FINAL

BROWNFIELDS ENVIRONMENTAL CONSULTANT/TESTING SERVICES
UNIFORM FEDERAL POLICY-QUALITY ASSURANCE PROJECT PLAN

CITY OF WHEAT RIDGE, COLORADO

Prepared for:

City of Wheat Ridge
7500 West 29th Avenue
Wheat Ridge, Colorado 80033

Prepared by:

RMC Consultants, Inc.
12295 West 48th Avenue
Wheat Ridge, Colorado 80033

January 2014

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS

ACM	Asbestos-Containing Material
ASTM	American Society for Testing and Materials
AAI	All-Appropriate-Inquiry
bgs	below ground surface
BTEX	benzene, toluene, ethylbenze and xylene
CDPHE	Colorado Department of Public Health and Environment
CPR	Cardiopulmonary Resuscitation
CAS	Chemical Abstract Service Registry Number
CCC	Calibration Check Compound
CCV	Continuing Calibration Verification
CERCLA	Comprehensive Environment Response, Compensation, and Liability Act
COC	Chain-of-Custody
CSM	Conceptual Site Model
DO	Dissolved Oxygen
DoD	Department of Defense
DQO	Data Quality Objective
DRO	Diesel Range Organics
EDD	Electronic Data Deliverable
EPA	U.S. Environmental Protection Agency
ESA	Environmental Site Assessment
FSP	Field Sampling Plan
GRO	Gasoline Range Organics
GC/MS	Gas Chromatograph/Mass Spectrometer
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCL	Hydrochloric Acid
ICAL	Initial Calibration
ICV	Initial Calibration Verification
ID	Identification
IDW	Investigation Derived Waste
LBP	Lead-Based Paint
LCS	Laboratory Control Sample
LOD	Limit of Detection
LOQ	Limit of Quantitation
MDL	Method Detection Limit
mL	milliliter

MS/MSD	Matrix Spike/Matrix Spike Duplicate
mS/cm	milliSiemens per centimeter
MTBE	methyl tert-butyl ether
NA	Not Applicable
NELAP	National Environmental Laboratory Accreditation Program
ND	Non-detect
NTU	Nephelometric Turbidity Units
ORP	Oxidation-Reduction Potential
OSHA	Occupational Safety & Health Administration
PM	Project Manager
ppm	parts per million
PQO	Project Quality Objectives
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
RF	Response Factor
RFP	Request for Proposals
RL	Reporting Limit
RMC	RMC Consultants, Inc.
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SEDD	Staged Electronic Data Deliverable
SOP	Standard Operating Procedure
SPCC	System Performance Check Compound
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
Std	Standard
SVOC	Semi-Volatile Organic Carbon
SW	Solid Waste
TOD	Transit Oriented Development
TPH	Total Petroleum Hydrocarbons
UFP	Uniform Federal Policy
VOA	Volatile Organic Analyte
VOC	Volatile Organic Compound
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound

WR2020	Wheat Ridge 2020
µg/L	microgram per liter
%	Percent

WORKSHEET #1 TITLE AND APPROVAL PAGE

Site Name/Project Name: Wheat Ridge, Colorado Community-Wide Brownfields Assessment Project

Site Location: Site locations will consist of properties located at Kipling and 38th Avenue, and 49th Avenue and Ward Road [future transit oriented development (TOD) site for the end-of-the-line station for the Gold Line light rail system], and Wheat Ridge urban renewal areas, including properties along the Wadsworth Boulevard corridor between 35th Avenue and 44th Avenue and at 44th Avenue and Ward Road (Figure 1).

Document Title: *Uniform Federal Policy*-Quality Assurance Project Plan (UFP-QAPP) for Brownfields Environmental Consultant/Testing Services, City of Wheat Ridge, Colorado

Lead Organization: City of Wheat Ridge, Colorado

Preparer's Name and Organization, Address, Telephone Number, and E-mail Address:

Jennifer Hussey - RMC Consultants, Inc.; 12295 West 48th Avenue, Unit A, Wheat Ridge, CO, 80033; 303.980.4101; jhussey@rmc-consultants.com

Revision Preparation Date (Day/Month/Year): Initial submittal

Investigative Project Manager: *David Groy/RMC Consultants* 1.29.2014
Signature/Date

Project Field Operations Manager: *Claude Murray/RMC Consultants* 1/29/14
Signature/Date

Lead Organization's Project Manager: Sally Payne, City of Wheat Ridge _____
Signature/Date

Approval: _____
Signature/Date

Printed Name/Title: _____

Approval: _____
Signature/Date

Printed Name/Title: _____

WORKSHEET #2 QAPP IDENTIFYING INFORMATION

Site Name/Project Name: Wheat Ridge, Colorado Community-Wide Brownfields Assessment Project

Title: UFP-QAPP for Brownfield Environmental Consultant/Testing Services

Site Location: Properties located at Kipling and 38th Avenues, 49th Avenue and Ward Road, (future TOD site for the Gold Line terminal), and Wheat Ridge urban renewal areas, including properties along the Wadsworth Boulevard corridor between 35th and 44th Avenues, and at 44th Avenue and Ward Road (Figure 1).

Revision Number: 0

Site Number/Code: NA

Revision Date: NA

Operable Unit: NA

Contractor Name: RMC Consultants, Inc.

Contractor Number: RFP No. 13-11

Contract Title: Brownfields Enviromental Consultants/Testing Services Agreement

1. *Identify regulatory program:* Work performed shall follow the standards for Phase II environmental site assessments (ESAs) established by the American Society for Testing and Materials (ASTM) to address the "All-Appropriate-Inquiry" (AAI) aspect to the Comprehensive Environment Response, Compensation, and Liability Act (CERCLA). Specifically, all work performed shall follow the guidance outlined in ASTM Standard E1903-97R02, Guide for Environmental Site Assessments: Phase II Environmental Site Assessment Process. Completion of Phase II work will also be consistent with the requirements of the Colorado Voluntary Cleeanup Program evaluation criteria for soil (e.g., risk-based guidance: Colorado Soil Evaluation Values) and water (i.e., Colorado state surface and ground water standards), where applicable.
2. *Identify approval entity*: City of Wheat Ridge with support from Wheat Ridge 2020 (WR2020) and the Environmental Protection Agency (EPA) Region 8
3. *The QAPP is (select one):* ☒Generic ☐Project Specific
4. *List dates of scoping sessions that were held:* NA
5. *List dates and titles of QAPP documents written for previous site work, if applicable:*

Title	Approval Date
NA	

6. *List organizational partners (stakeholders) and connection with lead organization*: WR2020, a community and economic development organization in partnership with the City of Wheat Ridge, and the EPA Region 8.
7. *List data users:* City of Wheat Ridge, WR2020, EPA, and RMC Consultants, Inc. (RMC)
8. *Document Control Numbering System*: A document control numbering system will not be used; QAPP recipients are listed on Worksheet #3.

Worksheet #2 QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
Project Management and Objectives		
2.1 Title and Approval Page	– Title and Approval Page	Worksheet #1
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	– Table of Contents – QAPP Identifying Information	Worksheet #2
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	– Distribution List – Project Personnel Sign–Off Sheet	Worksheet #3 Worksheet #4
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	– Project Organizational Chart – Communication Pathways – Personnel Responsibilities and Qualifications Table – Special Personnel Training Requirements Table	Worksheet #5 Worksheet #6 Worksheet #7 Worksheet #8
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	– Project Planning Session Documentation (including Data Needs tables) – Project Scoping Session Participants Sheet – Problem Definition, Site History, and Background – Site Maps (historical and present)	Worksheet #9 Worksheet #10
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	– Site–Specific PQOs – Measurement Performance Criteria Table	Worksheet #11 Worksheet #12

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
2.7 Secondary Data Evaluation	– Sources of Secondary Data and Information – Secondary Data Criteria and Limitations Table	Worksheet #13
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	– Summary of Project Tasks – Reference Limits and Evaluation Table – Project Schedule/Timeline Table	Worksheet #14 Worksheet #15 Worksheet #16
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	– Sampling Design and Rationale – Sample Location Map – Sampling Locations and Methods/SOP Requirements Table – Analytical Methods/SOP Requirements Table – Field Quality Control Sample Summary Table – Sampling SOPs – Project Sampling SOP, References, Table – Field Equipment Calibration, Maintenance, Testing, and Inspection Table	Worksheet #17 Worksheet #18 Worksheet #19 Worksheet #20 Worksheet #21 Worksheet #22
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	Analytical SOPs – Analytical SOP References Table – Analytical Instrument Calibration Table – Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	Worksheet #23 Worksheet #24 Worksheet #25

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	– Sample Collection Documentation Handling, Tracking, and Custody SOPs – Sample Container Identification – Sample Handling Flow Diagram – Example Chain-of-Custody Form and Seal	Worksheet #26 Worksheet #27
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples	– QC Samples Table – Screening/Confirmatory Analysis Decision Tree	Worksheet #28
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	– Project Documents and Records Table – Analytical Services Table – Data Management SOPs	Worksheet #29 Worksheet #30
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	– Assessments and Response Actions – Planned Project Assessments Table – Audit Checklists – Assessment Findings and Corrective Action Responses Table	Worksheet #31 Worksheet #32
4.2 QA Management Reports	– QA Management Reports Table	Worksheet #33
4.3 Final Project Report		

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
Data Review		
5.1 Overview		
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	– Verification (Step I) Process Table – Validation (Steps IIa and IIb) Process Table – Validation (Steps IIa and IIb) Summary Table – Usability Assessment	Worksheet #34 Worksheet #35 Worksheet #36 Worksheet #37
5.3 Streamlining Data Review 5.3.1 Data Review Steps to be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining	NA	NA

Worksheet #3 Distribution List

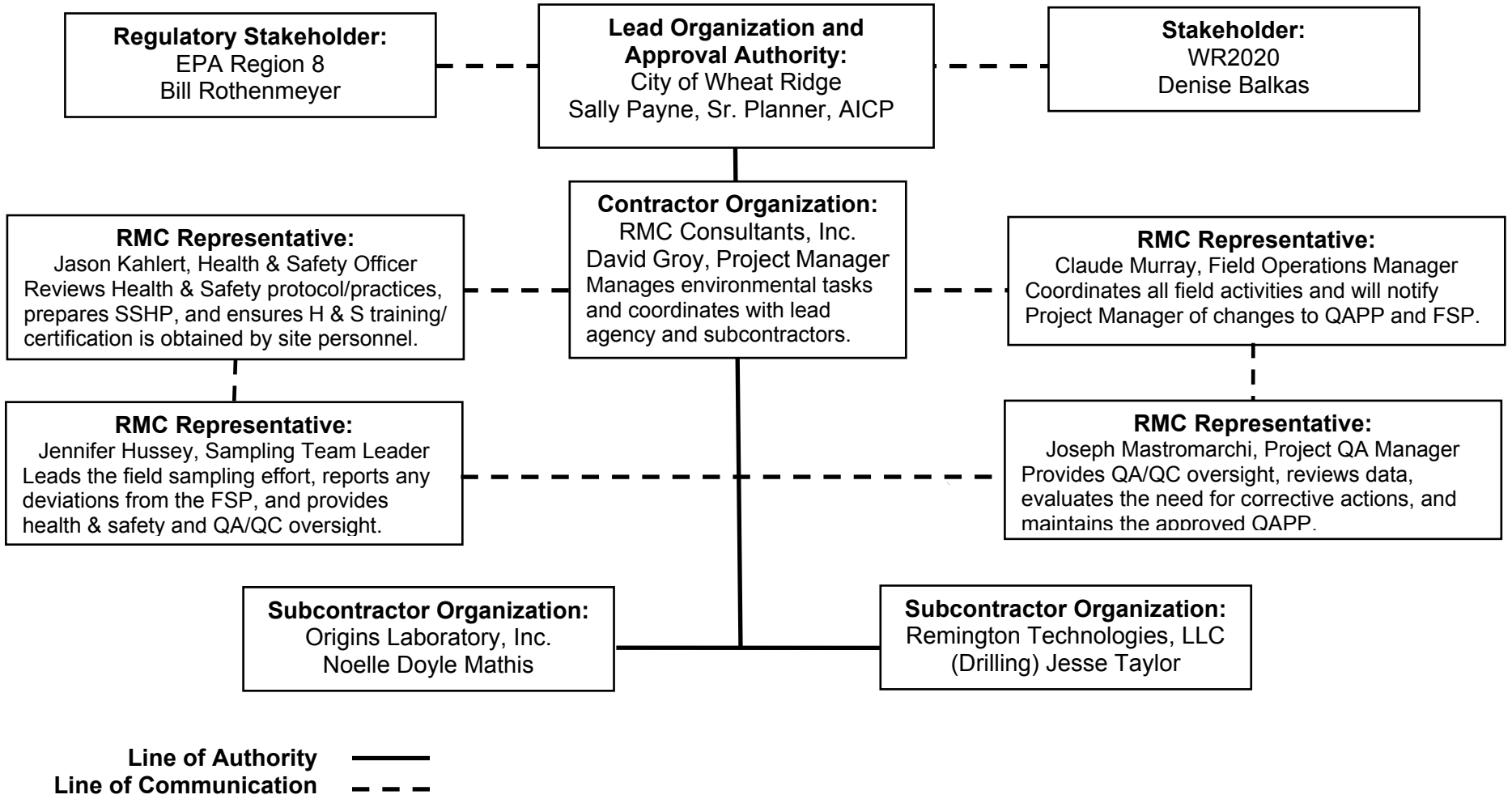
QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-mail Address	Document Control Number
Sally Payne	Senior Planner and Project Manager	City of Wheat Ridge	(303) 235-2852	(303) 234-2857	spayne@ci.wheatridge.co.us	Not Applicable
Bill Rothenmeyer	Brownfield Project Manager	U.S. EPA Region 8	(303) 312-6045	(303) 312-6065	rothenmeyer.william@epa.gov	Not Applicable
David Groy	Prime Contractor Project Manager	RMC	(303) 980-4101	(303) 980-4107	dgroy@rmc-consultants.com	Not Applicable
Jason Kahlert	Project Health & Safety Officer	RMC	(303) 980-4101	(303) 980-4107	jkahlert@rmc-consultants.com	Not Applicable
Claude Murray	Field Operations Manager	RMC	(303) 980-4101	(303) 980-4107	cmurray@rmc-consultants.com	Not Applicable
Joseph Mastromarchi	Project QA Manager	RMC	(303) 980-4101	(303) 980-4107	jmastromarchi@rmc-consultants.com	Not Applicable
Jennifer Hussey	Site Health & Safety Officer/ Sampling Team Leader	RMC	(303) 980-4101	(303) 980-4107	jhussey@rmc-consultants.com	Not Applicable
Noelle Doyle Mathis	Laboratory Project Manager	Origin Laboratory, Inc.	(303) 433-1322	(303) 265-9645	ndoyle@originslab.com	Not Applicable

Note: The Project Manager, Mr. David Groy, will distribute the QAPP electronically to all QAPP recipients listed in table.

Worksheet #4 Project Personnel Sign-Off Sheet

Project Personnel	Title	Telephone Number	Signature	Date Quality Assurance Project Plan Read
David Groy	Prime Contractor Project Manager	(303) 980-4101		
Jason Kahlert	Project Health & Safety Officer	(303) 980-4101		
Claude Murray	Field Operations Manager	(303) 980-4101		
Joseph Mastromarchi	Project QA Manager	(303) 980-4101		
Jennifer Hussey	Site Safety and Health Officer/Sampling Team Leader	(303) 980-4101		
Noelle Doyle Mathis	Laboratory Project Manager	(303) 433-1322		

Worksheet #5 Project Organizational Chart



Worksheet #6 Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure
Principal Point of Contact with EPA, WR2020, and RMC, Inc.	Lead Organization Project Manager	Sally Payne	(303) 235-2852	All materials and information about the project will be forwarded to EPA and WR2020 by Sally Payne.
Manage all Project Phases Involving Environmental Tasks	Project Manager	David Groy	(303) 980-4101	RMC liaison to Sally Payne.
QAPP changes in the field	Field Operations Manager	Claude Murray	(303) 980-4101	Mr. Murray will notify David Groy of changes to QAPP made in the field.
Reporting Lab Data Quality Issues	Laboratory Quality Assurance Officer	Noelle Doyle Mathis	(303) 433-1322	All laboratory quality assurance/quality control (QA/QC) issues will be reported by Noelle Doyle Mathis to Joseph Mastromarchi as soon as lab becomes aware of problem.
Field and Analytical Corrective Actions	Project QA Manager	Joseph Mastromarchi	(303) 980-4101	The need for corrective action for field and analytical issues will be determined by Joseph Mastromarchi.
Release of Analytical Data	Project QA Manager	Joseph Mastromarchi	(303) 980-4101	No analytical data can be released until data verification is completed and Joseph Mastromarchi has approved the release.
QAPP Amendments	Approval Authority Project Manager	Sally Payne	(303) 235-2852	Any major changes to the QAPP must be approved by Sally Payne before the changes can be implemented.

Worksheet #7 Personnel Responsibilities and Qualifications

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Sally Payne	Project Manager	City of Wheat Ridge	Oversees project and responds to regulatory agency	American Institute of Certified Planners (AICP) certification
David Groy	Project Manger	RMC	Manages environmental tasks - coordinates with Lead Agency	Master of Science, Environmental Policy and Management, 30 yrs. exp.
Jennifer Hussey	Sampling Team Leader	RMC	Leads the field sampling effort as necessary and provides Quality Assurance/Quality Control oversight	Bachelor of Science/Master of Arts, Geology, 16 yrs. exp.
Jason Kahlert	Project Health and Safety Officer	RMC	Reviews Health and Safety protocols and practices, responsible for ensuring OSHA-required H & S training and State-required asbestos certification obtained for applicable site personnel	Bachelor of Science, Geology, 19 yrs. exp.
Joseph Mastromarchi	Project QA Manager	RMC	Maintains the official, approved QAPP, reviews data and QA/QC procedures, and verifies that corrective action is taken when necessary. The Project QA Manager position is independent of the unit generating data.	Bachelor of Science, Geology, 24 yrs. exp.
Claude Murray	Field Operations Manager	RMC	Coordinates all field activities and provides Quality Assurance/Quality Control oversight. Provides health and safety oversight, acts as backup Site Safety and Health Officer	Bachelor of Science, Geology, 30 yrs. exp.
Noelle Doyle Mathis	Laboratory Project Manager	Origins Laboratory, Inc.	Manages laboratory project	

Worksheet #8 Special Personnel Training Requirements

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Site Worker	OSHA 40-hour HAZWOPER with annual refresher training	Qualified individual or institute	To be completed prior to field event	All site workers	Sampling Team Member RMC	Site worker's employer
Site Worker	First Aid/CPR	Qualified individual or institute	To be completed prior to field event	All site workers	Sampling Team Member RMC	Site worker's employer
Site Supervisor	OSHA 8-hour HAZWOPER Supervisor	Qualified individual or institute	To be completed prior to field event	Sampling Team Leader/SSHO	Sampling Team Leader RMC	Supervisor's employer
Building Inspector	CDPHE Asbestos Certification	Qualified individual or institute	To be completed prior to field event	Asbestos Building Inspector	Asbestos Building Inspector RMC	Inspector’s employer

Worksheet #9 Project Scoping Session Participants Sheet

Project Name: Brownfields Enviromental Consultant/Testing Services Projected Date(s) of Phase II: February - July 2014 Project Manager: David Groy, RMC Consultants, Inc.	Site Name: Will be determined, following Phase I ESA Site Location: Properties located at Kipling and 38th Ave. and 49th Ave. and Ward Rd. (future TOD site for the Gold Line terminal), and Wheat Ridge urban renewal areas, including properties along the Wadsworth Blvd. corridor between 35th Ave. and 44th Ave. and at 44th Ave. and Ward Rd.

