Wyoming Outdoor Council

To: Mr. Jason Thomas, WDEQ/WQD
From: Dan Heilig, Wyoming Outdoor Council
Date: 02/18/2020
Re: Comments on WY0002062 Aethon Energy

Our comments are attached. This comment portal prevented me from attaching all eight exhibits referenced in our letter. I will transmit the other three exhibits separately.

Thank you.

Transmitted via the DEQ's Public Comment Portal

February 18, 2020

Jason Thomas
Department of Environmental Quality
Water Quality Division
200 West 17th Street
Cheyenne, WY 82002

RE: COMMENTS ON THE REVISED DRAFT PERMIT FOR AETHON ENERGY (MONETA DIVIDE) DISCHARGE PERMIT # WY0002062.

Dear Mr. Thomas:

These comments are submitted on behalf of the Wyoming Outdoor Council, Powder River Basin Resource Council, Natural Resources Defense Council, and National Audubon Society in response to the Department of Environmental Quality's public notice dated January 17, 2020, inviting comments on the revised draft discharge permit for Aethon Energy's Moneta Divide oil and natural gas field.

Aethon's discharge permit was first proposed for renewal in March, 2019. Hundreds of public comments were received by the DEQ during the comment period, the vast majority of which were highly critical of the proposed permit renewal. Comments expressed a range of concerns about potential impacts to water quality in Boysen Reservoir and its tributaries, as well as to the Class 1 Wind River. As explained in its January, 2020 public notice, the DEQ has revised the proposal in an effort to address the issues and concerns raised by affected stakeholders. The notices states, in part, that:

> The allowable salt load from this facility will now remain unchanged from the previous existing permit, capped at 908 tons per month. This is the historic average output level for the project over the course of decades in operation. In addition, the revised draft permit includes several new requirements which are not

included in Aethon's existing permit. These new requirements are intended to address public comments related to monitoring and control of water quality at the facility and downstream.

The specific changes proposed by the DEQ include the following:

1. A compliance schedule for Chloride final effluent limit of 230 mg/L.
2. The addition of outfall 016.
3. Additional instream monitoring locations and new sampling requirements in Alkali and Badwater creeks and in Badwater Bay.
4. The addition of sampling requirement for BTEX constituents at the outfalls and in Alkali Creek, along with a commitment to add effluent limits in the next permit term if monitoring shows a reasonable potential for violations of water quality standards.
5. Including sampling requirement for trace constituents of well maintenance chemicals and hydraulic fracturing fluids.
6. Adding nutrient monitoring requirements for total nitrogen, total ammonia-nitrogen, nitrate + nitrite- nitrogen, total phosphorus, and orthophosphate-phosphorus in support of Boysen Watershed nutrient management planning.
7. Adding effluent limits at all outfalls for Temperature, Total Sulfide, Radium226+228, Total Recoverable Barium.
8. Including Whole Effluent Toxicity testing.
9. Revised language ensuring agency access to the facility.

We commend the DEQ for responding thoughtfully to public comment, and support many of the proposed revisions. However, based on careful review and analysis, we believe that the revised permit fails to satisfy applicable legal requirements, resulting in the continuation of unlawful discharges of pollution entering the state's surface waters. Given Aethon's violations of its existing permit, DEQ's regulations prohibit it from renewing the permit. Moreover, the permit continues to rely unlawfully on a discharge that may have existed in 1975 justify inadequately controlled discharges by a new operator.

Additional revisions –some mandated by law and others within the discretion of the DEQ-- are needed to safeguard Boysen Reservoir and its tributaries from the impacts of oil field wastewater. As discussed in detail below, those changes include reducing salt loads into Boysen Reservoir; adding effluent concentration limits for TDS to protect agricultural and wildlife uses; including effluent limits for chloride to restore and protect aquatic life in receiving waters; adding effluent limits for BTEX constituents; adding *chronic* WET testing; placing an additional monitoring station on Badwater Creek immediately upstream of Badwater Bay to detect pH values; as well as a number of other changes required to address fisheries and aquatic life concerns.

We also identify and discuss below several significant issues requiring additional clarification and analysis. Lastly, we recommend that DEQ commits to a timeframe to implement a clean-up plan for Boysen tributaries that have been degraded by decades of oil field pollutants.

I. DESCRIPTION OF PARTIES

Powder River Basin Resource Council was founded in 1973 by rural landowners and concerned citizens working to protect their land, water, and air. For 47 years our citizen-based organization has been dedicated to civil society and to the stewardship of Wyoming's human and natural resources. We are committed to community organizing, leadership development, and the empowerment of citizens.

Established in 1967, the Wyoming Outdoor Council is the state's oldest and largest independent conservation organization. Our mission is to protect Wyoming's environment and quality of life for future generations.

The mission of the National Audubon Society is to protect birds and the places they need, today and tomorrow.

The Natural Resources Defense Council's purpose is to safeguard the Earth: its people, its plants and animals and the natural systems on which all life depends. We work to restore the integrity of the elements that sustain life–air, land and water–and to defend endangered natural places.

Our organizations all have members who use and rely on the waters affected by the proposed discharges. We are not opposed to the expansion of the Moneta Divide oil and natural gas field, but believe that any further development must be carried out in a manner that complies with the law, protects the health and safety of Wyoming's residents, meets water quality standards, and respects the rights of downstream water users.

II. DISCUSSION

A. The Draft Permit Does Not Comply with the Water Quality Division's Rules and Regulations Governing Point Source Discharges.

As discussed in detail below, the revised draft permit fails to comply with rules governing the renewal of discharge permits; fails to demonstrate that the produced water is of good enough quality for livestock and wildlife, and that it is actually being put to that use; and fails to ensure that water quality standards in the receiving waters will be met.

1. Applicable Regulatory Requirements.

Chapter 2 of the Department of Environmental Quality Water Quality Division's Rules and Regulations regulates point source discharges to waters of the State. Among other things, Chapter 2, Section 5 requires technology-based effluent limitations (TBELs) to be included in all permits. Ch. 2, Section 5(c)(iii)(A). For oil and gas production facilities like Aethon's, Section 5 also requires compliance with additional technology based effluent limits "as described in Appendix H." Ch. 2, Sec. 5(c)(iii)(B)(III).

In addition to technology-based limits, Chapter 2 requires water quality based limitations when "necessary to ensure that violations of water quality standards do not occur." Ch. 2, Sec.

5(c)(iii)(C). Water quality based effluent limitations (WQBELs) "shall be established for constituents in discharges determined to have a reasonable potential of adversely impacting uses of surface waters of the state or of causing violations of water quality standards." Ch. 2, Sec. 5(c)(iii)(C)(I).

Chapter 2 also contains requirements that govern the review and renewal of existing permits. *See* Ch. 2, Section 10. Among other things, the DEQ must "insure" that the permittee is in compliance with the terms and conditions of the expiring permit, and that applicable water quality standards are protected.

Accordingly, under Wyoming's regulatory scheme, permits authorizing the discharge of produced water from oil and gas production facilities must contain applicable TBELs and any WQBELs needed to meet water quality standards contained in Chapter 1; comply with all permitting requirements in Chapter 2 including additional conditions set forth in Appendix H; and satisfy the permit review and renewal requirements contained in Section 10.

Key regulatory components of Appendix H that apply to Aethon's discharge include:

- The produced water discharged into surface waters of the state shall be of good enough quality to be used for wildlife or livestock watering or other agricultural uses and actually be put to such use during periods of discharge. App. H(a)(i).

- The produced water discharge must not contain toxic materials in concentrations or combinations which are toxic to human, animal or aquatic life. App. H(b)(i).

- Measures must be implemented to minimize erosion of the drainage at the point of discharge. App. H(b)(iv).

- Discharges of produced water must not contain substances that will settle to form sludge, bank or bottom deposits in quantities sufficient to result in significant aesthetic degradation, significant degradation of habitat for aquatic life or adversely affect public water supplies, agricultural or industrial water use, plant life or wildlife. App. H(b)(v).

- Discharges of produced water may not result in the formation of a visible hydrocarbon sheen on the receiving water. App. H(b)(vi).

- An effluent limitation of 10 mg/l for net oil and grease shall apply. App. H(c)(v).

- The discharge of waste pollutants into surface waters of the state from any source (other than produced water) associated with production, field exploration, drilling, well completion, or well treatment (i.e., drilling muds, drill cuttings, and produced sands) is expressly prohibited. App. H(b)(lx).

- Discharge permits must contain effluent limitations for chloride, sulfate, total dissolved solids (TDS), specific conductance, and pH. Appendix H(b)(vii).

Appendix H contains a provision that allows the DEQ to modify the above-referenced effluent limits on a case-by-case basis "for existing permits where the original permit was submitted prior to September 5, 1978" (*see* Appendix H(c)(i)) but also contains a critical safeguard to limit the possibility that a modification of an effluent limit granted by the DEQ will violate Wyoming's water quality standards: *"In no case will a modification of the effluent limit described above be permitted which would result in a violation of Wyoming Water Quality Rules and Regulations, Chapter 1."* App. H(c)(iii) (emphasis added). As discussed below, the revised draft permit fails to satisfy the applicable regulatory requirements.

2. The Revised Draft Permit Fails to Meet the Regulatory Requirements.

The permit proposed by the DEQ to authorize Aethon to discharge waste water to the surface fails to comply with applicable regulations in Chapter 1, Chapter 2, and Chapter 2 Appendix H. Under these circumstances the DEQ may not lawfully approve Aethon's proposed discharge permit.

a. Violations of the Existing Permit Precludes Renewal.

Chapter 2 of Wyoming's Water Quality Division Rules and Regulations requires state regulators to consider whether an entity has violated its permit when reviewing a permit renewal request. Chapter 2, Section 10(c). Specifically, the regulations require that the DEQ review a renewal request "in light of the existing permit" and that DEQ uses both the renewal request information provided by the permittee and "information available to the administrator bearing on the subject permit . . . ." *Id.* DEQ must use this information to "insure" three conditions exist: "(i) [t]hat the permittee is *in compliance with or has substantially complied* with all the terms and conditions of the expiring permit or authorization; (ii) [t]hat the *discharge is consistent with applicable effluent standards and compliance schedules, water quality standards, and other legally applicable requirements* imposed under these regulations; and (iii) [t]hat the *administrator has up-to-date information on the permittee's discharge*, either pursuant to the submission of new forms or pursuant to monitoring records and reports submitted to the administrator by the permittee." *Id.* (emphasis added). These conditions do not exist because Aethon has not complied with its permit, and its discharges have not complied with legally applicable requirements. Therefore, DEQ cannot renew permit WY0002062.

The permittee, Aethon, has repeatedly failed to comply with the conditions of permit WY0002062. Discharge Monitoring Report (DMR) data sets from the Environmental Protection Agency's Enforcement and Compliance History Online (ECHO) database reveal fifteen violations of effluent limits during monitoring periods ending May 31, 2015 to December 31, 2019. Aethon violated the permit effluent limits for dissolved iron, dissolved zinc, oil and grease, and pH. *See* Appendix A for attached DMR report. The DEQ itself has identified instances where Aethon violated its permit and water quality criteria. On December 17, 2019, the DEQ issued a Letter of Violation (LOV) to Aethon for the presence of black sediment deposits, water surface foams, mineral deposits, and free oil accumulations in Alkali and Badwater Creeks. A copy of the LOV is included in Appendix A. Aethon is aware of these violations as indicated by its January 16, 2020 response. *See* Appendix A, Aethon's response to LOV. These examples demonstrate that Aethon is not in compliance or substantial compliance with the permit limits in

WY0002062 or Wyoming's Water Quality Regulations. As a result, the DEQ cannot "insure" that the above conditions, required by Section 10(c) of Wyoming's Water Quality Regulations, exist and thus, it cannot renew permit WY0002062.

b. The Draft Permit Fails to Meet the Legal Criteria for the Discharge of Produced Water.

Federal and state water quality regulations require that the "produced water shall be of good enough quality to be used for wildlife or livestock watering or other agricultural uses and actually be put to such use during periods of discharge." *See* 40 C.F.R. Part 435 Subpart E., Ch. 2, Appendix H(a).[1] In this case, however, the DEQ proposes under Appendix H(c)(iii) to waive an essential effluent limit required by the regulations to ensure that produced water is of good enough quality; specifically, the maximum effluent *concentration* limit for total dissolved solids (TDS) would be waived and replaced with a *load* limit of 908 tons per month for all outfalls, 001-016.

Comments submitted by the public on the initial draft permit raised concerns that produced water containing total dissolved solids (TDS) concentrations well above the maximum limit specified in Appendix H would not be of good enough quality for livestock and wildlife watering, and questioned whether the produced water would actually be put to use. In response, the DEQ offered a letter from a landowner, Robert L. Hendry, purporting to address these concerns. *See* DEQ's Summary of Public Comments on Initial Draft Permit WY0002062 and WDEQ Response at pages 3 and 5.[2]

i. The Produced Water is Not of Good Enough Quality and is Not Being Put to Actual Use.

