Golder Associates Inc.
44 Union Boulevard, Suite 300
Lakewood, CO USA 80228
Telephone: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

PHASE 3 LONG-TERM PUMPING TEST DATA REPORT
PIÑON RIDGE PROJECT
MONTROSE COUNTY, COLORADO

Submitted to:

Energy Fuels Resources
44 Union Boulevard, Suite 600
Lakewood, Colorado 80228

Submitted by:

Golder Associates Inc.
44 Union Boulevard, Suite 300
Lakewood, Colorado 80228

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EXECUTIVE SUMMARY

Energy Fuels Resources Corporation (EFRC) is in the process of completing designs for a new uranium mill, termed the Piñon Ridge Project (the Site), located in Montrose County, Colorado. Golder Associates Inc. (Golder) was contracted to provide groundwater characterization and groundwater supply work for the Site.

In an effort to locate potential groundwater sources within the Site, a program consisting of drilling a series of groundwater exploratory holes (EX-series) was initiated by EFRC in the spring of 2008. Initially, six exploratory holes were drilled (EX-2 to EX-7). Three (3) of those exploratory holes (EX-5, EX-6 and EX-7) encountered water and were earmarked for short-term pumping tests. In addition to these exploratory holes, monitoring well MW-6 installed in 2007 by Kleinfelder West Inc. (Kleinfelder) also intercepted water. Short-term, variable-rate pumping tests were performed at EX-5, EX-6, EX-7 and MW-6 in April 2008 as part of the Phase 1 program conducted by Golder. Results of these tests are summarized in a technical memorandum to EFRC dated May 14, 2008 (Golder, 2008a).

Following the four initial pumping tests at EX-5, EX-6, EX-7 and MW-6 (Phase 1), additional exploratory holes (EX-8 through EX-15) were drilled in May 2008. Each of these holes encountered water near the contact between the Chinle and Moenkopi Formations. However, during drilling, estimated water-production potentials at EX-9, EX-13, and EX-14 were too low to merit additional testing (i.e., less than 5 gallons per minute). Short-term, variable-rate pumping tests were performed at EX-8, EX-10, EX-11, and EX-12 in May 2008 (Phase 2). The results of these tests are summarized in a technical memorandum to EFRC dated June 6, 2008 (Golder, 2008b).

Of the eight wells tested during the Phase 1 and Phase 2 programs, locations proximal to exploratory holes EX-6, EX-8, and EX-12 were selected as having the most favorable groundwater production potential, and considered for long-term pumping tests. In May and June of 2008, two observation wells were installed near each of the three selected exploration boreholes to observe aquifer response to pumping and aid in additional aquifer characterization at these locations. In July 2008, production wells were drilled near each of the selected exploration boreholes (PW-1 near EX-6, PW-2 near EX-8, and PW-3 near EX-12).

In August 2008, Golder conducted 48-hour constant-rate pumping tests on proposed water supply wells PW-1, PW-2 and PW-3. Analysis of drawdown and recovery data from pumping and observation wells during the three tests yielded similar results for hydraulic conductivity (approximately 3×10^{-3} cm/s).

Lower estimated storativity values for PW-1 and PW-2 (than for PW-3) suggest a confined aquifer, with a lower transmissivity. Elevated storativity from the PW-3 test suggests either an unconfined aquifer or fractured behavior, with a higher transmissivity. The assumption of a confined aquifer at wells PW-1 and PW-2, and an unconfined aquifer at well PW-3, is supported by evidence from the drilling logs.

During the PW-1 and PW-2 pumping tests, no response was observed at wells MW-3, MW-5, MW-6, MW-8, and MW-9 which are located between approximately 2,000 and 4,000 feet from the pumping wells. However, given the estimated radii of influence from each pumping test (developed with a Theis distance-drawdown method), we would not expect to observe drawdown in these wells as a result of our 48-hour pumping tests. Figure ES-1 presents the locations of the pumping wells, nearby observation wells, and estimated radii of influence.

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1.0 INTRODUCTION

Energy Fuels Resources Corporation (EFRC) is in the process of completing designs for a new uranium mill, termed the Piñon Ridge Project (the Site), located in Montrose County, Colorado. Golder Associates Inc. (Golder) was contracted to provide groundwater characterization and groundwater supply work for the Site.

