

Scope of Work

Phase 2: WDEQ 2014 Pavillion, Wyoming Investigation and Final Report

Objective: In close coordination and consultation with the Wyoming Department of Environmental Quality (WDEQ) Water Quality Division (WQD) and upon review of existing documents and data as directed by WDEQ, the Consultant will assist with fulfilling the requirements of the June 20, 2013 framework document (Attachment A) by completing the tasks detailed in this Scope of Work (SOW), including preparation of a final report. The project focuses on water quality in thirteen (13) domestic use wells (study wells) in the Pavillion area.

Tasks:

1. Generally describe the nature of the complaint that initiated the groundwater investigation and brief chronology and description of groundwater sampling, reporting, and other response actions (e.g. cistern installation, WDEQ/EPA/Encana Framework agreement, etc.) in response to that complaint.
2. Generally describe the geology, hydrogeology, land uses, groundwater quality, and known and potential sources of contamination within the study area.
3. Describe and/or illustrate the chronological development of natural gas wells and water wells within one-quarter (1/4) mile of each of the study wells.
4. Based upon published water quality data collected from the Wind River Formation prior to development of natural gas in the study area, or other available data that represents natural background (baseline) water quality, evaluate and describe the suitability of water drawn from the formation for Domestic, Agricultural, Livestock, or Industrial use in accordance with WDEQ/WQD's numeric and narrative standards (Water Quality Rules and Regulations, Chapter 8).
5. Incorporate into the Reports the status of the formation as an Underground Source of Drinking Water (USDW) as defined by WDEQ Water Quality Rules and Regulations. This will be provided to the Consultant by the WDEQ.
6. Review in their entirety the following documents. Evaluate and summarize the data, conclusions, and recommendations in the documents as they relate to the quality, palatability and safety issues of each of the thirteen (13) selected study wells.
 - a. Wyoming Oil and Gas Conservation Commission (WOGCC) Well Integrity Report (September 2014).
 - b. WOGCC Pits Evaluation Report (Final).
 - c. Pavillion Gas Well Integrity Evaluation, U.S. Environmental Protection Agency Region 8, July 25, 2013.
 - d. Pavillion Oil & Gas Field Pits Evaluation, U.S. Environmental Protection Agency Region 8, July 25, 2013.

7. Review the available analytical results for each of the thirteen (13) selected study wells. This includes analytical data (including QA/QC results) collected or developed by the Consultant for WDEQ, data reported or provided by EPA and Encana, data within WDEQ/WQD's Pavillion case file, and data within other reports and information highlighted on Attachment I. Describe the constituents¹ identified in the reports and potential sources discussed. Evaluate and describe the analytical data results, potential sources, and any summaries and or conclusions provided as they relate to the quality, palatability and safety issues of each of the thirteen (13) selected study wells. Identify any analytical data validation issues and any limitations this may place on the use of the data.
8. Review the additional data provided by the Wyoming State Engineer's Office (SEO), WOGCC, EPA, USGS, BLM, Northern Arapaho and Eastern Shoshone Tribes, Encana, and others (as requested by WDEQ). Describe the constituents identified in the reports and potential sources discussed. Evaluate and describe the analytical data results, potential sources, and any summaries and or conclusions provided as they relate to the quality, palatability, and safety issues of each of the thirteen (13) selected study wells. Create an index of all documents, files, meetings notes, and correspondence reviewed for the project (Tasks 6, 7, and 8) and provide it as an Appendix in the Reports.
9. For each sampling event for which valid sample data exists in the study wells, and applying WDEQ/WQD's Domestic use standards and/or action levels (Refer to Attachment A to the Framework), develop tables of the analytical results for all constituents identified. Four different categories of constituents shall be identified: constituents that were not detected; constituents detected below standards; constituents detected but, for which, there is no standard, and; constituents that were detected above standards. Individual tables will be created for each study well.
10. For each sampling event of the study wells for which analytical data exists, where a constituent exceeds WDEQ/WQD's Domestic use standards and/or action levels (Refer to Attachment A to the Framework), identify and describe:
 - Whether the constituents are naturally occurring and, if so, describe the natural variation in constituent concentrations (background) for the study area;
 - The common consumer, commercial, and industrial products that contain the constituent(s);
 - How those products are used, and how and where the constituent(s) may have been introduced into the environment, specifically into groundwater, and;
 - An assessment of pathways and conditions by which those constituent(s) may have migrated into the well(s).
 - a. If oil and gas related constituents, including volatile and semi-volatile organic compounds (VOCs and SVOCs) and Diesel Range and Gasoline Range organic compounds (DRO and GRO), are identified above Domestic use standards and/or

