APPENDIX 4-D

QUALITY ASSURANCE PROJECT PLAN

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GROUNDWATER POLLUTION PREVENTION, MONITORING AND RESPONSE ACTION PLAN FOR PINEDALE ANTICLINE PROJECT AREA, SUBLETTE COUNTY, WYOMING

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1.0 INTRODUCTION

NewFields Mining, Energy and Environmental Services, LLC (NewFields) prepared this Quality Assurance Project Plan (QAPP) on behalf of Ultra Resources, Inc. (Ultra) and QEP Energy Company (QEP) for a Groundwater Pollution Prevention, Monitoring and Response Action Plan (Plan) that was developed for the Pinedale Anticline Project Area (PAPA), a natural gas development in Sublette County, Wyoming. The Plan (NewFields 2014) complies with a September 2008 Record of Decision (ROD) by the U.S. Department of the Interior Bureau of Land Management (BLM) regarding the Supplemental Environmental Impact Statement (SEIS) for the Pinedale Anticline Oil and Gas Exploration and Development Project Area (i.e., PAPA). As part of this ROD, BLM approved development of the oil and gas resources within the PAPA as outlined in Alternative D of the Final SEIS (BLM 2008a), as modified in the ROD (BLM 2008b). The ROD emphasizes concentrating development, allowing for systematic development, performance based outcomes and adaptive management for reducing impacts, and cooperative monitoring with the State of Wyoming (BLM 2008b).

Besides complying with requirements of BLM's ROD, the Plan also satisfies regulations promulgated by the Wyoming Oil and Gas Conservation Commission (WOGCC). Beginning in March 2014, the WOGCC requires a groundwater baseline sampling, analysis and monitoring plan as part of the Application for Permit to Drill or Deepen a Well (WOGCC 2014; Operational Rules, Drilling Rules; Chapter 3, Section 46). WOGCC Rules allow for a master plan to cover a geographic area of development, and this Plan will serve as the master groundwater baseline sampling, analysis and monitoring plan for the PAPA.

Data generated during environmental monitoring and measurement efforts must be valid (i.e., supported by documented procedures), such that they can be used with confidence to support determinations regarding the need for response actions, including the design of subsequent monitoring or the need for corrective measures. This QAPP is a companion document to the Sampling and Analysis Plan (SAP; Appendix 4-C to the Plan [NewFields 2014]) and presents the policies, organization, objectives, functional activities, and specific quality assurance (QA) and quality control (QC) activities designed to achieve data quality goals of the Plan.

The primary monitoring activities for the PAPA will include: installing and developing new monitoring wells; collecting water samples from existing and new monitoring wells; and measuring water levels in monitoring wells. For purposes of the Plan, these groundwater monitoring activities are components of the Groundwater Monitoring Program (GMP) presented in Section 4.0 of the Plan (NewFields 2014), which is the subject of this QAPP.

This QAPP was prepared following EPA guidance in: "Guidance on Quality Assurance Project Plans" (EPA 2012); "Guidance on Environmental Data Verification and Data Validation" (EPA 2002); "National Functional Guidelines for Superfund Organic Methods Data Review (EPA 2008); and, "National Functional Guidelines for Inorganic Superfund Data Review" (EPA 2013). For the purpose of the GMP and QAPP, QA and QC are defined as follows:

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- **Quality Assurance** - The program or structure used to define procedures for the evaluation and documentation of investigation functions (*e.g.*, sampling and laboratory methodologies) to provide a uniform basis for reporting and managing data, and performing investigation functions.
- **Quality Control** - Tasks and procedures designed to provide measures of performance for analytical procedures, including accuracy and precision of data, and procedures for corrective action.

This QAPP consists of four primary elements that are arranged to reflect the logical flow of the project life-cycle of *Plan, Do, Check* and *Act*. The "project" is defined as the GMP.

- **Project Management (*Plan*)** – This element covers the basic area of project management, including the project history, project objectives, and roles/responsibilities of the participants.
- **Data Acquisition (*Do*)** – This element covers all aspects of measurement and data acquisition systems design and implementation. This step ensures the intended measurements, data collection, or acquisition methods are appropriate for achieving project objectives.
- **Assessments (*Check*)** – This element addresses the activities for assessing the effectiveness of the implementation of the project and associated QA/QC activities. The purpose of assessment is to ensure that the QAPP is implemented as prescribed and that project actions are implemented as expected.
- **Review, Evaluation of Usability, and Reporting Requirements (*Act*)** – This element covers the QA activities that occur after the data collection (or use) phase of the project is completed. Implementation of this element will help to determine that the data conform to the specified criteria, thus achieving the project objectives and ensuring that data usability can be documented in project reports.

Background information for this QAPP, including the history of natural gas development in the PAPA, geologic and hydrogeologic conditions, and results of previous groundwater sampling and analysis are provided in AMEC (2012, 2013). A summary of data sources for groundwater quality in the PAPA is presented in Section 1.7 of the Plan (NewFields 2014).

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2.0 PROJECT MANAGEMENT

This section of this QAPP presents information regarding management of the GMP (also referred herein as the Project). Aspects of project management discussed in this document include:

- Project organization, roles, and responsibilities;
- Problem definition and background;
- Project task description;
- Project data quality objectives (DQOs);
- Special training requirements; and
- Documentation and records management.

2.1 PROJECT ORGANIZATION, ROLES, AND RESPONSIBILITIES

The Operators' (Ultra and QEP) will designate a primary environmental consultant/contractor who will be responsible for implementation of field activities and in turn subcontract components of the activities to various specialty subcontractors (e.g., driller, surveyor, and laboratories). The relationships and lines of communication between key project personnel are presented in the organizational chart in **Figure 4D-1**. Roles and responsibilities for key project personnel are summarized in the following paragraphs.

BLM Project Lead

BLM's Project Lead serves as the liaison to the Operators and other agencies or organizations for the Project. Any significant changes to the planned activities, site access issues, public outreach issues, or significant problems encountered will be reported to the Operators and the Primary Contractor Project Manager. Any changes in systems defined in the site-specific plans for this Project must also be approved by BLM's Project Lead.

Primary Contractor Project Manager

The Primary Contractor Project Manager functions as the primary interface between the Operators, BLM and his/her Project team, and is responsible for achieving technical, financial, and scheduling objectives. The Project Manager will be the central point of contact for all matters concerning the Project. The Primary Contractor Project Manager's responsibilities include:

- Develop the detailed Sampling and Analysis Plan (SAP; Appendix 4-C in NewFields 2014) which conforms to GMP objectives (see Section 2.2 in NewFields 2014) and schedule;
- Establish project policies and procedures to address specific needs of the Project as a whole, as well as objectives of each task;
- Advise Operators and BLM of technical progress, program needs, potential problems, and recommended solutions;

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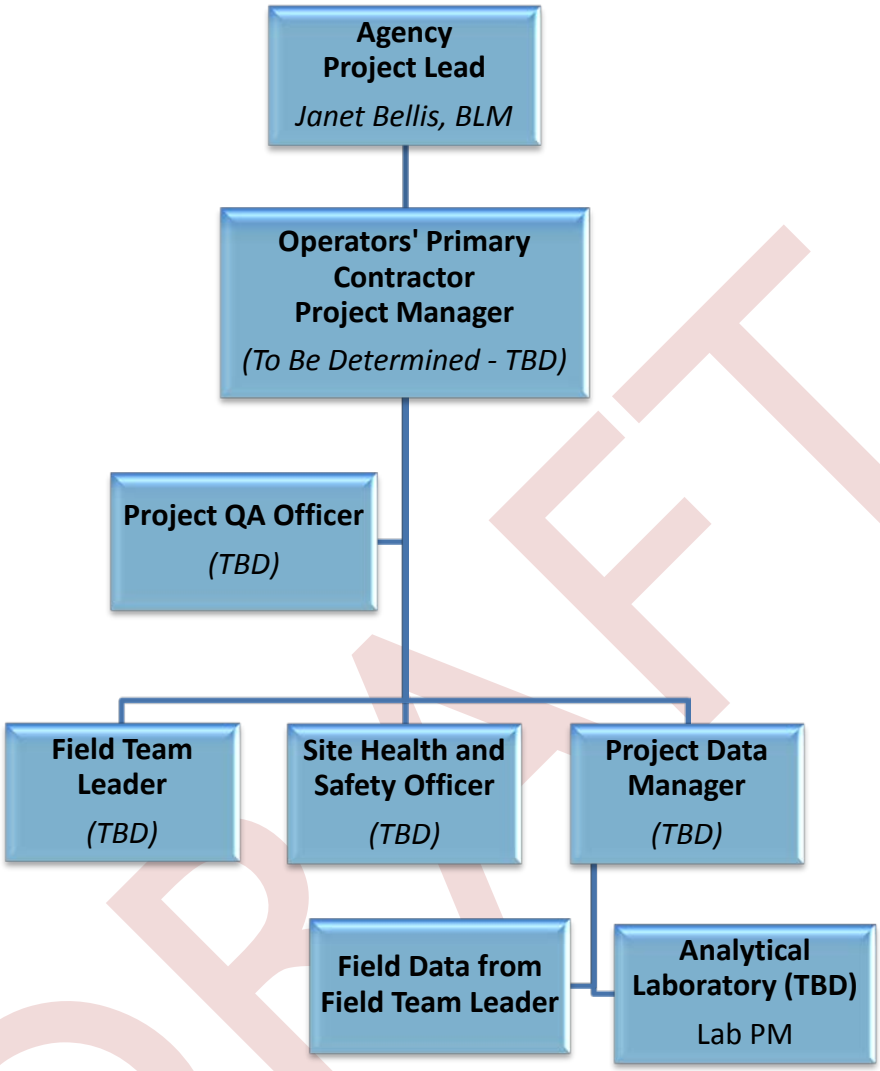

