EXHIBIT A

Dr. George F. Vance, Ph.D.
Certified Professional Soil Scientist
1714 Downey St.
Laramie, WY 82072
Phone: (307) 742-6662
Cell: (307) 760-2211
E-mail: gfv@uwyo.edu

VANCE CONSULTING, LLC

Natural Resources and Environmental Services

July 19, 2009

J. Mark Stewart
Davis & Cannon, LLP
42 W. 26th Street
Cheyenne, WY 82003

Subject: Evaluation of whether the effluent limits established in WYPDES Permit No. 0054364 are protective of the irrigation that will be made of the water after it is discharged into Prairie Dog and Wildcat Creeks.

Dear Mark;

The following report is an evaluation of Wyoming Department of Environmental Quality – Water Quality Division's (WDEQ-WQD) Statement of Basis associated with Permit No. 0054364 that you requested. Information that was evaluated included depositions and exhibit materials, and the synoptic sampling results provided on July 14, 2009. I also evaluated the Prairie Dog and Wildcat Creeks using the NRCS's Soil Survey website.

In Pennaco Energy, Inc.'s (Pennaco's) Proposed Modification/Renewal for WY0054364, dated September 11, 2007, a proposal was submitted to WDEQ-WQD to move outfall 001 and add another Outfall (Outfall 3), with Outfalls 1 and 2 used during the irrigation. Outfall 2 would fill Paul #3 reservoir and Outfall 1 would be used during the irrigation season. Outfall 3 was proposed as a discharge point during the non-irrigated season. Outfalls 1 and 2 are on Wildcat Creek and Outfall 3 is on Prairie Dog Creek.

The January 6, 2009 Statement of Basis Renewal released by the WDEQ-WQD included additional changes to the permit, but the discharge from Outfall 3 was now allowed for anytime of the year. Other changes included a 300 mg/L sodium limit (specific conductance, e.g., electrical conductivity (EC), was limited to 1,215 mmhos/cm or 1.215 dS/m) for Outfall 3 discharge and an SAR effluent limit based on EC for Outfalls 1 and 2. EC limits for discharges from Outfalls 1 and 2 were to be no greater than 1,330 mmhos/cm. Note that SAR values were not measured directly, but rather calculated based on EC values for Outfalls 1 and 2 and for Outfall 3 using a relationship between sodium and SAR determined for Prairie Dog Creek. A major modification of the permit, dated April 28, 2009, describes changes that included the removal of Outfall 1 and containment requirements and effluent limits at Outfall 2.

Irrigation

Base on information provided in Pennaco's Proposed Modification/Renewal for WY0054364 (September 11, 2007), irrigated agriculture is extensive along Prairie Dog Creek (see attached). In addition, there are several irrigated agriculture operations on Wildcat Creek with in-stream reservoirs retaining water that follows down Wildcat Creek and that which is diverted through the Ninemile Ditch. Currently, much of Prairie Dog and Wildcat Creeks agricultural practices involve alfalfa production using pivot irrigation systems. Alfalfa is a moderately sensitive crop to soil salinity, which is a function of soil properties, salinity of irrigation waters and management practices.

Water quality is an important component in irrigated agricultural operations. The WDEQ-WQD Agricultural Use Protection Policy, Chapter 1, Section 20 states that "Wyoming surface waters which have the natural water quality potential for use as an agricultural water supply shall be maintained at a quality which allows continued use of such waters for agricultural purposes. Degradation of such waters shall not be of such an extent to cause a measurable decrease in crop or livestock production." The goal of this policy is "to ensure that pre-existing irrigated crop production will not be diminished as a result of the lowering of water quality." The goal expressed in Section 20 is to maintain surface water quality at a level that will "continue to support the **local agricultural uses** that have developed around it." "The determination of what is acceptable water quality for irrigation must necessarily involve an evaluation of **local agricultural practices and background water quality conditions**." Therefore, in areas were agricultural practices are implemented, it is essential that background water quality be evaluated in order to prevent measureable decreases in crop production.

Two water quality measures used to evaluate irrigation water quality are EC, because it is a measure of salt content, and the sodium adsorption ratio (SAR), which is a measure of sodium risk. Salinity of irrigation water (ECw) and soil (ECe, saturated paste extracts) are important in managing agricultural operations, and controlling soil salinity problems requires a knowledge of water and soil ECs as well as the need for adequate soil drainage to allow leaching of salts below the root zone. Because there are no water or soil amendments that can directly control soil salinity, maintaining soil drainage and providing good irrigation management are essential in controlling soil salinity.

Irrigation water salinity influences soil salinity and the general assumption is that soil EC is at least 1.5 times higher than irrigation water EC. For alfalfa, the maximum soil EC_e causing no growth reduction, i.e., 100% yields, is 2.0 dS/m or less, which equates to a water EC_w of 1.33 dS/m. Good irrigation water quality (EC_w <0.75 dS/m) is usually considered acceptable and should not result in salt buildup; however, if the water is even slightly saline (EC_w = 1 to 1.5 dS/m) there is a greater potential for accumulation of salts without proper water management.

Effectively controlling soil salinity requires that soils contain acceptable levels of salts in the rooting zone. For irrigation waters that are slightly saline, additional water is needed to leach salt out of the rooting zone. The leaching requirement (LR) is the percentage of water required that is in excess of the crop's water requirement that must leach below the root zone to maintain soil salinity at a desired level:

$$LR = \frac{EC_w}{0.5(EC_e) - EC_w} \times 100$$

where EC_e (dS/m) is the maximum soil salinity that results in no reductions in growth or yield and EC_w (dS/m) is the salinity of the irrigation water. Thus, the greater the irrigation water salinity, the greater the leaching requirement. Therefore it is critical to monitor the salinity of irrigation water in order to prevent a buildup of salts in the rooting zone. Additional salt loads in irrigation waters will impose a greater burden on the agricultural operators in order to maintain soil conditions that will allow maximum crop production.

Degradation of water quality by additional salt loads and/or sodium concentrations would potentially reduce both crop productivity as well as impact soil resources. Infiltration capacity/rate is an essential soil characteristic that must be maintained in order to allow water movement and salt leaching. Relationships between EC and SAR developed over the years and which were reported in Agricultural Salinity and Drainage (Hanson et al., 2006) are limited by soil type. Soils high in clay contents are much more susceptible to dispersion and reduced

infiltration rates than are coarse-textured soils. Infiltration is also dependent on pH, clay type, texture, and other physical and chemical soil properties. If salinity is low, sodium can cause slaking and dispersion and soil structure deteriorate.

Irrigation water quality criteria related to EC and SAR have been questioned because the numerical values are based, in part, on laboratory column studies that measured infiltration rates and/or hydraulic conductivities on saturated disturbed soils. Field conditions that can influence soil hydraulic properties include wetting and drying cycles, crust formations, and rainfall and snowmelt events. Rainfall effects irrigated soils by increasing sodicity hazard due to inputs from low EC rain waters. Suarez et al. (2006, 2008) showed that the infiltration rates of two soils, cropped (e.g., alfalfa) and uncropped, studied over 4 months decreased at SARs above 4, with reductions becoming more severe with increasing SAR. Reductions in infiltration rates occurred during both irrigation and rain events. These results suggest there is a greater sensitivity to SAR than indicated in laboratory column studies and existing water quality criteria.

Soil Survey

A soil survey has been completed for Sheridan County, WY and can be accessed online at http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm. Using the web soil survey program, a Custom Soil Resource Report for the Prairie Dog and Wildcat Creek area was developed (see attached). Due to a 10,000 acre restriction, the information generated included the local area that was downstream of both Outfalls 2 and 3 that extend to the confluence of the two creeks. Information provided from the Custom Report includes mapping units with their associated soil taxonomy, clay percentage in soil surface and soil profiles, soil SARs and irrigated capability classes.

Soil in irrigated areas along Prairie Dog and Wildcat Creeks are classified in the soil orders of Entisols, Aridisols, and Mollisols. Specific soil family classifications are in the fine to fine-loamy textural classes, mixed and smectitic mineralogy, mesic soil temperature regime, active and superactive (high CEC/clay ratio), with ustic and aquic moisture regimes. Most of these soils are in the subgroups of Torriorthents, Torrifluvents, Haplargids, Argiustolls, and Argiaquolls. In general, these soils are comprised of higher clay and organic matter contents that are important to soil physical, chemical and biological properties. The chemistry of these soils plays an important role in soil quality.

Surface and soil profile clay contents vary depending on the location of the soils. Soils along Prairie Dog and Wildcat Creeks have surface clay contents around 25% with total profile contents at approximately 37%. The irrigated area soils also vary with respect to clay contents that range from 20 to 37.5% in the surface and 22 to 44% within the soil profile with many falling into the 35% range. As noted above, the classification of these soils suggest they can contain smectitic clays and high organic matter contents. Both of these soil parameters are susceptible to dispersion due to sodium.

Sodium adsorption ratios (SAR) were described for the soil profile due to the surface soils classifying at levels that were considered too low by the NRCS. Profile SARs for soils along the two creeks are approximately 2.0. The database for irrigated soils suggested profile SARs that are less than 3.0. This information would indicate irrigated soils do not contain high enough SARs to restrict plant productivity. Additional sodium provided in irrigation water could result in problems with increased SAR level that impact infiltration processes due to dispersion of clay-organic matter influenced structure. This would result in soil crusting, lack of water movement, and decreased plant growth.

Additional information provided in the Soil Survey Report describes the irrigation capability class for soils along the creeks and irrigated areas. Land capability classes range from Class 1 to Class 8 soils. Class 1 soils have few limitations, while Class 6, 7, 8 have severe limitations that make them generally unsuitable for cultivation. Soils along Prairie Dog and Wildcat Creeks fall into the Class 6 category. They are classified as fine, smectitic, mesic, Typic Argiaquolls with soil attributes of high clay, organic matter, and wetness. As noted above, increased expose of these soils to sodium impacted waters would result in soil dispersion. Irrigated lands have soils that are classified in as Class 3, which are described as soils that "have severe limitations that reduce the choice of plants or that require special conservation practices, or both." Therefore, additional salt loads, especially increases in sodium concentrations, would result in potential problems that would require special management practices. If not controlled, irrigated soils could become saline or saline-sodic. This has been shown to be a concern where CBM waters have been used in managed irrigation settings that utilized water and soil treatments to minimize sodium impacts (Ganjegunte et al., 2008; Vance et al., 2008).

Water Quality

Irrigation with saline and/or sodic waters requires great care and demands considerable management, otherwise there is a potential for salt and/or sodium impacts. Excessive salt accumulations in soil profiles can impact plant growth and irrigation waters with high SARs or sodium hazards can also be problematic (e.g., water logging) to both soils and plants. For example, sodic irrigation water can cause soil crusting, infiltration problems, and reduced soil hydraulic conductivity, all of which can adversely affect water availability and aeration that impacts plant growth and yield. Irrigation with saline-sodic waters can result in clay swelling that leads to aggregate dispersion. Soil degradation due to sodicity can result in a severe, irreversible reduction in infiltration rates when using high SAR waters, particularly when this practice is followed by heavy rainfall or snowmelt. This is especially important considering most of the Powder River Basin consists of soils with poor drainage (BLM, 2003).

Recent water quality evaluations have been conducted in Prairie Dog and Wildcat Creeks area – an April 3, 2008 sampling of Wildcat Creek reported by Scott Mason, Hydrometrics, Inc. and a synoptic sampling (June 15 and 16, 2009) of waters in both creeks conducted by a Pennaco contractor (see attached data). The subject of these analyses will be discussed in the appropriate sections below.

Prairie Dog Creek

In the recent synoptic sampling, Prairie Dog Creek waters were sampled upstream, close to the proposed effluent discharge point (Outfall 3) and downstream at the confluence with Wildcat Creek. Water parameter concentrations at each of these points were generally low but increased downstream. Values for specific water measures include: EC - 309 to 482 mmhos/cm; TDS – 183 to 307 mg/L; bicarbonate – 128 to 182 mg/L; sulfate 52 to 107 mg/L; calcium 30 to 50 mg/L; magnesium – 15 to 25 mg/L; sodium 10 to 14 mg/L; and SAR 0.37 to 0.40. Analysis of the $\delta^{13}C$ for these waters indicated there was little impact due to CBM waters.

It is noteworthy to point out that up to 1.47 MGD (5,556,600 L) of effluent would be allow for discharge at Outfall 3 into Prairie Dog Creek under Pennaco's WY0054364 permit. Based on the relationship between EC and total dissolved solids (TDS),

$$EC\ (dS/m) \times 640 = TDS\ (mg/L) \qquad \text{(Essington, 2004)}$$

and considering an EC of 1.215 dS/m, this would equate to a salt load of up to 1,577 metric tonnes (1,738 short tons) per year. In addition, 300 mg sodium/L would represent up to 38.5% (300/777.6) of the salt load. Assuming sodium is the dominate cation associated with the effluent discharge; a total of 13.0 meq/L would be needed to balance the anionic concentration of the water. Using bicarbonate (equivalent weight (EW) = 30.5) and sulfate (EW = 48) as the primary anions, a concentration of 300 mg sodium/L would require 400 to 624 mg/L, respectively to balance the water chemistry. Thus adding a calcium source such as gypsum to the high sodium effluent would exceed the EC limit of 1,215 mmhos/cm when the permitted high sodium concentration is in effect. As a comparison, current water qualities of Prairie Dog Creek waters described previously have low salt and sodium contents. The proportion of Prairie Dog Creek water to effluent discharge will determine overall water quality at any particular time; however, because the natural and diverted flow in the creek is low during non-irrigation times, effluent discharge will comprise the majority of the flow during this period. Salt loads and sodium concentrations will increase in the stream ecosystem during non-irrigation season, and will be released during the irrigation season when diverted waters are added through diversions upstream.

Wildcat Creek

Wildcat Creek was sampled earlier April, 2008 and mid June, 2009 (see attached). Based on the early April 2008 samples, waters analyzed from a CBM discharge upstream and several sample points along the creek to the TRIB 1 site, which is close to the confluence of Prairie Dog and Wildcat Creeks, it appears that all the samples were influenced by CBM discharge water. Basis for this suggestion would be comparison of water chemistry at many sites on Wildcat Creek in mid June, 2009. For example, when comparing similar cation and anion concentrations between the two sampling periods, and using waters analyses of sites located downstream of Ninemile Ditch to represent irrigation water quality, magnesium ranged from 150-180 vs 18-50; calcium 200->250 vs 36-75; sodium >100-150 vs 11-32; bicarbonate 450->500 vs 157-230; and sulfate 825-1,150 vs 53-273, which indicates much lower concentrations in waters used during the irrigation season. At two similar sampling locations, IMP-1 and TRIB 1, water chemistry was similar at one and varied markedly at the other: IMP-1 (magnesium 180 vs 124; calcium >300 vs 274; sodium 150 vs 145; bicarbonate 625 vs 604; sulfate 1,300 vs 1,250) and TRIB 1 (magnesium 180 vs 44; calcium 225 vs 72; sodium 150 vs 28; bicarbonate 450 vs 230; sulfate >1,100 vs 233). Based on the calcium and sulfate data one can assume that gypsum has been added to discharged CBM waters.

Research has shown that $\delta^{13}C$ can be used to determine the relative proportion of CBM waters to natural surface waters (Sharma and Frost, 2008). Using the mid June, 2009 synoptic water analysis, which evaluated inorganic chemistry as well as different isotopes, one can identify the general proportions of CBM to natural water utilizing a simple mixing model. Information using this approach (see attached Table) determined that water in the proposed pumpback location on Wildcat Creek contained approximately 40% CBM water that was believed to have leaked from the Paul #3 reservoir. Both the AIMP-1 and IMP-1 sites also contained CBM waters at levels of approximately 16-17%. Water chemistry determined with the mixing model were fairly consistent based on bicarbonate, calcium, magnesium and sodium approximations. It is well known that Paul #3 reservoir leaks and CBM waters flows down Wildcat Creek. With an additional discharge into Wildcat Creek allowed during over topping of Paul #3, more CBM water may flow into areas that are utilized for irrigation. In the future it is recommended that waters be analyzed for $\delta^{13}C$ to determine the percent contribution of CBM waters to the collected water samples.

Conclusions

Based on the soils along Prairie Dog and Wildcat Creeks and irrigated lands utilizing water from these sources, an increase the salt load and sodium concentrations in the creeks will impact soil resources and vegetation characteristics. Effluent discharges associated with 300 mg/L sodium and ECs that are significantly higher than the local ambient conditions that have been part of agricultural producers operations for many years will undoubtedly influence the environments that are exposed to these new conditions. Pennaco's Permit WY0054364 will result in local area water conditions impacting operations immediately downstream from the effluent discharge points, which is a violation of WDEQ's Agricultural Use Protection Policy, Chapter 1, Section 20. At the very least, as the permit is written the higher salt loads and sodium concentrations will place an undue burden on irrigators by requiring additional management of the waters.

It is my expert judgment that the amount of water proposed for discharge into Prairie Dog Creek, with water qualities allowed in the WY0054364, would have detrimental consequences on areas along the creeks and for irrigation operations using the water. Wildcat Creek concerns are related to potential leaking of Paul #3 reservoir and impacts to stream characteristics and downstream irrigators, some who utilize in-stream reservoirs for their irrigation water sources. Stream channel impacts would be expected due to dispersion causing the release of clay and organic matter, altering the soil chemical, physical and biological properties, and changing vegetative communities. Irrigated lands would be impacted due to added salts and sodium in waters used for crop production. This would include dispersion of soil structure, reducing infiltration as well as plant productivity. With dispersion there would be the potential for soil crusting that would reduce the amount of water for leaching of the added salts and sodium derived from the effluent discharges.

Please let me know if you need further elaboration on my evaluation.

George F. Vance

Dr. George F. Vance, CPSS
Vance Consulting, LLC
Laramie, WY

References

Bureau of Land Management (BLM). 2003. Final Environmental Impact Statement and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project. Volumes 1-4. Buffalo Field Office, Buffalo, WY. Available at: http://www.blm.gov/wy/st/en/info/NEPA/bfodocs/prb_eis.html.

Ganjegunte, G.K., L.A. King and G.F. Vance. 2008. Cumulative soil chemistry changes from application of saline-sodic waters. Special Issue: Environmental impacts and sustainable reuse of degraded water reuse. Journal of Environmental Quality 37:S-128-S138.

Hanson, B.R., S.R. Grattan and A. Fulton. 2006. Agricultural Salinity and Drainage Division of Agriculture and Natural Resources Publication 3375. University of California. 164 pp (Revised edition).

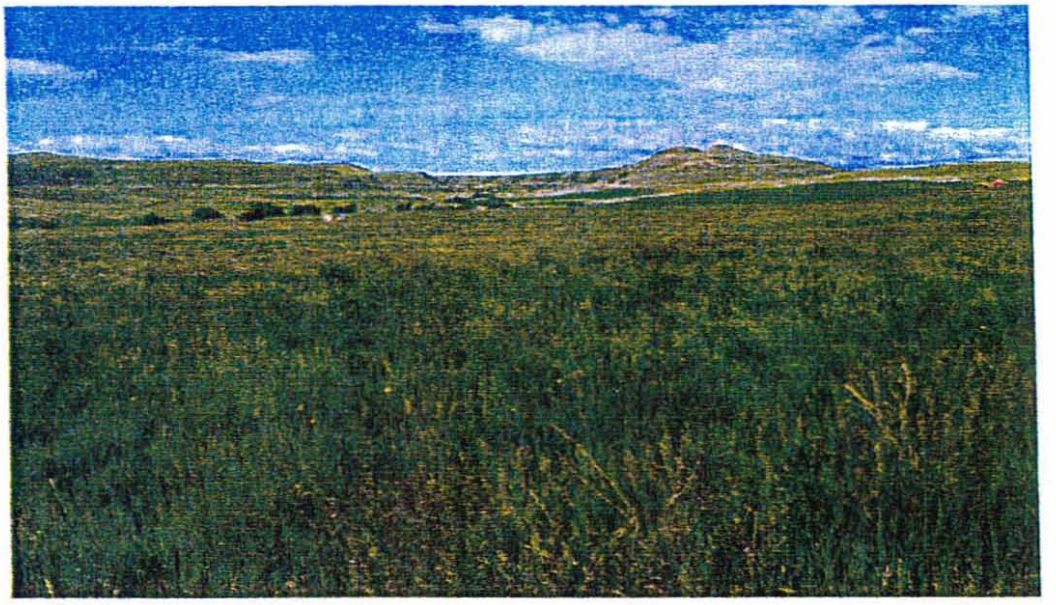
Suarez, D.L., Wood J.D., and Lesch S.M. 2006. Effect of SAR on water infiltration under a sequential rain-irrigation management system. Ag Water Manage. 86:150-164.

Suarez, D.L., Wood J.D., and Lesch S.M. 2008. Infiltration into cropped soils : Effect of rain and sodium adsorption ratio-impacted irrigation water. J Environ Qual. 37:S169-S179.

Vance, G.F. L.A. King and G.K. Ganjegunte. 2008. Soil and plant responses from land application of saline-sodic waters: Implication of management. Special Issue: Environmental impacts and sustainable reuse of degraded water reuse. Journal of Environmental Quality 37:S-139-S148.

EXHIBIT B

Assessment of the Protectiveness of Effluent Limits adopted under Permit WY0054364



Prepared by:

William Schafer, Ph.D.,
Schafer Limited LLC
Bozeman, MT

Submitted to:

Mark Ruppert, Esq
Holland & Hart
Cheyenne, WY

August 2009

Assessment of the Protectiveness of Effluent Limits adopted under Permit WY0054364

Prepared by:

William Schafer, Ph.D.,
Schafer Limited LLC
Bozeman, MT

August 2009

William M. Schafer

August 18, 2009

William M Schafer,Ph.D. Date

chemistry was estimated by using EC of 1,215 µS/cm and typical calcium and magnesium levels from a treatment plant test conducted in August 2009 (Appendix C). The permissible sodium value in effluent was calculated to maintain a final SAR in the mixture of 3.21, which was derived from the Hanson chart corresponding to the EC of the mixture of 991 uS/cm. The protective sodium level was 518 mg/L, which is higher than the original sodium limit derived by WDEQ of 420 mg/L, but is much higher than the value of 300 mg/L that Pennaco requested in early 2008.

Table 7. Calculation of a sodium effluent limit for outfall 003.

Constituent	Receiving Water [1,2,3]	Effluent [4,5,6]	Mixture [7]
Flow (cfs)	6.8	2.27	9.1
Calcium (mg/L)	111.5	26	90.1
Magnesium (mg/L)	61.1	7	47.5
Sodium (mg/L)	23.4		151.1
Allowable sodium in effluent		518	
SAR	0.54	23.3	3.21
Electrical Conductivity (uS/cm)	962	1,215	991
Target SAR of Mixture			3.21

[1] *Based on harmonic mean flow for irrigation season at Wakeley.*
[2] *Calcium, magnesium, and sodium in receiving water are statistically independent of streamflow so concentrations were based on average chemistry for samples at less than 10 cfs streamflow*
[3] *EC was correlated with streamflow, EC = -122 ln(flow cfs)+1196*
[4] *Calcium and magnesium in effluent based on treatment plant test dated 11 August 2009 (Appendix C)*
[5] *EC limit based on maximum effluent limit*
[6] *sodium limit back-calculated from target SAR of mixture*
[7] *Target SAR of mixture based on Hanson chart.*

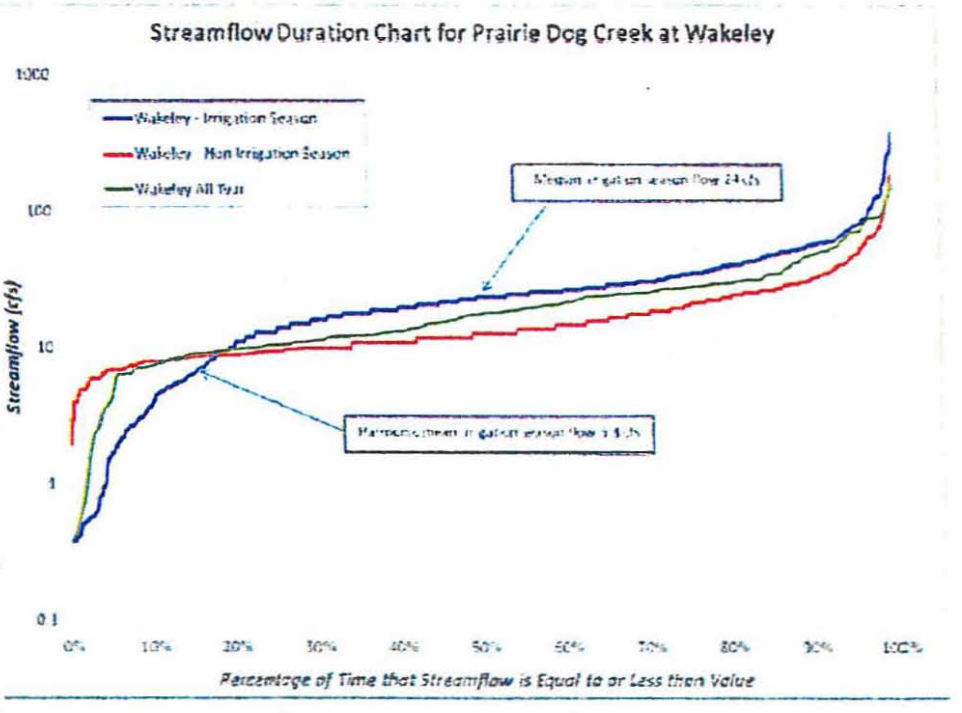


Figure 8. Flows in PDC at Wakeley (near outfall 003).

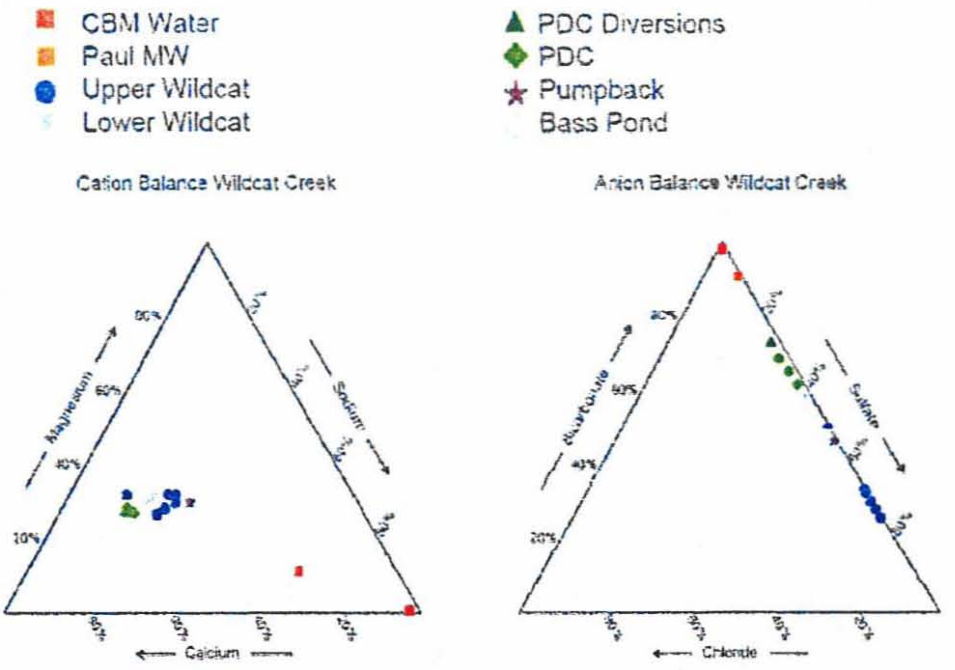


Figure 19. Trilinear diagrams illustrating differences in the relative proportion of major cations and anions in Wildcat Creek and PDC water take out extra symbols.

4.2.2 Assessment of Potential Contribution from the Paul #3 Reservoir to streamflow and chemistry of upper Wildcat Creek

Vance (2009) and O'Neill (2009) each concluded based largely on carbon isotope data (see section 4.2.3) that the Paul #3 Reservoir is leaking and water is mixing with surface water in upper Wildcat Creek at AIMP-1. They estimated that 18 % of the water at AIMP-1 is from the Paul #3 Reservoir. In the following section, I assess the likelihood that leakage from the Paul #3 Reservoir is contributing surface water to upper Wildcat Creek.

In order to assess the potential contribution of CBM water from the Paul # 3 Reservoir to surface water in upper Wildcat, and to assess the effects of CBM water on irrigation use of upper Wildcat Creek water, several factors have to be considered, namely,

- What processes would tend to occur as seepage from the Paul #3 Reservoir travelled about one-half mile to the point where water is first observed in Wildcat Creek?
- Are there other sources of CBM water that could account for the contribution to upper Wildcat Creek?
- How does water sampled in upper Wildcat compare to historic (1978, pre-CBM) water samples from neighboring watersheds (e.g. Dutch Creek)?
- If CBM water comprised 18 % of water in upper Wildcat Creek, what was the chemistry of the remaining water, and how do the CBM water and natural waters compare in terms of irrigation suitability?

- Could other pathways account for the water quality observed in upper Wildcat Creek samples? (e.g. AIMP-1)

Each of these issues will be discussed individually.