Other than Mr. Hendry's unsworn letter, the DEQ provides no evidence whatsoever that produced water containing high levels of TDS that exceed the maximum limits in Appendix H is of good enough quality for wildlife. In addition, Mr. Hendry's letter –while indicating that his livestock use water in various pits—does not demonstrate actual use of the *produced water*. The DEQ has failed to demonstrate compliance with the fundamental requirements of Appendix H and 40 CFR Part 435 Subpart E.

Mr. Hendry's letter makes reference to several pits containing water used by his cows, but does not explain the relationship of those pits to the outfalls described in the discharge permit. Which outfalls supply water to those pits? How far from the outfalls are the pits located? Do the pits contain water from other sources, such as springs, rainfall and/or snowmelt that may provide dilution? The produced water becomes available for wildlife and presumably for cattle

[1] For a discussion of the application of technology-based and water quality-based effluent limits required to ensure that produced water is of good enough quality for livestock and wildlife watering, see *See* EPA Region 8, Response to General Comments, available at https://www.epa.gov/sites/production/files/2017-01/documents/wy-0025232-wesco-operating-winkleman-dome-response-to-comments.pdf.

[2] The DEQ Director also addressed these issues in his response to a request for investigation submitted by WOC and PRBRC. *See* Appendix A, Complaint and Request for Investigation and DEQ Response.

that have access to the outfalls, the moment it exits the outfalls and touches the ground. The rules require that the *produced water* be of good enough quality; the fact that water in pits --whose locations and relationship to outfalls is not explained-- is alleged to be good enough quality is not dispositive.

As noted above, Appendix H requires two fundamental findings. First, that the produced water shall be of good enough quality to be used for wildlife or livestock watering or other agricultural uses. Second, the produced water shall actually be put to such use during periods of discharge. Neither Mr. Hendry's letter, nor the explanation provided by the Director in his response to the Complaint and Request for Investigation, demonstrate compliance with those requirements. There is no information in Mr. Hendry's letter or the DEQ's response showing any relationship between Pits #5, #6 and #7 and the outfalls. Which of the four flowing outfalls supply produced water to the pits? How far are the pits from the outfall? Is produced water entering the pits diluted by any other sources such as rainfall or snowmelt? Are the pits surrounded by fence?

Moreover, even if it had been properly determined that produced water from the existing *operating* outfalls 001, 003, 006 and 009, supply the water in Pits 5, 6 and 7, and that the water in the pits consists exclusively of the produced water from Aethon's outfalls undiluted by other sources, the draft permit fails to address the good enough quality and actual use requirements pertaining to not-yet-constructed outfalls 014, 015, and 016 and constructed but not currently operating outfalls, 002, 004, 005, 007, 008, 010, 011, 012, and 013. *See* 2019 Discharge Monitoring Reports for permit WY0002062, available on the DEQ's website: https://paperdmr.wyo.gov.

The requirements contained in Appendix H and Part 435, Subpart E apply to each and every outfall --*at the outfall*— where the produced water first becomes available for use by wildlife and livestock. The good enough quality requirement applies to the *produced water* (i.e., the effluent leaving the pipe) not to produced water that may have been diluted or mixed with other water contained in the pits discussed in Mr. Hendry's letter. And what may be considered good enough quality at one outfall does not demonstrate that the effluent from a different outfall is also of good enough quality. The DEQ has not demonstrated, or even attempted to demonstrate, that the produced water flowing, or which might in some future time flow, from currently inoperative and/or not-yet-constructed outfalls satisfies the quality and use requirements. Only four outfalls are currently flowing in the project area.

With all due respect to Mr. Hendry, anecdotal evidence –especially from an individual who reportedly stands to gain financially from the development— that livestock have consumed the produced water "with no issues at all" cannot be relied on by DEQ as evidence that the "good enough quality" standard is being met. This is especially true in light of the DEQ's own report cited in our earlier comments on the initial draft permit stating that much lower levels of TDS may be harmful to livestock. *See* Water Quality for Wyoming Livestock & Wildlife, A Review of the Literature Pertaining to Health Effects of Inorganic Contaminants, at 50 (hereinafter "2007 water quality report"). Available at: http://www.wyomingextension.org/agpubs/pubs/B1183.pdf

Table 2 of Aethon's application shows a TDS concentration of 5940 mg/L as representative of the quality at each of the outfalls. Yet the DEQ's 2007 water quality report cautions that concentrations well below 5,000 mg/L are a cause for concern:

> Total dissolved solids in drinking water serve as a very poor predictor of animal health. … We do not recommend relying upon TDS to evaluate water quality for livestock and wildlife; however, if no other information is available, TDS concentrations less than 500 mg/L should ensure safety from almost all inorganic constituents. Above 500 mg/L, the individual constituents contributing to TDS should be identified, quantified, and evaluated.

See DEQ 2007 Water Quality Report at 50. Despite this warning, the revised draft permit eliminates the effluent concentration limit for TDS, resulting in no limit whatsoever on the concentration of TDS permitted in the produced water. With no limits on the concentration of TDS in the draft permit, and evidence of TDS concentrations in the produced water greatly exceeding the limits contained in Appendix H, it is impossible for the agency to properly conclude that the produced water is of good enough quality for livestock and wildlife. The absence of evidence in the draft permit satisfying the required quality and use requirements precludes issuance of a final permit.

ii. DEQ Cannot Waive the TDS Effluent Limit Contained in Appendix H without additional analysis demonstrating that the produced water is of good enough quality for wildlife and livestock use.

As noted above, the revised draft permit waives the technology based effluent limit (TBEL) of 5,000 mg/l contained in Appendix H for TDS, and replaces it with a load limit of 908 tons per month. *See* Statement of Basis at 4. Importantly, information contained in Aethon's permit application shows that TDS levels in the effluent are much higher than the maximum concentration permitted in Appendix H, yet the DEQ provides no evidence that produced water containing TDS concentrations exceeding the maximum concentration limits specified in Appendix H be of good enough quality for livestock and wildlife.

The DEQ-funded 2007 review of the pertinent literature concluded that TDS concentrations in excess of 5,000 mg/L may be harmful to livestock and wildlife, and recommended that "the individual constituents contributing to TDS should be identified, quantified, and evaluated" when TDS levels exceeded 500 mg/L. *Id.*

In light of these findings, the lack of any TDS effluent concentration limit in the revised permit, coupled with produced water containing TDS concentrations much higher than the maximum limits specified in Appendix H, raise substantial doubts about whether the produced water is of good enough quality for livestock and wildlife use. To address that concern, the DEQ must prepare a reasonable potential analysis for TDS providing evidence that the produced water containing much higher concentrations of TDS than authorized in Appendix H(b)(vii)(C) is of good enough quality for livestock and wildlife. The approval of Aethon's permits without that

analysis and demonstration would violate the DEQ's rules and be arbitrary and capricious on its face.

As explained by EPA, the effluent concentration limit for TDS was based on "research and data concerning the effects of produced water on livestock and wildlife to determine what level of effluent could be considered "of good enough quality." See EPA's Response to General Comments on Permits WY-0020338, WY0024953, WY0024945, WY0025232, WY0025606, March 9, 2015, available at: https://www.epa.gov/sites/production/files/2017-01/documents/wy-0025232-wesco-operating-winkleman-dome-response-to-comments.pdf. Notably, DEQ fails to reference any research or data that might even remotely suggest that produced water containing TDS levels in excess of the concentrations specified in Appendix H is of good enough quality for livestock and wildlife. Indeed, the only evidence offered to support the DEQ's contention that the produced water is of good enough quality for livestock and wildlife is a letter by Mr. Hendry claiming that he has seen "no issues at all" with livestock using the water.

TBELS for produced water are based on effluent limitation guidelines (ELG) published by EPA in accordance with Section 304(b) of the Clean Water Act. The ELG for oil and gas productions facilities is contained in 40 CFR Part 435, Subpart E — Agricultural and Wildlife Water Use Subcategory. Specifically, the ELG provides at 40 CFR § 435.50 that produced water may only be discharged if it is 1) of good enough quality to be used for wildlife or livestock watering or other agricultural uses, and 2) is actually put to that use. As noted by EPA's response to comments document:

> [t]he TBELs EPA has developed for sulfate, specific conductance, chloride and TDS are based on the latest research, contained in the administrative record, concerning the effects of these pollutants on agriculture and wildlife use. The limits ensure that animal consumption of the discharged water will not cause acute or chronic health effects that would render the water unsuitable for agricultural or wildlife use.

The EPA's effluent limit for TDS in produced water is identical to the limit contained in Wyoming's Appendix H, 5,000 mg/l.

The DEQ has presented no scientific evidence of any kind confirming that the higher TDS levels contained in the produced water are safe for wildlife and livestock use. The letter from Mr. Hendry claiming that his "livestock have used the water with no issues at all" is not a substitute for scientifically supported conclusions. Because the produced water contains TDS concentrations significantly higher than the limits contained in Appendix H, and because there is no scientific evidence presented in the revised draft permit showing that produced water containing higher concentrations of TDS is of good enough quality for livestock and wildlife, it is incumbent on DEQ to demonstrate through a reasonable potential evaluation that the produced water discharged by Aethon is safe for wildlife and livestock. Without an analysis supporting these findings, renewal of the permit is unlawful.

iii. DEQ Cannot Lawfully Modify Effluent Limits Required by Appendix H if Such Change Would Violate Water Quality Standards.

Appendix H provides that: "In no case will a modification as described in paragraph (c)(1) or (c)(ii) of this appendix be permitted which would result in a violation of Wyoming Water Quality Rules and Regulations, Chapter 1." Ch. 2, Appendix H(c)(iii). The "modified" effluent limit proposed in the revised draft permit for TDS --908 tons per month instead of 5,000 mg/L-- would cause violations of water quality standards, and therefore may not be permitted.

Impacts to agricultural and wildlife uses.

Analysis of water quality data collected by DEQ from Alkali Creek show that TDS concentrations *in the creek* exceed the maximum limit specified for *produced water* in Appendix H *at the outfall*. *See* Appendix A, DEQ water quality sampling data showing instream TDS concentration of 5568 mg/L. Alkali Creek is a Class 3B stream with the following designated uses: aquatic life other than fish, recreation, wildlife, industry, agriculture and scenic value. *See* DEQ Ch. 1, Section 4(c). Chapter 1 explains that agriculture use includes livestock watering. Ch. 1, Sec. 3(a). Similarly, wildlife use "includes protection of water quality to a level which is safe for contact and consumption by avian and terrestrial wildlife species." Ch. 1, Sec. 3(h).

TDS concentrations *in the stream* exceed the levels specified in Appendix H that have been deemed safe by DEQ for wildlife and livestock watering and therefore are likely to impact designated uses in Alkali Creek. As discussed above, under DEQ rules, a discharge permit may not be issued or renewed if it would violate a water quality standard. Chapter 2, Section 10(c)(ii). *See also*, Chapter 1, Section 5, Standards Enforcement.

In order to determine whether higher concentrations of TDS present in the produced water entering Alkali Creek will violate Wyoming water quality standards in Chapter 1, the DEQ must conduct a reasonable potential evaluation to determine whether the water uses described in Chapter 1, Section 3 pertaining to Alkali Creek, including in particular, agricultural and wildlife uses, will be protected. *See* Chapter 2, Section 5(c)(iii)(C). The DEQ may not renew Aethon's discharge permit until a reasonable potential analysis has been completed, and appropriate water quality based effluent limits have been established, to protect designated uses in Alkali Creek.

Impacts to aquatic life.

High concentrations of TDS and other pollutants in the effluent have harmed aquatic life in Alkali Creek. *See* Memorandum from Professor Harold Bergman and Dr. Joseph Meyer, dated February 18, 2020, appended hereto in Appendix A, and fully adopted and incorporated by reference herein. The proposed waiver of the Appendix H effluent concentration limit for TDS of 5,000 mg/L will continue to cause harm to aquatic life in Alkali Creek, threatening its aquatic life use designation in violation of Appendix H(c)(iii). As noted above, this section provides that: "In no case will a modification as described in paragraph (c)(i) or (c)(ii) of this appendix be permitted which would result in a violation of Wyoming Water Quality Rules and Regulations,

Chapter 1. For this reason, the modification of the TDS effluent limit proposed by DEQ in the revised draft permit is unlawful and cannot be permitted.