During April and May 2008, Golder tested and evaluated the water supply potential of eight locations at the Site. Testing included short-term (6-hour) variable rate pumping tests to determine the presence and availability of water, and tentatively quantify aquifer properties. Golder conducted four of the short-term tests in April 2008 (Phase 1), and summarized the results in a technical memorandum to EFRC dated May 14, 2008 (Golder, 2008a). Following initial work, Golder tested four additional locations in May of 2008 (Phase 2) and summarized the results in a technical memorandum to EFRC on June 6, 2008 (Golder, 2008b).

The short-term testing programs assisted in selection of three locations which appeared to be the most favorable for groundwater production at the Site. In July, EFRC commissioned Gordan Smith Drilling Company to install three production wells at the Site at the selected locations. During August 2008, Golder conducted long-term (48-hour) constant-rate pumping tests on these production wells (Phase 3). This report summarizes the results of the Phase 3 testing program.

1.1 Objectives

The primary objectives of the long-term constant-rate pumping test program (Phase 3) at the three potential water supply wells included:

- Quantify the aquifer properties;
- Estimate long-term rates of groundwater pumping; and
- Provide further information about the hydrogeologic setting of the Piñon Ridge mill site, in particular, an estimation of the extent of the productive aquifer at the Site.

1.2 Background

In an effort to locate potential groundwater sources within the Site, a program consisting of drilling a series of groundwater exploratory holes (EX-series) was initiated by EFRC in the spring of 2008. Initially, six exploratory holes were drilled (EX-2 to EX-7). All groundwater exploratory drillhole and well installation locations are included in Figure 1. Three (3) of those exploratory holes (EX-5, EX-6 and EX-7) encountered water and were earmarked for short-term pumping tests. However, holes EX-2, EX-3, and EX-4 were dry. In addition to these exploratory holes, monitoring well MW-6 installed in 2007 by Kleinfelder also intercepted water. Short-term, variable-rate pumping tests were performed at EX-5, EX-6, EX-7 and MW-6 in April 2008 as part of the Phase 1 program conducted by Golder. Results of these tests are summarized in a technical memorandum to EFRC dated May 14, 2008 (provided for reference in Appendix A). The water bearing sandstone in these four pumping well locations was encountered at depths of 310 to 420 feet below the ground surface, and ranged in saturated thickness from 30 to 60 feet. Static water levels in these wells were typically 20 to 30 feet above the top of the water bearing sandstone, with the exception of EX-7 which was approximately 20 feet below (see Appendix A, Table 1).

Following the four initial pumping tests at EX-5, EX-6, EX-7 and MW-6 (Phase 1), additional exploratory holes (EX-8 through EX-15) were drilled in May 2008. Each of these holes encountered water near the contact between the Chinle and Moenkopi Formations. However, during drilling, estimated water-production potentials at EX-9, EX-13, and EX-14 were too low to merit additional testing (i.e., less than 5 gallons per minute). Short-term, variable-rate pumping tests were performed at EX-8, EX-10, EX-11, and EX-12 in May 2008 (Phase 2). The results of these tests are summarized in a technical memorandum to EFRC dated June 6, 2008 (provided for reference in Appendix B). Static water levels in the four wells tested varied between approximately 240 and 340 feet below ground surface (see Appendix B, Table 1).

Of the eight wells tested during the Phase 1 and Phase 2 programs, locations proximal to exploratory holes EX-6, EX-8, and EX-12 were selected as having the most favorable groundwater production potential, and considered for long-term pumping tests. In May and June of 2008, two observation wells were installed near each of the three selected exploration boreholes to observe aquifer response to pumping and aid in additional aquifer characterization at these locations. In July 2008, production wells were drilled near each of the selected exploration boreholes by Gordon Smith Drilling Company (PW-1 near EX-6, PW-2 near EX-8, and PW-3 near EX-12). These production wells were

completed using an air rotary method. The bit diameter for the first 24 to 27 feet of each of well installation was 12 inches, with 9-$^{5}/_{8}$-inch surface steel casing installed in this upper portion. The remainder of the well was drilled with an 8-¾-inch bit, with 6-$^{5}/_{8}$-inch steel casing installed. Table 1 summarizes the locations and installation details of the pumping wells and associated observation wells.