What processes would tend to occur as seepage from the Paul # 3 Reservoir travelled about one-half mile to the point where water is first observed in Wildcat Creek? – The Paul #3 Reservoir is not known to overflow, so the likely pathway of contribution is underground via shallow groundwater, that eventually discharges to the stream channel about one-half to 1 mile from the Reservoir. It is not known if a groundwater pathway exists that could move sufficient water laterally this distance while flowing under or around the pumpback sump. Assuming that a groundwater pathway exists to create a hydrologic connection between the Paul #3 and upper Wildcat Creek, samples from the Paul monitoring well provide important observations about chemical changes that occur along the groundwater flow path. Water in the monitor well (Appendix B), located a few hundred feet from the Paul #3, had similar carbon isotopic signature as the water stored in the Paul #3 Reservoir (section 4.2.3), and likely was derived from seepage. However, the calcium and magnesium levels are higher while sodium levels are lower in the well than in the Paul Pond. Overall the EC is about the same in both waters but SAR dropped from 29.8 in the pond to 5.6 in the well. Ion exchange is the most plausible process accounting for these changes.

Are there other sources of CBM water that could account for the contribution to upper Wildcat Creek? – There are a number of pivot and wheel-line irrigation systems in immediate proximity to upper Wildcat Creek near AIMP-1 (Figure 1). For example, a three-quarter mile long field irrigated with CBM water lies immediately east of Wildcat Creek adjacent to AIMP-1. Irrigation return flows or seepage from the irrigated fields would more readily account for contribution of water with a CBM carbon isotope signature (section 4.2.3) than seepage from the Paul #3 Reservoir because the irrigated fields are closer to surface water in upper Wildcat Creek. Contribution from the Paul #3 would require a long travel distance in shallow groundwater that somehow bypasses the pumpback area sump. The pumpback sump is a shallow depression in saturated alluvium adjacent to Wildcat Creek located about 800 feet below the Paul #3 Reservoir and above AIMP-1. Water sampled in the pumpback sump in June 2009 had water with oxygen and deuterium isotope signatures unlike CBM water. The circuitous groundwater pathway from the Paul #3 Reservoir, the dissimilarity of pumpback sump water to CBM water, and the proximity of CBM-irrigated fields to Wildcat Creek make seepage from the Paul #3 Reservoir implausible as a source of CBM contributions to upper Wildcat Creek.

How does water sampled in upper Wildcat compare to historic (1978, pre-CBM) water samples from neighboring watersheds (e.g. Dutch Creek)? – USGS collected 3 water samples in 1978 (pre-CBM development) from Dutch Creek (Appendix D) about 3 to 4 miles from upper Wildcat Creek. Dutch Creek samples collected in 1978 have no potential inputs of CBM water because they were collected before CBM development. Water quality in Dutch Creek samples, which had average EC and SAR of 2,630 µS/cm and 2.4 was very similar to EC and SAR in upper Wildcat Creek samples IMP-1 and AIMP-1 that averaged EC and SAR of 2,385 µS/cm and 1.6. The similar surface water chemistry in Dutch Creek and Wildcat Creek suggests that no CBM chemical input is needed to account for the chemistry of upper Wildcat Creek. Water in upper Wildcat Creek appears to consist of background surface water based on the similarity of pre-CBM surface water from Dutch Creek and present-day surface water in upper Wildcat Creek.

If CBM water comprised 18 % of water in upper Wildcat Creek, what was the chemistry of the remaining water, and how do the CBM water and natural waters compare in terms of irrigation suitability? –Chemical transformations occur in groundwater between the Paul #3 Reservoir and the Paul monitoring well (Appendix B) causing SAR to decrease. Consequently, CBM water that follows a groundwater pathway even a short distance is suitable for irrigation according to the Hanson Chart (Figure 20) owing to the reduction in sodium and increases in calcium and magnesium that are evident in the sample from the Paul monitoring well. Additionally, if a water mixture (such Wildcat Creek water at location IMP-1) is hypothetically composed of two different source waters and the composition of one of the source waters (groundwater in the Paul monitoring well) is known, then the composition of the other component of the mixture can be easily calculated (Figure 20). Vance (2009) and O'Neill (2009) alleged that CBM water contributes 18 % of the water in upper Wildcat Creek at IMP-1. Figure 20 shows the composition that the remaining 82 % of water must have to form IMP-1 water. As shown, the groundwater source from the Paul monitoring well has a more favorable EC (1,760 µS/cm) than the water that would contribute the remaining 82 % of water to upper Wildcat Creek (calculated EC 2,675 µS/cm).

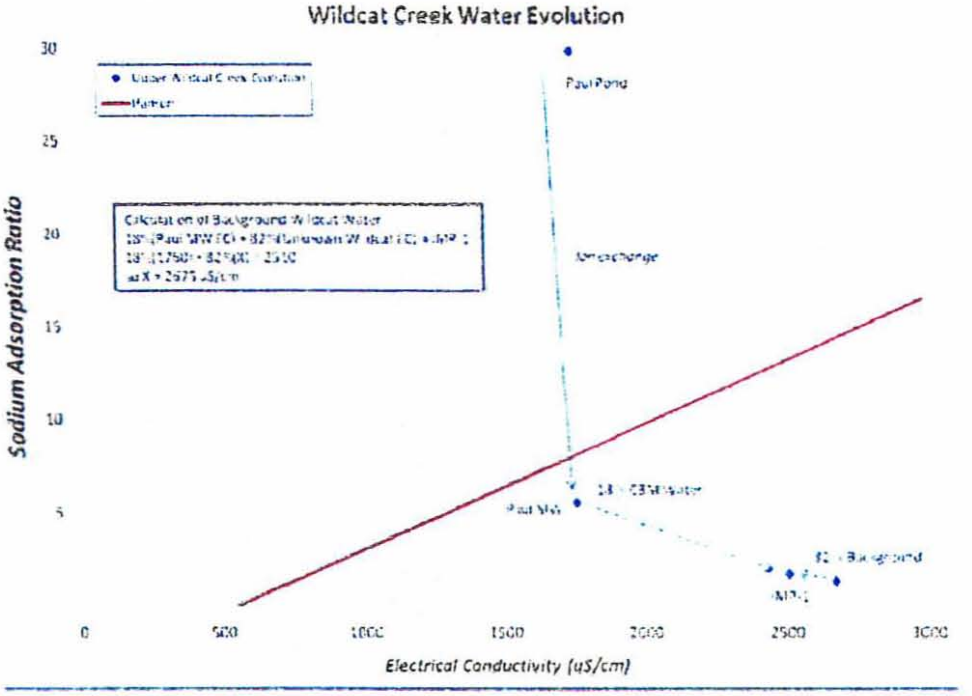


Figure 20. Evaluation of potential chemical contribution of CBM water to upper Wildcat Creek water at AIMP-1, June 2009.

Could other pathways account for the water quality observed in upper Wildcat Creek samples? (e.g. AIMP-1 and IMP-1) – A geochemical model was used to determine what chemical pathways could account for development of the water quality observed in upper Wildcat Creek (sample AIMP-1). The model, PHREEQC (Parkhurst and d'Appelo 1999), provides for inverse modeling. That is given a final water quality, and various starting water

sources and possible reactants, how could the final water form? For this evaluation, two PHRREQC runs were performed. In the first inverse model, only snowmelt water represented by upper PDC (sample UPDC, Appendix B) was the starting point. The water was allowed to evaporate; and to dissolve or precipitate aragonite (a low temperature form of $CaCO_3$) or gypsum; exchange carbon dioxide with the atmosphere; and to exchange calcium or sodium from clay minerals. In the second inverse model, three possible starting water sources could be used alone or in mixtures: Dawson Draw, PDC (UPDC), or CBM water. Use of the inverse model provides an objective means of identifying possible contributions to the water quality of upper Wildcat Creek.

Overall, there were 31 different pathways identified by PHREEQC that could account for the formation of Upper Wildcat Creek water quality. One of the simplest pathways involved evaporation of snowmelt (represented by sample UPDC), precipitation of calcite, dissolving gypsum, and off gassing carbon dioxide. Average percent difference in ion concentration between measured and predicted Wildcat Creek water was 5 %. A computed pathway with mixtures of Dawson Draw water and UPDC with modest evaporation and mineral interactions matched measured water quality within about 2 %, while mixtures of CBM and Dawson Draw water had about 9 % error (Figure 21). The PHREEQC results indicate that no single pathway for formation of upper Wildcat Creek water can be uniquely derived from the available data. Either a simple pathway involving evaporation of surface water and interaction with common mineral phases ($CaCO_3$, gypsum and exchangeable ions), a mixture of two different non-CBM surface waters, or a mixture of CBM and surface water could account for upper Wildcat Creek water quality. Based on the degree of similarity of modeled and predicted water quality from PHREEQC, the mixture of non CBM water and the simple evaporation pathway best described upper Wildcat Creek surface water (Appendix E).

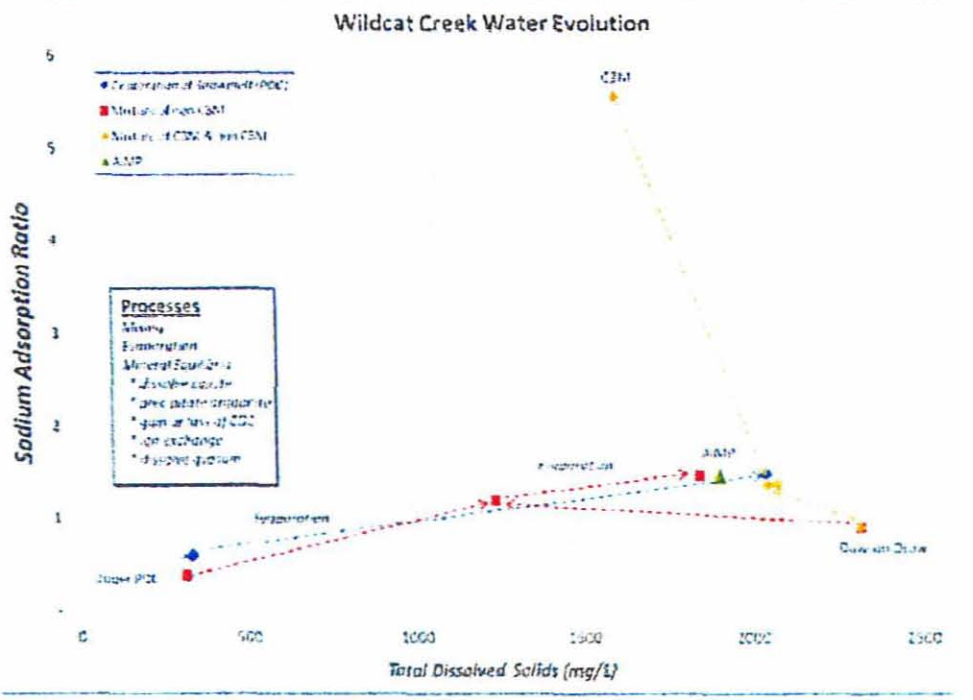


Figure 21. Three possible surface water chemical evolution pathways determined using PHREEQC.

4.2.3 Stable Isotopes

Recent research conducted at the University of Wyoming suggests that stable isotope ratios in water samples provide a signature that can be used to distinguish between groundwater from coal seams (e.g. CBM water) and natural surface waters (Sharma and Frost 2008). Water samples collected in June were analyzed for three pairs of isotopes including carbon ($^{13}C/^{12}C$ in dissolved bicarbonate), oxygen ($^{18}O/^{16}O$ in water), and hydrogen ($^{2}H/^{1}H$ in water). The stable isotopes ^{13}C, ^{18}O and ^{2}H (or deuterium) represent about 1.1 %, 0.2% and 0.015 % of the total carbon, oxygen and hydrogen normally present in water. Stable isotope abundance is expressed as a ratio in terms of the difference in parts per thousand (or per mil) from a standard material. For oxygen and hydrogen, the standard is mean ocean water and the difference in an isotope ratio is called the delta value, or $\delta^{18}O$ and $\delta^{2}H$. For ^{13}C, the standard material is a Cretaceous-aged fossil from a South Carolina Limestone (e.g. the Pee Dee belemnite or PDB).

Oxygen and hydrogen Isotopes - Several hydrologic and geochemical processes affect isotope ratios because many transformations such as vaporization, anaerobic and aerobic carbon decomposition and chemical precipitation will cause shifts in isotope abundance (Clark and Fritz 1997). For meteoric water (e.g. rain or snow), the ratios of oxygen and hydrogen vary significantly depending on the distance from the water source (typically the ocean) and the mean temperature. As air masses move inland, the induced rainfall tends to contain a larger proportion of lighter ^{16}O and ^{1}H than the air mass, so the delta value in remaining water vapor becomes more negative. Subsequent rain events also become increasingly negative in delta value. Colder air tends to have more complete rainout than warmer air at a particular locale, thus winter precipitation has a lower delta value than spring or summer precipitation (Clark and Fritz 1997).

Oxygen and hydrogen delta values for meteoric water samples tend to fall on a straight line called the global meteoric water line (GMWL, Figure 22). Within a single locale, samples further down the GMWL represent meteoric water that falls in winter while summer rainfall plots farther up the GMWL (e.g. closer to zero).

One other process that affects the oxygen and hydrogen ratio is evaporation. As increasing proportions of meteoric water evaporates, the remaining residual water becomes more enriched in oxygen and hydrogen, but the enrichment causes samples to deviate to the right of the GMWL. Because of these influences, the oxygen and hydrogen ratios can be used to assess the time of year that meteoric water fell and the cumulative evaporation reflected in the water samples. Isotope ratios are one of the primary means for determining the historic temperature record from ice core samples, for example.

Wildcat Creek samples had several distinct clusters of isotopic signatures. All samples were located right of the GMWL, which is indicative of evaporation. However, other samples of CBM water collected in the Powder River basin typically fall on the GMWL (as should the runoff samples from PDC). Small differences in the local meteoric water line or laboratory bias may account for PDC and CBM samples falling right of the MWL. The small apparent evaporation signature for these samples is probably erroneous. All other samples, which fall further right of the MWL are indicative of evaporation, however.

- Water in PDC, diverted PDC water (e.g. Ninemile Ditch) and in samples from lower Wildcat Creek all had virtually identical delta values for oxygen and deuterium indicating that lower Wildcat Creek water is chemically identical to PDC water.
- The CBM water being pumped into the Paul # 3 Reservoir indicated a meteoric water source derived during a colder part of the year than other water samples.
- Water in the Paul #3 Reservoir indicated that significant evaporation had occurred and direct rainfall may have partially diluted the CBM water.
- Samples from upper Wildcat Creek exhibited a wide range in isotope ratio indicating variable pathways of chemical evolution in different portions of the upper watershed.
- The differences between PDC samples (mostly derived from Piney Creek snowmelt with less evaporation signature) and upper Wildcat samples (more evaporation signature) is to be expected given the more arid nature of the ephemeral Wildcat Creek basin.
- Water from Wildcat Creek just above the Ninemile Ditch (WC above 9 Mile and WC section 28) exhibited stronger evaporation effects than water samples taken upstream at IMP and AIMP. The higher EC in the downstream samples supports the conclusion that more evaporation has occurred in these samples.
- Water from the pumpback sump appears more closely related to a natural Wildcat Creek water source than CBM water based on water isotopes.
- The Bass Pond on Gary Koltiska property suggests possible recharge from the Ninemile Ditch and subsequent evaporation.

Overall, water in PDC and lower Wildcat Creek were virtually identical in their isotope signatures and are reflective of recent runoff or snowmelt with little evaporation signature. CBM water has an isotope signature that reflects a colder-temperature recharge source than PDC. CBM water at the outfall has no evaporation signature while water in the Paul #3 Reservoir reflects significant evaporation. Water in the Paul monitoring well appears most similar to CBM water. Water from different locations along Wildcat Creek has widely varying isotope ratios indicating differences in water source or chemical evolution. Water in upper Wildcat Creek (AIMP-1 and IMP-1) is similar to CBM water in the Paul #3 Reservoir, but also could have formed through evaporation of water that was recharged at a similar temperature to CBM water.

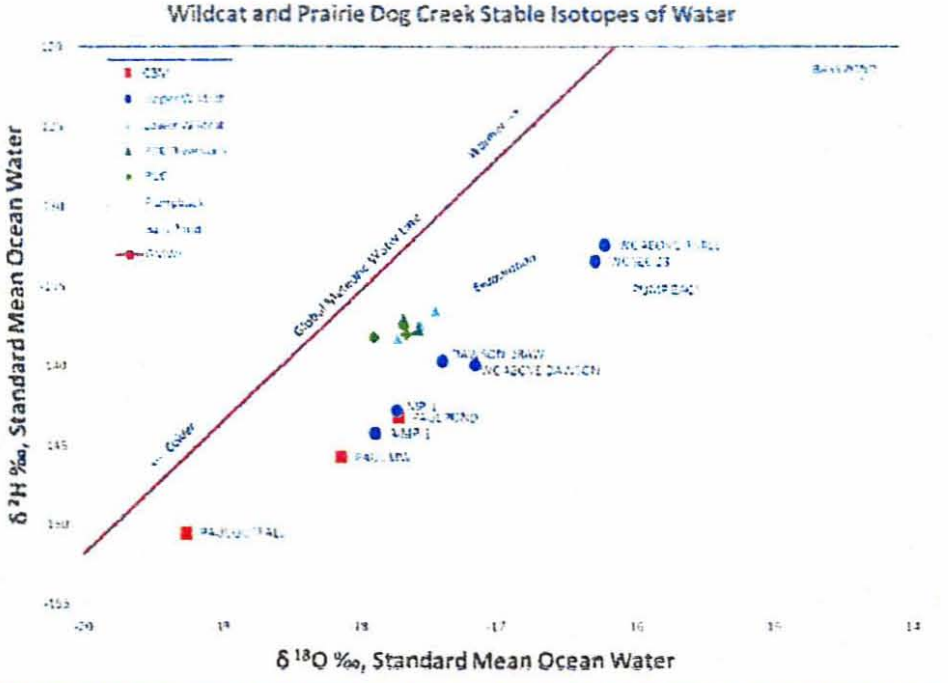


Figure 22. Stable isotopes of water in Wildcat Creek June 2009.

Carbon Isotopes - Carbon isotopes (Sharma and Frost 2008) reflect different physical and chemical processes than oxygen and deuterium. Inorganic carbon in most surface waters is derived from two sources, namely carbon dioxide evolved from soil organic matter decomposition and dissolution of limestone. In temperate regions, soil organic carbon has a $\delta^{13}C$ of about -25 per mil while limestone has a $\delta^{13}C$ around 0 per mil. Many surface waters have $\delta^{13}C$ of about -12 per mil indicating a blend of both carbon sources (Sharma and Frost 2008). The sources of carbon in natural water are shown in equation [3], which represents reaction in an open system where carbon dioxide is replenished from the soil atmosphere. One-half of the bicarbonate in water is from carbon dioxide and one-half is from limestone.

In a closed system, such as might be found in a subsurface environment, more of the inorganic carbon is derived from limestone because carbon dioxide is depleted during reaction [3]. Therefore, subsurface waters may have a somewhat higher $\delta^{13}C$ value (between -12 and -6) than surface waters. Where surface waters have long periods to equilibrate with the atmosphere, such as in lakes and ponds, the $\delta^{13}C$ values will approach atmospheric carbon dioxide of about -8 per mil.

$$C_{org}O_2 + H_2O + CaC_2O_3 = HC_{org}O_3^- + HC_2O_3^- + Ca^{+2} \quad [3]$$

In carbon-rich subsurface environments, including poorly-drained soils and coal seams, carbon dioxide can be reduced by microorganisms to methane. Conversion of carbon dioxide to methane favors the lighter ^{12}C carbon so that the residual bicarbonate in water where methane has formed becomes heavier. Consequently, CBM water, which forms due to methanogenesis has a distinctive $\delta^{13}C$ value that is generally greater than zero per mil and can vary by coal seam.

The carbon isotope and bicarbonate levels in water samples (Figure 23) show distinct groups for samples that share common chemical evolution pathways.

- All PDC waters and lower Wildcat Creek samples had similar carbon isotope signatures indicating common chemical evolution. Bicarbonate concentrations in these samples are low (<250 mg/L) due to a predominance of snowmelt and little interaction with soil and rock.
- CBM waters had much higher $\delta^{13}C$ values and bicarbonate concentrations than natural surface waters owing to methanogenesis.
- Water in the monitoring well downgradient of the Paul Reservoir also had elevated $\delta^{13}C$ and bicarbonate indicating that groundwater was derived largely from seepage out of the Reservoir.
- Water samples from upper Wildcat Creek had similar $\delta^{13}C$ delta values to PDC and lower Wildcat Creek but higher bicarbonate concentrations. The similarity in $\delta^{13}C$ values indicates a common source for the carbon (carbon dioxide and limestone). The higher bicarbonate concentrations are likely due to greater interaction with soil and rock and formation in a more closed system (e.g. less replenishment of carbon dioxide).
- Water samples collected near the most upstream occurrence of surface water in Wildcat Creek (AIMP-1) had slightly higher $\delta^{13}C$ values than other upper Wildcat samples just above the Ninemile Ditch but within the range that is typical for surface waters. According to Vance (2009) and O'Neill (2009), these results suggest that about 18 % of the water at AIMP-1 was derived from CBM. While this explanation is plausible, it is also possible that slight differences in the degree of gas exchange (e.g. open vs. closed system) between the two locales accounts for the differences in $\delta^{13}C$. Additionally, a limited amount of methane production in the saturated organically-enriched sediments beneath Wildcat Creek could also account for the higher $\delta^{13}C$ value in AIMP-1.
- Water from the pumpback sump also had a higher $\delta^{13}C$ than other waters in upper Wildcat Creek. While this could be due to contributions of CBM water, the oxygen and deuterium isotope signature tend to refute a CBM source. More likely, water in the pumpback sump was derived from natural sources in upper Wildcat Creek that had more limited gas exchange (e.g. subsurface water) or that had undergone limited methane production.
- Water from the Bass Pond reflects equilibrium with atmospheric carbon dioxide.

Overall, the similarity of samples from lower Wildcat Creek to PDC samples indicates that water diverted into Wildcat Creek from PDC chemically dominates Wildcat Creek below the Ninemile Ditch. CBM waters are isotopically distinct from either PDC or upper Wildcat Creek water. The chemical signature in CBM water reflects methanogenesis. Water in the Paul monitoring well appears to be mostly CBM water. Isotope delta values in Wildcat Creek samples are variable, which is consistent with variable water sources or chemical evolution pathways. The somewhat higher $\delta^{13}C$ values in samples from AIMP-1 and IMP-1 may be caused by small CBM contributions (as suggested by Vance (2009) and O'Neill (2009)) but could also be accounted for by a deeper subsurface water source resulting in methanogenesis or reduced carbon dioxide exchange.

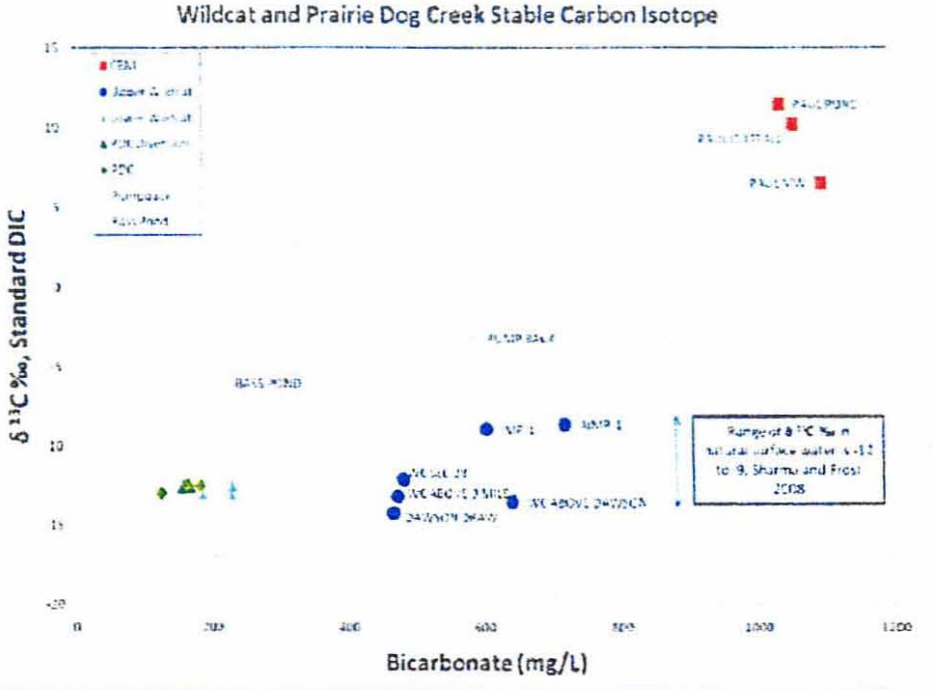


Figure 23. Stable isotopes of carbon vs. bicarbonate in Wildcat Creek June 2009.

EXHIBIT C

Kate M. Fox (Wy. Bar No. 5-2646)
J. Mark Stewart (Wy. Bar No. 6-4121)
DAVIS & CANNON, LLP
Attorneys for Protestants
422 W. 26th St.
P.O. Box 43
Cheyenne, WY 82003

BEFORE THE ENVIRONMENTAL QUALITY COUNCIL
OF THE STATE OF WYOMING

IN THE MATTER OF THE APPEAL OF JOHN D. KOLTISKA, AC RANCH, INC., a Wyoming Corporation, PRAIRIE DOG RANCH, INC. a Wyoming Statutory Close Corporation, and PRAIRIE DOG WATER SUPPLY COMPANY FROM WYPDES PERMIT NO. WY0054364	)	Docket No. 09-3805

RESPONSE TO PENNACO ENERGY INC.'S FIRST SET OF DISCOVERY REQUESTS TO JOHN D. KOLTISKA, AC RANCH, INC., PRAIRIE DOG RANCH, INC., PRAIRIE DOG WATER SUPPLY COMPANY

Petitioners in the above captioned matter for their responses to Pennaco Energy, Inc.'s First Discovery Request state as follows:

REQUESTS FOR ADMISSIONS

Request No.1: The modified Permit only allows natural overtopping of Paul # 3 Reservoir (Paul # 3) in the event of a precipitation event.

Response: Admit

Request No.2: No water discharged from outfall 002 will reach irrigated crops unless a precipitation event causes natural overtopping of Paul # 3.

Response: Deny

Request No.3: Natural overtopping from Paul # 3 caused by a precipitation event will mix produced water and natural precipitation.

Response: Admit, but affirmatively state there is no assurance of the mixing quantities and qualities.

Request No.4: Petitioners do not use water from Prairie Dog Creek or Wildcat Creek for livestock watering.

Response: Deny

Request No.5: In March 2008, Pennaco's water expert, Dr. William Schafer, held a question & answer session to address Petitioners' questions and concerns regarding CBM water.

Response: Deny

Request No.6: On April 29, 2009, the DEQ published the Major Modification of the Permit and the following claims raised by Petitioners' Petition concerning outfall 001 are now moot, including 3(h), 3(i) and 3(1).

Response: Admit

Request No.7: Chapter 1, Section 20 of the Wyoming Water Quality Rules and Regulations and the November 11, 2008 Agricultural Use Protection Policy does not require effluent limitations imposed by a WYPDES permit to preserve the ambient water quality.

Response: Admit

Request No.8: The Hanson Chart describes the potential restrictions on use of water irrigation based on Electrical Conductivity (EC) and Sodium Absorption Rate (SAR).

Response: Deny

Request No.9: Irrigation return flows into Prairie Dog Creek negatively impact the EC and SAR of water in Prairie Dog Creek.

Response: Deny

INTERROGATORIES

Interrogatory No.1: If Petitioners deny any portion of the requested admissions above, please explain in specific detail the complete factual and technical basis for any such denial.

ANSWER:

http://nwis.waterdata.usgs.gov/wy/nwis/qwdata/?site_no=06306250&agency_cd=USGS

USGS Water Quality Data, Prairie Dog Creek at Wakeley (Gauge No. 06306200) available at:
http://nwis.waterdata.usgs.gov/wy/nwis/qwdata/?site_no=06306200&

Prairie Dog Water Quality Data (JK000010 – 000106).

Request No.6: Please provide all documents related to your allegation in paragraph 3(p) of your Petition that the Permit's effluent limitations for EC, SAR, and sodium concentrations "have the reasonable potential to adversely impact the agricultural use of the receiving waters" and that these effluent limitations were "not derived from appropriate scientific methods ...."

Response: See response to RFP 4.

Request No.7: Please provide all documents related to your allegation in paragraph 3(q) of your Petition that the "Permit conditions do not provide compliance with the applicable requirements of W.S. 35-11-302 and the Water Quality Rules and Regulations in violation of Water Quality Rules and Regulations, Chapter 2, Section 9(a)(vi)."

Response: See response to RFP 4.

Request No.8: Please provide all water quality monitoring tests, results, and information conducted on Prairie Dog Creek and Wildcat Creek that were not obtained from the Wakeley Siding monitoring station or Acme monitoring station.

Response: See JK00010 – 00106, JK000107 – JK000109, JK000118 – 000119, JK000132– 134, JK000269 – 000281.

Request No.9: Please provide all documents related to your allegation in paragraph 3(s) of your Petition that the "Permit allows discharges of treated to water to alter the EC, SAR, and sodium concentrations in Prairie Dog Creek to levels that the DEQ has determined are likely to result in measurable decreases in production of irrigated crops."

Response: See Response to RFP 4.

DATED this _____ day of June, 2009.