Figure 4D-1. Project Organization

- Arrange, organize, monitor, direct, and control staff and other resources needed to execute the Project within budget and schedule restraints, and establish clear lines of communication within the Contractor's organization;
- Familiarize field leaders and support staff with the project's special considerations;
- Review the work performed and overall task performance for quality, responsiveness timeliness, and budgetary considerations;
- Oversee subcontractor operations and management;

- Obtain approval from the Operators and BLM for proposed changes to the SAP and QAPP that constitute major changes affecting the scope of the approved technical approach; any overseeing agency will be notified of change;
- Review external reports (deliverables) to ensure overall quality and technical completeness before submission to the Operators, BLM and WOGCC; and
- Represent the project team at meetings with the Operators, BLM and other Project stakeholders.

Project Quality Assurance (QA) Officer

The Project QA Officer is part of the Primary Contractor's team. Responsibilities of the Project QA Officer include:

- Develop and implement the QAPP;
- Identify and respond to quality assurance and quality control (QA/QC) needs, assist in resolving quality problems, and respond to requests for QA/QC guidance or assistance;
- Verify that appropriate corrective actions are taken for all QA/QC nonconformance;
- Perform program QA audits and participate in project and site audits, when appropriate;
- Perform QA verification activities as requested by the Primary Contractor Project Manager or Field Team Leader (see below) to verify compliance with the requirements and procedures contained in the SAP;
- Provide oversight of the contracted laboratory(ies);
- Provide oversight of data validation efforts; and
- Provide oversight of data management.

Field Team Leader

The Field Team Leader is responsible for all onsite activities during the Project, including sample collection, field analysis, and direction of any field subcontractor activities. This person is also part of the Primary Contractor's team. Other responsibilities include:

- Coordinate site activities with the Primary Contractor Project Manager and contract laboratory(ies);
- Monitor compliance of sampling personnel within the provisions of the SAP and QAPP;
- Ensure that the most current version of the SAP (including but not limited to QAPP and health and safety plan [HASP]) are available to the Project participants including subcontractors;
- Review project deliverables for technical accuracy and completeness before their release;
- Regularly communicate project status, progress, and any nonconformance or other problems to the Operators, BLM and the Project QA Officer;

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- Perform other responsibilities as directed by the Primary Contractor Project Manager;
- Coordinate the day-to-day sampling activities of the Project team and subcontractors;
- Provide site-specific sampling training, if needed, to all site personnel;
- Maintain close contact with the Primary Contractor Project Manager so that potential schedule, budget, and/or technical problems can be addressed in a timely manner;
- Coordinate with the Site Health and Safety Officer to ensure compliance with the HASP;
- Ensure compliance with the SAP and this QAPP;
- Coordinate field efforts, and provide and maintain sampling equipment and materials shipping and packing materials;
- Supervise the completion of chain-of-custody records, the handling and shipping of samples, and the completion of the field notebooks; and
- Implement the required field QA/QC measures and ensure that the sampling team follows approved policies and field procedures.

Site Health and Safety Officer

The Site Health and Safety Officer, who is part of the Primary Contractor's team, has the following responsibilities:

- Serve as a resource and contact point for all team members regarding issues/concerns related to health and safety;
- Provide review and approval of the HASP and subsequent addenda;
- Conduct field audits, if necessary, in accordance with approved policies and procedures; and
- Determine the cause and implement necessary corrective action in the event of an accident.

Project Data Manager

The Project Data Manager is responsible for overall management of the flow of data throughout the Project. This person is on the Primary Contractor's team. Responsibilities of the Project Data Manager include:

- Provide direct oversight of the contracted laboratory and coordinate sample analyses with the Project Manager of the Laboratory(ies);
- Direct data-quality evaluation and data validation efforts, and ensure their completion per requirements of the QAPP, and assess data usability in achieving Project DQOs and supporting Project decisions;
- Conduct QA and data management activities to ensure development of a complete and accurate Project database;
- Monitor and manage the flow of data throughout the Project;

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- Maintain the Project's Environmental Data Management System (EDMS) which will contain Project analytical data; and
- Oversee the production of data tables or other required output of the Project EDMS.

Laboratory(ies) Project Manager

The laboratory(ies) will have a designated Laboratory Project Manager for site samples. Laboratories have not yet been selected for the GMP that would provide analytical services for groundwater samples. Once the QAPP and SAP have received final approval, a request for proposal will likely be sent to several laboratories in the region to solicit qualifications and costs for conducting the required analyses.

The Laboratory Project Manager will report to the Project Data Manager regarding the scheduling of samples to be shipped to the lab, shipping methods, quality control procedures, paper copy reports and electronic data deliverables (EDD), including EDD format. The Laboratory Project Manager will ensure that all activities inside the respective laboratory meet project requirements. Such activities include the following:

- Ensuring proper documentation of sample check-in, including signing/dating chain-of-custody forms, completing sample check-in forms, documenting sample temperature, and checking for proper sample preservation;
- Providing early notification of any discrepancies or problems associated with sample custody and delivery;
- Ensuring all resources of the laboratory are available on an as-required basis; otherwise, having an alternate analysis plan for the testing of time-critical samples;
- Documenting results of all required quality control samples and procedures;
- Checking and documenting the required method detection limits (MDL) and practical quantitation limits (PQL) for each analyte;
- Providing written responses to all inquiries into custody, sample handling, or analytical performance issues;
- Verifying the quality and completeness of both paper copy and EDD analytical reports; and
- Inspecting, reviewing, and signing all final analytical reports prior to release to the Primary Contractor.

2.2 Project Task Description

Primary groundwater monitoring activities planned for the GMP include: installing and developing new monitoring wells; collecting water samples from existing and new monitoring wells; and measuring water levels in monitoring wells. The Plan (see Section 4.2.3 in NewFields 2014) establishes groundwater monitoring locations to provide for early detection of potential impacts from oil and gas activities in areas of greatest environmental sensitivity, as well as providing spatial coverage of the PAPA.

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Specific sampling locations and sample collection methodology are presented in the SAP (Appendix 4-C of the Plan [NewFields 2014]) and its accompanying standard operating procedures (SOPs). If a discrepancy exists between the QAPP and the SAP, the SAP takes precedent.

2.3 Project Data Quality Objectives

Data quality objectives (DQOs) are established to promote collection of data that are sufficient and of adequate quality for their intended uses. EPA guidance on systematic planning using the DQO process (EPA 2006) was consulted to prepare DQOs to assure that adequate data of sufficient quality will be collected to fulfill objectives and enable accurate decision-making. The process involves completing several steps aimed at: 1) defining the problem statement; 2) identifying the goal of the GMP and various decisions to be made; 3) identifying information/decision inputs; 4) defining boundaries for the GMP; 5) developing the analytic approach; 6) specifying performance or acceptance criteria; and, 7) developing the detailed plan for obtaining data (e.g., optimizing sample design). Refer to Section 4.1 and Table 4-1 of the Plan (NewFields 2014) for a description of the GMP's DQOs.