B. The DEQ's Proposal to "Grandfather" Harmful Pollutants is Unlawful.

For several decades, the DEQ has authorized the continuing discharge of massive quantities of salt-laden produced water from the Frenchie Draw field into Boysen Reservoir via Alkali and Badwater creeks. Previous discharge permits issued by the DEQ show that volumes of produced water and salt loads discharged from this field peaked in 2009–10, with **TDS loads exceeding 3036 tons per month** and effluent concentrations averaging **7456 mg/L**, well above the **5000 mg/L limit** specified in Appendix H. In a January 1, 2009 permit renewal, the Statement of Basis states as a matter of fact that "this facility is exempt from end-of-pipe effluent limits for chlorides, sulfates, specific conductance and total dissolved solids."

As discussed elsewhere in this letter, this unlawful exemption has caused and continues to cause significant impairment to Alkali and Badwater creeks, and poses an ongoing threat to water quality in Boysen Reservoir and in the Class 1 segment of the Wind River below the dam. Yet it continues, even though the practice is patently unlawful.

EPA has provided clear and unequivocal guidance regarding "grandfathering"; "grandfathering" discharges is impermissible under the CWA. Specifically, EPA has stated in its NPDES state program guidance that "[o]ther States have attempted to 'grandfather' or exempt discharges already in existence . . . [s]uch schemes are inconsistent with the CWA." Chapter Three: Statutory Authority and the Attorney General's Statement, National Pollutant Discharge Elimination System State Program Guidance for Development and Review of State Program Applications and Evaluation of State Legal Authorities (40 CFR Parts 122–125 and 403) Volume One (July 29, 1986) at 3-6–3-7. This guidance serves to advance the twin goals of the Clean Water Act: "to *restore* and to *maintain* the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. 1251(a). The DEQ's position that grandfathering is permissible is untenable in light of these goals. Indeed, if grandfathering "historic discharges" were lawful, major industrial pollutant discharges occurring in major industrial cities across America would still be dumping chemicals and raw sewage untreated into the nations surface waters.

Yet the modification to effluent limits was allowed to continue as the oil field expanded through multiple field ownerships, and through multiple renewals and modifications (both major and minor) of the discharge permit. In several 2010-era permit actions, it appeared that the DEQ was committed to reducing TDS loads from this field "to the pre-2009 grandfathered levels" which the DEQ stated was 908 tons per month. *See, e.g.,* Encana Oil and Gas Company, WY0002062, Statement of Basis for Minor Modification, dated 12/14/2010 (containing a compliance schedule to reduce TDS to 908 tons per month by January 1, 2013). But now, despite the opportunities presented by a change of ownership of the field along with a permit renewal, the DEQ is proposing to continue, rather than reduce, the monthly TDS load limit of 908 tons per month, and defer effluent limitations for chloride until 2024.

The DEQ cites Appendix H as justification to modify effluent limits for outfalls 001 to 012. Yet Appendix H applies only "where the original permit application was submitted prior to

September 5, 1978." Since the DEQ has not provided a copy of the "original permit application" the public is unable to verify that 12 outfalls were authorized in that original permit. This information should be disclosed to the public and included in the agency's response to public comment.

Assuming (for purposes of discussion only) that grandfathering in any form is lawful, the exception can only extend to the outfall(s) and to the discharge(s) that existed prior to September 5,1978. Were all 12 outfalls permitted and in operation prior to that date? If not, how does the DEQ justify grandfathering discharge permits that were issued after September 5, 1978?

The DEQ consolidated Encana WY0002062 (single outfall) with eleven other single-outfall permits in a permit "renewal" effective January 1, 2009. *See* Statement of Basis Renewal and Discharge Permit, Encana Oil and Gas Company, signed by the DEQ Director on 12/31/08. The eleven existing permits that were consolidated with WY0002062 included: WY0002089, WY0002101, WY0025526, WY0025534, WY0025542, WY0027227, WY0027235, WY0027243, WY0027251, and WY0027456. The SOB clearly states that: **"This permit originally established a chloride limit of 230 mg/L at the end of pipe for discharge into Class 3B waters."** (Emphasis added). If that is the case, what is the basis for grandfathering the much higher effluent limits?

1. **Outfalls 013, 014, and 015 were not grandfathered when approved and cannot be grandfathered now.**

As noted above, in December 2008, 12 outfalls were consolidated into a single permit, WY002062. In December 2010, the DEQ approved a minor modification to the permit that added two new outfalls, 013 and 014, and set effluent limits for those outfalls based on the limits contained in Appendix H. The Statement of Basis for the modification notes that: "Outfalls 013 and 014 include limits of 2000 mg/L of chloride and 3000 mg/L of sulfate, **a requirement of all non-grandfathered oil production unit WYPDES permits.**" (Emphasis added). The modification also added chloride and sulfate monitoring requirements for outfalls 001–012 for "data collection." This modification added a compliance schedule to ratchet down over a two-year period salt loads from 3036 tons per month to 908 tons per month.

Outfall 015 was added in a Permit Renewal effective 10/21/13, formerly WY0056791, outfall 001. The renewed permit retained Appendix H effluent limits on outfalls 013 and 014, and required the newly added outfall 015 to comply with Appendix H effluent limits for chloride (2000 mg/L); sulfate (3000 mg/L); and specific conductance (7500). In other words, grandfathering was not applied to outfall 015.

2. **Outfall 016 cannot be grandfathered.**

Outfall 016 was approved in a Major Modification to the permit in April 2015.[3] This modification also added the Neptune Treatment Facility, established an interim effluent limit for TDS of 1760 tons per month (nearly doubling the existing 908 tons per month limit) during a

[3] If Outfall 016 was added in April 2015, why does the DEQ's January 2020 revised draft permit propose to "Add outfall 016"?

four month start-up period, and included a compliance schedule that required the facility to limit TDS to no more than 908 tons per month for outfalls 001–016 effective September 1, 2015. The Statement of Basis for this modification indicates that "the new outfall location is at the stilling well at Pink Lake. Because the water source is largely from the grandfathered per Chapter 2 Appendix H sources, it is treated as such and there are no concentration limits for sulfate, chloride, specific conductance, or total dissolved solids." SOB at 1. Oddly, despite the preceding sentence, the modification retained Appendix H-based numeric effluent limits for outfalls 013–015, including effluent limits on chloride, sulfate, and specific conductance. As a newly approved outfall, outfall 016 should not have been grandfathered for the same reasons that 013, 014, and 015 were not grandfathered.

In sum, it is clear that outfalls 013, 014, 015, and 016 fail to meet the DEQ's own internal requirements for historical grandfathering (pre-September 5, 1978). These outfalls were not grandfathered when they came on-line, and there is no basis for grandfathering them now. This practice of retroactive grandfathering must end. Not only for outfalls 113–016, but also for 001–012.

C. The Draft Permit Violates the DEQ's Antidegradation Requirements.

The Statement of Basis (SOB at 8, 9) includes a discussion of the antidegradation review required by Chapter 1. Intended to achieve the Clean Water Act's goal of restoring and maintaining water quality, antidegradation is the third and arguably most important component of a water quality standard. Despite the DEQ's claim of regulatory compliance, our review shows that the draft permit violates Wyoming's antidegradation requirements for Alkali Creek (Class 3B) and Badwater Creek (Class 2AB). The DEQ's own analysis reveals existing and ongoing water quality impairment in both of these creeks attributable to WY0002062. Further, the SOB fails to contain any analysis to support the agency's antidegradation determination regarding Boysen Reservoir. The DEQ's improper and insupportable characterization of the existing discharge of oil and gas field wastewater as a "background condition within the watershed of the receiving water bodies…" has unfortunately resulted in the absence of a meaningful antidegradation analysis of the discharges from this facility at any time during its existence.

1. Regulatory requirements.

The DEQ's antidegradation requirements are set forth in Chapter 1, Section 8, and provide as follows:

> (a) Water uses in existence on or after November 28, 1975 and the level of water quality necessary to protect those uses shall be maintained and protected. Those surface waters not designated as Class 1, but whose quality is better than the standards contained in these regulations, shall be maintained at that higher quality. However, after full intergovernmental coordination and public participation, the department may issue a permit for or allow any project or development which would constitute a new source of pollution, or an

increased source of pollution, to these waters as long as the following conditions are met:

(i) The quality is not lowered below these standards;

(ii) All existing water uses are fully maintained and protected;

(iii) The highest statutory and regulatory requirements for all new and existing point sources and all cost effective and reasonable best management practices for nonpoint sources have been achieved; and

(iv) The lowered water quality is necessary to accommodate important economic or social development in the area in which the waters are located.

(b) The Water Quality Administrator (administrator) may require an applicant to submit additional information, including, but not limited to, an analysis of alternatives to any proposed discharge and relevant economic information before making a determination under this section.

(c) The procedures used to implement this section are described in the Antidegradation Implementation Policy.

2. Violations of regulatory requirements.

Alkali Creek (Class 3B). Alkali Creek is the first classified receiving water downstream of the outfall. As a Class 3B stream, it is entitled to the Tier 1 "basic" level of antidegradation protection. SOB at 8. *See* 40 CFR 131.12(a)(l). Under the Clean Water Act and its implementing regulations, Tier 1 protection requires the DEQ to protect existing uses—and the quality of water necessary to maintain those uses. Although the DEQ claims that "[t]he effluent limits for protection of this stream are set to equal the applicable class 3B standards" --implying that existing instream uses are protected-- that assertion is not correct.

Alkali Creek has been severely impaired by oil field wastewater, and the impairment has worsened over time as the Moneta Divide field has expanded to its current size of over 800 oil and gas wells. *See* Bureau of Land Management, Moneta Divide DEIS at 1-5. Decades of improperly controlled discharges have altered the physical, chemical and biological condition of this stream, and have caused ongoing violations of water quality standards. Although not disclosed in the revised draft permit, the DEQ's December 17, 2019, Letter of Violation to Aethon Energy Company describes the impaired conditions of this high desert stream. The ongoing modifications ("grandfathering") through multiple permit renewals of TDS and chloride concentration limits that exceed effluent limits contained in Appendix H are undoubtedly contributing factors, along with increasing volumes of produced water carrying heavier salt loads.

Alkali Creek is impaired by a variety of oil field pollutants including high levels of chloride that have harmed aquatic life and by high TDS concentrations that exceed limits regarded as being safe for use by livestock and wildlife. *See* DEQ Chapter 2, Appendix H(b)(vii). Professor Bergman's and Dr. Meyer's February, 18, 2020 Memorandum indicate that chloride and TDS concentrations authorized in the existing permit are harmful to aquatic life. Although protection of existing uses is a fundamental requirement of the Clean Water Act, it is clear that high chloride concentrations and other pollutants present in the effluent and in Alkali Creek are preventing the attainment of designated "aquatic life" uses in violation of Chapter 1. All evidence suggests that the DEQ is failing to meet the "basic" antidegradation requirements for Tier 1 waters.

Badwater Creek (Class 2AB). Badwater Creek is considered a "Tier 2" high quality surface water. SOB at 8, 40 CFR § 131.12(a)(2). For high quality waters, Chapter 1 provides that: "Those surface waters not designated as Class 1, but whose quality is better than the standards contained in these regulations, shall be maintained at that higher quality." As discussed below, the DEQ has failed not only to maintain the higher water quality required of Tier 2 streams, it has failed to maintain even the most basic Tier 1 level of protection. *See* Ch. 1, Section 8(a). In fact, the agency has failed to comply with every single requirement enumerated in Section 8 for Tier 2 waters:

- The quality of Badwater Creek has in fact been lowered below the applicable standards;

- Existing water uses of Badwater Creek have in fact not been fully maintained and protected;

- The highest statutory and regulatory requirements have in fact not been achieved (indeed, the SOB and draft permit proposed to "grandfather" a monthly load limit for TDS of 908 tons, and completely eliminates the effluent concentration limit for TDS contained in Appendix H); and

- The DEQ has in fact not made a determination that "lowered water quality is necessary to accommodate important economic or social development in the area in which the waters are located."

The DEQ's conclusion that since "there is no new or increased load with this renewal beyond those historic discharge levels, then this facility is not considered by WDEQ to be a source of significant degradation at this time" is insupportable. The DEQ has not provided any evidence of what the historic discharge levels were prior to 1975, and appears to be arguing that *any* discharge of *any* amount prior to 1975 provides a sufficient basis to grandfather current discharges, which could be and likely are vastly greater than the pre-1975 discharge.

The evidence shows that significant degradation—as defined in the DEQ's antidegradation policy—is already occurring; consequently, the DEQ cannot legally move forward with an action that would further degrade a "high quality" Tier 2 surface water, especially when it is not even meeting the basic Tier 1 level of protection.