As to answers to interrogatories:

_____
John D. Koltiska, personally and on

John D. Koltiska, personally and on behalf of AC Ranch, Inc., Prairie Dog Ranch, Inc.

John D. Koltiska, Vice-Chairman
Prairie Dog Water Supply Co.

STATE OF WYOMING)
) ss
COUNTY OF SHERIDAN)

The foregoing instrument was subscribed to and sworn before me by JOHN D. KOLTISKA this 3 day of JUNE, 2009.

My commission expires: _____

H.E. CORBETT - NOTARY PUBLIC
County of Sheridan State of Wyoming
My Commission Expires April 6, 2013

As to objections:

Kate M. Fox (Wy. Bar No. 5-2646)
J. Mark Stewart (Wy. Bar No. 6-4121)
DAVIS & CANNON, LLP
Attorneys for Protestants
422 W. 26th St.
P.O. Box 43
Cheyenne, WY 82003

CERTIFICATE OF SERVICE

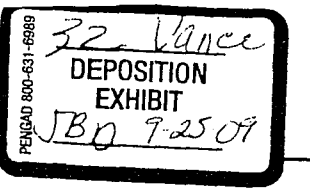
I hereby certify that on this 30th day of June, 2009, the foregoing was served via email and U.S. Mail to:

Mark Ruppert
Holland & Hart, LLP
P.O. Box 1347
Cheyenne, WY 82003 – 1347
MRuppert@hollandhart.com
Attorney for Pennaco Energy, Inc.

Mike Barrash
Wyoming Attorney General's Office
123 Capitol Building
Cheyenne, WY 82002
MBARRA@state.wy.us
Attorney for WDEQ

J. Mark Stewart

EXHIBIT D



Page 226

MR. COVERDALE: No, it didn't.
MR. MORRIS: Tim.
MR. FLITNER: I'd like to jump in here just a minute with an answer to the other part of your question as far as the does plant community matter? If you're in the forage harvesting business, it absolutely matters, and in most cases, it can make all the difference in the world. There are plants we want and plants we don't want and plants we can't have.

So those are a big consideration when we're talking about years from now as you say as these things keep changing -- and we've talked about this before up here -- somebody, sooner or later, is going to have to clean this up if we screw it up. And so that plant community plays a big part of that.

MR. MORRIS: Dr. Harvey (sic), what would be your recommendations for standards?
DR. VANCE: I'm sorry?
MR. MORRIS: What would be your recommendations for standards?
DR. VANCE: My recommendation would be Tier 1. I feel that it's of significant protection.
MR. MORRIS: And those numbers are what?
DR. VANCE: The SAR maximum of 10 with ECs that are protective of the plant.

Page 227

So again, we'd have to look at the environment to figure out what plants we're trying to protect and determine based upon those characteristics.

And then there is also once you determine that EC characteristic, then you can also back out the SAR relative to these other concerns such as infiltration.

MR. MORRIS: Thank you.
Mr. Wagner.
MR. WAGNER: One real quick question. Did you give us the correct Hanson chart value for an equation?
DR. VANCE: I gave you an equation that was recalculated based upon the correct figure.
MR. WAGNER: Thank you.
DR. VANCE: But again, that was primarily because Dr. Jim Rhodes was very upset that Wyoming was using something that was incorrect relative to Ayers and Westcot.
MR. SEARLE: In that regard, Mr. Wagner, which equation are you currently using in your proposal?
MR. WAGNER: Mr. Searle, I believe in our proposal is the historic Hanson chart that we've always been using.
MR. SEARLE: The one that we're suggesting, has been suggested, is incorrect?
MR. WAGNER: That's correct.

Page 228

MR. SEARLE: Thank you.
CHAIRMAN BOAL: Thank you, Dr. Vance.
DR. OGDEN: I do have a question.
DR. VANCE: You remembered.
CHAIRMAN BOAL: I was trying to get you off the stand.
DR. OGDEN: If we invoke some kind of a rule that preserves infiltration, in the end game after the discharge is finished, could you speculate about the condition of the soils? Because we are in a semi-arid environment, will they become, you know, sodium logged?
DR. VANCE: Saline sodium?
DR. OGDEN: Saline sodium anyway?
DR. VANCE: I suspect they will because we're adding saline sodic waters in most cases. We'll be leaching out some of the soils based upon the irrigation regime.

Quantity is going to be an important role in trying to just get the site to be preserved. Clearly, you don't want to have water impounded on the environment. That's not the -- that's not good for plant growth. But once you turn off the tap, the water that's there has salt and sodium in it and it's not going to disappear.

And then once you start to get rainfall events, the first thing that happens is that calcium magnesium

Page 229

tends to leach out. Sodium is preserved on these exchange sites and it actually increases the dispersivity of the soil.

And we have seen that -- I haven't seen it, but irrigation specialists have seen that. It's a well-known fact that once you start adding low ionic-strength waters to these systems, rainfall is a low ionic-strength water, it starts to disperse the clays. Because you don't have the salts and the calcium magnesium or other types of salts that are perfect for trying to keep them in a floculated state, a well-structured environment.

DR. OGDEN: Okay. Thank you.
MR. MORRIS: Dennis, you still got -- there was a look on your face.
CHAIRMAN BOAL: No. I'm glad you came and your testimony was very interesting. Thank you, sir.
DR. VANCE: I apologize for taking so long. I do have my card. Feel free to contact me.
MR. MORRIS: Do you have anything else, Mr. Wagner?
MR. WAGNER: No.
MR. MORRIS: Thank you, Dr. Vance. It's very good testimony.
DR. VANCE: Thank you.
MR. MORRIS: Okay. At this time we're

EXHIBIT E

Wyoming Department of Environmental Quality
Water Quality Division
WYPDES Program

STATEMENT OF BASIS

MAJOR MODIFICATION

APPLICANT NAME: Pennaco Energy Inc.

MAILING ADDRESS: 3601 Southern Drive
Gillette, WY 82718

FACILITY LOCATION: Adams Ranch Treatment Facility, located in the SWNE of Section 3 and the NESE of Section 6, Township 55 North, Range 83 West, in Sheridan County. The produced water will be treated and discharged directly to Prairie Dog Creek (class 2AB), and to one on-channel reservoir located on Wildcat Creek (class 3B), which is tributary to Prairie Dog Creek. The daily maximum permitted flow rate for the direct discharge to Prairie Dog Creek at this facility is 1.47 million gallons per day (MGD). Because the effluent at this facility is being discharged from treatment units with controllable output quality, this permit does not regulate which coal seam(s) may contribute to the discharge.

NUMBER: WY0054364

Because the permittee has determined that direct discharge to Wildcat Creek is no longer necessary at this facility, the permit is being modified by WDEQ, in accordance with Chapter 2, Section 12(d)(i) of the Wyoming Water Quality Rules and Regulations, as follows:

1) Remove outfall 001.

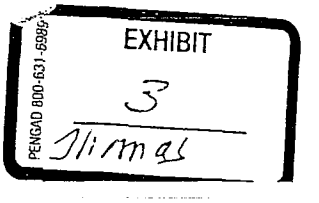
2) Add containment requirement to discharge at outfall 002 (See Part I.A.1.b).

3) Update effluent limits at outfall 002 to reflect containment of effluent, rather than direct discharge (See Part I.A.1.b).

All other conditions of this permit shall remain unchanged, and in full force and effect.

General Facility Description

This facility is a typical coal bed methane production facility in which groundwater is pumped from a coal bearing formation resulting in the release of methane from the coal bed. The permit authorizes the discharge to the surface of groundwater produced in this way provided the effluent quality is in compliance with effluent limits that are established by this permit. In developing effluent limits, all federal and state regulations and standards have been considered and the most stringent requirements incorporated into the permit. The effluent limits established in this permit are based upon Chapters 1 and 2 of the Wyoming Water Quality Rules and Regulations and other evaluations conducted by WDEQ related to this industry. This permit does not cover



activities associated with discharges of drilling fluids, acids, stimulation waters or other fluids derived from the drilling or completion of the wells.

The permittee has chosen option 2 of the coal bed methane permitting options. Under this permitting option, the produced water is immediately discharged to a class 2 or 3 receiving stream which is eventually tributary to a class 2AB perennial water of the state. Outfall 003 discharges directly to Prairie Dog from a treatment unit. Outfall 002 discharges from a treatment unit to an on-channel reservoir located on Wildcat Creek. The permit establishes effluent limits for the end of pipe, which are protective of all the designated uses defined in Chapter 1 of Wyoming Water Quality Rules and Regulations. This may include drinking water, game and non-game fish, fish consumption, aquatic life other than fish, recreation, agriculture (including irrigated agriculture), wildlife, industry and scenic value. Based on a review of this permit application, it has been determined that numerous active irrigation uses of surface water do occur downstream from this facility on Wildcat Creek and Prairie Dog Creek.

Below outfall 002, the permittee is required to contain all produced water within the reservoir during "dry" operating conditions, and discharge of effluent from the reservoir, except during periods of time in which natural precipitation causes the reservoir to overtop and spill, is prohibited. Intentional or draw-down type releases from the reservoir will constitute a violation of this permit. Discharge from the reservoir is limited by the permit to natural overtopping and shall not extend beyond a 48 hour period following commencement of natural overtopping. It is the responsibility of the permittee to adequately demonstrate the circumstances in which reservoir discharges occurred, if requested to do so by the WYPDES Program.

Effluent Limits (Outfall 003 – Direct Discharge to Prairie Dog Creek)

Permit effluent limits are based on state regulations and are effective as of the date of issuance. The permit requires that the pH must remain within 6.5 and 9.0 standard units, and limits sulfate to 3000 mg/l. These limits are based on water quality standards established in Chapter 2 of the Wyoming Water Quality Rules and Regulations for the protection of livestock and wildlife consumption.

A wasteload allocation (WLA) was used for the calculation of water quality based effluent limits at outfall 003 for this facility. Results are presented in the table below. To determine available dilution volume within Prairie Dog Creek under a worst-case scenario, a critical low-flow 7Q10 value was calculated for Prairie Dog Creek, using the EPA DFLOW model, and stream flow data from USGS station 06306250 "Prairie Dog Creek Near Acme, WY." This results in a calculated 7Q10 value of 1.20 cfs for Prairie Dog Creek. As an additional input to the waste load allocation, WDEQ used ambient water quality data collected from the same station.

Based on the previously-described WLA, the daily maximum effluent flow limit for outfall 003 is 1.47 MGD. In addition, the following water quality based effluent limits are established at outfall 003: a dissolved iron limit of 100 µg/l cadmium limit of 0.3 µg/l, a dissolved manganese limit of 50 µg/l, a dissolved copper limit of 12 µg/l, a dissolved lead limit of 3 µg/l, total recoverable arsenic limit of 3.7 µg/l, a total recoverable selenium limit of 2.0 µg/l, a chloride limit of 70 mg/l, a total recoverable barium effluent limit of 645 µg/l and a total recoverable Radium 226 + 228 effluent limit of 2 pCi/l. These water quality based effluent limits are based on standards for class 2AB waters which are intended to protect for the above listed designated uses and reflect the application of tier 2 antidegradation protection in accordance with the "Wyoming Surface Water Quality Implementation Policies for Antidegradation."

All effluent limits are to be met at the end of the final treatment unit, prior to dilution with any other waters of the state.

EXHIBIT F

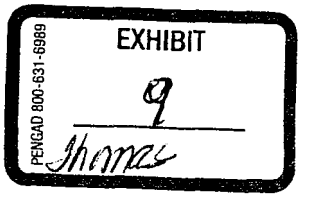
Department of Environmental Quality

To protect, conserve and enhance the quality of Wyoming's environment for the benefit of current and future generations.

Dave Freudenthal, Governor

John Corra, Director

November 21, 2007



Mr. Brian Lovett
WYPDES Compliance Supervisor
DEQ/Water Quality Division
122 West 25th Street
Herschler Building, 4th Floor-West
Cheyenne, Wyoming 82001

RE: Flow in Wildcat Creek, Sheridan County – Pennaco Energy, Inc: AC Ranch Central, Option 2 WYPDES Permit WY0052141

Dear Mr. Lovett:

On or about October 23, 2007 Ms. Jill Morrison, Powder River Basin Resource Council (PRBRC), reported that a CBM pit was being constructed in Wildcat Creek in an area that normally has cat tails. She has had an on-going concern about increased flow in Wildcat Creek and the impact on water quality. She feels the increased water flow in Wildcat Creek is from CBM water.

Pennaco reported that the "reservoir" in question is actually a private landowner's existing duck pond. Pennaco is assisting landowner Rob Koltiska by removing silt and debris that has accumulated over the years, but there is no reservoir or CBM discharge point being constructed.

There are five WYPDES permits on Wildcat Creek – WY0052132, WY0052141, WY0052671, WY0053881 and WY0054364, all of which belong to Pennaco Energy. Except for Paul #3 Reservoir associated with outfall WY0052141-003, there is no evidence that any of the outfalls or reservoirs are contributing flow to Wildcat Creek.

An inspection on November 1, 2007 revealed that water was seeping from the base of Paul #3 Reservoir shown in Photo1. Paul #3 is in the channel of Wildcat Creek and predates any CBM activity. The water flows down Wildcat Creek approximately 1700 feet to an existing depression shown in Photo 2. This existing depression is used as a pump back pond to pump water to Makayla Reservoir associated with outfall WY0053881-008. Anecdotal evidence indicates that Makayla has very little if any infiltration. There is no overland flow in Wildcat Creek immediately below the pump back pond. Surface flow in Wildcat Creek is first observable approximately 500 feet below the pump back pond. There was some standing water above this point. The ground was muddy at the time of the inspection and landowners in the area said there had been considerable rain recently.

1866 SOUTH SHERIDAN AVENUE • SHERIDAN, WY 82801
AIR, LAND AND WATER DIVISIONS
(307) 673-9337 • FAX (307) 672-2213

Pennaco reported they notified Kevin Wells, Cheyenne WYPDES Compliance Coordinator, on or about June 14, 2007 that Paul #3 Reservoir was seeping. Pennaco said they were given permission to pump the water back to Makayla Reservoir. A Pennaco field representative said they used the existing natural depression as a pump back pond because water collected there naturally and water could be pumped back without digging up Wildcat Creek.

Should you have any questions or comments concerning this matter, please contact me at 307-673-9337 or bbarre@state.wy.us.

Sincerely,

Bill Barrett
WYPDES Inspector
Water Quality Division

cc: WYPDES File # WY0052141
Aaron Urdiales, 8ENF-W-NP, US EPA, Denver
WYPDES Program, Cheyenne DEQ Office

EXHIBIT G

Lidstone and Associates, Inc.
Engineering, Geology and Water Resource Consultants

July 20, 2009

Mr. Mark Stewart
Davis and Cannon, LLP
Attorneys at Law
422 W. 26th Street
Cheyenne, Wyoming 82003

RE: Professional Opinion Concerning WYPDES Permit No: WY0054364

Dear Mark,

Lidstone and Associates, Inc. (LA) has been retained to provide a professional opinion into the scientific appropriateness of the methods used as the basis of the permit modification for Wyoming Pollution Discharge Elimination System (WYPDES) Permit No: WY0054364. John D. Koltiska, AC Ranch, Inc., Prairie Dog Ranch, Inc., and Prairie Dog Water Supply Company are appealing the Wyoming Department of Environmental Quality (WDEQ) issuance of the major modification of the referenced permit.

In order for WDEQ to issue a WYPDES permit in an area where the intent is to protect agricultural use they must follow the rules and regulations of Chapter 1, Section 20 of the WDEQ water quality rules and regulation which states that:

> *All Wyoming surface waters which have the natural water quality potential or use as an agricultural water supply shall be maintained at a quality which allows continued use of such waters for agricultural purposes.*
>
> *Degradation of such waters shall not be of such an extent to cause a measurable decrease in crop or livestock protection.*
>
> *Unless otherwise demonstrated, all Wyoming surface waters have the natural water quality potential for use as an agricultural water supply.*
>
> *The procedures used to implement this section are described in the "Agricultural Use Protection Policy."*

WDEQ has further responsibility as dictated by the requirement of Chapter 2 Section 5 (c) (iii) (C) (IV) which states:

> *Where the administrator determines that an effluent constituent has the reasonable potential to adversely impact a designated use of receiving surface waters of the state and no numeric standard has been promulgated in Wyoming Water Quality Rules and Regulations, Chapter 1 for the constituent, the administrator may establish a numeric effluent limitation based on values derived from appropriate scientific methods.*

Exhibit 4

4025 Automation Way, Building E, Fort Collins, Colorado 80525-3448 (970) 223-4705 fax: (970) 223-4706 e-mail: water@lidstone.com

The Agricultural Use Protection Policy (Policy) as referenced above lists electrical conductance (EC) and sodium adsorption ratio (SAR) as the basic water quality parameters of concern with regard to irrigation. The Policy also requires that the WDEQ establish appropriate effluent limits for EC and SAR in WYPDES permits such that irrigation water is protected for that use.

This document will identify deficiencies in the scientific methods and assumptions which were used by WDEQ to establish WYPDES effluent standards. In my professional opinion, the WDEQ methods and assumptions were not well founded and not in accordance with the Policy.

SITE LOCATION AND LAYOUT

The area of interest is east of Sheridan, Wyoming along Prairie Dog and Wildcat Creeks. **Figure 1** shows the location of the Acme and Wakeley Gages, Outfall 003, the Paul Reservoir, the applicant's Pumpback System, and IMP-1, all of which lie within the area of interest.

DATA AND DATA RELATIONSHIPS

In order to use appropriate scientific methods to derive protective effluent limitations, the data and data relationships must be sound. When the WDEQ completed the Major Modification of the existing WYPDES permit, they established water quality standards for the applicant's outfalls based on data that had been previously available and used in the original permit. Despite the availability of additional and a more complete data set, no new data were used. The data used to establish the Major Modification water quality standards are defined in the Major Modification, Statement of Basis (Basis) and were documented in deposition testimony by Kathy Shreve (Exhibit 16). The WDEQ failure to follow best scientific practice is discussed below.

The WDEQ did not use additional publically available data to assist in establishing water quality standards for the WYPDES outfall as part of the permit modification (WYPDES Permit No. WY0054364). Data for the Acme and Wakeley Gages exist beyond 2006 and these data were available to WDEQ at the time of the permit modification. Data from the USGS are readily accessible and should have been used to verify if the original data remain adequate as a standard of ambient water quality. If the original data were not adequate, good scientific practice dictate that the WDEQ should use the complete data set to modify the permit and serve as its Basis. The additional data from the Wakeley Gage, alone would have fully characterized the waters near the effluent point for outfall #003. Both the Acme and Wakeley data are shown in **Appendix A.**

WDEQ did not follow good scientific protocol in their use of both laboratory and field measurements of the same water quality sample on select sampling events. Effectively this doubling of the statistical populations for some of the sampling events and not others skews the data means towards the sampling events, where duplication of the data set has occurred. One would expect very limited and predictable differences between field EC and laboratory EC of the same water. In her deposition (page 20 and 21) Kathy Shreve (WDEQ) testified that she employed this practice. In my professional opinion, such a practice is unacceptable because it effectively provides more weight to the data that is duplicated versus the data that is not duplicated.

To demonstrate the limited population and skewness of the data set which served as the Basis, I have compiled **Figure 2** of this report that identifies the EC data presented in Exhibit 16 of the Shreve Deposition. Based on my opinion, this figure represents all the data WDEQ used at the time of the original permit and reused during the permit modification. Note that the earlier data collection time period is represented by Acme Gage data only and the later time period is Wakeley data alone. There is also an unexplained data gap between the two data sets. As

shown in **Figure 2** the Acme data set, where most of the duplication of field and laboratory measurements of EC took place, skews the data towards the higher (and poorer water quality) EC. It is unacceptable practice to arbitrarily augment your data set to increase your sample size and improve your statistical measures. WDEQ should have determined which of the two samples (field or laboratory) they felt was more representative and used that in calculating the average EC for the Basis instead of using both results for part of the data.

An equally important consideration is the fact that the waters from Acme and Wakeley Gages represent two different populations and should not be averaged for this permit modification. The Wakeley Gage is closer to the WYPDES points of discharge and points of use and should serve as the Basis for effluent limitations. To demonstrate this, I have prepared **Figure 3**, which shows publically available, monthly USGS EC data from both the Acme and Wakeley Gages. Although these data were available at the time of the Modification, the data sets presented in **Figure 3** were not used by WDEQ. This figure demonstrates the differences in water quality population as the Wakeley data is consistently lower (better quality) EC than the Acme data for all data points. Even when reviewing the data set used by the WDEQ (**Figure 2**), one can note that the earlier portion of the data (Acme Gage data set) have a higher (poorer water quality) average EC than the Wakeley Gage data which skews the data towards higher averages than the Wakeley Gage data set. This difference in population is more apparent when one reviews the more complete data set as shown on **Figure 3**. Best scientific practice should not mix different sample populations. Furthermore, it is my professional opinion that one should use the data set which best demonstrates the ambient water quality at the point of discharge and/or point of use. **Figure 1** shows the geographic difference between the two gages and the location of certain features documented in the permit. The Acme and Wakeley Gages are approximately 23 stream miles apart; Acme Gage has a drainage area of 358 square miles and the Wakeley Gage has a drainage area of 87.9 square miles according to the USGS website. In my professional experience the difference in basin size may potentially lead to large differences in water quality. WDEQ should have used the available Wakeley data set in the Modified Permit to establish water quality limits for the applicant's outfall. This data set contains at least monthly data from 2003 to the beginning of 2009 and is more representative of the ambient water quality within the project area.

Finally, WDEQ's use of the relationship between ambient water SAR and ambient water sodium concentration, as shown on Graph 1 of the Basis, to quantify the results of mixing effluent into the stream is incorrect. Two major points regarding this are:

(1) Regression analyses are frequently used to predict possible outcomes that fall outside the range of the data. However as one gets further from the data used for the regression, there is a higher probability that the defined regression no longer adequately predicts the outcome (Kutner et. al, 2004). In this case, the water downstream of the outfall in low flow situations will approach an SAR much higher than predicted by this equation based on mass balance calculations described below.

(2) Regressions are only valid for the conditions of the data (Kutner, et al, 2004). The regression presented as Graph 1 of the Basis represents ambient water of Prairie Dog Creek and is only valid for the creek water quality prior to the addition of the effluent. In my professional opinion the addition of CBM effluent may change the overall water chemistry. This can be verified by completing a mass balance over the ambient water and effluent data points for the entire Wakeley data set. The resultant regression is a non-linear polynomial function in sodium concentration as shown in **Figure 4**.

SODIUM ADSORPTION RATIO

SAR is defined as follows:

$$SAR = \frac{Na^{+}}{\sqrt{(Ca^{2+} + Mg^{2+}) / 2}}$$

Where Na, Ca, and Mg are measures in milliequivalents per liter of the respective ions. As one can see from the above equation, sodium (Na) levels only partly describe SAR.

In the Basis, WDEQ did not set an SAR limit for either outfall and instead set a surrogate limit using sodium for Prairie Dog Creek and did not set any SAR limit for the Paul Reservoir outfall. The Policy states that:

> *Appropriate effluent limits for EC and SAR will be calculated and applied to WYPDES permits in all instances where produced water discharge may reach any artificially irrigated land. (Page 56)*

WDEQ did not follow the guidance and procedures of the Policy when they set an effluent standard based on sodium, not SAR for discharges along Prairie Dog Creek. The WDEQ did not follow the Policy at Paul Reservoir, where they did not set any SAR or sodium limit.

Prairie Dog Creek

The surrogate limit set for Prairie Dog Creek was based on a relationship between ambient water SAR and ambient water sodium concentrations as discussed above. The Basis indicated that an SAR of 5 would be protective of the existing uses along Prairie Dog Creek. WDEQ used the relationship outlined in the Basis to determine that an effluent limitation of 349 mg/L of sodium is equal to an SAR limitation of 5. The final permit was written based on a voluntary commitment by the permittee to meet a sodium limit of 300 mg/L as noted in the Basis. This sodium level will not yield an SAR that is less than 5 for all flows within Prairie Dog Creek. As the flow in the creek decreases to some threshold level the SAR will increase to values higher than 5 as demonstrated by the mass balance output in **Figure 5**.

Data provided in Exhibit 3 (page 21 of 37) of the Applicant's request for permit modification and renewal indicates that the effluent SAR will be greater than 22 as it is discharged into the creek, based on the levels of sodium, calcium and magnesium in the effluent. WDEQ personnel indicated that the Basis of the Permit assumes that the entire flow in Prairie Dog Creek consists of effluent without any mixing of ambient water (Thomas Deposition page 60). WDEQ indicates that they felt the water would be buffered by the natural constituents of the stream (Shreve Deposition page 83 and Thomas Deposition pages 63 and 64) according to the regression described above between ambient water sodium concentration and ambient water SAR.

With respect to the latter statement, buffering will not occur instantaneously and the natural stream buffering will not be sufficient to protect the irrigators, especially during low flow. If all the water in Prairie Dog Creek were effluent as assumed by WDEQ with the parameters from Exhibit 3 referenced above, you would need to solubilize over 1,700 pounds of calcium per day and over 800 pounds of magnesium per day from native rocks and soils in order to meet an SAR of 5 as shown in **Appendix B**. This would allow the water to maintain similar calcium and magnesium ratios to what currently exists in the ambient water. If calcium buffering alone were used to meet the SAR limit, the effluent would need to dissolve a total of over 3,100 pounds of

calcium per day. Therefore, the assumption that the stream's natural constituents will provide adequate buffering prior to reaching the irrigation headgates is false. In my professional opinion, WDEQ should either set an SAR limit that meets the proposed effluent in Exhibit 3 along with a minimum base flow volume in the creek below which no effluent can be discharged or set an SAR limit of 5 for the effluent as indicated in the Basis as being protective of irrigation water quality.

Good scientific practice would suggest that in order to develop adequate water quality effluent limitations, the WDEQ should have completed a mass balance using the existing water quality and flow data from the Wakeley Gage. This would allow one to determine the water quality after effluent addition at every data point in the set. Plotting the results of the base flow versus the mixed SAR would have provided a power function as shown in **Figure 5**. This regression curve, which more closely describes the data, could be used to determine the minimum low flow requirements necessary to buffer the solution and protect the irrigators in compliance with Chapter 1 Section 20 and the Policy. This mass balance and flow regressions should have been completed for a number of possible effluent limitations and then WDEQ could have chosen the best effluent limitations for this particular situation.

Paul Reservoir

As noted, WDEQ did not set an SAR limit for discharge into Paul Reservoir within the Basis. WDEQ inspectors found that the reservoir leaks (DiRienzo Deposition, page 10). However, WDEQ contends that since the leakage is contained and pumped back there is not any bypass from the system (DiRienzo Deposition, page 12) and the water is generally contained-- except when the provisions in the permit as set forth allow a reservoir overtopping event during a large storm event.

Hydrometrics, Inc. completed a sampling event June 15 and 16, 2009 where they analyzed for CBM water indicators throughout the Wildcat Creek and Prairie Dog Creek drainages. The sampling indicates that CBM water is present in reservoir, monitoring well, and outfall as noted by the presence of delta C_{13} measurements in the range of 6 to over 11. Natural waters in the area have a negative delta C_{13} values that range from -12 to -14 as shown by the data. (For more information about this procedure see Sharma, 2008.) Sampling locations IMP-1, AIMP-1 and the pump back each have negative delta C_{13} values but they are less negative than the natural waters. This change in delta C_{13} from natural water towards pure CBM water indicates the presence of CBM water impacts. Recognizing that the sampled water in Dawson Draw is natural and unaffected by CBM water and that the water within Paul Reservoir is primarily CBM water, one can complete a calculation to determine an estimate of the percentage of CBM water present at IMP-1 to meet the measured calcium, magnesium, and sodium concentrations at that site. The calculation shows that approximately 20 percent of the flow at IMP-1 during the sampling event was CBM water. Based on these two analyses, one can conclude that the Paul Reservoir and its Pump Back System does not prevent CBM water from reaching artificially irrigated land as shown in **Appendix B**. It my professional opinion that due to the fact that CBM water may reach the irrigators, the WDEQ should have set an SAR limit in accordance with the Agricultural Use Policy.

ELECTRICAL CONDUCTANCE

In the Basis, WDEQ set an EC limit for Prairie Dog Creek based on ambient water quality. For the effluent at Paul Reservoir WDEQ used a threshold requirement based on the EC in the soils for the most salt-sensitive crops along Wildcat Creek which the Basis indicates are alfalfa and pumpkins. The main concern with the EC limits has to do with the ambient average calculated in Prairie Dog Creek. As described above, WDEQ skewed the EC ambient average by their use of

Acme Gage data, which lies 23 miles further downstream from the more appropriate Wakeley Gage. Good scientific practice would dictate that WDEQ use the additional data from the Wakeley gage that was available at the time of the permit modification to evaluate the ambient water quality and establish effluent standards along Prairie Dog Creek. This data set more closely resembles the water quality near the outfall than does the data from Acme or the combined data from Acme and Wakeley used in the permit modification. The ambient EC at Wakeley is approximately 870 microsiemens (ms). WDEQ should consider changing the existing EC limit from 1215 ms to 870 ms in order to meet the intent set forth in the Basis.