¹ Any analyte or measurement for which WDEQ/WQD has developed or otherwise recognizes a standard.

action levels, a review and evaluation of potential sources of contamination, including oil and gas activities, will be completed.

- b. If analytical results exceed Domestic use standards and/or action levels for constituents thought to be unrelated to oil and gas activities or are naturally occurring, a review and evaluation of land uses and potential sources of contamination will be completed. This review and evaluation will include, but not be limited to, agricultural practices, domestic water well and septic operation and maintenance, vehicle and equipment maintenance, fuel storage, solid waste disposal, and any other activities that might impact groundwater and/or domestic water wells.
11. For each of the study wells where a constituent has exceeded WDEQ/WQD's Domestic use standards and/or action levels (Refer to Attachment A to the Framework), identify and describe the potential palatability, safety, and/or health effects from using the water for all Domestic purposes.
12. For each of the study wells where a constituent exceeds WDEQ/WQD's Domestic use standards and/or action levels (Refer to Attachment A to the Framework), identify and describe the appropriate response(s) to reduce and/or eliminate palatability, safety, and/or health effects, the recommended type of response, and basis to support the recommendation.
13. For each of the study wells where a constituent exceeds WDEQ/WQD's Domestic use standards and/or action levels (Refer to Attachment A to the Framework), assist the WDEQ in working with each individual landowner (that allowed sampling during Phase I) to determine the causes and sources of quality, palatability, and safety issues and/or well contamination identified in each well. To the extent practical, identify the known or potential source(s) of contamination based on the currently available data and, together with WDEQ staff, meet with the well owner to discuss this information. Provide a summary of the information discussed with the well owner(s) and the outcome of the meeting with the well owner(s) in the Reports.
14. For each of the study wells, identify and describe any data gaps that preclude the determination of the source of any constituent(s) identified in the study wells that exceed WDEQ's standards and/or action levels (Refer to Attachment A to the Framework) for Domestic use/suitability, including descriptions of what data is needed, why it is necessary, methods for obtaining the data, and specific recommendations for additional testing, analysis, and/or investigation to obtain the data.
15. Compile the deliverables from the Tasks above and from Phase 1, into a Preliminary Draft Report, Final Draft Report, and Final Report according to the Process described below. At a minimum the Reports shall include :
 - A description of the Phase 1 water well sampling, the field methods used, any issues with data collection, complete field notes and documents, site

photographs, analytical laboratory data reports and documents related to quality assurance and quality control review of the laboratory data;

- Applicable site maps, tables, and other pertinent data, which may include, but not be limited to, stratigraphic cross sections, iso-concentration maps of up to five (5) selected parameters as determined by WDEQ;
- A time series map(s) showing the development of the gas field versus water well installation and home construction;
- Water well construction diagrams and other pertinent data from SEO files and;
- A summary of the downhole video field work with an evaluation of the data collected.

16. The Reports will be of sufficient technical accuracy and scientific completeness to fulfill industry standard requirements for environmental documents. An outline of the Final Report content will be provided to the WDEQ for review and approval prior to development of the Preliminary Draft Report.
17. Provide periodic, timely communication with the WDEQ for project updates and approvals, including: Gantt-type project management chart and/or spreadsheets for financial tracking and planning; regularly scheduled weekly conference calls; and verbal, email or other written updates as deemed necessary by the WDEQ.