Boysen Reservoir (Class 2AB). The Statement of Basis claims that "WDEQ has reviewed the expected mixed concentration of effluent within the Boysen Reservoir system, and has determined that the above condition is maintained. No pollutants from this facility are expected to result in mixed concentrations that consume 20% or more of the available assimilative capacity within the lake. Therefore, WDEQ's review has concluded that continued discharges from this facility will not result in significant degradation of Boysen Reservoir." SOB at 8. In order for the DEQ to reach this conclusion, it must know, *a priori,* the assimilative capacity within the lake, but this information in not provided. The burden is on DEQ to explain: 1) how it determined the assimilative capacity of the lake; 2) what the assimilative capacity is; and 3) how it determined that the discharge would consume less than 20% of the assimilative capacity. This information is required in order to ensure the DEQ considered all relevant factors and to verify that its calculations and methodology are sound. Without any discussion of how the DEQ reached its conclusions regarding impairment to Boysen Reservoir, the DEQ's antidegradation determination is deficient on its face and cannot be used to justify or support the agency's findings.

To the extent the DEQ is relying in any way on the Boysen Reservoir Modeling Study prepared by Aethon's contractor, Environmental Resources Management, we hereby adopt and incorporate by reference as if fully set forth below the Final Technical Memorandum, dated July 1, 2019, prepared by Hydros Consulting, submitted with our comments on the initial draft permit and now on file with the DEQ.

Wind River Below Boysen Dam (Class 1). As noted by DEQ, Wyoming Class 1 waters are "Outstanding waters . . . in which no further water quality degradation by point source discharges other than from dams will be allowed. The water quality and physical and biological integrity which existed on the water at the time of designation will be maintained and protected." Ch. 1, Section 4(a). Class 1 waters are subject to the highest level of antidegradation protection, "Tier 3." 40 CFR § 131.12(a)(3).

The DEQ has determined that because "the discharge itself represents a background concentration within the watershed of the receiving water bodies, including the Wind River Class 1 segment," compliance with applicable requirements has been achieved. SOB at 9. As noted above, we fundamentally disagree with the DEQ's characterization that a permitted discharge of pollutants should be treated as a "background concentration" rather than what it is, which is pollution contributing to impairment of water quality that has never been subject to a proper antidegradation review in accordance with the DEQ's rules and policies.

III. ADDITIONAL CONCERNS, QUESTIONS AND RECOMMENDATIONS

Evidence of historic amount of 908 tons per month of TDS must be provided. The draft permit claims that 908 tons per month is the "historic level" of salt discharge from the facility and bases all of its major decisions on that amount, but provides no historical evidence to support that claim.[4] Given that at least one previous permit contained a chloride limit of 230 mg/l, and

[4] For example, the DEQ justifies its conclusion that the discharge is not "a source of significant degradation" in Boysen Reservoir "[b]ecause this facility and its discharge predate the 1975 Clean Water Act …" SOB at 8.

presumably had smaller discharge volumes and loads, the DEQ must explain how it determined that 908 tons per month is the historic limit. What years/permits were considered in developing this "historic level"?

Assuming that any kind of grandfathering is legally permissible (we assert it is not), the discharge subject to grandfathering may only comprise that which existed prior to 1975, both in terms of the number and location of outfalls permitted, and the amounts and concentrations of pollutants being discharged. The DEQ has not provided any evidence, other than statements, about the specifics of the pre-1975 discharge. Again, assuming that grandfathering of any kind is lawful, the only discharge that could conceivably be grandfathered is the discharge that exited pre-1975. What evidence exists to show that the pre-1975 discharge contained 908 tons/month? This information needs to be provided to the public for review and confirmation.

Demonstration of agricultural and wildlife use of water required. The SOB at page 11 states that "[t]he Wyoming Game and Fish Department determined that discharge of produced water from all existing WYPDES-permitted oil production units in Wyoming enhances wildlife propagation and habitat." We request that you provide a copy of the WGFD "determination" in your response to public comments.

Antidegradation impairment review in the Statement of Basis is flawed.
The DEQ claims that:

> The discharge of wastewater and the effluent limits established in this permit ensure that the levels of water quality maintain and protect the designated uses of the receiving waters. An antidegradation review verifies that the permit conditions, including the effluent limitations established, provide a level of protection to the receiving water consistent with the antidegradation provisions of Wyoming surface water quality standards. In addition, an evaluation of the receiving waters revealed that they are not on the 303(d) list as waterbodies that cannot support designated uses.

SOB at 9.

The DEQ's LOV to Aethon reveals that the existing discharge has caused water quality impairment that has interfered with existing uses in the receiving waters. This paragraph must be revised to properly state the condition of Alkali and Badwater creeks. In addition, while it is true that these streams are not currently on the 303(d) list of impaired waterbodies, they should be. Thus, based on information contained in the DEQ's LOV and our own analysis, we will be submitting a request to DEQ to add Alkali and Badwater creeks to the draft 303(d) list.

Outfalls 013 and 014 are not "grandfathered" and therefore require numeric limits consistent with those set forth in Appendix H. A major permit modification signed by the DEQ Director on January 19, 2010, combined WY0002062 with WY0028771 resulting in the addition of two additional outfalls, 013 and 014, for a total of fourteen outfalls. According to the Statement of Basis for that major modification, "Outfalls 013 and 014 do not fall under the that rule provision [grandfathering] and have additional limits and monitoring requirements for

sulfates and chlorides." To avoid backsliding prohibited by the Clean Water Act, the current January 2020 permit renewal must acknowledge and include this requirement.

Outfall 015 is not "grandfathered" and must include effluent limits established in Appendix H. The renewal of WY0002062 on October 21, 2013, added outfall 015. The permit contained effluent limits consistent with requirements contained in Appendix H. *See* Part 1, A.1.b. (effluent limits for outfalls 013-015). For the same reason, those limits must be included in the January 2020 renewal.

Approval of 16 outfalls not justified. The revised draft permit proposes to authorize a discharge of pollutants from 16 outfalls, yet the existing discharge of approximately 2 million gallons per day –presumably from the four outfalls currently in operation—contributes a "historic level" of 908 tons per month of TDS. How can the DEQ justify a proposal to renew the permit for 16 outfalls when the existing discharge from four outfalls represents the permit "cap" on the salt load? What is the current existing discharge volume from the four functioning outfalls, and what volume is anticipated when the other outfalls come on line?

Reasonable Potential Analysis Required for Chloride in Alkali Creek. The DEQ "has determined that there is a reasonable potential for this facility to exceed the instream standard for chloride in Badwater Creek." *See* SOB at 3. To address this potential. the DEQ proposes "a final effluent limit of 230 mg/L for chloride, effective July 1, 2024." *Id.* We believe that the DEQ must establish a similar chloride standard to protect aquatic life in Alkali Creek. The fact that DEQ removed the chloride limit for Class 3 streams in an earlier rulemaking does not excuse the agency from complying with water quality standards for the protection of aquatic life.[5]

Even if –assuming for purposes of discussion- the removal of the 230 mg/L chloride instream limit was legal, the permit –at a bare minimum- must still protect designated uses. Protection of designated uses, and water quality necessary to protect those uses, is a fundamental requirement of the Clean Water Act. 40 C.F.R. §131.12(a)(1). It is clear from DEQ's own information that it has failed to protect designated uses in Alkali Creek by allowing the degradation of water quality resulting from excessive chloride and other pollutants. Accordingly, as explained above and supported by Dr. Meyer and Professor Bergman's analysis, a water quality based chloride limit must be established for this permit that is protective of aquatic life.

[5] The renewal of this permit on January 1, 2009 consolidated eleven discharge permits into a single new permit that authorized twelve outfalls, 001 to 012. The Anti-Backsliding Provision on page 2 of the Statement of Basis for the 2009 permit renewal explains that:

> This permit originally established a chloride limit of 230 mg/l at the end-of-pipe for discharge into Class 3B waters. Since the issuance of the original permit, chloride standards established in Chapter 1 of the Wyoming Water Quality Rules and Regulations have changed to excluding aquatic life standards for chloride in Class 3 waters. Therefore, WDEQ has removed the effluent limit and monitoring requirements for chloride in this permit. It is WDEQ's determination that removing chloride limit from this permit conforms to the anti-backsliding requirements established in Section 402(o)2.B.i. of the Clean Water Act.

See Chapter 2, Section 5(c)(iii)(C)(IV), page 2-40 ("Where the administrator determines that an effluent constituent has the reasonable potential to adversely affect a designated use of receiving waters of the state and no numeric standard has been promulgated … for the constituent, the administrator may establish a numeric effluent limitation based on values derived from appropriate scientific methods.").

Chloride is harmful to freshwater aquatic life. *See* Bergman/Meyer Memo. It is clear that the absence of a chloride limit in permit WY0002062 since 2009 has resulted in severe impact to native aquatic life in Alkali Creek. Yet the absence of a chloride limit in Chapter 1 for Class 3 streams does not –despite what it may believe-- relieve the DEQ from its responsibility to protect aquatic life in Alkali Creek.

Description of compliance schedule is incorrect. The description of the compliance schedule for chloride on page 2 of the Statement of Basis states that "[t]he previous permit versions for this facility did not include water quality based chloride effluent limits for protection of Badwater Creek as a class 2AB stream (cold water fishery)." That statement appears to be incorrect. As discussed above, the anti-backsliding provision on page 2 of the Statement of Basis for the 2009 permit renewal clearly states that "[t]his permit originally established a chloride limit of 230 mg/l at the end-of-pipe for discharge into Class 3B waters." We suggest a revision to this section to clarify that a 230 mg/L chloride limit was indeed included in previous permits.

Justification for compliance schedule is needed. The Compliance Schedule on page 3 of the Statement of Basis indicates that "full compliance" with a chloride limit of 230/mg/L will be required by July 1, 2024. The SOB states that "[t]he purpose of the four-year compliance schedule is to allow the permittee time to install additional treatment capacity and optimize its output, in order to meet the final effluent limit of 230 mg/L from the outfalls at this facility. The DEQ should explain why additional time is required, given that a treatment facility is located on site. Does this existing treatment facility not have the capacity to reduce salt loads required to achieve a 230 mg/L chloride limit? DEQ provides no compelling justification for this four-year compliance schedule.

Compliance issues should be explained. The existing permit underwent a MAJOR MODIFICATION in April of 2015 to address the start-up of the Neptune Treatment Facility. Yet the revised draft permit states that the Neptune Treatment Facility "has been inoperable since March of 2019, due to technical issues at the plant…" and that "the permittee has no specific plans to re-open the treatment plant at this time." SOB at 1.

The existing permit requires Aethon, to "properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit." *See* Authorization to Discharge Under the Wyoming Pollutant Discharge Elimination System, WY0002062, dated 4/27/15, Part II, A.3. Facilities Operation. In light of this system failure, the DEQ should explain both the reason(s) for the failure and how the existing 908-ton monthly load limit of TDS is being achieved in the absence of treatment.

Monitoring of pH on Badwater Creek Required. The only monitoring station proposed by DEQ will require on Badwater Creek is BWC1 "below its confluence with Alkali Creek". That station might totally miss the elevated pH that Bergman and Meyer predicted will occur as the oversaturated CO2 gas in the effluent degasses from Alkali and Badwater Creeks enroute to Badwater Bay in Boysen Reservoir. In addition to BWC1, at least one other monitoring station on Badwater Creek should be required immediately upstream of Badwater Bay (where the highest pH values in Badwater Creek might be expected).

Significant flaws exist in DEQ's approach to establish final effluent limit for sulfides. The DEQ determined that there is a reasonable potential for the facility to exceed the instream standard for hydrogen sulfide in Alkali Creek, and therefore included a final water quality based effluent limit of 20ug/L for Total Sulfide at each outfall "in order to meet the instream standard of 2 ug/L for Hydrogen Sulfide. SOB at 6. As discussed below, there are significant flaws to this approach.

Professor Bergman and Dr. Meyer note that the DEQ is requiring a total-sulfides analysis, which is only appropriate if the permit limit were set low enough to not allow high concentrations of H2S, i.e., above the aquatic life numeric criterion of 2 ug/L. However, the approach used by DEQ is not at all sufficient to achieve compliance with instream standards. The DEQ looked at the historical pH data for the effluent (data not provided) and determined that the median pH was 7.9. At that pH, only approximately 10% of the total sulfide (H2S + HS- + S2-) is H2S. Thus, the DEQ reasoned that if "the instream standard for Hydrogen Sulfide is 2 µg/L, a Total Sulfide level of 20 µg/L or less at the outfalls would be required to achieve an output level 2 µg/L or less for Hydrogen Sulfide." SOB at 6. The obvious flaw in this approach is the fact that 50% of the historical pH values were, by definition of the word "median", less than pH 7.9 -- meaning that the H2S concentration exceeded 10% of the total sulfide concentration more than 50% of the time. Therefore, in order to achieve the aquatic life numeric criterion of 2 ug/L, the DEQ should select a a lower pH percentile than the median (which is the 50th percentile), perhaps something like the 10th percentile, meaning expected errors would be belowc10% of the time.