2.4 Special Training Requirements

Project team members will be selected with the necessary experience and technical skills to perform required Project tasks. SafeLandUSA (http://www.safelandusa.org/) training or equivalent, and OSHA HAZWOPER training, are the minimum training requirements necessary for conducting groundwater monitoring activities in the PAPA. Additional training may be required by the Operators on a site-specific basis. The only additional training required is a mandatory review of the project-specific health and safety plan (HASP), which will be prepared by the Operators' Primary Contractor. The HASP must meet all health and safety requirements of the Operators, and be completed and approved prior to conducting any field work. All field staff for the site, including subcontractors, must meet the requirements specified in the QAPP, SAP, and HASP.

2.5 Documentation and Records Management

The following subsections describe documentation and record keeping requirements for the Project.

2.5.1 Field Documentation

Pertinent field investigation and sampling information will be recorded on a daily field log book and appropriate sampling forms to provide a continual record of actions taken each day on the site. All field documentation will be conducted in accordance the SAP (Appendix 4-C of the Plan [NewFields 2014]) and SOP-1 (see Annex 4C-1 in SAP). Field forms to be used for this Project are included in Annex 4C-2 of the SAP. Field notes will also include explanations of any problems encountered during field work, along with resolutions to the problems.

All entries will be made in indelible ink and all corrections will be made by drawing one line through the error and initialing and dating the correction. Each field team's lead investigator will be responsible for maintaining the field documentation and providing a copy of all field documentation to the Project QA Officer to allow appropriate reporting to the agencies and Operators.

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Because sampling situations vary widely, no general rules can specify the extent of information that must be documented. However, documentation will contain sufficient information to reconstruct the sampling activity without relying on the sampler's memory. Field documentation will be kept under strict chain-of-custody.

Unique sample IDs will be assigned to all groundwater samples collected according to the protocol presented in the SAP (see SOP-3 in Annex 4C-1 of the SAP [Appendix 4-C]) and this QAPP to prevent sample ID duplication in the Project EDMS. A record of the unique sample ID, time, and date of sampling will be maintained in the field sampling documentation as indicated in the SAP and within applicable chain-of-custody records as specified in **Section 3.3** of this QAPP.

2.5.2 Laboratory Documentation

Laboratory reports will be delivered as an electronic digital file (pdf) and electronic data deliverable (EDD), and possibly in paper copy. Data reports will include all applicable items listed in **Table 4D-1**. Any deviations from the analytical method or this QAPP shall be fully detailed in the case narrative, along with a description of any applied corrective actions. The laboratory's case narrative will address the following aspects of the analysis at a minimum:

- Sample receipt conditions, temperature, and completeness;
- Holding times;
- Blank samples;
- Laboratory quality control samples;
- Dates of analysis;
- Analytical methods; and
- Method detection limits (MDL) and practical quantitation limits (PQL).

The laboratory will be required to submit an electronic data deliverable (EDD) in a comma-delimited text file (.txt) or comma-separated value (.csv) file, in accordance with the format specified by the WOGCC. The laboratory's Project Manager shall verify that the pdf copy and EDD match each other prior to delivering the analytical results to the Primary Contractor. The product of this activity is accurate and complete analytical information ready for data evaluation and entry into the EDMS.

2.5.3 Project Record Maintenance and Storage

Each Project team member is responsible for filing all Project information or providing it to Contractor's administrative assistant familiar with the Project filing protocol. Individual team members may maintain separate files or notebooks for individual tasks, but must provide such files to the main Project file upon completion of each task. Upon return from the field, all log books and field forms completed during a field event will be scanned into electronic format and all Project files will be stored electronically on the Contractor's file server. A Project-specific index of file contents will be maintained with the Project files at all times.

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Table 4D-1. Summary of Deliverables for Laboratory Analytical Reports

All Analytical Fractions
Case Narrative – A detailed case narrative per analytical fraction is required and will include explanation of any non-compliance and/or exceptions and corrective action. Exceptions will be noted for receipt, holding times, methods, preparation, calibration, blanks, spikes, surrogates (if applicable), and sample exceptions.
Sample ID Cross Reference Sheet (Lab IDs and Operator IDs)
Completed Chain-of-Custody form and any sample receipt information
Copies of non-conformance memos and corrective actions
Organic Fractions
Sample Results
Initial and Continuing Calibration Blanks and Method Blanks Summary
Pre-digestion Matrix Spike Recoveries Summary
Duplicate or MS/MSD Precision Summary
Laboratory Control Sample Recovery Summary
Instrument or Method Detection Limit Summary
GC and/or GC/MS Identification Summary
Surrogate Recovery Summary
GC and/or GC/MS Surrogate Retention Time Summary
Metals Fractions
Sample Results
Initial and Continuing Calibration Blanks and Method Blanks Summary
Pre-digestion Matrix Spike Recoveries Summary
Native Duplicate or MS/MSD Precision Summary
Laboratory Control Sample Recovery Summary
Instrument or Method Detection Limit Summary

Note: GC = gas chromatograph; MS = Mass Spectrometer; ID = identification number; MS/MSD = matrix spike/matrix spike duplicate.

The general Project file categories are as follows:

- Admin / Project Management;
- Correspondence;
- Background Information;
- Field Investigation;
- Data and Analysis;
- General Reference Materials;
- Reports; and
- GIS Files.

3.0 DATA ACQUISTION

This section describes all aspects of data production and collection to ensure that appropriate methods for monitoring, sampling, measurement and analysis, data production, data handling and management, and quality control activities are employed and documented.

3.1 MONITORING AND SAMPLING PROCESS DESIGN

The SAP (Appendix 4-C of the Plan [NewFields 2014]) provides the analytical sampling requirements and design for the GMP. SOPs for each field method are provided in the SAP (Appendix 4-C). A total of 41 monitoring wells are included in the GMP network: 21 existing wells and 20 new wells. Sample media to be collected and analyzed for this Project will consist of groundwater from each of the monitoring wells. The planned monitoring well locations, rationale for selection, and analytical parameters for each location are detailed in the SAP.

3.2 MONITORING AND SAMPLING METHODS

Field activities to be completed for this Project include: drill, install, and develop 20 new monitoring wells; survey elevation and location of each monitoring well; measure depth to water in the wells; purge each well prior to sampling with measurement of field parameters; sample groundwater from each well; and submit samples to a laboratory for analysis. Specific SOPs or procedures for each field procedure are contained in Annex 4C-1 of the SAP (Appendix 4-C of Plan). The SOPs are listed in **Table 4D-2**.

3.3 SAMPLE HANDLING AND CUSTODY

The following subsections describe the groundwater sample handling and sample custody requirements.

3.3.1 Sampling Containers, Preservation, and Holding Time

Table 4D-3 summarizes the project requirements for sample containers, preservatives, and sample holding times for each analytical group regarding groundwater samples collected for this GMP. The table also includes analytical methods, filtration requirements, and reporting limits. The analytical parameters or analytes are divided into the following groups: inorganic compounds, hydrocarbons, and gases.

3.3.2 Sample Custody

When sampling is completed, it is critical that the process used to label and transport samples to the laboratory for analysis is sufficient to demonstrate with confidence that the samples were collected from the location indicated, and that during transport to the lab, no actions were taken to potentially alter the integrity of the samples. Strict sample labeling and chain-of-custody procedures must be followed to support the conclusion of valid analytical data.

The handling of all samples collected will be traceable from the time of collection, through analysis, until final disposition. Documentation of the sample history is referred to as chain-of-custody. A sample is considered to be under a person's custody if it is:

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- In a person's physical possession;
- In view of the person after he/she has taken possession;
- Secured by that person so that no one can tamper with the sample; and
- In a secure area accessible only to authorized personnel.

Table 4D-2. List of Standard Operating Procedures (SOP) Provided in Annex 4C-1 of the SAP (Appendix 4-C)

SOP No.	Title
1	Field Log Book and Field Sampling Forms
2	Equipment Decontamination
3	Sample Nomenclature, Documentation, and Chain-of-Custody Procedures
4	Sample Packaging and Shipping
5	Field Measurement of Groundwater Level
7	Field Measurement of Electric or Specific Conductance
8	Field Measurement of pH
9	Field Measurement of Dissolved Oxygen
10	Field Measurement of Oxidation Reduction Potential (ORP)
11	Field Sample Filtration
12	Groundwater Sampling
15	Monitoring Well Construction
18	Monitoring Well Development
24	Quality Control Sampling
25	Management of Investigative-Derived Waste
40	Worker Responsibility to Safety
41	Groundwater Sampling for Dissolved Gases
42	Monitoring Combustible Gas in Water Well Casing

Note: Additional SOPs for health and safety procedures are to be included in the Health & Safety Plan (HASP).