Date of Session: See below

Scoping Session Purpose:

Name	Title	Affiliation	Phone #	E-mail Address	Project Role

Comments/Decisions: The scope for Phase II work was specified in the Request for Proposals (RFP-13-11), Brownfields Enviromental Consultants/Testing Services for the City of Wheat Ridge, Colorado, *dated March 8, 2013.* This QAPP is not site-specific. Amendments to this QAPP will be included in the site-specific field sampling plans (FSPs), following the completion of the Phase I assessments and meetings with the City of Wheat Ridge and property owners. The scope of work for Phase II sites will be clearly stated in the site-specific field sampling plans.

Worksheet #10 Problem Definition

The problem to be addressed by the project: The objectives of the Phase I and II activities are to identify, inventory, assess, rank and select existing hazardous substance and petroleum substance sites/properties within the City of Wheat Ridge for site specific assessments, and also to develop liability management and remedial strategies that will allow for the safe and viable monitoring and/or redevelopment/reuse of those identified and selected properties.
The environmental questions being asked: First, is there the presence or absence of contamination? Second, what is the extent, magnitude, and cleanup options for contaminants that may pose a threat to redevelopment and future land use for properties evaluated during the Phase II environmental assessments?
Development of the project's conceptual site model (CSM) : A conceptual site model will be developed for each property evaluated during the Phase II assessments and included in the site-specific field sampling plan. The CSM for each site will include the following: sources of known or suspected hazardous waste; known or suspected contaminants primary release mechanism; fate and transport considerations; potential receptors and exposure pathways; land use considerations; and site conditions.
The possible classes of contaminants and the affected matrices: Potentially contaminated sites associated with hazardous substances and petroleum substances will be identified during the Phase I assessments. Contaminated media may include soil vapor, surface soil, subsurface soil, groundwater, and structures with asbestos-containing material (ACM) and lead-based paint (LBP).
The rationale for inclusion of chemical and nonchemical analyses: Potential contaminants of concern will be identified for each site during the Phase I assessments. The rationale for selected analyses will be provided in the site-specific FSPs prepared for the Phase II sites.
Information concerning various environmental indicators: Each Phase I ESA will include a review of regulatory agency enviromental databases (a radius map report) that will assist with ensuring compliance with ASTM E1527-13 and the EPA's All Appropriate Inquiry rule. See Worksheet #13.

Worksheet #11 Project Quality Objectives /Systematic Planning Process Statements

Who will use the data? City of Wheat Ridge, WR2020, EPA, and RMC.
What will the data be used for? The data will be used to address gaps identified in the CSM. Additionally, the data will be used to assess the sites and develop remedial strategies that will allow for the safe and viable monitoring and/or redevelopment/reuse of selected properties.
What type of data is needed? Off-site chemical analyses for organic and inorganic compounds and potential LBP and ACM performed by an accredited analytical testing facility under the National Environmental Laboratory Accreditation Program (NELAP). Water quality measurements including dissolved oxygen (DO), pH, specific conductance, oxidation-reduction potential [ORP], temperature, and turbidity may be recorded during well purging to ensure representative samples are collected.
How "good" do the data need to be in order to support the environmental decision? The data must be of known quality compared to the quality control (QC) requirements specified in this QAPP (Worksheets 12, 15, and 28).
How much data are needed? Up to 10 soil samples and 4 groundwater samples will be collected from each Phase II site. Sample collection will also consist of 1 field sample duplicate and 1 matrix spike/matrix spike duplicate (MS/MSD) sample pair per matrix at each site. The site-specific FSPs will specify the sampling needs to meet the project data quality objectives (DQOs).
Where, when, and how should the data be collected/generated? Phase II activities will be implemented upon the completion and approval of the Phase I environmental assessments. The samples and associated field data will be collected/generated using the procedures and protocols described in the Standard Operating Procedures provided in Appendix A. Sample locations will be specified in the site-specific FSPs prepared for each site that requires a Phase II environmental assessment. Analytical data will be generated by a contract analytical laboratory using USEPA approved analytical methods.
Who will collect and generate the data? RMC will collect all samples and submit them to Origins Laboratory in Denver, CO for analysis. The laboratory will submit hardcopy and electronic data to RMC for inclusion in the Phase II reports.

How will the data be reported? Origins Laboratory, Inc. will provide the analytical data as a hard copy report including a complete raw data package, and as a Staged Electronic Data Deliverable (SEDD) in the 2A format.
How will the data be archived? RMC will archive the data until it is turned over to the City of Wheat Ridge Project Manager at project completion. RMC archives all electronic analytical data deliverables by project number on the company's internal storage server; RMC servers are amended nightly and fully backed up weekly to ensure data preservation. Additionally, RMC will request a hard copy report of the analytical data. Origins Laboratory's records control process (i.e., storage and archival) is provided in Origins Laboratory document No. QU0009C, Title: Records Control and Maintenance and Data Documentation Practices, revision date 3/27/12.
What procedures will be used to demonstrate acceptability of hardware and software configurations? Hardware configurations (i.e., Pentium[R] Dual Core CPU processors at 2.8 GHz) will be used to run Microsoft Access, Word, and Excel 2010 under the Windows 7 Professional operating system. Information Technology (IT) staff are responsible for assuring hardware configurations meet the requirements for running current and future data management/database software as well as providing technical support. Software development and database administration are also the responsibility of the IT staff. IT staff, if necessary, develop applications based on user requests and assures full system compatibility prior to implementation.

Worksheet #12 Measurement Performance Criteria

Matrix: Water or Soil

Analytical Group/Concentration Level: Organics or Inorganics/Low

Analytical Method: All

QC Sample	Frequency	Data Quality Indicators	Measurement Performance Criteria[1]	Assesses Error[2]
Field Duplicate	1 per 10 field samples per media	Precision	≤ 30% RPD	S & A
Matrix Spike	1 per 20 field samples per media	Bias	DOD QSM 4.2 as noted in Worksheet #28	S & A
Matrix Spike Duplicate	1 per 20 field samples per media	Bias, Precision	DOD QSM 4.2 as noted in Worksheet #28	S & A
Surrogate Spike	All field and QC samples	Accuracy	DOD QSM 4.2 as noted in Worksheet #28	S & A
Equipment Rinse Blank	1 per site and per media when using non-dedicated or reusable sampling devices	Bias	Not detected > LOQ	S & A
Temperature Blank	1 per cooler	Bias	0ºC - 6ºC	S
Laboratory Control Sample	1 per preparatory batch of 20 or fewer samples	Accuracy	DOD QSM 4.2 as noted in Worksheet #28	A
Laboratory Method Blank	1 per preparatory batch of 20 or fewer samples	Bias	No analytes detected > ½ the LOQ	A
Laboratory Limit of Detection (LOD) determination and verification	Quarterly	Sensitivity	≤ LOQ	A
Laboratory Limit of Quantitation (LOQ) establishment and verification	Quarterly	Sensitivity	≤ Reporting limit	A

Matrix: Water or Soil

Analytical Group/Concentration Level: Organics or Inorganics/Low

Analytical Method: All

QC Sample	Frequency	Data Quality Indicators	Measurement Performance Criteria[1]	Assesses Error[2]
Not applicable	Each sample delivery group (SDG)	Completeness	< 10% data rejected	S & A

[1]QC acceptance criteria from the Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories Version 4.2, 10/25/2010 http://www.denix.osd.mil/edqw/) as noted in Worksheets where applicable. The DoD QSM was developed to provide baseline requirements for the establishment and management of quality systems for environmental testing laboratories performing services for the DoD; it is based on the National Environmental Laboratory Accreditation Conference (NELAC) Chapter 5 Quality Systems standard (July 1999). Although none of the Phase II properties are DoD sites, RMC intends to use the DoD QSM for guidance since the manual contains the minimum requirements essential to ensuring the generation of definitive environmental data of known quality, appropriate for their intended uses, and the requirements apply to all environmental laboratories regardless of size or complexity. The DoD QSM is referenced throughout this QAPP, as it pertains to QA/QC criteria.

[2]Sampling (S), Analytical (A), or both (S&A)

Worksheet #13 Secondary Data Criteria and Limitations

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Review of regulatory agency environmental databases	Enviromental GeoSearch™ Report	Enviromental GeoSearch™ Report by Historical Information Gatherers, Inc.. and provided in RMC's Phase I Enviromental Assessment.	A records search for facilities that handle or release hazardous materials and/or petroleum.	The radius map report assists with ensuring compliance with ASTM E1527-13 and the EPA's All Appropriate Inquiry rule
Review of the Colorado Department of Labor and Employment, Oil and Public Safety (OPS) database for registered and/or leaking underground petroleum storage tanks	Enviromental GeoSearch™ Report	Enviromental GeoSearch™ Report by Historical Information Gatherers, Inc.. and provided in RMC's Phase I Enviromental Assessment.	A records search for facilities with registered and/or leaking underground petroleum storage tanks.	State underground storage tank (UST) records may not be complete.
Review of Colorado Division of Water Resources (CDOWR) database	Enviromental GeoSearch™ Report	Enviromental GeoSearch™ Report by Historical Information Gatherers, Inc.. and provided in RMC's Phase I Enviromental Assessment.	A records search for well permits.	Not all wells within the specified search radius may be listed.
Review of topographic maps and aerial photographs	USGS and GeoSearch™ Report	Enviromental GeoSearch™ Report by Historical Information Gatherers, Inc. and provided in RMC's Phase I Enviromental Assessment.	Illustrates surface water drainage pathways and historical land use.	To be determined.

Worksheet #14 Summary of Project Tasks

Site-Specific Work Plans: Prepare site-specific work plans to address the Phase II assessment activities, the SAP, the site safety & health plan (SSHP), and any revisions/amendments to this QAPP based on site-specific conditions.
Direct Push Borings: Advance up to six boreholes to 25 feet below ground surface (bgs) using direct push technology at each site. Prior to the start of the field investigation, the locations of all utilities in the vicinity of the proposed boreholes will be determined to ensure a safe working environment during direct-push activities.
Drill and Install Temporary Monitoring Wells: Drill up to four boreholes (using hollow-stem augers) at each site and install a 2-inch temporary monitoring well in each borehole.
Limited Sampling: Collect one soil sample from each soil boring and one groundwater sample from each newly installed temporary well.
Sample Analysis: Sample analysis may include, but be not limited to, the following: volatile organic carbons (VOCs), semi-volatile organic carbons (SVOCs), benzene, toluene, ethylbenze and xylene (BTEX) & methyl tert-butyl ether (MTBE), total petroleum hydrocarbns (TPH) [diesel range organics (DRO) + gasoline range organics (GRO)], Resource Conservation and Recovery Act (RCRA) metals, lead (in soil), ACM, and LBP. Sample analysis will be site-specific and determined according to findings from the Phase I ESA. The following water quality parameters will be measured and recorded during well purging: DO, pH, specific conductance, ORP, temperature, and turbidity.
Quality Control Tasks: The following field QC samples will be collected and analyzed: field duplicates, matrix spikes, matrix spike duplicates, and (if necessary) equipment blanks. The following laboratory QC samples will be routinley analyzed: method blanks and laboratory control samples. Worksheets #12 and #28 list specific field QC sample types to be analyzed and evaluated. Laboratory data will be verified by the Project Chemist following receipt of data from the laboratory.
Asbestos and LBP Survey: Conduct an asbestos and LBP survey on subject properties located at 38th and Kipling (3 structures). One approximately 27,000 square-foot commercial retail center, one 2,875 square-foot commercial office building, and one 2,400 square-foot commercial retail center. These structures were built around 1974.
Data Review: The laboratory will verify all data are complete for samples received. Data will be verfired by the Project Chemist according to the requirements noted in Worksheets #34, #35, and #36. All data will be evaluated for project use.
Community Outreach: Assist the City of Wheat Ridge and WR2020 in community outreach efforts, including the development of informational materials and the participation in public meetings. One-on-one meetings will also be held with property owners to explain the Brownfields Grant program and to address concerns property owners may have about brownfields assessments being undertaken on their properties.

Phase II ESA Reporting: Prepare a report evaluating the potential concerns identified in the Phase I ESAs, identify the likely exposure pathways, and evaluate site-specific clean-up options, if warranted.
Site Cleanup Plan: Develop Clean-up Plans, as needed, based on results of Phase II Environmental Assessments. The City of Wheat Ridge and RMC will work closely with Colorado Department of Public Health and Environment (CDPHE) and EPA in identifying and reviewing the most appropriate and effective remedial options for each selected brownfield site's future clean-up and redevelopment.

Worksheet #15 Reference Limits and Evaluation Table

Analyte	CAS Number	Method Detection Limit	Reporting Limit
Matrix: **Water** Analytical Group/Method: **VOCs, SW-846 8260C** Unit: **µg/L**			
1,1,1,2-Tetrachloroethane	630-20-6	0.09	1.0
1,2,4-Trichlorobenzene	120-82-1	0.1	1.0
1,2,4-Trimethylbenzene	95-63-6	0.1	1.0
1,2-Dibromo-3-chloropropane	96-12-8	0.5	5.0
1,2-Dibromoethane (EDB)	106-93-4	0.1	1.0
1,2-Dichlorobenzene	95-50-1	0.07	1.0
1,2-Dichloroethane	107-06-2	0.7	1.0
1,2-Dichloropropane	78-87-5	0.06	1.0
1,3,5-Trimethylbenzene	108-67-8	0.04	1.0
1,3-Dichlorobenzene	541-73-1	0.07	1.0
1,3-Dichloropropane	142-28-9	0.09	1.0
1,1,1-Trichloroethane	71-55-6	0.04	1.0
1,4-Dichlorobenzene	106-46-7	0.08	1.0
2,2-Dichloropropane	590-20-7	0.1	1.0
2-Butanone	78-93-3	2.0	5.0
2-Chlorotoluene	95-49-8	0.02	1.0
2-Hexanone	591-78-6	0.03	5.0
4-Chlorotoluene	106-43-4	0.04	1.0
4-Isopropyltoluene	99-87-6	0.05	1.0
4-Methyl-2-pentanone	108-10-1	0.04	5.0
Acetone	67-64-1	3.8	8.0
Benzene	71-43-2	0.05	1.0
1,1,2,2-Tetrachloroethane	79-34-5	0.08	1.0
Bromobenzene	108-86-1	0.08	1.0
Bromochloromethane	74-97-5	0.1	1.0
Bromodichloromethane	75-27-4	0.08	1.0
Bromoform	75-25-2	0.1	1.0
Bromomethane	74-83-9	0.08	1.0
Carbon disulfide	75-15-0	0.2	2.0
Carbon tetrachloride	56-23-5	0.06	1.0
Chlorobenzene	108-90-7	0.04	1.0
Chloroethane	75-00-3	0.1	1.0
Chloroform	67-66-3	0.07	1.0
1,1,2-Trichloroethane	79-00-5	0.1	1.0
Chloromethane	74-87-3	0.1	1.0
cis-1,2-Dichloroethene	156-59-2	0.07	1.0
cis-1,3-Dichloropropene	10061-01-5	0.08	1.0
Dibromochloromethane	124-48-1	0.06	1.0
Dibromomethane	74-95-3	0.2	1.0
Ethylbenzene	100-41-4	0.07	1.0
Hexachlorobutadiene	87-68-3	0.1	1.5
Iodomethane	74-88-4	0.1	2.0
Isopropylbenzene	98-82-8	0.06	1.0
m,p-Xylene	108-38-3/106-42-3	0.1	2.0

Analyte	CAS Number	Method Detection Limit	Reporting Limit
1,1-Dichloroethane	75-34-3	0.1	1.0
Methylene Chloride	75-09-2	0.0	5.0
Methyl tert-Butyl Ether	1634-04-4	0.08	1.0
Naphthalene	91-20-3	0.2	10.0
n-Butylbenzene	104-51-8	0.06	1.0
n-Propylbenzene	103-65-1	0.09	1.0
o-Xylene	95-47-6	0.08	1.0
sec-Butylbenzene	135-98-8	0.04	1.0
Styrene	100-42-5	0.07	1.0
tert-Butylbenzene	98-06-6	0.05	1.0
Tetrachloroethene	127-18-4	0.06	1.0
1,1-Dichloroethene	75-35-4	0.07	1.0
Toluene	108-88-3	0.1	1.0
trans-1,2-Dichloroethene	156-60-5	0.04	1.0
trans-1,3-Dichloropropene	10061-02-6	0.09	1.0
Trichloroethene	79-01-6	0.05	1.0
Trichlorofluoromethane	75-69-4	0.07	1.0
Vinyl chloride	75-01-4	0.07	1.0
1,2-Dichloroethane-d4	17060-07-0	Not applicable	Not applicable
Toluene-d8	2037-26-5	Not applicable	Not applicable
4-Bromofluorobenzene	460-00-4	Not applicable	Not applicable
1,1-Dichloropropene	563-58-6	0.05	1.0
Fluorobenzene	462-06-6	Not applicable	Not applicable
Chlorobenzene-d5	3114-55-4	Not applicable	Not applicable
1,4-Dichlorobenzene-d4	3855-82-1	Not applicable	Not applicable
1,2,3-Trichlorobenzene	87-61-6	0.008	5.0
1,2,3-Trichloropropane	96-18-4	0.2	5.0
Matrix: **Water** Analytical Group/Method: **SVOCs, SW-846 8270D** Units: **µg/L**			
1,1-Biphenyl	92-52-4	3	10
1,2,4,5-Tetrachlorobenzene	95-94-3	3	10
1,2,4-Trichlorobenzene	120-82-1	3	10
1,2-Dichlorobenzene	95-50-1	3	10
1,2-Diphenylhydrazine	122-66-7	3	10
1,3,5-Trinitrobenzene	99-35-4	3	10
1,3-Dichlorobenzene	541-73-1	3	10
1,4-Dichlorobenzene	106-46-7	3	10
1,4-Dinitrobenzene	100-25-4	3	10
1,4-Dioxane	123-91-1	3	10
1,4-Naphthoquinone	130-15-4	3	10
1-Hexanol	111-27-3	3	10
1-Methylnaphthalene	90-12-0	0.3	1
1-Naphthylamine	134-32-7	3	10
1-Nitropyrene	5522-43-0	3	10
2,2'-Dichlorobenzil	21854-95-5	3	10
2,3,4,6-Tetrachlorophenol	58-90-2	3	10
2,3-Dichloroaniline	608-27-5	3	10
2,4,5-Trichlorophenol	95-95-4	3	10

