 100 µg/L TCE and 100 pCi/L ^{99}Tc in water samples from the east downgradient [monitoring wells] MW indicate that some dissolved contamination bypassing the South EW Field. Moreover, 2002 contaminant level trends suggest that the high-concentration core of the Northwest Plume persisted in migrating eastward and is now significantly bypassing the capture zone of the North EW Field." In the 2003 review, the assessors recommended that the EW field be evaluated for possible optimization.

Sitewide Remedy Review (March 2006)

In February and March 2006, DOE Headquarters (HQ) conducted a Site Wide Remedy Review at the PGDP. Recommendations in the Site Wide Remedy Review Report corroborated the recommendations and follow-up actions of the 2003 CERCLA Five-Year Review Report. The report specifically recommended evaluation of EW optimization for the NWP pump-and-treat system. One reason given for this follow-up action is that the high concentration core of the NWP (at the north EW field) has migrated eastward and is bypassing the capture zone of the well field. The review team noted that it is consistent with the ROD and the 2003 CERCLA Five-Year Review findings to modify the remedy in order to provide more cost-effective capture of the plumes.

Remedial Technology Review (October 2006)

At the request of the DOE HQ Office of Environmental Management, the Office of Groundwater and Soil Remediation secured the services of the U.S. Army Corps of Engineers to lead a Remediation System Evaluation (RSE) of the Northeast and Northwest Extraction Systems at PGDP during October 2006.

The RSE Review Team recommended terminating the extraction at the two northern EWs and increasing total extraction in the vicinity of the southern EWs by a similar amount. Additionally, the team suggested that there was no reason to permanently dismantle the wells, but rather the recommendation was only to terminate pumping from those wells. The design modification recommended would not require an increase in the capacity of the existing treatment plant according to the team recommendations.

Strategies recommended for increasing extraction in the vicinity of the southern wells included these:

- Increasing extraction at existing south wells and
- Adding additional extraction locations near the south well field.

2008 CERCLA Five-Year Review (May 2009)

The 2008 CERCLA Five-Year Review acknowledged that the IRA was reducing contaminant concentrations in the NWP, but it could be more effective by shutting off the pumps in the north field while increasing the pumping rate from the south well field. The primary concern expressed in the report with regard to the EW fields was the extent of the zones of capture. Hydrogeological information reviewed by the author(s) indicated that optimization of the extraction systems likely was warranted, and the author(s) acknowledged that a path forward was being pursued among the Federal Facility Agreement (FFA) parties.

This Five-Year Review documented DOE's commitment to modify the NWP IRA as recommended by the RSE Review Team. The RSE Review Team recommended terminating the extraction at the two northern wells and increasing total extraction in the vicinity of the southern wells. According to the team, the change would increase contaminant mass removal and enhance capture near the southern EWs, which are closer to the contaminant sources.

Site Management Plan (November 2010)

The D1 Site Management Plan for Fiscal Year 2010 identified DOE baseline planning assumptions for the NWP IRA System Optimization as follows:

- Discontinue extraction at the north well field, and

- Optimize extraction at the south well field through installation of additional EW(s) to increase effectiveness of capture of high concentration portions of the NWP in accordance with goals of the ROD and Five-Year Review.

1.2 SCOPE OF THE INTERIM REMEDIAL ACTION OPTIMIZATION

The NWP IRA System Optimization will include (1) design and installation of two new EWs; (2) design and installation of piping and leak detection monitoring stations; (3) design and construction of an overhead feeder to provide electrical power to the EWs; and (4) startup, testing, and system modifications. The wells will be installed in the vicinity of the current south well field and will have a design capacity of 220 gpm. The piping and leak detection system will transfer the extracted groundwater to the C-612 Treatment Facility. The current north EWs, EW228 and EW229, will be shut down and taken out of service. The current south wells, EW230 and EW231, will be taken off line, but will remain in stand-by mode to be made operational with minimal effort. Training of operations staff is included as a part of this project. Changes to the system operation will be documented in a revision to the Operations and Maintenance Plan (O&M) and will be further documented in a Post Construction Report.

2. REMEDIAL ACTION APPROACH

The DOE Environmental Restoration (ER) contractor has overall contractor responsibility for the design, construction, O&M, waste management, and disposal associated with the remedy. The major activities for this remedial action are outlined in this section.

Table 1 is a general list of activities typically governed by procedures. Procedures referenced in the table are those followed by the current DOE Prime Contractor. If a change in DOE Prime Contractor occurs, the procedures followed by the new DOE Prime Contractor will be substantially equivalent to those referenced below. The most current versions of all contractor procedures are to be used. This RAWP, plans referenced by this RAWP, and applicable procedures will be readily available in the field to project personnel, including subcontractors, either in hard copy or electronic format. If electronic files are provided, a computer will be available for accessing the document.

Table 1. General Activities Governed by Procedures

Activity	Applicable Procedure
Accident/Incident Reporting	PRS-ESH-1007, *Incident/Event Reporting*
Analytical Laboratory Interface	PRS-ENM-5004, *Sample Tracking, Lab Coordination, & Sample Handling Guidance*
Calibration of Measuring and Test Equipment	PRS-QAP-1020, *Control and Calibration of Measuring and Test Equipment*
Chain-of-Custody	PRS-ENM-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*
Collection of Samples	PRS-ENM-0018, *Sampling Containerized Waste* PRS-ENM-0023, *Composite Sampling* PRS-ENM-2101, *Groundwater Sampling* PRS-ENM-2300, *Collection of Soil Samples* PRS-ENM-2704, *Trip, Equipment, and Field Blank Preparation* PRS-ESH-5560, *Workplace Industrial Hygiene Sampling*

Table 1. General Activities Governed by Procedures (Continued)

Activity	Applicable Procedure
Conducting Assessments	PRS-QAP-1420, *Conduct of Assessments* PRS-REG-0003, *Performing Environmental Compliance Assessments and Identification and Reporting of Environmental Issues*
Construction Equipment Inspection	PRS-PRF-0004, *Construction Equipment Inspection and Maintenance*
Control of Sample Temperature	PRS-ENM-0021, *Temperature Control for Sample Storage*
Data Verification and Validation	PRS-ENM-0026, *Wet Chemistry and Miscellaneous Analyses Data Verification and Validation* PRS-ENM-0811, *Pesticide and PCB Data Verification and Validation* PRS-ENM-5102, *Radiochemical Data Verification and Validation* PRS-ENM-5103, *Polychlorinated Dibenzodioxins/Polychlorinated Dibenzofurans Data Verification and Validation* PRS-ENM-5105, *Volatile and Semivolatile Data Verification and Validation* PRS-ENM-5107, *Inorganic Data Verification and Validation*
Decontamination of Large Equipment	PRS-FCD-2701, *Large Equipment Decontamination*
Decontamination of Sampling Equipment	PRS-ENM-2702, *Decontamination of Sampling Equipment and Devices*
Document Control	PRS-DOC-1107, *Development, Approval, and Change Control for PRS Performance Documents*
Documenting and Controlling Field Changes to Approved Plans	PRS-WCE-0021, *Work Execution* PRS-WCE-0027, *Field Change Request (FCR), Field Change Notice (FCN), and Design Change Notice (DCN) Process*
Evaluations for Suspect/Counterfeit Items	PRS-QAP-1009, *Identification, Control, and Disposition of Suspect/Counterfeit Items*
Fall Prevention	PRS-ESH-2004, *Fall Prevention and Protection*
Field Engineering Inspections and Surveys	PRS-WCE-0001, *Field Engineering Inspections and Surveys*
Field Logbooks	PRS-ENM-2700, *Logbooks and Data Forms*
Graded Approach	PRS-QAP-1650, *Graded Approach*
Handling, Transporting, and Relocating Waste Containers	PRS-WSD-0661, *Transportation Safety Document for On-site Transport within the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*
Hoisting and Rigging Operations	PRS-WCE-0012, *Hoisting and Rigging Operations*
Inspection and Test Plans and Review of Vendor/Supplier QA Program	PRS-QAP-1208, *Supplier Quality Program Evaluation and Receipt Inspection and Testing Requirements*
Issue Management (includes corrective action)	PRS-QAP-1210, *Issues Management Program*
Lithologic Logging	PRS-ENM-2303, *Borehole Logging*
Nonconforming Items and Services	PRS-QAP-1440, *Control of Nonconforming Items and Services* PRS-ESH-2001, *Identifying Defective Equipment*
Powered Industrial Trucks	PRS-ESH-2007, *Industrial Motorized Trucks (Forklifts)*
Quality Assured Data	PRS-ENM-5003, *Quality Assured Data*
Quality Assurance Program	PRS-CDL-0058, *Quality Assurance Program Plan for the Paducah Environmental Remediation Project, Paducah Kentucky*
Radiation Protection	PRS-CDL-0060, *Radiation Protection Program for the Paducah Environmental Remediation Project*

Table 1. General Activities Governed by Procedures (Continued)

Activity	Applicable Procedure
Records Management	PRS-DOC-1002, *PGDP DMC Document/Record Requests and Records Submittals* PRS-DOC-1009, *Records Management, Administrative Record, and Document Control*
Revisions to Procedures or Work Packages	PRS-DOC-1107, *Development, Approval, and Change Control for PRS Performance Documents* PRS-WCE-0018, *Work Management Program for the Paducah Environmental Remediation Project Paducah, Kentucky* PRS-WCE-0021, *Work Execution*
Shared Site Issue Resolution	PRS-PRM-4010, *Shared Site Issues*
Shipping Samples	PRS-WSD-9503, *Off-Site Sample Shipping*
Subcontract Management	PRS-BFM-0008, *Receipt and Evaluation of Proposals*
Suspend/Stop Work	PRS-ESH-2018, *Suspension of Work (Safety Related)*
Temperature Extremes	PRS-ESH-5134, *Temperature Extremes*
Training	PRS-PROG-0016,*Project Training Program Description for the Paducah Environmental Remediation Project* PRS-TRN-0702, *Conduct of Training* PRS-TRN-0710, *Assignment of Training* PRS-TRN-0750, *Required Reading*
Transmission of Data	PRS-ENM-1001, *Transmitting Data to the Paducah Oak Ridge Environmental Information System (OREIS)*
Vendor/supplier evaluations	PRS-QAP-1208, *Supplier Quality Program Evaluation and Receipt Inspection and Testing Requirements*
Waste Management and Disposition	PRS-WSD-0016, *Waste Handling and Storage in DOE Waste Storage Facilities* PRS-WSD-0307, *Paducah Waste Characterization SAP* PRS-WSD-0437, *Waste Characterization and Profiling* PRS-WSD-3010, *Waste Generator Responsibilities for Temporary On-Site Storage of Regulated Waste Materials at Paducah*

The drilling subcontractor will have access to the C-752-C Decontamination Facility. Drill rigs, well "work over" rigs, all downhole tooling, and any well materials that are not shipped pre-cleaned to the site will be decontaminated according to procedure PRS-FCD-2701, *Large Equipment Decontamination*, prior to use in construction of the wells. These materials will be steam cleaned, using soap and high pressure hot water or steam (alternatively, the materials may be cleaned with tap water and soap, using a brush); rinsed with tap water; subsequently handled only by personnel wearing clean gloves, and then covered with clean plastic until use. The drilling subcontractor will clean all downhole tooling between boreholes and will clean all drill rigs, well "work over" rigs, and downhole tooling before leaving the site.

2.1 WELL FIELD OPTIMIZATION MODELING

The optimization effort was undertaken utilizing the updated PGDP groundwater flow model (DOE 2009) coupled with *Brute Force*, a particle tracking optimization code (Laase *et al*. 1999). *Brute Force* is based on sequential MODFLOW-2000 (Harbaugh *et al*. 2000) and MODPATH (Pollack 1994) runs and uses particles as surrogates for groundwater contamination. The particles are assigned unique identifiers corresponding to dissolved contaminant mass and required capture time. For this design effort, the assigned capture times were large to minimize potential changes to the regional horizontal hydraulic gradient except in the immediate vicinity of the EW(s). In addition to assigning individual particle weights and capture times, a global mass capture percentage is assigned for the design. The design goal was to capture 100% of the dissolved mass, if possible. None of the designs, however, achieved 100% global mass capture.

Candidate EWs are located within the model domain and are assigned minimum and maximum allowable and initial testing (unit stimuli) pumping rates. To determine the optimal well field configuration, the algorithm sequentially pumps each candidate well location at the initial testing rate to determine which well location captures the most particles (dissolved contaminant mass). After all the candidate wells have been tested, the wells are ranked from highest to lowest with respect to particle capture. The candidate well capturing the greatest dissolved mass (weighted particles) is selected for further evaluation, which entails incrementally increasing the well's pumping rate until the global mass capture criterion is achieved or the maximum allowable pumping rate is reached. If the first well fails to capture a sufficient number of particles, the particles captured by that well are identified as already being captured, the well is kept pumping in the model, and the candidate well evaluation is repeated with the best well being that capturing the greatest number of the remaining particles. The well evaluation loop continues until the assigned global mass capture criterion is satisfied or the maximum allowable number of wells is reached.

Simulation runs for one, two, three, and four well scenarios were executed for current flow field conditions (with anthropogenic recharge). Where multiple wells were simulated, they were modeled at equal extraction rates for a total flow of 250 gpm to the treatment system. Predicted mass capture for the different scenarios were 99.94%, 99.91%, 99.53%, and 99.86 % for the one, two, three, and four well scenarios, respectively.

Based on the predicted mass capture for the two well scenario above and the desire to use fewer EWs, the one and two well scenarios were executed to evaluate future flow field conditions (no anthropogenic recharge). Predicted mass capture was 99.98% and 99.99% for the one and two well scenarios, respectively.

Based on the results indicating that the two-well scenario performed very well under both current and future flow field conditions, the two-well scenario then was run to evaluate mass capture at a total extraction rate of 220 gpm, which is the historical maximum flow rate for the pump-and-treat facility. Mass capture predictions were 99.87% and 99.97% for the current and future flow field conditions, respectively.

2.2 WELL FIELD AND SYSTEM DESIGN

2.2.1 Key Design Changes

The NWP IRA optimization will implement the following design changes:

- The current north EWs, EW228 and EW229, will be shut down and taken out of service.
- The north EWs will not be abandoned at this time, but they will not be operational.
- The current south wells, EW230 and EW231, will be taken off line, but will remain in stand-by mode so as to be made operational with minimal effort.

2.2.2 Key Design Assumptions

The NWP IRA optimization will be designed based on the following key assumptions:

- The EW field volumetric flow rate is limited by the current treatment plant capacity (approximately 220 gpm).

- No upgrades are planned for the pump-and-treat facility to increase the treatment throughput.

- Well field design will be based on modeling results and on geotechnical data (grain size analyses and lithologic logs) gathered from boreholes installed in close proximity to the proposed well locations.

- Pumping tests will not be performed as a basis for design of the new EWs.

- Electrical power will be provided from existing feeder lines supplying power to the C-612 Treatment Facility and the current south EWs.

- No wetlands will be impacted as a result of proposed locations for new extractions wells.

- The NWP IRA Optimization activities will be performed in accordance with NWP IRA ROD applicable or relevant and appropriate requirements (ARARs) with the addition of new ARARs for MW and EW installation and abandonment.

2.2.3 Well Field Design

Well field optimization modeling indicates that a two well configuration is optimal. The two new wells, EW232 and EW233, will be located north of the fence line at the northwest corner of PGDP. Refer to Figure 1 for proposed well locations. The EWs will have a design capacity 220 gpm each, as allowable by the formation.

Boreholes were installed approximately 10 to 12 ft from the proposed locations for the two new EWs. Detailed lithologic logs were generated for these borings and samples were collected from each for grain size analyses (See Appendix). The well screen and filter pack design will be based on these grain size analyses and evaluation of the lithologic logs for the pilot borings.

2.2.4 Construction

Mechanical and electrical design will be compatible with the current NWP IRA system. Materials of construction will be appropriate for conditions associated with the NWP IRA system. The transfer pipeline will be dual-walled and will pass through manholes configured with leak detection. The transfer line for the new wells will tie in to an existing manhole on the east side of the C-612 Facility at the north well header. Refer to Figure 2 to see the site layout and pipeline profile. Refer to Figure 3 and Figure 4 for diagrams of the new EWs. The combined transfer line from EW232 and EW233 will cross the discharge ditch from C-616 Lagoon. During construction activities, best management practices will be implemented to minimize erosion and silt runoff into the ditch.

As indicated in the assumptions, the existing north wells, EW228 and EW229, will be taken out of operation. Instrumentation and control logic for EW228 and EW229 will be changed at the C-612 programmable logic controller thereby making them inoperable without additional effort. Mechanical, electrical, and instrumentation/control changes affecting the existing south wells, EW230 and EW231, will be minor to allow them to be put back into service quickly.

2.3 START UP AND TESTING

The NWP IRA System will be offline for an estimated five days to allow for final connections and construction acceptance testing activities. Intermittent shut downs will be required during integrated testing of the new wells and system control logic. The start up and testing plan will be documented in a revision to the O&M plan.

2.4 OPERATIONS AND MAINTENANCE

Upon successful completion of the integrated testing, the new wells are expected to be routinely operated at approximately 110 gpm each. Ongoing O&M will be performed in accordance with the revised O&M Plan and operating procedures. The U.S. Environmental Protection Agency (EPA) and KY will have an opportunity to review revisions to the O&M Plan prior to start up of the new wells for routine operations.

2.5 EFFECTIVENESS MONITORING

An effectiveness monitoring program consistent with the NWP ROD will be installed as part of the NWP IRA Optimization. The purpose of system effectiveness monitoring is to create and maintain an adequate database on the hydrogeological situation in the NWP and to enable changes to be made in extraction/injection that will optimize remediation and containment. Components of effectiveness monitoring include collection and assessment of hydraulic data and contaminant chemistry data. Specific elements of system effectiveness monitoring for the optimized NWP IRA system will be provided in the revised O&M Plan, currently in development.

2.6 WASTE MANAGEMENT AND DISPOSITION

Waste generated during drilling and construction activities will be managed and dispositioned in accordance with the Waste Management Plan (WMP) and ARARs. Waste characterization will be performed using analytical results from waste sample analysis in Section 8.3 and from process knowledge where applicable. Refer to the WMP for additional detail concerning waste management and disposition.

