June 24, 2019

MEMORANDUM

To: Dan Heilig, Wyoming Outdoor Council
Jill Morrison, Powder River Basin Resources Council

From: Mike Wireman, Granite Ridge Groundwater

Re: Review of:

1. March 13, 2019 WDEQ *Statement of Basis* (SOB) for the proposed renewal of a current Aethon Energy WPDES discharge permit

2. Draft *Authorization to Discharge Under the Wyoming Pollutant Discharge Elimination System*

I have reviewed the above referenced documents. The following comments summarize my review:

Summary of proposed discharge

- Aethons Energy's planned, expanded development of gas deposits may increase the produced water discharge currently permitted under WYPDES permit WY0002062, from about 4.37 mgd (104,000 barrels) to a maximum of 8.27 mgd (197,000 barrels).

- In the permit renewal application Aethon Energy proposes one new outfall (16) to be added to the 15 existing outfalls. Discharge of produced water will occur through the outfalls to Alkalai Creek via unnamed ephemeral stream channels. The SOB (p2) states that all blended water discharge will occur through outfall 1.Alkalai Creek is an ephemeral tributary to Badwater Creek which flows into Badwater Bay in Boysen Reservoir located about 40 miles downstream of the outfall locations. The permit renewal requests that the produced water be transported via Badwater Creek to a mixing zone in Badwater Bay on the eastern side of Boysen Reservoir.

- Aethon Energy retained Environmental Resources Management (ERM) of Melvern, PA to conduct a modeling evaluation of effects of Aethon Energy's increased produced water discharge on the water quality in the Class 1 segment of the Wind River below Boysen Reservoir.

- The SOB proposes:

    - effluent limits of 2419 mg/l for chloride and 6400 mg/l for total dissolved solids (TDS)
    - monthly mass load limits of 719 tons for chloride and 2161 tons for TDS.

  These limits are based on the mixing model analysis and compliance with antidegradation requirements applicable to the Class 1 segment of the Wind River below Boysen reservoir. The SOB states that the results of the modeling *"indicated that total monthly loads of chloride and TDS could be as high as 719 tons/month and 6571 tons/month respectively without exceeding the class 1 antidegradation targets on the Wind River below Boysen dam."* The chloride limits are also based on historical, grandfathered discharge effluent concentrations for permitted outfalls 1-15.

- Aethon Energy's Neptune treatment facility currently has the capacity to treat about 39,000 bpd (1.64 mgd). This limits the total produced water discharge to 4.37 mgd to assure compliance with applicable effluent limits. According to the Statement of Basis (based on the modeling report) Aethon Energy will need to treat 5.84 mgd (139,000 barrels) at the estimated maximum discharge (8.27 mgd) to meet standards required to protect the Class 1 section of the Wind River below Boysen Res. The remaining 2.43 mgd (58,000 barrels) will either be blended or discharged directly to Alkalai Creek. Additional treatment capacity would be needed to allow the maximum discharge of 8.27 mgd. It is unclear if the WDEQ is requiring an upgrade to the Neptune treatment facility to a capacity of (5.84 mgd). The SOB and the draft permit are clear that additional treatment capacity will be required if Aethon is required to meet the effluent limit of 230 mg/l for chloride (based on chloride standard for Class 2AB streams (Badwater Creek). However, Aethon Energy has requested a site-specific chloride standard for Badwater Creek. If this effort is successful -will WDEQ sill require additional treatment capacity at the Neptune treatment facility?

Major Comments

1. The focus of the watershed model (SWAT) and the mixing model (GEMSS) was to assess the impact of Aethon Energy's increased discharge of produced water to the Class 1 reach of the Wind River below Boysen Reservoir. The SOB does not include or refer to any empirical data that was used to characterize or assess the effects of mixing produced water discharges with water in Alkali Creek or Badwater Creek. Apparently, no analysis has been conducted to evaluate the impact of discharge of produced water to the quality of water, the physical stability or the aquatic environments in Alkali Creek and Badwater Creek. It is necessary to consider any 2nd or 3rd order chemical reactions that may occur in Alkali Creek or Badwater Creek and to consider the wide range of flow conditions in the lower part of Badwater Creek. Both Alkali Creek (3B) and Badwater Creek (2AB) are classified streams in Wyoming and established water quality standards are applicable to both creeks. A mixing analysis should be completed to help ensure that the applicable water quality standards in both creeks are not exceeded. In

addition, WDEQ should provide the water quality and flow data that was used to characterize and assess impacts to Alkali and Badwater Creeks.

2. A modification to permit WY0002062 was issued to Encana by WDEQ on April 27, 2015. This modification indicates that produced water will be discharged to Alkali Creek via Reservoir Creek and Pink Lake. There is no mention of these water bodies in the current SOB or draft permit. Apparently, these water bodies have been designated Class 3B. WDEQ should clarify whether these are regulated water bodies and they are not included in the proposed permit.