Analyte	CAS Number	Method Detection Limit	Reporting Limit
2,4,6-Tribromophenol	118-79-6	3	10
2,4,6-Trichlorophenol	88-06-2	3	10
2,4-Dichlorophenol	120-83-2	3	10
2,4-Dimethylphenol	105-67-9	3	10
2,4-Dinitrophenol	51-28-5	5	20
2,4-Dinitrotoluene	121-14-2	3	10
2,4-Toluene diisocyanate	584-84-9	10	10
2,6-Dichlorophenol	87-65-0	3	10
2,6-Dinitrotoluene	606-20-2	3	10
2-Acetylaminofluorene	53-96-3	3	10
2-Chloronaphthalene	91-58-7	0.41	1
2-Chlorophenol	95-57-8	3	10
2-Ethoxyethanol	110-80-5	3	10
2-Fluorobiphenyl	321-60-8	3	10
2-Fluorophenol	367-12-4	3	10
2-Methyl-4,6-dinitrophenol	534-52-1	3	10
2-Methylnaphthalene	91-57-6	0.3	1
2-Naphthylamine	91-59-8	3	10
2-Nitrophenol	88-75-5	3	10
2-Picoline	109-06-8	3	10
3,3'-Dichlorobenzidine	91-94-1	3	10
3,3'-Dimethylbenzidine	119-93-7	3.3	10
3-Methylcholanthrene	56-49-5	3	10
4,4'-Methylenebis(2-chloroaniline)	101-14-4	3	10
4-Aminobiphenyl	92-67-1	3	10
4-Bromophenylphenylether	101-55-3	3	10
4-Chloro-3-methylphenol	59-50-7	3	10
4-Chloroaniline	106-47-8	3.3	10
4-Chlorophenylphenylether	7005-72-3	3	10
4-Chlorothioanisole	123-09-1	3	10
4-Chlorothiophenol	106-54-7	3	10
4-Nitrophenol	100-02-7	3	10
4-Nitroquinoline-1-oxide	56-57-5	3.8	10
5-Methylchrysene	3697-24-3	3	10
5-Nitro-o-toluidine	99-55-8	3	10
7,12Dimethylbenz(a)anthracene	57-97-6	3	10
7H-Dibenzo(c,g)carbazole	194-59-2	3	10
Acenaphthene	83-32-9	0.3	1
Acenaphthylene	208-96-8	0.3	1
Acetophenone	98-86-2	3	10
Aniline	62-53-3	4.2	10
Anthracene	120-12-7	0.3	1
Aramite	140-57-8	3.7	10
Atrazine	1912-24-9	3	10
Benzaldehyde	100-52-7	3	10
Benzidine	92-87-5	3.9	10
Benzo(a)anthracene	56-55-3	0.3	1
Benzo(a)pyrene	50-32-8	0.3	1
Benzo(b)fluoranthene	205-99-2	0.3	1

Analyte	CAS Number	Method Detection Limit	Reporting Limit
Benzo(b,k)fluoranthene	NA	0.3	10
Benzo(ghi)perylene	191-24-2	0.3	1
Benzo(j)fluoranthene	205-82-3	3	10
Benzo(k)fluoranthene	207-08-9	0.3	1
Benzoic acid	65-85-0	6	20
Benzyl alcohol	100-51-6	3	10
Biphenyl	92-52-4	3	10
Butylbenzylphthalate	85-68-7	3	10
Caprolactam	105-60-2	3	10
Carbazole	86-74-8	0.3	1
Chlorobenzilate	510-15-6	3	10
Chrysene	218-01-9	0.3	1
Cresols (total)	1319-77-3	3	20
Di-n-butylphthalate	84-74-2	3	10
Di-n-octylphthalate	117-84-0	3	10
Diallate	2303-16-4	3	10
Dibenz(a,h)acridine	226-36-8	3	10
Dibenzo(a,e)pyrene	192-65-4	3.9	10
Dibenzo(a,h)anthracene	53-70-3	0.3	1
Dibenzo(a,h)pyrene	189-64-0	3	10
Dibenzo(a,i)pyrene	189-55-9	3	10
Dibenzo(a,j)acridine	224-42-0	3	10
Dibenzo(a,l)pyrene	191-30-0	3	10
Dibenzofuran	132-64-9	3	10
Diethylphthalate	84-66-2	3	10
Dimethoate	60-51-5	3	10
Dimethylphthalate	131-11-3	3	10
Dinoseb	88-85-7	3	10
Diphenyl disulfide	882-33-7	3	10
Diphenyl sulfide	139-66-2	3	10
Diphenylamine	122-39-4	3	10
Disulfoton	298-04-4	3	10
Ethyl Methanesulfonate	62-50-0	3	10
Ethyl methacrylate	97-63-2	3	10
Famphur	52-85-7	5	10
Fluoranthene	206-44-0	0.3	1
Fluorene	86-73-7	0.3	1
Hexachlorobenzene	118-74-1	3	10
Hexachlorobutadiene	87-68-3	3	10
Hexachlorocyclopentadiene	77-47-4	3	10
Hexachloroethane	67-72-1	3	10
Hexachlorophene	70-30-4	167	500
Hexachloropropene	1888-71-7	3	10
Hydroxymethyl phthalimide	118-29-6	5	20
Indeno(1,2,3-cd)pyrene	193-39-5	0.3	1
Isodrin	465-73-6	3	10
Isophorone	78-59-1	3.5	10
Isosafrole	120-58-1	3	10
Kepone	143-50-0	3	10

Analyte	CAS Number	Method Detection Limit	Reporting Limit
Methapyrilene	91-80-5	3	10
Methoxychlor	72-43-5	3	10
Methyl methacrylate	80-62-6	3	10
Methyl methanesulfonate	66-27-3	3	10
Methyl parathion	298-00-0	3	10
N-Methyl-N-nitrosomethylamine	62-75-9	3	10
N-Nitrosodi-n-butylamine	924-16-3	3	10
N-Nitrosodiethylamine	55-18-5	3	10
N-Nitrosodipropylamine	621-64-7	3	10
N-Nitrosomethylethylamine	10595-95-6	3	10
N-Nitrosomorpholine	59-89-2	3	10
N-Nitrosopiperidine	100-75-4	3	10
N-Nitrosopyrrolidine	930-55-2	3	10
Naphthalene	91-20-3	0.3	1
Nitrobenzene	98-95-3	3	10
Nitrobenzene-d5	4165-60-0	3	10
Octachlorostyrene	29082-74-4	3	10
Parathion	56-38-2	3	10
Pentachlorobenzene	608-93-5	3	10
Pentachloroethane	76-01-7	3	10
Pentachloronitrobenzene	82-68-8	3.4	10
Pentachlorophenol	87-86-5	3	10
Phenacetin	62-44-2	3	10
Phenanthrene	85-01-8	0.3	1
Phenol	108-95-2	3	10
Phenol-d5	4165-62-2	3	10
Phenyl sulfone	127-63-9	3	10
Phorate	298-02-2	3	10
Pronamide	23950-58-5	3	10
Pyrene	129-00-0	0.3	1
Pyridine	110-86-1	3	10
Quinoline	91-22-5	3	10
Safrole	94-59-7	3	10
Sulfotepp	3689-24-5	3	10
Tetrachlorophenols	Tetrachlorophenols	3	10
Thionazin	297-97-2	3	10
Thiophenol	108-98-5	3	10
Tributylphosphate	126-73-8	3	10
Trichlorophenols	Trichlorophenols	3	10
Triethylphosphorothioate	126-68-1	3	10
a,a-Dimethylphenethylamine	122-09-8	5.4	10
alpha-Terpineol	98-55-5	3	10
bis(2-Chloroethoxy)methane	111-91-1	3	10
bis(2-Chloroethyl) ether	111-44-4	3	10
bis(2-Chloroisopropyl)ether	39638-32-9	3	10
bis(2-Ethylhexyl)phthalate	117-81-7	3	10
bis(p-Chlorophenyl)disulfide	1142-19-4	3	10
bis(p-Chlorophenyl)sulfone	80-07-9	3	10
m,p-Cresols	65794-96-9	3.7	10

Analyte	CAS Number	Method Detection Limit	Reporting Limit
m-Dinitrobenzene	99-65-0	3	10
m-Nitroaniline	99-09-2	3	10
m-Toluidine	108-44-1	3	10
n-Decane	124-18-5	3	10
n-Octadecane	593-45-3	3	10
o-Cresol	95-48-7	3	10
o-Nitroaniline	88-74-4	3	10
o-Toluidine	95-53-4	3	10
p-(Dimethylamino)azobenzene	60-11-7	3	10
p-Benzoquinone	106-51-4	3	10
p-Nitroaniline	100-01-6	3	10
p-Phenylenediamine	106-50-3	100	500
p-Terphenyl-d14	1718-51-0	3	10
p-Toluidine	106-44-1	3	10
Matrix: **Water** Analytical Group/Method: **TPH, SW-846 8015C** Units: **mg/L**			
Gasoline (C6-C10)	Not applicable	4.67	5
Diesel (C10-C28)	Not applicable	1.05	5
Residual Range Organics (C28-C36)	Not applicable	1.22	10
TPH - Carbon Chain Total	Not applicable	0.0	5
o-Terphenyl	84-15-1	Not applicable	Not applicable
Matrix: **Water** Analytical Group/Method: **RCRA Metals, SW-846 6010C/7470A** Units: **µg/L**			
Arsenic	7440-38-2	5	30
Barium	7440-39-3	1	5
Cadmium	7440-43-9	1	5
Chromium	7440-47-3	1	5
Lead	7439-92-1	3.3	10
Selenium	7782-49-2	6	30
Mercury	7439-97-6	0.067	0.2
Silver	7440-22-4	1	5
Matrix: **SOIL** Analytical Group/Method: **VOCs, SW-846 8260C** Units: **µg/kg**			
1,1,1,2-Tetrachloroethane	630-20-6	0.4	4.0
1,2,4-Trichlorobenzene	120-82-1	0.4	4.0
1,2,4-Trimethylbenzene	95-63-6	0.2	4.0
1,2-Dibromo-3-chloropropane	96-12-8	1.9	20.0
1,2-Dibromoethane (EDB)	106-93-4	0.6	4.0
1,2-Dichlorobenzene	95-50-1	0.3	4.0
1,2-Dichloroethane	107-06-2	0.3	4.0
1,2-Dichloropropane	78-87-5	0.2	4.0
1,3,5-Trimethylbenzene	108-67-8	0.2	4.0
1,3-Dichlorobenzene	541-73-1	0.3	4.0
1,3-Dichloropropane	142-28-9	0.4	4.0
1,1,1-Trichloroethane	71-55-6	0.2	4.0

Analyte	CAS Number	Method Detection Limit	Reporting Limit
1,4-Dichlorobenzene	106-46-7	0.3	4.0
2,2-Dichloropropane	590-20-7	0.6	4.0
2-Butanone	78-93-3	8.0	20.0
2-Chlorotoluene	95-49-8	0.1	4.0
2-Hexanone	591-78-6	1.3	20.0
4-Chlorotoluene	106-43-4	0.2	4.0
4-Isopropyltoluene	99-87-6	0.2	4.0
4-Methyl-2-pentanone	108-10-1	1.4	20.0
Acetone	67-64-1	15.1	32.0
Benzene	71-43-2	0.2	4.0
1,1,2,2-Tetrachloroethane	79-34-5	0.3	4.0
Bromobenzene	108-86-1	0.3	4.0
Bromochloromethane	74-97-5	0.5	4.0
Bromodichloromethane	75-27-4	0.3	4.0
Bromoform	75-25-2	0.5	4.0
Bromomethane	74-83-9	0.3	4.0
Carbon disulfide	75-15-0	0.6	10.0
Carbon tetrachloride	56-23-5	0.2	4.0
Chlorobenzene	108-90-7	0.2	4.0
Chloroethane	75-00-3	0.4	4.0
Chloroform	67-66-3	0.3	4.0
1,1,2-Trichloroethane	79-00-5	0.5	4.0
Chloromethane	74-87-3	0.5	4.0
cis-1,2-Dichloroethene	156-59-2	0.3	4.0
cis-1,3-Dichloropropene	10061-01-5	0.3	4.0
Dibromochloromethane	124-48-1	0.2	4.0
Dibromomethane	74-95-3	0.6	4.0
Ethylbenzene	100-41-4	0.3	4.0
Hexachlorobutadiene	87-68-3	0.5	5.0
Iodomethane	74-88-4	0.7	10.0
Isopropylbenzene	98-82-8	0.2	4.0
m,p-Xylene	108-38-3/106-42-3	0.6	4.0
1,1-Dichloroethane	75-34-3	0.3	4.0
Methyl tert-Butyl Ether	1634-04-4	0.3	4.0
Methylene Chloride	75-09-2	1.0	20.0
Naphthalene	91-20-3	0.7	20.0
n-Butylbenzene	104-51-8	0.3	4.0
n-Propylbenzene	103-65-1	0.1	4.0
o-Xylene	95-47-6	0.3	4.0
sec-Butylbenzene	135-98-8	0.2	4.0
Styrene	100-42-5	0.3	4.0
tert-Butylbenzene	98-06-6	0.2	4.0
Tetrachloroethene	127-18-4	0.3	4.0
1,1-Dichloroethene	75-35-4	0.2	4.0
Toluene	108-88-3	0.4	4.0
trans-1,2-Dichloroethene	156-60-5	0.7	4.0
trans-1,3-Dichloropropene	10061-02-6	0.3	4.0
Trichloroethene	79-01-6	0.2	4.0
Trichlorofluoromethane	75-69-4	0.3	4.0

Analyte	CAS Number	Method Detection Limit	Reporting Limit
Vinyl chloride	75-01-4	0.3	4.0
1,2-Dichloroethane-d4	17060-07-0	Not applicable	Not applicable
Toluene-d8	2037-26-5	Not applicable	Not applicable
4-Bromofluorobenzene	460-00-4	Not applicable	Not applicable
1,1-Dichloropropene	563-58-6	0.3	4.0
Fluorobenzene	462-06-6	Not applicable	Not applicable
Chlorobenzene-d5	3114-55-4	Not applicable	Not applicable
1,4-Dichlorobenzene-d4	3855-82-1	Not applicable	Not applicable
1,2,3-Trichlorobenzene	87-61-6	0.9	10.0
1,2,3-Trichloropropane	96-18-4	0.6	10.0
1,1,1,2-Tetrachloroethane	630-20-6	0.4	4.0
1,2,4-Trichlorobenzene	120-82-1	0.4	4.0
1,2,4-Trimethylbenzene	95-63-6	0.2	4.0
1,2-Dibromo-3-chloropropane	96-12-8	1.9	20.0
1,2-Dibromoethane (EDB)	106-93-4	0.6	4.0
1,2-Dichlorobenzene	95-50-1	0.3	4.0
1,2-Dichloroethane	107-06-2	0.3	4.0
1,2-Dichloropropane	78-87-5	0.2	4.0
1,3,5-Trimethylbenzene	108-67-8	0.2	4.0
1,3-Dichlorobenzene	541-73-1	0.3	4.0
1,3-Dichloropropane	142-28-9	0.4	4.0
1,1,1-Trichloroethane	71-55-6	0.2	4.0
1,4-Dichlorobenzene	106-46-7	0.3	4.0
2,2-Dichloropropane	590-20-7	0.6	4.0
2-Butanone	78-93-3	8.0	20.0
2-Chlorotoluene	95-49-8	0.1	4.0
2-Hexanone	591-78-6	1.3	20.0
4-Chlorotoluene	106-43-4	0.2	4.0
4-Isopropyltoluene	99-87-6	0.2	4.0
4-Methyl-2-pentanone	108-10-1	1.4	20.0
Acetone	67-64-1	15.1	32.0
Benzene	71-43-2	0.2	4.0
1,1,2,2-Tetrachloroethane	79-34-5	0.3	4.0
Bromobenzene	108-86-1	0.3	4.0
Bromochloromethane	74-97-5	0.5	4.0
Bromodichloromethane	75-27-4	0.3	4.0
Bromoform	75-25-2	0.5	4.0
Bromomethane	74-83-9	0.3	4.0
Carbon disulfide	75-15-0	0.6	10.0
Carbon tetrachloride	56-23-5	0.2	4.0
Chlorobenzene	108-90-7	0.2	4.0
Chloroethane	75-00-3	0.4	4.0
Chloroform	67-66-3	0.3	4.0
1,1,2-Trichloroethane	79-00-5	0.5	4.0
Chloromethane	74-87-3	0.5	4.0
cis-1,2-Dichloroethene	156-59-2	0.3	4.0
cis-1,3-Dichloropropene	10061-01-5	0.3	4.0
Dibromochloromethane	124-48-1	0.2	4.0
Dibromomethane	74-95-3	0.6	4.0

Analyte	CAS Number	Method Detection Limit	Reporting Limit
Ethylbenzene	100-41-4	0.3	4.0
Hexachlorobutadiene	87-68-3	0.5	5.0
Iodomethane	74-88-4	0.7	10.0
Isopropylbenzene	98-82-8	0.2	4.0
m,p-Xylene	108-38-3/106-42-3	0.6	4.0
1,1-Dichloroethane	75-34-3	0.3	4.0
Methyl tert-Butyl Ether	1634-04-4	0.3	4.0
Methylene Chloride	75-09-2	1.0	20.0
Naphthalene	91-20-3	0.7	20.0
n-Butylbenzene	104-51-8	0.3	4.0
n-Propylbenzene	103-65-1	0.1	4.0
o-Xylene	95-47-6	0.3	4.0
sec-Butylbenzene	135-98-8	0.2	4.0
Styrene	100-42-5	0.3	4.0
tert-Butylbenzene	98-06-6	0.2	4.0
Tetrachloroethene	127-18-4	0.3	4.0
1,1-Dichloroethene	75-35-4	0.2	4.0
Toluene	108-88-3	0.4	4.0
trans-1,2-Dichloroethene	156-60-5	0.7	4.0
trans-1,3-Dichloropropene	10061-02-6	0.3	4.0
Trichloroethene	79-01-6	0.2	4.0
Trichlorofluoromethane	75-69-4	0.3	4.0
Vinyl chloride	75-01-4	0.3	4.0
1,2-Dichloroethane-d4	17060-07-0	Not applicable	Not applicable
Toluene-d8	2037-26-5	Not applicable	Not applicable
4-Bromofluorobenzene	460-00-4	Not applicable	Not applicable
1,1-Dichloropropene	563-58-6	0.3	4.0
Fluorobenzene	462-06-6	Not applicable	Not applicable
Chlorobenzene-d5	3114-55-4	Not applicable	Not applicable
1,4-Dichlorobenzene-d4	3855-82-1	Not applicable	Not applicable
1,2,3-Trichlorobenzene	87-61-6	0.9	10.0
1,2,3-Trichloropropane	96-18-4	0.6	10.0
Matrix: **SOIL** Analytical Group/Method: **SVOCs, SW-846 8270D** Units: **µg/kg**			
(2,3-Dibromopropyl)phosphate	126-72-7	333	1650
1,1'-Biphenyl	92-52-4	99.9	333
1,2,4,5-Tetrachlorobenzene	95-94-3	99.9	333
1,2,4-Trichlorobenzene	120-82-1	99.9	333
1,2-Dichlorobenzene	95-50-1	99.9	333
1,2-Diphenylhydrazine	122-66-7	99.9	333
1,3,5-Trinitrobenzene	99-35-4	99.9	333
1,3-Dichlorobenzene	541-73-1	99.9	333
1,4-Dichlorobenzene	106-46-7	99.9	333
1,4-Dinitrobenzene	100-25-4	99.9	330
1,4-Dioxane	123-91-1	99.9	333
1,4-Naphthoquinone	130-15-4	99.9	333
1-Hexanol	111-27-3	99.9	333
1-Methylnaphthalene	90-12-0	9.99	33.3