SIMPLE MASS BALANCE

WDEQ did not complete any mass balance in their analysis of the applicability of their proposed effluent limitations. A simple flow averaged mass balance at each data point provides comingled water flow weighted averages of constituents of concern. This methodology shows relationships between flow and water quality that can provide insight into protecting downstream users. As described above, this simple mass balance would have shown WDEQ that the relationship between mixed SAR and mixed sodium concentrations is a non-linear polynomial function in sodium concentration as shown in **Figure 4**. In addition, relationships between low flows and SAR can be derived as shown in **Figure 5**. These are particularly useful in Wyoming where irrigation demand generally peaks as base flows within the rivers and creeks of the area decrease as is the case along Prairie Dog Creek. The lowest flows on record occurred in May, June, July and August. Each of these months are irrigation months with the lowest recorded stream flow of 0.53 cfs occurring in August of 2006. A simple mass balance would have shown that the mixed SAR during such low flow events may exceed 5. WDEQ should complete simple mass balances and evaluate comingled water relationships while completing permit applications where downstream water quality maintenance is imperative.

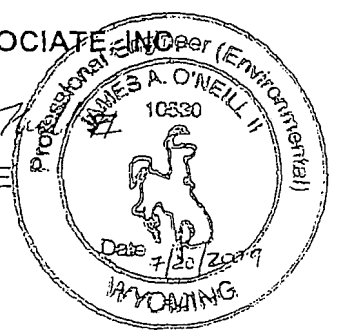
REFERENCES

Kutner, Michael H; Nachtsheim, Christopher J; and John Neter, Applied Linear Regression Models, 4th Edition, McGraw-Hill Irwin, New York, 2004

Sharma, S; and C.D. Frost; Tracing Coalbed Natural Gas-Coproduced Water Using Stable Isotopes of Carbon, Vol. 46, No. 2 Ground Water, March-April 2008.

If you have any question please feel free to give me a call.

Sincerely,
LIDSTONE AND ASSOCIATES, INC.



James A. O'Neill II, P.E.
Principal Engineer

JAO:rce

Sent via: Federal Express

DiRENZO

BEFORE THE ENVIRONMENTAL QUALITY COUNCIL
OF THE STATE OF WYOMING

IN THE MATTER OF THE APPEAL OF JOHN D. KOLTISKA, AC RANCH, INC., a Wyoming Corporation, PRAIRIE DOG RANCH, INC., a Wyoming Statutory Close Corporation, and PRAIRIE DOG WATER SUPPLY COMPANY FROM WYPDES PERMIT NO. WY0054364

Docket No. 09-3805

DEPOSITION OF BILL DiRIENZO
Taken by the Petitioners
2:17 p.m., Wednesday
June 24, 2009

PURSUANT TO NOTICE, the deposition of BILL DiRIENZO was taken in accordance with the applicable Wyoming Rules of Civil Procedure at the offices of the Environmental Quality Council, Herschler Building, 122 West 25th Street, Cheyenne, Wyoming, before Eric D. Nordberg, a Registered Professional Reporter and a Notary Public for the State of Wyoming.

Page 10

Paul reservoir.
Q. Were there any concerns during the public meeting or afterwards regarding containment in Paul Number 3, whether Paul Number 3 reservoir actually could contain --
A. We had --
Q. -- the discharge?
A. We had complaints. I don't know if -- I can't remember if that was -- if that came up at that meeting, but, yeah, we had previous complaints that the Paul reservoir leaked. We had our inspectors inspect it and so we knew about that, yes.
Q. What did your inspectors find when they inspected the Paul Number 3 reservoir?
A. That the reservoir did leak. I don't know if it was right at the toe of the reservoir or what, but they concluded that, yeah, water was coming out of the reservoir, flowing down the channel, but it had -- and it was being captured somewhere in that channel downstream and being pumped back to a third reservoir.
Q. Has there been any follow-up just to find out if all the flow is always captured at that pump-back point?
A. I don't know of any. I think that there was just the inspection by Bill Barrett. We might have -- there was -- I believe one of our inspectors had been out and done some winter monitoring in Wildcat Creek, but that was

Page 11

below Mr. Koltiska's house even. That was much farther on down the channel. So I think that was all in relation to that reservoir.
Q. When DEQ discovered the reservoir leaked, did they direct the permittee to do anything to correct the leak?
A. Well, the correction was the pumping of it back and still containing the water and keeping it from flowing on downstream.
Q. How far would you allow water to flow downstream?
A. It depends on the circumstance. If there's no irrigation in the -- we certainly wouldn't allow it to flow past a point where it would negatively affect irrigation and how far that is would depend on site-specific circumstances.
Q. And what follow-up do you do to confirm that all the water that's seeping out is being captured, if any?
A. What follow-up?
Q. Do you do follow-up inspections on a schedule or anything?
A. No. Our inspectors routinely inspect discharges on a schedule, and so they would eventually in the future be back at that point. But we didn't design any specific follow-up inspection for that that I know of.
Q. How long would it be between inspections?

Page 12

A. Again, that varies. Our basic requirement is to inspect each permit at least once during its term. That, though, some permits get inspected more often than that depending on circumstances.
Q. So does DEQ consider that, then, to still be -- Paul reservoir to still be fully containing the discharge?
A. Yes.
Q. Is there any regulation, policy or rule that you could point me to that says that you can allow leakage through a reservoir as long as it's recaptured downstream and still be considered to be containing the discharges?
A. I don't exactly know how to answer that question. The regulations are requiring that we protect that use, and so we would -- and containment requirements themselves.
Once the water is discharged, it's then discharged into a stream, discharged into one of these reservoirs, it is then technically water of the state. We don't require a permit for the release of that water out of that reservoir.
However, what we do is in setting the effluent limits, we set the effluent limits based on a certification by the operator that this water will be contained.
So in a circumstance on the Paul 3, the limits that they have are based contingent on them being able to contain it. So that's part of the permit and it is

Page 13

enforceable.
So if we come to a finding that that permit is, in fact, leaking, then it would be an enforcement circumstance. We could take an enforcement on the permit and we would force some remedial action.
Q. I understand that Paul Number 3 is also used as a discharge location for another permit, 52141, I believe.
A. If you say so.
Q. Yeah, or 54121. I can never keep it straight. So even though it leaks -- if the permit says that there's to be no discharge, even if a dam leaks, as long as it's recaptured, DEQ still considers the dam not to be --
A. On a case-by-case basis, we look and see what's happening there and we make that determination. There are reservoirs that have leaked and we did not make that determination and something else was done.
Q. Okay. Can you give me an example? What other things have been done?
A. Reservoirs have been abandoned and reclaimed.
Q. Have any of them been lined?
A. I don't know offhand.
Q. Okay.
A. You know, it would be handled by our enforcement folks who could tell you more specifically where this has occurred.

Page 14

Q. Okay.
A. We've had reservoirs fail, I mean completely fail, not just leak, breach, and we enforce and they get reclaimed.
Q. What was your involvement, if any, in establishing the effluent limits in the renewed permit and the modified permit?
A. I did not establish those limits.
Q. So is it safe to say, then, that if at a hearing -- strike that. I'll try again. If called to a hearing on this appeal, what, in general, would you be there to testify about?
A. I suppose whatever somebody was interested in asking me, but my involvement, again, is just kind of the oversight of these general policy-type things.
Q. So do you feel that -- let me back up. Are there any regulations or policies or guidelines that direct how permit writers are to set effluent limits for in a case such as this where you've got what is a perennial stream only because of a transbasin diversion?
A. There's no regulations that I know of that specifically talk about that circumstance.
Q. How about just for perennial streams?
A. Well, perennial streams, the regulations deal with discharges to the water of the state and then the

Page 15

limits that get set will be different for different circumstances.
Perennial streams generally are higher-class streams. They end up with more limitations because they are protected for more uses than ephemeral streams, such as there are human health uses on some streams, drinking water supply uses, wildlife, fisheries, things like that.
Q. Okay. What are the uses on Prairie Dog Creek, do you know?
A. I believe Prairie Dog is a 2AB. So it's designated for all uses.
Q. So ag?
A. Cold-water fish.
Q. Human consumption?
A. Right.
Q. What about Wildcat Creek, do you know?
A. Wildcat Creek would be a Class 3B, and it would not be protected for human health. It would be protected for general aquatic life, but not fisheries. And it's protected for -- all waters are protected for agriculture and wildlife, industrial uses, things like that.
Q. Okay. So the ag uses you protect for are livestock watering and irrigation?
A. That's correct.
MR. BARRASH: In Wildcat, you mean.

Page 16

THE WITNESS: Yes.
Q. (BY MR. STEWART) In Wildcat and in general.
A. On all streams.
Q. Those are the two classes of agricultural use?
A. Agriculture is a designated use on all waters. And not all waters are protected for irrigation. All are protected for agricultural uses, at least for livestock watering. All of them are protected for wildlife use. Those waters that support irrigation are protected for irrigation.
Q. Now, I know you were in for a part of Mr. Thomas' deposition yesterday, but I don't recall what points exactly. Were you there to hear him testify as to the assumptions inherent in the default limits DEQ uses to establish EC to protect alfalfa?
A. I'm sure I heard that that is -- that came up multiple times, I guess. I think I heard some discussion of that.
Q. Okay. Was there anything Mr. Thomas said that you'd disagree with?
A. Well, you'd have to tell me.
Q. I mean, is there anything -- any of his testimony that you heard yesterday that you would disagree with?
A. Nothing that strikes me as being off.
Q. So you would agree with him that the limits that

Page 17

are set in these -- in the renewed and the modified permit are protective of irrigation and agriculture.
A. Yes.
Q. You were here for a portion of Miss Shreve's deposition this morning. Was there anything you heard her testify to that you would disagree with?
A. I remember the discussion on the salt load that she eventually -- occurred to her that she was not looking at it right, but other than that, I think she was okay.
Q. Okay. So nothing that hit you, correct?
The Chapter 2 -- let's see. The permitting process is governed by the rules and regulations in Chapter 2; is that right?
A. Yes.
Q. Okay. What do those regulations require for establishing numeric limits when you're enforcing a narrative standard?
A. I'd have to look at the regulations to see specifically, but in general, we can interpret a narrative standard and derive numeric effluent limits based on the information that we have --
Q. Okay.
A. -- and the circumstances.
MR. STEWART: Mike, do you have a copy?
Q. (BY MR. STEWART) Yeah. This is a copy of

DEPONENT'S CERTIFICATE

I, BILL DiRIENZO, do hereby certify that I have read the foregoing transcript of my testimony given on June 24, 2009 and that the same is a full, true and correct record of my deposition.

_____
BILL DiRIENZO

( ) No changes ( ) Changes attached

Subscribed and sworn to before me this _____ day of _____, 2009.

_____
Notary Public

My commission expires: _____

CERTIFICATE

I, ERIC D. NORDBERG, a Registered Professional Reporter, and a Notary Public of the State of Wyoming, do hereby certify that the aforementioned witness was by me first duly sworn to testify to the truth, the whole truth, and nothing but the truth;

That the foregoing transcript is a true record of the testimony given by the said witness, together with all other proceedings herein contained.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my Notarial Seal this 10th day of July, 2009.

_____
ERIC D. NORDBERG
Registered Professional Reporter

My commission expires April 6, 2010.

KOLTISKA

BEFORE THE ENVIRONMENTAL QUALITY COUNCIL
STATE OF WYOMING

IN THE MATTER OF THE APPEAL OF JOHN D. KOLTISKA, AC RANCH, INC., a Wyoming corporation, PRAIRIE DOG RANCH, INC, a Wyoming statutory close corporation, and PRAIRIE DOG WATER SUPPLY COMPANY, FROM WYPDES PERMIT NO. WY0054364,

---

DEPOSITION OF JOHN D. KOLTISKA
Taken in behalf of DEQ

8:30 a.m., Thursday
June 18, 2009

PURSUANT TO NOTICE, the deposition of JOHN D. KOLTISKA was taken in accordance with the applicable Wyoming Rules of Civil Procedure at the Office of Davis & Cannon, 40 South Main, Sheridan, Wyoming, before Randy A. Hatlestad, a Registered Merit Reporter and a Notary Public of the State of Wyoming.

Page 82

don't have a list of the people that were at the meeting, and I don't remember back that far.
Q. (BY MR. OVERDYKE) Does your treasurer -- does your secretary, in the minutes, keep attendance of who attends the meeting?
A. I believe so.
Q. And it's your contention that some, if not all, were present, and they all voted for --
A. It was unanimous.
Q. It was unanimous. Gotcha.
A. If there was somebody against it, they didn't raise their hand. That's all I can say.
Q. What is Prairie Dog Water Supply Company's position on irrigation of CBM water?
A. Say that again.
Q. What is Prairie Dog Water Supply Company's position on irrigating with raw CBM water?
A. Our position?
Q. Correct. Perhaps an initial question would be do you have a position, an official position?
A. Prairie Dog Water Supply's position has been that as far as -- we never talked about irrigating with the water. As far as discharging the water into our irrigation system, we've always been against it.
Q. Okay. Thank you. Does the water supply

Page 83

company keep records of its members who irrigate with CBM water?
A. No.
Q. Do you know of any members who do irrigate with CBM water?
A. Yes.
Q. And who are those members?
A. It would be Perry, Brinkerhoff, and there's some people leasing Stella Barker's ground and Hutton's ground that are irrigating with it, and possibly Pilch.
Q. Is there CBM water in Wildcat Creek?
A. Do I believe so? Yes.
Q. Yes, sir.
A. I believe so.
Q. And why do you believe that?
A. Because I believe the reservoir leaks.
Q. What leads you to that conclusion?
A. As a child -- the Paul Number 3 gets its name from my father, Paul.
Q. Yes, sir.
A. That was his third reservoir. I believe it leaks because of how many acre-feet of water into that. And there's no way in the world they can account for it. Also, as a child, the reservoir -- if we had a downburst and it filled the reservoir, it was only full for maybe

Page 84

two weeks, tops. Then it was empty. Also, I've flown over Cat Creek. And it's got more water in it directly below the reservoir where it never did have water. Also, if you look at the permit for the construction of the Paul Number 3 reservoir, you will note on there that it says Cat Creek typically does not flow water. And also, when I was flying over it, you could see that there was no water above the reservoir.
Q. When did you do your fly-over?
A. It was in May.
Q. And where did you start?
A. I flew the whole -- both Cat creeks, top to bottom.
Q. And so is it fair to say that your belief that Paul 3's leaking is because there's water -- that you perceive there to be water in Cat Creek where there wasn't water before?
A. That's not the only reason. The other reasons are in -- I don't have my notes with me. But I think it was in 2008, there was a lot of water showed up in Cat Creek. And also, the EC got up as high as 2,800. And typically Cat Creek didn't flow water down in our place above where we put water in the Ninemile from.
Q. When you say "typically," what do you mean by that?

Page 85

A. Come midsummer, there's no water there.
Q. And that's as far as back as you can remember?
A. That goes back into the '70s.
Q. And do you get a sense of, is water flowing or is water just present in Wildcat?
A. Water's flowing.
Q. In Wildcat. From the base of the Paul 3 reservoir downward?
A. Yes.
Q. Is there an open breach?
A. Well, you know, from -- it's hard to see whether it was flowing or not. But it's not just like a pond of water sitting there.
Q. And have you -- have you seen this from a fly-over --
A. Yes.
Q. -- or have you been on the creek itself?
A. I've been on the creek itself prior to the -- and there was never any water in the creek. There could have been a few pools or, you know, like a slight spring, but there was never water running down the creek like it is now.
Q. Have you seen any impact from water that you believe to be escaping into Wildcat?
A. No. And I don't want to, either. I've limited

A. Yes.

MR. OVERDYKE: That's it.

(Deposition proceedings concluded 12:18 p.m., June 18, 2009.)

DEPONENT'S CERTIFICATE

I, John D. Koltiska, do hereby certify that I have read the foregoing transcript of my testimony consisting of 106 pages taken on June 18, 2009, and that the same is a full, true and correct transcript of my testimony.

_____
JOHN D. KOLTISKA

( ) No changes ( ) Changes attached

Subscribed and sworn to before me this ____ day of _____, 2009.

_____
Notary Public

My Commission Expires_____.

CERTIFICATE

I, RANDY A. HATLESTAD, a Registered Merit Reporter and a Notary Public of the State of Wyoming, do hereby certify that the aforementioned deponent was by me first duly sworn to testify to the truth, the whole truth, and nothing but the truth;

That the foregoing transcript is a true record of the testimony given by the said deponent, together with all other proceedings herein contained.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my notarial seal this 26th day of June, 2009.

_____
RANDY A. HATLESTAD
Registered Merit Reporter

My Commission Expires April 2, 2012.

O'NEILL

BEFORE THE ENVIRONMENTAL QUALITY COUNCIL
STATE OF WYOMING

IN THE MATTER OF THE APPEAL OF JOHN D. KOLTISKA, AC RANCH, INC., a Wyoming corporation; PRAIRIE DOG RANCH, INC., a Wyoming statutory close corporation; and PRAIRIE DOG WATER SUPPLY COMPANY, FROM WYPDES PERMIT NO. WY0054364.

DEPOSITION OF JAMES O'NEILL, II
TAKEN ON BEHALF OF MARATHON OIL COMPANY

9:00 a.m., Wednesday
September 23, 2009

PURSUANT TO NOTICE, the deposition of JAMES O'NEILL, II, was taken in accordance with the applicable Wyoming Rules of Civil Procedure at the offices of Holland and Hart, 2515 Warren Avenue, Suite 450, Cheyenne, Wyoming, before Janet Davis, a Registered Merit Reporter, Federal Certified Realtime Reporter, and a Notary Public of the State of Wyoming.

Page 14

Q. Yes?
A. Yes, that's correct.
Q. We have your report and we have the exhibits from your report, and I have the two documents you just referenced. Are there any documents of any kind that you relied on in authoring your report that were not part of the report and not what we've already identified?
A. There are no documents. I have some hand calculations and other things that were not included as part of the -- the report that were used and stuff, so...
Q. Do you have copies of those with you today --
A. I do.
Q. -- that we could --
A. Yes.
Q. At a break if I could get those from you, we will take a --
MR. STEWART: Did you bring copies or just your originals?
THE WITNESS: I just brought the originals.
MR. RUPPERT: We will need to get copies made.
MR. STEWART: Yeah.
Q. (BY MR. RUPPERT) And in doing your report -- doing your analysis and offering your report, did you

Page 15

confer with anyone else?
A. No.
Q. So this is your own work?
A. Yes.
Q. You didn't confer with a colleague?
A. The only thing I had a colleague do was review the English of the report to be sure it sounded good. I am an engineer.
Q. That's a good idea.
Do you -- well, other than Mr. Stewart, did you talk to anyone else in Mr. Stewart's firm about your report?
A. No.
Q. All right. And did you and he talk about a draft report that you may have done?
A. I don't think I sent him a draft. I sent him a final.
Q. And as you were going through the report and putting pen to paper, so to speak, did you and he talk about what the report should or should not contain?
A. No. On occasion I would tell him some of the things that I was learning, but he never said, "Well, I want you to go this direction or that direction." But I would on occasion call him and say, "My analysis is showing this or that."

Page 16

Q. I think you probably had a fairly compressed time frame to get your report out, didn't you?
A. We did have a very compressed time frame. I think it was like two weeks max, three weeks max. It wasn't very long at all.
Q. How much time would you say total that you spent on the report?
A. Probably 60 to 80 hours, I would guess.
Q. And that's your time?
A. My time, yeah, I would guess.
Q. We have been talking a lot about your report. Let's go ahead and mark one as a deposition exhibit and talk about that.
(Deposition Exhibit 3 marked for identification.)
Q. (BY MR. RUPPERT) Mr. O'Neill, I've handed you what's been marked as Deposition Exhibit 3 which I believe is a complete copy of your report. Can you confirm that?
A. This is my copy, so you haven't handed me a copy yet.
Q. I'm sorry.
A. There we go. I will hand it back in a second.
Q. No, you can keep it.
A. The figures are in order, and it all appears to be there.

Page 17

Q. You can go ahead and keep that.
I don't have any specific questions yet on the report, but I did want to talk about your background and experience as an engineer.
What kind of engineer are you generally, a civil engineer?
A. I would call myself an environmental engineer.
Q. Environmental engineer. Does that include agricultural engineer?
A. No.
Q. Prior to this case, have you had any experience with coalbed methane projects?
A. No.
Q. Coalbed methane-produced water?
A. No.
Q. Clean Water Act Section 402 discharge permits?
A. Uh-huh.
Q. Yes?
A. I think so, yes.
Q. And what was the context generally of that previous experience?
A. Most of the discharge permits that I've worked on have been for pump-and-treat systems for refineries and gasoline stations and stuff like that where we treated the effluent and then discharged it into a local drainage.

Page 18

Q. All right. If I say NPDES permits, do you know what I'm talking about?
A. NPDES, yes.
Q. Have you ever been involved with what is known as a WYPDES permit?
A. We've done a few WYPDES permits for wastewater treatment systems.
Q. But no coalbed methane-produced water?
A. No. I haven't anyway.
Q. Do you have any experience in previous projects in evaluating electrical conductivity?
A. Uh-huh.
Q. Yes?
A. Yes, I do.
Q. Can you tell me about that?
A. Electrical conductivity, I've had experience in monitoring it by taking samples. I've done that quite a few times. It is also a parameter we look at in terms of water treatment, wastewater treatment, and other treatment processes.
Q. So from now on during the day we can call that EC, and we will be on the same page?
A. We will be on the same page.
Q. What about sodium adsorption ratio? Any experience with that?

Page 19

A. Yes.
Q. What would that be?
A. I know what it is. I know the definition of it. I also have looked at it at least in terms of this case and other cases in terms of what if we put constituents into the water, what the SAR would be. And we've looked at it in terms of for some of our irrigating clients whether or not water that's coming down the creek at certain times of the year has too high of SAR or not.
Q. Have you ever previously given an opinion as to what a permit limit for SAR should be before this case?
A. No.
Q. Have you ever given an opinion in a previous case as to what the EC permit limit should be before this case?
A. No.
Q. Do you have any background or experience in water chemistry?
A. A little, I do.
Q. Can you describe that, please.
A. My training is in chemical engineering, so we take a lot of water chemistry. Also in my Master's work I've taken several water chemistry classes and also done some modeling in terms of water chemistry for permits for discharges previously.

Page 20

Q. Did that water chemistry permitting involve either EC or SAR?
A. No.
Q. And do you have experience or background in soil chemistry?
A. No.
Q. Do you have any experience or background in agronomy?
A. No.
Q. Let's dive into your report, and I'm looking at page 1 of the actual report.
A. Okay.
Q. On page 1 you cite Chapter 1, Section 20 of the WDEQ water quality rules and regulation. Before this case have you ever seen that rule before?
A. Not Chapter 1, Section 20. No, I had not.
Q. So you've never given an opinion on Chapter 1, Section 20 before?
A. No.
Q. Down lower on page 1, you recite Chapter 2, Section 5(c)(iii)(C)(IV). Do you see that?
A. Uh-huh, yes, I do.
Q. Had you ever seen that regulation before?
A. No.
Q. So you had never given an opinion on that

Page 21

regulation before either?
A. No.
Q. And then going over to page 2, you recite the Agricultural Use Protection Policy which I'm going to shorten to ag use policy, so we're on the same page. Before this case had you ever reviewed that before?
A. No.
Q. So you had not ever given an opinion on that before?
A. No.
Q. Before you sent out this final report to Mr. Stewart, did you conduct any site visits up around Sheridan?
A. I did.
Q. Can you tell me about that?
A. I went up and met with Mr. Koltiska, and he took us on a tour where he drove us around. And we got to see the building where the treatment plant is and the evaporation pond, and we got to see Wildcat Creek and his property there along Wildcat Creek. We drove along Prairie Dog and the approximate location where Outfall 3 would be located. We drove down to Wakely gauge and then all the way down to the Acme gauge.
Q. Did you take photographs?

Page 26

than one.
Q. And were you interested in whether or not that was causing any problem to their crops?
A. I was interested. I asked. He said that for some he really didn't know. For a couple he was -- that were up closer to the treatment plant area up Wildcat Creek, there were some locations that, from what I recall, he pointed out that they wouldn't have been able to have any crops at all if they hadn't been using coalbed methane water because they just didn't have enough water up that direction.
Q. Does the name Warren Adams ring a bell?
A. No.
Q. Just people along Wildcat Creek?
A. Yes.
Q. So along Wildcat Creek at least there were people who were using CBM water to irrigate with?
A. Uh-huh.
Q. Was that true along Prairie Dog, too, or do you know?
A. Yes, I think he pointed out a few as we drove by that said -- his a lot of times he would say, "I believe that they're using it," and, "They're using it," as we were driving by.
Q. Did he express -- other than, "These people

Page 27

wouldn't have any crop if it weren't for CBM water," did he express any opinion on that?
A. He was concerned in the long run it was going to cause them to salt their fields and that they wouldn't -- in the long run it would be damaging to their crops.
Q. Was he concerned that their use of CBM water would get up Wildcat Creek and into his irrigated fields?
A. I think he was. That wasn't expressed directly, but I think just from the way he was talking, I think that's his -- his concern, yes.
Q. And do you recall the landowner immediately upstream of him on Wildcat Creek irrigating pumpkins with CBM water? Does that ring a bell?
A. No.
Q. So he didn't express any concern about that upstream irrigator using CBM water?
A. I don't recall him doing so, no.
Q. And was that one site visit that you made?
A. I only went up there once, that's correct.
Q. And how long were you there, for the day?
A. We were there -- I would guess I was there for three or four hours. It was a long drive up and a long drive back, so --
Q. Long day?
A. Yes.

Page 28

Q. Did you meet with anyone other than John Koltiska?
A. Mark and I. I took Mark with me.
Q. So you didn't talk to anyone else?
A. Huh-uh.
Q. No?
A. No.
Q. Back on your report again, and I'm still on page 2 and I'm in the middle of page 2, that first paragraph under Data and Data Relationships. In the last part of that paragraph you say, "The WDEQ failure to follow best scientific practice is discussed below." Do you see that?
A. Where we at?
Q. The bottom of the paragraph.
A. Yes.
Q. Are you with me?
A. Yes.
Q. Just before we delve into the report, I'm curious whether the standard of best scientific practice is different than the standard of an appropriate scientific method in your mind?
A. Explain that question a little better, please.
Q. You used the term "best scientific practice," and I'm wondering if in your mind that equates to appropriate scientific method or if best scientific

Page 29

practice is, perhaps, a more stringent or a higher standard than the term "appropriate scientific method."
A. That's an interesting question. Never really thought about it.
Q. That's why we're here.
A. I think that in -- my feeling was they didn't use appropriate method to -- for this, and so scientific practice or scientific method in this case would be interchangeable in my vernacular.
Q. So you would equate the two?
A. That's correct.
Q. Did you find the term "best scientific practice" anywhere in the DEQ water regulations that you reviewed?
A. I don't recall.
Q. Now, as I understand a portion of your report here, you are critical that DEQ did not use all of the data that were available from the USGS stations in Prairie Dog Creek. Is that correct?
A. That's correct.
Q. And I'm looking on page 2 at the second paragraph under the heading Data and Data Relationships, and in the middle of that paragraph you start a sentence by saying, "If the original data were not adequate..." Do you see that?
A. Yes, I do.

Page 34

A. That's true.
Q. Why, in your opinion, is it appropriate to use only Wakely data and not appropriate to use Acme data?
A. Well, there's two reasons. One is if you look at the data, they are two separate populations and you have an average for one and an average for the other. And if you look at the data, they're just two different populations. The water chemistry changes from upstream to downstream.
Q. Right.
A. So in my opinion it makes the most sense to find out what you're going to do to the water closest to the discharge point. That's what we would do in a wastewater discharge treatment plant. It is what we would do in most effluent discharges. You would want to know what the effluent is when it mixes with the water that's closest to you, so you want the water that is as close to the effluent as you can.
Q. Do you know how that desire to see what's going to happen with the water as close to your effluent as you can fits with the requirements of Chapter 1, Section 20?
A. Well, my understanding of Chapter 1, Section 20 is we're trying to protect irrigators, and there are irrigators, I mean, all the way up and down the creeks. And so especially for #3, I don't know where the next --

Page 35

where we take off water the next time. It would be great to know what the mixed effluent would be at the place where we take water out that first time to see what kind of impact that we're going to have on an irrigated field or the effluent and the mixed water would be.
So that would be one of the reasons why -- I mean, if we could get water quality and have good sampling results right where we were going to mix it together, that would be the best.
Q. Do you know what a protective EC level is for alfalfa?
A. No.
Q. No idea?
A. Nope. Didn't look at that, so...
Q. Right. Okay. So --
A. I would --
Q. Go ahead.
A. I would look at somebody else to tell me what that was and as an engineer look to design a system that would put effluent in that would meet those requirements.
Q. Before I hand you another exhibit, let me just talk to you a little bit about -- you said you reviewed the depositions given by the DEQ people, correct?
A. Correct.
Q. Jason Thomas, Kathy Shreve?

Page 36

A. Uh-huh.
Q. And you looked at the permit in this case and the Statement of Basis for that permit?
A. Yes.
Q. Did you look at the previous 2007 permit and the Statement of Basis for that permit?
A. No.
Q. You weren't asked to?
A. I was not.
Q. Do you know why DEQ was using the sampling data from Wakely and Acme to set a permit limit at all? In other words, were they doing that to try to set a permit limit protective of alfalfa, or did they have another goal in mind?
A. I don't recall. The only thing that I do recall from the depositions was the reason why they felt like they should mix the data was they wanted an average over the entire length of the creek, from what I recall from the depositions.
Q. And do you recall from the depositions the idea that there was this collateral or peripheral goal in this permit -- and by this permit I mean the one you looked at -- as well as the previous permit of protecting the Tongue River water quality in Montana? Do you remember that at all?