To establish the documentation necessary to trace sample possession from the time of collection, a chain-of-custody record will be completed and accompany every sample shipment. Each person who has custody of the samples must sign the record. The completed chain-of-custody record will be put in a waterproof plastic bag and placed inside the sample cooler if the samples are to be shipped or transported to a laboratory. A completed sample custody seal will be taped onto the outside of each sample cooler such that the seals will be broken when the cooler is opened.

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SOP-3 describes sample nomenclature, documentation and chain-of-custody procedures that must be followed for this GMP. SOP-4 describes procedures required for packaging and shipping requirements, as well as the chain-of-custody procedures for transport to the laboratory. The SOPs are provided in Annex 4C-1 of the SAP (Appendix 4-C of the Plan [NewFields 2014]).

The laboratory Sample Custodian will assess the integrity of the cooler seals upon sample arrival. The Sample Custodian will also verify and document the following information upon sample receipt on a sample check-in form:

- Condition of shipping container;
- Condition of sample containers;
- Condition of custody seals;
- Presence/absence of custody seals;
- Presence/absence of custody records (chain-of-custody form);
- Presence/absence of air-bill;
- Presence/absence of properly completed sample labels;
- Agreement/non-agreement of documents;
- Cross-reference of laboratory numbers;
- Evidence of proper preservatives in samples, where appropriate; and
- Temperature inside shipping container using temperature blanks provided laboratory.

Shipment papers, including bills of lading and airbills, should be retained by the laboratory with chain-of-custody records. The Sample Custodian will document any problems or discrepancies with the samples or custody documents, contact the sampling organization, and document the resolution to the problems or discrepancies.

3.4 Analytical Methods

Laboratory analytical methods, target detection limits, calibration procedures and frequency, and criteria for laboratory QC samples are specified in the following sections. The analytical methods are specified in **Table 4D-3** and are based on the WOGCC sampling and analysis procedure (Appendix K of WOGCC Rules). Any future changes in laboratory procedures will be included in revisions to this QAPP.

Analytical methods will conform to EPA test methods such as: Test Methods for Evaluating Solid and Hazardous Waste (SW-846; EPA 1999); Standard Methods (SM) for the Examination of Water and Wastewater; and/or EPA Methods for Chemical Analysis of Water and Wastes (MCAWW) (EPA 1983). Method-specific QC requirements are provided in the referenced analytical methods. Any omission in this QAPP of relevant requirements, tasks, and other items found in the referenced methods does not constitute a waiver of the omitted requirement, task, or item. The laboratory manager and analysts are expected to be cognizant of all relevant aspects of the referenced methods to the extent necessary to provide accurate, precise, and defensible data.

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Table 4D-3. Laboratory Parameters, Methods, and Sample Requirements for the GMP

Analyte	CAS #	Field Method	Analytical Method	Sample Containers	Preservatives	Reporting Limit	Holding Time
Inorganic Compounds							
Alkalinity (total bicarbonate, and carbonate as $CaCO_3$)	471-34-1	Unfiltered	SM 2320b	2x 250-mL poly	Cool to 6˚C	10 mg/L	14 days
Bromide	24959-67-9		EPA 300.0 or 9056			0.1 mg/L	28 days
Chloride	16887-00-6		EPA 300.0 or 9056			0.2 mg/L	28 days
Total Dissolved Solids	---		SM 2540 C	1x 500-mL poly		10 mg/L	7 days
Barium	7440-39-3	0.45-micron (µm) filter in field	EPA 200.7/200.8 or SW 846 6010 or SW 846 6020	1x 250-mL poly	Nitric Acid (HNO_3) to pH <2 Cool to 6˚C	0.05 mg/L	180 days
Boron	7440-42-8					0.005 mg/L	
Calcium	7440-70-2					1.0 mg/L	
Manganese	7439-96-5					0.001 mg/L	
Potassium	7440-09-7					1.0 mg/L	
Sodium	7440-23-5					1.0 mg/L	
Strontium	7440-24-6					0.01 mg/L	
Hydrocarbons							
Benzene	71-43-2	Unfiltered	SW 846 8260B	3x 40-mL VOA vials (no headspace)	Hydrochloric Acid (HCL) to pH<2 Cool to 6˚C	0.001 mg/L	14 days
Ethylbenzene	100-41-4					0.001 mg/L	
Toluene	108-88-3					0.001 mg/L	
Xylenes, Total	---					0.003 mg/L	
Naphthalene	91-20-3					0.001 mg/L	
TPH-DRO	---		EPA 8015D with silica gel cleanup	2x 1000-mL glass	Sulfuric Acid (H_2SO_4) to pH<2; Cool to 6˚C	0.5 mg/L	7 days
TPH-GRO	---		EPA 5035/8015D	3x 40-mL VOA vials (no headspace)	Hydrochloric Acid (HCL) to pH <2; Cool to 6˚C	0.02 mg/L	14 days
Gases							
Dissolved Methane	74-82-8	Unfiltered	RSK175	3x 40-mL VOA vials (no headspace)	Cool to 6˚ C	0.026 mg/L	14 days
Dissolved Ethane	4-84-0						
Dissolved Propane	74-98-6						

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Analyte	CAS #	Field Method	Analytical Method	Sample Containers	Preservatives	Reporting Limit	Holding Time
Gas Compositional Analysis (to be used only for the initial sample from a new well where dissolved methane >5 mg/L)							
Fixed Gases C1-C6	---	Dissolved Gases	RSK175	Specialized (lab supplied)	Benzoalkonium	0.026 mg/L	14 days
Stable isotropic concentration of the carbon (^{12}C and ^{13}C) and hydrogen (^{1}H and ^{2}H) in the methane	---		Laboratory Specific SOP			Variable	28 days

Notes:

TPH-DRO – Total Petroleum Hydrocarbons - Diesel Range Organics; TPH-GRO – Total Petroleum Hydrocarbons Gasoline Range Organics; VOA – Volatile Organic Analysis; mL – milliliters; mg/L – milligrams per liter; SOP – standard operating procedure; °C – degrees Celsius.

Modified from: Wyoming Oil and Gas Conservation Commission (WOGCC 2014), Table 1 in Appendix K (Sampling and Analysis Procedures for the Wyoming Oil and Gas Conservation Commission, Groundwater Baseline Sampling, Analysis, and Monitoring Program).

The following analytes were removed from WOGCC Table 1 in Appendix K due to site-specific development of the Core and Supplemental lists in Section 4 of the Plan (NewFields 2014): fluoride, sulfate, total phosphorus, nitrate+nitrite, iron, magnesium, selenium, iron reducing bacteria (IRB), and sulfate reducing bacteria/slime forming bacteria (SRB/SFB). Note that dissolved ethane gas, dissolved propane gas, fixed gases C1-C6, and stable isotopes of carbon and hydrogen are analyzed only if the dissolved methane gas concentration is >5 mg/L in the initial sample collected from a new monitoring well.

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Analytical methods will conform to EPA test methods such as: Test Methods for Evaluating Solid and Hazardous Waste (SW-846; EPA 1999); Standard Methods (SM) for the Examination of Water and Wastewater; and/or EPA Methods for Chemical Analysis of Water and Wastes (MCAWW) (EPA 1983). Method-specific QC requirements are provided in the referenced analytical methods. Any omission in this QAPP of relevant requirements, tasks, and other items found in the referenced methods does not constitute a waiver of the omitted requirement, task, or item. The laboratory manager and analysts are expected to be cognizant of all relevant aspects of the referenced methods to the extent necessary to provide accurate, precise, and defensible data.

An accredited laboratory will be subcontracted to perform the required groundwater sample analyses as discussed in **Section 2.1**. Samples will be analyzed by a laboratory that is accredited by the National Environmental Laboratory Accreditation Program (NELAP) or American Association for Lab Accreditation (A2LA) for the analytical methods that will be used as part of the GMP. The Primary Contractor's Project Manager will ensure that the laboratory selected to perform sample analyses actively participates in EPA/State Water Supply Performance Programs.