Analyte	CAS Number	Method Detection Limit	Reporting Limit
1-Naphthylamine	134-32-7	99.9	333
1-Nitropyrene	5522-43-0	99.9	333
2,2'-Dichlorobenzil	21854-95-5	99.9	333
2,3,4,6-Tetrachlorophenol	58-90-2	99.9	333
2,3-Dichloroaniline	608-27-5	99.9	330
2,4,5-Trichlorophenol	95-95-4	99.9	333
2,4,6-Trichlorophenol	88-06-2	99.9	333
2,4-Dichlorophenol	120-83-2	99.9	333
2,4-Dimethylphenol	105-67-9	99.9	333
2,4-Dinitrophenol	51-28-5	99.9	666
2,4-Dinitrotoluene	121-14-2	99.9	333
2,4-Toluene diisocyanate	584-84-9	333	333
2,6-Dichlorophenol	87-65-0	99.9	333
2,6-Dinitrotoluene	606-20-2	99.9	333
2-Acetylaminofluorene	53-96-3	99.9	333
2-Chloronaphthalene	91-58-7	9.99	33.3
2-Chlorophenol	95-57-8	99.9	333
2-Ethoxyethanol	110-80-5	333	1650
2-Methyl-4,6-dinitrophenol	534-52-1	99.9	333
2-Methylnaphthalene	91-57-6	9.99	33.3
2-Naphthylamine	91-59-8	99.9	333
2-Nitrophenol	88-75-5	99.9	333
2-Picoline	109-06-8	99.9	333
3,3'-Dichlorobenzidine	91-94-1	99.9	333
3,3'-Dimethylbenzidine	119-93-7	99.9	330
3,5-Dimethylphenol	108-68-9	99.9	333
3-Methylcholanthrene	56-49-5	99.9	333
4,4'-Methylenebis(2-chloroaniline)	101-14-4	333	1650
4-Aminobiphenyl	92-67-1	99.9	333
4-Bromophenylphenylether	101-55-3	99.9	333
4-Chloro-3-methylphenol	59-50-7	133.2	333
4-Chloroaniline	106-47-8	99.9	333
4-Chlorophenylphenylether	7005-72-3	99.9	333
4-Chlorothioanisole	123-09-1	99.9	333
4-Chlorothiophenol	106-54-7	99.9	333
4-Nitrophenol	100-02-7	99.9	333
4-Nitroquinoline-1-oxide	56-57-5	99.9	333
5-Methylchrysene	3697-24-3	99.9	333
5-Nitro-o-toluidine	99-55-8	99.9	333
7,12Dimethylbenz(a)anthracene	57-97-6	99.9	333
7H-Dibenzo(c,g)carbazole	194-59-2	99.9	333
Acenaphthene	83-32-9	9.99	33.3
Acenaphthylene	208-96-8	9.99	33.3
Acetophenone	98-86-2	99.9	333
Aniline	62-53-3	99.9	333
Anthracene	120-12-7	9.99	33.3
Aramite	140-57-8	99.9	333
Atrazine	1912-24-9	133.2	333
Benzaldehyde	100-52-7	99.9	333

Analyte	CAS Number	Method Detection Limit	Reporting Limit
Benzidine	92-87-5	99.9	330
Benzo(a)anthracene	56-55-3	9.99	33.3
Benzo(a)pyrene	50-32-8	9.99	33.3
Benzo(b)fluoranthene	205-99-2	9.99	33.3
Benzo(ghi)perylene	191-24-2	9.99	33.3
Benzo(j)fluoranthene	205-82-3	99.9	333
Benzo(k)fluoranthene	207-08-9	9.99	33.3
Benzoic acid	65-85-0	166.5	660
Benzyl alcohol	100-51-6	99.9	333
Biphenyl	92-52-4	99.9	330
Butylbenzylphthalate	85-68-7	99.9	333
Caprolactam	105-60-2	99.9	333
Carbazole	86-74-8	9.99	33.3
Chlorobenzilate	510-15-6	99.9	333
Chrysene	218-01-9	9.99	33.3
Cis-diallate	2303-16-4	99.9	330
Cresols (total)	1319-77-3	99.9	666
Di-n-butylphthalate	84-74-2	99.9	333
Di-n-octylphthalate	117-84-0	99.9	333
Diallate	2303-16-4	99.9	333
Dibenz(a,h)acridine	226-36-8	99.9	333
Dibenzo(a,e)pyrene	192-65-4	99.9	330
Dibenzo(a,h)anthracene	53-70-3	9.99	33.3
Dibenzo(a,h)pyrene	189-64-0	99.9	333
Dibenzo(a,i)pyrene	189-55-9	99.9	333
Dibenzo(a,j)acridine	224-42-0	99.9	333
Dibenzo(a,l)pyrene	191-30-0	99.9	333
Dibenzofuran	132-64-9	99.9	333
Diethylphthalate	84-66-2	99.9	333
Dimethoate	60-51-5	99.9	333
Dimethylphthalate	131-11-3	99.9	333
Dinoseb	88-85-7	99.9	333
Diphenyl disulfide	882-33-7	99.9	333
Diphenyl sulfide	139-66-2	99.9	333
Diphenylamine	122-39-4	99.9	333
Disulfoton	298-04-4	99.9	333
Ethyl Methanesulfonate	62-50-0	99.9	333
Ethyl methacrylate	97-63-2	99.9	333
Famphur	52-85-7	99.9	333
Fluoranthene	206-44-0	9.99	33.3
Fluorene	86-73-7	9.99	33.3
Hexachlorobenzene	118-74-1	99.9	333
Hexachlorobutadiene	87-68-3	99.9	333
Hexachlorocyclopentadiene	77-47-4	99.9	333
Hexachloroethane	67-72-1	99.9	333
Hexachlorophene	70-30-4	3862.8	16500
Hexachloropropene	1888-71-7	99.9	333
Hydroxymethyl phthalimide	118-29-6	99.9	333
Indeno(1,2,3-cd)pyrene	193-39-5	9.99	33.3

Analyte	CAS Number	Method Detection Limit	Reporting Limit
Isodrin	465-73-6	66.6	333
Isophorone	78-59-1	99.9	333
Isosafrole	120-58-1	99.9	333
Kepone	143-50-0	99.9	333
Methapyrilene	91-80-5	99.9	333
Methoxychlor	72-43-5	99.9	333
Methyl methacrylate	80-62-6	99.9	333
Methyl methanesulfonate	66-27-3	99.9	333
Methyl parathion	298-00-0	99.9	333
N-Methyl-N-nitrosomethylamine	62-75-9	99.9	330
N-Nitrosodi-n-butylamine	924-16-3	99.9	333
N-Nitrosodiethylamine	55-18-5	99.9	333
N-Nitrosodipropylamine	621-64-7	99.9	333
N-Nitrosomethylethylamine	10595-95-6	99.9	333
N-Nitrosomorpholine	59-89-2	99.9	333
N-Nitrosopiperidine	100-75-4	99.9	333
N-Nitrosopyrrolidine	930-55-2	99.9	333
Naphthalene	91-20-3	9.99	33.3
Nitrobenzene	98-95-3	99.9	333
Octachlorostyrene	29082-74-4	99.9	333
Parathion	56-38-2	99.9	333
Pentachlorobenzene	608-93-5	99.9	333
Pentachloroethane	76-01-7	99.9	333
Pentachloronitrobenzene	82-68-8	99.9	333
Pentachlorophenol	87-86-5	99.9	333
Phenacetin	62-44-2	99.9	333
Phenanthrene	85-01-8	9.99	33.3
Phenol	108-95-2	99.9	333
Phenyl sulfone	127-63-9	99.9	333
Phorate	298-02-2	99.9	333
Phthalic Anhydride	85-44-9	532.8	1650
Phthalic acid	88-99-3	99.9	333
Pronamide	23950-58-5	99.9	333
Pyrene	129-00-0	9.99	33.3
Pyridine	110-86-1	99.9	333
Quinoline	91-22-5	99.9	333
Safrole	94-59-7	99.9	333
Sulfotepp	3689-24-5	99.9	333
Thionazin	297-97-2	99.9	333
Thiophenol	108-98-5	99.9	333
Tributylphosphate	126-73-8	99.9	333
Triethylphosphorothioate	126-68-1	99.9	333
a,a-Dimethylphenethylamine	122-09-8	116.55	330
alpha-Terpineol	98-55-5	99.9	330
bis(2-Chloroethoxy)methane	111-91-1	99.9	333
bis(2-Chloroethyl) ether	111-44-4	99.9	333
bis(2-Chloroisopropyl)ether	39638-32-9	99.9	333
bis(2-Ethylhexyl)phthalate	117-81-7	99.9	333
bis(Chloromethyl)ether	542-88-1	99.9	333

Analyte	CAS Number	Method Detection Limit	Reporting Limit
bis(p-Chlorophenyl)disulfide	1142-19-4	99.9	333
bis(p-Chlorophenyl)sulfone	80-07-9	99.9	333
m,p-Cresols	65794-96-9	99.9	333
m-Dinitrobenzene	99-65-0	99.9	330
m-Nitroaniline	99-09-2	99.9	333
m-Toluidine	108-44-1	99	330
n-Decane	124-18-5	99.9	330
n-Octadecane	593-45-3	99.9	330
o-Cresol	95-48-7	99.9	333
o-Nitroaniline	88-74-4	109.89	333
o-Toluidine	95-53-4	99.9	330
p-(Dimethylamino)azobenzene	60-11-7	99.9	330
p-Benzoquinone	106-51-4	199.8	660
p-Nitroaniline	100-01-6	99.9	333
p-Phenylenediamine	106-50-3	3330	16500
p-Toluidine	106-44-1	99.9	333
Matrix: **SOIL** Analytical Group/Method: **TPH, SW-846 8015C** Units: **mg/kg**			
Gasoline (C6-C10)	Not applicable	16.8	50.0
Diesel (C10-C28)	Not applicable	13.0	50.0
Residual Range Organics (C28-C36)	Not applicable	4.6	100
TPH - Carbon Chain Total	Not applicable	0.0	50.0
o-Terphenyl	84-15-1	Not applicable	Not applicable
Matrix: **SOIL** Analytical Group/Method: **RCRA Metals, SW-846 6010C/7471B** Units: **mg/kg**			
Arsenic	7440-38-2	0.5	3
Barium	7440-39-3	0.1	0.5
Cadmium	7440-43-9	0.1	0.5
Chromium	7440-47-3	0.15	0.5
Lead	7439-92-1	0.33	1
Selenium	7782-49-2	0.5	3
Mercury	7439-97-6	0.00402	0.01
Silver	7440-22-4	0.1	0.5
Matrix: **TCLP** Analytical Group/Method: **VOA, SW-846 8260B** Units: **mg/L**			
1,1-Dichloroethylene	75-35-4	0.003	0.01
1,2-Dichloroethane	107-06-2	0.0025	0.01
1,4-Dichlorobenzene	106-46-7	0.0025	0.01
2-Butanone	78-93-3	0.0125	0.05
Benzene	71-43-2	0.003	0.01
Carbon tetrachloride	56-23-5	0.003	0.01
Chlorobenzene	108-90-7	0.0025	0.01
Chloroform	67-66-3	0.0025	0.01
Tetrachloroethylene	127-18-4	0.003	0.01
Trichloroethylene	79-01-6	0.0025	0.01

Analyte	CAS Number	Method Detection Limit	Reporting Limit
Vinyl chloride	75-01-4	0.005	0.01
Matrix: **TCLP** Analytical Group/Method: **SVOCs, SW-846 8270C** Units: **mg/L**			
1,4-Dichlorobenzene	106-46-7	0.015	0.05
2,4,5-Trichlorophenol	95-95-4	0.015	0.05
2,4,6-Trichlorophenol	88-06-2	0.015	0.05
2,4-Dinitrotoluene	121-14-2	0.015	0.05
Hexachlorobenzene	118-74-1	0.015	0.05
Hexachlorobutadiene	87-68-3	0.015	0.05
Hexachloroethane	67-72-1	0.015	0.05
Nitrobenzene	98-95-3	0.015	0.05
Pentachlorophenol	87-86-5	0.015	0.05
Pyridine	110-86-1	0.015	0.05
m,p-Cresols	65794-96-9	0.015	0.05
o-Cresol	95-48-7	0.015	0.05
Matrix: **TCLP** Analytical Group/Method: **RCRA Metals, SW-846 6010C** Units: **mg/L**			
Arsenic	7440-38-2	0.05	0.3
Barium	7440-39-3	0.01	0.05
Cadmium	7440-43-9	0.01	0.05
Chromium	7440-47-3	0.01	0.05
Lead	7439-92-1	0.033	0.1
Selenium	7782-49-2	0.06	0.3
Silver	7440-22-4	0.01	0.05
Mercury	7439-97-6	0.00066	0.002

Worksheet #16 Project Schedule Timeline

Activities	Organization	Dates		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Public Meetings	RMC Consultants will assist City of Wheat Ridge and WR2020	1st meeting is on 12/11/13 2nd meeting is estimated to be on 3/11/14 3rd meeting is estimated to be on 6/4/13	NA	RMC will assist with the community outreach effort and participate in public meetings	Date of meeting
Prepare UFP-QAPP	RMC Consultants	December 2013	Early December 2013	A general UFP-QAPP	Prior to the start of Phase II work
Phase II Investigation	RMC Consultants	February 2014	July 2014	Site-Specific Field Sampling Plans, Final Phase II ESA Reports, and Analytical Data – EDD and Hard Copy	Within 2 months of completing field sampling and investigations

Note: Only activities associated with Phase II work are listed. Phase I activities are not addressed in this QAPP.

Worksheet #17 Sampling Design and Rationale

Sampling approach: Sampling activities must be adequate to determine the presence or absence, magnitude, extent, and cleanup options for contaminants that may pose a threat to redevelopment and future land use. The sampling approach will address data gaps identified during the Phase I ESAs.
Sampling design and rationale: Findings from the Phase I ESAs will be used to determine the sampling design and rationale, which will be presented in the site-specific work plans.

Worksheet #18 Sampling Locations and Methods/SOP Requirements Table

Sampling Location	Matrix	Sample Depth (ft bgs)	Analytical Group	Number of Samples per Site	Sample Collection SOP Reference[1]	Rationale for Sampling Location
Surface Soil	Soil	0 to 0.5	VOCs, BTEX & MTBE, SVOCs, TPH, RCRA Metals	Only if warranted; number to be determined in site-specific FSP	SOP-2 Surface Soil Sampling	To be determined; dependent upon Phase I ESA findings
Soil Borings One sample will be collected from each borehole. Up to 10 soil borings (4 of which will be completed as temporary wells) will be advanced at each site.	Soil	To be determined during direct push and drilling activities	VOCs, BTEX & MTBE, SVOCs, TPH, RCRA Metals	Up to 10 soil samples	SOP-3 and 4 Direct-Push Advancement & Sampling Hollow-Stem Auger Drilling & Sampling	To be determined; dependent upon Phase I ESA findings
Temporary Monitoring Wells Up to four temporary wells will be installed at each site.	Groundwater	Dependant upon well screen placement	VOCs, BTEX & MTBE, SVOCs, TPH, RCRA Metals	Up to 4 groundwater samples	SOP-8 Groundwater Sample Collection	To be determined; dependent upon Phase I ESA findings
IDW	Soil and Groundwater	NA	TCLP (VOCs, SVOCs, TPH, Metals)	One composite sample per matrix per site	SOP-10 Investigation Derived Waste Management	NA

[1]See Sample Collection SOP References table (Worksheet #21)

Worksheet #19 Analytical SOP Requirements Table: Sample Containers, Preservation, and Hold Times

Matrix	Analytical Group/Analytes	Analytical and Preparation Method/SOP Reference [1]	Sample Volume (oz or mL)	Containers	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Soil	VOCs	5030A/8260C	4 oz	4 oz Glass, wide mouth	Cool, 4°C, No Headspace	14 days
	SVOCs	3541C/8270D	8 oz	8 oz Glass, wide mouth	Cool, 4°C	14 days
	BTEX & MTBE	5030A/8260C	4 oz	4 oz Glass, wide mouth	Cool, 4°C, No Headspace	14 days
	TPH - GRO	3580/8015C	4 oz	4 oz Glass, wide mouth	Cool, 4°C	14 days
	TPH - DRO	3580/8015C	8 oz	8 oz Glass, wide mouth	Cool, 4°C	14 days
	RCRA 8 Metals	3050B/6010C/ 7471B	4 oz	4 oz Glass, wide mouth	Cool, 4°C	6 months
Groundwater	VOCs	5030B/8260C	3 x 40 mL	3 x 40 mL Glass, Teflon-Lined Septum Cap	Cool, 4°C, HCl to pH<2, No Headspace	14 days
	SVOCs	3510C/8270D	2 x 1,000 mL	2 x 1,000 mL Glass (Amber)	Cool, 4°C	7 days
	BTEX & MTBE	5030B/8260C	3 x 40 mL	3 x 40 mL Glass, Teflon-Lined Septum Cap	Cool, 4°C, HCl to pH<2, No Headspace	14 days
	TPH - GRO	3511 Mod/8015C	3 x 40 mL	3 x 40 mL Glass, Teflon-Lined Septum Cap	Cool, 4°C, HCl to pH<2, No Headspace	14 days
	TPH - DRO	3511 Mod/8015C	2 x 1,000 mL	2 x 1,000 mL Glass (Amber)	Cool, 4°C	7 days
	RCRA 8 Metals	3005A/6010C/ 7470A	500 mL	1 x 500 poly container	Cool, 4°C, HNO_3 to pH<2	6 months

[1]Analytcial SOP References table (Worksheet #23)

Worksheet #20 Field Quality Control Sample Summary Table

Matrix	Analytical Group	Normal Field Samples (per site)	Field Duplicate Samples	Matrix Spike/Matrix Spike Duplicate Pairs	Field Blanks	Equipment Blanks	Others	Total Samples* (per site)
Soil	VOCs	Up to 10	1	1	0	1	0	Up to 13
	SVOCs	Up to 10	1	1	0	1	0	Up to 13
	BTEX & MTBE	Up to 10	1	1	0	1	0	Up to 13
	TPH (GRO & DRO)	Up to 10	1	1	0	1	0	Up to 13
	RCRA 8 Metals	Up to 10	1	1	0	1	0	Up to 13
	Lead	Up to 10	1	1	0	1	0	Up to 13
Groundwater	VOCs	Up to 4	1	1	0	1	0	Up to 7
	SVOCs	Up to 4	1	1	0	1	0	Up to 7
	BTEX & MTBE	Up to 4	1	1	0	1	0	Up to 7
	TPH (GRO & DRO)	Up to 4	1	1	0	1	0	Up to 7
	RCRA 8 Metals	Up to 4	1	1	0	1	0	Up to 7
Soil & Groundwater IDW	TCLP parameters	1 per media	0	0	0	0	0	2 (1 for soil, 1 for purge/decon water)

*Note: Total number of field samples and quality control samples are listed for each site. Number of Phase II sites and total number of sample locations per site will be provided in the Phase II site-specific FSPs.