Three geologic formations were encountered at the production well locations: the Windgate Sandstone (fine-grained, cliff-forming sandstone); the Chinle Formation (siltstone with interbedded lenses of sandstone, shale, and limestone-pebble and clay pebble conglomerate); and the Moenkopi Formation (shale, sandy-mudstone, sandstone, and arkosic conglomerate). At the three production wells, the Windgate Sandstone overlies the Chinle Formation, and is between 50 and 120 feet thick. The Chinle Formation overlies the Moenkopi Formation and ranges in thickness from 210 to 340 feet at the three production wells (see Figures 2 to 4). The Chinle and Moenkopi Formations are known to exhibit fractures and fault zones that may affect the long-term water yield from the identified aquifer. The wells were screened across the contact between the Chinle and Moenkopi Formations, which was evaluated during the Phase 1 and 2 programs to be the most productive zone encountered. The production well annuluses were grouted with cement from 5 to 40 feet below the ground surface. Below 40 feet, the borehole was left open. No sand pack was placed in the wells. To prevent invasion of cement grout into the wellbore and sloughing of ground from above the screen, an annulus rubber packer was installed at the bottom of the grouted section (40 feet) and above the screened interval. Well construction diagrams, geophysical borehole data and geologic contacts for the three production wells are included in Figures 2 to 4.

Between August 5 and August 14, 2008, constant-rate pumping tests were conducted by Golder on proposed water supply wells PW-1, PW-2 and PW-3 for 48 hours. The results of this Phase 3 testing program are summarized in this report.

2.0 METHODS

Long-term (48-hour) pumping tests, followed by recovery observations of nearly the same duration, were conducted in order to estimate aquifer parameters, estimate the long-term water production potential, and characterize the hydrogeologic regime within and near the Site. Given information from shorter-term (6-hour) pumping tests previously conducted on the exploratory EX-series boreholes located near the newer production wells, a target pumping rate was selected that would adequately stress the aquifer and allow observation of significant drawdown in nearby observation wells, but which could be sustained for the length of the test without dewatering the production well below two-thirds ($^2/_3$) of the saturated thickness. During the pumping and recovery phases of the test, water levels in the observation wells and pumping wells were recorded with pressure transducers for use in data analyses.

Valley Pump Company of Montrose, Colorado was contracted to provide pump testing services. In well PW-2, a Goulds 33GS50, 5 horsepower, 4-inch diameter pump was used. For wells PW-1 and PW-3, a Goulds 65L10, 10 horsepower, 6-inch diameter pump was used. Prior to setting the pump, a Level Troll® 700 100-psi pressure transducer was taped approximately 3 feet above the intake for the pump. Personnel from Valley Pump Company placed the pumps in the wells using 2-inch diameter PVC piping. For each test, the pump was installed in the lower portion of the well screen, to allow maximum drawdown in the pumping well, as shown in Figures 2 through 4. Pressure transducers were also installed in the two observation wells and the nearest additional monitoring well (except for PW-3, which did not have any additional monitoring wells nearby) to monitor drawdown during the pumping tests. Besides monitoring water levels with transducers in observation wells and proximal monitoring wells, manual water levels were taken with an electric tape three times each day in all monitor wells within approximately one-half mile of each pumping well during the course of each test. The purpose of monitoring water levels in wells northeast of the pumping wells (Figure 5) was to help define the boundaries of the productive aquifer at the Site.

After setting the pump in the wells, pumping rates were adjusted to determine an optimal pumping rate for a constant-rate pumping test. Once an optimal rate was determined, water levels were allowed to return to static conditions prior to starting the constant-rate pumping test. Each well was pumped for 48-hours. During each test, a flow totalizer was used to monitor well discharge rates. Constant rates were maintained during the length of the tests at PW-2 and PW-3.

However, during the early stages of the PW-1 test, the initial pumping rate had to be reduced by 20 percent to eliminate the possibility of excessive dewatering of the aquifer. The pumping rates for the Phase 3 testing program are summarized in Table 2.

AQTESOLV software (Duffield 2007) was used to analyze the test data. To estimate saturated hydraulic conductivities, results from the pumping tests were analyzed using both the Theis equation (Theis 1935) and the Cooper-Jacob method (Cooper & Jacob 1946). The Theis equation is an analytic solution for transient flow to a fully penetrating well completed in a confined aquifer. The Cooper-Jacob method is a straight-line approximation of the Theis equation which also assumes that the aquifer is confined and the well screen fully penetrates the aquifer thickness.