Table 4D-3 summarizes GMP requirements for sample containers, preservatives, and sample holding times for each analytical method for groundwater samples. Laboratory reporting limit requirements are also listed in **Table 4D-3** by analytical method and analyte. Available groundwater quality standards, threshold values, and laboratory reporting limits used for data comparisons are listed in **Table 4D-4**.

3.5 Quality Control

This section presents the various QC samples to be collected during the GMP activities. Quality control has two important aspects: preventive and corrective. The preventive aspect is designed to prevent quality problems before they are observed. This is achieved through the use of proactive procedures that minimize variability and bias at each stage of measurement. Corrective aspects of QC are to "repair" something that could potentially cause an error in interpretation. Data verification and validation may be considered examples of corrective action.

3.5.1 Field Quality Control Samples

The general QC objective is to ensure that data are not biased by contamination or sampling error. To meet this objective, the following QC samples will be collected in the field (see **Table 4D-5** for the frequency of field QC groundwater samples to be included for the GMP).

3.5.1.1 Field Duplicate

Field duplicates are samples that are collected at the same time and location in an effort to replicate the collection of a particular sample. Field duplicate samples are used to assess precision of the total process, including sampling, analysis, and site heterogeneity. Field duplicates will be submitted as blind QC samples to the laboratory. A field duplicate sample is prepared by splitting a homogeneous sample into two separate sample containers. Both samples are then submitted to the laboratory with different and unique sample identification numbers. The identity of the duplicate samples will be recorded in the field-sampling logbook, and this information is forwarded to the Project Data Manager. Field duplicates will be collected at a rate of 1 per 20 field samples, or 5 percent, per matrix for all analyses.

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Table 4D-4. Available Groundwater Quality Standards and Reporting Limits for Groundwater Monitoring Program (GMP)

Analyte[1]	EPA MCL[2]	DEQ VRP[3] Cleanup	DEQ WQD[4] Class	WOGCC[5] Action or Notice Level	Absolute Threshold Value[6]	Threshold Basis[7]	Lab Reporting Limit[8]	Core or Supplemental Analyte List
Unit[9]	mg/L	mg/L	mg/L	mg/L	mg/L	---	mg/L	---
Inorganic Compounds								
Alkalinity	---	---	---	---	329	B	10	Supplemental
Bromide	---	---	---	---	NC [10]	B	0.1	Supplemental
Chloride	---	250	250	---	214	B	0.2	Core
TDS	---	500	500	---	1,096	B	10	Core
Barium	2.0	2.0	2.0	---	1.0	A	0.05	Core
Boron	---	0.75	0.75	---	0.375	A	0.005	Core
Calcium	---	---	---	---	92	B	1.0	Supplemental
Manganese	---	0.05	0.05	---	0.025	A	0.001	Core
Potassium	---	---	---	---	3.4	B	1.0	Supplemental
Sodium	---	---	---	---	394	B	1.0	Supplemental
Strontium	---	20	---	---	10	A	0.01	Core
Hydrocarbons								
Benzene	0.005	0.005	---	0.005	0.0025	A	0.001	Core
Ethylbenzene	0.7	0.7	---	0.7	0.35	A	0.001	Core
Toluene	1.0	1.0	---	1.0	0.5	A	0.001	Core
Xylenes	10	10	---	10	5.0	A	0.003	Core
Naphthalene	---	0.667	---	0.729	0.3335	A	0.001	Core
TPH-DRO	---	1.0 or 10[11]	---	1.1 or 10[11]	0.5 or 5	A	0.5	Core
TPH-GRO	---	6.6	---	7.3	3.3	A	0.02	Core
Gases								
Dissolved Methane	---	---	---	5 mg/L increase	5 mg/L increase	C	0.026	Core

Notes:

1. TDS – total dissolved solids; TPH – total petroleum hydrocarbons; DRO – diesel range organics; GRO – gasoline range organics.
2. EPA – U.S. Environmental Protection Agency; MCL – maximum contaminant level (EPA 2009).
3. DEQ – Wyoming Department of Environmental Quality; VRP – Voluntary Remediation Program (DEQ 2014).
4. WQD – Water Quality Division Class I for domestic use (DEQ 2005).
5. WOGCC – Wyoming Oil and Gas Conservation Commission; in Appendix K – Sampling and Analysis Procedures for the Wyoming Oil and Gas Conservation Commission, Groundwater Baseline Sampling, Analysis, and Monitoring Program (WOGCC 2014).
6. Absolute threshold values calculation method shown on Figure 4-13 in the Plan.
7. Threshold basis: A = threshold is one-half the applicable standard; B = threshold is the Upper Confidence Level (UCL; 95%) based on statistical evaluation; C = threshold is based on WOGCC notification level for methane.
8. Laboratory reporting limits are listed in Table D-3.
9. mg/L – milligrams per liter.
10. NC – not calculated for bromide because a standard does not exist and there are insufficient data to calculate an UCL.
11. For TPH-GRO, the lower concentration (1.0 mg/L) is applicable when naphthalene and or 2-methylnaphthalene, along with other chemicals of concern, are detected in groundwater above the EPA MCL; or when there is free product on the groundwater table. The upper concentration (10 mg/L) is applicable when naphthalene and/or 2-methylnaphthalene, along with other chemicals of concern, are below the EPA MCL.

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Table 4D-5. Minimum QA/QC Samples for Groundwater Monitoring Program (GMP)

Sample Medium	Duplicates[1]	Trip Blanks[2]	Equipment Rinsate Blanks[1]
Groundwater	1 duplicate in 20 natural samples	One trip blank bottle set per daily set of sample shipment containers containing VOC samples	1 per 20 decontamination procedures

[1] Duplicate and rinse blank samples are collected at the minimum rate of 1 per 20 samples. If fewer than 20 samples are collected, one duplicate sample and one rinse blank sample (if decontamination procedures are performed) must be collected.

[2] Trip blanks are prepared in the laboratory or at another off-site location from distilled or deionized water. They are never prepared on-site, or from soils or other solid material.

3.5.1.2 Equipment Rinsate Blank

The purpose of a rinsate blank is to assess the adequacy of the decontamination process. After non-disposable sampling equipment is fully decontaminated, it will be rinsed with deionized water and a sub-sample of this rinsate is collected as the equipment blank. The equipment rinsate blank is preserved, handled, and stored in the same manner as the normal field samples. The equipment blank is then sent to the lab and typically analyzed for the same analytical parameters as the corresponding normal samples that were taken with that equipment that day. The equipment blank is used to monitor potential cross-contamination caused by improper equipment decontamination. Equipment blanks will be collected at a rate of 1 per 20 normal samples, or 5 percent, for groundwater samples. Samples that involve dedicated or disposable sampling equipment, and thus are not at risk for cross-contamination due to improper equipment decontamination, will not require equipment rinsate blanks.

3.5.1.3 Trip Blank

Trip blanks are required only when samples are collected for analysis of volatile organic compounds (VOC). The purpose of a trip blank is to assess whether contamination is introduced during sample handling and shipment. For this GMP, the VOCs are benzene, toluene, ethylbenzene, and xylenes (BTEX). Trip blanks are prepared from analyte-free (deionized) water by the laboratory, and are transported to the sampling site with the VOC sample bottles for the investigative sampling. They are kept with the samples throughout the sampling program and are shipped for analysis with the samples. They are not opened on site, and are designed to evaluate VOC contamination encountered within the coolers during the shipping and handling procedures. Trip blanks are prepared in 40 ml VOA vials with Teflon septum lids, and must be chilled and handled in the same manner as a water sample for VOC analysis. Two trip blank vials per each daily set of shipping containers or coolers containing VOC samples will be included with the groundwater samples. Trip blanks will be analyzed for BTEX.

3.5.2 Laboratory Quality Control Samples

QC samples that will routinely be analyzed in the laboratory include matrix spikes, method blanks, duplicates, and laboratory control standards. Established acceptance criteria for these samples, described in the following subsections, will be used to assess the acceptability of the data. The calculations to be used during this assessment are presented in **Section 5.1**. See **Table 4D-1** for the types of laboratory QC samples and procedures that will typically be included with the lab reports.