Process: The Consultant and WDEQ will coordinate in developing the Reports as follows:

1. Upon Consultant's completion of a Task outlined above, and prior to developing a Preliminary Draft deliverable document, the WDEQ and Consultant will collaborate on the issues, topics and recommendations to be included in the deliverable for each Task.
2. The Consultant will prepare the Preliminary Draft Report. Within 130 days after the notice to proceed for Phase 2 of the Pavillion Project is given, the Consultant shall deliver to the WDEQ one original (to Cheyenne) and two (2) additional hard copies (to Lander) of the Preliminary Draft Report, including a digital (CD or other media) version for each set. The Consultant will make all reasonable efforts to submit the Preliminary Draft Report as early as possible to the WDEQ.
3. WDEQ will review and discuss the Preliminary Draft Report with the Consultant, and develop edits and changes to the draft. The WDEQ intends to provide comments within 20 days of receipt of the Preliminary Draft Report, however in the event that the WDEQ does not, subsequent milestone dates will be adjusted accordingly.
4. Within 10 days following receipt of the WDEQ comments, the Consultant will revise the Preliminary Draft document per WDEQ instructions and incorporate the revised document into the Final Draft Report for review and comment by others. Five (5) hard and digital copies of the Final Draft Report will be delivered to the WDEQ. Three (3) copies will be sent to the Cheyenne office and two (2) copies will be sent to the Lander office.
5. In collaboration with WDEQ, the Consultant will review and evaluate the comments on the Final Draft Report, revise the document per WDEQ instructions, and incorporate the

edits into the Final Report. Four (4) hard and digital copies of the Final Report will be delivered to the WDEQ within 14 days following receipt of the WDEQ comments. Two (2) copies will be sent to Cheyenne and two (2) copies will be sent to Lander.

All work shall be performed in accordance with plans, schedules, and procedures developed by the Consultant and approved by WDEQ/WQD.

The Consultant, in cooperation with the WDEQ, is responsible for identifying needed additional resources, experts, etc. to ensure the project timeline, budget, and scientific goals and integrity are met. If the Consultant determines that a third party is required to assist with fulfilling this scope of work, the Consultant shall be responsible for subcontracting, and managing sub-contractors to ensure timely project completion. The Consultant shall provide vetting information of suggested sub-contractors to WDEQ/WQD for screening and approval. The WDEQ/WQD retains final approval authority for all sub-contractors.

ATTACHMENT G
Phase 2 Schedule

Pavillion, WY 2014 Groundwater Investigation Phase 2: Evaluation

**Phase 2
Evaluation
Schedule*
(Notice to
Proceed =
Day 1)**

	SOW Task	Budget Task	Project Task as related to AME draft Budget Summary Spreadsheet for Phase 2	Deliverable Day	Deliverable Date	Milestones
Notice to Proceed					1/15/2015	
Upon receipt of NTP	Task 6	Task 1	Review WOGCC Well Integrity Report Review completed and documented in Final Draft Report to WDEQ			Review by expert to begin upon receipt of NTP. Subcontract Well Integrity expert to complete review within 45 days.
Upon receipt of NTP	Task 6	Task 1	Review WOGCC 2014 Pits Report Review completed and documented in Final Draft Report to WDEQ			Review by AME to begin upon receipt of NTP. Unable to forecast time needed for review without having seen report.
	Task 7	Task 1	Attachment C Document Review Review and documented in Final Draft Report to WDEQ	Notes from each individual document review will be provided to Wyoming as it is completed.		Review to begin upon receipt of NTP, first document reviews to WDEQ within 45 days of NTP.