Unfortunately, because DEQ did not provide the pH data, it is impossible to know what the 10th percentile of those historical pH values is. The following example shows how important this could be in terms of meeting in-stream numeric criterion for H2S. *At a pH of 7.0 (see the speciation diagram at the top of page 6) H2S is approximately 50% of the total sulfide concentration.* Thus, at a pH of 7.0, the total sulfides effluent limit concentration should not exceed 4 mg/L (instead of the 20 mg/L at pH 7.9) in order to not exceed an H2S concentration of 2 mg/L. Therefore, in order to set an effluent limit that is protective of the aquatic criterion, it important to know the entire distribution of historical pH values, not only the median pH. The simplest and most efficient approach would be for DEQ require that the H2S concentration be calculated from the measured pH and measured total sulfide concentration in each effluent, using the well-known pKa (acid dissociation constant) of H2S -- thus avoiding any intermediate assumptions and receiving the concentration of actual interest.

More information needed to support agency's Reasonable Potential analysis for manganese, fluoride, uranium, and E.coli. The DEQ states that "[e]ffluent limits for Manganese,

Fluoride, Uranium and E. coli were not included in the permit because based on *available data*, the facility has no reasonable potential to exceed the calculated effluent limits for those pollutants." SOB at 7 (emphasis added). The DEQ should provide the historical data for concluding there is no reasonable potential for exceedances of the standards (or limits) for F, Mn, U, and E. coli.

The permit must include both chronic and acute WET testing. Without providing any explanation for the change, the DEQ proposes to eliminate chronic whole effluent toxicity (WET) testing from the permit. SOB at 10. Under the revised draft permit, only acute toxicity testing would be required. Both Acute *and* Chronic WET testing were included in the initial draft permit, and the reasoning for including both chronic and acute WET testing was sound. March 13, 2019, SOB at 11, 12. The proposal to remove chronic WET testing requires an explanation.

Alkali Creek is Class 3B, and "Uses protected for Class 3B streams such as this include aquatic life, …" (page 8). Bergman and Meyer have concluded that passing only acute toxicity tests with Daphnia magna and fathead minnows (Pimephales promelas) will not ensure protection of at least 95% of the aquatic life, especially sensitive invertebrates. Effluents from this facility could easily pass acute toxicity tests and fail at least the D. magna (and possibly also the fathead minnow) chronic toxicity tests. For these reasons, the DEQ must restore chronic WET testing in the permit.

The DEQ's failure to analyze and disclose critical water quality sampling data precludes permit renewal. The DEQ/WQD administrator is required to ensure that an application for a WYPDES permit is complete and that the general and specific information requirements outlined in Chapter 2 are satisfied. *See* Chapter 2, Section 5(a). As part of the processing of a permit application, the administrator is required to make several determinations including that the proposed effluent limits will ensure that water quality standards will not be violated. Chapter 2, Section 5(b)(i). The failure of the DEQ to consider critical water quality data *in its possession* in the context of this proposed renewal undermines the integrity of the process and interferes with the agency's ability to ensure that proper monitoring and effluent limits are included in the revised permit. Chapter 2, Section 5(b)(iii).

Our groups recently requested all documents held by the DEQ related to this permitting process. While the agency produced a variety of documents, some lab reports and water quality analyses were withheld from production because these results had not yet been finalized by the agency. It is troubling that these documents were not finalized and ready for public inspection before the close of this comment period. As a result, our organizations were unable to consider these documents to inform our understanding of the severity of the water quality issues and the relationship between current water quality violations and this permitting process. What's more troubling is that the agency failed to finalize these reports prior to *its* analysis of the permit. The DEQ should not issue this permit until the water quality results are finalized, and should re-notice the permit for public comment when the results are available.

Pollutants detected in Alkali Creek are harmful to wildlife and impede attainment of designated uses. The December 2019 letter of violation issued to Aethon Energy documents the presence of pollutants that are harmful to birds and other species. *See* Ramirez, Pedro, Oil Field

Produced Water Discharges into Wetlands in Wyoming, U.S. Fish and Wildlife Service, Contaminant Report R6/718C/02, attached in Appendix A. Alkali Creek is a Class 3B stream, and its designated uses include use by wildlife. *See* DEQ/WQD Chapter 1, Section 3(h) (Wildlife use includes protection of water quality to a level which is safe for contact and consumption by avian and terrestrial wildlife species.") As discussed above, the DEQ must ensure that the discharge of produced water does not violate water quality standards. *See, e.g.*, Chapter 2, Section 10(c); Appendix H(c)(iii). Here, the DEQ has failed to ensure that the discharge is consistent with water quality standards, and therefore may not lawfully renew WY0002062.

Response to Public Comments. This letter, and the attached Memorandum from Dr. Harold Bergman and Dr. Joseph Meyer, contain a number of specific comments and recommendations. In accordance with the DEQ's rules governing public participation in the reissuance of draft permits, in the event a comment or recommendation is overruled, we would appreciate a statement of reasons explaining "why any comments did not result in a change to the draft permit." DEQ/WQD Rules and Regulations, Chapter 2, Section 15. Public Participation, (g)(iii).

IV. CONCLUSION

Although substantially improved over the earlier version, the revised draft permit still allows unlawful, unacceptable and environmentally damaging amounts of salts and other pollutants to enter Boysen Reservoir and its tributaries. The existing discharge of wastewater from the Moneta Divide oil and gas field has violated state water quality standards, causing significant damage to Alkali and Badwater creeks. We urge DEQ to require Aethon to take immediate action to repair the damage caused by years of neglect and restore the natural ecological function of surface waters impacted by this development.

We would appreciate being notified directly at the addresses shown below of any additional public comment and/or objection opportunities related to WYPDES Permit No. WY0002062. In addition, we request advance written notice of any public comment and/or objection opportunities provided in connection with any use attainability analyses (UAA) and/or proposed changes to water quality standards, including designated uses and numeric and/or narrative criteria, for Alkali and Badwater creeks.

Sincerely,

Dan Heilig
Senior Conservation Advocate
Wyoming Outdoor Council
262 Lincoln St.
Lander, WY 82520
(307) 332-7031 x13

Sharon Buccino
Senior Attorney
Natural Resources Defense Council
1152 15th St NW
Washington, DC 20005
(202) 289-6868

dan@wyomingoutdoorcouncil.org

Jill Morrison
Executive Director
Powder River Basin Resource Council
934 N Main St.
Sheridan, WY 82801
(307) 672-5809
jmorrison@powderriverbasin.org

sbuccino@nrdc.org

Brian Rutledge
Director, the Sagebrush Ecosystem Initiative
National Audubon Society
4510 CR 82E
Livermore, CO 80536
(307) 262-1061
brutledge@audubon.org

CC: Governor Mark Gordon
Beth Callaway, Policy Advisor
Todd Parfitt, WDEQ Director
Kevin Frederick, WQD Administrator
Darcy O'Connor, EPA Region 8,
Assistant Regional Administrator
Office of Water Protection

Enclosures:

Aethon DMR Violations
DEQ water quality sampling data
Bergman/Meyer Memorandum, dated February 18, 2020.
Letter of Violation re: WYPDES No. 0002062
Aethon Energy Company's Response to LOV
WOC/PRBRC Complaint and Request for Investigation
DEQ Response to Complaint and Request for Investigation
U.S. Fish and Wildlife Service, Contaminant Report R6/718C/02

APPENDIX A – Exhibits

Aethon DMR violations

Letter of Violation issued to Aethon Energy Company

Aethon's Response to Letter of Violation

DEQ water quality sampling data

WOC/PRBRC Complaint and Request for Investigation

DEQ's Response to Complaint and Request for Investigation

Bergman/Meyer Memorandum, dated February 18, 2020

U.S. Fish and Wildlife Service, Contaminant Report R6/718C/02

Permit WY0002062
As summarized below, Discharge Monitoring Report (DMR) data reveal fifteen violations of effluent limits for monitoring periods ending May 31, 2015 through Dec. 31, 2019.

Pollutant	Outfall No.	Effluent Limit	Value Reported in DMR	Percent Exceedence	Monitoring Period End Date
Dissolved Iron µg/L	001	1000	1300	30%	2/28/18
Dissolved Zinc, µg/L	006	118.1	170	44%	8/31/15
Dissolved Zinc, µg/L	009	118.1	260	120%	12/31/16
Oil and Grease, mg/L	009	10	38.9	289%	12/31/16
Oil and Grease, mg/L	009	10	19.5	95%	6/30/17
Oil and Grease, mg/L	009	10	11	10%	10/31/17
Oil and Grease, mg/L	003	10	21	110%	12/31/17
Oil and Grease, mg/L	009	10	22	120%	2/28/18
Oil and Grease, mg/L	003	10	10.8	8%	2/28/18
Oil and Grease, mg/L	009	10	15	50%	4/30/18
pH	001	6.5 - 9.0	10.8	n/a	6/30/16
pH	001	6.5 - 9.0	3.8	n/a	12/31/16
pH	001	6.5 - 9.0	9.6	n/a	6/30/18
pH	001	6.5 - 9.0	9.91	n/a	12/31/18
Total Dissolved Solids, tons/month	sum of all outfalls	908	1347	48%	3/31/18

Sources of data:

EPA Enforcement and Compliance History Online
https://echo.epa.gov/tools/data-downloads/icis-npdes-dmr-and-limit-data-set
https://echo.epa.gov/detailed-facility-report?fid=110055199663

DEQ Paper DMR Download Utility
https://paperdmr.wyo.gov/
https://paperdmr.wyo.gov/ReportDisplay.aspx?Ty=LR&IV=yes&RT=PDF&PN=WY0002062&EE=08/31/2015,12/31/2017&LR=05/01/2015,12/15/2027

Memorandum

February 18, 2020

To: Dan Heilig, Wyoming Outdoor Council, Lander, WY; and
Jill Morrison, Powder River Basin Resource Council, Sheridan, WY

From: Harold Bergman, PhD, Professor Emeritus, University of Wyoming, Laramie, WY; and
Joseph Meyer, PhD, Chief Scientist, Applied Limnology Professionals LLC, Golden, CO

Regarding: Analysis of, and comments on, proposed WDEQ Wastewater Discharge Permit for Aethon Energy Operating, LLC – WY0002062-RENEWAL-12-17-19 (Draft 2)

We have reviewed a series of documents including WDEQ-WQD's proposed WYPDES discharge permit WY0002062-RENEWAL-12-17-19 (Draft 2) for Aethon Energy Operating, LLC, Moneta Divide Gas Field; Aethon's original application for this permit renewal dated August 8, 2016; portions of Environmental Resources Management's (ERM's) Water Quality Compliance Analysis report to Aethon Energy dated April 23, 2018; ERM's Blackwater – Alkali Creek: Sediment and Surface Water Sampling Results report to Aethon Energy dated October 23, 2019; WDEQ's Response to Public Comments from the original draft permit; ERM Whole Effluent Toxicity Test Result reports dated 12 July 2017 and 13 March 2019; WDEQ's Letter of Violation for WYPDES permit WY0002060 dated December 17, 2019; and Aethon's Response to Letter of Violation dated January 16, 2020. We also have reviewed and used information from a several peer-reviewed publications on the chemistry of produced waters from oil and gas operations and the toxicity of these waters to aquatic biota, and we have cited these references, as appropriate, in the text below.

We commend the WDEQ-WQD for this improved draft WYPDES renewal permit, which is a substantial improvement compared to DEQ's earlier draft renewal permit, in that the current draft includes better analysis of the conditions related to Aethon's discharge and its effects on downstream water quality, and it imposes more stringent requirements of the discharger, particularly a reduction in allowed discharge from 8.274 MGD to 2 MGD and the eventual effluent limit of 230 mg Chloride/L. However, we have several concerns about other parts of the draft renewal permit.

In the text that follows, we present our analyses, conclusions and positions related to water chemistry and aquatic toxicity of Aethon's produced water and WDEQ's proposed issuance of a discharge permit renewal for Aethon's discharge.

Compliance schedule for Chloride final effluent limits (Pages 2 and 3):

The compliance schedule of 4 years until July 1, 2024 to meet the 230 mg Cl/L effluent limit is much too long and should be shortened, especially since WDEQ has provided no justification for a 4-year compliance schedule or provided interim effluent limits at, say, annual

intervals up to the 4-year deadline to meet the 230 mg Cl/L limit. A shorter compliance schedule or, at least, annually staged improvements in effluent limits for Chloride would be reasonable, given that the technology for water treatment to reduce Chloride is straightforward, and given that Aethon already has a reverse osmosis plant in place (Neptune Plant). This plant is apparently inoperable at this time but could be repaired/improved in time to meet a shorter compliance schedule.