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3.5.2.1 Matrix Spike

A matrix spike (MS) is a sample that is spiked by the analytical laboratory with a known concentration of target analytes prior to sample preparation and then carried through the entire preparatory and analytical procedure. The percent recoveries of spiked compounds will be calculated to assess analytical accuracy. An MS typically will be analyzed with each batch of 20 samples or less. Control limits for MS recovery is specified by EPA National Functional Guidelines (EPA 2008, 2013).

The matrix spike duplicate (MSD) is an intra-laboratory split of the same sample used for the MS that is also spiked with identical concentrations of target analyte(s) and treated just as the MS sample. MS/MSDs are used to monitor and document possible bias for a given analytical method in a given sample matrix. MS/MSDs are also used to measure the precision and accuracy of the laboratory analytical procedure.

3.5.2.2 Method Blank

A method blank consists of laboratory-grade pure water containing all of the reagents utilized in the analytical procedure. A method blank is prepared by the laboratory in the same manner as a sample and is processed through all analytical steps, including sample preparation. Method blanks will be analyzed to determine whether there is glassware, reagent, instrument, or laboratory contamination. Method blanks will be analyzed for each batch of groundwater samples.

No contaminants should be present in the method blanks above detection limits. Sample results greater than the detection limits, but less than five times the concentration in a method blank, will be flagged by the data users as potentially biased.

3.5.2.3 Laboratory Duplicate

Laboratory duplicates are splits of environmental samples and are indicators of laboratory precision. For groundwater samples, a control limit of 20 percent will be used for the Relative Percent Difference (RPD) between duplicate water results greater than five times the contract detection limit. A control limit of ± two times the contract detection limit will be used for groundwater sample results less than five times the contract detection limit, including the case when only one of the duplicate results is less than the contract detection limit. Laboratory duplicates will be analyzed for every batch of samples.

3.5.2.4 Laboratory Control Sample

Laboratory control samples (LCS) are an interference-free matrix with known quantities of target analytes. Laboratory control samples serve as monitors of the overall performance of all steps in the analytical process, including sample preparation. Control limits for water LCS will be those from the LCS provider. LCS will be analyzed for every batch of groundwater samples.

3.5.3 Field and Laboratory Corrective Action

The following subsections discuss the field and laboratory corrective action requirements that will be considered when problems are discovered during the GMP.

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3.5.3.1 Field Corrective Action

Any project team member may initiate a field corrective action process. The corrective action process consists of identifying a problem, acting to eliminate the problem, monitoring the effectiveness of the corrective action, verifying that the problem has been eliminated, and documenting the corrective action.

Field corrective actions may include such activities as correcting chain-of-custody forms, solving problems associated with sample collection, re-packing samples to ensure sample integrity, correcting an entry in a field logbook, or providing a team member with additional training in sampling or water level measurement procedures. More extensive corrective actions may involve re-sampling or evaluating and revising sampling procedures. The Field Team Leader will summarize the problem, establish possible causes, and designate the person responsible for a corrective action. The Field Team Leader will then verify that the initial action has been taken and that it appears to be effective. Finally, the Field Team Leader will follow-up at a later time to verify that the problem has been resolved.

If a corrective action could potentially affect the quality of the analytical process, the Field Team Leader must notify the Project Manager immediately and inform him/her of the situation.

3.5.3.2 Laboratory Corrective Action

Laboratory nonconformance is defined as any analytical procedure that deviates from standard protocol, or those data associated with QC samples that fail to meet acceptance criteria. Data reporting errors are also considered nonconformance. Laboratories typically use QC charts to assist in identifying nonconformance.

If, as a result of audits or QC sample analyses, analytical systems prove to be unsatisfactory, corrective action will be implemented. The Field Team Leader is responsible for corrective actions in the field, and the Laboratory Project Manager is responsible for corrective actions in the laboratory. The Primary Contractor Project Manager and/or Project QA Officer will review and confirm corrective actions by the laboratory. For immediate or long-term corrective actions by the laboratory, steps comprising a closed-loop corrective action system follow:

1. Define the problem.
2. Assign responsibilities for problem investigation.
3. Investigate and determine the cause of the problem.
    a. Check all calculations;
    b. Re-analyze the sample;
    c. Verify the integrity of the standards, spiking solution, laboratory control sample, or calibration sample; and
    d. Check instrument operating conditions to preclude the possibility of malfunctions or operator error.
4. Determine the corrective action(s) necessary to eliminate the problem.
5. Assign and accept responsibilities for implementing the corrective action.
6. Evaluate the effectiveness of the corrective action and implement the corrective action.
7. Verify and document that the corrective action has eliminated the problem.

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Depending upon the nature of the problem, the corrective action implemented may be formal or informal. In either case, occurrence of the problem, the corrective action employed, and verification that the problem has been eliminated will be documented.

3.6 Instrument/Equipment Testing, Inspection, and Maintenance

The Field Team Leader is responsible for overseeing proper operation of all field equipment. Field equipment testing, inspection, and maintenance will be performed in accordance with the instrument manuals. Any field equipment malfunction shall be reported to the Operators' Primary Contractor Project Manager to determine what corrective action is necessary. Field equipment that will be utilized for this Project is described in the SAP (Appendix 4-C of the Plan [NewFields 2014]).

Laboratory equipment testing, inspection, and maintenance will be in accordance with the laboratory's Quality Assurance Plan (QAP). The laboratory QAP will discuss the schedule, procedures, criteria, and documentation for verifying that all analytical equipment is operating in an accurate and precise manner. Any laboratory equipment malfunction that will affect sample analysis shall be reported immediately to the Laboratory Project Manager to determine corrective action.

3.7 Instrument/Equipment Calibration and Frequency

Any field instruments used will be calibrated in accordance with manufacturers' specifications before the beginning and end of sampling activities for each field day. For field instruments calibrated by the manufacturer, calibration will be verified daily. If a field instrument cannot be properly calibrated, the instrument will not be used and will be replaced with a functioning instrument. All field instrument calibration results will be documented in the field book or on field forms.

All laboratory instruments will be calibrated in accordance with manufacturers' directions, method requirements, and laboratory SOP specifications.

3.8 Inspection/Acceptance of Supplies and Consumables

The Operators' Primary Contractor is responsible for supplying all required supplies and consumables for the duration of the Project. Any purchased supplies or other subcontract service must meet the project scope, specified levels of quality, and submittal schedule. Project subcontractors are expected to have contractual arrangements with their suppliers of materials.

3.9 Data Management and Reporting

Data gathered during the GMP, as well as any relevant data gathered during previous monitoring programs, will be consolidated, compiled and downloaded into the EDMS, which will be used to evaluate site conditions and data trends.

Project data management includes the following project-specific objectives:

- Establish a controlled, functional, and efficiently operated data management system (i.e., EDMS) and accompanying procedures to manage, analyze, document, and transfer the environmental data that are collected and generated;

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- Maintain the EDMS throughout the life of the Project;
- Process specific data requests from Review Team members (see Section 1.5 of NewFields 2014); and
- Transfer the EDMS or specific data components to other parties, as appropriate and as authorized by the Operators.

3.9.1 Data Tracking and Management

The following subsections describe the tracking and management procedures for hardcopy data and electronic data input procedures.

3.9.1.1 Hardcopy

Measurements made during field data collection activities will be recorded in field logbooks and on field forms. Field data will be reduced, summarized, and stored along with the field logbooks. These field logbooks and forms will be scanned daily, if possible, and will be provided to the Project Data Manager for entry into the Project database, as needed, unless alternate electronic delivery of the data has been provided.

All hardcopy analytical laboratory data will be stored in Project files. This may include chain-of-custody forms, case narratives, analytical bench sheets and reports, instrument printouts and chromatograms, certificates of analyses, and QA/QC report summaries. These data documents will be scanned for entry into the Project database.

3.9.1.2 Data Input Procedures

Sampling information shall be entered into the Project database electronically using field forms and by uploading laboratory results from the EDD files. Field data will be either downloaded from field equipment or manually entered to electronic database templates.

Data validation qualifiers applied by the Laboratory Project Manager or laboratory chemist during the analytical data validation process shall be manually entered into the Project database by the Data Manager or his designee, or will be uploaded as part of the EDD files, if available. Similarly, data validation qualifiers established by the Primary Contractor during its data validation process will be entered into the Project database.