Recovery data were analyzed using the Cooper-Jacob method by applying Agarwal's transformation to the time variable (Agarwal 1980). Analyses focused on drawdown and recovery in the observation wells for each test, as they are known to give the best estimates of storativity and transmissivity. Two groundwater samples were collected during each 48-hour test by EFRC personnel. The first sample was collected at least one hour after the beginning of the test to ensure adequate purging of the borehole. The second sample was collected close to the end of the test. Water quality parameters of pH, temperature, and conductivity were collected during the tests by Golder personnel. Once data is available, geochemical analyses will be conducted to improve the hydrogeologic characterization at the Site. A geochemical comparison of samples from the pumping wells, as well as near and distant monitor wells, may help delineate the extent of the productive aquifer at the Site. Additionally, samples collected at the beginning and end of the pumping tests will be compared to ascertain if different sources of groundwater are contributing during pumping periods.

3.0 RESULTS AND ANALYSES

This section provides the test results and hydrogeologic analyses conducted to support the Phase 3 groundwater supply study for the Piñon Ridge Project.

3.1 Pumping Test Analyses

Drilling logs from EX-6 and EX-8 (located near PW-1 and PW-2, respectively) note that water was first encountered near the Chinle-Moenkopi contact (see Appendix C). Static water levels in PW-1 and PW-2 are above this contact, suggesting a confined aquifer (Figures 2 and 3).

PW-1 was initially pumped at a rate of approximately 65 gpm. After 5 hours of pumping, the pumping rate was reduced to a sustainable rate of approximately 52 gpm. At the reduced pumping rate, the maximum observed drawdown in PW-1 was 45.6 feet, with 12.5 and 5.8 feet of displacement observed in observation wells A and B, respectively. The PW-1 aquifer testing well locations and drawdown observations are presented on Figure 6.

PW-2 was pumped at approximately 10.3 gpm for 48 hours. The maximum observed drawdown in the pumping well was 33.5 feet, with 2.6 feet of displacement observed in observation well A. No drawdown was observed in observation well B. MW-7 demonstrated 2.1 feet of drawdown during the test. The PW-2 aquifer testing well locations and drawdown observations are presented on Figure 7.

The drilling log from EX-12 (located near PW-3) does not identify the depth at which water was encountered. However, evidence from other pumping tests suggests that the most productive zone is near the Chinle-Moenkopi contact. The static water level in this well is near the Chinle-Moenkopi contact, suggesting an unconfined aquifer. PW-3 was pumped at a rate of 67.5 gpm, demonstrating a maximum drawdown of 54.2 feet. Observation wells A and B exhibited 8.2 and 2.0 feet of displacement, respectively. The PW-3 aquifer testing well locations and drawdown observations are presented on Figure 8.

3.2 Pumping Test Results

When data from the PW-1 and PW-2 pumping tests were analyzed using a Theis confined solution, the estimated storativity values (approximately 10^{-4}) agree well with the assumption of a confined

aquifer (10^{-3} to 10^{-5} as defined in Driscoll 1986). For these wells, the saturated thickness was assumed to be restricted to the Moenkopi Formation (i.e., 30 feet for PW-1 and 40 feet for PW-2), as no water was encountered in the overlying Chinle Formation. Estimated hydraulic conductivities for these wells are close to 3×10^{-3} cm/s (values ranging from 2.68×10^{-3} to 7.93×10^{-3} cm/s). Results of pumping test analyses are summarized in Table 3. All *AQTESOLV* analyses are included in Appendix D.

PW-3 pumping test data was analyzed with a Cooper-Jacob unconfined solution. Estimated storativity values for the observation wells (approximately 10^{-2}) agree with the characteristic of an unconfined aquifer at this location. A confined fractured aquifer may also behave like a homogeneous unconfined aquifer (Kruseman & de Ridder 2000). Given our knowledge of the geology at the Site, fractured behavior could be an alternative explanation for the apparent unconfined behavior at well PW-3. Assuming an aquifer thickness corresponding to the thickness of the Moenkopi Formation at this location (i.e., 80 ft) the estimated hydraulic conductivity values (ranging from 1.46×10^{-3} to 3.38×10^{-3} cm/s) are similar to those calculated for the PW-1 and PW-2 tests (see Table 3).