Page 37

A. Uh-huh, yes, I do.
Q. And as we sit here today is it your understanding that's why they were looking at water quality data at Acme, Wakely and Prairie Dog Creek?
A. Maybe it is. I don't recall that. My opinion is, though, if you protect the water at Wakely, you protect the water in the Tongue.
Q. And so if the ambient water quality in the Tongue, for example, is 1300 EC and I have 500 EC at Wakely, then I'm going to be protective of the Tongue, is that what you're saying?
A. Yes, that's correct.
Q. And that's overprotective of the Tongue, right?
A. It may be.
Q. And is that okay under the regulations, or do you know?
A. I have no idea.
Q. All right.
MR. RUPPERT: It is early to take a break. Do you mind if we take about a five-minute break?
MR. STEWART: No, not at all.
(Recess taken 9:50 a.m. until 9:58 a.m.)
(Deposition Exhibit 4 marked for identification.)
Q. (BY MR. RUPPERT) I'll show you what's marked as

Page 58

Q. I will help you out. Would it be 3?
A. It is 3.
Q. That's all right. And you also have -- in the same sentence I just read that DEQ did not set an SAR for the Paul Reservoir Outfall -- and do you know why they didn't do that?
A. Yes. Because they -- it was their opinion that the Paul Reservoir wasn't impacting anybody because it wasn't leaking.
Q. Because it wasn't --
A. Because the water was going in and evaporating and not getting out of the reservoir.
Q. Or not getting beyond the pumpback station?
A. Correct. They considered that as part of the reservoir from the testimony I read.
Q. And do you have any basis to know whether or not that's a reasonable position based on your experience, or do you have an opinion on that?
A. I've got opinions, but I don't know that they're expert opinions, so...
Q. That's a good point. Do you have an expert opinion on that?
A. No, I do not.
Q. Do you know what an IMP is?
A. No. I mean, they call it an IMP in the report,

Page 59

but I don't --
Q. Don't know what that stands for?
A. No. And there's an AIMP, too.
Q. Right. You don't know what that stands for either?
A. (Witness shakes head.)
Q. I want to make sure I understand your opinion. I don't think you're saying, but I want to confirm -- I don't think you're saying that it is not scientifically appropriate not to set an SAR limit, are you? That's not one of your expert witness in this case?
A. Please restate that.
Q. Sure. Do your expert opinions in this case include an opinion that it is not scientifically appropriate to set an SAR at end of pipe?
A. So is it my expert opinion whether or not it is appropriate to set an SAR limit at the end of the pipe? Is that what you're asking?
Q. No. DEQ did not set end of pipe SAR limits for either Paul 3 or Prairie Dog Creek.
A. Correct.
Q. Okay. And as I understood your previous testimony, you -- you thought that might be an error because of your reading of the ag use policy, correct?
A. Correct.

Page 60

Q. And I don't think you had any other basis for your statement, correct?
A. No, that's correct.
Q. That's correct. So all I'm asking you is pretty much a restatement of what we just went over. And it may not be the greatest question in the world, but I'm really trying to just nail down the fact that you're not saying --
A. Yeah, I am not saying -- I'm not making an opinion, I guess, on whether or not it is appropriate except for the fact that their ag use policy asked me to do so.
Q. In other words, you don't have a scientific basis for that?
A. Correct.
Q. From your previous work on water discharge permits, are you familiar with the concept of trying to protect from acute application of certain effluent constituents compared to chronic application of effluent constituents?
A. Yes.
Q. Yes?
A. (Witness nods head.)
Q. What is the difference?
A. My understanding is that an acute would be

Page 61

something that you would have immediate impact or short -- if you were exposed to it for a short amount of time you would have an impact. A chronic would be you would have to sustain that exposure over a long period of time before you would see an impact.
Q. So for a constituent that fit in the chronic category, in setting an effluent limit you wouldn't be as concerned about an acute one-time or very infrequent application; you would be more concerned about the long-term impact of chronic application over time?
A. Correct.
Q. All right. For the constituents in this permit that we're talking about are the effluent limits, maybe it is a better term for EC and SAR, are we talking chronic or acute application?
A. I have no idea.
Q. You don't know?
A. No.
Q. Never studied that before?
A. No. I mean, Bill talked about that in his report. That was -- so never studied that before.
Q. All right. So you don't have any reason to agree or disagree with whether or not it is an issue of chronic or acute application?
A. No.

Page 98

that SAR of 5 on your figure?
A. Restate that, please.
Q. You've given alternate recommendations, either an SAR of 22 with a low flow limit or SAR of 5 with no flow limit. And I understand, I think, that the reason for your recommendation or opinion that an SAR limit of 5 needs to be set is to protect against these two low flow events that you show on Figure 5 that are above the SAR of 5?
A. To protect for any low flow events that would create an SAR greater than 5.
Q. Right. And in five and a half years we see two of those?
A. That's correct.
Q. And based on that you recommend an SAR limit of 5?
A. Or 22 with a low flow limit.
Q. With a 22?
A. Right.
Q. Right, okay. Your approach is not consistent with a harmonic mean flow approach, is it?
A. I don't know if it is or not. I don't think that it is.
Q. And it is not consistent with a 7Q10 flow approach either?

Page 99

A. No.
Q. Okay. And it is not consistent with a -- assuming SAR is an issue of chronic application, it is not consistent with that either, is it?
A. No. It is only consistent with what the language in the policy is about all instances where produced water discharge may reach artificially irrigated lands.
Q. Whether that makes sense scientifically or not, it is following the language in the policy?
A. Correct.
Q. Do you know whether or not that approach is even done for acute -- acute aquatic life protection?
A. I don't.
MR. RUPPERT: Do you want to take a lunch break, Mark?
MR. STEWART: Sure.
(Deposition proceedings recessed 12:12 p.m. and reconvened 1:30 p.m., September 23, 2009.)
Q. (BY MR. RUPPERT) All right. I'm on page 5 of your report under Paul Reservoir, and as I read this second paragraph under Paul Reservoir, am I correct in concluding that your opinion is that there are CBM water impacts at IMP-1, AIMP-1 and the pumpback?

Page 100

A. That's correct.
Q. And are you saying that that CBM water is coming from the Paul 3 Reservoir?
A. I believe that it is, just based on the information that was provided in the depositions that the reservoir is leaking. I did see Bill's report where it said that potentially it was coming from field runoff. I didn't look at that.
Q. Didn't consider that?
A. No.
Q. The basis for your opinion in here seems to be your analysis of the carbon 13 isotope data, right?
A. Correct.
Q. Have you used stable isotopes in your work before?
A. No.
Q. This is the first time?
A. That's correct.
Q. All right. Where did the idea to use that come from, from what you had already seen in the sampling, or did Mr. Stewart suggest that, or how did that come about?
A. I saw the paper, the Sharma paper on tracing coalbed methane.
Q. When did you see that paper?
A. Either right after we started or right before we

Page 101

started the process.
Q. Did someone give you that paper?
A. Yes.
Q. Was that Mr. Stewart?
A. Yes.
Q. And so this is the first time you've used any stable isotopes in your work?
A. Correct.
Q. And the other isotopes that -- the isotope sampling that's been done in this case, oxygen and deuterium, you haven't used those before?
A. Nope.
Nope.
Q. And you didn't use those here either?
A. I did not.
Q. Is there a reason you used the carbon isotope and not the oxygen or the deuterium isotope?
A. The only reason I used carbon was from the paper, and the mass balance worked out pretty well for it, so that's the reason.
Q. All right. And when you say the paper, that's the Sharma and Frost paper?
A. That's correct.
Q. So I think from your analysis here what I'm gathering is that because you saw some carbon 13 values in

Page 106

Q. All right. Do you consider yourself an expert in stable isotope chemistry?
A. No.
Q. And are you aware of any other causative mechanisms that could cause carbon 13 measured the way it was at IMP-1?
A. No.
Q. Based on your review of the carbon 13 data, is there a carbon 13 signature that suggests CBM water downstream of IMP-1?
A. It would appear from looking at the data that pretty much by the time you get to IMP-1, once you get to Wildcat, which is the next one down, it would appear from looking at it that it is pretty much back to normal, the normal isotope signature based on the other population.
Q. When you say Wildcat, that's the next sampling point?
A. Wildcat above Dawson Drop, that's correct.
Q. So there doesn't appear to be a CBM influence there based on carbon 13, in your mind?
A. That's correct.
Q. Although you're not an expert in carbon 13?
A. Correct.
Q. And if CBM water is reaching IMP-1, is it your belief that the Paul 3 Reservoir is the source of that CBM

Page 107

water?
A. Yes.
Q. Based on?
A. Based on the deposition that the reservoir leaks, and just based on looking at the data, it would appear that it is coming from that source.
Q. Are there other potential sources of CBM water?
A. There are other potential sources of CBM water.
Q. And I don't see any discussion of those other sources in your report. Did you consider those and discount those or not even evaluate those? How did that work before you authored the report?
A. This data came to me so late in the report, I didn't have a chance to look at anything. I just pulled this off real quick at the end, so I didn't look at any other sources.
Q. Is it fair to say that based on the deposition you had already read that you had a belief that the Paul 3 was leaking and that this data was just consistent with what you already believed?
A. That's correct.
Q. And I know you said you didn't apparently analyze the oxygen or deuterium isotope data, but do you recall, did the water in the pumpback system have an oxygen or deuterium signature that suggests that it was

Page 108

derived from CBM water?
A. I don't know. I didn't look at it.
Q. Okay. Do you think that the water in the Paul monitor well represents CBM water?
A. Yes, I do.
Q. And we talked about the Hanson chart this morning. Do you know whether or not that water would meet the Hanson chart limits for SAR?
A. I don't. I know what the SAR water was when I sampled it.
Q. But not whether or not it meets Hanson limits?
A. No.
(Deposition Exhibit 11 marked for identification.)
Q. (BY MR. RUPPERT) I will show you this map --
MR. ESCH: Off the record.
(Discussion held off the record.)
Q. (BY MR. RUPPERT) We're looking at Deposition Exhibit 11. Let's look at it so we can see it like this. Based on your review of this map, this is a map that appears to show the Prairie Dog Creek and Wildcat Creek drainage as well as irrigated lands within a portion of those drainages. Would you agree with that?
A. Yeah.
Q. And have you seen a map like this before?

Page 109

A. Of a portion which is John Koltiska's information. I think it just shows this. I haven't seen the whole map with all of this information on it.
Q. Is this the drainage where you took a site visit, as far as you know?
A. Yes.
Q. All right. Looking up and down -- and I'm looking at Wildcat Creek, and you see Wildcat Creek here on the map as it flows?
A. I do.
Q. There appears to be -- between the Paul 3 Reservoir and up here where Wildcat goes into Prairie Dog Creek appears to be various pivot and sideroll irrigation areas that are shown on the map along Wildcat Creek, would you agree with that?
A. Yes.
Q. And were some of the areas in Wildcat Creek areas that were irrigated with CBM water?
A. Yes.
Q. Do you know where those are on this map?
A. Good question. I think some were in these areas, up here in these areas by the Paul Reservoir (indicating).
Q. You're pointing in areas 34 and 27?
A. Yes.

Page 110

Q. All right. Were there others up here in 28?
A. I don't recall him talking about any of the others. I do recall him talking about the ones that were up here (indicating).
Q. All right. And so with what you've shown so far, there's a source of CBM water that's irrigated in the vicinity of Wildcat Creek, correct?
A. That's true, yes.
Q. And is it possible that some of that managed irrigation water, CBM water, is getting into Wildcat Creek after the irrigation as a return flow?
A. I don't know. It is possible.
Q. Is it any more or less possible that that's the source of CBM water -- let me ask that question a different way.
You've concluded based on the carbon 13 data that the Paul 3 Reservoir is the source of CBM water that you saw at IMP-1 and AIMP-1?
A. Correct.
Q. Is it just as likely that the source of that CBM water was irrigation return flows from CBM irrigation?
A. I don't know that I could make that statement.
Q. Do you know?
A. No.
Q. You don't know. And you didn't consider that,

Page 111

apparently?
A. I did not at the time, that's correct.
Q. All right. I want to sit down and ask you a few more questions. But before we do, on Dawson Draw, did you view any part of Dawson Draw on your site visit?
A. No.
Q. Could you see Dawson Draw from the road?
A. I might have been able to, but I don't know if it was pointed out or not.
Q. Does there appear to be irrigation pivots on both sides of Dawson Draw?
A. Yeah, it is possible that that's what those are.
Q. And do you know whether or not those are CBM water?
A. I do not.
Q. Nobody ever told you one way or the other?
A. No.
Q. All right. Let's go ahead and sit down.
Looking at the same paragraph on page 5 of your report, and you make a statement, "Recognizing that the sampled water in Dawson Draw is natural and unaffected by CBM water...," do you see that portion of the statement?
A. Yes.
Q. What's the basis for your conclusion that Dawson Draw is natural and unaffected by CBM water?

Page 112

A. I believe I may have asked that question and received that information.
Q. From Mr. Koltiska or Mr. Stewart?
A. Both of them, potentially.
Q. So they both would have told you that Dawson Draw -- one or both would have told you that Dawson Draw is unaffected by CBM water?
A. Right.
Q. So you didn't consider whether CBM irrigation in the vicinity of Dawson Draw could have caused a return irrigation flow and a CBM water signature?
A. No, I didn't consider it. As I think about it, though, it would appear to me that if that were the case, that return flows were the source of the signature -- and again, I'm not an expert in this, but if they were, we would see the signature carry further downstream than we currently see it.
Q. Further downstream in Wildcat?
A. Yes.
Q. Just to be clear, as we sit here today, the only basis for your conclusion that Dawson Draw is natural and unaffected by CBM is a statement made by either Mr. Stewart or Mr. Koltiska and that's it?
A. Correct.
Q. Did you see any pivot irrigation anywhere near

Page 113

Dawson Draw on your visit?
A. I don't recall.
Q. Might have, might not have, just don't know?
A. Right, don't know.
Q. If there were return flow impacts into Wildcat Creek at IMP-1 and AIMP-1, could those be caused -- excuse me -- could -- let me back up.
The numbers that you quoted to me earlier on the carbon 13 of negative 8.6 and negative 8.9 that you conclude is a CBM water influence, could that influence come from return irrigation flows as well as Paul 3?
A. It is possible.
Q. Don't know?
A. Don't know.
Q. If the Paul 3 is not leaking or is not getting beyond the pumpback, is there a need to have an SAR limit at Outfall 2?
A. As long as the water does not impact irrigated lands, then the policy would allow for not setting a limit.
Q. The ag use policy, when you say policy?
A. Yes.
Q. And so if the CBM water that you're seeing in Wildcat Creek is from irrigation return flows and not from the Paul 3, then there's no need to set an SAR, right?

Page 114

A. Potentially.
Q. What does that mean?
A. Well, you've got to prove that it is not.
Q. Okay. Well, that's why I said if. So let's assume that the Paul 3 -- that the source of CBM water in the Wildcat Creek is from irrigation return flows and not from Paul 3. Is there any need to set an SAR?
A. Not according to the policy.
Q. Is there any other need that you're aware of?
A. No.
Q. And are you aware based on your site visit or other information of any irrigation going on in the area of IMP-1 or AIMP-1?
A. I believe there is.
Q. And do you know who that is?
A. No.
Q. If I told you that's Warren Adams, would you know whether that was right or wrong?
A. No, I wouldn't know.
Q. You looked at the Wildcat Creek water sample common ion chemistry, right?
A. I think so.
Q. Do you know how that compared to other ephemeral watersheds in the area that may not have been affected by any CBM water?

Page 115

A. No.
Q. Didn't look at that?
A. No.
Q. Have you ever had occasion to look at that data before?
A. No.
Q. Okay. In the same paragraph now you're saying that the calculation shows approximately 20 percent of the flow at IMP-1 is CBM water, right?
A. Right.
Q. You're not saying that's from the Paul 3, are you? You're just saying it is CBM water?
A. It is CBM water.
Q. Right. Could be from return irrigation flows; could be from the Paul 3, don't know?
A. Correct.
Q. Did you read Dr. Schafer's report on explaining other possible pathways to explain the water quality data and the isotope data?
A. I did.
Q. Is there anything that you recall now that struck you as something you agree or disagree with?
A. I don't know that I agree or disagree with it.
Q. Okay. Were those other pathway possibilities that you were discussing something that you normally don't

Page 116

do in your work?
A. I normally don't do it.
Q. That's not part of your expertise?
A. No.
Q. Assuming that 20 percent of the water in Wildcat Creek is CBM water, does the common ion chemistry suggest to you that that water quality is actually of better quality?
A. I didn't look at that.
Q. All right. Not important?
A. No.
Q. So if that chemistry suggested that the CBM-influenced water is actually lower in EC than background water quality, that's not something that you looked at or considered in any way?
A. No.
Q. And whether or not that water if mixed with CBM water met Hanson limits is, I assume, based on our previous discussion not something you looked at at all?
A. No.
Q. If the EC were lower and that's what the data showed, that water would actually be more suitable for irrigation than the background water quality, correct?
A. That would be my understanding.
Q. But you're not an irrigation expert?

Page 117

A. I am not an irrigation expert.
Q. All right. Is it your understanding that the water in the Paul Reservoir, Paul 3 Reservoir, is primarily CBM water?
A. That's my understanding.
Q. All right. Do you know if it has some natural water in it or from what source that might be?
A. I do not. I would presume that it probably does have some natural water in it just being on a reservoir on a drainage.
Q. From precipitation or something like that?
A. Correct.
Q. Do you know how that natural water in Paul 3 Reservoir affects the carbon 13 readings for Paul 3 water?
A. No.
Q. I want to assume for a moment that your figure of 20 percent of the flow at IMP-1 is CBM water. I want to assume that that's correct for a moment.
A. Okay.
Q. Do you have in your data what the flow rate is at IMP-1?
A. Yes. IMP-1 is .07 cfs.
Q. All right. And so if the Paul 3 is 20 percent of that flow, what is that number? Is that 20 percent times .07?

Page 122

the previous Statement of Basis that talked about protection of the Tongue River, were you?
A. No.
Q. All right. And so your recommendation of 870 I believe has nothing to do with the ag use policy, does it?
A. It has to do with the Statement of Basis of what DEQ stated their intent was for the permit.
Q. Right. And nothing to do with the ag use policy?
A. Correct.
Q. As we discussed this morning, your opinions -- other opinions in your report, and I guess I'm thinking in particular your opinion on an SAR limit, were based on what the language said in the ag use policy, right?
A. Correct, and what was stated in the Basis as well.
Q. All right. Mr. O'Neill, do you have any special expertise in reading or interpreting the ag use policy?
A. No.
Q. Do you have any special expertise in reading or interpreting the DEQ Statement of Basis?
A. No.
Q. Have you ever done that before --
A. Yes.
Q. -- in other permits?

Page 123

A. Uh-huh.
Q. Non-CBM?
A. Right.
Q. Different rationale, I take it, than what you see here?
A. Uh-huh.
Q. Much different?
A. I don't know if it is much different. Protecting water quality is protecting water quality in some respects.
Q. Other Statement of Basis that you've read for other permits, I assume those are other water discharge or wastewater permits that we talked about this morning, did you find some kind of flaw or problem in those Statements of Basis?
A. In what way? What do you mean?
Q. When you looked at the Statement of Basis, did it make sense?
A. Yeah.
Q. It did?
A. Uh-huh.
Q. When you looked at this Statement of Basis, did it make sense?
A. It made sense. I felt like the analysis was flawed, but it made sense.

Page 124

Q. Okay. Just so I understand, at the end of the day, you're not here, I don't think anyway, in your report or today in your deposition giving an opinion on whether or not the limits in this permit for EC or SAR are protective of alfalfa, are you?
A. No.
Q. Okay. You're relying on DEQ's rationale and their Statement of Basis for your opinions?
A. That's correct.
MR. RUPPERT: I think I'm about ready to wrap it up. Let's take a five-minute break.
(Recess taken 2:14 p.m. until 2:21 p.m.)
MR. RUPPERT: Mr. O'Neill, I'm finished now. Thank you.
THE WITNESS: You're welcome.
MR. ESCH: Mr. O'Neill, I don't think I have any questions for you.
MR. STEWART: Well, can we take another 15 minutes, then? I have some stuff I need to ask Jim to clean up. I figured you guys were going to go for a while, and we'd take a break and I'd do it then.
MR. ESCH: Mark covered everything I have written down.
(Recess taken 2:20 p.m. until 2:39 p.m.)

Page 125

CROSS-EXAMINATION
Q. (BY MR. STEWART) Mr. O'Neill, do you recall earlier today Mr. Ruppert asked you about some proceedings on public hearing in Oregon?
A. Correct.
Q. Do you recall that?
A. Yes.
Q. And I believe he had you look at Exhibit 5 and 6 -- I guess we need the real ones there, not copies?
A. Yes.
Q. And I believe you said you had not seen those before?
A. That is correct.
Q. But were you aware of the outcome of these hearings?
A. Yes, I was.
Q. What was the nature of the hearings?
A. It was a flood development permit. We had a public hearing in front of a hearing officer for the appeal.
Q. So it was a public hearing?
A. Yes.
Q. Were you sworn in?
A. No.
Q. Were you under oath when you testified?

Page 138

Q. So at least for that snapshot?
A. That's correct. Other times it would be different percentages if the relationships hold true in time.
Q. You have, I understand from your earlier testimony, experience with hydrology and hydraulics?
A. Yes.
Q. Ephemeral drainages?
A. Uh-huh.
Q. Water quality in ephemeral drainages?
A. Yes.
Q. In your experience is it good scientific practice to base -- strike that.
In your experience is it good scientific practice and appropriate scientific assumption, I guess would be the word I would want to use, to characterize water quality in an ephemeral drainage based on a single sampling event?
A. No.
Q. Why is that?
A. Because every time -- depends on when the sampling event was taken, depends on what your water quality -- if you take it right in the middle of a flood event, your water quality is going to be different than if it is base flow at a later time in the ephemeral drainage.

Page 139

Q. So water quality depends on when you take the sample in relation to what?
A. Flow events and the amount of water that's coming down and what constituents are in the water.
Q. Would you rely on this single event, this single sampling event to say that that accurately characterizes the water quality in Wildcat Creek?
A. No, no.
Q. I will have you grab Exhibits 8 and 9. You and Mr. Ruppert spent a fair amount of time going over Exhibit 8 which is titled Revised Figure 5; is that correct?
A. That is correct.
Q. And can you tell me what, based on your review of this figure, Mr. Schafer used for a sodium concentration to come up with his curve?
A. 196.
Q. And what did you use when you were developing your curve?
A. 300.
Q. Why did you use 300?
A. It was the information that was provided as the Basis for the permit.
Q. And what is 300? How does that compare to the effluent limit?

Page 140

A. That is the effluent limit.
Q. So you would recognize and I guess concede that if you discharge -- consistently discharge water that was consistently below that 300 you might have a curve that --
A. It will be a different curve.
Q. If one consistently discharged water at sodium of 196, calcium at 26 and magnesium at 7, do you have any reason to believe that the curve Mr. Schafer described here -- that it wouldn't follow on that curve?
A. I don't have any reason to doubt that.
Q. But yours was based on that effluent limit?
A. That's correct.
Q. You have some experience with WYPDES permits. Is the permittee allowed to discharge water with concentrations, constituent concentrations at the effluent limit that's established?
A. Yes.
Q. They're only in violation if they're over?
A. Over.
Q. Okay. I will have you grab your report, Mr. O'Neill, which is Exhibit 3, and we will go to Figures 4 and 5 in your report. Do you recall Mr. Ruppert asking you about -- I'm looking at Figure 5. Do you recall Mr. Ruppert asking you about some of the data points on the lower end of this graph, the lower base limit of this

Page 141

graph?
A. Yes.
Q. And I believe during that discussion he was talking -- characterized them as three or four samples, or this one sample, this one flow. Why is there only one flow or one sample shown on your -- used on your graph?
A. It was the flow data that we had with water chemistry, so we used the data that came from USGS that actually they had taken water chemistry at the same time. There's other data, flow data available.
Q. Okay. So if -- and I don't remember the dates, but one of these samples, I believe, was a May 2006 sample?
A. I believe that that's correct.
Q. All right. Does that -- is it safe to say that that flow rate occurred on only that day, on that one day in May?
A. That's the only information that we have is that it occurred on that one day. It is possible that other days that that same flow rate happened or on either side it could have been lower or higher. We have no data. We didn't look at that.
Q. But you only used data where you had water quality data?
A. Water quality data, that's correct.

Page 142

Q. It is not collected daily, on a daily basis?
A. That's correct.
Q. Looking at the data in your -- USGS data in your -- where was it -- Appendix A to your report --
A. Yes.
Q. -- how often is water quality data collected at Wakely on average through the period of record that you looked at?
A. About monthly.
Q. Approximately once a month?
A. Approximately once a month.
Q. So would it be accurate to assume, then, that based on your graph that this low flow condition on Figure 5 where you've shown an SAR being above 5 -- would it be safe to assume that would have only happened once in a given year irrigation season?
A. Not necessarily. We just don't have any information as to how often that would occur.
Q. You didn't look at that?
A. We didn't look at that.
Q. Is there -- can you tell me, are there any general trends between water quality and flow in your experience in a typical stream?
A. As the water quality -- the water quality -- the water quality decreases as the flow decreases, generally.

Page 143

Q. Generally. By water quality decreasing, you mean --
A. The dissolved constituencies increase in concentration as the flow goes down.
Q. That's a typical pattern?
A. That's a typical pattern.
Q. Did you try to -- you didn't -- I understand you didn't try to correlate --
A. I did not try to correlate that, no.
Q. -- flow?
I believe that Mr. Ruppert asked you whether your expertise included interpreting DEQ regulations. Do you remember him asking you that question?
A. I do.
Q. Do you remember what your answer was?
A. I'm not an expert in interpreting regulations, but I do spend quite a bit of time in the regulations so that we can make sure that our permits meet the requirements that are put forth by different governing bodies, so we look at them in terms of engineering analyses and things like that.
Q. Is it within your expertise to evaluate the methods DEQ used to establish the effluent limits in this permit?
A. Yes, it is.

Page 144

Q. Was that the main purpose of your report?
A. Yes.
Q. And I think Mr. Ruppert asked you this, but I'm going to do it as well. In your report where you talk about best scientific practice, I want to be absolutely clear that I believe you said that that is in your mind and you're using that synonymously with appropriate scientific method?
A. Correct.
Q. They mean the same thing in your report?
A. Yes.
Q. Okay. I do remember one other thing I wanted to clarify.
Talked about the potential or what the synoptic data indicated as to possible percentage of CBM water that was present at the IMP.
A. Right.
Q. I believe you said that it could be from irrigation return flows; is that correct?
A. That's correct.
Q. Could it be from the Paul #3 leaking as well?
A. It could be.
Q. How would the water -- how would it be possible for water that's leaking from Paul #3 to get past the pumpback and get to the IMP?

Page 145

A. Not having ever seen the pumpback, but depending on how low those pumps are set or the flow, either through that pumpback system or even through the gravel beds, et cetera, there could be flow that gets past those. It depends on how much they pump and how big their cone of depression is.
Q. If you knew that the pumpback was just a pump placed in a natural depression, would that influence your -- what you just told me?
A. It would be -- yeah, it would -- it would be easier if it weren't -- if it is just in a natural depression, it would be easier for water to get back past it.
MR. STEWART: Can we go off the record for one second?
(Discussion off the record.)
Q. (BY MR. STEWART) Mr. O'Neill, I've handed you what's marked as Exhibit 9 from Jason Thomas' deposition. Do you recall having seen that?
A. I may have. I recall Mr. Thomas talking about it in his deposition when I read through his deposition.
Q. Okay. You don't remember if you went and actually looked at the exhibit or not?
A. I don't recall if I did.
Q. If you would, in the -- I believe it is the

opinions in this case, correct?
A. True.
Q. The last thing I want to talk to you about was this flow past the pumpback issue. I don't recall seeing it in your report, but was whether or not there was CBM flow past the pumpback and how that could occur part of your report or your opinions in this case?
A. No.
Q. All right. Is that something you're just answering today as we talk about it?
A. Correct.
Q. All right. It sounds to me, and correct me if I'm wrong, but as you come up with potential explanations for how that can happen -- perhaps gravel, subsurface gravel or something else -- that pretty much just speculating as to how that can get past the pumpback, is that fair?
A. Sure.
MR. RUPPERT: I think that's all I have. Thank you again.
MR. ESCH: Nothing further.
MR. STEWART: We will read and sign.
(Deposition proceedings concluded 3:26 p.m., September 23, 2009.)

DEPONENT'S CERTIFICATE

I, JAMES O'NEILL, II, do hereby certify that I have read the foregoing transcript of my testimony consisting of 154 pages taken on September 23, 2009, and that the same is a full, true and correct record of my deposition.

_____
JAMES O'NEILL, II

( ) No changes ( ) Changes attached

Subscribed and sworn to before me this day of , 2009.

_____
Notary Public

My commission expires:

CERTIFICATE

I, JANET DAVIS, a Registered Merit Reporter, Federal Certified Realtime Reporter and a Notary Public of the State of Wyoming, do hereby certify that the aforementioned witness was by me first duly sworn to testify to the truth, the whole truth, and nothing but the truth;

That the foregoing transcript is a true record of the testimony given by the said witness, together with all other proceedings herein contained.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my Notarial Seal this 29th day of September, 2009.