Worksheet #21 Project Sampling SOPs Reference Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Sampling Equipment Type	Modified for Project Work? (Check if yes)	Comments
SOP-1	Field Headspace Screening, 12/2013	RMC Consultants	PID	☐	See Appendix A for SOP
SOP-2	Surface Soil Sampling, 12/2013	RMC Consultants	Stainless steel spoon, mixing bowl	☐	See Appendix A for SOP
SOP-3	Direct-Push Advancement and Sampling, 12/2013	RMC Consultants	Direct-push equipment, stainless steel spoon, mixing bowl	☐	See Appendix A for SOP
SOP-4	Hollow-Stem Auger Drilling and Sampling, 12/2013	RMC Consultants	Stainless steel split spoon sampler, liner, stainless steel spoon, mixing bowl	☐	See Appendix A for SOP
SOP-8	Groundwater Sampling, 12/2013	RMC Consultants	HF SCIENTIFIC MICRO TPW, YSI PRO PLUS, & portable submersible pumps	☐	See Appendix A for SOP
SOP-9	Equipment Decontamination, 12/2013	RMC Consultants	N/A	☐	See Appendix A for SOP
SOP-10	Investigation Derived Waste Management, 12/2013	RMC Consultants	N/A	☐	See Appendix A for SOP
SOP-11	Sample Handling, Documentation, and Tracking, 12/2013	RMC Consultants	N/A	☐	See Appendix A for SOP
SOP-13	Instrument Calibration and Maintenance, 12/2013	RMC Consultants	N/A	☐	See Appendix A for SOP
SOP-14	ACM and LBP Testing, 12/2013	RMC Consultants	Sampling tool	☐	See Appendix A for SOP

Worksheet #22 Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[2]	SOP Reference[1]
HF SCIENTIFIC MICRO TPW Turbidity Meter	Calibrate with 2 standards. - 0 and 20 NTU for drinking water like samples or 4 standards (0, 20, 100, 800 NTU) if higher sample values are expected	As required	Visual inspection		Daily, before use	±0.1 NTU between each sample cell No error codes displayed during calibration	If turbidity reading exceeds criterion, then prepare new calibration standards or clean and re-oil sealed vial standards, clean meter, or service as necessary	Sampling Team Leader	SOP-13
YSI PRO PLUS Dissolved Oxygen Probe	Calibrate with 2 standards. - % Saturated DO std. and 0.0 mg/L DO std.				Daily, before use	± 0.2 mg/L for 0.0 mg/L DO std.	If DO reading exceeds criterion, then prepare new 0.0 mg/L std., clean probe and/or change membrane. Recalibrate or service as necessary.	Sampling Team Leader	SOP-13
YSI PRO PLUS pH Probe	Calibrate probe with 2 temperatures. equilibrated standards. to bracket expected pH values				Daily before use	2 standards provide stable readings ±0.1 pH unit within 3 min.	If probe reading fails to stabilize, do not use. Check/replace membrane and recalibrate or service as necessary.	Sampling Team Leader	SOP-13

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[2]	SOP Reference[1]
YSI PRO PLUS pH Probe		Check mechanical and electronic parts, verify system continuity, check battery, and clean probe			Daily before use and when unstable readings occur	Stable after 3 min.	Clean probe, and/or replace membrane, and/or replace or service other defective parts.	Sampling Team Leader	SOP-13
YSI PRO PLUS pH Probe			Visual inspection		Daily before use	No defective parts noted	Clean probe, and/or replace membrane, and/or replace or service other defective parts.	Sampling Team Leader	SOP-13
YSI PRO PLUS Conductivity Probe	Calibrate electrode with 1 std.				Daily before use	± 1 mS/cm of std.	If conductance reading exceeds criterion, then clean probe or service as necessary and recalibrate.	Sample Team Leader	SOP-13
YSI PRO PLUS Temperature Sensor	Calibrate against NIST traceable certified thermometer				Daily before use	± 0.15°C of NIST certified thermometer	If temperature sensor reading exceeds criterion, service or replace as necessary and recalibrate.	Sample Team Leader	SOP-13
MiniRAE 2000 PID	Calibrate with fresh air and 100 ppm isobutylene gas	Check battery, and change probe filter if needed	Perform bump test		Daily before use	0.0 ppm for fresh air, within 5% of 100 ppm isobutylene gas	Clean the sensor, lamp, and lamp housing or replace lamp.	Sample Team Leader	SOP-13

[1]Specify the appropriate reference letter or number from the Project Sampling SOP Reference table (Worksheet #21)

[2]The RMC Project Manager will be responsible for the procurement of equipment and supplies.

Worksheet #23 Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
SOP-13	Instrument Calibration and Maintenance	Screening Data	Dissolved oxygen	YSI PRO PLUS	RMC Consultants	☐
SOP-13	Instrument Calibration and Maintenance	Screening Data	pH	YSI PRO PLUS	RMC Consultants	☐
SOP-13	Instrument Calibration and Maintenance	Screening Data	Temperature	YSI PRO PLUS	RMC Consultants	☐
SOP-13	Instrument Calibration and Maintenance	Screening Data	Specific conductance	YSI PRO PLUS	RMC Consultants	☐
SOP-13	Instrument Calibration and Maintenance	Screening Data	Oxidation Reduction Potential	YSI PRO PLUS	RMC Consultants	☐
SOP-13	Instrument Calibration and Maintenance	Screening Data	Turbidity	HF SCIENTIFIC MICRO TPW	RMC Consultants	☐
SOP-13	Instrument Calibration and Maintenance	Screening Data	PID	MineRAE 2000 PID	RMC Consultants	☐
LP002B	Determination of Volatile Organics by GC/MS –Method SW846 8260C/5030A, Revised 01/07/2012	Definitive	VOC	GC/MS	Origins Laboratory-Denver	☐
GL-OA-E-01 & GL-OA-E-009	Determination of Semi-Violatile Organics by GC/MS - Method SW846 8270D/3541C	Definitive	SVOC	GC/MS	Origins Laboratory-Denver	☐

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
GL-OA-E-66 & GL-OA-E-009	Determination of Semi-Violatile Organics by GC/MS - Method SW846 8270D/3510C	Definitive	SVOC	GC/MS	Origins Laboratory-Denver	☐
LP002B	Determination of TPH by GC/FID - Method SW846 8015C, Revised 01/07/2012	Definitive	TPH	GC/FID	Origins Laboratory-Denver	☐
GL-MA-E-006, GL-MA-E-013, GL-MA-E-010	Determination of RCRA Metals - Method SW846 6010C/7470A/3005A	Definitive	Metals	ICP	Origins Laboratory-Denver	☐
GL-MA-E-009, GL-MA-E-013, GL-MA-E-010	Determination of RCRA Metals - Method SW846 6010C/7471B/3050B	Definitive	Metals	ICP	Origins Laboratory-Denver	☐

Worksheet #24 Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Tuning	Prior to ICAL and the beginning of each 12 hour period	Refer to the analytical method for specific ion criteria	Retune instrument and verify Rerun affected samples	Lab Manager/ Analyst	DV-MS-0010 DOD QSM
GC/MS	Initial Calibration (ICAL)	Initial calibration prior to sample analysis	1. Average response factor (RF) for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane, and ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethene. 2. RSD for RFs for CCCs: VOCs ≤ 30% and one option below: a. Option 1: linear-mean RSD for all analytes ≤ 15% b. Option 2: linear least squares regression	Locate the source of the problem If expected RFs are not met, check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem then repeat initial calibration If SPCC is non-compliant, it could be a result of standard degradation or active presence to active sites in the system Correct the problem and repeat calibration If CCC is non-compliant, it could be a result of system leaks, or reactive column sites or standard degradation	Lab Manager/ Analyst	DV-MS-0010 DOD QSM

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
			$r \geq 0.995$ when RSD >15% c. Option 3: non-linear regression – coefficient of determination $r^2 \geq 0.99$ (6 points will be used for second order, 7 points shall be used for third order)	Correct the problem and recalibrate If RSD is non-compliant, check for outlier and repeat that ICAL point; otherwise perform instrument troubleshooting and repeat calibration		

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Second source calibration verification (ICV)	Once after each initial calibration	Value of second source for all project analytes within ±20% of expected value (initial source)	Prepare fresh standard and reanalyze second source to rule out standard degradation or inaccurate injection If problem persists, perform instrument adjustment and/or maintenance, and rerun initial calibration and second source verification standard If problem continues, new standards may need to be purchased, prepared, and analyzed	Lab Manager/ Analyst	DV-MS-0010 DOD QSM

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Calibration Verification (CV)	Daily, before sample analysis, and every 12 hours of analysis time	1. Average RF for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane, and ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethene 2. %Difference/Drift for CCCs and target compounds ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or non-linear calibration)	If SPCC is non-compliant, it could be a result of standard degradation or active presence to active sites in the system Correct the problem and repeat calibration If CCC is non-compliant, it could be a result of system leaks, or reactive column sites or standard degradation Correct the problem and recalibrate	Lab Manager/ Analyst	DV-MS-0010 DOD QSM
GC/MS	Retention time (RT) window width calculated for each analyte and surrogate	At method set-up and after major maintenance (e.g., column change)	RT width is ± 3 times standard deviation for each analyte RT from a 72-hour study	None	Lab Manager/ Analyst	DV-MS-0010 DOD QSM

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Retention time window position establishment for each analyte and surrogate	Once per ICAL and at the beginning of the analytical shift	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed On days when ICAL is not performed, the initial CCV is used	None	Lab Manager/ Analyst	DV-MS-0010 DOD QSM

Worksheet #25 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[1]	SOP Reference
GC/MS	Clean sources, maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps twice per year, other maintenance as needed	Tune and CCV pass criteria	Recalibrate instrument	Laboratory Chemist	DV-MS-0010

[1]The Laboratory Project Manager will be responsible for the procurement of equipment and supplies.

Worksheet #26 Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection: Sample Team Leader/ RMC Consultants
Sample Packaging: Sample Team Leader/ RMC Consultants
Coordination of Shipment: Sample Team Leader/ RMC Consultants
Type of Shipment/Carrier: Hand delivery by RMC Consultants or Overnight Carrier/FedEx, UPS, etc.
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt: Sample Custodian /Origins Laboratory
Sample Custody and Storage: Sample Custodian/ Origins Laboratory
Sample Preparation: Lab Analyst/ Origins Laboratory
Sample Determinative Analysis: Lab Analyst/ Origins Laboratory
SAMPLE ARCHIVING
Field Sample Storage: There will be no onsite storage of samples. Samples will be hand delivered to the laboratory.
Sample Extract/Digestate Storage (No. of days from extraction/digestion): Extracts/Digestates will be analyzed as soon as possible, and held until the project is invoiced.
Biological Sample Storage: Not applicable because no biological samples will be collected.
SAMPLE DISPOSAL
Personnel/Organization: Sample Custodian/Origins Laboratory
Number of Days from Analysis: Origins Laboratory will dispose of samples, sample extracts and digestates 30 days after project invoice.

Worksheet #27 Sample Custody Requirements

Field Sample Custody Procedures: See Worksheet #21
Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal): Maintained in the Laboratory QA Manual
Sample Identification Procedures: Will be provided in the site-specific FSP
Chain-of-custody Procedures: See Worksheet #21

Worksheet #28 QC Samples Table

Matrix: **Water and Soil**
Analytical Group/Concentration Level: **Organics and Inorganics/Low**
Analytical Method: **All**

QC Sample/QC Check	Minimum Frequency	Acceptance Criteria[1]	Corrective Action	Flagging Criteria	Comments
Field Duplicate	1 per 10 field samples per media	%RPD ≤ 30%	Examine the project-specific DQOs.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	The data shall be evaluated to determine the source of difference.
Matrix Spike (MS)	1 per 20 field samples per media	LCS criteria cited in DOD QSM v4.2 Tables G-4 through G-10, G-18 and G-19	Examine the project-specific DQOs.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.
Matrix Spike Duplicate (MSD)	1 per 20 field samples per matrix	LCS criteria cited in DOD QSM v4.2 Tables G-4 through G-10, G-18 and G-19 %RPD ≤ 30%	Examine the project-specific DQOs.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.

Matrix: **Water and Soil**
Analytical Group/Concentration Level: **Organics and Inorganics/Low**
Analytical Method: **All**

QC Sample/QC Check	Minimum Frequency	Acceptance Criteria[1]	Corrective Action	Flagging Criteria	Comments
Surrogate Spike	All field and QC samples.	QC acceptance criteria cited in DOD QSM v4.2 Table G-3. Otherwise, use in-house control limits.	For QC and field samples, correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	Apply J-flag to all associated analytes if acceptance criteria are not met.	Alternative surrogates are recommended when there is obvious chromatographic interference.
Laboratory Control Sample (LCS) containing all analytes to be reported, including surrogates	One per preparatory batch.	LCS criteria cited in DOD QSM v4.2 Tables G-4 through G-10, G-18 and G-19	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply J-flag to specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Laboratory Method blank	One per preparatory batch	No analytes detected > ½ RL and > 1/10 the amount measured in	Correct problem. If required, reprep and reanalyze method blank	If reanalysis cannot be performed, data must be qualified and	Problem must be corrected. Results may not be

Matrix: **Water and Soil**
Analytical Group/Concentration Level: **Organics and Inorganics/Low**
Analytical Method: **All**

QC Sample/QC Check	Minimum Frequency	Acceptance Criteria[1]	Corrective Action	Flagging Criteria	Comments
		any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	and all samples processed with the contaminated blank.	explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Results reported between DL and LOQ	Not applicable	Not applicable	Not applicable	Apply J-flag to all results between MDL and RL	Results reported between DL and LOQ.

[1]QC acceptance criteria from the Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories Version 4.2, 10/25/2010 http://www.denix.osd.mil/edqw/) as noted in Worksheets where applicable. The DoD QSM was developed to provide baseline requirements for the establishment and management of quality systems for environmental testing laboratories performing services for the DoD; it is based on the National Environmental Laboratory Accreditation Conference (NELAC) Chapter 5 Quality Systems standard (July 1999). Although none of the Phase II properties are DoD sites, RMC intends to use the DoD QSM for guidance since the manual contains the minimum requirements essential to ensuring the generation of definitive environmental data of known quality, appropriate for their intended uses, and the requirements apply to all environmental laboratories regardless of size or complexity. The DoD QSM is referenced throughout this QAPP, as it pertains to QA/QC criteria.

Worksheet #29 Project Documents and Records Table

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records
Field Notes	Sample Receipt, Custody, and Tracking Records	Sample Receipt, Custody, and Tracking Records	Field Sampling Audit Checklists
Chain-of-Custody Records	Standards Traceability Logs	Standard Traceability Logs	Field Analysis Audit Checklists
Air Bills	Equipment Calibration Logs	Equipment Calibration Logs	Data Validation Reports
Custody Seals	Sample Preparation Logs	Sample Preparation Logs	Corrective Action Forms
Telephone Logs	Run Logs	Run Logs	Telephone Logs
Corrective Action Forms	Equipment Maintenance, Testing, and Inspection Logs	Equipment Maintenance, Testing, and Inspection Logs	Data Quality Assessment
	Corrective Action Forms	Corrective Action Forms	Data Usability Assessment
	Reported Field Sample Results	Reported Field Sample Results	Final Project Report
	Sample Disposal Records	Reported Results for Standards, Quality Control Checks, and Quality Control Samples	
	Telephone Logs	Instrument Printouts (raw data) for Field Samples, Standards, Quality Control Checks, and Quality Control Samples	
		Data Package Completeness Checklists	
		Sample Disposal Records	
		Telephone Logs	
		Extraction/Clean-up Records	
		Raw Data (stored on disk or CD-R)	

Worksheet #30 Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory / Organization	Backup Laboratory/ Organization
Groundwater	Water Quality Screening	Low	To be determined.	See Worksheet #23	Included in draft and final report	RMC Consultants	NA
Groundwater	All analyses	Low	To be determined	See Worksheet #23	15 Business days of sample receipt	Origins Laboaratory-Denver	NA
Soil	All analyses	Low	To be determined	See Worksheet #23	10 Business days of sample receipt	Origins Laboaratory -Denver	NA

Worksheet #31 Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing CA	Person(s) Responsible for Monitoring Effectiveness of CA
Field Sampling Technical Systems Audit	One at sampling startup	Internal	RMC Consultants	Claude Murray Field Operations Manager RMC Consultants	Jennifer Hussey Sampling Team Leader RMC Consultants	Jennifer Hussey Sampling Team Leader RMC Consultants	Claude Murray Field Operations Manager RMC Consultants
Offsite Laboratory Technical Systems Audit	Origins Laboaratory -Denver is audited periodically as part of accreditation with the National Environmental Laboratory Accreditation Program (NELAP).						

Worksheet #32 Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Field Sampling Technical Systems Audit	Written audit report	Joseph Mastromarchi QA Manager RMC Consultants	3 Business days after audit	Written response	Claude Murray, Field Operations Manager RMC Consultants Joseph Mastromarchi QA Manager RMC Consultants	5 Business days after receipt of written report
Offsite Laboratory Technical Systems Audit	See Worksheet #31	See Worksheet #31	See Worksheet #31	See Worksheet #31	See Worksheet #31	See Worksheet #31

Worksheet #33 QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Field Sampling Technical Systems Audit Report	One at startup of sampling each site	Any deviations from the QAPP or FSP will be addressed in the final Phase II report	Claude Murray Field Operations Manager RMC Consultants	Joseph Mastromarchi QA Manager RMC Consultants David Groy Project Manager RMC Consultants
Offsite Laboratory Technical Systems Audit Report	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Data Usability Assessment Report	One per site	After all data are generated and validated	Joseph Mastromarchi QA Manager RMC Consultants	David Groy Project Manager RMC Consultants

Worksheet #34 Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification
Chain-of-custody and shipping forms	Chain-of-custody forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. One copy of the chain-of-custody will be retained in the project file, and the original and remaining copies taped inside the cooler for shipment. See SOP-11 Sample Handling, Documentation, and Tracking in Appendix A for further details.	Internal	Claude Murray Field Operations Manager RMC Consultants
Audit Reports	Upon report completion, a copy of all audit reports will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the site file.	Internal	Joseph Mastromarchi QA Manager RMC Consultants
Field Notes	Field notes will be reviewed internally and placed in the project file. A copy of the field notes will be included with the final report.	Internal	Claude Murray Field Operations Manager RMC Consultants
Laboratory Data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	Internal	Noelle Doyle Mathis Laboratory Project Manager Origins Laboratory
Laboratory Data	Data will be provided by the laboratory in a Staged Electronic Data Deliverable (SEDD) 2A format. The SEDD electronic data will be verified against the analytical method criteria and requirements contained in the DoD QSM Version 4.2.	Internal	Joseph Mastromarchi QA Manager RMC Consultants

Worksheet #35 Validation (Steps IIa and IIb) Process Table

Step IIA/IIB	Validation Input	Description	Responsible for Validation
IIA/IIB	Onsite analytical work	All onsite analytical data will be reviewed against QAPP requirements for completeness and accuracy based on the field calibration records.	Claude Murray Field Operations Manager RMC Consultants
IIA/IIB	SOPs	Ensure that all sampling SOPs were followed. Ensure that all analytical SOPs were followed	Claude Murray Field Operations Manager RMC Consultants Joseph Mastromarchi QA Manager RMC Consultants
IIA/IIB	Documentation of Method QC Results	Establish that all method required QC samples were run and met required limits.	Joseph Mastromarchi QA Manager RMC Consultants
IIA/IIB	Documentation of QAPP QC Sample Results	Establish that all QAPP required QC samples were run and met required limits.	Joseph Mastromarchi QA Manager RMC Consultants
IIA/IIB	Project Reporting Limit	All sample results met the project detection limits specified in the QAPP.	Joseph Mastromarchi QA Manager RMC Consultants
IIA/IIB	Raw data	Data will be provided by the laboratory as a complete report and raw data package. A data review will be completed to ensure that project data quality objectives were satisfied and to evaluate data usability.	Joseph Mastromarchi QA Manager RMC Consultants