	Task 1-17	Task 2	Data Analysis				AME review to begin on receipt of WOGCC Rpt review from expert & both sampling event results. Length of review time needed contingent on results of findings of both items.
	Task 13	Task 3		Prepare Summary Report and Meeting with WDEQ and Well Owners			
ongoing, ~ weekly & monthly	Task 17	Task 4	Progress Reporting	Progress Reporting (provide weekly project status conference calls with WQD, monthly schedule updates using Gantt-type time management tools, and monthly financial spreadsheet updates).			
		Task 5		Preliminary Draft Report list of contents to WDEQ for review and comment	Day 130	2/14/2015	AME to provide to WDEQ for review and comment
	Task 1-17	Task 5	Preliminary Final Draft Report	Preliminary Final Draft Report to WDEQ for review	Day 130	5/25/2015	AME to begin reviewing and writing report per Phase 2 SOW upon receipt of NTP.
	Task 15	Task 5	Preliminary Final Draft Report	WDEQ comments on Preliminary Final Draft Report to consultant	Day 130 +20	6/14/2015	
	Task 15	Task 6	Final Draft Report	Consultant revises and provides Final Draft Report to WDEQ, EPA and Encana for 30 day review	Day 130 + 40	7/4/2015	
	Task 15	Task 6	Final Draft Report	WDEQ, EPA and Encana comments on Final Draft Report to consultant	Day 130 + 70	8/3/2015	
	Task 15	Task 7	Final Report	Consultant (and WDEQ) address comments and provides Final Report for Public Review	Day 130 + 100	9/2/2015	
		Task 8		Collaboration			As Needed

*Phase 2 Evaluation schedule is predicated on the following critical path items:

- Assumes 01/15/2015 Phase 2 NTP provided to AME from WDEQ.
 - Attachment I documents are readily available to Consultant and WDEQ geospatial data on Pavillion groundwater and oil and gas development is provided to Consultant in electronic/GIS format.
 - Attachment I total of other documents not otherwise specified is 500 pages or less.
 - WOGCC Well Integrity and Pits Reports are approximately 1,000 or fewer pages of information, each.
 - Well Integrity expert provides opinion/review report within 45 days of receipt of WOGCC report.
 - Geospatial data in the WOGCC Reports is provided to Consultant in electronic/GIS format.
 - Draft Final Report provided by WDEQ to EPA and Encana for 30 day review.
 - EPA and Encana comments on Final Draft Report provided by WDEQ to Consultant.
- DEQ will provide timely review of a) draft report list of contents and b) collaboration items. DEQ review time period will be defined within the email transmittal of each item for review.

ATTACHMENT H
Phase 1 and 2 Budget Summary

ACTON MICKELSON ENVIRONMENTAL, INC.
BUDGET SUMMARY

	Tasks	2014
	Sampling – Phase 1	
1s	SAP, QAPP, HASP	\$ 6,914
2s	Kickoff Meeting	\$ 4,823
3s	Site Reconnaissance	\$ 16,057
4s	Ancillary Data Acquisition and Compilation	\$ 4,260
5s	Sampling Preparation and Collection	\$ 332,370
6s	Data Validation and Electronic Data Entry	\$ 57,390
7s	Downhole Video-Recording Workplan Addendum	\$ 1,852
8s	Downhole Video-Recording	\$ 64,359
9s	Interview Well Owners	\$ 11,549
10s	Project Reports	\$ 10,511
11s	Project Reports - Preliminary Report No. 3	\$ 42,240
12s	Progress Reporting	\$ 8,037
	Subtotal Sampling	\$ 560,363
	Evaluation – Phase 2	
	Attachment A Document Review (including Well Integrity and Pits Report)	\$ 79,936
	Data Analysis	\$ 99,917
	Prepare Summary Report and Meet with WDEQ and Well Owners	\$ 16,355
	Progress Reporting	\$ 7,632
	Prepare Preliminary Draft Report	\$ 36,541
	Prepare Final Draft Report Based on Comments	\$ 8,683
	Prepare Final Report Based on Comments	\$ 8,683
	Collaborate with WDEQ During Evaluation Phase	\$ 4,998
	Subtotal Evaluation	\$ 262,745
	Force Account	\$ 40,264
	TOTAL	\$ 863,372