We acknowledge, however, that the draft permit specifies that the 230 mg Cl/L effluent limit is being required for all Aethon outfalls (001-016), and this is what will be required to begin the recovery of what can clearly be characterized as severely impaired conditions in both Alkali and Badwater creeks. With this Chloride limit placed on all 16 discharge outfalls, it is likely that Aethon will need to consolidate its outfalls to one reverse osmosis treatment plant to reduce the current untreated discharge of around 2,200 mg Cl/L. Aethon's current Neptune Plant is located at outfall 001, yet Aethon is actively considering consolidating all its surface discharges to outfall 016 (Aethon's January 16, 2020, Response to WDEQ Letter of Violation), to improve their ability to treat wastewater for reduction of sulfide and temperature.

Thus, given the requirement to meet the 230 mg Cl/L discharge limit for all outfalls (including unnamed tributaries to Alkali Creek and Alkali Creek), Aethon may need to consolidate its discharges to outfall 001 where the current Neptune Plant is located, or build a new reverse osmosis plant at a consolidation location at outfall 016. Under these circumstances, Aethon and WDEQ will likely need to negotiate an appropriate time frame for consolidating all the current outfalls (presumably using pipelines to avoid in-stream violations in Alkali Creek and Alkali Creek tributaries) and treatment upgrades at this new outfall location to achieve compliance with the 230 mg Cl/L discharge limit as well as the need to comply with limits for sulfide and temperature. Under no circumstances, though, should the discharge be allowed to exceed the 230 mg Cl/L at any discharge location, including on Alkali Creek or tributaries to Alkali Creek.

Instream Monitoring (Pages 3 and 4):

In WDEQ's new draft 2 Aethon discharge permit, the only monitoring station WDEQ will require on Badwater Creek is BWC1 "below its confluence with Alkali Creek." The BWC1 station will likely totally miss the elevated pH that we predicted in our earlier comments (dated June 27, 2019 on the first proposed renewal permit) will occur as the over-saturated CO_2 gas in the effluent degasses from Alkali and Badwater Creeks enroute to Badwater Bay in Boysen Reservoir. We strongly recommend that, in addition to BWC1, at least one other monitoring station on Badwater Creek should be required immediately upstream of Badwater Bay (where the highest pH values in Badwater Creek might be expected).

We extensively explained and reviewed this likely problem of over-saturated CO_2 partial pressure in Aethon's produced water causing elevated instream pH values above 9 in our earlier comments (dated June 27, 2019) to WDEQ's draft 1 proposed permit. In summary, we estimated that the partial pressure of CO_2 (pCO_2) in Aethon's discharge could be approximately 372-fold over-saturated in CO_2 at Aethon's discharge. This means that the over-saturated CO_2 will de-gas from the discharge water as it flows downstream in Alkali and Badwater Creeks until the CO_2

reaches equilibrium with the atmosphere. As the CO_2 degasses, the H^+ concentration will decrease and, thus, the pH of the water will increase. In our earlier analysis of this issue, we used the WHAM geochemical-speciation software (Lofts, 2012) and calculated that the in-stream water might reach a pH as high as 9.6 after the discharged produced water's over-saturated pCO_2 level fully equilibrated with the atmosphere, thus exceeding WDEQ's instream standard of pH 6.5 to 9. The realized pH will also depend on the extent to which concomitant precipitation of calcite ($CaCO_3$) remains oversaturated in the creek water.

Based on this analysis, as noted above, we strongly recommend an additional Badwater Creek monitoring station immediately upstream of its discharge into Badwater Bay. In addition, we also strongly recommend that Aethon be required to report temperature and alkalinity (from which, along with pH, pCO_2 can be calculated) of the discharge and at all monitoring sites so that this potential instream pH violation can be evaluated.

Water Quality Based Effluent Limits (Pages 4-7):

Chloride:

In the Compliance Schedule section of the draft permit, WDEQ concludes that there is a reasonable potential for this facility to exceed the in-stream chloride standard of 230 mg Cl/L for Badwater Creek (Class 2AB), because Badwater Creek is intermittent, resulting in no dilution flow during parts of the year. Thus, in the draft permit WDEQ appropriately sets the discharge limit for all of Aethon's outfalls the same as the in-stream standard of 230 mg Cl/L in Badwater Creek.

We note that this 230 mg Cl/L effluent limit technically applies to all of the unnamed tributaries to Alkali Creek and to Alkali Creek as well as Badwater Creek, particularly because outfalls 001 to 015 all discharge to unnamed tributaries of Alkali Creek and outfall 016 discharges to Alkali Creek (Table 1 and Attachment 1 in Aethon's original application for this permit renewal dated August 8, 2016).

Even though WDEQ's justification for the 230 mg Cl/L effluent limit is based on a reasonable potential analysis of in-stream requirements in Badwater Creek, WDEQ should explicitly also apply that same logic and same reasonable potential analysis for in-stream requirements and effluent limits for Alkali Creek and its tributaries (Class 3B – aquatic life other than fish). Because Alkali Creek and its tributaries are also intermittent, no dilution flow can be expected for much of the year; and because a Class 3B water should protect aquatic life other than fish, the same 230 mg Cl/L instream requirement should also apply. Given a recent analyzed Chloride concentration of 1,540 mg/L in Alkali Creek on August 20, 2019 (Table 2 in ERM's Blackwater – Alkali Creek: Sediment and Surface Water Sampling Results report), the aquatic community in Alkali Creek needs more regulatory protection than the draft renewal permit will provide.

The current USEPA freshwater aquatic life chronic criterion for chloride of 230 mg Cl/L was derived numerically (i.e., based on lab toxicity tests, not based on field observations) and first appeared in the USEPA water quality criteria document for chloride in 1988 (EPA 440/5-

88-001) (https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table#table). The chloride criterion is "driven" by invertebrates (see Table 3 in that document). Of the 12 genera of aquatic organisms used in the 1988 derivation, the 6 most-sensitive genera were invertebrates [including cladocerans (two *Daphnia* species), a snail, an isopod, midges, and a caddisfly -- meaning a wide variety of types of aquatic invertebrates]; and 5 of the 6 least-sensitive genera were fish [i.e., only 1 of the 6 least-sensitive genera was an invertebrate (a mosquito)]. Thus, based on that toxicity dataset, it would be appropriate to conclude that chloride concentrations exceeding 230 mg Cl/L would not be safe for many invertebrates. [Note: The USEPA water quality criteria are intended to protect 95% of species. Thus, "on average", one might expect approximately 5% of the species to be adversely affected even at only 230 mg Cl/L.]

Thus, in our professional opinion, the existing USEPA criteria document provides sufficient evidence to support an argument that 230 mg Cl/L should be a maximum instream chloride concentration for protection of aquatic invertebrates in Alkali Creek, and a reasonable potential analysis would support an effluent limit of 230 mg Cl/L for all permitted effluent outfalls into Alkali Creek or its tributaries.

Total Dissolved Solids (TDS):

Though water quality for protection of aquatic life in Alkali and Badwater Creeks would be improved by reducing Chloride concentrations in the Aethon effluent to 230 mg/L, there is still a major problem with WDEQ's allowed in-stream Total Dissolved Solids (TDS) concentrations. High concentrations of TDS, exceeding 5,000 mg/L, in the effluent have clearly harmed aquatic life in Alkali Creek. The proposed waiver of the Appendix H effluent concentration limit for TDS will continue to cause harm to aquatic life in Alkali Creek and downstream in Badwater Creek, threatening aquatic life use designation for these surface waters. Table 2 in Aethon's original application for permit renewal at Frenchie Draw (dated August 8, 2016) shows a TDS concentration of 5,940 mg/L in the effluent at outfall 6. A more recent analysis of inorganic constituents from an in-stream water sample from Alkali Creek taken immediately upstream of the confluence with Badwater Creek on August 20, 2019, added up to a TDS concentration of 6,303 mg/L (Table 2 in ERM's Sediment and Surface Water Sampling Results report to Aethon Energy).

To estimate the effect of this high a measure of TDS on aquatic biota, we ran the Mount et al. (1997) major-ion-toxicity model with the water chemistry data in Table 2 of the 2019 ERM report. The model-predicted survivals of *Ceriodaphnia dubia* (48 hours), *Daphnia magna* (48 hours), and fathead minnows (96 hours) are less than or equal to 0.2%. An approximately 5-fold dilution of that high TDS water with distilled water (or with really pure reverse-osmosis water) would be needed for the model-predicted survivals to exceed 90%. And that's only for acute toxicity, which is all the model is designed to predict. By simple logic, even more dilution would be needed to avoid chronic toxicity. These model-predicted acute toxicity results demonstrate that Alkali Creek is impaired downstream of the Aethon effluent discharges.

In our professional opinion, even the WDEQ's traditionally allowed TDS limit of 5,000 mg/L is way too high for protection of aquatic life. WDEQ should complete a reasonable potential analysis to re-evaluate the 5,000 mg/L TDS limit.

Total Sulfide:

In our professional opinion, the WDEQ effluent limit of 20 micrograms/L (µg/L) for Total Sulfide in this proposed discharge permit will not be stringent enough to meet the 2 µg/L instream standard for Hydrogen Sulfide. WDEQ is requiring a Total Sulfides analysis rather than a direct Hydrogen Sulfide measurement, which would be acceptable if the permit limit for Total Sulfide were set low enough to not allow high concentrations of Hydrogen Sulfide at all times. However, they used an indirect approach for estimating Hydrogen Sulfide concentrations that would allow the Hydrogen Sulfide concentration to exceed the 2 µg/L standard 50% of the time. Specifically, WDEQ looked at the historical pH data for the effluent (data not provided) and stated that the median pH was 7.9. At that pH, only approximately 10% of the total sulfide ($H_2S + HS^- + S^{2-}$) is H_2S. Thus, WDEQ reasoned that if "the instream standard for Hydrogen Sulfide is 2 µg/L, a Total Sulfide level of 20 µg/L or less at the outfalls would be required to achieve an output level 2 µg/L or less for Hydrogen Sulfide." But hidden in that reasoning is the fact that 50% of the historical pH values were, by definition of the word "median", less than pH 7.9 -- meaning that the H_2S concentration exceeded 10% of the total sulfide concentration more than 50% of the time. Therefore, WDEQ should have chosen a lower pH percentile than the median (which is the 50^{th} percentile), perhaps something like the 10^{th} percentile (meaning one would not expect to err more than 10% of the time). We don't know what the 10^{th} percentile of those historical pH values is, because WDEQ did not provide the pH data. However, just to give an idea of how important this could be, H_2S is approximately 50% of the total sulfide concentration at pH 7.0 (see the speciation diagram at the top of page 6 in the proposed permit). Thus, at a pH of 7.0, the total sulfides concentration should not exceed 4 µg/L (instead of the 20 µg/L at pH 7.9) in order to not exceed an H_2S concentration of 2 µg/L. Therefore, it is important to know the entire distribution of historical pH values, not only the median pH.

Actually, the simplest and best thing for WDEQ to do would be to specify that the water quality based effluent limit is 2 µg H_2S/L and require that the permit holder calculate and report the H_2S concentration based on the measured and reported pH and the measured and reported total sulfide concentration in each effluent, using the well-known pK_a (acid dissociation constant) of H_2S (Broderius and Smith 1976) -- thus avoiding any intermediate assumptions and thereby directly knowing the concentration of actual interest rather than a measurement of Total Sulfide.

Reasonable Potential (Page 7):

WDEQ should provide the historical data, that they presumably have, for concluding that there is no reasonable potential for exceedances of the standards (or limits) for F, Mn, U, and *E. coli*.

Screening for Well Additives and Hydraulic Fracturing Fluids (Pages 9-10):

We agree that these kinds of well additives and fracturing chemicals should be monitored in the Aethon discharge to demonstrate that Aethon is not violating its permit by comingling these chemicals with production water and including them in their discharge. But we recommend that, in addition to listing of the suspect chemicals and their CAS#, WDEQ also should require reporting of analytical methods used and the detection limit for each analysis. In our professional experience, under these circumstances, a "non-detectable" analyte determination may not be trustworthy or may not be at a low enough detection limit to be toxicologically interpretable. By requiring the permittee to report the analytical method and detection limit, this potential problem can be avoided.

Whole Effluent Testing (Pages 10-11):

The newly revised draft permit only requires annual acute lethality Whole Effluent Toxicity (WET) tests with *Daphnia magna* and Fathead Minnows (*Pimephales promelas*). It is problematic that, in this new Aethon draft renewal discharge permit (12/17/2019), WDEQ eliminated chronic WET testing that had been included in the earlier draft permit dated 5/4/2017. Alkali Creek is Class 3B, and "Uses protected for Class 3B streams such as this include aquatic life, …" (page 8). We do not understand how WDEQ can support an argument that passing only acute lethality toxicity tests with *Daphnia magna* and Fathead Minnows (*Pimephales promelas*) will ensure protection of aquatic life, especially sensitive invertebrates.