Worksheet #36 Validation (Steps IIa and IIb) Summary Table

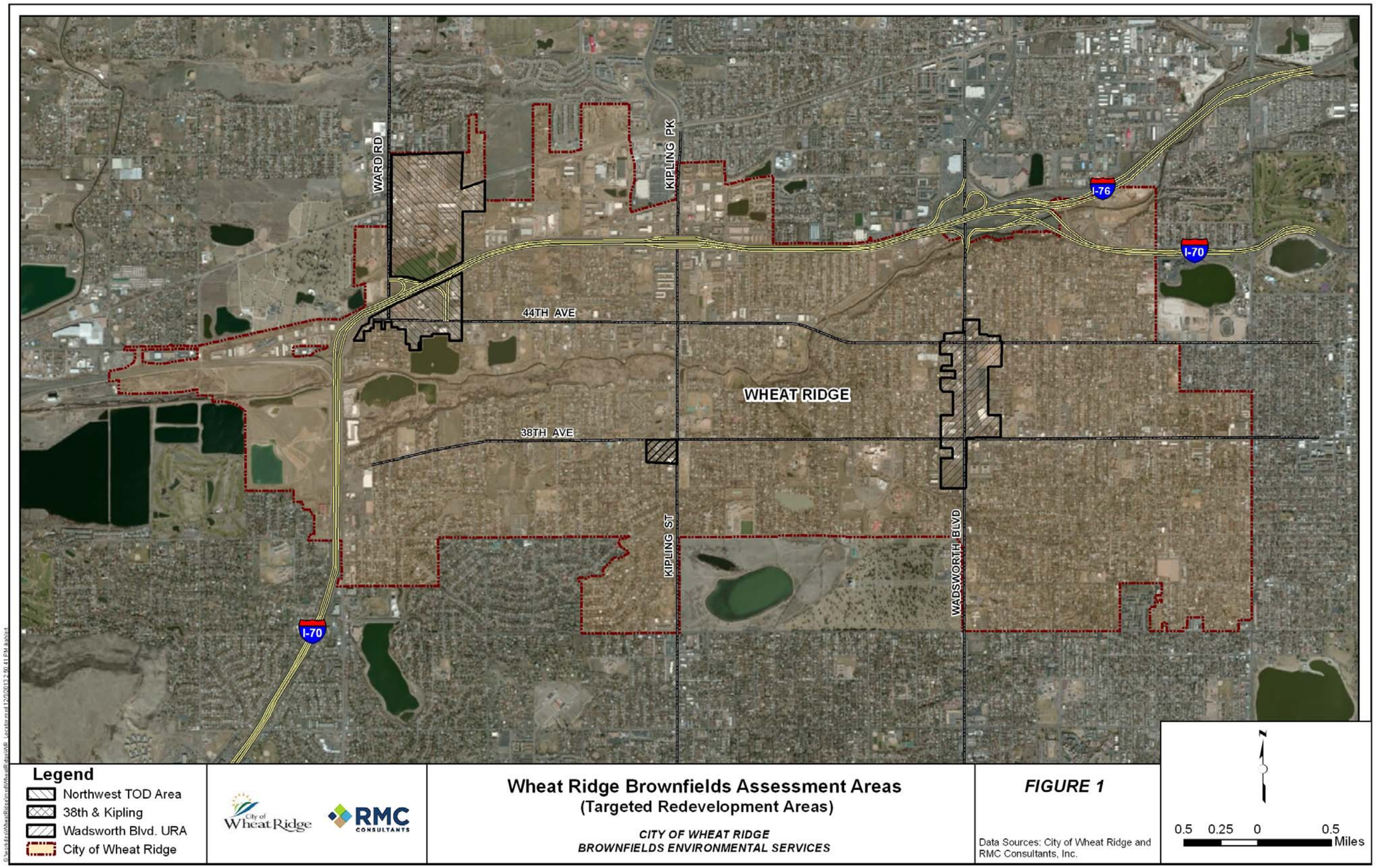
Step IIA/IIB	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator
IIA/IIB	Groundwater	VOC, BTEX & MTBE, SVOC, TPH, RCRA Metals	Low	SW-846 Methods 8260C, 8270D, 8015C, 6010C DoD QSM QAPP Worksheet #28	Joseph Mastromarchi QAManager RMC Consultants
IIA/IIB	Soil	VOC, BTEX & MTBE, SVOC, TPH, RCRA Metals	Low	SW-846 Methods 8260C, 8270D, 8015C, 6010C DoD QSM QAPP Worksheet #28	Joseph Mastromarchi QAManager RMC Consultants

Worksheet #37 Usability Assessment

The Data Usability Assessment will be performed by the QA Manager/Project Chemist. The results of the Data Usability Assessment will be presented in the final project report. The following items will be assessed and conclusions drawn on their results:

Precision - Results of field QC sample duplicates. For each field sample duplicate and matrix spike sample duplicate, the relative percent difference (RPD) will be calculated for each analyte (for the field sample duplicate pair, the parent and duplicate values must both be greater than or equal to the LOQ to calculate an RPD). The RPDs will be checked against the measurement performance criteria presented on Worksheet #12. Conclusions about the precision of the field QC sample results will be drawn and any limitations on the use of the data will be described.
Accuracy - Results of laboratory control samples (LCS) and surrogate standards. For each LCS and surrogate standard, the percent (%) recovery will be checked against the measurement performance criteria presented on Worksheet #12. Conclusions about the accuracy of the analyses based on the LCS and surrogate standard results will be drawn and any limitations on the use of the data will be described.
Bias - Results of laboratory method blanks and matrix spike samples. For each method blank the detected analyte concentration, and for each matrix spike the % recovery, will be compared to the requirements listed on Worksheet #12. Conclusions about the bias of the analyses based on the method blank and matrix spike results will be drawn and any limitations on the use of the data will be described.
Sensitivity – Listed LODs and LOQs. The reported detection limits for each analyte will be checked against the detection limit criteria presented in Worksheet #15. Conclusions about the sensitivity of the analyses will be drawn and any limitations on the use of the data will be described.
Representativeness - Representativeness during field collection and during laboratory analysis. For field sample collection to be representative, the work plan should be followed, and proper sampling techniques and sample handling procedures should be used. For laboratory analysis to be representative, the project samples will be prepared and analyzed together if possible. Documentation will establish sample identification and integrity, and that proper procedures and protocols have been followed in the field and laboratory. Conclusions about representativeness will be drawn and any limitations on the use of the data will be described.
Comparability - Results of this study will be used for determining comparability for data collected during previous and future sampling events using the same or similar sampling and analytical SOPs. Conclusions about comparability will be drawn and any limitations on the use of the data will be described.
Completeness - Completeness will be calculated based on the number of field samples expected to be collected and analyzed. Completeness criteria are presented on Worksheet #12. For each analyte, completeness will be calculated as a percentage of the number of valid (i.e., not rejected to quality considerations) results divided by the total number of expected results. Conclusions about data completeness will be drawn and any limitations on the use of the data will be described.

FIGURES


WARD RD
KIPLING PK
I-76
I-70
44TH AVE
WHEAT RIDGE
38TH AVE
KIPLING ST
WADSWORTH BLVD
I-70
Legend
Northwest TOD Area
38th & Kipling
Wadsworth Blvd. URA
City of Wheat Ridge
Wheat Ridge Brownfields Assessment Areas
(Targeted Redevelopment Areas)
CITY OF WHEAT RIDGE
BROWNFIELDS ENVIRONMENTAL SERVICES
FIGURE 1
Data Sources: City of Wheat Ridge and RMC Consultants, Inc.
0.5 0.25 0 0.5
Miles

APPENDIX A

STANDARD OPERATING PROCEDURES

Standard Operating Procedures

SOP #1	Field Headspace Screening, December 2013
SOP #2	Surface Soil Sampling, December 2013
SOP #3	Direct-Push Advancement and Sampling, December 2013
SOP #4	Hollow-Stem Auger Drilling and Sampling, December 2013
SOP #5	Borehole Logging and Lithologic Description, December 2013
SOP #6	Temporary Monitoring Well Installation, December 2013
SOP #7	Monitoring Well Development, December 2013
SOP #8	Groundwater Sample Collection, December 2013
SOP #9	Equipment Decontamination, December 2013
SOP #10	Investigation Derived Waste Management, December 2013
SOP #11	Sample Handling, Documentation, And Tracking Procedures, December 2013
SOP #12	Field Documentation, December 2013
SOP #13	Instrument Calibration and Maintenance, December 2013
SOP #14	ACM and LBP Testing, December 2013
SOP #15	Borehole Abandonment, December 2013

STANDARD OPERATING PROCEDURE #1
FIELD HEADSPACE SCREENING

SOP Preparation/Revision Date: December 2013

Equipment/Material Needs

- Photoionization Detector (PID)
- Ziplock™ bag
- Field logbook

Soil will be screened from each five-foot sample interval using an 11.7 electron volt PID meter to determine the relative presence of organic compounds and identify locations which may warrant the collection of soil samples. Headspace screening measurements will be recorded in the field in accordance with the following protocol:

1. A representative portion of soil collected from each sample will be placed in a clean Ziplock™ bag and sealed air tight.

2. The Ziplock™ bag containing the soil will be agitated for at least fifteen seconds and then allowed to volatilize in direct sunlight for a minimum of five minutes.

3. The bag will then be shaken and the vapor sampling probe of the PID will be used to puncture the bag to measure the volatile vapor headspace. The maximum meter response (within the first 2 to 5 seconds) will be recorded.

The headspace screening measurements will be recorded on the appropriate field documentation forms (e.g., boring logs and/or field notebooks).

STANDARD OPERATING PROCEDURE #2
SURFACE SOIL SAMPLING

SOP Preparation/Revision Date: December 2013

Equipment/Material Needs

Laboratory-supplied sample containers
Personal protective equipment (PPE)
Field logbook
Stainless steel scoop or spoon and mixing bowl
Sample collection supplies (e.g., waterproof markers, sample labels, cooler for sample storage, trash bags)
Decontamination equipment and supplies (e.g., high pressure sprayer/washer, wash/rinse tubs, brushes, Alconox, plastic sheeting, paper towels, sponges, garden-type water sprayers, large plastic bags, potable water, distilled water and/or deionized water
Surveying stakes or flags for marking sampling locations

Surface soil samples will be collected as follows:

1. All debris and plant material shall be scraped from the surface soil sample location prior to collection.
2. The surface soil sample will be collected with a decontaminated stainless steel trowel or spoon from 0 to 0.5 feet bgs. A stainless steel pick may be used as needed to loosen the soil. To the extent possible, eliminate gravel size or larger particles or debris based on visual observation. Be sure to collect sufficient sample volume to meet analytical requirements.
3. Samples designated for VOC, SVOC, BTEX, and GRO analysis will be placed directly in sample containers without being homogenized to avoid potential volatilization of target chemicals. Immediately fill the sample containers fully to eliminate head space. Tightly seal the containers with the appropriate lids.
4. The soil samples designated for DRO and RCRA metals will be composited in a stainless-steel bowl. To homogenize, divide the sample into four quarters and mix each quarter, then combine the four quarters and mix the entire sample. Then place samples in appropriate labeled sample containers and immediately place on ice and cool to approximately 4 °C.
5. Decontaminate the sampling equipment in accordance with SOP No. 9, Equipment Decontamination.

STANDARD OPERATING PROCEDURE #3
DIRECT-PUSH ADVANCEMENT AND SAMPLING

SOP Preparation/Revision Date: December 2013

Equipment Needs

- Geoprobe and equipment
- Sampling equipment
- Tape measure
- Pocket knife
- Hand lens
- Camera
- Field forms
- Field logbook

Prior to direct-push activities, RMC personnel will ensure all utilities in the area have been suitably located. Soil borings will be advanced using a truck-mounted GeoProbe® operated by Remington Technologies, LLC based in Loveland, Colorado. All borings will be advanced to a maximum depth of 25 feet below ground surface (bgs), or until groundwater or refusal is encountered.

Soil borings will be advanced using direct-push continuous sampling techniques with 2.25-inch clear sampling tubes/sleeves. Soil borings will be continuously logged using the Unified Soil Classification System (USCS) for unconsolidated materials (see SOP #5). One soil sample will be collected from each borehole at locations targeting potential areas of concern identified in the Phase I ESA. Soil samples will be field screened for VOCs using a MiniRae 2000 photo ionization detector (PID) or equivalent (see SOP #1 for details). All drilling equipment used to advance soil borings will be steam-cleaned before use at each borehole. All soil generated during direct push activities will be containerized pending receipt of analytical results and handled according to the practices described in SOP#10, IDW Management.

RMC personnel will provide on-site support for direct-push activities. This support will consist of the following:

- Supervision and coordination of the drilling operation.
- Completion of the soil boring log, making lithologic interpretations, observed colors/odors, and any other information that is relevant to investigative activities.
- Physical collection of the soil samples to be taken.

RMC personnel on site will include, at a minimum, a qualified geologist. RMC personnel will be 40-Hour/8-Hour OSHA trained and will participate in the company's medical monitoring program.

STANDARD OPERATING PROCEDURE #4
HOLLOW-STEM AUGER DRILLING AND SAMPLING

SOP Preparation/Revision Date: December 2013

Equipment/Material Needs

- Hollow-stem auger drill rig with appropriately sized augers and drill rods
- Sampling equipment for hollow-stem auger rig (e.g., stainless steel split spoon sampler, liners, plastic end caps, teflon sheeting and tape)
- Stainless steel scoop or spoon, knife, and mixing bowl
- Sample collection supplies (e.g., waterproof markers, sample labels, cooler for sample storage, trash bags)
- Tape measure
- Hand lens
- Camera
- Boring log forms
- Field logbook
- Appropriate field monitoring instruments and personal protective equipment (PPE) as outlined in the HSP
- Drums or other approved containers for containing soil and water
- Decontamination equipment and supplies (e.g., high pressure sprayer/washer, wash/rinse tubs, brushes, Alconox, plastic sheeting, paper towels, sponges, garden-type water sprayers, large plastic bags, potable water, distilled water and/or deionized water, decon pad construction materials)
- Surveying stakes or flags for marking sampling locations

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to conduct drilling and sampling of unconsolidated material from hollow-stem auger borings at the Wheat Ridge Brownfields Phase II sites.

Before drilling, borings will have been located, numbered, and identified using stakes or paint sticks on paved surfaces. RMC personnel will ensure all utilities in the area have been suitably located. Soil borings intended for monitoring well installation will be drilled using hollow-stem augers methods by Remington Technologies, LLC based in Loveland, Colorado. All drilling and sampling equipment will be steam-cleaned before use at each borehole and decontaminated in accordance with SOP No. 9, Equipment Decontamination.

Soil samples will be obtained either with standard split spoon drive samplers, or with a continuous core barrel. Either method will allow for collection of soil samples over continuous intervals or at discrete depths or depth intervals. Drive sampling will normally obtain a 12- to 18-inch-long sample depending on the length of the sampler. Drive sampling involves advancing the augers to the top of the desired sample interval depth, breaking the augers, and then inserting a split spoon sampling device. The split spoon is then driven through the sample interval using a rig-mounted hammer. The number of blows necessary to drive the split spoon for each 6-inch interval is recorded. Following this, the sampler is removed from the boring and opened at the surface to obtain the sample. The augers are then reattached and advanced to the top of the next sample interval. For continuous sampling, this method can be time consuming because it requires frequent breaking of the augers and trips in and out of the borehole with the sampler.

A continuous coring barrel can obtain up to 5-foot-long cores while the augers are advancing. The continuous coring method advances a split barrel that is contained within the lead auger. The augers rotate

around the sampler and cut while the sample barrel is prevented from rotating. Continuous core samples are collected in the barrel. At the end of each 5-foot run, the core barrel is removed and opened at the surface to obtain the sample.

Boreholes advanced through the unconsolidated materials at the Phase II sites will be continuously sampled/logged for lithologic characterization purposes unless otherwise specified in the FSP. Liners in the split spoon or core barrel may be required by the FSP for chemical testing purposes. The samplers will also be decontaminates between sample collection intervals. Once the sampler is brought to the surface and opened, the entire length of the sample will be screened for the presence of VOCs using a photoionization detector (PID) or flame ionization detector (FID). One sample will be collected from each boring for analysis based on the highest PID/FID readings or other indications of potential contamination (e.g., odors or staining). Soil samples for VOC, SVOC, and GRO analyses should be collected immediately upon sample retrieval without being homogenized to avoid potential volatilization of target chemicals. Samples collected for the remaining analytical parameters will be composited in a stainless-steel bowl, placed in appropriate labeled sample containers, and immediately placed on ice and cooled to approximately 4 °C. Samples not retained for chemical analysis will be discarded with the borehole cuttings and containerized pending receipt of analytical results and handled according to the practices described in SOP #10, IDW Management.

A "rig geologist" (qualified geologist, hydrogeologist, engineer, or technician) experienced in borehole drilling and soil sampling will be present at each operating drill rig during drilling and sampling operations. This rig geologist will be responsible for documenting drilling operations, health and safety monitoring, decontamination procedures, IDW handling, sample collection, and preparing detailed boring logs. All activities and information associated with borehole drilling and sampling will be recorded on boring logs, in designated project field logbooks, and/or on approved standard forms.

STANDARD OPERATING PROCEDURE #5
BOREHOLE LOGGING and LITHOLOGIC DESCRIPTION

SOP Preparation/Revision Date: December 2013

Equipment Needs

- Drill rig and equipment
- Boring log forms
- Waterproof pens
- Tape measure
- Stainless steel knife
- Hand lens
- Dilute Hydrochloric acid (10%)
- Latex or nitrile gloves and other required PPE
- Camera
- Field logbook
- Appropriate field monitoring instruments (e.g., photoionization detector [PID])
- Reference tables listing ASTM and/or USCS codes and descriptions
- Munsel color chart

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to log boreholes drilled in unconsolidated material during environmental investigations at the Brownfields Phase II sites.

The boring log is the primary record of observations of physical conditions encountered during borehole drilling. The primary purpose of the boring log is to document all pertinent information that may be necessary for someone other than the rig geologist to understand and interpret the geologic and hydrogeologic conditions observed during drilling. The rig geologist will be responsible for preparing detailed, complete, and accurate boring logs, as the drilling is performed. Soil samples will be classified according to the Unified Soil Classification System (USCS), following methods outlined in ASTM 2488 (Standard Practice for Description and Identification of Soils, Visual-Manual Procedure). The field geologist will describe and classify soil materials based on field observations using methods discussed below and will enter the lithologic classifications into an HTRW boring log. .