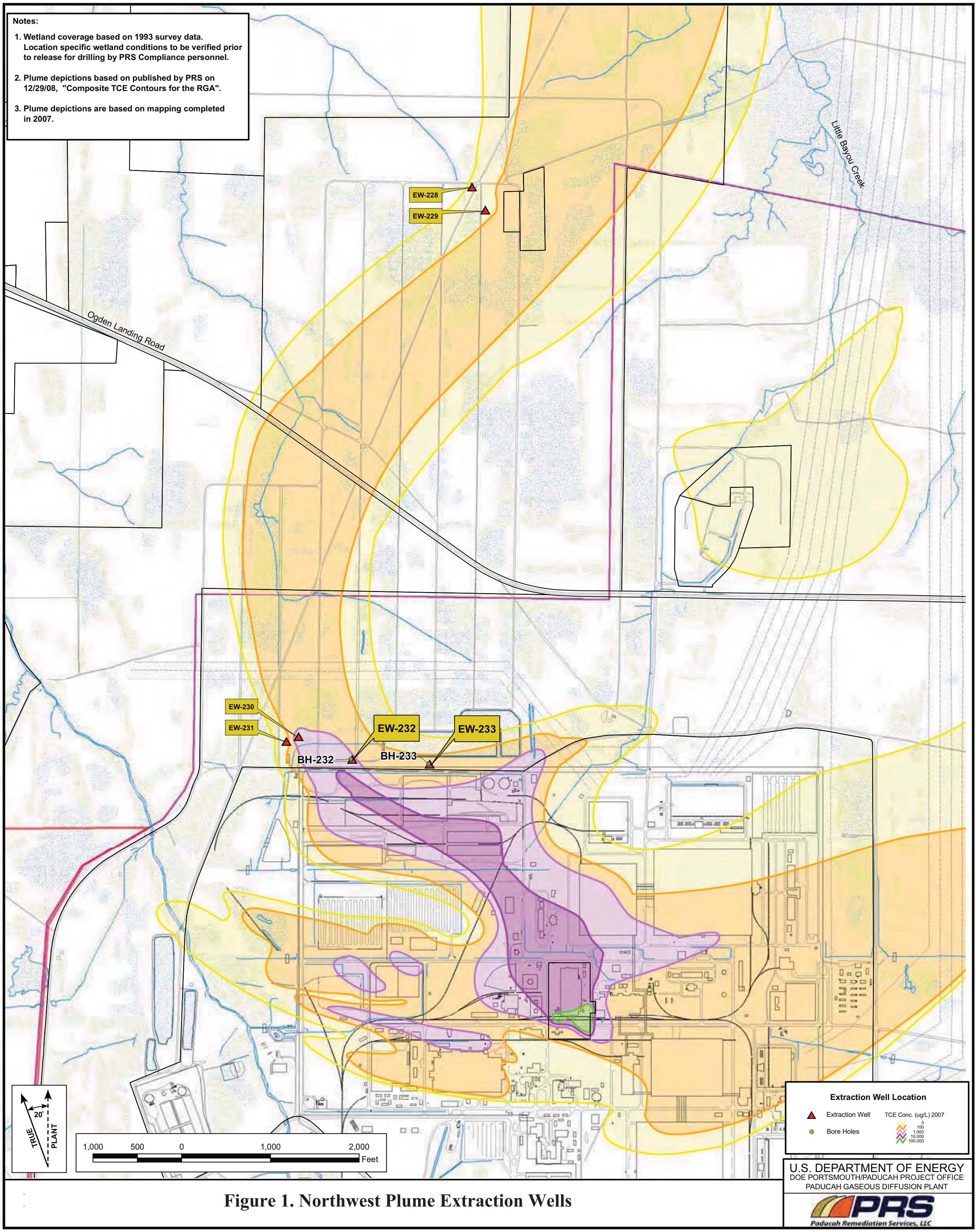

Figure 1. Northwest Plume Extraction Wells

FIGURE No. \\GIS\...\NW_Plume\EW_Locations.mxd
DATE 02-04-2010

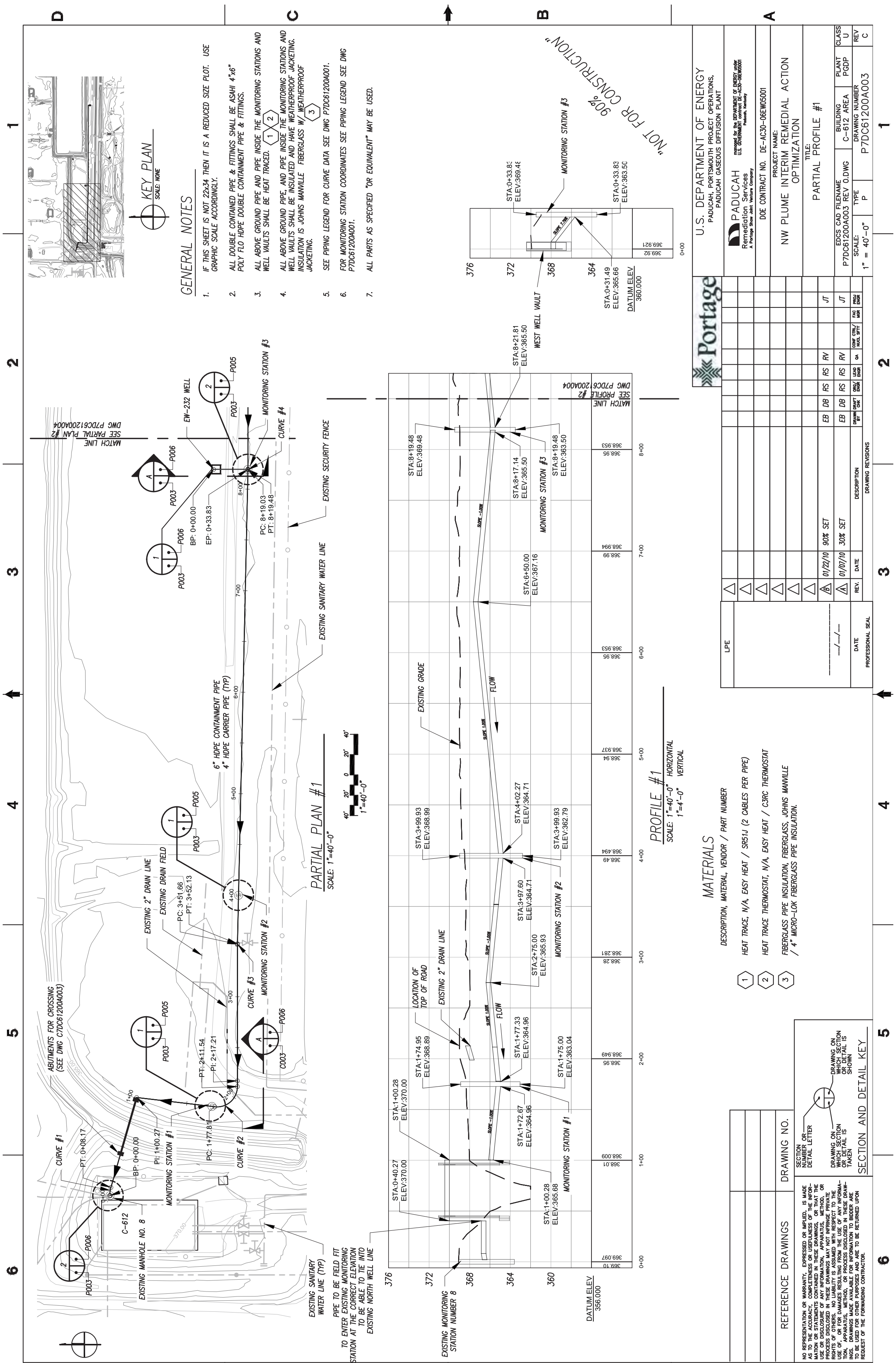

Figure 2. Site Plan and Pipeline Profile

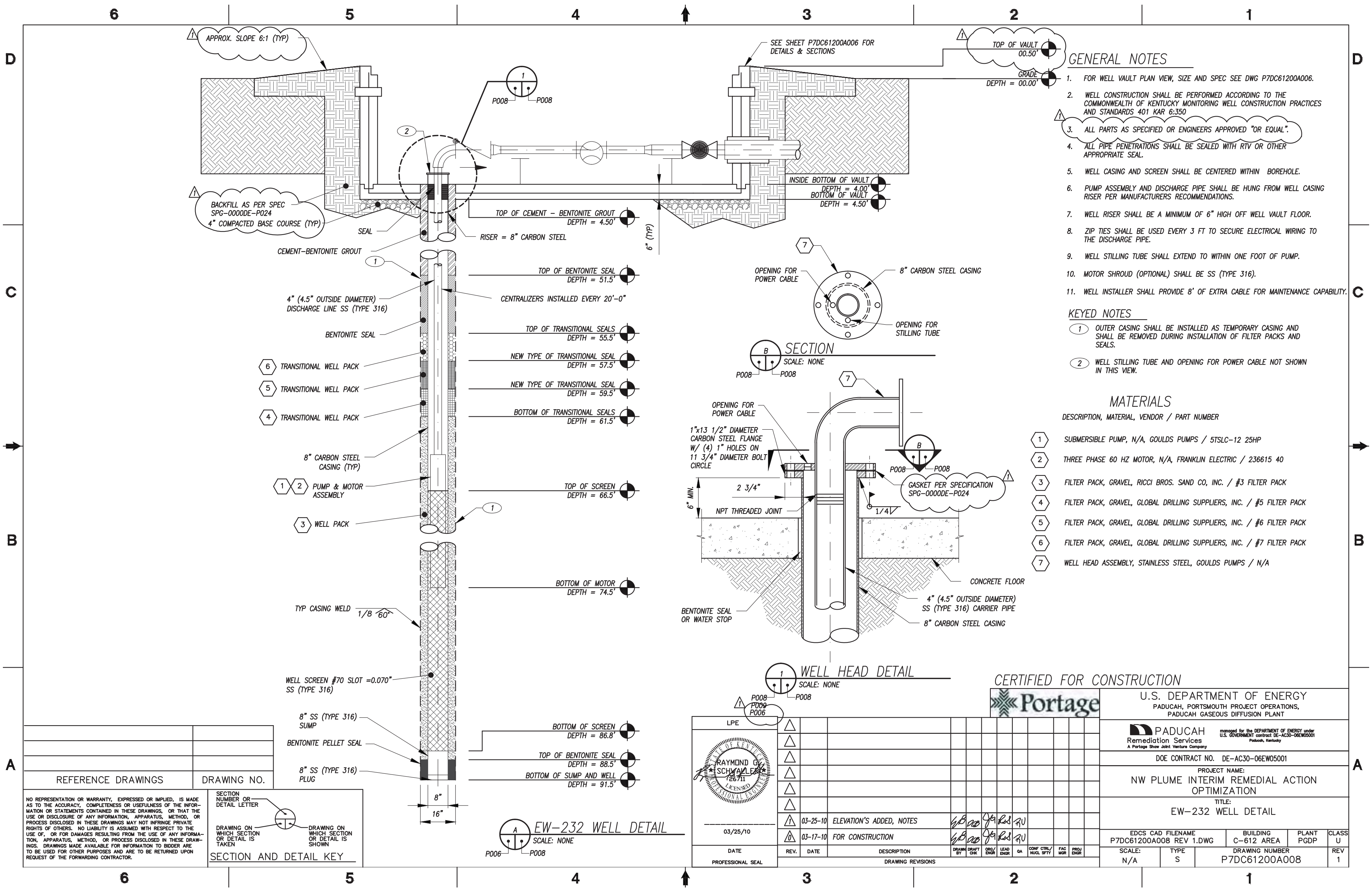

Figure 3. EW232 Well Detail

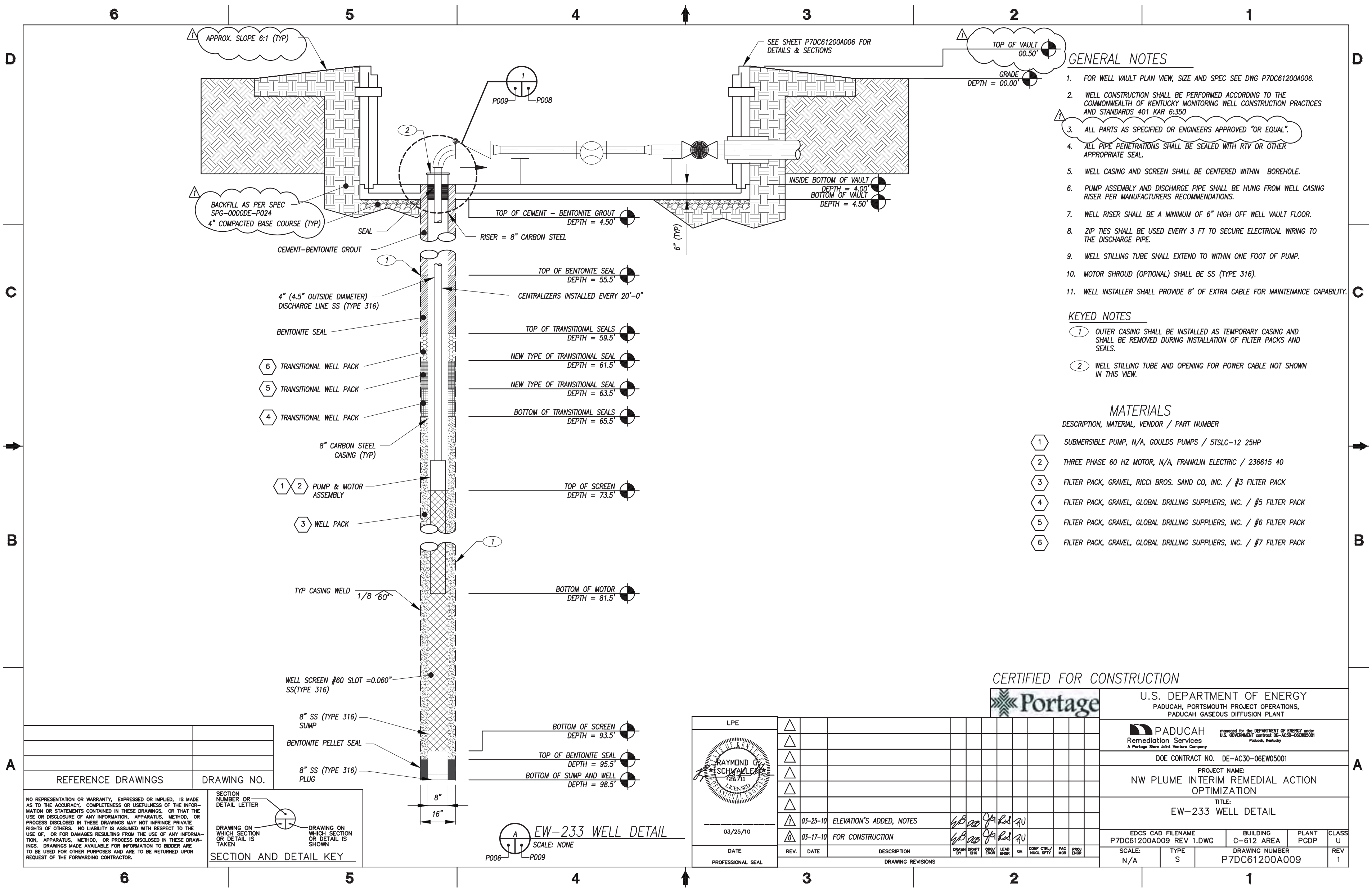

Figure 4. EW233 Well Detail

3. PROJECT ORGANIZATION

The roles and responsibilities of the project team members are described below.

DOE Project Manager—Serves as the point of contact with regulatory agencies, and directs the overall completion of the remedial action in accordance with the approved RAWP.

Prime Contractor Project Manager—Serves as the primary point of contact with DOE to implement the remedial action. Performs work in accordance with the baseline scope and schedule and directs the day-to-day activities of Contractor personnel.

Quality Assurance/Quality Control Manager—Verifies all work is completed in accordance with the Quality Assurance Plan. Develops Quality Assurance (QA)/Quality Control (QC) procedures and implementing administrative procedures that govern both technical and non-technical work.

Field Superintendent—Oversees all field activities and verifies field operations follow established plans and procedures.

Health and Safety Representative—Assists in the development of the Health and Safety (H&S) Plan, and Activity Hazard Analysis and verifies implementation of Worker Safety and Health Program and Integrated Safety Management Systems. The H&S Representative provides oversight for safety and health compliance performance.

Environmental Compliance Representative—Oversees implementation of the Environmental Management Systems. The Environmental Compliance Representative provides direct support to the Prime Contractor Project Manager.

Waste Management Coordinator—The Waste Management Coordinator (WMC) will manage all waste according to PGDP facility requirements and the WMP. WMC responsibilities include coordinating daily activities with field personnel, overseeing daily waste management operations, and maintaining a waste management logbook.

Field Technical Staff—Provides direct support to the Field Superintendent concerning technical aspects of the project.

Subcontractors—Provides equipment and expertise during drilling, EW installation, and pipeline construction.

Training of project personnel will be in accordance with training matrices developed for this project.

4. PROJECT SCHEDULE

A generalized project planning schedule is shown in Table 2.[1]

Table 2. Project Planning Schedule

Activity	**Date**
Regulatory Concurrence to Proceed with Procurement	January 21, 2010
Final Design Complete	February 12, 2010
RAWP	
Submittal of Draft D1 to EPA/KY	February 11, 2010
Joint Comment Resolution	February 26, 2010
Submittal of D1 RAWP to EPA/KY	April 27, 2010
Approval of D1	May 7, 2010
ESD	
Submittal of D1 Explanation of Significant Difference to EPA/KY	May 18, 2010
Joint Comment Resolution	June 17, 2010
Regulatory Approval of D2	August 2, 2010
Issue Public Notice of Availability	August 18, 2010
Construction Mobilization	March 3, 2010
Drilling/Construction Start	March 18, 2010
Construction Complete	June 30, 2010
O&M Plan	
Submittal of the draft revised O&M Plan to EPA/KY	May 14, 2010
Joint Comment Resolution	June 1, 2010
Approval of revised O&M Plan	June 8, 2010
System Start Up and Testing Complete	July 13, 2010
System Turnover to O&M Personnel	July 13, 2010
Post Construction Report	
Submittal of the D1 Post Construction Report to EPA/KY	August 31, 2010
Submittal of the D2 Post Construction Report to EPA/KY	October 15, 2010
Approval of D2 Post Construction Report	November 22, 2010

[1] Projected schedules for completion of activities set forth herein are estimates provided for informational purposes only and are not considered to be enforceable elements of the remedial action or this document. The enforceable milestones for performance of activities included as part of the remedial action are set forth in the Federal Facility Agreement (FFA) (EPA 1998). Any additional milestones, timetables, or deadlines for activities included as part of the remedial action will be identified and established independent of this RAWP, in accordance with existing FFA protocols.

5. HEALTH AND SAFETY PLAN

The NWP IRA Optimization project will incorporate by reference the H&S Plan requirements from the *Remedial Action Work Plan for the Interim Remedial Action for the Volatile Organic Compound Contamination at the C-400 Cleaning building at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0004&D2/R1 (C-400 RAWP) (DOE 2008). The C-400 RAWP H&S Plan will be applicable as written with the following exception:

- Replace references to the C-400 IRA with NWP IRA Optimization project.

6. ENVIRONMENTAL COMPLIANCE PLAN

Environmental regulatory compliance will be facilitated during the implementation of this optimization project by adhering to ARARs. The original ARARs from the Northwest Plume ROD remain in effect and are incorporated by reference. Table 3 presents additional ARARs for the installation of the wells.

6.1 WELL CONSTRUCTION VARIANCE REQUEST

A variance from 401 *KAR* 6:350 § 3(3)(a) will be relied upon to allow for the use of a thread lubricant during the drilling of EWs. The thread lubricant will be a petroleum, hydrocarbon-free product such as Well-Guard® by Jet-Lube of Canada LTD. Supporting information for the requested variance is detailed below. Approval of this document signifies that use of the variance for thread lubricant is allowed.

6.1.1 Description of Land Use at the Site

DOE holds a total of 3,556 acres of land at the Paducah Site. The industrial portion of PGDP is situated within a fenced security area consisting of approximately 650 acres. Within this area, designated as secured (i.e., fenced and patrolled) industrial land use, are numerous buildings and offices, support facilities, equipment storage areas, and active and inactive waste management units. Outside the fenced security area is approximately 1,986 acres of land that is licensed to the Commonwealth of Kentucky through the Kentucky Department of Fish and Wildlife Resources (KDFWR) as part of the West Kentucky Wildlife Management Area (WKWMA). The entire WKWMA covers approximately 6,823 acres. The land leased to the WKWMA is designated as recreational and is used extensively for outdoor recreation such as hunting and fishing. The remaining portions of the Paducah Site consist of approximately 800 acres of land owned and maintained by DOE outside of the secured area (that are not part of the WKWMA) and 133 acres of easements acquired by DOE.

PGDP is designated as on-site secured (i.e., fenced) industrial land use. The DOE property outside the security area is designated as industrial land use. It is noted that the proposed EW locations are outside of the security fence. The DOE property that is part of the WKWMA is designated as recreational land use. The WKWMA also is designated recreational land use. North of the DOE property, the Tennessee Valley Authority (TVA) operates the Shawnee Steam Plant. This TVA property is designated as industrial land use.