JANET DAVIS
Registered Merit Reporter
Federal Certified Realtime Reporter

My commission expires 2/20/2011.

SCHAFER

BEFORE THE ENVIRONMENTAL QUALITY COUNCIL
STATE OF WYOMING

IN THE MATTER OF THE APPEAL OF JOHN D. KOLTISKA, AC RANCH, INC., a Wyoming corporation; PRAIRIE DOG RANCH, INC., a Wyoming statutory close corporation; and PRAIRIE DOG WATER SUPPLY COMPANY, FROM WYPDES PERMIT NO. WY0054364.

DEPOSITION OF WILLIAM SCHAFER, Ph.D.
TAKEN ON BEHALF OF PROTESTANTS

9:00 a.m., Thursday
September 24, 2009

PURSUANT TO NOTICE, the deposition of WILLIAM SCHAFER, Ph.D., was taken in accordance with the applicable Wyoming Rules of Civil Procedure at the offices of Holland and Hart, 2515 Warren Avenue, Suite 450, Cheyenne, Wyoming, before Janet Davis, a Registered Merit Reporter, Federal Certified Realtime Reporter, and a Notary Public of the State of Wyoming.

Page 6

A. I worked for the Extension Service as a soil scientist from 1979 until 1985. I then began a consulting firm called Schafer and Associates in 1985. We worked in a variety of environmental consulting areas. I sold that business in 1999 to Shepherd Miller who I worked for for a couple years. And then I since year 2001 have worked as an individual practitioner under the name Schafer Limited, L.L.C., again as an environmental consultant.

Q. Environmental consultant, how do you define that term?

A. Well, I work in a number of different areas. Most of my projects relate to water quality evaluation, soil chemistry evaluations, geochemical evaluations of different sorts.

Q. For what kind of clients typically?

A. Clients have included federal and state agencies, a number of private companies, probably the majority are mining companies, and obviously, as the case here, oil and gas companies as well.

Q. I think I would like to start talking to you about your report. I've -- since it is so long, I've put it in a binder to hopefully make it a little easier.

MR. STEWART: I've not made copies for the other parties, but I think you have copies; is that right?

MR. RUPPERT: Yes.

Page 7

(Deposition Exhibit 14 marked for identification.)

Q. (BY MR. STEWART) Mr. Schafer, I've handed you what's been marked as Exhibit 14. Could you thumb through that and confirm for me that is your expert report submitted in this case?

A. Yes, it is.

Q. Looks to be a complete copy?

A. Yes.

Q. I would like to just have you turn to page 1, and we'll start right there. Your Purpose and Scope, I see that you say here, "As part of my analysis and related work I have evaluated water quality and surface water flow regimes in Prairie Dog Creek and Wildcat Creek."

Can you tell me what that entailed? Can you describe your evaluation of water quality and surface water flow regimes in Prairie Dog Creek?

A. On the water quality side, I looked at the data I had available to evaluate water quality in Prairie Dog Creek. Most of that information comes from two USGS monitoring stations which are talked about extensively through the report. One is at Wakely and one is at Acme. Each -- from each of those stations USGS has collected a number of water quality samples over the years.

There is less water quality information on

Page 8

Wildcat Creek. The information that I relied on was in part from some monitoring done as part of permit compliance by Pennaco which was through year 2008.

And then we did what we call a synoptic sample which just means we collected several samples along Wildcat Creek and Prairie Dog Creek in June of this year and measured water quality and flows at a number of stations on both drainages and so we relied on that information as well.

The final bit of information that was available to us that was very useful was some information collected by Sheridan County Conservation District. They have a number of stations along Prairie Dog Creek and several of its tributaries where they have monitored flows and water quality I believe through 2007 and 2008. I used the data from 2008 primarily. I think they have about 15 stations, roughly. And they monitored about eight or ten times on most of the monitoring events they measured I think just field parameters and on selected events they measured more full chemistry on each station.

Q. What about the flow regimes?

A. The flow regimes were derived from the data collected at the same two USGS stations on Prairie Dog Creek which, again, were Wakely and Acme. And they have differing periods of record, but they collect and

Page 9

summarize daily average flows at each of those stations.

The data on Wildcat Creek, again, are -- there was less data available on Wildcat Creek, but as part of the synoptic sampling I described in June we also measured flows.

Q. Do you have any other flow measurements for Wildcat Creek?

A. None that I can recall.

Q. You talked about here studying soil -- studied background soil characteristics. Could you briefly describe for me what that entailed?

A. Pennaco developed a program we called the Prairie Dog Creek AMPP -- A-M-P-P. That stands for the Agricultural Monitoring and Protection Program. That program was begun in 2008. And under that program we identified some sort of reference irrigated fields, a couple in Wildcat Creek and the majority of Prairie Dog Creek. We wanted to develop kind of a long-term soil monitoring program. And so that's, you know, the basis for the detailed background soil characterization work that I'm referring to here.

(Deposition Exhibit 15 marked for identification.)

Q. (BY MR. STEWART) Did you -- you prepared a report for the -- what did you call it, the AMPP?

safety in using a EC limit already. There's regional research that suggests that a 4000 EC limit is protective of alfalfa. That argument has been discussed on and on. We don't need to go through all the merits of whether you should use that regional research or not, but I believe there's a margin of safety.

Q. You're referring to what people have been calling the Bridger Center?

A. Data from the Bridger Center. There's data from the University of Saskatchewan research facilities.

For three -- well, I will have to come back to that. I'm blanking on my third point.

Any other follow-up?

Q. No.

A. The third clarification is earlier this morning we were talking about compositing of soil samples, and again, in that context you suggested that compositing mass spatial variability -- I think I was the one that suggested that one of the purposes of compositing was to reduce the effects of spatial variability on measured average soil conditions.

And in that context you brought up a statement that shouldn't DEQ protect for the most sensitive soil. And I think, again, the record leaves maybe the reader misled that in terms of my experimental approach and

infers that I was sampling on different kinds of soils across the field and by compositing I was somehow masking out differences in soils.

Again, to reiterate, all of our composite locations were located within a single map unit delineation. It was our intent and belief that the locations were all representing the same or very similar soils within that field. So the intent isn't to reduce the expression of a minor soil within the field. In fact, by reducing spatial variability, it has the effect of refining our ability to detect changes, temporal changes in soil chemistry. So I think in fact it is a necessity to perform compositing in a field soil study such as this if your intent is to detect temporal changes. If you fail to do that, you will have more spatial variability, and you will have more difficult time detecting changes.

MR. STEWART: That's all I have for now, Mr. Ruppert.

Dr. Schafer, thank you.

MR. ESCH: I don't think we have any questions.

MR. RUPPERT: No questions.

(Deposition proceedings concluded 3:11 p.m., September 24, 2 009.)

DEPONENT'S CERTIFICATE

I, WILLIAM SCHAFER, Ph.D., do hereby certify that I have read the foregoing transcript of my testimony consisting of 163 pages taken on September 24, 2009, and that the same is a full, true and correct record of my deposition.

_____

WILLIAM SCHAFER, Ph.D.

( ) No changes ( ) Changes attached

Subscribed and sworn to before me this day of , 2009.

_____

Notary Public

My commission expires:

CERTIFICATE

I, JANET DAVIS, a Registered Merit Reporter, Federal Certified Realtime Reporter and a Notary Public of the State of Wyoming, do hereby certify that the aforementioned witness was by me first duly sworn to testify to the truth, the whole truth, and nothing but the truth;

That the foregoing transcript is a true record of the testimony given by the said witness, together with all other proceedings herein contained.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my Notarial Seal this 30th day of September, 2009.

JANET DAVIS
Registered Merit Reporter
Federal Certified Realtime Reporter

My commission expires 2/20/2011.

VANCE

BEFORE THE ENVIRONMENTAL QUALITY COUNCIL
STATE OF WYOMING

IN THE MATTER OF THE APPEAL OF JOHN D. KOLTISKA, AC RANCH, INC., a Wyoming corporation; PRAIRIE DOG RANCH, INC., a Wyoming statutory close corporation; and PRAIRIE DOG WATER SUPPLY COMPANY, FROM WYPDES PERMIT NO. WY0054364.

DEPOSITION OF GEORGE VANCE, Ph.D.
TAKEN ON BEHALF OF DEQ

9:00 a.m., Friday
September 25, 2009

PURSUANT TO NOTICE, the deposition of GEORGE VANCE, Ph.D., was taken in accordance with the applicable Wyoming Rules of Civil Procedure at the offices of Holland and Hart, 2515 Warren Avenue, Suite 450, Cheyenne, Wyoming, before Janet Davis, a Registered Merit Reporter, Federal Certified Realtime Reporter, and a Notary Public of the State of Wyoming.

Page 18

the parameters were. What were the numeric limits you were concerned about?
A. Specifically?
Q. Yeah. I mean the EC -- I think we already discussed that EC, SAR and sodium were the main ones that you were evaluating.
A. Right.
Q. So I'm asking now what were the limits on those that you were concerned about. Those are the parameters and the limits -- and you just identified the EC limits you're concerned about, so I'm asking about the SAR and sodium, what the permit limits are that you think are not -- I guess is it your opinion in your report that the limits in the permit are not protective of irrigation?
A. I -- my opinion is that if you're going to be adding salts to the system that you are impinging upon somebody's use of that water in their traditional manner. So increasing salts, either as higher EC or higher sodium -- and sodium is my specific concern because of the potential problems that can be associated with sodium -- it is my contention that an increase in those salts are going to impact the irrigators downstream.
Q. And I believe in your conclusions in your report on page 6 -- you have your report there -- that the -- and that's Exhibit, I think we said -- Exhibit 26, was it?

Page 19

A. It is 26.
Q. In your conclusions I think you're saying that the permit will result in conditions impacting operations immediately downstream which is in violation of the ag use policy in Chapter 1, Section 20.
So is the gist of your opinion that adding sodium is what is -- that the adding sodium up to the allowable limits here is what is causing the violation of Chapter 1, Section 20? Is that the gist of it?
A. Well, adding salts as a whole will violate that because it is going to impact the use of that water by the downstream irrigators.
Q. Okay. So are there limits that you feel would be protective, or is it just the fact that the permit allows the addition of salts, period, that is a violation of Chapter 1, Section 20, in your opinion?
A. That's my opinion, yes.
Q. What is?
A. That adding salts will violate the --
Q. Okay. So then if coalbed-produced water, because it is groundwater that has whatever the natural sodium content of that water is, is adding sodium to the surface system, that, per se, is then what violates Chapter 1, Section 20?
A. Well, the salts as a whole would impact

Page 20

potential irrigators and plant production.
Q. Well, then, is the setting of effluent limits just, I guess, an academic exercise? If adding any salts at all is going to affect irrigation, then in your view it is impinging on their use of the water and violating Section 20, then really are there any limits that they could set other than distilled water that would not be violating Chapter 1, Section 20?
A. Well, no, I wouldn't say just distilled water. I would say if you knew what the quality of the water was that was being used, then you could try and mimic that in the process of trying to discharge into those -- into those systems.
Q. So then does it basically boil down to a no change in quality standard, that as long as your -- any discharges are not -- are not resulting in any change in water quality, that that is what is needed to comply with Chapter 1, Section 20?
A. That, and the fact that with this particular permit there was such a high sodium content, and sodium, again, has negative consequences on the environment.
Q. The sodium content being the limits on the discharge, that it is allowing water discharge up to those limits, is that what you mean by sodium content?
A. Right.

Page 21

Q. Do you know what the actual sodium content of the water discharged is?
A. Discharged?
Q. The actual quality of the -- those are limits in the permit saying it can't go above that.
A. Right.
Q. Do you know what the actual quality of the water coming out of the ground is that's being discharged?
A. That's being discharged where?
Q. Yeah, into Prairie Dog and Wildcat under this permit.
A. I'm not aware of what is being discharged into Prairie Dog, but I know that there are -- there's information, data associated with what is being discharged into Paul 3 Reservoir.
Q. The quality of the water that's being discharged into that, you're saying?
A. Right.
Q. You mean into the treatment plant?
A. From the outfall at Paul 3. I'm not aware, and I didn't see it in the permit, of what the actual water that's being discharged from the treatment facility -- what the quality of that water is.
Q. Because there's two different things. There's the quality of the water that's being brought up from the

Page 22

ground, and then there's the limits in the permit on what the quality of the discharge can be. And so the limits in the permit are saying it is not supposed to go above that. That doesn't mean that that's -- the quality could either be above or below it. If it is above it, it is a violation. If it is below it, it is not.

But you were talking about the sodium content, and I was wondering, were you referring to the limits in the permit?

A. Yes.

Q. Okay. Well, what was the information you had on the discharges to Paul 3?

A. I had information from the synoptic sampling that was conducted this summer that provided soil chemistry data for 19 points, 19 different sites on Prairie Dog and Wildcat.

Q. But did you have -- but were you saying that you had data on the quality of the water that was actually discharged? That's soil samples, I believe you were saying. Right now, I mean were you saying synoptic samples from the soils?

A. No, no, that was the water testing program that was conducted June 15th and 16th, collecting water samples at various points along Wildcat Creek and also Prairie Dog.

Page 23

Q. And did you have any samples from the actual -- from the outfalls themselves? Did you have water quality data of that?

A. There was one sample that was given as far as the outfall goes.

Q. And that was the Outfall 1 to the reservoir?

A. It was -- yes.

Q. And what was the EC of that water, do you recall?

A. EC was 1.6 deciSiemens per liter.

Q. That was a sample taken from Outfall -- from Outfall 1?

A. Paul Outfall during the synoptic sampling that was conducted this summer, June 15th and 16th.

Q. Did you have any samples from Outfall 3?

A. Outfall 3 is where the discharge from the water treatment plant is proposed.

Q. Right, right.

A. And I'm not aware of water that's being discharged. I have never seen an analysis of water that was discharged at that point yet. And I believe the permit has allowed it, but I'm not sure if there's any data that's out there that -- again, if data comes in, I can look at it, but right now I haven't seen anything.

Q. What's your opinion of irrigation limits,

Page 24

numeric limits on SAR, EC, sodium that would be protective for irrigation in Wildcat, Prairie Dog? Your opinion is that the ones in the permit are not protective. What's your opinion about numeric limits that would be needed to be protective?

A. You want me to give you a specific number?

Q. If you have an opinion.

A. Well, my concern is that with the added salts that you are changing what the irrigators are going to have to do with their system. And the idea of adding more sodium to the system is going to cause that much more management required by the irrigators in order to satisfy their operations the way they've done it in the past. So as far as a specific number, I can't give you that.

Q. Let me ask you this. You're saying it is over what the irrigators use. Have you gone -- have you been to Wildcat and Prairie Dog Creek? Have you visited them since you've been working on this?

A. I've just looked at them. I've been up there once, yes.

Q. Since you've been working on this?

A. Yes.

Q. What are the practices or what are the specific water irrigation practices being used that are going to be impacted by additional sodium? I mean, have you -- have

Page 25

you looked at how individual irrigators are using water and determined that their particular uses would require alteration because of this water?

A. It is my understanding that adding sodium to a system is going to increase concerns, particularly with infiltration, dispersion effects, and then also the fact that you're adding additional salts and the higher ECs, that could also impact the operations.

I didn't go and talk to and go around and look at a lot of different places in that area. I went up there with a new student I have to provide some idea of what CBM operations are ongoing to get him to start looking at sampling protocols, provide some information relative to him developing his doctoral proposal. It was more of a reconnaissance trip just to give him a better understanding of what the CBM operations are all about.

Q. Well, I mean, I think I'm hearing you say that changing the quality of the water by adding these discharges could affect how irrigators are able to use the water that they've been using.

A. Correct.

Q. And you don't assume that all irrigators use water in a uniform, identical way, are you?

A. No.

Q. So in terms of how any irrigator would be

Page 26

affected, you would have to know how that irrigator is using the water to know either how or whether they're even being affected, wouldn't you?
A. To a certain degree.
Q. Are you aware of any irrigators up there that consciously use the water that's available, including mixed coalbed water? Are there any of them that do that you're aware of?
A. I've conducted research on sites where we have had CBM water applications on different fields.
Q. Are there any in Prairie Dog and Wildcat that you're aware? Is there anybody that use it up there that you're aware of?
A. Yes.
Q. And how are they able to use it without being -- without being detrimentally impacted?
A. Well, the application of CBM waters in a managed approach would require that you also add amendments to your land. Oftentimes that's in the form of gypsum and also reduced sulfur to try and reduce the effect of the sodium, the SAR.
There are opportunities for using CBM water on areas where there's no water being -- opportunities on lands where water is not being applied right now. So people have tried that. My research has shown that over

Page 27

time in some locations the EC and the SARs do build up in the soil profile which could be very detrimental to the soils in the future.
Q. Just from coalbed water or any water?
A. This is coalbed methane water.
Q. Well, natural water coming down the channel, based on the -- I guess the geologic circumstances of that channel, they would have some sodium content as well, wouldn't they?
A. A small amount, probably.
Q. So you're saying that natural water without coalbed is always low sodium water?
A. Natural -- when you say natural, what do you mean by that?
Q. Surface water in, say, the Powder River Basin?
A. There are some locations where sodium levels are higher.
Q. Are those places that there's any irrigated agriculture? Are you aware of any in the Powder River Basin that people irrigate with --
A. High sodium waters?
Q. Well, let's put it this way: Are you aware of any irrigation in the Powder River Basin with water that has EC levels above 1330? Do people irrigate with water anywhere in the Powder River Basin with water that's

Page 28

higher sodium -- higher EC levels than that?
A. I am not aware of -- I am not -- I'm not that up on the actual irrigation practices that are -- that people are using relative to their water qualities.
Q. So do -- in your work on, you know, your soil work on these types of issues have you looked at other areas of the Powder River Basin aside from coalbed, whether it is coalbed or not -- have you looked at soils and irrigation -- use of irrigation water in the Powder River Basin?
A. No, I haven't. My experience is with the use of CBM waters in a proposed managed operation.
Q. When you say proposed managed, you mean where someone is setting up a project? What do you mean proposed?
A. Well, they've proposed that it is managed in the sense that they're adding amendments to those systems in hopes that they are maintained at a level that can be productive.
Q. So as far as general use of surface waters, whether there's coalbed or it is just all natural surface waters in the Powder River Basin, you don't have any particular knowledge about use of waters with EC levels above 1330 in the Powder River Basin, whether it is being used and what the consequences of that are, what the

Page 29

success or problems are?
A. No, I don't.
Q. Would it be -- would it be your opinion, you know, based on the things you said in your report that people could not make practical use of surface waters for irrigation that had EC levels above 1330, then? Let's say 1330 for alfalfa. What about, say, for wheatgrass? What would, in your view, be a protective or a necessary water quality in terms of the EC limit for successful irrigation of wheatgrass?
A. Wheatgrass has a different salt tolerance.
Q. Right.
A. So it could potentially survive with different water qualities. The actual values --
Q. Let's say alfalfa since we've been talking about that. What -- do you have any knowledge of the water quality of other areas in the Powder River Basin where people irrigate alfalfa?
A. Outside of CBM water?
Q. Well, outside of these two drainages.
A. Oh, with respect to the water quality?
Q. Right.
A. No, I don't.
Q. Is your opinion here about the protectiveness of these limits in Prairie Dog and Wildcat -- is that an

Page 30

evaluation of the quality of water that's mixed coalbed and creek water or just the discharge quality of the water? I mean, when you're -- when you're -- you say these limits aren't protective. These waters are either being discharged, say, in the case of Prairie Dog, or potential overtopping in the case of Wildcat, and you're saying those limits aren't protective.

Are you talking about those -- quality of water that meets those exact limits, or are you talking about the mixed water downstream that would actually be applied, the mixed water being the discharged water meeting those limits and whatever natural flows in there at the time?

A. I would say both.

Q. So you're saying that there would be no -- did you -- so you're saying that coalbed discharges meeting these limits and the irrigation would be below the discharges, that mixing with whatever surface flows there, the water still would not be protective for irrigation?

A. It would impact the operations as they have been done in the past.

Q. Okay.

A. So there would be an impact, yes.

Q. Did you do any -- any mixing calculations to determine what the quality of the water would be if you had discharge water meeting the effluent limits and then

Page 31

mixing with different quantities of flow before it is applied for irrigation?

A. No, I did not.

Q. Okay. Did you make any assumptions about the mixing or the effect of mixing?

A. My assumption is that the amount of sodium being added to the system and the additional salts will have an impact.

Q. Did you actually -- I know you have some information there. Did you do any sampling of the -- of mixed water that was actually being used for irrigation to see the quality of the water that was being used?

A. Specifically what waters are you talking about?

Q. Well, say if there was any water -- if there was any water down in Wildcat that was from overtopping -- are you aware whether there's been any overtopping from the reservoir?

A. I'm not aware of overtopping, but I'm aware that that reservoir has in the past seeped and has leaked.

Q. What are the -- what do the irrigators below the reservoir use for irrigation in Wildcat, what water? Where do they get water if there's no overtopping? Do they just use the water out of -- that seeps out of the reservoir, or do they -- or is there other water that's available to them in that channel that they're using? How

Page 32

are they irrigating? What are they -- what kind of water are they using to irrigate with?

A. Well, you're talking about above or below Ninemile Ditch?

Q. Well, below the reservoir.

A. Below the reservoir? Below the reservoir to Ninemile Ditch there is very little water that's entering into the system.

Q. Is there any irrigation there?

A. There's irrigation with, from what I gather, predominantly CBM waters.

Q. Okay. And did you evaluate the soils where that's taking place?

A. I didn't evaluate any soils, per se, other than using the soil survey information.

Q. Well, the soil survey information, that's just talking about the types of soils, isn't it, I mean, whether it is clay and what type of clay?

A. Soil surveys provide series descriptions, family. It can provide information relative to the different characteristics of the soils in the area.

Q. But as far as evaluating impacts from coalbed water, did the survey give you information to let you do that? Not what you expect or project impacts would be, I mean, do they do any -- did you have any information from

Page 33

those surveys on samples that show what impacts are -- have or are taking place?

A. Soil surveys don't show you what kind of impacts there are relative to application of CBM waters. Is that what you're asking?

Q. Well, I mean, your concern is what the effect of the CBM water would have on soils, and you're saying that between the reservoir and the Ninemile Ditch about the only water they could be irrigating with is what you're saying is CBM water.

So I was asking, have you done any sampling of those soils where water was applied for irrigation to see what the effects of using CBM water have been or are?

A. Not in Wildcat, but my other research has looked at that.

Q. Where is that?

A. That's been up in the northern part of Sheridan area. We've had sites over in Johnson County.

Q. Okay. Well, on this stretch of Wildcat that is below the reservoir and above Ninemile, you're saying that's just CBM waters is their source of water for irrigation?

A. That I'm not exactly sure about. I mean, they might be tapping into some groundwater. They might have some groundwater wells. That -- my understanding is that

Page 46

of the surface water system.
Q. Prairie Dog, how would you characterize -- Wildcat, what would you consider that? I know you're a soil scientist, not necessarily a, you know, flow expert, but how would you characterize Wildcat Creek as far as being perennial, ephemeral, intermittent?
A. Well, my take on it based on some of the data is that it is certainly not perennial. There was basically no water sampled above Paul Pond at the time of the synoptic sampling, so I would say it is ephemeral in the sense that during snowmelt and heavy rainfall that there would be some flow.
Q. What about in Prairie Dog? What's your understanding of the nature of that stream?
A. The Prairie Dog receives its water from the Big Horn Mountains, so it gets a significant amount of water that's diverted into that so it is going to have water that's associated with it for a fair time of the year. As far as the Prairie Dog watershed upstream from the diversion where water from the Big Horns comes in, I'm not sure.
Q. But, I mean, as far as the stretch that we're concerned with for this case, the water quality that's subject to the effluent, or that would be affected by the discharges authorized by this permit, what -- how do you

Page 47

characterize or understand the Prairie Dog Creek to operate in terms of its flow?
A. I think it varies throughout the year.
Q. But based on what?
A. Based on added water due to diversions.
Q. So is it a hybrid kind of system that it is part -- naturally, in its natural state, what would you expect it to be, or do you know?
A. I don't know.
Q. Okay. But the way it operates, is it kind of flow-on-demand sort of thing? I mean, when water is added from up above, then it is constant flow?
A. That would be an interesting way of putting it, flow on demand, because if water is put into it, there's potential for water flow.
Q. But as far as evaluating the effect on irrigation due to the discharges subject to these limits, are you looking at the effect on water that's continually flowing or only flows in response to storm events, or what are you evaluating when you're evaluating the -- I mean, your report says you're evaluating whether the limits are protective of irrigation in those two creeks. So how are you evaluating Prairie Dog's water supply dynamics for your review here?
A. I'm evaluating it based upon water quality data

Page 48

that I receive, the chemistry of that water quality data and the chemistry of the water associated with the Outfall 3 and the water quality in the Outfall 3, not knowing specifically what it is, but knowing what the limits are, and attainment of those limits would, in my mind, increase the amount of salt and specifically the sodium associated with those waters.
Q. Well, when -- what's your understanding of when water is flowing as a result of the diversion coming over -- how much flow is going down there?
A. I am not sure, and I think that varies. I think it is going to vary depending on how much water is being diverted and the time of year that it is being diverted. The irrigation district has some control over how much water is allowed to go down Prairie Dog with respect to its diversion rights.
So I don't know the specific amounts of water, if that's what you're asking.
Q. Well, in your report on the section on Prairie Dog Creek under Water Quality, and it is over on page 5, you say, "The proportion of Prairie Dog Creek water to effluent discharge will determine overall water quality at any particular time." So I was wondering, do you know -- I mean, do you know what the amount of Prairie Dog Creek water is? Do you know what the proportions are at any

Page 49

given time? I mean, I understand the concept here, but do you --
A. Do I know?
Q. Yeah.
A. At a particular time?
Q. Yeah.
A. No, I do not. And plus, I don't know what the amount of outfall is out of Outfall 3 as well. That information has never been provided, and I -- the only thing I'm going by is the permit that specifies the specific chemistry of the water and content that's achievable, so there's an amount of water, there's a quantity of water that's being permitted, and it is not just quality, but it is quantity as well.
And so in the DEQ permit, the fact that there was both quantity -- and DEQ, I know, has to regulate quality, but since there was a quantity expressed in the permit, and I was using that as a total amount of salt that could be potentially added.
Q. Do you know how many people are withdrawing water for irrigation from Prairie Dog Creek?
A. That would be the irrigation district's knowledge, but I have seen figures that show several irrigators along Prairie Dog and then also the irrigators on Wildcat.

Page 50

Q. Okay. But you don't know how much they divert or flow down that channel or have available for irrigation?
A. No, I don't.
Q. So you talked about, I guess, a bottom line maximum amount of salt loading from the permitted discharge, but you don't have any clear idea of the other side of the total of water which is the amount of receiving water that that would be mixing with?
A. No, I don't. And presumably -- and this is a concern -- is that that water could be discharged all year long. And so your question about what the irrigators are using would only be relevant during the growing season. At other times it would be -- it would be different.
Q. Is there water flowing down during nonirrigation season? I mean, we talked about the nature of that creek.
A. In Prairie Dog?
Q. Yeah.
A. I believe there is.
Q. Do you have any idea about the quantities of water or volumes? Not coalbed, whatever would be natural water coming down.
A. No. As I already mentioned, I am not familiar with the actual flows. I just would suspect that it would vary at different times of the year, particularly related

Page 51

to diversions, snowmelt events, rainfall events.
Q. Do you know what types of irrigation are used on Prairie Dog Creek?
A. Like sprinkler systems?
Q. Is it passive flood irrigation, or what's your understanding?
A. I've seen a lot of center pivots. I've seen a lot of siderolls. I don't know what all of the irrigation practices are, but again, that would be something that the irrigation district would understand better.
Q. Well, if it is not -- if it is during nonirrigation season, and if the water for irrigation is pumped out, it is not a passive spread or flood irrigation, then how does the quality of the water coming down affect irrigation if they're not applying that water during nonirrigation season?
A. Well, at that particular time there would be no direct effect. That's not to say that there wouldn't be an impact of selenium -- sodium storage in the alluvial aquifer that would then impact the water quality during the irrigation season. And I have seen in the Powder River Basin that the drainage systems that have been impacted by CBM water sodium has caused dispersion resulting in not only clays that have migrated onto the sides of the channels, but also a lot of organic

Page 52

deposition that has occurred, not only in stream channels, but also in irrigated lands where sodium has caused dispersion, reducing infiltration and resulting in ponding.
And all of those ponds, or the ponds that I've noticed, are dark in color, representative of organic matter dispersion.
Q. So that would just be something sitting in -- you're saying would be sitting in the channel or in the bank as a result of -- so you're saying the flow during nonirrigation wouldn't continue to carry that on down the channel all the way?
A. There would be some that is moved downstream, but also there would be some that interacts with the alluvial aquifer as well as with the sediments associated with the river channel and the banks themselves. That's -- in some places we have seen cutting of the banks in particular locations in part because of dispersion of clays and organics that stabilized at one time the river channels.
Q. Well, then, when you get to spring before irrigation season and you have runoff, what effect is that going to have? Doesn't that come down and flush out things that have been deposited in the channel?
A. Depends on the volume of the water. There could

Page 53

be some movement. A lot of it is going to depend on quantity. And I'm not that familiar with the Prairie Dog water system as far as volumes.
Q. Well, speaking of the effect of infiltration, if you have that high sodium water in Paul Reservoir, why isn't that swelling the soils there and sealing up the seeps?
A. I don't know what kind of material the reservoir is comprised of.
Q. You mean that they may have brought in some nonlocal material to build the dam or something, or what?
A. Well, could have been that they dug out the surface and they got down to something that was more coarse texture in nature or the sandier an alluvial material that has a greater chance of infiltration.
Q. So you think they would have built the dam out of the leaky material?
A. I'm not sure of the structure of the reservoir itself. I'm not sure what kind of material they would have used for the berm to hold the water in.
Q. So if they had something that was -- had clay content and they had sandy, leaky material, you think they might have used the sandy, leaky material to build a dam instead of the clay?
A. Well, you're talking about just the dam?