At a minimum, the following information will be documented on the boring log:

- Project name
- contractor name
- Boring identification number
- Start date and time
- End date and time
- Rig geologist name
- Drilling subcontractor and personnel
- Drill rig type
- Drilling method
- Bit diameter (i.e., borehole diameter)

- Auger external and internal diameter
- Sampling method
- Total depth of borehole recorded to the nearest 0.1 feet
- Ground surface elevation (recorded on log following surveying)
- Surveyed horizontal coordinates (recorded on log following surveying). If surveyed horizontal coordinates are not available at the time of drilling, location sketches referencing measured distances to prominent surface features (e.g., building corners, existing wells, fence corners) shall be recorded in the geologist's field log book.
- Sample depths or intervals
- Sample number and disposition
- Blow counts
- Sample recovery
- USCS classification for unconsolidated materials
- Rock type classification for consolidated materials
- Graphic representation of material
- Detailed lithologic description. For unconsolidated materials the description should address the parameters listed in Table 1, including compaction/consistency, water content, color, texture (grain sizes, sorting, and shapes) and plasticity, major and minor constituents (e.g., gravel, sand silt, clay), and major mineralogy (as identifiable from the sample). For rock materials the description should address the parameters listed in Table 2, including weathering classification, color, texture, hardness, rock type and major mineralogy, and presence and orientation of fractures, staining, and bedding.
- Stratigraphic/lithologic changes. Where distinct lithologic changes are directly observed, they will be identified on the boring log by a solid horizontal line. Gradational transitions and changes identified indirectly from cuttings or methods other than direct observation and measurement will be identified by a horizontal dashed.
- Detailed description of basis for identification of top of weathered bedrock and top of unweathered bedrock.
- Depth at which water is first encountered, the depth of water at the completion of drilling, and the static depth to water (if possible). Static water level data will include time allowed for levels to stabilize. The absence of water in borings will also be indicated.
- Borehole field meter readings (e.g., PID, FID, CGI)
- Other drilling, sampling, and borehole observations as appropriate (e.g., resistant layers, odors or other indications of potential contamination)

Parameters used in providing detailed lithologic descriptions for both unconsolidated materials and rock materials are listed in Table 1 and 2, respectively.

TABLE 1

LOG DESCRIPTORS FOR UNCONSOLIDATED SOIL

Parameter	Example
Depositional environment and formation, (if named and if known).	Alluvium; Piney Creek
Unified Soil Classification System and designation.	Clayey sand (SC), sandy clay (CL)
Secondary components and estimated quantities either by percentages or by descriptive percentage ranges (note: terms used to indicate ranges should be described on the log or in a general legend).	Sand: fine, with trace of med. Trace gravel
Color. May use Munsel color chart.	Gray, brown, yellowish, 5YR 3/2, 5YR 4/4
Consistency (cohesive soil). Use relative term.	Very soft, soft, medium, stiff, very stiff, hard
Density (non-cohesive soil). Use relative term.	Loose, medium, dense, very dense
Moisture content. Use relative term. Do not express as a percentage unless a value has been measured.	Dry, damp, moist, wet, saturated
Texture/fabric/bedding	No apparent bedding, thinly bedded
Grain angularity	Rounded, subangular
Sorting (sands)	Poorly sorted, well graded
Grain or fragment size	Coarse, very fine
Mineralogical indicators	Quartz, feldspar grains
Note "fill", "top of natural ground", "top of weathered bedrock", and “top of unweathered bedrock” where appropriate	

TABLE 2

LOG DESCRIPTORS FOR CONSOLIDATED ROCK

Parameter	Example
Formation name (if known)	Denver Formation
Rock type	Sandstone, shale, siltstone
Modifier denoting variety	Shaly, calcareous, siliceous, argillaceous, sandy, micaceous
Hardness	Very soft, soft, moderately hard, hard, very hard
Color	Medium brown, bluish-gray
Bedding	Parting band, thin bedded, medium bedded, thick bedded, massive, structureless, interbedded (Note: provide thickness range of each in legend)
Texture	Poorly cemented, well cemented, fine, coarse
Degree of weathering	Unweathered, intensely weathered
Degree of fracturing, fracture staining or filling	Highly fractured, limonite staining in fractures, MnO staining, calcite or zeolite fracture filling
Fracture orientation	Inclined 30º, horizontal
Structure and Orientation	Dipping beds at 10
Mineralogical indicators	Andesite, volcanic grains, mafic minerals
Moisture content	Dry, damp, moist, wet, saturated

STANDARD OPERATING PROCEDURE #6
TEMPORARY MONITORING WELL INSTALLATION

SOP Preparation/Revision Date: December 2013

Material and Equipment Needs

HAS Drill Rig
Water level indicator
Field logbook and field documentation forms
Well construction materials including:
Two-inch (I.D.), Schedule 40 flush threaded, 0.010 continuous slotted, PVC screen • Two-inch (I.D.), Schedule 40 flush threaded PVC riser pipe
Silica sand (10-20 mesh size)
Weighted tape measures
Drums or other approved containers
Decontamination equipment and supplies (e.g., high pressure sprayer/washer, wash/rinse tubs, brushes, Alconox, plastic sheeting, paper towels, sponges, garden-type water sprayers, large plastic bags, potable water, distilled water and/or deionized water, decon pad construction materials)
Appropriate field monitoring instruments and personal protective equipment (PPE) as outlined in the HSP

Monitoring Well Specifications – Up to four temporary monitoring wells will be installed at selected boring locations at each Phase II site. Each temporary monitoring well will be constructed of Schedule 40 slotted (0.010-inch slot size) two-inch diameter flush-threaded PVC well screens, and two-inch PVC riser, unless stated otherwise in the FSP. Monitoring wells will be constructed with 10-foot screens. Sandpack consisting of clean 10-20 mesh size silica sand will be placed around each well screen. For installation of 2-inch ID wells, a minimum nominal 6-inch ID hollow-stem auger assembly will be used. The procedures for temporary monitoring well installation specified below may be modified for project-specific objectives in the project-specific FSP.

Well Casings and Screens – Well casings will consist of new, 2-inch ID (unless otherwise specified) threaded, flush-joint schedule 40 PVC monitoring well casing. All joints within the casing string will be threaded. Well screens will consist of new threaded PVC monitoring well screen with 0.010-inch factory-machined slots. All well screens will have an internal diameter equal to that of the well casing. The wall thickness of PVC screen will be the same as that of the well casing. A threaded end cap will be provided at the bottom of the screen. Unless otherwise specified, 10 feet of well screen will be installed for wells. Monitoring wells will be constructed 2 inches in diameter and installed across the water table (i.e., screened three feet above and seven feet below the water table for a total screen length of 10 feet).

Filter Pack - The filter pack material will be chemically inert, rounded, silica sand of appropriate size for the well screen and host environment. The filter pack will extend a minimum of approximately 2 feet above the top of the screen. The weight on the tape measure will be stainless steel in the event that it accidentally becomes embedded in the filter pack. During placement of the filter pack, the sand will be added slowly and the sand level will be continuously monitored using a weighted tape measure to ensure bridging does not occur.

Seal and Surface Completion - There will be no bentonite seal, grout, surface completion, or extensive development (as it normally applies to permanent monitoring wells) for the installation of temporary monitoring wells.

Temporary wells may be left overnight, for sampling the following day, but the well must be secured, both against tampering and against the fall hazard of the open annulus. If the well is not sampled immediately after construction, the well should be purged prior to sampling.

During and upon completing the wells, drilling logs and well construction diagrams will be completed.

STANDARD OPERATING PROCEDURE #7
MONITORING WELL DEVELOPMENT

SOP Preparation/Revision Date: December 2013

Equipment Needs

- Bailer
- Submersible pump and tubing
- Water level meter
- Water quality meter
- Development forms
- Deionized water spray bottles
- Five-gallon buckets

Temporary monitoring wells will not require formal development. Following well construction, temporary wells will be surged to remove fine-grained material, followed by bailing and/or pumping. During well development, the rig geologist or development technician will sample the development water for pH, temperature, specific conductance, turbidity and other observations (i.e., color and clarity) after each well casing volume has been evacuated. The well will be developed until the water is relatively clear (if possible) or a decrease in turbidity is observed. The rig geologist or development technician will determine when the well has been adequately developed. All purge water from the wells will be placed into an appropriate container and handled as investigation derived waste in accordance with SOP No. 10, Investigation Derived Waste Management.

A detailed, complete, and accurate record of well development will be documented on the Well Development Record form to be completed during or immediately following well development.

WELL DEVELOPMENT RECORD

SHEET _____ of _____

Project Name:_____ Project No.:_____

Well ID:_____ **Date Installed:**_____

Casing Diameter:_____ Development Contractor:_____

METHOD OF DEVELOPMENT

☐ Swabbing ☐ Bailing ☐ Pumping ☐ Describe_____

Equipment decontaminated prior to development ☐ Yes ☐ No

Describe _____

_____

_____

CASING VOLUME INFORMATION

Casing ID (inch)	1.0	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (A) (gal/ft)	0.04	0.09	0.16	0.2	0.37	0.65	0.75	1.0	1.5	2.0	2.6

PURGING INFORMATION

Measured Well Depth (B)_____ft.

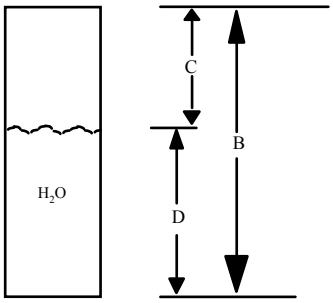
Measured Water Level Depth (C)_____ ft.

Length of Static Water Column (D)_____ - _____ = _____ft.
(B) (C)

Casing Water Volume _____ x _____ = _____gal
(A) (D)

Volume of Water Added to Well During Installation = _____gal

Total Purge Volume = _____ (gal)



Time	Pump Rate	Water Level Depth (ft)	Volume Removed (gal)	pH	Cond (mS/cm)	Temperature F or C	Turbidity (NTU)	Comments

Developer Signature:_____ Date:_____

STANDARD OPERATING PROCEDURE #8
GROUNDWATER SAMPLE COLLECTION

SOP Preparation/Revision Date: December 2013

Equipment List

- Bailers (if needed)
- Submersible pump and generator
- Electronic water level probe
- Assorted tools (knife, screwdriver, etc.)
- Nylon rope or twine
- Field water quality multi-parameter probe with flow-through cell
- Calculator
- Field notebook
- Groundwater sample form
- Waterproof and permanent marker
- 55-gallon drum or holding tank for storing purged water (where necessary)
- Appropriate health and safety equipment
- Well completion information sheet
- Appropriate decontamination equipment
- 5-gallon buckets
- Sampling apparatus
- Cooler with ice
- Sample jars and labels

Observations made during sample collection should be recorded in the field notebook and field sampling sheet. Prior to groundwater sample collection, as warranted, the presence of any immiscible layers will be assessed, using an oil-water-interface meter. The immiscible layers will be assessed visually for non-aqueous phase liquids. If non-aqueous phase liquids are not present, the groundwater wells will be purged prior to sampling. Before any purging or sampling begins, all well probes, bailers, and other sampling devices will be decontaminated according to the procedures in SOP No. 9.

Well Purging - The purpose of well purging is to remove stagnant water from the well and obtain representative water from the geologic formation being sampled while minimizing disturbance to the collected samples. Before a sample is collected, the well will be purged until a minimum of either three well casing volumes have been removed or field water quality parameters have stabilized to within 10 percent or 0.1 units, or until the well is pumped or bailed dry and allowed to recover. All wells will be purged on the same day that samples are collected. Prior to the start of purging, the depth of static water level will be measured to the nearest 0.01 foot.

Field water quality measurements will be recorded at a minimum after evacuation of each well volume to determine whether the groundwater chemistry has stabilized. Generally, subsequent readings within 10 percent of each other or 0.1 units indicate adequate stability of the water chemistry.

Sample Collection - The samples shall be taken from within the well screen interval. The following sampling procedure is to be used at each temporary monitoring well:

1. Decontaminated sampling equipment will be assembled. If bailers are used, new nylon rope or twine will be used for each well.
2. Identification labels for sample bottles will be filled out for each well.
3. When bailers are used, the bailer will be retrieved smoothly and the water will be slowly drained into the sample containers through the bailer's bottom discharge control device.
4. VOA sample vials should be completely filled so the water forms a convex meniscus at the top, then capped so that no air space exists in the vial. Turn the vial over and tap it to check for bubbles in the vial, which indicate air space. If air bubbles are observed in the sample vial, discard the sample vial and repeat the procedure with a new vial until no air bubbles are present after capping.
5. Time of sampling will be recorded.
6. Field documentation will be completed, including the groundwater sampling form and chain-of-custody (see SOP No. 12).

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name:_____ Project No.:_____
Site Name:_____ Field Crew: _____
Sampling Date:_____ Weather Conditions:_____
Monitoring Instruments: _____ Readings:BZ_____ TOC:_____
Analytical Instruments: pH:_____ Specific Conductivity:_____
Temp:_____ Turbidity:_____
D.O:_____ ORP:_____
Well ID No.:_____ Purging Equipment:_____
Type of Well:_____ CASING VOLUME CALCULATION FOR 2" WELL:
Casing Stickup:_____ (TD(ft) - DTW(ft)) x0.654 gal/ft = 1 casing volume (gallons)
Static Water Level:_____
Well Depth/Diameter:_____

Time	Casing Volumes	Gallons Removed	Dissolved Oxygen (mg/l)	ORP (mV)	Temp (°C)	pH	Conductivity (mS/cm)	Turbidity (NTUs)

Depth to Water after purging:_____ Yield of Well: L - M - H
Sampling Equipment:_____
Analysis to be performed and Number of Containers:
VOCs _____ SVOCs _____ BTEX _____ DRO_____ GRO____ RCRA Metals _____

Comments:_____
_____
_____
_____
_____
_____
_____

Sampler Signature(s):_____

STANDARD OPERATING PROCEDURE #9
EQUIPMENT DECONTAMINATION

SOP Preparation/Revision Date: December 2013

Equipment List

Decontamination pad or mobile station (if required)
Steam cleaner (hot water sprayer - Hotsy®, or similar brand, if required)
Brushes
Wash tubs or buckets
Scrapers, flat bladed
Sponges or paper towels
Alconox detergent (or equivalent)
Potable water
Deionized or distilled water
Garden-type water sprayers
Spray bottles
Appropriate containers for temporarily storing decontamination fluids as Investigation-Derived Waste (IDW)

The overall objective of the sampling programs is to obtain samples that accurately depict the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminants can be brought onto the sampling location and/or introduced into the medium of interest during the sampling program (e.g., using sampling equipment that is not properly or fully decontaminated). Trace quantities of contaminants can consequently be captured in a sample and lead to false positive analytical results and, ultimately, to an incorrect assessment of the contaminant conditions associated with the site. Decontamination of sampling equipment (e.g., all non-disposable equipment that will come in direct contact with samples) and field support equipment (e.g., vehicles) is, therefore, required prior to, between, and after uses to ensure that sampling cross-contamination is prevented and that on-site contaminants are not carried off-site.

If heavy equipment (i.e., drill rigs) decontamination activities are required at a site, a decontamination pad will be constructed at a location believed to be free of contamination and agreed upon by the appropriate facility personnel. The pad will be constructed to contain all products of the decontamination process. The temporary pad will be lined with water impermeable material. Liquids will be removed frequently from the pad to prevent overflowing of the pad. The pad shall be constructed on a level surface, and wooden racks shall be placed on the plastic pad floor to place equipment on during cleaning. At the end of the site activities, the pad will be taken apart and properly disposed. Any accumulated liquids will then be containerized pending laboratory analysis and final disposal. Decontamination of small tools and supplies is expected to be completed at each site. Decontamination liquids from these activities will also be containerized pending analysis and final disposition.

Sampling Equipment Decontamination Procedure - Personnel will dress in suitable safety equipment to reduce personal exposure as required by the Site Safety and Health Plan (SSHP). Gross contamination on equipment will be scraped off at the site. Equipment that cannot be damaged by water will be placed in a wash tub containing Alconox or low-sudsing non-phosphatic detergent along with potable water and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water in a second wash tub followed by a triple deionized water rinse.

Equipment that may be damaged by water will be carefully wiped clean using a sponge and detergent water and rinsed with deionized water. Care will be taken to prevent equipment damage. Rinse and detergent water will be replaced with new solutions between borings or sample locations. Tubing used for sampling will not be reused at different sampling locations. New tubing will be used at each sampling location.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent contact with contaminated soil. If the equipment is not used immediately after decontamination, the equipment will be covered or wrapped in aluminum foil to minimize potential contact with contaminants.

Drill Rigs and Heavy Equipment - Drill rigs and other heavy equipment will be decontaminated at the decontamination pad. The decontamination station may consist of a temporary structure capable of collecting all decontamination fluids. Mobile decontamination trailers may be used to decontaminate heavy equipment at each site. Personnel will dress in suitable PPE to reduce personal exposure as required by the SSHP. Equipment showing gross contamination or having caked-on soil will be scraped with a flat-bladed scraper at the site. Equipment that cannot be damaged by water, such as drill rigs and shovels, will be washed with a hot water, high-pressure sprayer then rinsed with potable water. Care will be taken to adequately clean the insides of the equipment. Following decontamination, equipment will be placed on the clean drill rig and moved to a clean area. If the equipment is not used immediately, it should be stored in a designated clean area.

Documentation - Sampling personnel will be responsible for documenting the decontamination of sampling and heavy equipment. The documentation will be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination should include the following:

- Decontamination personnel
- Date and start and end times
- Decontamination procedures and observations
- Weather conditions

Rinsate Blanks - Equipment rinsate samples (rinsate blanks) equipment may be collected to verify the effectiveness of the decontamination procedures. The rinsate sampling procedure will include rinsing deionized water through or over a decontaminated sampling tool (such as a split-spoon) and collecting the rinsate water into the appropriate sample bottles. The rinsate sampling procedure, including the sample number, will be recorded in the field notebook.

STANDARD OPERATING PROCEDURE #10
INVESTIGATION DERIVED WASTE MANAGEMENT

SOP Preparation/Revision Date: December 2013

Equipment List

DOT-approved 55 gallon drums
500-gallon polyethylene holding tank
Sampling equipment and sample containers (if applicable)

Liquid IDW - All IDW liquid will be stored in 55-gallon drums or a 500-gallon polyethylene holding tank for temporary storage. The containers used to store purge/decontamination water will be marked with the following information:

- Site name and number
- Type of IDW (i.e., purge water)
- Well number(s)
- Date(s) of accumulation
- Name and phone number of City of Wheat Ridge contact

One composite liquid sample for laboratory analysis will be collected from the liquid IDW (purge and decontamination water) at each site and submitted for the appropriate TCLP analysis. Upon receipt of the results, determination of appropriate liquid IDW disposal will be made by the project team.

Solid IDW – Soil IDW generated from drilling and direct-push activities will be containerized in 55-gallon drums and staged on-site, to await determination of disposal options once soil sample analyses are obtained. All drums containing soil IDW will be marked with similar information as listed above for liquid IDW. One composite soil sample for laboratory analysis will be collected from each site and submitted for the appropriate TCLP analysis. Upon receipt of the results, determination of appropriate soil IDW disposal will be made by the project team.

Personal protective equipment (PPE) used during investigation activities (including latex or nitrile gloves, paper towels, etc.) is expected to have minimal contamination, and will not be required to be containerized. Sample tubing that is not dedicated to individual wells will be discarded as solid waste also.

All solid waste IDW will be placed in plastic trash bags and disposed of offsite at a trash receptacle or dumpster, or taken to a permitted landfill. Well materials from abandoned temporary wells will be pulled from the ground, scraped clean, and disposed of as solid waste at a trash receptacle or dumpster. Waste packaging material from well installation (sandbags, screen wrappers, etc.) will also be disposed of offsite as solid waste.