As we stated in our earlier comments (dated June 27, 2019) related to the earlier draft permit, to test whether Aethon's produced water discharges might adversely affect fish and/or other aquatic organisms in Alkali Creek, Badwater Creek and Badwater Bay, stricter toxicity testing requirements will be needed in a final discharge permit. Whole Effluent Toxicity (WET) tests should be required quarterly (rather than annually), include each outfall, include acute 48-hour lethality tests with *Daphnia magna* and acute 96-hour lethality tests with Fathead Minnows, and include chronic toxicity tests for 7-day larval Fathead Minnow growth and 7-day *Ceriodaphnia magna* reproduction. In addition, to facilitate interpretation of all WET test results, WDEQ should require Aethon to analyze and report concentrations of a full suite of inorganic constituents (including Ca, Mg, Na, K, Cl, and SO_4), alkalinity, pH, BETX constituents, and Total Organic Carbon in the water sample collected for each WET test.

In fact, from several sets of information available to us now from reports on in-stream sample chemistry and toxicity, we already know that the Aethon discharge will be toxic most or all the time. For instance, WET test results on in-stream samples from monitoring site DMP1 in Alkali Creek above its confluence with Badwater Creek from June 2017 and February 2019 were recently released by WDEQ (ERM Whole Effluent Toxicity Test Result reports dated 12 July 2017 and 13 March 2019). The two WET test files present two different views of Alkali Creek. In June 2017, the acute toxicity for *Daphnia magna* and Fathead Minnows at all sites in Alkali and Badwater Creeks was almost nil, even at the Alkali Creek DMP1 site many miles downstream from Aethon's discharge and above Alkali Creek's confluence with Badwater Creek. However, in February 2019, the acute toxicity for *Daphnia magna* and Fathead Minnows

at the same DMP1 site was substantial, resulting in test failure. And, as might be expected, the chronic toxicity for Fathead Minnows in the February, 2019 sample from DMP1 was even greater than the acute toxicity, with significant lethality and growth reduction. We can only speculate about the difference in the June 2017 and February 2019 WET test results, but it may be that there was significant dilution flow in Alkali Creek in June 2017, when no toxicity was observed, and little or no dilution flow in Alkali Creek in February 2019, when significant toxicity was observed. Or perhaps treatment-plant operating conditions differed considerably between the two time periods. Since stream discharge in Alkali Creek and descriptions of operating conditions were not included in these reports, we can only speculate about the observed difference in toxicity.

Given what we know about Aethon's discharge, at least until Aethon completes its effluent treatment upgrades under the WDEQ's proposed Compliance Schedule, we can be sure that Aethon's effluent will consistently fail any WET tests. We base this conclusion on mortality predictions for *Ceriodaphnia dubia*, *Daphnia magna*, and Fathead Minnows using Mount et al. (1997) models for major-ion toxicity, with major-ion concentrations that were reported in Table 2 in the first version of the draft renewal permit and in Table 2 in ERM's Blackwater – Alkali Creek: Sediment and Surface Water Sampling Results report. Additionally, the untreated effluent is highly contaminated with roughly 2,200 mg Cl/L plus very high concentrations of organic carbon (68 mg/L on August 20, 2019, as reported in Table 2 in ERM's Blackwater – Alkali Creek: Sediment and Surface Water Sampling Results report), Hydrogen Sulfide and other contaminants; and the Neptune reverse osmosis plant at outfall 001 is inoperable at this time. With regulatory oversight from WDEQ, Aethon should use regular WET tests along with Toxicity Identification procedures to identify other specific contaminants in addition to Chloride, Hydrogen Sulfide and temperature that will need to be controlled during the period of time allowed under WDEQ's proposed Compliance Schedule.

References Cited

Broderius, S.J. and **L.L. Smith, Jr.** 1976. Effect of hydrogen sulfide on fish and invertebrates. Part II – Hydrogen sulfide determination and relationship between pH and sulfide toxicity. EPA-600/3-76-062b. U.S. Environmental Protection Agency, Duluth, Minnesota, USA.

Lofts, S. 2012. User's Guide to WHAM7: Windermere Humic Aqueous Model, Version 7. Centre for Ecology and Hydrology, Natural Environment Research Council, UK.

Mount, D.R., D.D. Gulley, J.R. Hockett, T.D. Garrison and **J.M. Evans.** 1997. Statistical models to predict the toxicity of major ions to *Ceriodaphnia dubia*, *Daphnia magna* and *Pimephales promelas* (fathead minnows). *Environ. Toxicol. Chem.* **16**:2009–2019.

Curriculum Vitae for Bergman and Meyer

Harold L. Bergman
Emeritus Professor of Zoology and Physiology
University of Wyoming
bergman@uwyo.edu • (307) 460-0015

EDUCATION
Eastern Michigan University Biology B.A., 1968
Eastern Michigan University Biology M.S., 1971
Michigan State University Fisheries Biology Ph.D., 1973

PROFESSIONAL POSITIONS
2011-2013 Department Head, Department of Zoology and Physiology, University of Wyoming
1995-2016 J.E. Warren Distinguished Professor of Energy and Environment, University of Wyoming
1998-2008 Director, William D. Ruckelshaus Institute and Helga Otto Haub School of Environment and Natural Resources, University of Wyoming
1988 Visiting Scientist, U.S. Environmental Protection Agency, Duluth, Minnesota
1986-1987 Acting Director, Wyoming Water Research Center, University of Wyoming
1984-2016 Professor, Department of Zoology and Physiology, University of Wyoming (Retired 2016)
1984-1999 Director, Red Buttes Environmental Biology Laboratory, University of Wyoming
1975-1984 Asst. & Assoc. Professor, Dept. of Zoology and Physiology, University of Wyoming

PROFESSIONAL AWARDS AND DISTINCTIONS (Selected)
Founder's Award, Society of Environmental Toxicology and Chemistry, 2018
Distinguished Faculty Graduate Mentor Award, University of Wyoming, 2014
Extraordinary Merit in Advising, Arts & Sciences College, University of Wyoming, 2014
Elected Fellow, American Association for the Advancement of Science, 1995
George Duke Humphrey Distinguished Faculty Award, University of Wyoming, 1995
Conservation Educator of the Year, Wyoming Wildlife Federation, 1986
President of the Society of Environmental Toxicology and Chemistry, 1984-85
President of the Water Quality Section, American Fisheries Society, 1982-83
Editorial Board, Environmental Toxicology and Chemistry, 1981-84
EPA Doctoral Traineeship, Michigan State University, 1971-73

STATE, NATIONAL AND INTERNATIONAL ADVISORY & REVIEW PANELS (Selected)
Wyoming Environmental Quality Council, 1983-95; Chairman, 1985-87
National Research Council - National Academy of Sciences Committees/Board
- Ecological Risk Assessment, 1986-87
- Animals as Monitors of Environmental Hazards, 1987-91
- NRC Board of Agriculture and Natural Resources, 2009-2016

Environmental Protection Agency, ORD, Peer Review Panels/Review Committees
- Exploratory Grants Program, Environmental Biology Panel, 1986-96
- National Acid Precipitation Assessment Program, Aquatic Effects Program, Panel Chair, 1987
- Graduate Fellowship Review Panel, 1995-98, 2009-12
- Environmental Protection Agency, Science Advisory Panel for Pesticides (FIFRA), 1984-87
- Science and Technology Achievement Awards, 1986-87
- Water Quality Standards Research Review, 1986
- Ecological Risk Assessment Research Review, 1986
- Environmental Protection Agency, Board of Scientific Councilors, 1996-97

The Royal Society (London), Surface Water Acidification Program Review Panel, 1990
Private Sector Board and Advisory Positions
- PacifiCorp, Inc., Environmental Forum, Portland, OR, 2000-04
- Wyoming Outdoor Council Board, Lander, WY, 2009-2015; 2017-present

SELECTED RELEVANT PUBLICATIONS (Selected from over 100 publications)

Johnson, E.O., B.D. Cherrington and H.L. Bergman. 201_. Assessment of endocrine disrupting compounds in Wyoming surface waters. Environ. Toxicol. Chem. (In Preparation).

Firkus, T., F.J. Rahel, H.L. Bergman and B.D. Cherrington. 2017. Warmed winter water temperatures alter reproduction in two fish species from the South Platte River, Colorado. Environmental Management 61(4) https://doi.org/10.1007/s00267-017-0954-9.

Pham, D.T., H.M. Nguyen, T.Boivin, A. Zajacova, S.V. Huzurbazar and H.L. Bergman. 2015. Predictors for dioxin accumulation in residents living in Da Nang and Bien Hoa, Vietnam, many years after Agent Orange use. Chemosphere 118:277-283.

Godwin, B.L., S.E. Albeke, H.L. Bergman, A. Walters and M. Ben-David. 2015. Density of river otters (*Lontra canadensis*) in relation to energy development in the Green River Basin, Wyoming. Science of the Total Environment 532: 780-790.

Wood, C.M., H.L. Bergman, A. Bianchini, P. Laurent, J. Maina, O.E. Johannsson, L. Bianchini, C. Chevalier, G.D. Kavembe, M.B. Papah and R.O. Ojoo. 2012. Transepithelial potential in the Magadi tilapia, a fish in extreme alkalinity. J. Comp. Phyiol. B 182: 247-258.

Bergman, H.L. (ed.). 2009. Research and Development Concerning Coalbed Natural Gas. Final Report to the NETL, U.S. Department of Energy, Ruckelshaus Institute of Environment and Natural Resources, University of Wyoming, Laramie, Wyoming. 177pp.

Bergman, H.L., A.M. Boelter, and K.S. Parady (eds.). 2008. Research needs and management strategies for pallid sturgeon recovery. Final Report to the U.S. Army Corp of Engineers, Ruckelshaus Institute of Environment and Natural Resources, University of Wyoming, Laramie, Wyoming. 36pp. + App.

Bergman, H.L. (ed.). 2005. Water Production from Coalbed Methane Development: A Summary of Quantity, Quality and Management Options. Ruckelshaus Institute of Environment and Natural Resources, University of Wyoming, Laramie, Wyoming. 64 pp. + App.

Lease, H.M., J.A. Hansen, H.L. Bergman and J.S. Meyer. 2003. Structural changes in gills of Lost River suckers exposed to elevated pH and ammonia concentrations. Comp. Biochem. Phys. Part C, 134: 491-500.

Bergman, A.N., P. Laurent, G. Otiang'a-Owiti, H.L. Bergman, P.J. Walsh, P.W. Wilson, and C.M. Wood. 2003. Physiological adaptations of the gut in the Lake Magadi tilapia, *Alcolapia grahami*, in an alkaline- and saline-adapted teleost fish. Comp. Biochem. Phys. Part A, 136. 701-715.

DiToro, D.M., H.E. Allen, H.L. Bergman, J.S. Meyer, P.R. Paquin and R.C. Santore. 2001. Biotic ligand model of the acute toxicity of metals. 1. Technical basis. Environ. Toxicol. Chem. 20:2383-2396.

Hansen, J.A., D.F. Woodward, E.E. Little, A.J. DeLonay and H.L. Bergman. 1999. Behavioral avoidance: Possible mechanism for explaining abundance and distribution of trout species in a metals-impacted river. Environ. Toxicol. Chem. 18: 126-130.

MacRae, R.K., D.E. Smith, N. Swoboda-Colberg, J.S. Meyer and H.L. Bergman. 1999. Copper binding affinity of rainbow trout (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*) gills: Implications for assessing bioavailable metal. Environ. Toxicol. Chem. 18:1180-1189.

Bergman, H.L. and E.J. Dorward-King. (eds.). 1997. Reassessment of Metals Criteria for Aquatic Life Protection: Priorities for Research and Implementation. SETAC Press, Pensacola, FL. 114 pp.

Boelter, A.M., F.N. Lamming, A.M. Farag, and H.L. Bergman. 1992. Environmental effects of saline oil-field discharges on surface waters. Environ. Toxicol. Chem. 11:1187-1195.

Gulley, D.D., D.R. Mount, J.R. Hockett and H.L. Bergman. 1992. A statistical model to predict toxicity of saline produced waters to freshwater organisms. pp 89-96 In: J.P. Ray and F.R. Engelhardt (eds.). Produced Water: Technological/Environmental Issues and Solutions. Plenum Press, New York.

Bergman, H.L., R.A. Kimerle and A.W. Maki (eds.). 1986. Environmental Hazard Assessment of Effluents. Pergamon Press, Elmsford, N.Y. 366 pp.