Approximately 10 percent of the final electronic result of any data uploaded to EDMS will be verified against the original hardcopy reports to ensure the accuracy of the EDD and of any manual transcription. All data entry evaluation procedures and results will be appropriately documented. The product of this activity is an accurate and complete EDMS ready to support data evaluation.

3.9.1.3 Computer Database

All data will be input the project's EDMS (see Section 1.7.3 of the Plan [NewFields 2014]). The system will be used for reporting, analysis, and linking of data to other programs such as ESRI ArcGIS as described in Section 4.6 and 4.7 of the Plan (NewFields 2014). Pre-defined queries allow for quick updates and analysis of new information. Additionally, spatial data will be incorporated into the EDMS for reporting, graphics, and analysis. A data usability review, and data validation will be conducted on all

data collected by the Primary Contractor during this GMP. Data usability and validation undertakings will be completed as described in **Section 5.0**.

3.9.1.4 Documentation

Documentation of data management activities will be completed because it provides:

- A record of Project data management activities;
- Reference information critical for database users;
- Evidence that activities have been properly planned, executed, and verified; and
- Continuity of data management operations when personnel changes occur.

3.9.2 Presentation of Analytical Data

Data presentation will vary depending on the data user needs. At a minimum, data analysis will be performed as described in Section 4.62 of the Plan (NewFields 2014). The results reporting system for the GMP is defined in Section 4.7 of the Plan (NewFields 2014).

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4.0 ASSESSMENTS

This section describes how assessment and oversight activities, response actions, and reports to management will be performed. Assessments ensure that planned project activities are implemented as described in the QAPP, and that reports are provided to apprise management of the project status and any QA issues that arise during implementation.

4.1 ASSESSMENTS AND RESPONSE ACTIONS

Assessment and oversight activities are performed to determine whether the QC measures identified in the SAP and this QAPP are implemented and documented, as required. The Primary Contractor Project Manager, Project QA Officer, Project Data Manager, and Field Team Leader will perform assessment and oversight activities during each annual sampling event to monitor conformance to plans. For example, during a field review, the SAP may be checked to verify that field QC samples were collected at the appropriate frequency. Additional checks may address the following questions:

- Is the SAP being followed completely and correctly?
- Is non-conformance being identified, resolved, and documented with a process or system?
- Are identified deficiencies being corrected?
- Are quality control samples being prepared and submitted at the proper frequency?
- Are field instruments being maintained and calibrated at the proper frequency?
- Are sampling operations being performed as stated in the SAP?
- Are sample labels being filled out completely and accurately?
- Are chain-of-custody forms complete and accurate?
- Are field logbooks being filled-out completely and accurately?
- Are the documents generated during assessment activities being stored as described in the QAPP?

The need for a check can be determined independently by the Primary Contractor Project Manager, or assigned by the Project Manager to another team member. Assessment activities may include surveillance, inspection, peer review, audits, management system review, performance evaluation, and/or data quality assessment. Results of the assessment and oversight activities will be reported to the Project Manager, who will be responsible for ensuring that the corrective action response is completed, verified, and documented.

Potential response actions include the field and laboratory corrective actions described in **Section 3.5.3**. Any Project team member may initiate a field corrective action process. As described previously, the corrective action process consists of identifying a problem, acting to eliminate the problem, monitoring the effectiveness of the corrective action, verifying that the problem has been eliminated, and documenting the corrective action. The Field Team Leader is responsible for corrective actions in the field, and the Laboratory Project Manager is responsible for corrective actions in the laboratory. The Primary Contractor Project Manager and/or Project QA Officer will review and confirm corrective actions by the laboratory.

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4.2 REPORTS TO MANAGEMENT

Effective communication among all Project team members shall be established and maintained throughout the course of the GMP. The Primary Contractor Project Manager will coordinate status reports to the Review Team as necessary. Status reports will discuss current activities, problems encountered and their resolution, and planned work activities. Refer to **Section 3.9.2** for additional reporting information.

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5.0 DATA REVIEW, VALIDATION, AND USABILITY

This section discusses the procedures for evaluating the field and laboratory analytical data and determining its usability. This element covers the QA activities that occur after the data collection (or use) phase of the project is completed. Implementation of this element will help to determine that the data conform to the specified criteria, thus achieving the project objectives and ensuring that data usability can be documented in annual summary reports.

5.1 DATA REVIEW, VERIFICATION, AND VALIDATION REQUIREMENTS

Data review is the process by which data generated in support of a project are reviewed against the data QA/QC requirements. For this Project, the QA/QC requirements are those specified by applicable EPA methods, SOPs, this QAPP, EPA's Guidance on Environmental Data Verification and Data Validation (EPA 2002), and EPA's National Functional Guidelines for Inorganic Data Review (EPA 2013) and Organic Data Review (EPA 2008).

Data verification consists of confirmation by examination and provision of objective evidence that the specified requirements (sampling and analytical) have been completed.

Data validation is a sampling and analytical process that includes evaluating compliance with method, procedures, or contract requirements, and extends to evaluating against criteria based on the quality objectives.

Data usability is the determination of adequacy of data, based on the results of validation and verification, for the decisions or estimates to be made for the project.

In cases where specific groundwater data are deemed of insufficient quality to satisfy acceptance criteria or Project DQOs, the data will be flagged as "estimated" or "rejected" and thus qualified for use to support Project decisions. After the data review is completed, a Data Validation Report will be prepared to document the findings. This will be appended to the annual summary report (see Section 4.7 in NewFields 2014).

Definitive data are of known quality with a substantial level of associated QA/QC. The definitive data results undergo an extensive quality system of data review and data evaluation. Definitive data can be used for the following:

- Investigate the presence, nature and extent of site-related (PAPA-related) constituents;
- Support human health and ecological risk assessment tasks; and
- Show that an area has or has not been affected by site-related constituents.

Definitive data can be generated by various methods, ranging from onsite field measurements to laboratory analyses. All data collected for the GMP will constitute definitive data.

Data quality will be assessed in terms of its precision, accuracy, representativeness, completeness, and comparability (PARCC). The PARCC objectives are defined in the following paragraphs. Acceptance limits for precision and accuracy are provided.

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Precision is the degree of reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a pair of measurements compared to their average value, expressed as relative percent difference (RPD). The overall precision of a sampling event has a sampling and analytical component. Laboratory and field duplicate data will be reviewed to evaluate sampling and analytical precision.

RPDs of laboratory duplicates are measures of laboratory precision and RPDs of field replicates are measures of combined sampling and analytical precision. Laboratory duplicates will be analyzed for every batch of 20 samples or less; field duplicate analyses will be conducted at a 5 percent frequency (1 in 20 samples) (**Table 4D-5**).

RPD will be calculated according to the following equation, where A and B represent duplicate sample results:

$$RPD = \frac{A - B}{(A + B)/2} \times 100$$

The RPD threshold for laboratory duplicates is 20 percent. The precision acceptance criterion for field duplicates is 20 percent for water samples.

Accuracy is the degree of agreement for a measurement with an accepted reference or true value, and is a measure of bias in a system. The closer the measurement is to the true value, the more accurate is the measurement. Accuracy is controlled by proper use, calibration, and maintenance of both field and laboratory equipment and instruments for measurement of physical and chemical parameters. Laboratory accuracy will be evaluated by comparing the analytical difference of measurements to reference values. Laboratory accuracy will be expressed as percent recovery (%R). The accuracy of data collected in support of the sampling program will be assessed in the following manner:

- Calculation of %R of matrix spikes (MS) and laboratory control samples (LCS).
- Percent recovery will be calculated according to the following calculations:

For matrix spikes: $\%R = \frac{\text{Spiked Sample Result - Sample Result x 100}}{\text{Spike Added}}$

For LCSs: $\%R = \frac{\text{Analyzed Value x 100}}{\text{True Value}}$

Accuracy acceptance criteria for MSs and LCSs are 75-125 percent and 80-120percent, respectively, for groundwater samples. Laboratories may also have their own acceptance ranges determined for analytical methods for each parameter or analyte. Although accuracy of the field program cannot be assessed quantitatively, the following criteria will be used for a qualitative accuracy assessment for this Project: sample handling, shipping, preservation, holding time, and instrument calibration.

Representativeness indicates whether the results appear to reflect site conditions in the sampled unit or target area. Representativeness is evaluated by review of the sampling design, and by use of blank samples (i.e., trip blanks, lab blanks, and rinsate blanks). A trip blank will be included with each daily set of sample shipping containers (**Table 4D-5**). Equipment rinsate blanks will be collected at the frequency of 1 in 20 decontamination procedures for nondisposable sampling equipment (**Table 4D-5**).