Page 58

are located? I mean, you talk about soil -- soil types and clay content based on the NRCS information.
A. Uh-huh.
Q. Does your report and the attachments show the location in these drainages of those -- of those soils?
A. I selected the soils along the drainages in evaluating their characteristics.
Q. Based on the information in the NRCS data, you mean?
A. Correct.
Q. Okay.
MR. BARRASH: Would it be helpful to get the big map out and have those things --
MR. RUPPERT: We have it.
MR. BARRASH: No, but I'm saying to show on that map where the soils that are -- you know, the different clays are located that he's referring to.
THE WITNESS: The different soils I used in order to do this evaluation? I was selecting the soils based upon the soil associations that are listed on the map that was produced by selecting a specific area in the NRCS soil survey.
So I didn't select these areas up here where there was no irrigation associated with at least the Prairie Dog and the Wildcat Creek. And I was basing that

Page 59

on the figure that I saw that showed irrigation in these areas.
So it was my premise that I would use the soils where irrigated lands were. I didn't want to select lands away from the irrigation.
Q. (BY MR. BARRASH) Have you gone out and viewed specific crop or soil damage associated with coalbed discharges in the Powder River Basin?
A. I've seen areas that have been impacted by CBM irrigation, yes.
Q. And what was the type of impact you saw?
A. Ponding. One site that had a center pivot had trenches that were at least a foot deep.
Q. Was that from surface flow, you mean, or from the quality?
A. The trenches were basically from the tires from the center pivots, but then those center -- those trenches, then, were filled with water. And then there were sites where there was ponding that prevented any plant growth. In fact, there was nothing growing there.
Q. Was it the quality of the water or the presence of the water, or both?
A. I would say both.
Q. And where -- where were those?
A. One was the Oxbow site off the Schoonover area.

Page 60

The other that I saw, we just -- we could see the water flowing off the fields. Vegetation had a yellowish color to it, in part because it was anaerobic in that environment.
Q. Where is the Oxbow site?
A. This is a different site, but Oxbow is located east of Buffalo off of Interstate 90 to the south by Schoonover Roads. I don't know what the actual road is that it is on, but it is up in that vicinity.
Q. Have you seen any damage up in these drainages?
A. I haven't seen damages, per se, no. My role has been with the role of soil chemistry associated with the surface applications of CBM waters.
Q. Do you know what leaching fraction the irrigators in Wildcat or Prairie Dog are attaining in their operations?
A. No, I do not.
Q. Do you know about what the actual root zones of alfalfa or the other crops in Prairie Dog and Wildcat are?
A. No, I do not. And I haven't read anything that shows specific information that provides rooting depth. We heard yesterday that alfalfa has a taproot that can go down I've heard as deep as 10 meters, over 30 feet in some locations, not specifically the Powder River Basin. But it is a deep-rooted plant. So its root zone is going to

Page 61

be deeper than, for instance, say a grass.
Q. I wasn't here for Mr. O'Neill's testimony, but I was told that he said that flow at the IMP and Wildcat was .07 cfs, so if I'm getting that wrong, someone can correct that because I wasn't here.
So would you expect that a flow of .07 cfs would even reach the Ninemile Ditch?
A. I mean, that's just a flow at one particular point at one time of the year, right? Was that --
Q. I'll have to let someone -- I wasn't here so I will have to let someone else follow up.
You said you did get to look at the September 2009 report by Drs. Hendrickx and Buchanan?
A. Yes, I read over it quickly.
Q. And that's Deposition Exhibit 23, I think. That's Exhibit 23. If you go to the executive summary on page little ii, and in the executive summary in the first sentence of the second paragraph they say, "We present scientific evidence that no unique relationship exists between irrigation water quality on the one hand and root zone soil salinity and crop productivity on the other." And then the last line in paragraph 3 says, "The true problem is the quantity of CBM waters rather than its quality."
Do you agree or disagree with that statement --

Page 66

leaking of the reservoir.
Q. That's the DEQ information that you talked about earlier?
A. Yes, yes.
Q. Anything else?
A. I think that that's all that comes to mind right now.
Q. Did you talk to Mr. Koltiska or any other Prairie Dog Water Supply Company shareholders before offering your report?
A. No, I did not.
Q. Did you talk to any of the landowners along Wildcat Creek or Prairie Dog Creek before authoring your report?
A. No, I did not.
Q. Did you talk to any other people that you would consider experts in the area of soil science before you authored your report?
A. Talk to them about what, this project?
Q. Yes.
A. No, I have not communicated with others on this project.
Q. All right. And I take it that means you haven't conferred with Mr. O'Neill either, correct?
A. No, I have not.

Page 67

Q. And you're not giving any opinion today or in your report on DEQ's methodology for setting limits in this permit, correct?
A. Excuse me. Could you repeat that?
Q. Sure. I didn't read your report to offer any opinions concerning DEQ's methodology for setting limits. I know you have issues on the protectiveness of those limits, but in terms of actual derivation of those limits, I didn't read your report to offer any opinion one way or another on DEQ's methodology.
Am I reading that correctly?
A. I didn't put anything specifically in the report related to that.
Q. Right.
A. The concern was that the methodology was used in order to come up with that 300 milligrams of sodium per liter, which I would question, yes, based on my background. But I didn't point that out in the report.
Q. So is that an opinion that you may give at the hearing in this matter, even though it is not in your report?
A. I would, yes, questioning the methodology, yes.
Q. Okay. Can you tell me about that opinion now, then, since I don't have any way of knowing what it is?
A. Well, the fact that the limit of 300

Page 68

milligrams -- 300 milligrams of sodium per liter is being allowed far exceeds the level of sodium that's in the receiving waters at the point of discharge, and to me it just doesn't make sense to try and extrapolate many miles down the road to come up with a value that would be protective at the point of discharge.
Q. So I want to try to restate that in terms that I understand. And if I get it wrong, tell me.
What I hear you saying is since DEQ set a limit on sodium of 300 and that's more than background in Prairie Dog Creek, that you are concerned about the setting of that limit for that reason?
A. Correct.
Q. In terms of any sort of calculations, mathematical underpinnings, that kind of thing, that's not where you're going with this? You're more concerned with the number as it compares to background, am I correct?
A. Correct.
Q. And you said you have visited the site with a graduate student, correct?
A. Correct.
Q. Do you recall when that was, what month?
A. August.
Q. And was that a day trip, up and back the same day?

Page 69

A. Yep -- well, drove up the night before, spent the night, and then looked around. That particular trip was also with Ginger Paige and Larry Munn because the intent of this trip was to give this student perspective on activities, things that are going on. We visited sites over in the Gillette area. We stopped at the Powder River, collected some samples. Then we also visited some of the fields in the Wildcat Creek area.
Q. Did you collect any soil or water samples in the Wildcat Creek or Prairie Dog Creek drainages?
A. Yes, we did.
Q. You did?
A. (Witness nods head.)
Q. And were those samples analyzed?
A. The soils were collected from the fields and yes, we just looked at EC and SAR, pH of those. We did collect some waters just to get the technique of trying to determine stable isotopes. But the water samples were collected without measuring the temperature and the bicarbonate concentrations which limits that particular data.
Q. Do you have that sampling analysis with you today?
A. No, I don't.
Q. Is that something you provided Mr. Stewart

Page 70

already?
A. No, I haven't.
Q. Is that something you would provide to us?
A. Well -- do you want it? Is that what you're asking for?
Q. Yes.
A. I could, yes.
MR. RUPPERT: I would make that question.
MR. STEWART: I didn't know that these were there.
Q. (BY MR. RUPPERT) And how many samples -- I may have missed that -- did you take in Wildcat and Prairie Dog, roughly?
A. They were pretty much all on Wildcat. And soils, I think we had 16 samples. We were looking at unique places. John Koltiska took us to a seep that was on his property and also to a -- one of his fields where there was a wetland that had developed. So we collected soils at those locations. I think there were about 16 soil samples.
And then we collected some water samples. But again, we collected soil samples at Tutor Rogers over by -- north of Gillette, and then we collected water samples by Gillette, and they're not part of this particular area.

Page 71

Q. My request only relates to the ones in Wildcat and Prairie Dog, if you could provide those. And the sampling analysis from any of those samples in Prairie Dog or Wildcat, did you rely on any of those for any of your opinions in your report today?
A. Well, the report was done well before I visited in August.
Q. Okay.
A. So --
Q. So this was after the fact?
A. Yes.
Q. All right. Did they change any of the opinions in your report?
A. No, because I wasn't specifically looking at the context of the report itself. We were looking at giving this student the general concept of, you know, sampling soils and collecting waters and giving him the opportunity to go out in the field. Newer student who has got a degree in chemistry and hasn't done a lot of fieldwork and he's very interested in the issue of CBM and CBM waters and soils.
Q. All right. And so at this point, based on that sampling analysis, you don't intend to author any supplement to your report in this case, or do you?
A. Based on those samples?

Page 72

Q. Correct.
A. I don't -- I feel like that was a reconnaissance trip to provide this student with some background. It is not something that I see that would basically impinge upon this particular project.
Q. All right. And so given the timing in August, roughly a month, maybe, after you authored your report in this case, that reconnaissance site visit really didn't inform you at all, obviously, for purposes of your report that we have with us?
A. Inform me as far as my conclusions?
Q. Yes.
A. It did give me a better perspective of what's there.
Q. Before you wrote your report you obviously weren't informed as to what you learned on that trip a month later?
A. Yes, right.
Q. On that trip you mentioned you did talk to John Koltiska, correct?
A. Yes. And the idea was to help this student see what the area was like where CBM activity was. His only scope of knowledge on that was based on websites and publications and things like that. He hasn't been up in that part of the country.

Page 73

Q. All right. Did John Koltiska tell you, either on that visit or anytime that you may have spoken to him, that he's concerned that any leakage from the Paul 3 is getting all the way up Wildcat into his irrigated fields?
A. No, he told me right off the bat that we're not supposed to talk about this case. And so we didn't talk about it.
Q. All right. Fair enough. Did you talk to anyone other than John Koltiska on that visit by way of landowners?
A. Not -- Jill Morrison was with us as well because she was working with Ginger on another project. Ginger was -- Ginger Paige, Dr. Paige, was up there to meet with the EPA, and while we were there, EPA canceled the trip, so this was an opportunity for Dr. Paige and Jill to discuss what they were going to do with the EPA.
Q. And Jill Morrison is with the Powder River Basin Resource Council?
A. Correct.
Q. Is that one of your clients in your role as the owner of the L.L.C.?
A. I have worked with the Powder River Basin Resource Council in the past, yes.
Q. In what role?
A. A lot of it has been basically just conversing

Page 74

with what is happening relative to -- with respect to CBM, predominantly.
Q. Consulting on a paid or unpaid basis, but fairly frequent basis, would that be fair?
A. No.
Q. How frequent?
A. I've only seen Jill, I think, two or three times in my life.
Q. Talking to her on the phone?
A. Two or three times. So it hasn't been -- we see each other at meetings. She was present when I gave a presentation to the EQC last September, and then I, like I said, saw her in August. And I had met her one time prior to that. And I can't remember specifically where that was.
Q. All right. During this reconnaissance trip did you and Dr. Munn or you and Dr. Paige discuss your opinions in this case?
A. No, I didn't, because, again, I've been told that I should not be disclosing the fact that I'm even consulting on this project.
Q. All right. And who told you that?
A. I believe that was part of the agreement.
Q. With Mr. Stewart?
A. Right. It is typical with other jobs that I do

Page 75

for consulting. I don't disclose my activities associated with consulting.
Q. But do you know that once you are designated as an expert witness you need to disclose whatever those conversations and engagements are?
A. Correct.
Q. And that's -- so that's why you don't talk to people about it?
A. Well, I'm just under the understanding that it is best to not discuss the case.
Q. All right. And do you recall meeting with a Gary Koltiska at all when you were up there?
A. No, I didn't. Just John.
Q. Just John?
A. And we spent just a few hours out in the field looking at a seep which was very unique to his one field and then the wetland at another site. But we never met with anybody else.
Q. That seep, as you understand it, was from two reclaimed reservoirs near those fields?
A. That was one of the locations. The other was a site that was to the north of the road north of his house, in that hayfield.
Q. I know you said that he said -- and he meaning John -- that you two weren't supposed to talk about

Page 76

anything. But did you get the impression, either from anything that was said during that reconnaissance visit or from your own observation, that those two problem areas were caused by the Paul 3 at all?
A. No.
Q. All right. In addition to the current permit in this case, what I will call the current permit, the permit renewal that came out, I believe, in January of 2009, is that the one you reviewed?
A. I looked at that one and the previous permit as well.
Q. You did look at the previous permit?
A. Yes.
Q. Which previous permit, since there are several?
A. I think I looked at the one from 2007, the original permit, and then the changes, so the September 11th permit and then the changes up and to January 2000.
Q. Did you look at the original permit from 2006 that was styled "new"? Do you recall looking at that one?
A. 2006?
Q. Yes.
A. I don't recall.
Q. Do you recall in the earlier permit that you did look at looking at or reviewing a discussion on protection of the Tongue River?

Page 77

A. Associated with --
Q. Sodium limits?
A. -- setting the sodium limits?
Q. If that's what you recall.
A. I believe that's -- in reviewing this -- I clearly don't recall specifically protecting the Tongue River. I recall the formulation of these limits with the discharge that were extrapolated over the reach of the Prairie Dog or -- yeah, the Prairie Dog Creek. So specifically to protect Tongue, no, I don't recall.
Q. Don't recall seeing that?
A. No. And in my mind I think that would be after the fact because you really want to protect close to home before you protect far down the watercourse.
Q. You can protect for both and not be inconsistent, right?
A. You can try, but if you're going to set your limits based on some point downstream, then you could be impacting local settings.
Q. Now, you're here today as a soil science expert, is that essentially correct?
A. Yes.
Q. Are you an irrigation expert?
A. No.
Q. I'm looking at the first page of your CV. Do

Page 78

you have that in front of you?
A. No, I do not. I can see it in front of you, though. I typically don't carry that around with me.
MR. STEWART: How many pages is that, Mark, do you know? About 50?
MR. RUPPERT: I will look at the first page, but it appears to be 59 pages.
MR. STEWART: I can fit mine on one.
Q. (BY MR. RUPPERT) My only question for you is in the middle of the page where it talks about your current faculty position and it gives a breakdown by percentages of responsibilities -- is the way I read that. Is that correct?
A. Right.
Q. And the very last category of Advising, 2 percent, who is that you are advising?
A. That's undergraduates and graduate students.
Q. All right. So that doesn't have anything to do with advising landowners?
A. No.
Q. But you do advise landowners in your capacity as your L.L.C.; is that correct?
A. I do --
Q. In your private capacity, so to speak, and not as a university professor, right?

Page 79

A. Correct.
Q. If we had to do a similar percentage breakdown and university professor, X percent, and whatever you do as a part of your Vance Consulting, L.L.C. as Y percent, can you fill in X and Y for me?
A. The university allows faculty to spend up to 20 percent of their time consulting. I don't do anywheres near that. I would say throughout the course of the year, and it varies from year to year -- this is not my primary job. Being a professor is at the university. I would say that it amounts to maybe 2 percent of my time.
Q. All right. And in your work as part of Vance Consulting, L.L.C., we've already talked about that including the Powder River Basin Resource Council, and I guess it includes John Koltiska. Does it include other landowners, I assume?
A. Well, specifically I'm looking at this not just because of John Koltiska, but based on the permit and being involved with Mark Stewart. So other landowners, I have worked with groups looking at selenium issues associated with coal mining activities, phosphorus mining activities.
Q. Any industry clients?
A. I have worked with DEQ in the past on a consulting basis. I have worked on several research

Page 80

projects with industry.
Q. By that do you mean projects that industry has funded?
A. Yes, in various ways.
Q. Yes. But in terms of advising, say, a corporation that has coalbed methane operations, have you ever done that?
A. No. I've worked indirectly through BLM on activities that dealt with CBM and different companies.
Q. And I think Mr. Barrash already covered this, but you've also never worked with any landowner that's using CBM to irrigate with, correct?
A. I have worked with industry on their sites where they have been land applying and the industry is working with the landowners.
Q. But in terms of advising the actual landowner, that's not been part of that, right?
A. No, not as far as irrigation practices. Is that what you mean?
Q. Yes.
A. No, I have not.
Q. Have you ever testified as an expert in the last four years?
A. My recollection is that I did a telephone testimony with the West Virginia Department of

Page 81

Environmental Protection on issues associated with selenium in coal mines.
Q. And what year was that, roughly?
A. I want to say 2004, so it has been more than four years. I think it was 2004.
Q. Sorry for interrupting you. Anything in the last four years?
A. No, I have not.
Q. Any expert testimony before the Wyoming Environmental Quality Council in the last four years?
A. I provided testimony last September in front of the Environmental Quality Council with concerns associated with Tier 2.
Q. All right. And was that listed in your report anywhere? I may have missed that.
A. In this report?
Q. Yes. In your report or your curriculum vitae?
A. I believe the vitae that you have -- what's the date on that, just the front?
MR. STEWART: July '09.
Q. (BY MR. RUPPERT) 17 July '09, that's what mine says, last modified.
A. I'm not sure if I included it in there or not..
Q. I want to retread on a few things you testified about this morning and make sure I fully understand, so

Page 82

let me look at my notes of your testimony.
I thought I understood you to say, and I just want to get confirmation or not so that I understand it, adding any salts to an irrigation water will not be protective. Am I understanding your opinion correctly?
A. No, I didn't say it specifically that way.
Q. Okay. How would you say it?
A. I would suggest that there's a burden put on the landowner if additional salts are added to the irrigation water.
Q. All right. And I also --
A. And specifically sodium.
Q. Go ahead.
A. And specifically if it is sodium.
Q. All right. And I wrote down that to avoid that result of burdening the irrigator that you have to mimic background water quality; in other words, have no change in the background water quality so that you would not be burdening that irrigator. Did I get that right?
A. That would be what I would -- I would propose, yes.
Q. Right. You know -- are you familiar with Chapter 1, Section 20 of the Wyoming water quality rules and regulations?
A. The rules that are revised at this time?

Page 83

Q. No, the rule that simply provides no measurable increase in livestock or crop production?
A. Yes, I've read that.
Q. Is what you're proposing more restrictive than that standard?
A. It depends what you consider measurable.
Q. What do you consider measurable?
A. Well, any decrease would be considered a measurable decrease. I mean, if there was a decrease associated with water quality, then -- and it was measurable in some way, or hypothetically it had some impact, then it would be against DEQ's guidelines.
Q. Okay. I want to compare that -- I understand that. But I want to compare that to what you just proposed. In other words, if you add any kind of a salt load such that you're no longer mimicking background water quality in a stream like Prairie Dog Creek, are you equating that with the standard in Chapter 1, Section 20?
A. I am -- and the standard that is associated with Prairie Dog has a very high sodium limit that concerns me. That would be potentially problematic with respect to DEQ's guidelines.
Q. Okay. Well, let's -- I know we're here to talk about this permit, but let's forget about the permit for a minute and talk about a hypothetical permit where -- let's

Page 84

go back to a number you used earlier of 30 instead of 300. Let's say we're going to add 30 milligrams per liter of sodium to Prairie Dog Creek. That's adding a salt load to Prairie Dog Creek that's not already there, correct?
A. Well, it depends on -- also on the quality of the water in Prairie Dog.
Q. All right.
A. So I'm not saying that you can't add no water.
Q. That you can't add any --
A. Water.
Q. -- salt load. You could add some salt load, is that what you're saying?
A. You would be adding salt, but you would be also adding water, so the quality would remain the same. You could do it that way.
Q. And so is what is important is concentration of sodium?
A. It plays a big role, yes.
Q. All right. Concentration as opposed to just pure load is what we ought to be looking at, right?
A. Probably look at both.
Q. Okay. But if the load doesn't change your concentration, then does it matter?
A. The load doesn't change your concentration?
Q. Right. If a salt load doesn't change your

Page 85

sodium concentration, would you be concerned, your background sodium --
A. So.
Q. -- concentration?
A. So in essence you're saying if you add two waters of the same quality together, you're not going to change your water quality.
Q. You're not changing the sodium concentration. If I'm adding some kind of salt load, but the concentration doesn't increase beyond whatever it is, that's okay?
A. Right.
Q. Okay. I just want to make sure I understand what your opinion is. All right.
It is only when we add salts or sodium that increase the background sodium concentration in the waters that it becomes a problem?
A. In my mind, yes.
Q. Yes. Which may or may not be consistent with Chapter 1, Section 20?
A. When you say inconsistent or consistent, you're -- it would depend on what kind of problem you're going to see with the amount of sodium that you're adding.
Q. Okay. Are there scenarios where under your proposal and we can't change the sodium concentration in

Page 86

an irrigation water -- are there scenarios where if we do that, if we do increase the sodium concentration somewhat, whatever that number is -- I'm not asking you to put a number on it yet, I'm just saying, are there some scenarios where we could increase sodium concentration in an irrigation water and not cause a measurable decrease in crop production?

A. First of all, it would depend on the amount of sodium you're adding, and then the other point of this whole issue would be is there calcium, magnesium to potentially counteract the amount of sodium that's being added.

Q. Do you know what the background sodium concentration is in Prairie Dog Creek?

A. Prairie Dog? Based on this sampling, sodium is pretty low.

Q. That's Wildcat Creek, or is that Prairie Dog Creek?

A. That's both.

Q. What is the number there?

A. For Prairie Dog?

Q. Yes.

A. It would run between 10 and 14 milligrams per liter.

Q. All right. Well, then let's say that we're

Page 87

going to add an effluent with 15 milligrams per liter. As I understand your testimony, your concern is that that's going to impose a burden on the irrigators, correct?

A. My testimony is that the limits of 300 milligrams per liter will impose on the landowners. Clearly that's a significant amount over and above the 10 to 12 that's in the system now.

Q. Okay. Well, I thought we had agreed earlier -- I thought I understood your testimony earlier for you to be saying that your proposal is that adding any salts and increasing the sodium concentration of an irrigation water is going to impose a burden on an irrigator, regardless of that increase. Did I get that wrong?

A. Well, there's -- if you're talking about a minor change of 15 milligrams per liter over and above, you know, the 10 to 14 that's already there.

Q. Could you go back and answer my question that I just asked?

A. I would say that it depends on the absolute amount that's being --

Q. Depends on what, I'm sorry?

A. The amount that's associated with the concentration.

Q. Okay.

A. And for me to give you a particular number, I

Page 88

can't do that.

Q. So there are some amounts over background water quality in terms of sodium concentration that you could add to increase that sodium concentration and not cause the concern for irrigators? Is that what you're saying, some minor amount?

A. Minor amount, and it would be nice if there was calcium, magnesium associated with them.

Q. All right. So earlier I thought we had this hard line over which we weren't crossing of no additional salt load, no additional sodium concentration. But apparently we don't have a hard line now; we've got a fuzzy line where we can increase background water quality somewhat -- we haven't defined what that is yet -- and not cause the concern that you had expressed to irrigators, right?

A. Right. Again, my concern is that 300 milligrams of sodium per liter.

Q. Right. Okay. I'm looking at your report on page 2 at the bottom of the first paragraph where you say, "It is essential that background water quality be evaluated in order to prevent measurable decreases in crop production."

Is this tracking the idea that we were just talking about, that's why you need to know background

Page 89

water quality?

A. Correct, yes.

Q. So you can know when you're going to add an additional sodium concentration that's going to be above that background water quality, right?

A. Not so much the sodium only. It is the salts that are being included as well. And so understanding the system for irrigated management requires that you understand not only the water but also your soils, and then you adapt your management practices accordingly.

Q. I didn't see in your report a recommendation or an opinion that DEQ should have set an SAR limit for the permit. Did I miss that, or did you not give that opinion?

A. I did not give that opinion.

Q. All right. In your third paragraph on page 2 you describe water that is slightly saline as 1 to 1.5 deciSiemens per meter, right?

A. Uh-huh.

Q. I tend, by the way, to use the micromhos per centimeter, so I'm probably going to lapse into bigger numbers here, but you and I still know what we're talking about.

A. Right.

Q. And it goes without saying, I don't think

Page 98

Dr. Gangegunte took lead on.
Q. And the previous article I showed you titled Soil and Plant Responses from Land Application of Saline-Sodic Waters - Implication of Management, you're first on the list there, so I'm assuming you didn't step away from that, correct?
A. No, but Lyle King did.
Q. Right. So at the time this was published was there anything in the article that you disagreed with?
A. Well, the general concept of the article was to point out what some of the soil chemical changes were relative to irrigation with CBM waters. Some of the specifics as far as past research or, you know, proposed guidelines, those I would have to say that I would disagree with those.
Q. Is there a way of expressing that disagreement in an article, or do you just not do that?
A. I'm not sure what you mean. Can you rephrase that?
Q. Sure. Let's take the specific example. Since you disagree with the statement made in both articles here that, "An SAR of 10 is generally considered suitable for irrigation water use with sensitive plant species" -- since you're saying you disagree with that statement, is there a way of expressing that disagreement or dissent in

Page 99

the article somewhere, or do you just not do that?
A. Well, no, I think that would be something that you could suggest based upon research that it was -- that it is not an appropriate guideline.
Q. So caveat it in some way, is that what you're saying?
A. I'm sorry?
Q. Caveat that statement?
A. Yeah.
Q. But I don't see any caveating in either article that an SAR of 10 is not protective. Is there one?
A. Is there a caveat?
Q. Is there a caveat that an SAR of 10 is not protective?
A. That wasn't really the premise of the research. The research was basically to describe what changes were occurring based upon the research that we were doing.
Q. But the research was premised on CBM water exceeding an SAR of 10, correct?
A. Correct.
Q. Have you reviewed the USGS data in this case that was available at Wakely station and Prairie Dog Creek?
A. Reviewed the water quality data?
Q. Correct.

Page 100

A. No, I have not. I think I've seen it, but, you know, looking at it and reviewing it are two different things.
Q. Right. It wasn't really reviewed for your report?
A. No, it was not.
Q. Wasn't really important to review for your report?
A. The fact that it had low water quality criteria -- or contents relative to Acme, that's the only difference that I noticed, was the overall quality of the two waters at different times. And it was apparent that as the water migrated downstream that it did tend to increase in EC.
Q. Based on your at least seeing the data at Wakely, even though you didn't apparently rely on it for your report, would you ever expect a discharge under this permit to result in an SAR of 10 at the Wakely stream gauge?
A. It would depend on the water quality that's being discharged and the amount of water that's in the creek.
Q. So the more water in Prairie Dog, that would be one answer, and low flow in Prairie Dog would be another answer in terms of what your SAR was going to be?

Page 101

A. Correct.
Q. All right. Would you expect -- do you know what the lowest flow in Prairie Dog is during irrigation season?
A. No, I do not.
Q. All right.
A. And as I mentioned earlier, that the irrigation district would have that information. And USGS would have that information as well as far as --
Q. And USGS does have that and that data is available to us, but that's not data that you really reviewed?
A. No.
Q. Is that because in your mind it doesn't really matter what the mixture is; it is still going to cause, no matter what the mixture is, a burden on the downstream irrigator?
A. The mixing is going to be dependent upon the distance and the volume of water being added. You're going to find a bigger impact closer to the discharge than you will downstream.
Q. But at a 300-milligram-per-liter permitted limit -- let's just say that the effluent -- and just to confirm something else I heard you say earlier this morning, you don't know what the amount of effluent,

Page 110

Q. Is this 750 still valid, then, in your mind?
A. Oh, I think a lot of this is not valid anymore because it is getting old.
Q. To include the 750 number, do you believe?
A. Yes.
Q. All right.
A. And again, the reference to that in these papers is to just point out that we're using waters for our study that are much higher levels than have been listed in Handbook 60 and others.
Q. Okay. Thanks for looking for that.
A. I can see where if you were looking for specific numbers, it doesn't state it, but you go to that table and you can calculate it.
Q. Okay. I understand.
A. Is this part of the document? I'm not aware of that. It looks like other information.
Q. Doesn't appear to be, no.
A. I thought that was a little big.
MR. RUPPERT: I'm going to strip that off of the deposition exhibit since it is not part of that.
MR. STEWART: No. And Dr. Schafer is familiar with that, I'm sure. He can confirm that's not part of Handbook 60.
DR. SCHAFER: That's not part of it.

Page 111

That's something different.
Q. (BY MR. RUPPERT) I'm looking at an article again, and I don't know the deposition exhibit number. It is one of the ones we went over this morning. This is the one called Soil Chemical Changes Resulting from Irrigation with Water Coproduced with Coalbed Natural Gas. Do you have that one?
A. Yes.
Q. Again, I'm looking at page 2221.
A. Okay.
Q. And I'm looking in the middle of that right-hand column, the paragraph beginning, "In arid environments..." Do you see where I'm at?
A. Yes.
Q. And to read the rest of the sentence, "...use of groundwaters with appreciable salt concentrations, EC greater than .75 deciSiemens per meter for irrigations on soils with poor drainage can result in salt buildup..." And I won't read the rest of the sentence. I know we just went over the .75 and how that may have been modified since Handbook 60, and it appears that there is a linkage between the number in your article here of .75 and poor drainage in soils; is that correct? Am I reading that correctly?
A. On soils with poor drainage?