Table 3. Summary of ARARs for Monitoring and Extraction Well Installation and Abandonment

Monitoring and Extraction Well Installation and Abandonment			
Monitoring well installation	Permanent monitoring wells shall be constructed, modified, and abandoned in such a manner as to prevent the introduction or migration of contamination to a water-bearing zone or aquifer through the casing, drill hole, or annular materials.	Construction of monitoring well as defined in 401 *KAR* 6:001 § 1(18) for remedial action—**applicable**.	401 *KAR* 6:350 §1(2)
	All permanent monitoring wells (including boreholes) shall be constructed to comply with the substantive requirements provided in the following Sections of 401 *KAR* 6:350: • Section 2. Design Factors; • Section 3. Monitoring Well Construction; • Section 7. Materials for Monitoring Wells; and • Section 8. Surface Completion.		401 *KAR* 6:350 § 2, 3, 7, and 8
	If conditions exist or are believed to exist that preclude compliance with the requirements of 401 *KAR* 6:350, may request a variance prior to well construction or well abandonment. *NOTE: Variance shall be made as part of the FFA CERCLA document review and approval process and shall include:* • A justification for the variance; and • Proposed construction, modification, or abandonment procedures to be used in lieu of compliance with 401 *KAR* 6:350 and an explanation as to how the alternate well construction procedures ensure the protection of the quality of the groundwater and the protection of public health and safety.		401 *KAR* 6:350 § 6 (a)(6) and (7)
Development of monitoring well	Newly installed wells shall be developed until the column of water in the well is free of visible sediment. This well-development protocol shall not be used as a method for purging prior to water quality sampling.	Construction of monitoring well as defined in 401 *KAR* 6:001 § 1(18) for remedial action—**applicable**.	401 *KAR* 6:350 §9

Table 3. Summary of ARARs for Monitoring and Extraction Well Installation and Abandonment (Continued)

Direct Push monitoring well installation	Wells installed using direct push technology shall be constructed, modified, and abandoned in such a manner as to prevent the introduction or migration of contamination to a water-bearing zone or aquifer through the casing, drill hole, or annular materials.	Construction of direct push monitoring well as defined in 401 *KAR* 6:001 § 1(18) for remedial action—**applicable**.	401 *KAR* 6:350 § 5 (1)
	Shall also comply with the following additional standards: (a) The outside diameter of the borehole shall be a minimum of 1 inch greater than the outside diameter of the well casing; (b) Premixed bentonite slurry or bentonite chips with a minimum of one-eighth (1/8) diameter shall be used in the sealed interval below the static water level; and (c) 1. Direct push wells shall not be constructed through more than one water-bearing formation unless the upper water bearing zone is isolated by temporary or permanent casing. 2. The direct push tool string may serve as the temporary casing.		401 *KAR* 6:350 § 5 (3)
Monitoring well abandonment	A monitoring well that has been damaged or is otherwise unsuitable for use as a monitoring well, shall be abandoned within 30 days from the last sampling date or 30 days from the date it is determined that the well is no longer suitable for its intended use.	Construction of monitoring well as defined in 401 *KAR* 6:001 § 1(18) for remedial action—**applicable**.	401 *KAR* 6:350 § 11 (1)
	Wells shall be abandoned in such a manner as to prevent the migration of surface water or contaminants to the subsurface and to prevent migration of contaminants among water bearing zones.		401 *KAR* 6:350 § 11 (1)(a)
	Abandonment methods and sealing materials for all types of monitoring wells provided in subparagraphs (a)-(b) and (d)-(e) shall be followed.		401 *KAR* 6:350 § 11 (2)
EW installation	Wells shall be constructed, modified, and abandoned in such a manner as to prevent the introduction or migration of contamination to a water-bearing zone or aquifer through the casing, drill hole, or annular materials.	Construction of extraction well for remedial action—**relevant and appropriate**.	401 *KAR* 6:350 § 1 (2)

Surrounding the DOE property, WKWMA, and TVA is private property. This property is primarily rural residential and agricultural land use.

In addition, 26% of the total land area of Ballard County and 24% of McCracken County are designated as commercial forestland.

The two EWs covered by this variance request will be installed on DOE property at the northwest corner of PGDP, outside of the fenced area.

6.1.2 Distance between the Proposed Location and Other Existing Water-Supply Wells

The locations of EW232 and EW233 are approximately one mile from the nearest residential wells. These residential wells are just outside of the boundary of the DOE water policy that supplies residents with municipal water.

6.1.3 Distance between the Proposed Extraction Wells and Potential Pollution Sources

The new EWs are being installed outside of the secured area on the northwest corner of PGDP. The wells will be completed in the Regional Gravel Aquifer (RGA) for the purpose of extracting TCE and ^{99}Tc contaminated groundwater from the NWP. The western most well, EW232, is being installed approximately 500 ft from an existing septic drain field for the C-612 trailer complex. The eastern most well, EW233 is approximately 1,200 ft from the drain field. The new wells are located approximately 3,500 ft downgradient of the C-400 area. EW232 is being installed adjacent to SWMUs 30 and 7. EW233 is being installed approximately 500 ft west of SWMU 7. EW232 and EW233 are approximately 2,500 ft north of SWMU 4.

6.1.4 A Description of the Geologic Conditions Expected at the Site

In general, the stratigraphy expected at the site from ground surface to bedrock is as follows:

- Alluvium or loess ranging from 0 to 43-ft thick. The alluvium is brown or gray sand and silty-clay or clayey silt with streaks of sand. The loess is brown or yellowish-brown to tan unstratified silty clay.

- Beneath the loess are continental deposits consisting of an upper clay facies with mottled gray to brown clayey silt and silty clay; some very fine sand and a trace of gravel; and a lower gravel facies with reddish-brown clayey, silty and sandy chert gravel, and beds of gray sand. The continental deposits range in thickness from 3 to 121 ft. Within these continental deposits is a specific facies known as the RGA. The top of the RGA typically lies 40 to 60 ft bgs. The depth of the RGA in the proposed well locations is between 60 to 98 ft bgs. Near the present-day Ohio River floodplain, the RGA lies only 5 to 10 ft bgs due to incising creeks approaching the Ohio River.

- Underlying the continental deposits is the McNairy Formation, a grayish-white to dark gray micaceous clay, often silty, interbedded with light gray to yellowish-brown very fine to medium gray sand with lignite and pyrite. The upper part is interbedded clay and sand and the lower part is sand. The McNairy Formation is 200- to 300-ft thick.

- Beneath the McNairy is the rubble zone, which consists of a 5 to 20 ft-thick layer of subangular chert and silicified limestone fragments.

- Bedrock beneath the rubble zone is Mississippian limestone and is 500+ ft thick.

The EWs will be terminated at the bottom of the continental deposits in the RGA, although some drilling into the upper McNairy is possible. All sediments/cuttings will be containerized.

6.1.5 Administrative Regulation for Which the Variance Is Needed

This requested variance applies to 401 *KAR* 6:350**§** 3(3)(a), which states, "Lubricant shall not be used on drill pipe threads, hollow-stem or solid-stem augers, or on the exterior of the drill pipe, unless approved in advance by the cabinet…."

6.1.6 A Justification for the Variance

The lubricant is intended to be applied on joints of the drill string. These joints commonly become stuck during drilling in the absence of a lubricant, requiring the drillers to apply excessive force to "break" the joints. The use of excessive force to separate the drill string joints is a safety concern, which can result in broken tooling and injured drillers. It is anticipated that the application of lubricant can significantly reduce the incidence of stuck tooling.

6.1.7 Protection of the Quality of the Groundwater and of Public Health and Safety

Two aspects of this variance request protect the quality of groundwater. First, only a petroleum, hydrocarbon-free product (such as Well-Guard® by Jet-Lube of Canada LTD) will be used. The lubricant is nontoxic and biodegradable. Second, the lubricant will be applied, only to the inner drill string. The inner drill string is encased in the steel outer casing while drilling, thus minimizing any smearing directly on the borehole wall and well construction materials.

6.2 WITHDRAWAL OF PUBLIC WATERS

In accordance with Section XXI of the FFA, which requires that DOE identify permits that otherwise would have been required in the absence of CERCLA Section 121(e) (1) and the National Contingency Plan, this section identifies the Commonwealth of Kentucky requirement for a permit to withdraw water from a public groundwater source (*KRS* Chapter 151.150). Such a permit is not needed for this CERCLA action.

The NWP IRA Optimization project, a CERCLA action, includes the installation of two new EWs for the purpose of extracting contaminated groundwater from the Northwest Plume. The wells will be installed in accordance with ARARs in Table 3.

The proposed locations of the new wells, EW232 and EW233, are shown on Figure 1. Refer to Figures 3 and 4 for design details for the wells. Installation of the new wells and commencement of water withdrawal will be in accordance with the planning schedule shown in Section 4. Withdrawal rates will be measured by flow meters installed at each well. Combined groundwater extraction from these two wells is not expected to exceed 250 gpm (or 360,000 gpd).

7. WASTE MANAGEMENT

This WMP is the primary document for management and final disposition of waste material that will be generated as a result of the NWP IRA Optimization project. The project includes the installation of two EWs and construction of a pipeline to transfer the groundwater to the C-612 Treatment Facility.

This WMP addresses the management of waste from the point of generation through final disposition. The NWP IRA Optimization project is part of DOE prime contractor's ER program, and the DOE prime contractor shall be responsible for all waste management activities. Standard practices and procedures outlined in this WMP pertaining to the generation, handling, transportation, and storage of waste will comply with all DOE, Resource Conservation and Recovery Act (RCRA), and Toxic Substances Control Act (TSCA) requirements.

Copies of this WMP will be available during fieldwork. The DOE prime contractor's ER WMC and the Filter Press Operations Supervisor will be responsible for implementing procedures and requirements of this WMP.

The WMP for the NWP IRA Optimization project underscores the following objectives:

- Management of project waste in a manner that is protective of human health and the environment
- Minimization of waste generation
- Compliance with federal, state, and DOE requirements
- Selection of storage and disposal alternatives

All waste management activities must comply with this WMP; applicable procedures; the C-746-U Landfill waste acceptance criteria (WAC) (*Waste Acceptance Criteria for the Department of Energy Treatment, Storage and Disposal Units at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, PRS-WSD-0011); *Hazardous Waste Facility Operating Permit*—Permit No. KY8-890-008-982; and the WAC for off-site treatment, storage, and disposal facilities (TSDF) designated to receive waste. The decision has not been made as to the final TSDF that will be used. Potential off-site TSDFs that may be used include, but are not limited to, Energy*Solutions*, Nevada Test Site, Perma-Fix, and Waste Control Specialists.

During the course of this project, additional PGDP and DOE waste management requirements may be identified. Necessary revisions to the WMP will ensure the inclusion of these additional requirements into the daily activities of waste management personnel. DOE will inform the FFA parties of any substantive changes to the WMP. The criteria for document changes will be those found in the *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant* (EPA 1998).

7.1 WASTE GENERATION AND PLANNING

7.1.1 Waste Generation

A variety of waste may be generated during this project, including soil cuttings and water from drilling activities in the Upper Continental Recharge System and RGA; dewatered soil and water from waste water filtration activities; personal protective equipment (PPE); sample residual (used sample bottles, etc.); grout; and sanitary trash. The waste generated from field-related activities has the potential to contain contaminants related to known or suspected past operations; therefore, this waste must be stored and disposed of in accordance with ARARs. Waste that is likely to have either hazardous or radiological contamination typically will be stored on-site in containers in CERCLA waste storage areas in accordance with PRS-WSD-3010, *Waste Generator Responsibilities for Temporary On-Site Storage of Regulated Waste Materials at Paducah*, during the characterization period and prior to treatment/disposal. Consistent with EPA Policy, the generation, storage, and movement of waste during a CERCLA project and storing it on-site does not trigger the administrative RCRA storage or disposal requirements. On-site waste storage areas will be managed in accordance with the substantive RCRA hazardous waste storage standards. Among the substantive requirements are compatible containers in good condition, regular inspections, containment to control spills or leaks, and characterization of run-on and run-off, either by process knowledge or by sampling. Final disposition of the materials will depend on final characterization. Table 4 summarizes estimated quantities and container types.

Waste generated during field activities will require a comprehensive waste-tracking system capable of maintaining an accurate inventory of waste. To prevent inappropriate disposal of waste, all generation, storage, and characterization information must be included in the tracking system. Specifically, the waste inventory must include the following information:

- Generation date
- Request for Disposal (RFD) number
- Waste origination location
- Waste matrix (solid, liquid)
- Waste description (soil, PPE, etc.)
- Quantity
- Storage location
- Sampling status
- Sampling results status
- Date of disposal

Table 4. Estimation of Waste

Waste Stream	Volume	Container Type and Quantity	Disposition Facility	Treatment Required
Soil and other solid media (cuttings, drill tool decontamination solids, lithologic core, filter press solids)	65 yd^3	4 roll off/intermodal boxes	C-746-U or off-site facility	None or off-site LDR treatment*
Well Installation Water	20,000 gal	Mobile, Portable Containers	C-612	C-752-C Solids removal
Decontamination Water	5,000 gal	Mobile, Portable Containers	C-612	C-752-C Solids removal
Well Development Water	150,000 gal	Mobile, Portable Containers	C-612	C-752-C Solids removal
Personal Protective Equipment	3 yd^3	29 1A2X Drums	C-746-U or off-site facility	None or off-site LDR treatment
Grout/Concrete	1 yd^3	34.5 1A2X Drums	C-746-U or off-site facility	None or off-site LDR treatment

* Waste not meeting the definition of hazardous waste at the point of generation and meeting the requirements of the WAC may be disposed of in the C-746-U Landfill with no further treatment. Waste meeting the definition of hazardous waste at the point of generation must be treated to LDR standards prior to landfill.

7.1.2 Drill Cuttings and Excavated Soil from Drilling and Construction Activities

Solid waste drilling cuttings and excavated soil will be generated from installation of the new EWs and pipeline construction. These solid wastes will be containerized as they are generated, labeled, and managed on-site according to the substantive requirements of RCRA, until they either are determined not to be RCRA waste or dispositioned to an appropriate disposal facility. Wastes will be stored at a CERCLA storage areas set up at the C-612 drilling area during characterization. The C-612-01 and

C-612-02 CERCLA storage areas will be managed according to the substantive requirements of RCRA. The solid waste will be sampled and analyzed as described in Section 8 for proper waste determination.

Drill cuttings and excavated soil waste may be containerized in drums, ST-90 boxes, or 25-yd^3 roll-off containers during generation. The roll-off container is preferred because it is the most reusable container and its greater size reduces both physical risk and cost by minimizing container movements as well as sampling activities. If used, the roll-off containers will be loaded until approximately half-full, ensuring that the weight limit for the transport vehicle is not exceeded.

7.1.3 Personal Protective Equipment

PPE will be worn as specified in the H&S Plan by personnel performing the field tasks. While site personnel use procedures and best management practices to minimize opportunities for contacting TCE contaminated media and equipment, it is likely that some PPE or related debris (e.g., plastic sheeting) will come into contact with TCE contaminated materials during the remediation process. Process knowledge, visual inspections, or direct sampling will be used to characterize PPE and any related debris. Based on the results of the characterization, any PPE or the related debris determined by site personnel to be contaminated by a listed waste or exhibiting a RCRA characteristic will be managed as hazardous waste, decontaminated, or a no longer contaminated-with determination will be made pursuant to Section 8.1. In cases where site personnel conclude, based on the above characterization process, that the PPE or related debris has not been contaminated by a listed waste or does not exhibit a characteristic, then the materials will not be considered a RCRA hazardous waste.

7.1.4 Grout

Bentonite grout is used to hold new well sheathing in place. There is a potential for grout to become waste due to test pours, spillage, or leftover material in a batch following a pour. Grout will be packaged separately from other waste streams and managed as nonhazardous material.

7.1.5 Well Installation/Development/Decontamination/Sample Residual Water

Dual Rotary drilling technology will be used to drill the EWs. With dual rotary drilling, the bit is advanced slightly behind the bottom of the outer casing. Compressed air is used to force soil cuttings and groundwater up the annulus between the drill pipe and casing. These cuttings and water are diverted through a discharge swivel and directed via flexible hose to a cyclone separator. Soil cuttings and water fall out of the bottom of the separator into a container while air is released from the top of the separator.

Newly installed EWs will be developed to remove fine material from the formation around the well screen. This process will generate water with high suspended solids content. Additional waste water with suspended solids will be generated as a result of drilling equipment decontamination activities.

Waste water generated during drilling, well development, and decontamination activities will be processed through particulate filters at the drill site or accumulated and stored on-site until it can be processed through the on-site C-752-C filter press for removal of suspended solids, as necessary. The filtered water will be pumped to dual wall holding tanks until verification that it meets the appropriate acceptance criteria for suspended solids before transfer to the on-site C-612 Northwest Plume Groundwater System. Potential contaminants of concern in this filtered waste water will be assumed to be consistent with those in the NWP groundwater currently treated at the C-612 and no additional sampling and analysis is planned. The estimated 175,000 gal of treated drilling, development, and decontamination water to be discharged from C-612 is a small fraction of the approximately 8 million gal released annually from current sources through Outfall 001.

Waste water generated during drilling, well development, and decontamination activities that has undergone wastewater treatment and meets the Kentucky Pollutant Discharge Elimination System (KPDES) discharge limits shall be considered to "no longer contain" listed hazardous waste (i.e., TCE). This treated wastewater may be directly discharged to permitted KPDES Outfall 001 or on-site ditches that flow to permitted Outfall 001.

7.1.6 Miscellaneous Non-contaminated/Clean Trash

DOE has implemented waste management activities for the segregation of clean trash (i.e., trash that is not chemically or radiologically contaminated). Examples of clean trash are office paper, aluminum cans, packaging materials, and glass bottles not used to store potentially hazardous chemicals, aluminum foil, and food items. During implementation of this WMP, clean trash will be segregated according to those guidelines and then collected and recycled/disposed of by the WMC when it has been approved for removal.

7.2 WASTE CHARACTERIZATION

Waste characterization will be performed based on sample analyses, evaluation of existing data, or process knowledge. Refer to Section 8 of this document for more information on waste characterization sampling.

7.3 CONTAINERS, ABSORBENT, AND DRUM LINERS

WAC approved absorbent will be used if necessary to ensure there are no free liquids in the waste being disposed of in the C-746-U Landfill. Table 4 summarizes container types and estimated quantities of containers.

7.4 WASTE MANAGEMENT ROLES AND RESPONSIBILITIES

7.4.1 Waste Management Tracking Responsibilities

Waste generated during remediation activities at PGDP is tracked using a system capable of maintaining an up-to-date inventory of waste. The inventory database is used to store data that will facilitate determination of management, storage, treatment, and disposal requirements for the waste.

7.4.2 Waste Management Coordinator

The WMC will ensure that all waste activities are conducted in accordance with PGDP facility requirements and this WMP. Responsibilities of the WMC also include coordinating activities with field personnel, overseeing daily waste management operations, and maintaining a waste management logbook that contains a complete history of generated waste and the current status of individual waste containers. Designated waste operators also may complete the waste management logbook.

The WMC will ensure that procurement and inspection of equipment, material, or services critical for shipments of waste to off-site TSDFs are conducted in accordance with appropriate procedures. In addition, the WMC will ensure that wastes are packaged and managed in accordance with applicable requirements (e.g., the WAC for the landfill).

Additional responsibilities of the WMC include the following:

- Maintaining an adequate supply of labels;
- Maintaining drum inventories at sites;
- Interfacing with all necessary personnel;
- Preparing RFDs;
- Tracking generated waste;
- Ensuring that drums are properly labeled;
- Coordinating waste recycling, disposal, or transfers;
- Sampling waste containers to characterize wastes;
- Coordinating pollution prevention and waste minimization activities;
- Transferring characterization data to DOE Prime Contractor's Data Manager; and
- Ensuring that temporary project waste storage areas are properly established, maintained, and closed.

The WMC or designee will update a computer-generated status sheet that can be retrieved quickly and will list all waste generated during field activities. The waste status sheet will supply information such as the following:

- Generation date;
- RFD number;
- Waste origination point;
- Waste type (solid or liquid);
- Description (e.g., soil, PPE, plastic);
- Quantity of waste;
- Current location of waste;
- Sampling status;
- Sampling results status; and
- Resampling needed.

