Geochemical Consulting Services, LLC

Solubility, Speciation, and Reaction-Path Modeling
Groundwater and Soil Geochemistry
Environmental Assessment
Risk Assessment

October 31, 2009

Coloradoans Against Resource Destruction (CARD)
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Members of CARD:

Geochemical Consulting Services, LLC (GCS) is submitting the following comments on Powertech's proposed Baseline Plan (R Squared, 2009). The comments are based on best-industry practice, sound scientific analysis, and over 20-years of GCS experience in the fields of environmental investigations, sampling and analysis plans, groundwater monitoring, and remediation of contaminated groundwater and soil.

Comment 1. Section 2.1 Groundwater Monitoring

The importance of groundwater sampling procedures and the collection of 8 representative samples from each well is noted. However, the discussion fails to recognize the importance of using valid statistical methods for locating the wells (e.g., systematic grid or random selection; Gilbert, 1987; EPA, 2002; Matzke et al., 2007) to ensure representative samples are collected from the aquifer. EPA (2002, p. 8) notes that *"A well-planned sampling design is intended to ensure that resulting data are adequately representative of the target population and defensible for their intended use."*

The ore zone is a very small fraction of the total aquifer volume in the proposed exemption zone. The frequency of wells placed in the ore zone should reflect a very small percentage of the wells sampled for baseline water quality of the aquifer (e.g., less than 5 percent of the wells should be placed in the ore zone, or 1 in 20 wells can be in the ore zone). This small percentage of wells in the ore body is accounted for by using a valid statistical method for locating the wells, such as a systematic grid placed over the proposed aquifer exemption zone. For a systematic grid, a 400-by-400 foot grid should be placed over the proposed aquifer exemption area to ensure that a minimum of one well is placed in every 4 acres (NRC, 2003; p. 5-39).

The importance of sampling all horizons of the aquifer is also omitted from the discussion of representative samples. If screened intervals are limited to 20 ft (SOP 5, Section 5.2.1.1, bullet #5), nested wells must be used to obtain water samples from screened intervals throughout the entire aquifer thickness. A sample from a single 20 ft interval (e.g., the ore zone) of a much thicker aquifer is not a representative sample. This situation

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is well described by EPA (2002, p. 8) *"In this case, the sampling units are defined by the investigator and need to be appropriate for selecting a representative sample of material from the medium of interest."* Well completion logs are necessary to determine if the collected samples are representative of the various sand horizons in the aquifer, but do not appear to have been provided for previously drilled wells.

Comment 2. Section 2.1 Groundwater Monitoring

The last paragraph describes the field parameters that will be measured prior to sample collection. Standard Operating Procedure 8, Section 5.2.3 and 5.2.4 note that dissolved oxygen and Eh will be measured in the sampling container. This procedure is problematic in that it introduces oxygen from the atmosphere into the groundwater being measured, which yields a non-representative measurement of the indicated parameters.

Additionally, there is no mention of turbidity measurements in Section 2.1. Standard Operating Procedure 8, Section 5.2.5 states that turbidity may be measured at the time of sample collection. However, the applicant provides no basis for omitting the required turbidity measurement. Proper well development is needed to remove the sediment and contamination prior to collecting the first round of water-quality samples (EPA, 1992b; p. 6-46), and the nephelometric turbidity unit (NTU) should be below 5 NTU prior to sample collection (EPA, 1992b; p. 6-48).

Section 5.3.1 of Standard Operating Procedure 8 describes the acceptance criteria for Quality Control ("QC") checks on field measurements. The QC checks are a standard practice. However, they should not serve as an illusion that fulfillment of the criteria means the measurement is representative of the media sampled. For example, turbidity measurements of 28 NTU and 30 NTU are within 10% (the acceptance criterion), but they indicate significant suspended material in the sample, which may bias analytical results to high levels. Also, meeting the acceptance criteria for DO and Eh measurements is meaningless when the measurements are made on groundwater contacting the atmosphere, as the sample does not represent conditions in the aquifer.