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The acceptance criterion for representativeness is a parameter concentration in a blank sample is not greater than the laboratory detection limit (method detection limit [MDL] or practical quantitation limit [PQL]). Some QC programs also include the additional stipulation that the detected value is more than five times (5X) the laboratory detection limit.

Completeness is defined as the percentage of the total number of measurements judged to be acceptable for their intended use under normal conditions. Under normal sampling and analysis efforts, the completeness target is 90 percent or higher. For purposes of the GMP, the completeness goal will be to obtain a sufficient amount of valid data to address the objectives stated for the GMP and to reach the necessary conclusions. Completeness will be assessed by calculating the percentage of valid data points compared to the total data set. A valid data point is judged to be acceptable for its intended use.

Comparability is a qualitative parameter that indicates the confidence with which one data set can be compared to another. Comparability will be assessed by assuring that groundwater samples are collected using an approved SAP and standard operating procedures; samples are handled and transported properly; samples are analyzed in accordance with standard EPA methods; and reporting data are in uniform units. The laboratory project manager verifies that laboratory analyses are performed according to standard protocols and QC procedures.

5.2 Validation and Verification Methods

The data validation or review process is conducted to assess the effect of sampling and analytical processes on the usability of data. There are two areas of review: laboratory performance evaluation; and effect of matrix interference or sampling error. Evaluation of laboratory performance is a relatively straightforward examination. This evaluation determines whether or not the laboratory met the QC requirements of the analytical methods and other stated protocol requirements. The assessment of potential matrix effects and sampling error consists of an evaluation of the analytical results for the samples, as well as a number of QC measures (e.g., blank samples, duplicate samples, MS/MSD, and LCS), and then assessing if these results could affect usability of the data.

All analytical data will be supported by a data package, which will contain the relevant items listed in **Section 2.7.2** of this QAPP. Before the laboratory will release each data package, the Laboratory Project Manager or Laboratory QC Officer must review the sample and laboratory performance QC data to verify sample identity, the completeness and accuracy of sample and QC data, and compliance with method specifications.

Analytical data will be evaluated against the analytical QC standards set forth in the applicable SOPs, this QAPP, and other applicable methods, as required. If these standards are not met, the data are appropriately qualified during the validation process. In cases where the data are deemed of insufficient quality to satisfy project DQOs, the data will be qualified as estimated or possibly rejected and will not be used to support project decisions.

All analytical data obtained in support of this GMP will be reviewed by the Project Data Manager or designee in accordance with criteria described in **Section 5.1**. Sample results will then be assigned data qualifiers as needed to express the degree of usability based upon overall data quality. After completion of the data validation effort, a Data Validation Report will be prepared to discuss the findings of the review.

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Data validation includes inspection and evaluation of both field and laboratory data. All field and laboratory data for groundwater samples collected for the GMP are considered valid unless data validation identifies field and/or analytical problems that require the data to be qualified. When it becomes necessary to qualify individual data records, the following standard qualifier codes will be applied:

- **U**: The analyte was not detected above the reported laboratory detection limit (reporting limit or method detection limit).
- **J**: The associated numerical value is an estimated quantity (due to one or more problems identified during the validation process); the associated numerical value is the approximate concentration of the analyte in the sample.
- **UJ**: The analyte was not detected above the reported laboratory detection limit; the detection or reporting limit is approximate and may be inaccurate or imprecise.
- **R**: The data are unusable; the sample results are rejected due to serious deficiencies in meeting QC criteria based on professional judgment; the analyte may or may not be present in the sample.

These standard qualifier codes will be posted in the EDMS tables for the analytical results that did not achieve the QA/QC criteria. Footnotes can also be used in the database to explain certain problems associated with the field and analytical data. Data validation includes evaluation of field methods, measurements, and records to provide confidence that the field data are accurate, and the methods used to collect samples for laboratory analysis follow standard operating procedures established for the collection of groundwater samples (see SAP in Appendix 4-C of the Plan [NewFields 2014]).

5.3 Reconciliation with Project Requirements

The final data evaluation task is to assess whether the data meet Project DQOs (Section 4.1 of the Plan [NewFields 2014]). The final validated analytical results, which may have been modified during the data validation process, will be checked against the DQOs, and an assessment will be made as to whether or not the data are of sufficient quality to support the DQOs.

If the data are deemed sufficient to achieve project objectives, the EDMS will be updated with the newly validated data and any qualifiers or comments that were applied during the course of the review.

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6.0 REFERENCES

AMEC Environment & Infrastructure, Inc. (AMEC). 2012. Technical Report – Hydrogeologic Data Gaps Investigation, Interim Plan, Pinedale Anticline Project Area ROD, Sublette County, Wyoming, May 2012.

_____**. 2013**. Final Technical Report, Evaluation of Low-Level Petroleum Hydrocarbon Compounds Detected in Groundwater, Interim Plan. Pinedale Anticline Project Area ROD, Sublette County, Wyoming. October 2013.

BLM, see U.S. Department of the Interior, Bureau of Land Management

EPA, see U.S. Environmental Protection Agency

NewFields Mining, Energy, and Environmental Services LLC (NewFields), 2014. Draft, Groundwater Pollution Prevention, Monitoring and Response Action Plan, Pinedale Anticline Project Area, Sublette County, Wyoming. Prepared on behalf of Ultra Resources, Inc. and QEP Energy Company, for the U.S. Department of Interior Bureau of Land Management, Wyoming Oil and Gas Conservation Commission, Wyoming Department of Environmental Quality, Wyoming State Engineer's Office and U.S. Environmental Protection Agency. December.

U.S. Department of the Interior, Bureau of Land Management (BLM). 2008a. Final Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project, Sublette County, Wyoming. Available on-line: http://www.blm.gov/wy/st/en/info/NEPA/documents/pfo/anticline/seis.html

_____**. 2008b**. Record of Decision. Final Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project. Sept. 2008. Available on-line: http://www.blm.gov/style/medialib/blm/wy/information/NEPA/pfodocs/anticline/rod.Par.50775.File.dat/00ROD.pdf.

U.S. Environmental Protection Agency (EPA). 2013. National Functional Guidelines for Inorganic Superfund Data Review. OSWER 9200.2-133; EPA-540-R-013-001. October 2013.

_____**. 2012.** Guidance on Quality Assurance Project Plans. CIO 2106-G-05 QAPP. Final Draft, 17 January 2012.

_____**. 2009**. National Primary and Secondary Drinking Water Regulations. EPA 816-F-09-004. May 2009.

_____**. 2008**. USEPA Contract Laboratory Program, National Functional Guidelines for Superfund Organic Methods Data Review. OSWER 9240.1-48; USEPA-540-R-08-01. June 2008.

_____**. 2006**. Guidance on Systematic Planning Using the Data Quality Objectives Process (QA/G4). USEPA Office of Environmental Information; EPA/240/B-06/001. February 2006. U.S. Environmental Protection Agency (EPA), 2007. CLP Statement of Work Method CLP ILM05.4.

_____**. 2002**. Guidance on Environmental Data Verification and Data Validation. EPA/240/R-02/004. November 2002.

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_____**, 1999**. SW-846 Test Methods for Evaluating Solid Waste.

_____**. 1983**. EPA Methods for Chemical Analysis of Water and Wastes (MCAWW).

Wyoming Department of Environmental Quality (DEQ). 2014. Fact Sheet #12: Soil Cleanup Levels. Appendix A: Cleanup Levels for Total Petroleum Hydrocarbons in Soil and Groundwater. Voluntary Remediation Program (VRP). 08/27/2014 – R6. Available on-line: http:deq.state.wy.us/volremedi/index.asp.

_____**. 2005.** Water Quality Rules and Regulations. Chapter 8, Quality Standards for Wyoming Groundwaters. Available on-line: http://deq.state.wy.us/wqd/WQDrules/Chapter_08.pdf.

Wyoming Oil and Gas Conservation Commission (WOGCC). 2014. Wyoming Oil and Gas Conservation Rules and Regulations, Chapter 3: Operational Rules, Drilling Rules; Section 46; Appendix K. Available on-line: http://soswy.state.wy.us/Rules/RULES/9411.pdf.

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