Waste item container logs will be used to document each addition of waste to containers.

The WMC and waste operators will perform the majority of waste handling activities. These activities will involve coordination with the DOE Prime Contractor IRA Project Manager or designee who will perform periodic inspections to verify that drums are labeled in accordance with the WMP guidelines.

The WMC will be responsible for ensuring characterization sampling of the waste in accordance with the procedures outlined in this plan. When sampling is complete, the WMC will transfer the waste into the waste holding area established for this project, if necessary.

The WMC or designee will complete all chain-of-custody forms relating to the shipment of waste characterization samples. The chain-of-custody forms, along with the associated samples, will be transferred to the personnel responsible for packaging and delivery of the samples.

The WMC or designee will inspect the decontamination facility to ensure that waste generation is minimized to the extent possible and that the transfer of liquids to the waste holding area is arranged such that the work schedule is not delayed. If improper waste-handling activities are observed, the WMC will notify the DOE Prime Contractor Project Manager and temporarily stop decontamination activities. All activities not in compliance with the WMP will be identified and corrected before decontamination activities continue.

7.4.3 Coordination with Field Crews

The WMC will be responsible for daily coordination with project field crews involved in activities that generate waste. The WMC will inspect work sites to oversee the waste collection and will verify that procedures used by the field crews comply with the WMP guidelines. Deficiencies will be documented in the waste management logbook, and appropriate direction will be given to the field crews. Site visits will be documented in the field logbook.

7.4.4 Coordination with Treatment, Storage, and Disposal Facilities

The waste streams generated on the NWP IRA Optimization project may be managed and disposed of in a variety of ways depending on characterization and classification. Waste will be temporarily stored on-site as previously discussed. Waste that is to be shipped to an off-site TSDF must be done so in accordance with applicable DOE Contractor procedures and U.S. Department of Transportation requirements.

7.4.5 Waste Management Training

The WMC and other project personnel with assigned waste management responsibilities will be trained and qualified in accordance with the approved project training matrix.

7.5 TRANSPORTATION OF WASTE

The areas where the NWP IRA Optimization activities will be conducted are on DOE property. Transportation of waste on DOE property will be conducted in accordance with applicable DOE, PGDP, and DOE Contractor policies and procedures. In the event that it becomes necessary to transport known or suspected hazardous waste over public roads, coordination will be initiated with PGDP Security, as necessary, which may result in the temporary closing of roads. Once hazardous wastes are transported from a CERCLA site, they are subject to full RCRA regulation; therefore, all transportation and TSDF requirements under RCRA must be followed. Off-site shipments must be accompanied by a manifest. Off-site disposal of hazardous wastes will occur only at a RCRA facility in a unit in full compliance with the Subtitle C requirements. Transportation of known or suspected hazardous waste on public roads will be conducted in accordance with applicable U.S. Department of Transportation regulations (*CFR* Title 49).

7.6 SAMPLE SCREENING

7.6.1 Screening of Analytical Samples

During the course of the NWP IRA Optimization field activities, screening of samples in the field and in an on-site laboratory routinely will be performed to protect the health and safety of on-site personnel and to ensure compliance with regulatory requirements.

7.6.2 Field Screening

Field screening for health and safety will be conducted during project field activities and sample collection. The field screening to be performed will incorporate the use of instrumentation to monitor for organic vapors, as well as radiation meters capable of detecting alpha and beta/gamma radioactivity. An elevated reading from field monitoring may be cause for reevaluation of current waste classification, labeling, and handling activities.

7.6.3 On-Site Laboratory Radiation Screening

A fixed-base laboratory will analyze all waste characterization samples. All samples to be shipped off-site for laboratory analysis will be screened for radiation at an on-site laboratory before shipment and will receive approval for off-site shipment.

7.7 WASTE MINIMIZATION

Waste minimization requirements that will be implemented, as appropriate, include those established by the 1984 Hazardous and Solid Waste Amendments of RCRA; DOE orders 5400.1, 5400.3, and 435.1; and requirements specified in the WMP (PRS-CDL-0029, *Waste Management Plan for the Paducah Environmental Remediation Project*) concerning waste generation, tracking, and reduction techniques will be followed.

To support the DOE Contractor's commitment to waste reduction, an effort will be made during field activities to minimize waste generation, largely through ensuring that potentially contaminated waste material is localized and is not allowed to come into contact with clean material. Such an event could create more contaminated waste. Waste minimization also will be facilitated by not containerizing material known to originate from clean areas, such as above the RGA or outside the industrial area of PGDP.

Solid wastes such as Tyvek coveralls and packaging materials will be segregated. An attempt will be made to separate visibly soiled coveralls from clean coveralls. In some instances, partially soiled coveralls can be cut up and segregated. Other solid waste will not be allowed to contact potentially contaminated soil waste. Efforts will be made to keep Tyvek coveralls clean, reuse clean coveralls, and use coveralls only when necessary. Proper waste handling and spill control techniques will help minimize waste, particularly around decontamination areas where water must be containerized.

7.8 HEALTH AND SAFETY ISSUES RELATED TO WASTE ACTIVITIES

Waste management activities will be conducted in compliance with health and safety procedures documented in the H&S Plan.

8. SAMPLING AND ANALYSIS PLAN

This plan describes sampling to support analysis of waste generated from the installation of two EWs, EW232 and EW233. Solid waste will be generated from drill cuttings, while aqueous liquids (groundwater, well purge and development water, and sample residuals water) also will be generated during drilling. The project team will perform sampling work in accordance with contractor-approved procedures and work instructions. Procedures related to the sample collection are listed below. Additional procedures are referenced in Section 2, Table 1.

• PRS-ENM-0018, *Sampling Containerized Waste*
• PRS-ENM-0021, *Temperature Control for Sample Storage*
• PRS-ENM-0023, *Composite Sampling*
• PRS-ENM-2101, *Groundwater Sampling*
• PRS-ENM-2300, *Collection of Soil Samples*
• PRS-ENM-2303, *Borehole Logging*
• PRS-ENM-2700, *Logbooks and Data Forms*
• PRS-ENM-2702, *Decontamination of Sampling Equipment and Devices*
• PRS-ENM-2704, *Trip, Equipment, and Field Blank Preparation*
• PRS-ENM-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*
• PRS-ENM-5003, *Quality Assured Data*
• PRS-ENM-5004, *Sample Tracking, Lab*
• PRS-WSD-9503, *Off-Site Sample Shipping*

Wastes generated from sites designated as potentially contaminated will be characterized to classify the waste for proper handling, record keeping, transfer, storage, and disposal. Waste analyses will be performed using the EPA-approved procedures, as applicable. Analyses required for hazardous waste classification will reference EPA SW-846 or other EPA-approved methods, as required. Wastewater analyses will reference the applicable analytical requirements in PGDP's KPDES permit, Clean Water Act, or Safe Drinking Water Act. QA/QC requirements and data management requirements, as specified in Sections 9 and 10 of this document, will be followed for waste characterization sampling activities.

Characterization requirements and guidance are provided in the site WAC, PRS-WSD-0437, *Waste Characterization and Profiling*, and PRS-WSD-0307, *Paducah Waste Characterization SAP*. Section 8.2 lists the analytical testing methods that will be used for analysis. The WMC will coordinate with the DOE Contractor NWP IRA Optimization project manager and DOE Contractor sample and data management group for required analyses and guidance on collection and transfer of characterization samples to a Sample Management Office-approved fixed-base laboratory that has been audited under DOE Consolidated Audit Program (DOECAP).

8.1 CONTAINED-IN/CONTAMINATED-WITH DETERMINATIONS

Some of the waste debris, other than PPE, and environmental media such as drill cuttings generated during this project will be characterized and the results compared to health-based standards to determine whether or not any concentrations of TCE and 1,1,1-trichloroethane (TCA) are above health-based levels listed in Table 5. If the concentrations are below the levels contained in Table 5, then the waste will be deemed not to contain or not to be contaminated with a RCRA listed waste (based on TCE/TCA content) for the purposes of management at the site.

Table 5. Health-Based Levels for TCE and 1,1,1-TCA

Constituent	Concentration in solids (ppm)
TCE	39.2
1,1,1-TCA	2,080

Because data from previous sampling events indicate that conditions for C-746-U Landfill disposal potentially will be met, characterization for C-746-U Landfill disposal will be undertaken Land disposal restrictions (LDRs) generally apply to media and debris generated from this project that no longer contain or no longer are contaminated with RCRA hazardous waste. The LDR treatment standard is below the contained-in level; therefore, if a contained in determination is made, the LDR treatment standard also will be satisfied.

Health-based standards of 39.2 ppm TCE and 2,080 ppm 1,1,1-TCA in solids will be used as the criteria for making contained-in/contaminated-with determinations for environmental media and debris designated for disposal at the C-746-U Landfill. Solid waste disposed of at landfills other than C-746-U will be subject to a contained-in/contaminated-with determination that will be approved by the Commonwealth of Kentucky and the state in which the receiving landfill is located. The Kentucky Energy and Environment Cabinet (KEEC) has agreed to consult with DOE and the state where the off-site facility is located to reach agreement upon the appropriate health-based standard for making such determinations for waste that is to be shipped to such a facility.

Aqueous liquids (groundwater, well purge and development water, and sample residuals water) contaminated with TCE will be treated to the wastewater effluent limit of 0.030 mg/L or less in an on-site permitted wastewater treatment facility. Treated effluent meeting the discharge limit of 0.030 mg/L also shall be below the health-based level and considered to "no longer contain" listed hazardous waste (i.e., TCE). Based on process knowledge of the C-612 treatment facility's performance in achieving effluent levels for TCE that are significantly below health-based levels, this treated wastewater may be directly discharged to KPDES Outfall 001 or to on-site ditches that flow to KPDES Outfall 001 without providing KEEC supporting analytical data or contained-in/contaminated-with determinations.

Soil and debris wastes shall be sampled and analyzed in accordance with Section 8.3. For soil and debris waste meeting the health-based standards above, DOE shall submit its contained-in determination and supporting analytical data to the KEEC. The KEEC will review DOE's determination and supporting analytical data and provide DOE with notification of any concerns the Cabinet has within 30 days. After 30 days, if the Cabinet has not notified DOE of any concerns, DOE may dispose of soil and debris waste at the C-746-U Landfill if it meets WAC. Soil and debris waste from this project not meeting the WAC for the C-746-U Landfill will be shipped off-site for disposal at an appropriate facility.

8.2 WASTE CHARACTERIZATION

Waste characterization sampling will be performed in accordance with procedure PRS-WSD-0437, *Waste Characterization and Profiling.* Based on sample analyses, existing data, or process knowledge, the waste may be classified into one of the following categories:

- RCRA-listed hazardous waste
- RCRA characteristic hazardous waste
- Polychlorinated biphenyl (PCB) waste
- Transuranic waste (TRU)
- Low-level waste (LLW)
- Mixed waste or
- Nonhazardous solid waste

Tables 6, 7, 8, and 9 list the analytical testing methods that will be used for analysis.

Wastes generated from sites designated as potentially contaminated will be characterized to classify the waste for proper handling, record keeping, transfer, storage, and disposal. Waste analyses will be performed using the EPA-approved procedures, as applicable. Analyses required for hazardous waste classification will reference EPA SW-846 or other EPA-approved methods, as required. Wastewater analyses will reference the applicable analytical requirements in the PGDP KPDES permit, the Clean Water Act, or Safe Drinking Water Act. QA/QC requirements and data management requirements will be followed for waste characterization sampling activities.

Table 6. TCLP Parameters for Analysis of Solid Waste

Constituent	Method	TCLP Regulatory Limit (mg/L)	20 Times TCLP Regulatory Limit (mg/kg)
1,1-Dichloroethene	8240/8260	0.7	14
1,2-Dichloroethane	8240/8260	0.5	10
1,4-Dichlorobenzene	8270	7.5	150
2,4,5-TP (Silvex)	8150	1.0	20
2,4,5-Trichlorophenol	8270	400.0	8,000
2,4,6-Trichlorophenol	8270	2.0	40
2,4-D	8150	10.0	200
2,4-Dinitrotoluene	8270	0.13	2.6
Arsenic	7060/6010/6020	5.0	100
Barium	6010/6020	100.0	2,000
Benzene	8240/8260	0.5	10
Cadmium	6010/6020	1.0	20
Carbon tetrachloride	8240/8260	0.5	10
Chlordane	8081	0.03	0.6
Chlorobenzene	8240/8260	100.0	2,000
Chloroform	8240/8260	6.0	120
Chromium	6010/6020	5.0	100
Endrin	8081	0.02	0.4
Heptachlor	8081	0.008	0.16
Hexachlorobenzene	8270	0.13	2.6
Hexachlorobutadiene	8270	0.5	10
Hexachloroethane	8270	3.0	60
Lead	7421/6010/6020	5.0	100
Lindane	8081	0.4	8
Mercury	7470/6020	0.2	4
Methoxychlor	8081	10.0	200
Methylethylketone	8240/8260	200.0	4,000
Nitrobenzene	8270	2.0	40
Pentachlorophenol	8270	100.0	2,000
Pyridine	8270	5.0	100
Selenium	7740/6010/6020	1.0	20
Silver	6010/6020	5.0	100
Tetrachloroethene	8240/8260	0.7	14
Total cresol	8270	200.0	4,000
Toxaphene	8081	0.5	10
Trichloroethene	8240/8260	0.5	10
Vinyl chloride	8240/8260	0.2	4

TCLP = Toxic Characteristic Leaching Procedure

Table 7. Analytical Parameters for Radiological and PCB Characterization

Constituent	C-746 U Landfill Limit	Method
Total uranium	150 pCi/g	Mass Spec
Neptunium-237	3 pCi/g	Alpha Spec
Plutonium-239/240	3 pCi/g	Alpha Spec
Plutonium-238	3 pCi/g	Alpha Spec
Thorium-230/232	30 pCi/g	Alpha Spec
Technetium-99	500 pCi/g	Liquid Scintillation
Cesium-137	3 pCi/g	Gamma Spec
PCB	49 mg/kg	8082

PCB = polychlorinated biphenyl

Table 8. Waste Characterization Requirements for Solid Waste

Constituent	Method
TCLP VOCs	SW-846 1311, 8260
TCLP SVOCs	SW-846 1311, 8270
TCLP metals	SW-846 1311, 6010/7470
TCLP pesticides	SW-846 1311, 8150
TCLP herbicides	SW-846 1311, 8150
Reactivity	SW-846 Section 7.3
Corrosivity	SW-846 1110
Moisture content	ASTM D2216
Xylene	8260
Acetone	8260
Toluene	8260
Total cyanides	9010

ASTM = American Society for Testing and Materials
TCLP = toxicity characteristic leaching procedure

Table 9. Waste Characterization Requirements for Decontamination, Development, and Purge Water

Parameter	Method	Detection Limit
Oil and grease	EPA 1664	10 mg/L
Total residue chlorine	Field Test	N/A
TCE	EPA 624	0.001 mg/L
1,1,1-TCA	EPA 624	0.001 mg/L
PCBs	EPA 608	varies by aroclor
Total uranium	EPA900/HASL-300[a]	30 pCi/L
Dissolved and suspended alpha	EPA900/HASL-300	15 pCi/L
Dissolved and suspended beta	EPA 900/HASL-300	50 pCi/L
Technetium-99	EPA 900/HASL-300	25 pCi/L
Total recoverable metals*	EPA 200.8/245.2	varies by metal
Total suspended solids	EPA 160.2	30 mg/L

[a] The procedure is derived from a variety of sources including, but not limited to, *Environmental Measurements Laboratory Procedures Manual* (DOE 1982) and *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980).
* Total recoverable metals: antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, nickel, calcium, silver, tantalum, uranium, zinc, and mercury.

Characterization requirements and guidance are provided in the site WAC and PRS-WSD-0437, *Waste Characterization and Profiling*. Section 2 of this document lists the analytical testing methods that will be used for analysis. The evaluation of the analytical results will comply with the QA Plan (PRS-CDL-0058, *Quality Assurance Program Plan for the Paducah Environmental Remediation Project*). The WMC will coordinate with the DOE contractor project manager and DOE contractor sample and data management group for required analyses and guidance on collection and transfer of characterization samples to a Sample Management Office-approved fixed-base laboratory that has been audited under DOECAP.

8.2.1 RCRA-listed Hazardous Waste

Based on process knowledge and existing historical sample data, the generation of RCRA-listed hazardous waste is expected on this project. The waste is listed-hazardous due to the presence of TCE in the RGA underlying the majority of the area in which the soil borings and wells are to be installed. Waste generated during soil borings (i.e., drilling cuttings, purge water, sample residuals), will be classified as RCRA-listed hazardous wastes with waste codes F001, F002, and U228 if analytical results for the associated soil samples and water samples are above the health-based levels discussed in Table 5. If the concentrations are below the levels contained in Table 5, then the waste will be deemed not to contain or not to be contaminated-with a RCRA listed waste (based on TCE/TCA content) for the purposes of on-site management. If the WAC is met, the waste will be properly disposed of in the C-746-U Landfill.

See Section 8.1 for a discussion on conducting a listed hazardous waste determination on aqueous liquids. Aqueous liquids that have undergone wastewater treatment and meet the KPDES discharge limits shall be considered to “no longer contain” listed hazardous waste (i.e., TCE). This treated wastewater may be directly discharged to permitted KPDES Outfall 001 or on-site ditches that flow to permitted KPDES Outfall 001.

8.2.2 RCRA-characteristic Hazardous Waste

Based on process knowledge and existing historical sample data, the generation of RCRA characteristic-hazardous waste is possible during this action. Any waste determined to be RCRA characteristic-hazardous waste will be treated in the same manner as RCRA listed-hazardous waste for storage and disposal requirements.

8.2.3 PCB Wastes

Based on process knowledge and existing historical sample data, the generation of PCB-contaminated waste is not expected on this project.

8.2.4 TRU Wastes

TRU wastes are those that are contaminated with elements that have an atomic number greater than 92, including neptunium, plutonium, americium, and curium that are in concentrations greater than 100 nCi/g. Although it is possible that TRU elements may be detected in characterization samples collected on this project, it is unlikely that any of the waste generated will be at or above the TRU threshold limit.

8.2.5 LLW

LLWs are described as any nonhazardous, non-PCB, or non-TRU waste containing radioactivity or other radionuclides in a concentration greater than authorized limits or the latest off-site release criteria and are not classified as high-level waste, TRU waste, spent nuclear fuel, or by-product material. LLW may be generated from materials removed from the radiological areas. All wastes from this project have the potential to be classified as LLW. The radiological contaminant of concern is ^{99}Tc. Due to varying levels of ^{99}Tc, some work may be performed under a radiological work permit (RWP).

8.2.6 Mixed Wastes

Mixed waste contains both hazardous waste and source, special nuclear, or byproduct material subject to the Atomic Energy Act of 1954. The generation of mixed waste is possible on this project.

8.2.7 Nonhazardous Wastes

Waste that does not meet the classification requirements of RCRA hazardous wastes, PCB wastes, LLW, TRU waste, or mixed wastes will be classified as nonhazardous solid waste.

8.3 SAMPLING AND ANALYSIS OF WASTE

The WMC will be responsible for coordinating the sampling of solid and liquid waste in accordance with this section. During sampling, all appropriate health and safety concerns will be addressed in accordance with Section 5. All samples will be screened for radioactivity based on the RWP and appropriate actions taken to prevent the spread of contamination. Sample materials from different containers will not be mixed unless they are from the same waste stream, and only containers requiring further characterization will be sampled. Samples will be assigned a unique identifier. The following text summarizes the waste characterization requirements and describes the sampling procedures.

8.3.1 Solid Waste

For solid wastes, the “20 times” rule will be used to determine if the waste is characteristically hazardous. That is, if the total concentrations of RCRA constituents are less than 20 times the TCLP limits in 40 *CFR* § 261.24, then the waste will be considered not to be characteristically hazardous. Where the total concentrations of RCRA constituents are greater than 20 times the TCLP limits, TCLP analyses will be performed to confirm the result.