Comment 3. Section 2.4.2 Monitoring of Particulates in Air

Monitoring should be performed around the vacuum dryer and drum loading facility, as a release here could result in significant exposure to workers. Without active monitoring, there is no way to recreate the dose that a worker receives during a release. (Note: this may be covered under an operations plan)

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Comment 4. Section 2.4.3 Monitoring of Radionuclides in Air

In general, high-volume air sampling stations should be placed N, NE, E, SE, S, SW, W, and NW of the property or facility center point. Winds can be highly variable during storms and two stations in the primary down wind direction are inadequate to capture the true distribution of wind-blown particulate. It is unclear why such monitoring is not proposed, as it is an insignificant cost relative to the cost of operations.

Comment 5. Section 2.4.4 Radon in Air

Monitoring should be performed around the ion exchange columns or other equipment that receives pregnant lixiviant. Without active monitoring, there is no way to recreate the dose that a worker receives during a release. (Note: this may be covered under an operations plan)

Comment 6. Section 3.1.

DQOs are briefly discussed, but Powertech does not address how the selected well locations fulfill the objective to obtain representative groundwater samples from the Fox Hills aquifer. In general, the boundary of the project needs to be defined and representative samples must be collected from the proposed aquifer exemption zone (See Comment 1).

Comment 7.

There is no discussion in the plan on an acceptable statistical methodology which will be used to generate baseline values. Guidance on statistical analysis of groundwater data is readily available. (EPA, 1989; EPA 1992a; ASTM, 1998). These widely used standards make it clear that the use of the mean (or average) and standard deviation to establish baseline water quality are only applicable if it can be demonstrated that the data are representative of the media (Comments 1 and 2) and the data set follows a normal or lognormal distribution. However, Powertech relies on the mean and standard deviation to develop the baseline values without the proper testing of data distributions.

The first test that must be performed on a data set is a test to determine if the data follow a normal or lognormal distribution. Statistical tests for normality are widely available through spreadsheet programs (e.g., Microsoft Excel with Analyse It), and the Shapiro-Wilk Test is generally the most robust test for demonstrating that data follow a normal distribution (Shapiro and Wilk, 1965; Shapiro, Wilk and Chen, 1968; Madansky, 1988).

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The probability statistic, *p*, returned by the Shapiro-Wilk Test determines whether the data follow a normal distribution for the stated confidence interval. For a stated confidence level of 95 percent, *p* must be greater than 0.05 to accept the null hypothesis that the data follow a normal distribution. If the data do not follow a normal distribution, the data may be log transformed (using the natural logarithim) and re-run to determine if the log-transformed data follow a lognormal distribution. If neither the original data nor log-transformed data pass the Shapiro-Wilk Test (i.e., *p* less than 0.05), then it must be concluded that the data do not follow a normal or lognormal distribution. When the data do not follow a normal or lognormal distribution, the mean and standard deviation are meaningless because these parameters are defined ONLY for a normal or lognormal distribution.

Data sets that do not follow a normal or lognormal distribution generally include those sets that have a large number of results at or near the detection limit or some results at very high values (i.e., an asymmetrical distribution). This type of data set is a non-normal data set, and it's sample distribution must be analyzed with nonparametric techniques (Gilbert, 1987; Madansky, 1988) to define the median, quantiles, and inter-quantile range (IQR), provided the results at the detection limit do not exceed approximately 75 percent of the data points. The non-normal data sets are ordered, from lowest to highest values, and the median is the central value in the ordered data set, while the 0.25, 0.5 and 0.75 quantiles are the values such that 25%, 50% and 75% of all values fall below that value. The IQR is the difference between the 0.75 and 0.25 quantiles. Median and IQR are better indicators of the distribution in a non-normal, asymmetric distribution, because these statistical quantities are influenced less, relative to the mean and standard deviation, by very large or very small values.

Powertech should describe the valid statistical methods that will be used to develop the baseline values in accordance with accepted guidance.

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Sincerely,

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