Page 112

Q. Yes.
A. Yes.
Q. Okay. It seems to say the same thing lower in that paragraph, the sentence, "Dissolution of soil salts and contribution of salts from CBNG water irrigation coupled with poor drainage, the PRB soils and high evapotransportation rates have the potential for increasing soluble salts in the root zone."
I will stop reading there. Do you see that sentence?
A. Yes, I do.
Q. Is it conveying the same idea that if you have salts and soils with poor drainage, then you have a potential problem?
A. Yes, you can have a potential problem. And again, that's another reason why management is so critical.
Q. And it is especially critical where you have soils with poor drainage; is that correct?
A. Yes.
Q. All right. I understand now.
(Deposition Exhibit 32 marked for identification.)
Q. (BY MR. RUPPERT) I've marked a portion of a transcript as Deposition Exhibit 32, and this is just a

Page 113

follow-up to a discussion that we had this morning on SAR of 10 and your testimony that that, despite what it said in the articles, was not really an appropriate SAR level.
I want to direct your attention to page 226 of this testimony. I think you said earlier you did testify as an expert to the Environmental Quality Council, I think you said September. This appears that it is October 24th of 2008 and appears to have testimony by a Dr. Vance.
Is this your testimony that you were referring to earlier, or a portion of it, on this page?
A. I believe so.
Q. And at the bottom of page 226 Mr. Morris -- who was a council member, I believe; is that correct?
A. Yes.
Q. -- asked, "What would be your recommendation for standards?"
And your answer was, "My recommendation would be Tier 1. I feel it is of significant protection."
And the follow-up question was, "And those numbers are what?"
And you said, "The SAR maximum of 10 with ECs that are protective of the plant."
So my question for you is in your opinion on this case and in the opinion you expressed earlier that an SAR of 10 is not an acceptable number, is that different

Page 134

I have the article out, the only question I have for you is -- I'm assuming but usually when I assume something, I make a mistake. I'm assuming that you would disagree with these statements in this article as well, that, in other words, you would disagree that an SAR level of 10 is an acceptable value?

A. It was a level we were trying to achieve with using zeolites as a water treatment process, and it is with respect to that that we focused on in this particular paper and again --

Q. Does that mean you had the same issue that you had with the other papers specifying an SAR of 10?

A. Again, that was the limit as to what Tier 1 was proposing, and we just have followed that as far as water treatment goes. We did not use this water. We were trying to come up with a treatment that would be useful as far as reducing the sodium content.

Q. To an acceptable level?

A. To the acceptable level of 10, yes.

Q. All right. Do you happen to know the flow that would be required in Prairie Dog Creek for any irrigator along Prairie Dog Creek to irrigate?

A. No, I do not.

Q. Okay. Now, on page 3 of your report you talk about the soil survey that you performed and downloading a

Page 135

custom report off the NRCS website, correct?

A. Correct.

Q. And even though you said you took some soil samples after your report, your report is based on this soil survey and not any particular soil sampling. Do I have that correct?

A. That's correct.

Q. All right. Were you ever shown the Prairie Dog Creek AMPP samples that Mr. Schafer testified about yesterday?

A. I was not shown those until I reviewed his report.

Q. All right.

A. And can I look at that report again?

Q. Schafer's?

A. Yes.

Q. Yes.

MR. STEWART: His expert report or the AMPP?

THE WITNESS: The expert. I think there was something in here that --

A. I did note that even in his report he did list several soils that had montmorillonitic or smectitic clays associated with them.

Q. (BY MR. RUPPERT) Is that based on the NRCS

Page 136

characterization?

A. Yes.

Q. As he testified yesterday, his actual sampling in Prairie Dog Creek did not show, except for one sample, predominantly smectitic clays; is that correct?

A. I'm not sure that --

MR. STEWART: Object to the form of the question.

A. Yeah, I don't recall that.

Q. (BY MR. RUPPERT) Do you recall his testimony yesterday generally with regard to what he found with regard to soil sampling and clay content, smectitic clay content?

A. I recall looking at the figures as he was discussing them and having, I believe, 32 percent clay or -- there was an initial increase, if I recall correctly. The clay content, I believe, increased in the profile. I don't recall the specifics of the AMPP program. I didn't read that document. I've never received it to look at.

Q. Right. Okay. The soil survey information that you portray in your report at the back of the report in several color maps, are there limitations to using this soil survey information?

A. Yes, there are.

Page 137

Q. What are those?

A. The limitations are there could be very site-specific conditions that obviate the direct connection between what is in the survey and what's actually there.

Q. All right. And I think I read something similar in your report, actually one of the appendices of your report, page 2 of the custom soil resource report that you downloaded as a preface. Do you see that? In the beginning of the third paragraph it says, "Although soil survey information can be used for general farm, local and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments." Do you agree with that?

A. Yes, I do.

Q. All right. And were you attempting to do a soil quality assessment here?

A. Yes. I didn't have any -- I didn't sample the area, and so the information that I obtained from the soil survey which has quantitative information associated with it but it is, again, a soil survey that provides you with some direction.

Q. Kind of a starting point?

A. Yes.

Page 138

Q. And had you had the time or opportunity, then, what I hear you saying is you agree it would have been appropriate to do some onsite investigation to do a soil quality assessment for these drainages; is that correct?
A. That could be quite expensive if I was going to go out there and conduct something --
Q. Do you agree with -- I'm sorry. Go ahead. Do you agree with that?
A. If I had the time that I would go out there and do a soil sampling.
Q. Do the onsite investigation?
A. To get more information, yes.
Q. I'm going to generalize some of the main conclusions that I gleaned out of the soil survey part of your report, and I want to talk about those.
The first conclusion that I gleaned out of this is that along Prairie Dog Creek and Wildcat Creek the soils were generally what is known as Class 6, correct?
A. Uh-huh.
Q. But in terms of the irrigated lands, those soils are Class 3, correct?
A. Correct.
Q. And there's no irrigation occurring along Class 6 areas, is there?
A. Correct.

Page 139

Q. The second main conclusion that I gleaned out of this is the soils can contain smectitic clays; is that correct?
A. Correct.
Q. The third conclusion that I drew from this is that the soils that we're talking about here had poor drainage qualities; is that correct?
A. I didn't look at specifically the drainage with this particular example.
Q. I may have read -- go ahead.
A. I'm sorry. I would have -- I mean, based on the conditions, the parameters provided in this whole survey, I would say that there's a potential for poor drainage.
Q. All right. And I may have read more into the statement than you intended, but I'm looking at the last sentence on the middle of page 4 under Water Quality where you say, "This is especially important considering most of the Powder River Basin consists of soils with poor drainage."
And what I concluded from that that you were saying was that you thought there was a high likelihood that the soils in question here in Wildcat and Prairie Dog Creeks also suffer from poor drainage. Am I correct?
A. I would say that is a general perspective of the Powder River Basin, and particularly here because I used

Page 140

that result that came from the BLM report.
Q. Okay.
(Deposition Exhibit 34 marked for identification.)
Q. (BY MR. RUPPERT) And I've marked Deposition Exhibit 34, a soil survey performed from the same website, and I want you to take a minute to review it, and then I want to ask you a few questions about it.
A. Okay.
Q. Have you had a chance to look at that?
A. Yes.
Q. First page appears to be just an overview of the Prairie Dog Creek and Wildcat Creek irrigated drainage areas, just to give you a reference point. Would you agree with that description?
A. Yeah. I can't read some of these, but I'm assuming this is Prairie Dog Creek, and I believe it is since it is due east of Sheridan.
Q. Right. Okay. Let's take a look at the second page. And this is the north portion of that large overview. Again, just to orient you, and this is the kind of -- similar kind of map and product that you have, I believe, in your report where it maps soil types. That's the way I'm reading it. Is that the way you would read it?

Page 141

A. Yes.
Q. All right. And you can see these irrigated dark green -- appear to be irrigated lands to you?
A. Yes.
Q. And the next page talks about a land capability class, and this appears to be consistent with your report showing that the irrigated areas there in the green and yellow are, in fact, Class 3 areas, correct?
A. Class 3, Class 4. You said the green -- the dark green within the yellow? Yes.
Q. Dark green within the yellow.
A. Class 3.
Q. All Class 3 areas? Appear to be?
A. For the most part.
Q. Right. Next page on the drainage class, they all appear to be in these areas that are irrigated, well drained according to this survey, would you agree with that?
A. Based on this figure, yes.
Q. All right. And the next page, depth to groundwater, they all appear to be greater than 200 centimeters, would you agree with that?
A. Yes, based on this figure.
Q. What's the significance of that, by the way, that depth to groundwater?

Page 154

A. I don't believe it is.
Q. Do you know whether or not there is another permit that's not part of this proceeding that allows Pennaco to discharge untreated CBM water into the Paul 3?
A. I believe they're doing that right now.
Q. So it is your understanding there is another permit that allows that?
A. Well, it is part of this permit that allows CBM waters to be discharged into Paul 3, and it is not supposed to be overflowing except during an extreme rainfall event.
Q. So it is your understanding that under this challenged permit, Marathon is discharging untreated CBM effluent into the Paul 3, right?
A. Correct, correct.
Q. And that's a basis in part for some of your opinions on Wildcat Creek, then, I take it?
A. Yes.
Q. Back to your report -- and I'm getting there. I'm on page 5 now. First paragraph, about five lines down, you talk about using bicarbonate equivalent weight of 30.5. Do you see that?
A. Uh-huh.
Q. Do you believe that 30.5 is a correct number?
A. No.

Page 155

Q. No?
A. It should be 61.
Q. Should be 61. Will that change anything in terms of your conclusions?
A. I would mean that there was -- it would have to be significantly higher concentration of bicarbonate in the system to equate with the concentrations associated with 300 milligram per liter sodium.
Q. Later in that paragraph you say, "Thus, adding a calcium source such as gypsum to high sodium effluent would exceed the EC limit of 1215." Do you see that?
A. Correct.
Q. Are you assuming that they are going to add gypsum as part of the treatment process?
A. That would be an assumption in order to get the calcium levels up.
Q. Could lime be added to that process?
A. It could be if it was soluble enough.
Q. Are you suggesting -- I can't tell and that's why I'm asking -- that Pennaco cannot or will not meet the EC limit of 1215?
A. I'm suggesting that at this 300 milligrams per liter sodium level using bicarbonate or sulfate as an accompanying anion.
Q. In the two-page sampling analysis from the

Page 156

treatment plant effluent that I've just handed you, what was the treated sodium level?
A. Sodium was 207 and 185.
Q. And what were the treated EC levels?
A. 991 and 970.
Q. So apparently whatever they added didn't exceed the EC limit, at least for those two tests, did it?
A. Not for these two tests.
Q. And you're not suggesting gypsum was the only thing they could add for the treatment process, are you?
A. No.
Q. All right. And in this same paragraph later on you state that -- toward the bottom of that paragraph, "Effluent discharge will comprise the majority of the flow during this period," meaning nonirrigation period?
A. That was my assumption because of the diversion of water into Prairie Dog Creek for use for irrigation.
Q. So when you made this statement, you didn't review the actual flow data from USGS?
A. No, I didn't.
Q. All right. Do you know how much of the time Prairie Dog Creek is below the 2.27 cfs effluent limit during nonirrigation season?
A. No, I do not.
Q. Would it surprise you to know that 99 percent of

Page 157

the time the USGS data shows that the nonirrigation flow is actually greater than 2.27 cfs?
A. That's at the discharge point?
Q. At Wakely.
A. It surprises me, yes, it does.
Q. All right. And finally, the last sentence when you talk about a release during the irrigation season and concentrations increasing in the stream ecosystem, are you talking about bank storage or what process are you talking about of storage and release during nonirrigation -- or at least storage during nonirrigation season?
A. I am suggesting that there's a chance for sodium to be adsorbed into the alluvial aquifer as well as in the sediments and also the banks of the Prairie Dog as well.
Q. And if my statement that I just made to you were correct that 99 percent of the flow exceeded 2.27 cfs during nonirrigation season, would that conclusion change?
A. No, I think that the sodium would still result in being part of the ecosystem.
Q. The banks?
A. Could be.
Q. The streambed?
A. Could be. Sediments.
Q. Depending on flow or not depending on flow?
A. Flow might determine the location where some of

Page 162

Q. All right. That's what you're relying on?
A. Yes.
Q. And we will talk about that. All right.
So let's go ahead and get into that. In paragraph 3 on page 5 you state that, "Both the AIMP-1 and IMP-1 sites also contained CBM waters at levels of approximately 16 to 17 percent." Right?
A. Correct.
Q. And this conclusion is based on isotope data, correct?
A. Carbon isotope data, yes.
Q. Carbon isotope data. Is it based on the oxygen or deuterium isotope data in any way?
A. No, it is not. It is associated with the carbon itself.
Q. Did you review and try to analyze the oxygen or deuterium isotope data?
A. No, I did not, other than look at it to see what the variation was relative to the samples. If I recall correctly, there was a -- well, a small change relative to the carbon date.
Q. Have you used oxygen or carbon isotope data in the past and tried to utilize that in the past?
A. No.
Q. Have you used carbon 13 data in the past and

Page 163

tried to analyze that?
A. Analyze?
Q. Analyze carbon 13 isotope data.
A. For looking at waters.
Q. Yes.
A. No, this was an occasion where I had the opportunity to look at carbon 13 data.
Q. All right.
A. I'm familiar with the process. We have the stable isotope lab in our department, and I have read Sharma's paper.
Q. Is that the Sharma and Frost 2008 paper that you cite here?
A. Yes.
Q. Had you read it before this case?
A. I had looked at it, yes.
Q. All right. Did you read it again before you did whatever analysis you did in this case?
A. No, I did not.
Q. All right. Did you talk to Sharma or Frost?
A. I have talked to Sharma about just the overall process of how isotopes work.
Q. Did you talk to Sharma about your analysis in this case?
A. I did.

Page 164

Q. Did Sharma help you with your analysis in this case?
A. No, she did not help me with this particular simple model approach. I mean, it was -- it was based upon the idea that there are distinct differences in isotope ratios for CBM waters and surface waters.
Q. Do you have this in front of you (indicating)?
A. Yes.
Q. All right. That's been marked as Deposition Exhibit 27, just for the record.
A. Yes.
Q. I want to talk to you about this a little bit. Is this your work?
A. This -- I helped develop all of this based upon the information that I was -- I received. I didn't go out and get the chemistry.
Q. I understand that, but in terms of the chart that we're looking at here, is this your work on the chart?
A. The work on the chart is associated with the samples that I looked at, yes, and just lumping together.
Q. Okay. Just to put it in plain English, did you put this chart together?
A. Yes, I did.
Q. All right. So I'm looking in the middle of the

Page 165

chart at the blue triangles labeled 6 and 7. Do you see those?
A. Yes.
Q. And I believe those are IMP and AIMP; is that correct?
A. Yes, they are.
Q. Okay. And as I recall, the carbon 13 values at those locations were approximately negative 8.4 and negative 8.9. Does that sound correct?
A. Yes.
Q. And does that look right, according to your chart here anyway?
A. Yes.
Q. Such a figure could represent just normal surface water without a CBM influence, right?
A. Well, based upon the values 8 through 10 and 12 through 20, which I'm suggesting are representative of waters that aren't influenced by CBM, there is some influence.
Q. You said you were familiar with the Sharma paper. The Sharma paper in the abstract actually says that the negative carbon 13 of most surface and groundwater, and then it gives a range from negative 8 to negative 11. Are you familiar with that?
A. I believe I read that, but I'm going solely on

Page 166

the data and how it lumped together.
Q. You're not going on the Sharma paper?
A. No, I'm not.
Q. All right. And you've never done this before, right?
A. No, I haven't. It is not my specific area of expertise, but it is an idea that I've been very interested in.
Q. Okay. Well, the fact that Sharma gives this range of minus 8 to minus 11 for, in her words, most surface and groundwater, that could describe what we're seeing at IMP and AIMP-1 at negative 8.4 and negative 8.9, could it not?
A. Based on those numbers, yes.
Q. All right. Well, let's look at the next number to the right that's labeled number 11.
A. Okay.
Q. Do you know where that sample is located?
A. It is in Bass Pond.
Q. This would suggest to you that Bass Pond has a CBM influence?
A. To me that particular -- I don't know anything about the Bass Pond itself. It sounds like it is not a direct connection to the Wildcat Creek, and so that particular site could be influenced by plant uptake,

Page 167

differential adsorption of carbon 12 versus carbon 13. It could be a stagnant area. I would suggest it is probably associated with some potential evaporation as well.
Q. Do you know whether or not that's what the deuterium and oxygen isotopes are pointing toward?
A. I'm not aware of that.
Q. All right. So the processes you just described to come up with this -- and I don't know, looking at your chart, maybe the Bass Pond is about a minus 6, give or take, would you agree with that?
A. Yes.
Q. So the processes you just described to make the Bass Pond a minus 6 could also occur at IMP and AIMP-1 except for stagnation, correct?
A. The processes at Bass Pond?
Q. You just described to explain why we're seeing the Bass Pond at a negative 6, except for stagnation, they could apply at IMP or AIMP-1?
A. My assumption would be this is a pond that's vegetated and there's plant growth that could be impacting the overall ratio of carbon 12, carbon 13 at Bass Pond.
Q. Is that explanation in Sharma's article anywhere?
A. I'm not sure.
Q. It is a deposition exhibit I think we have.

Page 168

Yes, Deposition Exhibit 10.
A. I don't see that specific comment made in here.
Q. Okay. Where did you get that information?
A. That is information that I've gleaned from presentations associated with this kind of work.
Q. All right. And as I think you just stated, you're not an expert in this area?
A. No, I'm not.
Q. Looking at IMP and AIMP-1, the water in Wildcat when it flows continues to flow downstream to or above Dawson Draw, correct?
A. Correct.
Q. Does the carbon 13 value for Wildcat Creek above Dawson Draw indicate a CBM influence?
A. No, not based on this data.
Q. Because that's negative 14, right?
A. Yeah.
Q. And how about Wildcat Creek above Ninemile? Is there a carbon 13 CBM signature there?
A. No, I don't see that. And that's potentially because of mixing of water that has diluted out any CBM by the time it has gotten there.
Q. So you're saying at that point there may just not be any more CBM water left in that water?
A. Yes, that's what I would suggest.

Page 169

Q. So going back to your earlier statement in the previous paragraph that all the samples above Ninemile were influenced by CBM discharge, the carbon 13 isotopes don't support that conclusion at Dawson Draw or at Wildcat Creek above Ninemile, do they?
A. Correct. Dawson Draw, sample was actually collected up the draw, it looks like, and it wasn't strictly in Wildcat Creek.
Q. What about the Wildcat Creek above Ninemile? That was in Wildcat Creek, wasn't it?
A. Correct.
Q. And that doesn't show any sort of carbon 13 CBM signature, does it?
A. No. So it appears based upon this data that as you move down the creek there's mixing and at some point and the alluvial waters are the dominant source and very little CBM waters are associated with the waters that were sampled in this particular sampling study.
Q. So would you change your statement that all the samples upstream of Ninemile were influenced by CBM discharge?
A. I would have to say that's correct.
Q. That's correct, that you would change that?
A. Yes, based on this data.
Q. Toward the end of that page 5, about four or

Page 170

five lines up, you say, "It is well-known that the Paul 3 Reservoir leaks and CBM waters flow down Wildcat Creek." That well-known statement is based on the DEQ document that you were shown?
A. Yes.
Q. But according to the discussion that we just had, CBM waters don't flow down Wildcat Creek past Dawson Draw, do they?
A. Based on this, the data suggests that it doesn't.
Q. All right. And that's both the common ion data as well as the carbon 13 data, correct?
A. Correct.
Q. So even if Paul 3 is leaking, that leak is not going to impact Mr. Koltiska's irrigation, is it?
A. Well, that's hard to say.
Q. Well, if there's no CBM water getting beyond Dawson Draw, how is that going to happen?
A. Well, in the future if there's a greater amount of leakage, that could potentially happen.
Q. Okay. So based on the existing data, there's no evidence that that would happen?
A. Correct.
Q. Do you recall earlier, maybe it was this morning, when we were talking about protective SAR limits,

Page 171

and I want to say I remember that you told me that an SAR level of 3 was generally protective?
A. Correct.
Q. Would an SAR level of 3 in mixed waters in Prairie Dog Creek, and by mixed I mean effluent and natural background water, be protective of irrigation along Prairie Dog Creek?
A. I would believe so.
Q. How about 3.2?
A. Well, then you're nitpicking there. I would -- I would have to say that the general consensus is 3.
Q. All right. So 3 is and 3.2 might not be?
A. Might not be.
Q. Okay. Would more water in Prairie Dog Creek to those irrigators who don't have all the water they want enhance the production of alfalfa crop?
A. Are there irrigators that don't have enough water? I'm -- you know, again, that's the irrigation district. But if you didn't have water and there was additional water applied or supplied, then clearly that would benefit production of a crop.
Q. And so assuming that there are irrigators along Prairie Dog Creek who would want additional water that's not already appropriated, they would benefit from that additional water in terms of enhanced crop production?

Page 172

A. If they are limited in water, yes.
Q. All right. Are we saying here that the discharge of CBM water into Prairie Dog Creek at the permit limits would cause a risk of decreased production of alfalfa to the irrigators who use that mixed water? Is that basically what we're saying here?
A. I would say yes, and it would impose additional management requirements on them.
Q. Is there any way to quantify that risk based on these permit limits?
A. To put a specific quantification on it would take an evaluation of the actual water qualities that are being land applied, so the water that's available to the landowner. And it would be specific to the landowner that you're discussing as well.
Q. How about Mr. Koltiska?
A. It could. It would depend on the quality of the water that he actually is going to receive and the concentrations associated with that water.
Q. So that depending on the mix and the concentrations, there may be a risk, there may not be a risk; is that what we're saying?
A. It would depend on the quality of the water, yes.
Q. But as we talked this morning, there is a

Page 173

scenario that I think we talked about where if there is enough, whatever that figure is, natural water in the channel to be mixed with that effluent water, then there would not be a risk at that point; we just haven't defined that point? Does that make sense?
A. I think -- rephrase. I'm sorry.
Q. I don't know if I can remember all of that. We talked this morning about if there's enough flow in the channel, and we didn't define what enough flow is, but if there's enough natural flow to mix with the effluent flow, but then at some point, and we didn't attempt to define what that point is, then there's really no longer a risk to a downstream irrigator? That's really what I'm asking.
A. I believe we indicated that if the water quality of the discharge was very similar to the water quality of the flowing water body, that there would be no downstream impact. Is that -- that's the point I was trying to make, I guess.
Q. I think I understand that point. But if there's enough natural water in the channel, and we're mixing that with effluent, then at some point that mixture is going to be protective and what you're saying is it is going to be protective only if the background water quality in the channel is unchanged?
A. Going back to my original contention, the

Page 178

dispersion due to SAR concerns, sodium in particular through dispersion effects of organics and clays.
Q. So would you characterize that as an educated guess?
A. No, I've seen that occur at these sites that I've worked at.
Q. With untreated water?
A. With untreated water.
Q. Okay. And you just mentioned, I think -- what may be my last question -- an issue of this morning, you indicated you didn't know the leaching fraction that certain irrigators are attaining, correct?
A. Correct.
Q. Wouldn't you want to know that to be able to determine specific impact on specific -- on a specific irrigator?
A. I think it would be important to know how much water is being moved through their system, yes. So water quantity is going to be important as well as water quality.
MR. RUPPERT: If we can take a five-minute break, I think I'm finished, but I just want to make sure.
(Recess taken 3:38 p.m. until 3:50 p.m.)
MR. RUPPERT: I'm finished, Dr. Vance. Thank you.

Page 179

THE WITNESS: I do have one comment. I would like to clarify the fact that we were talking about Paul 3, and I see there, there is a containment requirement and effluent limit for Outfall 2 which I presume is the treated water that's going to be applied to Paul 3 as well.
Q. (BY MR. RUPPERT) All right. Does that change any of your other testimony that we talked about with reference to Outfall 2 or Paul 3 or Wildcat Creek?
A. No, it doesn't.
MR. RUPPERT: All right. Thanks again.
REDIRECT EXAMINATION
Q. (BY MR. BARRASH) I just have one question and that's regarding Exhibit 27, this one. And it says draft, and I was wondering, is there a final or is this the final?
A. The picture?
Q. Yeah, the map.
A. Oh, I stole this from the synopsis sampling that they did, and then I incorporated these numbers on here to identify the sites.
Q. So the fact that it says draft doesn't imply that there's some other document that's more conclusive of what your opinions or evaluation is, does it?
A. No.

Page 180

Q. This is the one?
A. This is -- I'm assuming that these are the locations where those water samples were collected.
MR. BARRASH: Okay, thanks. I have no more questions.
CROSS-EXAMINATION
Q. (BY MR. STEWART) Dr. Vance, earlier this morning when you were talking with Mr. Barrash, do you recall a discussion about -- I believe it is in page 56 your report in the discussion about the carbon 13 and the different percentages of CBM water versus Wildcat Creek water that your analysis indicated.
A. Correct.
Q. You recall that discussion?
A. Yes, I do.
Q. Did you mean to imply during that that that 40 percent or that 16 to 17 percent ratio would hold for all conditions?
A. No. I was under the assumption that that was a one-time -- not assumption. That was based on a one-time sampling event and the results suggested that based on that sampling event these were the values that could be calculated based upon the mixing model.
Q. And the mixing model you were using was a simple mixing model?

Page 181

A. Very simple.
Q. What, using water from the Paul #3 and the Dawson Creek sample as a surrogate for pre-CBM Wildcat Creek water?
A. Yes.
Q. Is it your opinion that that -- the carbon 13 data from that synoptic sampling indicates that there is the addition of CBM water to the Wildcat Creek drainage below Paul #3?
MR. RUPPERT: I'm going to object to the form of that and other questions if they're leading questions since this is your own witness.
MR. STEWART: I will try to --
Q. (BY MR. STEWART) What does your analysis of carbon 13 data from that synoptic sample indicate to you about the presence or absence of CBM water below Paul #3?
A. That that particular sampling event indicates that there has been CBM water that has contributed to the water quality of Wildcat Creek below the Paul #3 Reservoir.
Q. And why is that of -- why is that important or of concern?
A. Well, it is important that if that water ends up migrating downstream far enough, it could impact the other irrigators that are using that water, so impair the water

MR. STEWART: One last question, and you guys may have some follow-up.

RECROSS-EXAMINATION

Q. (BY MR. STEWART) Dr. Vance, is there any mention in any of your articles that an SAR of 10 is protective in all cases?

A. No. That's not the approach that we are using within the article itself, so the intent of using an SAR of 10 was primarily to set some limit that we were well above. So we were basically using a number that has been used in the past. It is not to suggest that that is protective. It is just a number that we felt was a level that -- particularly with respect to the criteria that's been out there, it is a level that others have used. It is not a level that we are using specifically to try and protect the lands that we're investigating.

MR. STEWART: Thank you.

FURTHER RECROSS-EXAMINATION

Q. (BY MR. RUPPERT) Is there a difference between protective and suitable?

A. Difference between protective and suitable? The definitions are different to me. If you put it into a specific context, it --

Q. You used the word "suitable" in your articles. Another word you use is "acceptable" for an SAR of 10. So

I guess I would have the same question, is there a difference between acceptable and protective?

A. The acceptable levels that I'm presenting here in these articles are those that others have suggested. Protective, I would say that that's a qualifying term that is hard to distinguish relative to SAR 10.

Q. You've already opined that the permit limits here are not protective. Do you think they're suitable or acceptable?

A. No. Suitable for -- you know, that again -- suitable for what? For discharging into the --

Q. Suitable for irrigation, suitable for protection of downstream irrigators?

A. No, I still feel that there's the potential for problems and the burden is going to be put on the landowners downstream.

Q. All right. Even though an SAR of 10 you've described as suitable and acceptable in your articles, correct?

A. Yes.

MR. RUPPERT: All right. Thank you.

MR. BARRASH: You going to read and sign?

MR. STEWART: Read and sign.

(Deposition proceedings concluded 4:27 p.m., September 25, 2009.)

DEPONENT'S CERTIFICATE

I, George Vance, Ph.D., do hereby certify that I have read the foregoing transcript of my testimony consisting of 199 pages taken on September 25, 2009, and that the same is a full, true and correct record of my deposition.

_____

GEORGE VANCE, Ph.D.

( ) No changes ( ) Changes attached

Subscribed and sworn to before me this day of , 2009.

_____

Notary Public

My commission expires:

CERTIFICATE

I, JANET DAVIS, a Registered Merit Reporter, Federal Certified Realtime Reporter and a Notary Public of the State of Wyoming, do hereby certify that the aforementioned witness was by me first duly sworn to testify to the truth, the whole truth, and nothing but the truth;

That the foregoing transcript is a true record of the testimony given by the said witness, together with all other proceedings herein contained.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my Notarial Seal this 1st day of October, 2009.

JANET DAVIS
Registered Merit Reporter
Federal Certified Realtime Reporter

My commission expires 2/20/2011.