For listed waste determinations for media or debris, the total concentrations of TCE and 1,1,1-TCA will be compared to the approved health-based levels of 39.2 ppm for TCE and 2,080 ppm for 1,1,1-TCA. If total concentrations are detected, but less than 39.2 ppm TCE and 2,080 ppm 1,1,1-TCA, the waste will be determined to “no longer contain” listed constituents. Detection limit for TCE and 1,1,1-TCA is 5 ppb. If the results exceed the health-based levels, the waste will be considered a RCRA-listed hazardous waste and must be managed and disposed of as such.

Solid waste may be containerized in drums, ST-90 boxes, or 25-yd^3 roll-off containers during generation. The roll-off is the preferred container for solid wastes such as soil cuttings from drilling because it is the most reusable container and its greater size reduces both physical risk and cost by minimizing container movements as well as sampling activities. Specific sampling event plans (including parameters, required detection limits, and QC requirements) will be identified when the proposed final waste containers have been presented to the waste characterization organization. Physical sampling will be performed in accordance with approved standard operating procedures.

The waste sampling strategy for a roll-off is based on the following assumptions that allow the waste volume to be broken into five equal volume sections laterally:

- Waste typically is loaded from the center resulting in mounding toward the center.

- Approximate waste weight is 35,000 lbs. Using a density of 90 lbs/ft3, this yields an assumed volume of 389 ft^3.

When keeping with these assumptions, the roll-off is broken into five sections that are approximately 4.3- ft wide on the edges, (2) 4.1-ft wide inside the edges, (2) and a center section that is 3.3 ft wide. This results in five sections that are all approximately equal. Figure 5 shows a diagram of the approximate divisions. One VOC sample will be taken from each of the five sections of the roll-off using an EnCore sampler (or an alternate method described in PRS-ENM-2300, *Collection of Soil Samples*) that is designed for VOC sampling. Per procedure, three EnCore samples will be used to represent a single sample point. Each sample point will be chosen randomly. This will result in five random and representative VOC samples per roll-off that have not been composited to minimize the loss of contaminants due to volatilization. Where waste in a roll-off is in excess of 35,000 pounds, an additional randomly located VOC sample will be 76 collected for each additional 7,000 pounds (partial or full) of waste in the roll-off. Other methods, such as always performing VOC sampling first (prior to disturbing the waste with other sampling activities) will be employed to minimize VOC losses during sampling. Hold times and sample preservation will be performed in accordance with EPA method SW-846 8260. VOC laboratory results will be statistically evaluated and the 95% upper confidence limit at 2 sigma will be used to represent VOC concentrations in the roll-off. For all parameters, except VOC samples, one core sample will be taken from the center of each of the 10 grids depicted in Figure 5 for composite sampling. These ten cores will be mixed individually and then equal volumes from each core will be composited into a single sample. This physically representative sample of the roll-off will be aliquoted for all parameters except VOCs.

Additional analyses to meet off-site disposal WAC also may be required and will be specified uponselection of the disposal site.

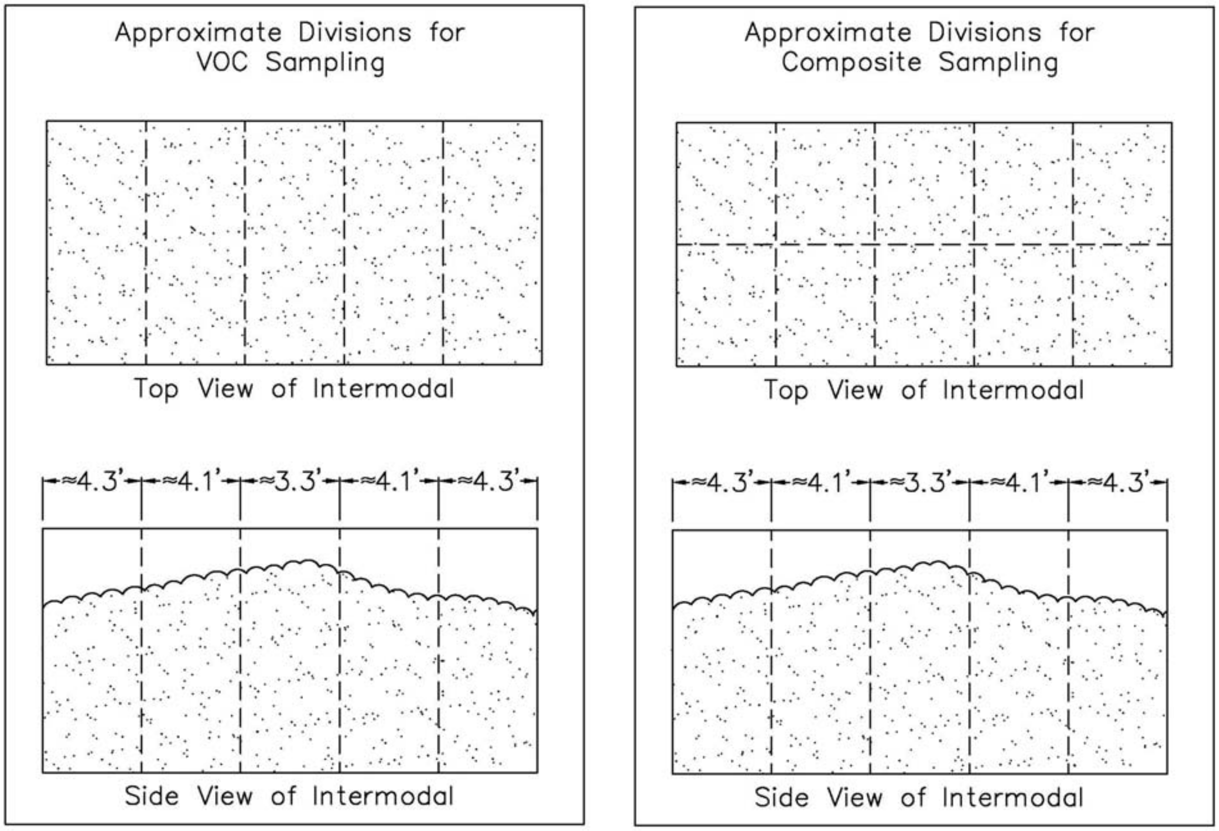

Figure 5. Approximate Division Locations for Roll-off Waste Sampling

8.3.2 Aqueous Liquids

Waste water generated during drilling, well development, and decontamination activities will be processed through particulate filters at the drill site or accumulated and stored on-site until it can be processed through the on-site C-752-C Filter Press for removal of suspended solids, as necessary. The filtered water will be pumped to dual-wall holding tanks until verification that it meets the appropriate acceptance criteria for suspended solids before transfer to the on-site C-612 NWPGS. Potential contaminants of concern in this filtered waste water will be assumed to be consistent with those in the NWP groundwater currently treated at the C-612, and no additional sampling and analysis is planned.

Waste water generated during drilling, well development, and decontamination activities that has undergone wastewater treatment and meets the KPDES discharge limits shall be considered to "no longer contain" listed hazardous waste (i.e., TCE). This treated wastewater may be discharged directly to permitted KPDES Outfall 001 or on-site ditches that flow to permitted Outfall 001.

9. QUALITY ASSURANCE

The NWP IRA Optimization project will incorporate by reference the *Construction Quality Control Plan for the Interim Remedial Action for the Volatile Organic Compound Contamination at the C-400 Cleaning building at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0031&D2

(CQCP). The CQCP will be implemented as written for scope elements associated with the NWP IRA Optimization project. Sections 1 and 2 of the CQCP are not applicable. For incorporated sections, references to the C-400 IRA project should be replaced with "NWP IRA Optimization project" and references to the C-400 Remedial Design Report should be replaced with "Certified for Construction drawings and specifications."

10. DATA MANAGEMENT AND IMPLEMENTATION PLAN

The NWP IRA Optimization project will incorporate by reference the Data Management and Implementation Plan (DMIP) requirements from the C-400 RAWP. The C-400 RAWP DMIP, Sections 10.2 through 10.8, will be implemented as written for scope elements associated with the NWP IRA Optimization project. References to the C-400 IRA project should be replaced with NWP IRA Optimization project.

11. REFERENCES

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APPENDIX

GRAIN SIZE ANALYSES AND BORING LOGS

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BOREHOLE 498

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BH498 Sieve Analysis
GRAIN SIZE

mm	Inch (25.4)	001 Wts	001 %	002 Wts	002 %	003 Wts	003 %	004 Wts	004 %	005 Wts	005 %	006 Wts	006 %	007 Wts	007 %	007D Wts	007D %	008 Wts	008 %	009 Wts	009 %	009D Wts	009D %
31.5	1.240	0	0.0	0.0	0.0		0.0		0.0		0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
16	0.630	0		0.0		0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
8	0.315	0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
4	0.157	126	26%	79.9	18%	120.3	25%	82.0	20%	96.4	20%	141.3	35%	110.1	28%	28.8	18%	95.7	23%	121.1	29%	140.9	25%
2	0.079	78.9	16%	51.0	11%	75.1	16%	49.9	12%	56.7	12%	87.9	22%	83.0	21%	36.8	23%	65.1	16%	72.2	17%	94.9	17%
1	0.039	49.3	10%	35.8	8%	56.9	12%	42.4	10%	56.4	12%	44.2	11%	60.4	15%	26.7	17%	59.7	14%	54.6	13%	76.0	14%
0.5	0.020	40.1	8%	91.9	20%	79.8	17%	83.1	20%	96.8	20%	59.0	15%	67.7	17%	32.1	20%	75.6	18%	71.7	17%	106.3	19%
0.25	0.010	129	26%	126.3	28%	106.9	22%	103.8	25%	149.1	31%	50.3	13%	51.1	13%	25.7	16%	60.2	15%	53.8	13%	83.4	15%
0.125	0.005	31.5	6%	26.4	6%	19.8	4%	30.1	7%	15.2	3%	8.8	2%	8.9	2%	4.6	3%	36.6	9%	25.4	6%	28.9	5%
0.063	0.002	15.9	3%	18.7	4%	8.6	2%	10.6	3%	5.8	1%	4.0	1%	3.7	1%	2.5	2%	9.3	2%	8.5	2%	11.2	2%
PAN		17.2	4%	22.9	5%	10.6	2%	13.9	3%	7.5	2%	5.6	1%	5.2	1%	3.3	2%	11.8	3%	9.5	2%	11.3	2%
TOTAL		488	100%	452.9	100%	478.0	100%	415.8	100%	483.9	100%	401.2	100%	390.1	100%	160.5	100%	414.0	100%	416.8	100%	553.0	100%

BH498 Sieve Analysis (Cummulativ Cum % Ret

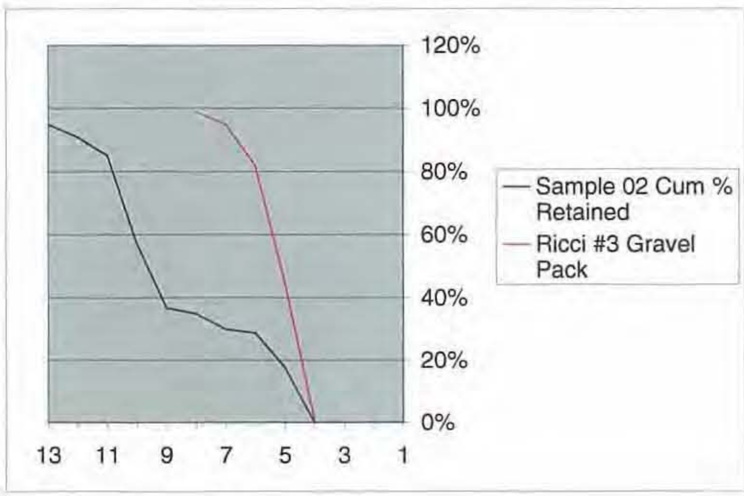
mm	inch (25.400)	001	002	003	004	005	006	007	007D	008	009	009D
31.5	1.240	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
16	0.630	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
8	0.315	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
4	0.157	26%	18%	25%	20%	20%	35%	28%	18%	23%	29%	25%
2	0.079	42%	29%	41%	32%	32%	57%	50%	41%	39%	46%	43%
1	0.039	52%	37%	53%	42%	43%	68%	65%	58%	53%	59%	56%
0.5	0.020	60%	57%	69%	62%	63%	83%	82%	78%	72%	77%	76%
0.25	0.010	87%	85%	92%	87%	94%	95%	95%	94%	86%	90%	91%
0.125	0.005	93%	91%	96%	94%	97%	98%	98%	96%	95%	96%	96%
0.063	0.002	96%	95%	98%	97%	98%	99%	99%	98%	97%	98%	98%
PAN		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

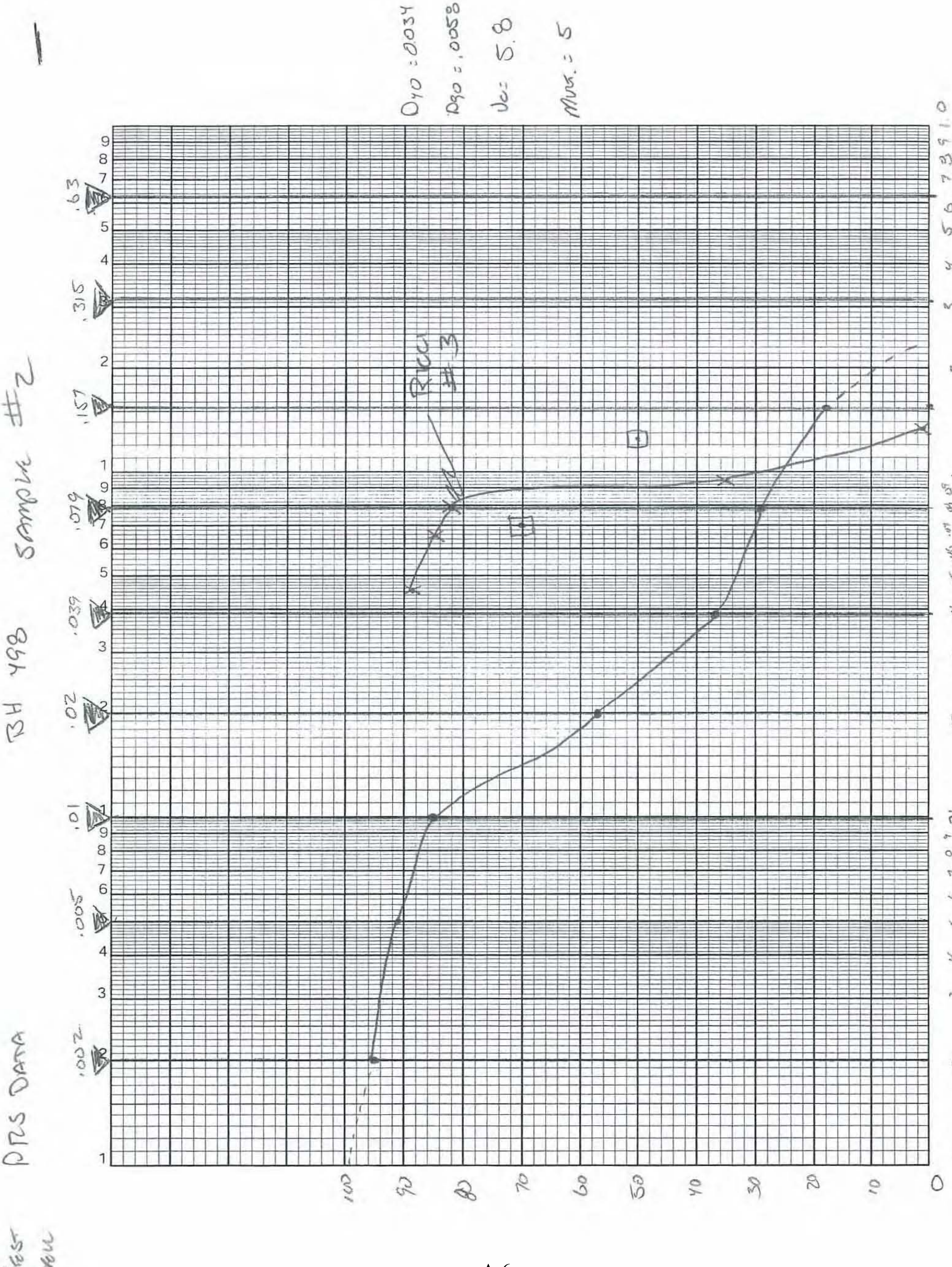
Ricci #3

	% Pass	% Ret
0.188	100.000	0
0.132	99.000	1
0.094	55.000	45
0.067	5.000	95
0.045	1.000	99
0.033		
0.023		

Sample No. 2 - Finest in screen section

Sample 02 Cum % Retained	Ricci #3 Gravel Pack	Sieve (in)
0%		0.6299
0%		0.315
0%		0.1575
0%	1%	0.132
18%	45%	0.094
29%	82%	0.0787
30%	95%	0.067
35%	99%	0.045
37%		0.0394
57%		0.0197
85%		0.0098
91%		0.0049
95%		0.0025





BH 498
SAMPLE #2
PRS DATA
West wall

Sieve Analysis

Used Balance Enclosure				Settings:	Amp - 9	Relay - 2	Mains - 2			
		12/28/2009		/ C09351012001 MW498PART1209-001						
									Sample	Sample
Size	WT.(g)	5 minutes	2 minutes	1 minute	1 minute			Sieve	Weight	%
	4563.4	5306.7	5306.5	5306.3	5305.7			Size mm	Ret/Sieve	Ret/Sieve
LID	241.4	241.5	241.4	241.4	241.4			Lid		
31.5 mm	480.2	480.2	480.2	480.2	480.2			31.5	0	0.0
16 mm	495.2	561.5	561.5	561.4	561.4			16	66.2	8.9
8 mm	477	667	666.2	665.1	665			8	188	25.3
4 mm	455.1	587.6	583.3	582.6	581.4			4	126.3	17.0
2mm No10	432	513.4	512.9	511.7	510.9			2.0 (#10)	78.9	10.6
No. 20	403.4	453.9	453.1	452.9	452.7			1.0 (#20)	49.3	6.6
No. 35	346.1	388	387.2	386.7	386.2			0.5 (#35)	40.1	5.4
No. 60	327.6	452.4	454.8	455.9	456.5			0.25 (#60)	128.9	17.3
No. 120	307.1	334.8	336.9	337.8	338.6			0.125 (#120)	31.5	4.2
No. 200	299	313	313.9	314.5	314.9			0.063 (#200)	15.9	2.1
PAN	299.3	313.7	315.3	316	316.5			Fines	17.2	2.3
TOTAL	4563.4	5307	5306.7	5306.2	5305.7			Total*	742.3	99.9
Bag/Sample (g)		765.5		Sieve+SampleWt(g)		5306.80				
Bag Weight (g)		22.1		Sieve Wt		4563.4				
Sample Weight (g)		743.4		Sample Wt (g)		743.4				
*Note -										
mlg-ASTMD422										

Appr: RG Foliver 12/31/09

			Sieve Analysis					
Used Balance Enclosure				Settings:	Amp - 9	Relay - 2	Mains - 2	
		12/28/2009		/ C09351012002 MW498PART1209-002				
Size	WT.(g)	5 minutes	2 minutes	1 minute	1 minute	Sieve	Sample Weight	Sample %
	4564	5257.4	5257.3	5257.2	5257.2	Size mm	Ret/Sieve	Ret/Sieve
LID	241.4	241.4	241.4	241.4	241.4	Lid		
31.5 mm	480.1	480.2	480.2	480.2	480.2	31.5	0.1	0.0
16 mm	495.1	582.9	582.9	582.9	582.8	16	87.7	12.6
8 mm	477	633.3	631.7	631.2	631.2	8	154.2	22.2
4 mm	455.2	536	536	535.6	535.1	4	79.9	11.5
2mm No10	431.9	482.3	482.6	482.9	482.9	2.0 (#10)	51	7.4
No. 20	403.4	440	439.4	439.4	439.2	1.0 (#20)	35.8	5.2
No. 35	346.2	441.7	439.1	438.1	438.1	0.5 (#35)	91.9	13.3
No. 60	327.8	448.8	451.5	452.4	454.1	0.25 (#60)	126.3	18.2
No. 120	307.3	332.9	333.3	333.6	333.7	0.125 (#120)	26.4	3.8
No. 200	299.2	318.1	317.7	317.8	317.9	0.063 (#200)	18.7	2.7
PAN	299.3	319.8	321.5	321.9	322.2	Fines	22.9	3.3
TOTAL	4563.9	5257.4	5257.3	5257.4	5258.8	Total*	694.8	100.2