STANDARD OPERATING PROCEDURE # 11
SAMPLE HANDLING, DOCUMENTATION, AND TRACKING PROCEDURES

SOP Preparation/Revision Date: December 2013

Equipment Needs

Chain of Custody forms
Sample labels
Field logbook
"Fragile" labels
Ice
Federal Express forms
Coolers
Ziploc bags, 1-qt. and 1-gal.
Bubble wrap
Cooler receipt forms
Strapping tape, 1"
Clear tape, 2"
Custody seals
Trash bags
Address labels

Sample Identification - In order to identify and accurately track the various samples, all samples collected during the project, including QA/QC samples, will be designated with a unique number. The number will serve to identify the site, sampling location, sampling depth (as applicable) and QA/QC qualifiers. The sample designation format will be specified in the site-specific FSP.

Sample Labeling - Sample labels will be filled out as completely as possible by a designated member of the sampling team. The date, time and sampler's signature should not be completed until the time of sample collection. All sample labels will be filled out using waterproof ink. At a minimum, each label will contain the following information:

- Project name
- Site Location
- Client Name
- Sampler's signature and/or inititials
- Date and time of collection
- Sample ID number, which includes location, depth, and QC suffix
- Analysis required
- Preservatives (if any) used

Sample Handling and Shipping - All samples will be stored on ice at 4ºC in an insulated cooler until packed for shipment to the laboratory. The ice will be double bagged in Ziploc-type storage bags. The sample containers will be wrapped in protective packing material (bubble wrap). Samples will then be placed right side up in a cooler with ice (double bagged using plastic bags), and taped with a custody seal for delivery to the laboratory. Samples will be hand delivered or shipped by overnight express carrier for delivery to the analytical laboratory. All samples must be shipped for laboratory receipt and analyses within specific holding times. This may require daily shipment of samples with short holding times. A CoC

form, enclosed in a Ziploc-type bag and taped to the inside lid of the cooler, will accompany each cooler. The temperature of all coolers will be measured upon receipt at the laboratory. Therefore, a temperature blank will be included in each cooler for temperature measurement purposes.

Sample Documentation and Tracking - Documentation of observations and data acquired in the field will provide information on the acquisition of samples and provide a permanent record of field activities. The observations and data will be recorded using pens with permanent waterproof ink in a permanently bound weatherproof field logbook containing consecutively numbered pages.

The information in the field book should include the following information as applicable:

- Names of personnel
- Location of sample
- Date and time of sample collection
- Sample identification code including QC and QA identification
- Description of samples (matrix sampled)
- Sample depth (if applicable)
- Number and volume of samples
- Sampling methods or reference to the appropriate SOP
- Sample handling, including filtration and preservation, as appropriate for separate sample aliquots
- Analytes of interest
- Field observations
- Results of any field measurements, such as depth to water, pH, temperature, and conductivity
- Level of PPE used during sampling
- Weather conditions at time of sample collection
- Condition of the well
- Decontamination information
- Initial static water level and total well depth
- Calculations (e.g., calculation of purged volume)
- Analyses that will be performed by the laboratory
- Equipment calibration information
- Headspace analysis (if taken)

Changes or deletions in the field book should be lined out with a single strike mark, initialed, dated, and remain legible. Sufficient information should be recorded to allow the sampling event to be reconstructed without relying on the sampler's memory. The field book will be signed by the person making the last entry at the end of each day. Anyone making entries in another person's field book will sign and date those entries.

During field sampling activities, traceability of the sample must be maintained from the time the samples are collected until laboratory data are issued. Initial information concerning collection of the samples will be recorded in the field logbook as described above. Information on the custody, transfer, handling, and shipping of samples will be recorded on a CoC form.

The sampler will be responsible for initiating and filling out the CoC form. The sampler will sign the CoC when the sampler relinquishes the samples to anyone else. One CoC form will be completed for each cooler of samples collected daily. The CoC will contain the following information:

- Sampler's signature and affiliation
- Project number
- Date and time of collection
- Sample identification number
- Sample type
- Analyses requested
- Number of containers
- Signature of persons relinquishing custody, dates, and times
- Signature of persons accepting custody, dates, and times
- Method of shipment
- Shipping air bill number (if appropriate)

The field person responsible for delivery of the samples to the shipping company will sign the CoC form, retain the last copy of the three-part CoC form, document the method of shipment, and send the original and the second copy of the CoC form with the samples. Upon receipt at the laboratory, the person receiving the samples will sign the CoC form and return the second copy to the Project Manager. Copies of the CoC forms documenting custody changes and all custody documentation will be received and kept in the central files. The original CoC forms will remain with the samples until final disposition of the samples by the laboratory. The analytical laboratory will dispose of the samples in an appropriate manner 60 to 90 days after data reporting. After sample disposal, a copy of the original CoC will be sent to the Project Manager by the analytical laboratory to be incorporated into the central files.

ORIGINS LABORATORY, INC

www.originslaboratory.com

page ____ of ____

1725 Elk Place | Denver, CO 80211 | Phone: 303.433.1322 | Fax: 303.265.9645

Client: ____ Project Manager: ____

Address: ____ Project Name: ____

Project Number: ____

Telephone Number: ____ Samples Collected By: ____

Email Address: ____

Sample ID Description	Date Sampled	Time Sampled	# of Containers	Preservative				Matrix				Analysis	Sample Instructions
				Unpreserved	HCl	HNO_3	Other	Groundwater	Soil	Air Summa Canister #	Other		
													1
													2
													3
													4
													5
													6
													7
													8
													9
													10

Relinquished By:	Date:	Time:	Received By:	Date:	Time:	Turnaround Time:
						Same Day ○ 24 Hr ○
Relinquished By:	Date:	Time:	Received By:	Date:	Time:	48 Hr ○ 72 Hr ○
						Standard ◉

Date Results Needed ____

STANDARD OPERATING PROCEDURE #12
FIELD DOCUMENTATION

SOP Preparation/Revision Date: December 2013

Several types of documentation will be prepared in the field to record information concerning soil borings, well installation and sampling related activities. These will include field logbooks, boring logs and those forms referenced in previous SOPs. Protocol for sample documentation is provided in SOP #11.

Boring Logs - A complete and accurate log entry for each soil boring will be prepared and entered onto a separate boring log. These boring logs will be considered the primary location to record information obtained during drilling. Each log will include the name of the project, hole number, location of boring, type of sampling device, diameter of boring, location and number of each sample, types of sampling equipment, groundwater information, and description of materials. Soil materials will be visually classified using the USCS. Soil descriptions will follow ASTM D 2488-84, etc. Descriptions will be based on visual inspection of the material in the field (refer to SOP #5).

Field Logbook - The field geologist will record field observations and readings in a bound notebook. This will be done so that the logic of decisions may be traced, or data comparisons may be accomplished once off-site analytical results become available. In addition, the logbook is the legal document for field activities. Indelible ink will be used for entries. Each page must be signed and dated by the preparer. A brief listing of pertinent data to be recorded in the field notebook includes, but is not limited to the following:

- Date/time
- Sample location
- Weather information
- Instrument calibration data
- Brief descriptions of sample matrices, including any observations
- The number of samples obtained, ID numbers, number and type of containers used, preservation methods used
- Comments, remarks about field activities
- Sampler's name and initials

STANDARD OPERATING PROCEDURE #13
INSTRUMENT CALIBRATION AND MAINTENANCE

SOP Preparation/Revision Date: December 2013

Electronic equipment used during groundwater sampling includes a multi-parameter field water quality instrument (YSI 556 [see YSI 556 Operation Manual], or equivalent) with a flow-through cell, turbidity meter (Hach 2100P [see Hach 2100P Instrument and Procedures Manual], or equivalent) and a water level measurement probe. Before going into the field, the sampler shall verify that these instruments are operating properly. The water quality instrument requires calibration prior to use every day. Calibration will be according to the manufacturer's instructions.

Air monitoring equipment will consist of a Mini-Rae 2000 photoionization detector (PID) equipped with a 11.7 millivolt lamp. The PID is calibrated using 100 ppm isobutylene, which is supplied in pressurized canisters. The PID should be calibrated before use each day.

Where equipment cannot be repaired in the field or consumables have been prematurely depleted or irreparably contaminated, site personnel will contact suppliers and order replacement parts, replacement equipment, or supplies for prompt delivery. Parts and supplies must meet or exceed the original equipment manufacturer's recommended specifications. Site personnel will make every effort to have enough equipment and supplies on hand for the planned activities.

Equipment List
Spray bottle w/ clean potable water
Waste bucket
Calibration standards:

For Water Quality Instrument:	pH 7 and 10 buffer solutions
	1.413 milliSeimens/cm conductivity solution,
	Range of turbidity standards (e.g., 1.0, 20, 200, and 800 NTU standards)
For Air Monitoring Instrument:	100 ppm Isobutylene canister with regulator valve; 1-liter Tedlar bag

Water Quality Instrument Calibration Procedure – The instrument User Manual should be read before using the unit. If a hard copy is not available, a "pdf" file containing the manual is available at the manufacturer's website for download. The following steps are an adaptation of the calibration instructions contained in the manual; the user should become thoroughly familiar with the manual calibration instructions.

The YSI 556 should be turned on at least 10 minutes prior to calibration to allow the circuits to equalize. The sensor cover is a container that screws on over the sensors.

pH Sensor Calibration: Remove the cover and pour about ¾ inch of pH 7 buffer in the cup, and screw it back on the sensor head. Agitate the sensor to coat the sensors with the solution. Unscrew the cup and discard the solution in a sink or other container. Pour more pH 7 buffer solution in the cup to the half-way mark. Replace the cup on the sensor head. Agitate lightly. Observe the reading; after the reading stabilizes, record the reading in the field logbook under a heading for the calibration event, noting the instrument name and serial number.

Pour out the buffer solution, and rinse the sensors with clean water. Pour ¾ inch of pH 10 buffer in the cup. Screw the cup onto the sensor head. Agitate, coating the sensors with solution. Discard the solution. Pour more pH 10 buffer solution in the cup to the half-way mark. Replace the cup on the sensor head. Agitate lightly. Observe the reading; after the reading stabilizes, record the reading in the field logbook. If either of the pH readings vary by more than 0.1 units, perform a Calibration sequence. The pH calibration sequence is initiated by accessing the Calibration mode using the navigation buttons on the instrument. Perform the sensor rinse with the pH 7 buffer, and then refill the cup halfway with buffer solution, and replace on the sensor head.

The instrument requires a minimum two-point calibration. Enter the value of the first calibration standard (7.0). The instrument readout will appear as in normal operation except the word Calibrate is displayed at the top. When the reading has stabilized, press "Enter" on the keypad. The pH reading should read 7.0. Press "enter" again and the instrument will ask for the 2nd calibration value (10.0). First perform the sensor rinse and refill the cup halfway with pH 10 buffer solution, then enter the standard value (10.0). After the reading has stabilized, press "Enter" to calibrate and then press "Enter" again. Use the "escape key to back out of the calibration menu. Re-check the pH calibration by repeating the check as performed prior to calibration. Document the calibration in the field logbook.

Conductivity Sensor Calibration: Repeat the sensor rinse with clean water, and then rinse with the conductivity standard solution. Refill the cup halfway with the conductivity solution and replace over the sensor head. Note the reading and record in the logbook, along with the temperature reading. The solution conductivity value is specific to standard temperature (25°C), so if the solution temperature is lower or higher, the conductivity reading will vary from 1.413 mS/cm. A temperature correction chart may sometimes be obtained along with the calibration solution. Many of the newer models of YSI 556 include a readout for uncorrected conductivity and also specific conductivity, which is the conductivity value corrected to 25°C. This readout should always read 1.413 mS/cm in the solution, while the other will read an actual value. If the conductivity reading varies by more than 0.1 mS/cm from the expected value, note the reading and perform a calibration sequence. Perform the sensor rinse with the conductivity standard, and then refill the cup halfway with buffer solution, and replace on the sensor head. When the reading has stabilized, press "Enter" on the keypad. The reading should show the expected value. Press "enter" again and the instrument will return to the calibration menu. Back out of the menu and re-check the calibration reading. Document the sensor check and calibration in the field logbook.

Calibration of additional sensors, if the instrument is so equipped, follows the same procedure described above for pH and conductivity. The only exception is the temperature sensor. A scientific alcohol thermometer should be used to check the temperature sensor operation. Note all calibration steps in the field logbook.

Water Quality Instrument Maintenance –The YSI 556 MPS should be stored at room temperature or close to it when not in use. The unit is powered by four C-size batteries. When turning the instrument off, replace the sensor head protective cover. Make sure there is about ½ inch of potable water in the cup before screwing it on the head. This keeps the sensor probes from drying out and losing effectiveness. Distilled water is not recommended for probe storage.

Since the YSI 556 MPS units used are procured from an equipment rental vendor, the sensors are typically well-maintained and in good working order. In the event of equipment malfunction to the point

where one or more of the sensors will not calibrate, a replacement unit should be requested immediately from the supplier.

Turbidimeter Calibration Procedure – The Hach 2100P rental units used in the field are supplied with a kit of Gelex calibration check standards of various turbidity values. Typically these are supplied in sealed vials and can be re-used through out the field survey, and are returned with the unit to the supplier. The Gelex standards are used to field check calibration. Formazin standards are used for calibration. The manufacturer recommends use of Hach StablCal Stabilized Formazin for calibration (Kit w/ 20-,100-, and 800-NTU sealed vials, Cat. No. 26594-05). Standards may also be ordered in 500-mL bottles. A (nominal) zero-value standard is also required (<0.1 NTU StablCal® Stabilized Formazin Standard, 100 mL, Cat. No..26597-42).

Detailed calibration instructions are contained in the Hach 2100P User Manual. If a hard copy is not available, a "pdf" file containing the manual is available at the manufacturer's website for download.

Turbidimeter Maintenance – The turbidimeter should be stored at room temperature. The unit is powered by four AA-size batteries. The Hach 2100P is not waterproof. If used in the field during rain events, care must used to keep excessive water from splashing onto the unit.

PID Calibration Procedure – The Mini-Rae 2000 PID is calibrated using a 100-ppm isobutylene gas, supplied in a pressurized canister. A regulating valve is used to dispense the gas.

The PID should be turned on and allowed to operate in survey mode for at least 10 minutes before performing a calibration check. Calibration check is performed by filling a 1-liter Tedlar bag with calibration gas, and then attaching the flexible tubing from the Tedlar bag to the PID probe tip. Slight hand pressure is maintained on the Tedlar bag to keep the gas flowing steadily. Instrument response should occur within a few seconds of attaching the tubing. Note the reading in the field logbook. If the reading varies by more than a few percent from the expected value, perform a calibration procedure.

Calibration is performed by placing the unit in Calibration mode by menu navigation using the keypad. Once in calibration mode, the unit will confirm that the calibration gas is 100 ppm isobutylene. After confirming, connect a full Tedlar bag of 100 ppm isobutylene to the probe tip and confirm the "Start Cal" prompt. The unit will prompt when calibration is complete. Disconnect the Tedlar bag. Return the unit to Survey Mode. Re-check the calibration. Document the calibration in the field logbook.

Mini-Rae 2000 PID Maintenance – The PID should be stored at room temperature. The unit is powered by a rechargeable battery pack, which should be re-charged daily. The ionizing chamber lamp is subject to fogging in damp or humid environments. A moisture trap is typically supplied with each unit; this is an in-line filter module that attaches to the probe tip.

STANDARD OPERATING PROCEDURE #14
ACM AND LBP TESTING

SOP Preparation/Revision Date: December 2013

RMC may conduct an asbestos and LBP survey during Phase II activities. Observations and interviews conducted during the Phase I will assist in providing additional details regarding the potential for the presence of asbestos and/or LBP in any site structures. The proposed number of samples will be determined during the preparation of the site-specific FSP. One of RMC's licensed asbestos professionals, accredited by the EPA under the AHERA and certified by the Colorado Department of Public Health and Environment (CDPHE) as an Asbestos Building Inspector, will sample potential ACM and submit samples to a subcontract laboratory (to be determined) for ACBM bulk sample analysis. ACM is defined by state and federal regulations as "any material that contains greater than 1% asbestos." All suspect ACM sampled during the inspection will be analyzed by Polarized Light Microscopy (PLM), EPA Method 600/M4-82-020. An RMC representative, who is an EPA certified LBP inspector, will also collect potential LBP samples and submit samples to an appropriate laboratory (to be determined).

RMC will inventory all suspect interior and exterior painted surfaces and all suspect building materials with potential asbestos content during a visual inspection. Each suspect paint or building material will be inventoried by age, condition, quantity, type/color, location, and friability. Using this information, the various paints and building materials will be assigned sampling priorities.

Inspection for the presence of ACM and LBP will consist of the following:

- Visually examine accessible areas and identify the locations of suspect ACM and LBP.
- Collect and analyze representative bulk samples of materials suspected of containing Asbestos and samples of suspected LBP.
- Document ACM and LBP quantities.
- Generate a final report documenting sample locations, analysis results, conditions, ACM and LBP quantities, and recommendations.

The Asbestos Hazard Emergency Response Act (AHERA) regulations specify sampling density protocol based on the quantity and type of material. Selected sample locations will be representative of the various homogeneous materials. RMC inspectors will collect samples at selected locations using a random sampling scheme. As destructive testing is outside of the scope of many projects, samples will be collected in obscure or hidden locations whenever practical, which does limit the definition of a randomly selected sample location. Suspect homogeneous materials will be sampled to determine if they contain asbestos or are non-asbestos materials. Homogeneous areas/materials will be determined using visual observations made in the field regarding material appearance, texture, size, color, construction era, and/or manufacturers' labels.

At the point of sample collection, the ACM and LBP samples will be placed in a sample container and coded by the inspector. The sampling tool will then be cleaned to prevent contamination of subsequent samples. Any debris will be cleaned up and sealed in plastic for disposal.

STANDARD OPERATING PROCEDURE # 15
BOREHOLE ABANDONMENT

SOP Preparation/Revision Date: December 2013

Material and Equipment Needs

Personal protective equipment (PPE) as outlined in the HSP
Grouting materials and equipment (potable water, bentonite powder, bentonite chips, cement for grouting [portland type II or IV], large tank for mixing grout, trash pump for mixing grout, plastic or steel tremie pipe)

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to seal and abandon boreholes at the Phase II sites. The objective of abandonment is to eliminate the potential vertical pathway to the subsurface associated with boreholes. Abandonment will be performed at the Phase II sites following the drilling and sampling of direct push soil borings and temporary monitoring wells. Direct push boreholes drilled for collection of subsurface soil samples will be abandoned immediately following sampling and/or data collection. The following steps will be performed to abandon a borehole in accordance with applicable State of Colorado regulations regarding test hole/borehole abandonment and specifically the State Engineers Office RULE 16 STANDARDS FOR PLUGGING, SEALING, AND ABANDONING WELLS AND BOREHOLES:

> Borings will be abandoned by filling each test hole with high solid bentonite grout to within five (5) feet of the ground surface. For temporary monitoring wells, the PVC screen and riser will be pulled from the borehole prior to grouting and disposed of as solid IDW. Grouting will be completed using a tremie pipe from the total depth of the penetration to ensure proper abandonment of the test hole. Cement grout will consist of 90 percent Portland cement and 10 percent by volume bentonite powder mixed with clean water at a ratio of no more than seven gallons for 100 pounds of cement and bentonite. Settlement of the grout shall be checked 24 hours after it is placed. For the remainder of the test hole, medium bentonite chips will be poured directly into the test hole and hydrated with a minimum of 5 gallons of potable water. This will ensure that the permeability of the test hole will be greater than the permeability of the surrounding cap.