ATTACHMENT I
Document Review List

ATSDR, August 2010 - Evaluation of Contaminants in Private Residential Well Water, Pavillion, Wyoming, Fremont County

Bureau of Reclamation, 1951 – Annual Project History for Riverton Project

Bureau of Reclamation, Robert Autobee, 1996 – Riverton unit Pick-Sloan Missouri Basin Project

Encana, October 2013 – Data Summary

Encana, October 2013 – Well Location Information

Smith-Comeskey Groundwater Science LLC, January 2013 – Report on US EPA’s Investigatory Approach to Palatability Issues in Domestic Wells Near Pavillion, WY

Gores and Associates, October 2011 – Pavillion Area Water Supply, Level I Study Final Report

Gorody, Anthony, PhD, June 2008 – Case Study, Louis Meeks Water Well 9/04 to 11/07

Johnson, Ronald and Rice, Dudley, 1993 – Variation in Composition and Origins of Gases from Coal Bed and Conventional Reservoirs, Wind River Basin, Wyoming (USGS Special Symposium)

Stephens, Daniel B., August 2014 – Analysis of the Groundwater Monitoring Controversy at the Pavillion, Wyoming Natural Gas Field, *Groundwater*, National Groundwater Association

US EPA, August 2009 - Site Inspection - Analytical Results Report: Pavillion Area Groundwater Investigation Site, Pavillion, Fremont County, Wyoming, URS Operating Services, Inc. (Phase I).

US EPA, August 30, 2010 - Expanded Site Investigation - Analytical Results Report: Pavillion Area Groundwater Investigation, Pavillion, Fremont County, Wyoming, URS Operating Services, Inc., (Phase II).

US EPA, November 8, 2011 - Ground-Water Quality Investigation - Pavillion, Wyoming, U.S. Environmental Protection Agency, Methods, Graphics, and Data Tables, (Phases III and IV).

US EPA, December 2011 – DRAFT Investigation of Groundwater Contamination near Pavillion, Wyoming, EPA 600/R-00/000

US EPA, December 2012 – EPA Briefing to the American Petroleum Institute

US EPA, August 2013 – Pavillion Oil and Gas Field Pits Evaluation

US EPA, August 2013 – Pavillion Gas Well Integrity Evaluation

USGS, 1959 – Ground-Water Resources of Riverton Irrigation Project Area, Wyoming

USGS, 1969 – Groundwater Resources of the Wind River Indian Reservation Wyoming

USGS, 1993 – An Assessment of In-Place Gas Resources in Low-Permeability Upper Cretaceous and Lower Tertiary Sandstone Reservoirs, Wind River basin, Wyoming

USGS, 1996 – Water Resources of the Wind River Indian Reservation, Wyoming

USGS, March 2000 – Pesticides in Ground Water - Fremont County, Wyoming, 1998-99

USGS, 2012 – Sampling and Analysis Plan for the Characterization of Groundwater Quality in Two Monitoring Wells near Pavillion, WY, Open File Report 2012-1197

USGS, 2012 – Groundwater-quality and quality-control data for two monitoring wells near Pavillion, Wyoming, April and May 2012. USGS Data Series 718

WDEQ Pavillion Case Files

WGS/USGS, 2011 – Geologic Background Wind River Formation

WOGCC, September 2014 – Pavillion Gas Well Integrity Report

WOGCC, PENDING – Pavillion Oil and Gas Field Pits Report

Other data provided to the WDEQ/WQD by the Wyoming State Engineer's Office (SEO), WOGCC, EPA, USGS, BLM, Northern Arapaho and Eastern Shoshone Tribes, Encana and others upon request.

Yellow highlight = reports for detailed review. The review will evaluate and assess the data and conclusions presented in each report as it pertains to the 13 selected domestic wells and consider the suitability of incorporating these data and conclusions into the final report.

Non highlighted = reports that are primarily for information and/or reference.