3. There is no discussion of the fate of the large chloride and TDS mass loads from the produced water discharge (up to 719 tons per month for chloride and 2161 tons per month TDS) as it is transported in Alkali and Badwater Creek and into Badwater Bay. The ERM report states that the model runs are conservative because they assume that all mass moves through the Reservoir and to the Wind River. The model did not consider the effects of chloride and TDS mass loading that may catalyze chemical reactions that may result in degradation of water in Alkalai Creek or Badwater Creek that would result in exceedances of Class 2AB standards. The chemical and biological fate of these large mass loads should be included in a water quality mixing analysis (see Major Comment 1).

4. Because Boysen Reservoir water is used for drinking water - an analysis of changes to the quality of the Reservoir water as a result of the inflow of Aethon Energy's produced water should be conducted. This analysis should include modeling the fate and transport of all major constituents contained in the inflows to Boysen Reservoir as these inflows mix with and disperse within the reservoir.

5. The Statement of Basis envisions a mixing zone in Badwater Bay where Badwater Creek flow enters Boysen Reservoir. The mixing zone will encompass an area 330 ft long and 730 wide and presumably extending from the surface to the bottom of the Bay. Establishment of a mixing zone within the Reservoir Bay is very problematic. Water levels and inflows to Badwater Bay fluctuate greatly and in drought years the Bay could be dry. How do these varying conditions affect use of the Bay water for mixing?

   The SOB contains confusing information regarding the mixing zone. On page 9 of the SOB it states *that "critical low flows below this facility (Aethon outfalls) historically approach zero during certain times of the year."* On page 8 the SOB states that *"the model found that complete mixing occurs, even under natural flow conditions in Badwater Creek before Badwater Creek fully enters Boysen Reservoir."* How can complete mixing occur if there is no base flow in the lower reaches of Badwater Creek?

   Chapter 1 Section 9 of the rules and Regulations for Wyoming Surface Water Quality Standards requires that *"Except for the zone of initial dilution, which is the initial 10% of the mixing zone, the mixing zone shall not contain pollutant concentrations that exceed the aquatic life acute values. In addition, there shall be a zone of passage around the*

mixing zone which shall not contain pollutant concentrations that exceed the aquatic life chronic values." There is no discussion of how compliance with these requirements will be achieved in the SOB or in Water quality Compliance Analysis report prepared by ERM. Given the significant annual fluctuations in Badwater Bay and the likelihood of future below average annual precipitation, how will the zone of passage be delineated? How will compliance be verified?

6. The SOB states that *"This permit does not cover activities associated with discharges of drilling fluids, acids, stimulation fluids or other fluids from drilling or completion of the wells."* How will this be achieved? What disposal method will be used for these fluids? Flowback water, produced in the early stages of drilling, well completion and production contain these fluids mixed with produced formation water. Aethon Energy should provide details on the technology /methods that will be used to separate and segregate these fluids from produced water.

7. On page 2 of the SOB it is stated: *For permitting purposes in Wyoming, the background quality of a Class 1 water is considered to be the range between the upper and lower first standard deviations of the mean background concentrations for each parameter of interest.* Is this a policy or is it included in the promulgated regulations? Does it conform with the applicable regulation? The Standard Deviations shown in Table on page 3 of SOB are very high. For seven of the constituents included the standard deviation is greater than the mean. This indicates that the water quality data values have a large range, likely a result of sparse background data. Use of the upper standard deviation as an allowable background condition allows for a much higher discharge effluent concentration. This will result in new baseline in the Class I Wind River below Boysen that will likely be used by future potential dischargers.

8. Wyoming's antidegradation policy includes two important principles with respect to class I waters: (1) existing discharges may not increase the level of pollution that existed at the time the water was designated class I and, (2) point source discharges to tributaries of Class I waters will be limited to the extent that the existing quality of the Class I segment will not be degraded, i.e. no measurable decrease in water quality. Per Chapter 1, section 4 of the Wyoming Water Quality Rules and Regulations – *"the water quality and physical and biological integrity which existed on the water at the time of designation will be maintained and protected."* The ERM model is based on data from 2010-2016 not on data from 1979 when the segment of the Wind River below Boysen reservoir was designated as Class I. Reportedly data does exist from the 1979 period and should have been used. With respect to the 2nd point – the use of the upper standard deviation values as compliance limits will clearly result in measurable increase in regulated contaminants.

9. The SOB does not include any discussion of other point source discharges located within the Badwater Creek watershed. If there are NPDES permits issued by US EPA, other WYPDES permits, stormwater disposal permits or UIC permits within the watershed, information should be provided on the location, discharge volumes and discharge chemistry. The cumulative impacts should be addressed.