Bag/Sample (g)	715.7	Sieve+SampleWt(g)	5257.40
Bag Weight (g)	22.1	Sieve Wt	4564
Sample Weight (g)	693.60	Sample Wt (g)	693.40

*Note -
mlg-ASTMD422

Approved: RG Tolosa 12/31/09

			Sieve Analysis						
Used Balance Enclosure				Settings:	Amp - 9	Relay - 2	Mains - 2		
		12/29/2009		/ C09351012003 MW498PART1209-003					
								Sample	Sample
Size	WT.(g)	5 minutes	2 minutes	1 minute	1 minute		Sieve	Weight	%
	4564	5331.4	5331.2	5331.2	5330.6		Size mm	Ret/Sieve	Ret/Sieve
LID	241.4	241.4	241.4	241.4	241.4		Lid		
31.5 mm	480.2	480.2	480.2	480.2	480.2		31.5	0	0.0
16 mm	495.1	594.2	594.2	594.2	594.2		16	99.1	12.9
8 mm	477	674.4	674.2	672.2	666.3		8	189.3	24.7
4 mm	455.2	574.1	572.3	573.7	575.5		4	120.3	15.7
2mm No10	431.9	505.2	505.5	505.5	507		2.0 (#10)	75.1	9.8
No. 20	403.4	459.7	459.7	459.7	460.3		1.0 (#20)	56.9	7.4
No. 35	346.3	428.5	427.5	427.1	426.1		0.5 (#35)	79.8	10.4
No. 60	328	431.4	432.6	433.2	434.9		0.25 (#60)	106.9	13.9
No. 120	307.5	325.9	326.5	326.7	327.3		0.125 (#120)	19.8	2.6
No. 200	298.9	307.3	307.4	307.5	307.5		0.063 (#200)	8.6	1.1
PAN	299.3	309.3	309.7	309.8	309.9		Fines	10.6	1.4
TOTAL	4564.2	5331.6	5331.2	5331.2	5330.6		Total*	766.4	99.9
Bag/Sample (g)		811.8		Sieve+SampleWt(g)		5331.40			
Bag Weight (g)		44.3		Sieve Wt		4564			
Sample Weight (g)		767.50		Sample Wt (g)		767.40			
*Note -									
mlg-ASTMD422									

Appr: RGTlivw 12/31/09

Sieve Analysis

Used Balance Enclosure — Settings: Amp - 9 | Relay - 2 | Mains - 2

12/29/2009 / C09351012004 MW498PART1209-004

Size	WT.(g)	5 minutes	2 minutes	1 minute	1 minute	Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
	4564.6	5247.5	5247.4	5247.3	5247.1			
LID	241.5	241.4	241.4	241.4	241.4	Lid		
31.5 mm	480.2	480.2	480.2	480.2	480.2	31.5	0	0.0
16 mm	495.1	622	617.6	617.6	617.6	16	122.5	17.9
8 mm	477	618.7	621.8	621.7	621.7	8	144.7	21.2
4 mm	455.1	536.3	537.2	537.1	537.1	4	82	12.0
2mm No10	431.9	482	481.8	481.8	481.8	2.0 (#10)	49.9	7.3
No. 20	403.4	445.5	445.8	445.7	445.8	1.0 (#20)	42.4	6.2
No. 35	346.4	429.6	429.4	429.5	429.5	0.5 (#35)	83.1	12.2
No. 60	328	432.6	432.6	432.3	431.8	0.25 (#60)	103.8	15.2
No. 120	307.5	337.5	337.5	337.6	337.6	0.125 (#120)	30.1	4.4
No. 200	299.1	309.6	309.6	309.6	309.7	0.063 (#200)	10.6	1.6
PAN	299.2	312	312.7	312.9	313.1	Fines	13.9	2.0
TOTAL	4564.4	5247.4	5247.6	5247.4	5247.3	Total*	683	100.0

Bag/Sample (g)	704.9	Sieve+SampleWt(g)	5247.50
Bag Weight (g)	21.9	Sieve Wt	4564.6
Sample Weight (g)	683.00	Sample Wt (g)	682.90

*Note -
mlg-ASTMD422

Appr: RGSolivw 12/31/09

			Sieve Analysis						
Used Balance Enclosure				Settings:	Amp - 9	Relay - 2	Mains - 2		
		12/29/2009		/ C09351012005 MW498PART1209-005					
								Sample	Sample
Size	WT.(g)	5 minutes	2 minutes	1 minute	1 minute		Sieve	Weight	%
	4564	5283.3	5283.2	5283.2	5283.2		Size mm	Ret/Sieve	Ret/Sieve
LID	241.4	241.4	241.4	241.4	241.4		Lid		
31.5 mm	480.1	480.1	480.2	480.1	480.1		31.5	0	0.0
16 mm	495.1	602.8	602.8	602.8	602.9		16	107.8	15.0
8 mm	477	612.5	608	606.4	604.8		8	127.8	17.8
4 mm	455.2	546.4	549.5	550.2	551.6		4	96.4	13.4
2mm No10	431.8	488.2	488.2	488.5	488.5		2.0 (#10)	56.7	7.9
No. 20	403.3	460.7	460.4	460	459.7		1.0 (#20)	56.4	7.8
No. 35	346.2	445	443.9	443.6	443		0.5 (#35)	96.8	13.5
No. 60	327.9	473.4	475.3	476.3	477		0.25 (#60)	149.1	20.7
No. 120	307.4	321.7	322.1	322.4	322.6		0.125 (#120)	15.2	2.1
No. 200	298.9	304.6	304.7	304.7	304.7		0.063 (#200)	5.8	0.8
PAN	299.3	306.4	306.6	306.7	306.8		Fines	7.5	1.0
TOTAL	4563.6	5283.2	5283.1	5283.1	5283.1		Total*	719.5	100.0
Bag/Sample (g)		741.7		Sieve+SampleWt(g)		5283.30			
Bag Weight (g)		22.2		Sieve Wt		<u>4564</u>			
Sample Weight (g)		719.50		Sample Wt (g)		719.30			
*Note - mlg-ASTMD422									

Appr: [signature] 12/31/09

			Sieve Analysis						
Used Balance Enclosure				Settings:	Amp - 9	Relay - 2	Mains - 2		
		12/28/2009		/ C09351012006 MW498PART1209-006					
								Sample	Sample
Size	WT.(g)	5 minutes	2 minutes	1 minute	1 minute		Sieve	Weight	%
	4563.4	5219.4	5219.1	5219	5219		Size mm	Ret/Sieve	Ret/Sieve
LID	241.4	241.5	241.5	241.5	241.4		Lid		
31.5 mm	480.1	480.2	480.2	480.2	480.2		31.5	0.1	0.0
16 mm	495	567	567	567	567		16	72	11.0
8 mm	477	662.7	661.8	661.8	659.9		8	182.9	27.9
4 mm	455.2	596.6	596.2	595.2	596.5		4	141.3	21.5
2mm No10	431.8	519.5	519.2	519.5	519.7		2.0 (#10)	87.9	13.4
No. 20	403.5	447	447.4	447.5	447.7		1.0 (#20)	44.2	6.7
No. 35	346.2	406.5	406.5	405.8	405.2		0.5 (#35)	59	9.0
No. 60	327.6	375.9	376.3	377.2	377.9		0.25 (#60)	50.3	7.7
No. 120	307	315.2	315.5	315.7	315.8		0.125 (#120)	8.8	1.3
No. 200	298.9	302.9	302.9	302.9	302.9		0.063 (#200)	4	0.6
PAN	299.4	304.7	304.9	305	305		Fines	5.6	0.9
TOTAL	4563.1	5219.7	5219.4	5219.3	5219.2		Total*	656	100.0
Bag/Sample (g)		678.1		Sieve+SampleWt(g)		5219.40			
Bag Weight (g)		22.1		Sieve Wt		4563.4			
Sample Weight (g)		656.00		Sample Wt (g)		656.00			
*Note -									
mlg-ASTMD422									
					Appr: RgTolive			12/31/09	

			Sieve Analysis						
Used Balance Enclosure				Settings:	Amp - 9	Relay - 2	Mains - 2		
		12/21/2009		/ C09351012007 MW498PART1209-007					
Size	WT.(g)	5 minutes	2 minutes	1 minute	1 minute		Sieve	Sample Weight	Sample %
	4562.5	5192.4	5192.4	5192.3	5192.3		Size mm	Ret/Sieve	Ret/Sieve
LID	241.4	241.5	241.5	241.4	241.5		Lid		
31.5 mm	480.2	480.2	480.2	480.2	480.1		31.5	-0.1	0.0
16 mm	495.2	579.2	579.2	579.2	579.2		16	84	13.3
8 mm	477	632.6	632.6	632.6	632.6		8	155.6	24.7
4 mm	455.2	566.5	565.6	565.6	565.3		4	110.1	17.5
2mm No10	431.8	514.6	514.8	514.7	514.8		2.0 (#10)	83	13.2
No. 20	403	464.2	463.3	463.4	463.4		1.0 (#20)	60.4	9.6
No. 35	345.9	415.8	413.2	413.3	413.6		0.5 (#35)	67.7	10.7
No. 60	327.5	376.1	379.3	379.1	378.6		0.25 (#60)	51.1	8.1
No. 120	307	315	315.8	315.9	315.9		0.125 (#120)	8.9	1.4
No. 200	298.9	302.5	302.6	302.6	302.6		0.063 (#200)	3.7	0.6
PAN	299.5	304.4	304.6	304.6	304.7		Fines	5.2	0.8
TOTAL	4562.6	5192.6	5192.7	5192.6	5192.3		Total*	629.7	100.0
Bag/Sample (g)		652.3		Sieve+SampleWt(g)		5192.40			
Bag Weight (g)		22.4		Sieve Wt		<u>4562.6</u>			
Sample Weight (g)		629.90		Sample Wt (g)		629.80			
*Note -									
mlg-ASTMD422									
						Appr. RG[illegible]			12/31/09

			Sieve Analysis						
Used Balance Enclosure				Settings:	Amp - 9	Relay - 2	Mains - 2		
		12/29/2009		/ C09351012007DUP MW498PART1209-007DUP					
								Sample	Sample
Size	WT.(g)	5 minutes	2 minutes	1 minute	1 minute		Sieve	Weight	%
	4565	4768.1	4768.1	4768.1	4767.8		Size mm	Ret/Sieve	Ret/Sieve
LID	241.4	241.4	241.4	241.4	241.4		Lid		
31.5 mm	480.1	480.1	480.1	480.1	480.1		31.5	0	0.0
16 mm	495.2	508.3	508.3	508.3	508.3		16	13.1	6.5
8 mm	477	506.3	506.3	506.3	506.3		8	29.3	14.4
4 mm	455.2	484.3	484.2	484	484		4	28.8	14.2
2mm No10	431.8	469.2	468.9	468.8	468.6		2.0 (#10)	36.8	18.1
No. 20	403.7	430.4	430.4	430.5	430.4		1.0 (#20)	26.7	13.1
No. 35	346.7	380.5	379.9	379.5	378.8		0.5 (#35)	32.1	15.8
No. 60	328	351.8	352.6	353	353.7		0.25 (#60)	25.7	12.7
No. 120	307.4	311.6	311.8	311.9	312		0.125 (#120)	4.6	2.3
No. 200	299.2	301.6	301.7	301.7	301.7		0.063 (#200)	2.5	1.2
PAN	299.3	302.5	302.6	302.6	302.6		Fines	3.3	1.6
TOTAL	4565	4768	4768.2	4768.1	4767.9		Total*	202.9	99.9
Bag/Sample (g)		225.2		Sieve+SampleWt(g)		4768.10			
Bag Weight (g)		21.8		Sieve Wt		4565			
Sample Weight (g)		203.40		Sample Wt (g)		203.10			
*Note -									
mlg-ASTMD422									

Approved: RGLbiw 12/31/09

Sieve Analysis

Used Balance Enclosure — Settings: Amp - 9 | Relay - 2 | Mains - 2

12/29/2009 / C09351012008 MW498PART1209-008

Size	WT.(g)	5 minutes	2 minutes	1 minute	1 minute		Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
	4564.1	5274.1	5273.5	5274.1	5273.1				
LID	241.4	241.4	241.4	241.4	241.4		Lid		
31.5 mm	480.2	480.2	480.1	480.2	480.2		31.5	0	0.0
16 mm	495.1	608.6	608.6	608.6	608.6		16	113.5	16.0
8 mm	477	659	658.9	658.8	658.8		8	181.8	25.6
4 mm	455.2	551.5	551.2	551	550.9		4	95.7	13.5
2mm No10	431.8	496.6	496.8	496.9	496.9		2.0 (#10)	65.1	9.2
No. 20	403.3	463.3	463.2	463.2	463		1.0 (#20)	59.7	8.4
No. 35	346.2	423.3	422.4	423.1	421.8		0.5 (#35)	75.6	10.6
No. 60	327.9	389.5	388.3	388.1	388.1		0.25 (#60)	60.2	8.5
No. 120	307.4	342.3	343.1	343.6	344		0.125 (#120)	36.6	5.2
No. 200	299.2	308	308.3	308.4	308.5		0.063 (#200)	9.3	1.3
PAN	299.3	310.5	310.7	311	311.1		Fines	11.8	1.7
TOTAL	4564	5274.2	5273	5274.3	5273.3		Total*	709.3	99.9

Bag/Sample (g)	732.7	Sieve+SampleWt(g)	5274.10
Bag Weight (g)	22.6	Sieve Wt	4564.1
Sample Weight (g)	710.10	Sample Wt (g)	710.00

*Note -
mlg-ASTMD422

Appr: RGJoliece 12/31/09

Sieve Analysis

Used Balance Enclosure | Settings: Amp - 9 | Relay - 2 | Mains - 2

12/29/2009 / C09351012009 MW498PART1209-009

Size	WT.(g)	5 minutes	2 minutes	1 minute	1 minute	Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
	4565.2	5261.3	5261.3	5260.9	5260.8			
LID	241.5	241.4	241.4	241.3	241.4	Lid		
31.5 mm	480.2	480.2	480.2	480.2	480.2	31.5	0	0.0
16 mm	495.1	559.1	559.1	559.1	559.1	16	64	9.2
8 mm	477	692.4	692.3	692.3	692.2	8	215.2	30.9
4 mm	455.2	576.8	576.6	576.3	576.3	4	121.1	17.4
2mm No10	432	504.2	504.2	504.2	504.2	2.0 (#10)	72.2	10.4
No. 20	403.5	458.3	458.3	458	458.1	1.0 (#20)	54.6	7.8
No. 35	346.5	418.4	419.3	417.5	418.2	0.5 (#35)	71.7	10.3
No. 60	328	383.1	381.4	382.7	381.8	0.25 (#60)	53.8	7.7
No. 120	307.5	332.3	332.5	332.9	332.9	0.125 (#120)	25.4	3.6
No. 200	299.2	307.4	307.6	307.6	307.7	0.063 (#200)	8.5	1.2
PAN	299.3	307.9	308.4	308.7	308.8	Fines	9.5	1.4
TOTAL	4565	5261.5	5261.3	5260.8	5260.9	Total*	696	100.0

Bag/Sample (g)	718.3	Sieve+SampleWt(g)	5261.30
Bag Weight (g)	22.2	Sieve Wt	4565.2
Sample Weight (g)	696.10	Sample Wt (g)	696.10

*Note -
mlg-ASTMD422

App: R. [illegible] 12/31/09

Sieve Analysis

Used Balance Enclosure — Settings: Amp - 9 | Relay - 2 | Mains - 2

12/28/2009 / C09351012010 MW498PART1209-009D

Size	WT.(g)	5 minutes	2 minutes	1 minute	1 minute	Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
	4563.2	5358.8	5358.8	5358.7	5358.7			
LID	241.4	241.4	241.4	241.5	241.4	Lid		
31.5 mm	480.1	480.2	480.2	480.2	480.2	31.5	0.1	0.0
16 mm	495	527.2	521.2	521.2	516.1	16	21.1	2.7
8 mm	477	689.7	694	693.8	698.9	8	221.9	27.9
4 mm	455.2	597.6	596.5	596.3	596.1	4	140.9	17.7
2mm No10	431.8	528.1	526.2	526.1	526.2	2.0 (#10)	94.4	11.9
No. 20	403.5	481.5	479.7	479.9	479.5	1.0 (#20)	76	9.6
No. 35	346.2	453.5	452.8	453.5	452.5	0.5 (#35)	106.3	13.4
No. 60	327.6	411.2	412.3	410.4	411	0.25 (#60)	83.4	10.5
No. 120	307	333.2	335.3	335.6	335.9	0.125 (#120)	28.9	3.6
No. 200	298.9	308.5	309.7	310	310.1	0.063 (#200)	11.2	1.4
PAN	299.4	306.8	309.5	310.4	310.7	Fines	11.3	1.4
TOTAL	4563.1	5358.9	5358.8	5358.9	5358.6	Total*	795.4	100.0

Bag/Sample (g)	818.2	Sieve+SampleWt(g)	5358.90
Bag Weight (g)	22.3	Sieve Wt	4563.2
Sample Weight (g)	795.90	Sample Wt (g)	795.70

*Note -
mlg-ASTMD422

Appr: Rg[illegible] 12/31/09

Sieve Analysis

Used Balance Enclosure — Settings: Amp - 9, Relay - 2, Mains - 2

12/21/2009 / C09351012011 MW498PART1209-010

Size	WT.(g)	5 minutes	2 minutes	1 minute	1 minute		Sieve	Sample Weight	Sample %
	4562.7	4829.1	4829.2	4829.2	4829.4		Size mm	Ret/Sieve	Ret/Sieve
LID	241.4	241.4	241.4	241.4	241.4		Lid		
31.5 mm	480.1	480.2	480.2	480.2	480.2		31.5	0.1	0.0
16 mm	495.2	531.2	526.2	526.1	526		16	30.8	11.6
8 mm	477	559.9	560.9	560.2	559.7		8	82.7	31.1
4 mm	455.1	517.6	516.9	516.2	515.5		4	60.4	22.7
2mm No10	431.8	467.1	468.2	468.9	468.9		2.0 (#10)	37.1	13.9
No. 20	403.1	424.7	425.8	426	426.5		1.0 (#20)	23.4	8.8
No. 35	346.2	359.8	360.3	360.5	360.7		0.5 (#35)	14.5	5.4
No. 60	327.6	335.5	336	336.1	336		0.25 (#60)	8.4	3.2
No. 120	307	311.5	312.2	312.5	312.8		0.125 (#120)	5.8	2.2
No. 200	298.9	300.3	300.6	300.7	300.9		0.063 (#200)	2	0.8
PAN	299.3	300	300.3	300.5	300.7		Fines	1.4	0.5
TOTAL	4562.7	4829.2	4829	4829.3	4829.3		Total*	266.5	100.2

Bag/Sample (g)	288.8	Sieve+SampleWt(g)	4828.90
Bag Weight (g)	22.5	Sieve Wt	4562.7
Sample Weight (g)	266.30	Sample Wt (g)	266.20