During the PW-1 pumping test, manual water level observations in wells MW-3 and MW-9, as well as pressure transducer water level observations in MW-5, demonstrated no response as a result of pumping. The maximum observed drawdowns during the PW-1 pumping test and estimated radius of influence are shown in Figure 6.

During the PW-2 test, no response was observed in wells MW-5, MW-6, MW-8, MW-9, or observation well B (i.e., PW-2 OB-B) (see Figure 7). During the PW-3 test (see Figure 8), no wells were monitored in addition to the nearby observation wells, as no monitor wells existed close enough to expect drawdown during the 48-hour test. Theis distance-drawdown plots were used to extrapolate an approximate radius of influence for each test at a time of 48 hours (see Appendix D). The radius of influence was estimated to be the distance at which the extrapolated drawdown was greater than 1 foot, which was deemed to be within the range of effects of possible external factors such as temperature and barometric fluctuations. The approximate radii of influence for the tests at wells PW-1, PW-2, and PW-3 were 1,000 feet, 650 feet, and 400 feet, respectively. The radii of influence are shown in Figures 6 to 8. The absence of observable response in the wells located to the northeast of pumping wells PW-1 and PW-2 (see Figure 5) appears to suggest that the productive aquifer does

not extend northeast towards the center of the Site. However, given the extrapolated radii of influence from the distance-drawdown plots, we would not expect substantial drawdown at any distant monitor wells after 48 hours of pumping. The tests conducted at wells PW-1 and PW-3 demonstrated slow recovery of water levels after termination of pumping (see Appendix D). This observation could suggest limited recharge to the aquifer. However, recovery may be slow in fractured systems, as the fractures serving as conduits to the majority of the flow may be dewatered, with a longer time-frame necessary to recover water from the matrix. Slow recovery of the pumping and observation wells may be a result of the combined effects of a limited areal extent of the aquifer, limited recharge, and the natural behavior of the fractured system.

4.0 SUMMARY AND RECOMMENDATIONS

Three 48-hour constant-rate pumping tests were performed on recently-installed production wells at the proposed uranium mill site in Montrose County, Colorado. These tests were conducted as part of an ongoing study to assess the long-term availability of water from on-site sources. Analysis of drawdown and recovery data from pumping and observation wells during the three tests yielded similar results for hydraulic conductivity (approximately 3×10^{-3} cm/s).

Lower estimated storativity values for PW-1 and PW-2 (than for PW-3) suggest a confined aquifer, with a lower transmissivity. Elevated storativity from the PW-3 test suggests either an unconfined aquifer or fractured behavior, with a higher transmissivity. The assumption of a confined aquifer at wells PW-1 and PW-2, and an unconfined aquifer at well PW-3, is supported by evidence from the drilling logs.

During the PW-1 and PW-2 pumping tests, no response was observed at wells MW-3, MW-5, MW-6, MW-8, and MW-9 which are located between approximately 2,000 and 4,000 feet from the pumping wells. However, given the estimated radii of influence from each pumping test (developed with a Theis distance-drawdown method), we would not expect to observe drawdown in these wells as a result of our 48-hour pumping tests.

5.0 USE OF THIS REPORT

This report has been prepared exclusively for the use of Energy Fuels Resources Corporation (EFRC) for the specific application to the Piñon Ridge Project. The engineering analyses reported herein were performed in accordance with accepted engineering practices. No third-party engineer or consultant shall be entitled to rely on any of the information, conclusions, or opinions contained in this report without the written approval of Golder and EFRC.

The site investigation reported herein was performed in general accordance with generally accepted Standard of Care practices for this level of investigation. It should be noted that special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions. Even a comprehensive sampling and testing program implemented in accordance with a professional Standard of Care may fail to detect certain subsurface conditions. As a result, variability in subsurface conditions should be anticipated and it is recommended that a contingency for unanticipated conditions be included in budgets and schedules.

Golder sincerely appreciates the opportunity to support EFRC on the Piñon Ridge Project. Please contact the undersigned with any questions or comments on the information contained in this report.

Respectfully submitted,

GOLDER ASSOCIATES INC.

Kimberly Finke Morrison, P.E., R.G.
Senior Project Manager

Roman Popielak, P.G.
Senior Consultant

Nathan Monnig
Staff Hydrologist

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