10. Existing outfalls 1-12 have been grandfathered since they were permitted prior to September 5, 1978 and pre-date the designation of the Class 1 reach of the Wind River below Boysen Reservoir and the designation of Badwater Creek as a class 2AB stream. Since the recently permitted outfalls 13-15 and the new proposed outfall (16) are part of the same permit, WDEQ proposes to grandfather these outfalls as well and allow an effluent discharge standard of 2419 mg/l for chloride based on historical effluent concentrations. In the Antidegradation discussion on pages 9 and 10 of the SOB the WDEQ states that the increased discharge flows with the same Cl concentrations will not degrade Badwater Creek because the new discharge will have chloride concentrations that are lower than historical discharges. To further support this conclusion WDEQ cites Section 4(a)(i)(A)(IV) of the Wyoming Surface Water Quality Standards Implementation Policy for Antidegradation which states that *" a permitted discharge activity shall be considered not to result in significant degradation if the activity will result in only temporary or short term changes in water quality."* This is a highly qualitative conclusion that is based only on the assumption that chloride concentrations will not increase in the new permitted discharge. WDEQ fails to adequately consider the change in flow/ annual water budget in Badwater Creek and the increased chloride and TDS mass load that the produced water discharge will deliver to Badwater Creek. The changes to water quality in Alkali and Badwater Creek will likely be significant and long term. This further supports the need for a water quality mixing analysis for Badwater Creek.

11. The chloride standard for Badwater Creek is 230 mg/l. The SOB proposes a 4-year compliance schedule to allow Aethon energy to add additional treatment capacity to be able to achieve a 230 mg/l effluent limit. However, Aethon Energy has requested a site-specific chloride standard for Badwater Creek which would require a use attainability analysis and concurrence by the US EPA. If approved, there would be little incentive for Aethon Energy to add the additional treatment required to prevent further degradation of Badwater Creek. It is my understanding that WDEQ has the discretion to discontinue the grandfathered standards. WDEQ should use this new permit application to bring the facility into compliance by requiring effluent standards aimed at protecting designated uses in Alkali Creek, Badwater Creek, Boysen Reservoir and the Wind River and stop historical loading. This would eliminate the need for a site-specific chloride standard.

12. Per Chapter 1, Section 8 (Antidegradation) of the Wyoming Water Quality Rules and Regulations, WDEQ should require an economic analysis to evaluate the feasibility of treating 100 % of the produced water discharge. Treatment should include treating to drinking water standards for those constituents that have drinking water standards and treatment to remove any compounds associated with drilling, formation stimulation, ad well development and completion. The economic analysis should include piping the treated effluent to Boysen Reservoir. If feasible, this would eliminate impacts to water quality and aquatic life in Alkalai creek and Badwater Creek and would significantly minimize water quality changes in Boysen Reservoir. It seems reasonable to analyze the economics and environmental impacts for alternatives to using Badwater Creek as a conveyance for contaminated produced water.

13. The SOB does not include any discussion of potential impacts to groundwater in alluvial aquifers along Badwater Creek. The WDEQ has designated the shallow alluvial aquifer in the vicinity of Lysite and Lost cabin as a high-priority aquifer (Bedessem, et, al, 2005). High-priority aquifers are those aquifers that serve as drinking water sources and / or are most susceptible to point and non–point source pollution. The permit applicant should be required to analyze potential impacts to these aquifers as a result of increased flow and contaminant loading to Alkali and Badwater Creeks and the potential for contaminated water in from these Creeks discharging to the shallow, surficial, high-priority aquifers.

14. The SOB indicates that WDEQ will require instream monitoring at four locations: (1) Alkali Creek below project area (below outfalls), (2) Badwater Creek, (3) Badwater Bay and (4) the Wind River below Boysen reservoir

    a. Samples from these locations will be analyzed for TDS, chloride, oil & grease, pH and temperature. In addition, the samples from Alkali Creek below the project area will be analyzed for benzene, toluene, ethylbenzene and xylene. These constituents do not include any Category 4 or 5 parameters (per table -page 3 SOB). This is a serious omission since these parameters have water quality standards.
    b. The SOB states that the instream monitoring locations are *"for data collection purposes only and do not constitute a regulated discharge point."* These data should be used to help assure that the water quality in Alkali Creek, Badwater Creek and the Class 1 segment of the Wind River meets or exceeds the applicable classification standards. The sampling results made available to the public.

15. The SOB indicates that instream monitoring location on Alkali Creek (DMP1) will be monitored for BTEX constituents, including benzene. Since benzene is highly toxic (EPA MCL is 5 ug/l) and a known compound in naturally occurring oil and gas. WDEQ should require monitoring for benzene in the discharged effluent and Badwater Creek.

Reference

2005, Bedessem, M.E, B. Casey, K. Frederick, and N. Nibbelink. 2005. Aquifer Prioritization for Ambient Groundwater Monitoring. Ground Water Monitoring & Remediation 25, no. 1: 150-158. Map 11.