*Note -
mlg-ASTMD422

Appr. Rhodes 12/31/09

BH498

3-inch core   Drilled by Jimmy Householder

12/15/09 @ 11:40 to 12/16/09 @ 14:13

Drilled Interval Top	Drilled Interval Bottom	Recovery	Depths Top	Depths Bottom	Description	Notes
0.0	8.0	5.6	0.0	8.0	Silt with some clay, 10YR7/3 (very pale brown), with 10YR4/4 (dark yellowish brown) mottling, soft to moderately stiff, moderate plasticity, moist	
8.0	18.0	7.5	8.0	11.7	Silt with some clay as above	
			11.7	13.5	Clay with Silt, 7.5YR6/6 (reddish yellow), moderately stiff, low plasticity, slightly moist	Includes little fine Sand
			13.5	18.0	Silt with Sand, 10YR7/3 (very pale brown) with 10YR8/1 (white) mottling, soft to moderately stiff, low plasticity, moist to wet; sand is fine grained	
18.0	28.0	10.6	18.0	23.7	Clay with Silt and some Sand, mottled 7.5YR6/3 (light brown) and 7.5YR7/1 (light gray), soft to stiff, slightly moist to wet; sand is fine grained	Occasional pebbles
			23.7	28.0	Sand with Silt, 10YR6/4 (light yellowish brown) with 7.5YR7/1 (light gray) mottling, medium density, slightly moist; sand is very fine to fine grained	
28.0	38.0	10.0	28.0	30.2	Sand with Silt as above	
			30.2	34.1	Sand, 7.5YR6/4 (light brown), medium density to loose, wet; sand is fine grained	Trace Silt
			34.1	38.0	Clay, mottled 10YR6/1 (gray) and 10YR6/8 (brownish yellow), moderately stiff, moderate plasticity	
38.0	48.0	10.0	38.0	40.6	Clay as above	
			40.6	42.9	Clay, mottled 10YR6/1 (gray) and 10YR6/8 (brownish yellow) with iron oxide nodules, very stiff, high plasticity	- 41.6 - 42.9 ft: manganese oxide staining of fracture - 42.8 ft: chert pebbles
			42.9	47.6	Clay, 7.5YR5/8 (strong brown), very stiff, low plasticity	Trace Silt
			47.6	48.0	Silt with Sand, 10YR6/1 (gray), very stiff; sand is fine grained	
48.0	58.0	9.6	48.0	51.9	Silt with Sand as above but mottled 10YR7/1 (light gray) and 7.5YR5/8 (strong brown)	
			51.9	53.4	Sand, 2.5YR8/1 (white), loose, moist; sand is very fine to fine grained, micaceous	Trace Silt
			53.4	58.0	Sand, 7.5YR6/6 (reddish yellow) to 7.5YR5/8 (strong brown), medium density, wet; sand is fine to medium grained	
58.0	68.0	10.0	58.0	58.5	Sand as above	
			58.5	68.0	Sand with some Gravel, 7.5YR3/2 (dark brown), loose; sand is subangular to subrounded, coarse grained; gravel is subangular to subrounded, chert	- Trace Silt - 59.5 - 60.5 ft: sample MW498PART1209-001 - 64.5 - 65.0 ft: sample MW498PART1209-002
68.0	78.0	10.0	68.0	69.0	Sand with some Gravel as above	
			69.0	73.0	Gravel with Sand, 7.5YR5/6 (strong brown), loose; gravel is subangular to subrounded, poorly sorted, up to 3.0 inch diameter; sand is coarse grained	70.0 - 70.5 ft: sample MW498PART1209-003
			73.0	75.0	Sand with Gravel, 7.5YR3/3 (dark brown), loose, poorly sorted; sand is coarse grained	73.5 - 74.0 ft: sample MW498PART1209-004
			75.0	78.0	Sand with Gravel, 10YR6/6 (brownish yellow), subangular to subrounded; sand is very coarse	76.0 - 76.5 ft: sample MW498PART1209-005
78.0	88.0	6.9	78.0	82.3	Sand with Gravel as above	79.5 - 80.0 ft: sample MW498PART1209-006
			82.3	85.2	Gravel and Sand, 10YR6/6 (brownish yellow), loose, poorly sorted	Sample MW498PART1209-007
Bottom of Screen 86.5			85.2	88.0	Sand with Gravel, 10YR6/6 (brownish yellow), poorly sorted, loose; sand is medium to coarse grained	86.5 - 87.0 ft: sample MW498PART1209-008
88.0	98.0	9.8	88.0	88.8	Sand with Gravel as above	
			88.8	89.4	Clay with Silt, 10YR4/2 (dark grayish brown), very stiff, slightly moist	
			89.4	91.5	Gravel with Sand, 10YR5/6 (yellowish brown), loose; gravel diameter ranges up to 3 inches; sand is coarse grained	90.0 - 90.5 ft: samples MW498PART1209-009 and MW498PART1209-009D
Bottom of sump			91.5	93.1	Gravel with Sand and some Clay, 10YR5/6 (yellowish brown), medium density	
			93.1	94.6	Clay with some Gravel and Sand, 10YR6/6 (brownish yellow), soft to moderately stiff; sand is coarse grained	Sample MW498PART1209-010
			94.6	97.1	Sand, 5YR7/2 (pinkish gray) to 5YR7/8 (reddish yellow) and 2.5YR6/8 (light red), medium density; sand is very fine to fine grained, well sorted	
			97.1	98.0	Clay, 2.5YR4/1 (dark reddish gray), stiff to very stiff, high plasticity; with Sand stringers, sand is fine grained	
TD = 98.0 ft						

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BOREHOLE 500

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BH500 Sieve Analysis
GRAIN SIZE

GRAIN SIZE	001		002		003		004		005		006		006D		007		008		009		
31.5	0		0		0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
16	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0
8	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0
4	64.2	17%	95.6	25%	80.1	15%	102.2	20%	117.5	29%	232.4	42%	200	33%	66.6	22%	62.9	20%	56.2	17%	65.4
2	52.8	14%	60.1	16%	42.9	8%	57.5	11%	71.9	18%	174.6	32%	213	35%	42.8	14%	50.5	16%	41.6	13%	49.6
1	69.9	18%	44	11%	36.1	7%	36.5	7%	39.5	10%	58.9	11%	82.2	14%	41.1	13%	39.1	13%	30	9%	57.2
0.5	90.8	24%	62.3	16%	67.6	13%	50	10%	34.4	8%	29.2	5%	37.6	6%	37.6	12%	40.7	13%	30.1	9%	77.5
0.25	52.9	14%	80.9	21%	243.5	45%	165.1	32%	93.2	23%	39.1	7%	51.6	9%	81.9	27%	78.6	25%	111.9	34%	24.8
0.125	26.6	7%	19.9	5%	29.7	5%	43.7	8%	31.8	8%	8.5	2%	11.5	2%	24.8	8%	23.4	8%	38.8	12%	9.6
0.063	25.8	7%	11.7	3%	18.3	3%	30.3	6%	7.9	2%	2.9	1%	3.9	1%	5.2	2%	6.1	2%	8.3	3%	5.9
PAN	0	0%	12.9	3%	22	4%	30	6%	8.9	2%	4	1%	5.2	1%	6.5	2%	7.9	3%	10.1	3%	8.2
TOTAL	383	100%	387.4	100%	540.2	100%	515.3	100%	405.1	100%	549.6	100%	605	100%	306.5	100%	309.2	100%	327	100%	298.2

BH500 Sieve Analysis (Cummulative)

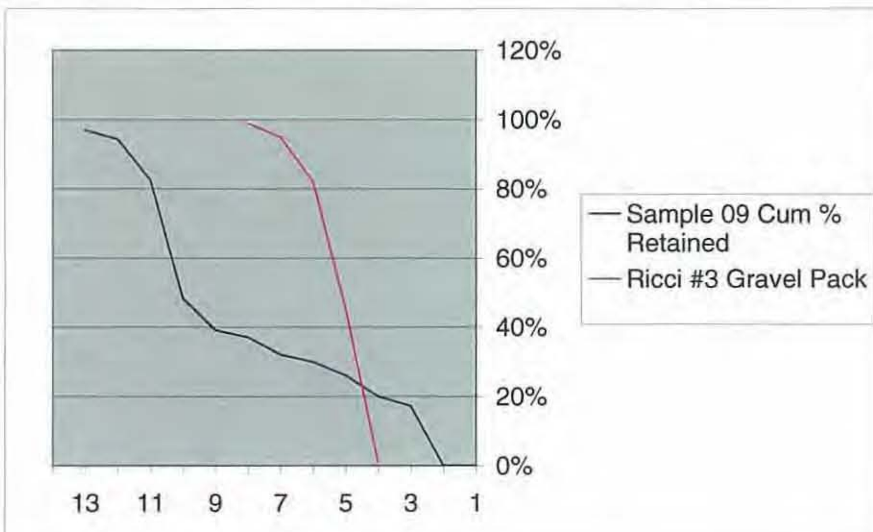
		001	002	003	004	005	006	006D	007	008	009
31.5	1.240	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
16	0.630	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
8	0.315	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
4	0.157	17%	25%	15%	20%	29%	42%	33%	22%	20%	17%
2	0.079	31%	40%	23%	31%	47%	74%	68%	36%	37%	30%
1	0.039	49%	52%	29%	38%	57%	85%	82%	49%	49%	39%
0.5	0.020	73%	68%	42%	48%	65%	90%	88%	61%	62%	48%
0.25	0.010	86%	89%	87%	80%	88%	97%	97%	88%	88%	83%
0.125	0.0049	93%	94%	93%	88%	96%	99%	98%	96%	95%	94%
0.063	0.0025	100%	97%	96%	94%	98%	99%	99%	98%	97%	97%
PAN		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

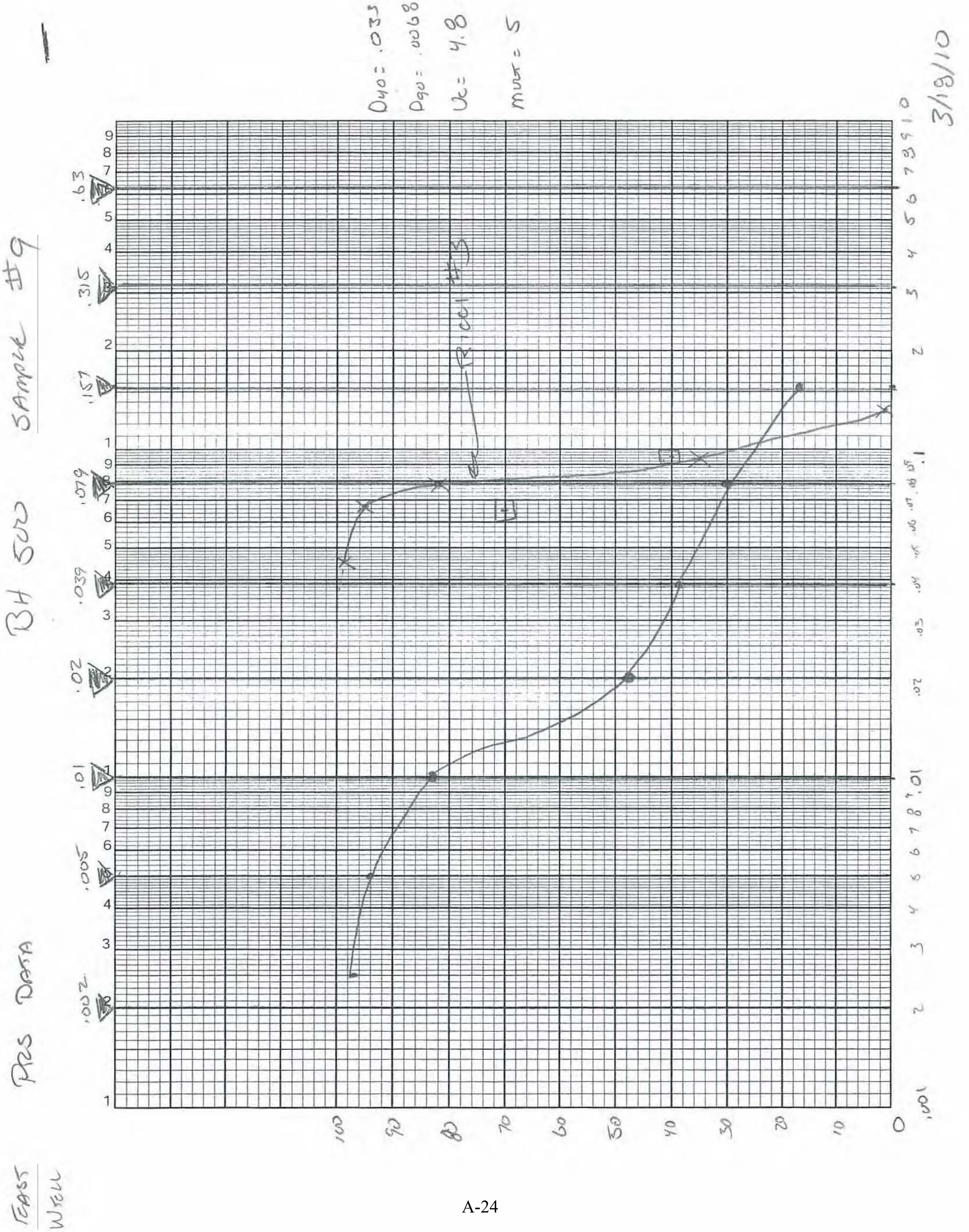
Ricci #3

	% Pass	% Ret
0.188	100	0
0.132	99	1
0.094	55	45
0.067	5	95
0.045	1	99

Sample No. 9 - Finest in screen section

Sample 09 Cum % Retained	Ricci #3 Gravel Pack	Sieve (in)
0%		0.6299
0%		0.315
17%		0.1575
20%	1%	0.132
26%	45%	0.094
30%	82%	0.0787
32%	95%	0.067
37%	99%	0.045
39%		0.0394
48%		0.0197
83%		0.0098
94%		0.0049
97%		0.0025





SAMPLE #9
BH SW
PRS DATA
EAST WELL
D40 = .033
D90 = .0068
Uc = 4.8
MULT = 5
3/18/10
.63
.315
.157
.079
.039
.02
.01
.005
.002
100
90
80
70
60
50
40
30
20
10
0

SIEVE ANALYSIS

C09355012001 Settings: Amp – 9 Relay – 2 Mains – 2

MW500PART1209-001

BALANCE: AND GX6000/CI 435

Size	Weight (g)	5 min.	2 min.	1 min.	1min.
LID	241.4	241.4	241.4	241.4	241.4
31.5 mm	480.1	480.1	480.1	480.1	480.1
16 mm	495.1	615.7	615.4	615.4	615.4
8 mm	476.9	665.6	662	660.4	658.8
4 mm	455.1	570.1	560	560	558.9
2 mm No. 10	431.9	496.9	496.3	495.7	496.1
No. 20	403.6	456.5	456.2	456.1	456.4
No. 35	346.7	422.5	421.8	421	416.6
No. 60	328.1	409.8	415.7	416.3	418.9
No. 120	307.3	352.8	356.7	357.7	360.2
No. 200	299	322.8	324.5	325.1	325.6
PAN	299.2	320.3	323.6	324.4	325
TOTAL	4564.4	5354.5	5353.7	5353.6	5353.4

Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
LID	0	0.0
31.5	120.3	15.2
16	181.9	23.0
8	103.8	13.1
4	64.2	8.1
2.0 (#10)	52.8	6.7
1.0 (#20)	69.9	8.8
0.5 (#35)	90.8	11.5
0.25 (#60)	52.9	6.7
0.125 (#120)	26.6	3.4
0.063 (#200)	25.8	3.3
Fines	0	0.0
Total	789	99.9

Bag/Sample (g)	811.8	Sieve + Sample Wt. (g)	5354.30
Bag Weight (g)	21.9	Sieve Wt.	4564.4
Sample Weight (g)	789.90	Sample Wt. (g)	789.90

Analyzed By: YML Grisham | 30404 | 1-6-10
Signature/Badge No./Date
Roby Iribarri

CP-23072 (Page 1 of 1)
(5-9-05)

SIEVE ANALYSIS

C09355012002 Settings: Amp – 9 Relay – 2 Mains – 2

MW500PART1209-002

BALANCE: AND GX6000/CI435

Size	Weight (g)	5 min.	2 min.	1 min.	1min.
LID	241.4	241.4	241.4	241.5	241.4
31.5 mm	480.2	583.9	583.8	583.7	583.7
16 mm	495.1	691.4	685.4	677.8	677.7
8 mm	476.9	589.9	594.1	601.6	601.5
4 mm	455.1	551.6	551.2	550.9	550.7
2 mm No. 10	431.8	492.5	491.9	491.8	491.9
No. 20	403.6	448.1	447.8	447.7	447.6
No. 35	346.6	413.8	411.5	410.4	408.9
No. 60	328	402.8	406.6	407.6	408.9
No. 120	307.4	326.1	326.8	327.1	327.3
No. 200	299.2	310.9	310.8	310.9	310.9
PAN	299.3	310.6	311.7	312	312.2
TOTAL	4564.6	5363	5363	5363	5362.7

Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
LID	0	0.0
31.5	103.5	13.0
16	182.6	22.9
8	124.6	15.6
4	95.6	12.0
2.0 (#10)	60.1	7.5
1.0 (#20)	44	5.5
0.5 (#35)	62.3	7.8
0.25 (#60)	80.9	10.1
0.125 (#120)	19.9	2.5
0.063 (#200)	11.7	1.5
Fines	12.9	1.6
Total	694.6 798.1	100.0

Bag/Sample (g)	820.8	**Sieve + Sample Wt. (g)**	5363.00
Bag Weight (g)	22.4	**Sieve Wt.**	4564.7
Sample Weight (g)	798.40	**Sample Wt. (g)**	798.30

Analyzed By: ML Grisham | 30404 | 1-6-10
Signature/Badge No./Date

CP-23072 (Page 1 of 1)
(5-9-05)

SIEVE ANALYSIS

C09355012003 Settings: Amp – 9 Relay – 2 Mains – 2

MW500PART1209-003

BALANCE: AND GX6000/CI435

Size	Weight (g)	5 min.	2 min.	1 min.	1min.
LID	241.4	241.3	241.5	241.4	241.4
31.5 mm	480.1	480.1	480.1	480.1	480.1
16 mm	495.1	553.4	553.5	553.4	553.4
8 mm	476.9	580.9	577.6	577.6	577.5
4 mm	455.1	534.1	535.4	535.2	535.2
2 mm No. 10	431.9	474.7	474.8	474.9	474.8
No. 20	403.6	441.1	439.8	439.8	439.7
No. 35	346.7	425.2	415	414.6	414.3
No. 60	328.1	564.5	571.6	571.6	571.6
No. 120	307.5	331.7	337.2	337.2	337.2
No. 200	298.8	318.3	317.6	317	317.1
PAN	299.2	318.3	320	320.9	321.2
TOTAL	4564.4	5263.6	5264.1	5263.7	5263.5

Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
LID	0	0.0
31.5	0	0.0
16	58.3	8.3
8	100.6	14.4
4	80.1	11.5
2.0 (#10)	42.9	6.1
1.0 (#20)	36.1	5.2
0.5 (#35)	67.6	9.7
0.25 (#60)	243.5	34.8
0.125 (#120)	29.7	4.2
0.063 (#200)	18.3	2.6
Fines	22	3.1
Total	699.1	100.0

Bag/Sample (g) 721.7

Bag Weight (g) 22.3

Sample Weight (g) 699.40

Sieve + Sample Wt. (g) 5263.80

Sieve Wt. 4564.5

Sample Wt. (g) 699.30

Analyzed By: ML Grisham / 30404 / 1-6-10
Signature/Badge No./Date

CP- 23072 (Page 1 of 1)
(5-9-05)

SIEVE ANALYSIS

C09355012004 Settings: Amp – 9 Relay – 2 Mains – 2

MW500PART1209-004

BALANCE: AND GX6000/CI435

Size	Weight (g)	5 min.	2 min.	1 min.	1min.
LID	241.4	241.4	241.4	241.4	241.4
31.5 mm	480.1	480.2	480.2	480.1	480.1
16 mm	495.1	545.6	545.6	545.5	545.5
8 mm	476.9	627.7	627.6	627	626.9
4 mm	455.1	557.2	556.9	557.4	557.3
2 mm No. 10	431.9	489.1	489.3	489.4	489.4
No. 20	403.5	439.9	440	440	440
No. 35	346.6	397.5	397	396.8	396.6
No. 60	327.9	494.3	493.4	493.3	493
No. 120	307.3	351.6	350.9	350.9	351
No. 200	299.2	329.9	330.2	329.6	329.5
PAN	299.3	326.1	328	329	329.3
TOTAL	4564.3	5280.5	5280.5	5280.4	5280

Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
LID	0	0
31.5	0	0.0
16	50.4	7.0
8	150	20.9
4	102.2	14.3
2.0 (#10)	57.5	8.0
1.0 (#20)	36.5	5.1
0.5 (#35)	50	7.0
0.25 (#60)	165.1	23.1
0.125 (#120)	43.7	6.1
0.063 (#200)	30.3	4.2
Fines	30	4.2
Total	715.7	100.0

Bag/Sample (g)	738.3	Sieve + Sample Wt. (g)	5280.50
Bag Weight (g)	22.3	Sieve Wt.	4564.5
Sample Weight (g)	716.00	Sample Wt. (g)	716.00

Analyzed By: ML Grisham/30404/1-6-10
Signature/Badge No./Date

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(5-9-05)

SIEVE ANALYSIS

C09355012005 Settings: Amp – 9 Relay – 2 Mains – 2

MW500PART1209-005

BALANCE: AND GX6000/CI435

Size	Weight (g)	5 min.	2 min.	1 min.	1min.
LID	241.3	241.5	241.4	241.4	241.4
31.5 mm	480.1	480.2	480.2	480.1	480.1
16 mm	495.1	667.1	656.1	656	656
8 mm	476.9	695.8	704.7	703.9	703.4
4 mm	455.2	572.1	571.9	572.3	572.7
2 mm No. 10	432.2	503.9	504.2	504.2	504.1
No. 20	403.6	442.7	443	443.1	443.1
No. 35	346.6	384	381.2	381.1	381
No. 60	328	423.8	422.9	421.5	421.2
No. 120	307.3	332.5	337.3	338.7	339.1
No. 200	298.9	306.3	306.6	306.7	306.8
PAN	299.2	307.5	307.9	308	308.1
TOTAL	4564.4	5357.4	5357.4	5357	5357

Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
LID	0	0
31.5	0	0.0
16	160.9	20.3
8	226.5	28.6
4	117.5	14.8
2.0 (#10)	71.9	9.1
1.0 (#20)	39.5	5.0
0.5 (#35)	34.4	4.3
0.25 (#60)	93.2	11.8
0.125 (#120)	31.8	4.0
0.063 (#200)	7.9	1.0
Fines	8.9	1.1
Total	792.5	100.0

Bag/Sample (g) 815.1

Bag Weight (g) 22.3

Sample Weight (g) 792.80

Sieve + Sample Wt. (g) 5357.20

Sieve Wt. 4564.7

Sample Wt. (g) 792.50

Analyzed By: M L Brisham/30404/1-6-10
Signature/Badge No./Date

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(5-9-05)

SIEVE ANALYSIS

C09355012006 Settings: Amp – 9 Relay – 2 Mains – 2

MW500PART1209-006

BALANCE: AND GX6000/C1435

Size	Weight (g)	5 min.	2 min.	1 min.	1min.
LID	241.4	241.4	241.4	241.4	241.4
31.5 mm	480.2	480.1	480.2	480.1	480.1
16 mm	495.1	495.2	495.2	495.1	495.2
8 mm	476.9	637.9	636.1	632.5	631.7
4 mm	455.1	692.1	687.2	687.6	687.5
2 mm No. 10	432	601.5	605.4	606.2	606.6
No. 20	403.5	458.5	460.2	462	462.4
No. 35	346.6	378.7	377.4	375.9	375.8
No. 60	327.9	363.5	365.4	367.1	367
No. 120	307.3	315.1	315.4	315.7	315.8
No. 200	298.8	301.6	301.7	301.7	301.7
PAN	299.2	303	303.2	303.2	303.2
TOTAL	4564	5268.6	5268.8	5268.5	5268.4

Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
LID	0	0.0
31.5	-0.1	0.0
16	0.1	0.0
8	154.8	22.0
4	232.4	33.0
2.0 (#10)	174.6	24.8
1.0 (#20)	58.9	8.4
0.5 (#35)	29.2	4.1
0.25 (#60)	39.1	5.5
0.125 (#120)	8.5	1.2
0.063 (#200)	2.9	0.4
Fines	4	0.6
Total	704.5	100.0

Bag/Sample (g) 726.7

Bag Weight (g) 22

Sample Weight (g) 704.70

Sieve + Sample Wt. (g) 5268.70

Sieve Wt. 4564.1

Sample Wt. (g) 704.60

Analyzed By: ML Grisham | 30404 | 1-6-10

Signature/Badge No./Date

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(5-9-05)

SIEVE ANALYSIS

C09355012007 Settings: Amp – 9 Relay – 2 Mains – 2

MW500PART1209-006D

BALANCE: AND GX6000/CI435

Size	Weight (g)	5 min.	2 min.	1 min.	1min.
LID	241.4	241.5	241.4	241.4	241.4
31.5 mm	480.1	480.2	480.3	480.1	480.1
16 mm	495.1	545.6	545.6	539.6	539.7
8 mm	476.9	582.4	578.9	584.9	583.5
4 mm	455.1	664.1	657	656.5	655.1
2 mm No. 10	431.8	643.1	644.4	644.4	644.8
No. 20	403.5	476.6	483.2	483.6	485.7
No. 35	346.6	388.7	385.5	385.6	384.2
No. 60	327.9	373.9	378.6	378.3	379.5
No. 120	307.3	317.6	318.2	318.4	318.8
No. 200	298.9	302.7	302.7	302.8	302.8
PAN	299.2	304.2	304.4	304.4	304.4
TOTAL	4563.8	5320.6	5320.2	5320	5320

Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
LID	0	0.0
31.5	0	0.0
16	44.6	5.9
8	106.6	14.1
4	200	26.4
2.0 (#10)	213	28.2
1.0 (#20)	82.2	10.9
0.5 (#35)	37.6	5.0
0.25 (#60)	51.6	6.8
0.125 (#120)	11.5	1.5
0.063 (#200)	3.9	0.5
Fines	5.2	0.7
Total	756.2	100.0

Bag/Sample (g) 778.8

Bag Weight (g) 22.2

Sample Weight (g) 756.60

Sieve + Sample Wt. (g) 5320.30

Sieve Wt. 4563.9

Sample Wt. (g) 756.40

Analyzed By: M L Chisham / 30404 / 1-6-10
Signature/Badge No./Date

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(5-9-05)

SIEVE ANALYSIS

C09355012008 Settings: Amp -- 9 Relay – 2 Mains – 2

MW500PART1209-007

BALANCE: AND GX6000/CI435

Size	Weight (g)	5 min.	2 min.	1 min.	1min.
LID	241.4	241.4	241.4	241.4	241.4
31.5 mm	480.2	480.1	480.1	480.1	480.1
16 mm	495.2	550.6	550.7	550.7	550.6
8 mm	477	564.9	565	564.9	564.9
4 mm	455.1	522.2	522.2	521.9	521.7
2 mm No. 10	432	475	474.8	474.7	474.8
No. 20	403.6	444.7	444.7	444.8	444.7
No. 35	346.6	384.8	384.4	384.3	384.2
No. 60	328	411.2	410.6	410.2	409.9
No. 120	307.4	330	331	331.6	332.2
No. 200	299.1	304.2	304.3	304.3	304.3
PAN	299.2	305.2	305.5	305.5	305.7
TOTAL	4564.8	5014.3	5014.7	5014.4	5014.5

Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
LID	0	0.0
31.5	-0.1	0.0
16	55.4	12.3
8	87.9	19.5
4	66.6	14.8
2.0 (#10)	42.8	9.5
1.0 (#20)	41.1	9.1
0.5 (#35)	37.6	8.4
0.25 (#60)	81.9	18.2
0.125 (#120)	24.8	5.5
0.063 (#200)	5.2	1.2
Fines	6.5	1.4
Total	449.8	100.0

Bag/Sample (g) 472 Sieve + Sample Wt. (g) 5014.50

Bag Weight (g) 22.1 Sieve Wt. 4564.8

Sample Weight (g) 449.90 Sample Wt. (g) 449.70

Analyzed By: M L Grisham | 30404 | 1-6-10
Signature/Badge No./Date

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(5-9-05)

SIEVE ANALYSIS

C09363004001 Settings: Amp – 9 Relay – 2 Mains – 2

MW500PART1209-008

BALANCE: AND GX6000/C1435

Size	Weight (g)	5 min.	2 min.	1 min.	1min.
LID	241.4	241.4	241.3	241.4	241.4
31.5 mm	480.1	480.1	480.1	480.1	480.1
16 mm	495	495.1	495.1	495.1	495
8 mm	476.9	524.5	522.9	522.9	522
4 mm	455.1	518.2	518.5	517.4	518
2 mm No. 10	431.9	482.4	481.9	482.2	482.4
No. 20	403.2	441.8	442.1	442.1	442.3
No. 35	346.3	388.5	387.9	387	387
No. 60	327.8	405.1	405.6	406.4	406.4
No. 120	307.1	328.7	329.7	330.3	330.5
No. 200	298.7	304.9	304.7	304.8	304.8
PAN	299.1	306.3	306.9	307	307
TOTAL	4562.6	4917	4916.7	4916.7	4916.9

Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
LID	0	0.0
31.5	0	0.0
16	0	0.0
8	45.1	12.7
4	62.9	17.7
2.0 (#10)	50.5	14.2
1.0 (#20)	39.1	11.0
0.5 (#35)	40.7	11.5
0.25 (#60)	78.6	22.2
0.125 (#120)	23.4	6.6
0.063 (#200)	6.1	1.7
Fines	7.9	2.2
Total	354.3	100.0

Bag/Sample (g)	376.4	Sieve + Sample Wt. (g)	4917.00
Bag Weight (g)	22.1	Sieve Wt.	4562.6
Sample Weight (g)	354.30	Sample Wt. (g)	354.40

Analyzed By: Michelle Grisham/30404-11-6-10
Signature/Badge No./Date

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(5-9-05)

SIEVE ANALYSIS

C09363004002 Settings: Amp – 9 Relay – 2 Mains – 2

MW500PART1209-009

BALANCE: AND GX6000/C1435

Size	Weight (g)	5 min.	2 min.	1 min.	1min.
LID	241.4	241.4	241.4	241.3	241.4
31.5 mm	480.1	480.1	480.1	480.1	480.2
16 mm	495.1	495.1	495.1	495.1	495
8 mm	476.9	534.4	534.4	534.3	534.4
4 mm	455.1	511.5	511.4	511.3	511.3
2 mm No. 10	431.9	473.8	473.6	473.6	473.5
No. 20	403.2	433.7	433.4	433.2	433.2
No. 35	346.3	377.8	377.2	376.9	376.4
No. 60	327.8	441.2	440.3	439.9	439.7
No. 120	307.1	343.3	344.5	345.3	345.9
No. 200	298.9	307	307.1	307.1	307.2
PAN	299.1	308.2	308.9	309.1	309.2
TOTAL	4562.9	4947.5	4947.4	4947.2	4947.4

Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
LID	0	0
31.5	0.1	0.0
16	-0.1	0.0
8	57.5	15.0
4	56.2	14.6
2.0 (#10)	41.6	10.8
1.0 (#20)	30	7.8
0.5 (#35)	30.1	7.8
0.25 (#60)	111.9	29.1
0.125 (#120)	38.8	10.1
0.063 (#200)	8.3	2.2
Fines	10.1	2.6
Total	384.4	100.0

Bag/Sample (g) 406.4

Bag Weight (g) 21.9

Sample Weight (g) 384.50

Sieve + Sample Wt. (g) 4947.20

Sieve Wt. 4562.8

Sample Wt. (g) 384.40

Analyzed By: M L Grisham / 30404 / 1-6-10
Signature/Badge No./Date

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(5-9-05)

SIEVE ANALYSIS

C09363004003 Settings: Amp – 9 Relay – 2 Mains – 2

MW500PART1209-010

BALANCE: AND GX6000/CI435

Size	Weight (g)	5 min.	2 min.	1 min.	1min.
LID	241.3	241.3	241.4	241.4	241.4
31.5 mm	480.1	480	480.1	480.1	480
16 mm	495.1	523.1	523.1	523	523.1
8 mm	476.9	562.1	562.1	561.3	561.3
4 mm	455.1	519.8	519.7	520.5	520.5
2 mm No. 10	431.8	482	481.7	481.4	481.4
No. 20	403.2	461.8	460.8	460.7	460.4
No. 35	346.3	423.2	423.3	424	423.8
No. 60	327.8	353	353.2	352.4	352.6
No. 120	307.1	316.5	316.6	316.6	316.7
No. 200	298.9	304.6	304.8	304.8	304.8
PAN	299.1	306.3	306.7	307.1	307.3
TOTAL	4562.7	4973.7	4973.5	4973.3	4973.3

Sieve Size mm	Sample Weight Ret/Sieve	Sample % Ret/Sieve
LID	0.1	0.0
31.5	-0.1	0.0
16	28	6.8
8	84.4	20.5
4	65.4	15.9
2.0 (#10)	49.6	12.1
1.0 (#20)	57.2	13.9
0.5 (#35)	77.5	18.9
0.25 (#60)	24.8	6.0
0.125 (#120)	9.6	2.3
0.063 (#200)	5.9	1.4
Fines	8.2	2.0
Total	410.6	99.9

Bag/Sample (g)	433.4	Sieve + Sample Wt. (g)	4973.80
Bag Weight (g)	22.2	Sieve Wt.	4562.7
Sample Weight (g)	411.20	Sample Wt. (g)	411.10

Analyzed By: M L Grisham / 30404 / 1-6-10
Signature/Badge No./Date

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(5-9-05)

BH500

3-inch core — Drilled by Jimmy Householder

12/18/09 @ 13:35 to 12/29/09 @ 11:15

Drilled Interval Top	Drilled Interval Bottom	Recovery	Depths Top	Depths Bottom	Description	Notes
0.0	8.0	7.0	0.0	2.7	Fill; Silt with Clay and Gravel	
			2.7	8.0	Silt, 10YR7/1 (light gray) to 10YR7/4 (very pale brown), soft to moderately stiff, moderate plasticity, moist	
8.0	18.0	10.0	8.0	8.5	Silt as above	
			8.5	12.6	Clay with Some Silt, 10YR7/2 (light gray) to 10YR7/3 (very pale brown) with 10YR6/6 (brownish yellow) mottling, soft, high plasticity, very moist	
			12.6	16.3	Clay with Some Silt, 10YR6/3 (pale brown) with 10YR7/1 (light gray) mottling, stiff, low plasticity, moist	Includes little Sand
			16.3	18.0	Clay with Sand and some Gravel, 7.5YR5/4 (brown), very stiff, low plasticity, slightly moist	
18.0	28.0	9.3	18.0	20.6	Clay with Sand and some Gravel as above	
			20.6	23.9	Gravel with Sand and some Clay, 10YR5/2 (grayish brown), loose to medium density, wet; gravel is angular to subrounded; sand is medium to coarse grained	
			23.9	26.4	Clay with Silt, 10YR6/4 (light yellowish brown), very stiff, low plasticity, slightly moist	23.9 - 25.0 ft: mottled with 2.5YR7/1 (light reddish gray) and 2.5YR6/6 (light red)
			26.4	28.0	Clay with Sand, 10YR6/6 (brownish yellow), stiff, low plasticity, dry to slightly moist; sand is fine to medium grained	
28.0	38.0	10.0	28.0	34.6	Clay with Sand as above	
			34.6	38.0	Sand with some Silt, 10YR6/8 (brownish yellow), medium density, wet; sand is well sorted, grading downward from fine to medium grained	
38.0	48.0	10.0	38.0	38.6	Sand with some Silt as above	
			38.6	42.8	Sand with Silt and some Gravel, 10YR6/8 (brownish yellow), medium density; sand is medium to coarse grained; gravel is subangular to subrounded, poorly sorted	
			42.8	48.0	Clay with Silt, mottled 5YR6/1 (gray) and 5YR5/6 (yellowish red), very stiff, moderate plasticity, slightly moist	
48.0	58.0	7.4	48.0	58.0	Clay with Silt as above	
58.0	68.0	10.5	58.0	58.9	Clay with Silt as above	
			58.9	60.5	Silt with Sand, mottled 5YR7/1 (light gray) and 5YR6/8 (reddish yellow), stiff, slightly moist	
			60.5	62.8	Sand with Silt, mottled 5YR7/1 (light gray) and 5YR6/8 (reddish yellow), medium density, moist; sand is fine to medium grained	Trace Gravel
			62.8	68.0	Sand and Gravel, 7.5YR5/8 (strong brown), loose, wet; sand is medium to coarse grained; gravel is subangular to subrounded	- 64.0 - 64.5 ft: sample MW500PART1209-001 - 67.5 - 68.0 ft: sample MW500PART1209-002
68.0	78.0	10.0	68.0	70.5	Sand and Gravel as above	Contact at 70.5 ft is approximate
			70.5	73.0	Sand with some Gravel, 2.5YR5/8 (red), loose; sand is medium to coarse grained; gravel is subangular to subrounded	- Contacts at 70.5 and 73.0 ft are approximate - 70.5 - 71.0 ft: sample MW500PART1209-003
			73.0	78.0	Sand with Gravel, 7.5YR5/8 (strong brown), loose; sand is fine to coarse grained; gravel is poorly sorted, subangular to subrounded	- Contact at 73.0 ft is approximate - 75.0 - 75.5 ft: sample MW500PART1209-004
78.0	88.0	8.0	78.0	79.6	Sand, 7.5YR6/4 (light brown), fine to coarse grained, poorly sorted	- Contact at 79.6 ft is approximate - 78.5 - 79.0 ft: sample MW500PART1209-005
			79.6	85.8	Gravel with little Sand, 7.5YR5/6 to 7.5YR4/6 (strong brown), fine to coarse gravel, poorly sorted, subangular to subrounded	- Contacts at 79.6 and 85.8 ft are approximate - 83.0 - 83.5 ft: samples MW500PART1209-006 and MW500PART1209-006D
			85.8	88.0	Gravel with Sand, loose; gravel is poorly sorted, subangular to subrounded; sand is fine to coarse grained	- Contact at 85.8 ft is approximate - 86.5 - 87.0 ft: sample MW500PART1209-007
88.0	98.0		88.0	91.1	Gravelly Sand, 10YR7/4 (very pale brown), loose, moist; sand has bimodal distribution - predominately fine, quartz sand but includes coarse to very coarse, angular to subangular chert sand; gravel is rounded to subrounded chert with iron patina, 0.25 - 1.0 inch diameter	~ 60% Sand and 40% Gravel - 89.5 - 90.0 ft: sample MW500PART1209-008

		91.1	93.6	Sand with some Gravel, 10YR8/3 (very pale brown), loose, moist; sand is predominately fine quartz with little angular to subangular, coarse chert; gravel is subrounded chert with iron patina, 0.5-1.0 inch diameter	92.0 - 92.5 ft: sample MW500PART1209-009
	8.2	93.6	95.7	Gravelly Sand, 7.5YR6/6 (reddish yellow), loose, moist; sand is medium, subrounded quartz to coarse to very coarse, subangular to angular chert; gravel is chert with iron patina, 0.5 inch diameter, rounded pebbles to 1.5 inch diameter, subrounded to subangular gravel	~ 60% Sand and 40% Gravel - 94.5 - 95.0 ft: sample MW500PART1209-010
		95.7	97.3	Clayey Silt, 7.5YR6/6 (reddish yellow) grading downward to interlaminated 7.5YR7/2 (pinkish gray) and 7.5YR5/1 (gray), moderately dense, plastic, moist	
		97.3	98.0	Sandy Silt, interlaminated 7.5YR7/2 (pinkish gray) and 7.5YR5/1 (gray), soft, low plasticity, moist	
TD = 98.0 ft					

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