Joseph S. Meyer
Chief Scientist, Applied Limnology Professionals LLC
jsmeyer@ALPsColorado.com • (303) 524-4373

EDUCATION
Lehigh University, Chemical Engineering B.S., 1973
University of Wyoming, Zoology and Physiology Ph.D., 1986

PROFESSIONAL POSITIONS

2016-Present	Chief Scientist, Applied Limnology Professionals LLC, Golden, CO
2012-Present	Affiliated Faculty Member, Department of Chemistry and Geochemistry, Colorado School of Mines, Golden, CO
2007-2016	Technical Expert and Principal Scientist, Arcadis, Lakewood, Colorado
2005-2007	Professor, Department of Zoology and Physiology, University of Wyoming
1999-2005	Associate Professor, Department of Zoology and Physiology, University of Wyoming
1999 2004	Director, Red Buttes Environmental Biology Laboratory, University of Wyoming
1994-1999	Assistant Professor, Department of Zoology and Physiology, University of Wyoming
1991-1993	Coordinator, Wastewater Utilization Graduate Program, Humboldt State University, Arcata, CA
1990-1993	Lecturer, Department of Fisheries, Humboldt State University, Arcata, CA
1989-1990	Postdoctoral Researcher, University of Wyoming-National Park Service Research Center, University of Wyoming
1988-1989	Postdoctoral Researcher, Lake Research Laboratory, Swiss Federal Institute for Water Resources and Water Pollution Control (EAWAG/ETH), Kastanienbaum, Switzerland
1987-1988	NATO Postdoctoral Research Fellow, Lake Research Laboratory, Swiss Federal Institute for Water Resources and Water Pollution Control (EAWAG/ETH), Kastanienbaum, Switzerland
1987	Research Scientist, Department of Zoology and Physiology, University of Wyoming
1986	Graduate Research and Teaching Assistant, Department of Zoology and Physiology, University of Wyoming
1980-1983	Associate Scientist, Western Aquatics, Inc., Laramie, WY [part-time]
1976-1985	Research Scientist, Department of Zoology and Physiology, University of Wyoming
1972	Student Participant, NASA Summer Institute for Biomedical Engineering, Howard University and Goddard Space Flight Center, Greenbelt, MD

PROFESSIONAL AWARDS AND DISTINCTIONS (Selected)
Fellow of Society of Environmental Toxicology and Chemistry, 2018-Present
President of Rocky Mountain Chapter of Society of Environmental Toxicology and Chemistry, 2004-2005
Member of Editorial Board, *Environmental Toxicology and Chemistry*, 1997-2000
Member of Board of Directors of Rocky Mountain Association of Environmental Professionals, 1983-1984

STATE, NATIONAL AND INTERNATIONAL ADVISORY & REVIEW PANELS (Selected)
U.S. Environmental Protection Agency: Member, Aquatic Life Criteria Consultative Panel of the Science Advisory Board of the U.S. Environmental Protection Agency. 2005.
U.S. Environmental Protection Agency: Member, Health and Ecological Effects Subcommittee of the Advisory Council on Clean Air Compliance Analysis of the Science Advisory Board (SAB) of the U.S. Environmental Protection Agency. 1998-2002.
Environment Canada: Member, Environmental Resource Group for the Assessment of Chloramine under the Canadian Environmental Protection Act. 1996-1999.
U.S. Environmental Protection Agency: Member, Advisory Council on Clean Air Compliance Analysis Physical Effects Review Subcommittee of the Science Advisory Board of the U.S. Environmental Protection Agency. 1994-1997.
U.S. Department of Energy: Review of documents addressing damages and benefits of various fuel cycles. 1992-1993.

SELECTED RELEVANT PUBLICATIONS (Selected from 100 publications)

Meyer, J.S. and D.K. DeForest. 2018. Protectiveness of copper water quality criteria against impairment of behavior and chemo/mechanosensory responses: An update. *Environmental Toxicology and Chemistry* 37:1260-1279.

Traudt, E.M., J.F. Ranville and J.S. Meyer. 2017. Acute toxicity of ternary Cd-Cu-Ni and Cd-Ni-Zn mixtures to *Daphnia magna*: Dominant metal pairs change along a concentration gradient. *Environmental Science and Technology* 51:4471-4481.

Müller, B., J.S. Meyer and R. Gächter. 2016. Alkalinity regulation in calcium carbonate-buffered lakes. *Limnology and Oceanography* 61:341-352.

Traudt, E.M., J.F. Ranville, S.A. Smith and J.S. Meyer. 2016. A test of the additivity of acute toxicity of binary-metal mixtures of Ni with Cd, Cu, and Zn to *Daphnia magna*, using the inflection point of the concentration-response curves. *Environmental Toxicology and Chemistry* 35:1843-1851.

Farley, K.J. and J.S. Meyer. 2015. Metal mixtures modeling evaluation: 3. Lessons learned and steps forward. *Environmental Toxicology and Chemistry* 34:821-832.

Farley, K.J., J.S. Meyer, L.S. Balistrieri, Y. Iwasaki, M. Kamo, S. Lofts, C.A. Mebane, W. Naito, A.C. Ryan, R.C. Santore and E. Tipping. 2015. Metal mixtures modeling evaluation: 2. Comparison of four modeling approaches. *Environmental Toxicology and Chemistry* 34:741-753.

Meyer, J.S., K.J. Farley and E.R. Garman. 2015. Metal mixtures modeling evaluation: 1. Technical background. *Environmental Toxicology and Chemistry* 34:726-740.

Meyer, J.S., J.F. Ranville, M. Pontasch, J.W. Gorsuch and W.J. Adams. 2015. Acute toxicity of binary and ternary mixtures of Cd, Cu, and Zn to *Daphnia magna*. *Environmental Toxicology and Chemistry* 34:799-808.

Fulton, B.A. and J.S. Meyer. 2014. Development of a regression model to predict copper toxicity to *Daphnia magna* and site-specific copper criteria across multiple surface-water drainages in an arid landscape. *Environmental Toxicology and Chemistry* 33:1865-1873.

Meyer, J.S. and GG. Pyle. 2013. Effects of anthropogenic chemicals on chemosensation and behavior in fish: Organismal, ecological, and regulatory implications. *Fisheries* 38:283-284.

Meyer, J.S., S.J. Clearwater, T.A. Doser, M.J. Rogaczewski and J.A. Hansen. 2007. *Effects of Water Chemistry on the Bioavailability and Toxicity of Waterborne Cadmium, Copper, Nickel, Lead, and Zinc to Freshwater Organisms*. SETAC Press, Pensacola, Florida, USA.

Meyer, J.S., W.J. Adams, K.V. Brix, S.N. Luoma, D.R. Mount, W.A. Stubblefield and C.M. Wood (eds.). 2005. *Toxicity of Dietborne Metals to Aquatic Organisms*. SETAC Press, Pensacola, Florida, USA.

Meyer, J.S. and J.A. Hansen. 2002. Subchronic toxicity of low dissolved oxygen concentrations, elevated pH, and elevated ammonia concentrations to Lost River suckers. *Transactions of the American Fisheries Society* 131:656-666.

Dare, M.R., W.A. Hubert and J.S. Meyer. 2001. Influence of stream flow on hydrogen sulfide concentrations and distributions of two trout species in a Rocky Mountains tailwater. *North American Journal of Fisheries Management* 21:971-975.

Di Toro, D.M., H.E. Allen, H.L. Bergman, J.S. Meyer, P.R. Paquin and R.C. Santore. 2001. Biotic ligand model of the acute toxicity of metals. 1. Technical basis. *Environmental Toxicology and Chemistry* 20:2383-2396.

Goldstein, J.N., W.A. Hubert, D.F. Woodward, A.M. Farag and J.S. Meyer. 2001. Naturalized salmonid populations occur in the presence of elevated trace element concentrations and temperatures in the Firehole River, Yellowstone National Park, Wyoming. *Environmental Toxicology and Chemistry* 20:2342-2352.

Santore, R.C., D.M. Di Toro, P.R. Paquin, H.E. Allen and J.S. Meyer. 2001. Biotic ligand model of the acute toxicity of metals. 2. Application to acute copper toxicity in freshwater fish and *Daphnia*. *Environmental Toxicology and Chemistry* 20:2397-2402.

Meyer, J.S., D.A. Sanchez, J.A. Brookman, D.B. McWhorter and H.L. Bergman. 1985. Chemistry and aquatic toxicity of raw oil shale leachates from Piceance Basin, Colorado. *Environmental Toxicology and Chemistry* 4:559-572.

Laboratory Analytical Report

Water Quality Division Laboratory

December 30, 2019

208 South College Drive
Cheyenne, WY 82002
Phone: 307-777-7317

Michael Thomas
200 West 17th Street
Cheyenne, WY 82002

Workorder No.: 2019-04-24-001

Project Name.: WATERSHED PROTECTION PRO

Sample ID	Field ID	Collection Date/Time	Submittal Date
AE00490	MJT-19-113-1	4/23/19 09:08	4/24/19
Ordered Tests:	Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total		
AE00491	MJT-19-113-2	4/23/19 10:11	4/24/19
Ordered Tests:	Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total		
AE00492	MJT-19-113-3	4/23/19 10:40	4/24/19
Ordered Tests:	Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total		
AE00493	MJT-19-113-4	4/23/19 11:30	4/24/19
Ordered Tests:	Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total		
AE00494	MJT-19-113-5	4/23/19 12:15	4/24/19

Ordered Tests: Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total

AE00495	MJT-19-113-6	4/23/19	13:29	4/24/19

Ordered Tests: Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total

AE00496	MJT-19-113-7	4/23/19	14:24	4/24/19

Ordered Tests: Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total

AE00497	MJT-19-113-8	4/23/19	14:39	4/24/19

Ordered Tests: Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total

AE00498	MJT-19-113-9	4/23/19	14:53	4/24/19

Ordered Tests: Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total

AE00499	MJT-19-113-10	4/23/19	16:20	4/24/19

Ordered Tests: Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total

AE00500	MJT-19-113-11	4/23/19	16:39	4/24/19

Ordered Tests: Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total

AE00501	MJT-19-113-12	4/23/19	16:56	4/24/19

Ordered Tests: Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total

AE00502	MJT-19-113-13	4/23/19	17:58	4/24/19

Ordered Tests: Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total

AE00503	MJT-19-113-14	4/23/19	17:58	4/24/19

Ordered Tests: Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total

AE00504	MJT-19-113-15	4/23/19	18:56	4/24/19

Ordered Tests: Silver Dissolved, Silver Total, Aluminum Dissolved, Alkalinity, Ammonia (as Nitrogen), Arsenic Dissolved, Arsenic Total, Barium Total, Beryllium Total, Calcium Dissolved, Cadmium Dissolved, Cadmium Total, Chlorides, Chromium Total, Copper Dissolved, Copper Total, Dissolved Organic Carbon Combustion, Iron Dissolved, Iron Total, Fluoride, Hardness, Calculation (as CaCO3), Potassium Dissolved, Magnesium Dissolved, Manganese Dissolved, Sodium Dissolved, Nickel Dissolved, Nickel Total, Nitrate-Nitrite (as Nitrogen), Nitrogen, Wet Digestion, Lead Dissolved, Lead Total, Phosphorus, Total, Antimony Total, Selenium Dissolved, Selenium Total, Sulfates, Total Sulfide (S2-), Total Dissolved Solids, Thallium Total, Uranium Total, Zinc Dissolved, Zinc Total

Report Approved by:  On: 12/17/2019

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client:	WATERSHED_SWM	Report Date:	12/30/2019
Project:	WATERSHED PROTECTION PRO	Collection Date:	04/23/2019 09:08
Lab ID:	AE00490	Date Received:	4/24/19
Field ID:	MJT-19-113-1	Matrix:	WATER
Field Location:	BADWATER CREEK - SITE 1		

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	362	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	1544	mg/L		10	SM2540 C	04/24/2019 16:17	MLATADY
Chlorides	183	mg/L		10	EPA300.0 R2.1	04/26/2019 17:22	JOHANNAHMAY
Sulfates	548	mg/L		20	EPA300.0 R2.1	04/26/2019 17:22	JOHANNAHMAY
Calcium Dissolved	86	mg/L		1	EPA 200.7	06/18/2019 16:40	MLATADY
Magnesium Dissolved	36	mg/L		1	EPA 200.7	06/18/2019 16:40	MLATADY
Potassium Dissolved	12	mg/L		1	EPA 200.7	06/18/2019 16:40	MLATADY
Sodium Dissolved	426	mg/L		1	EPA 200.7	06/18/2019 16:40	MLATADY
Aluminum Dissolved	1520	ug/L		50	EPA 200.8	06/07/2019 17:01	MLATADY
Antimony Total	<11	ug/L		11	EPA 200.8	07/03/2019 15:57	MLATADY
Arsenic Dissolved	3	ug/L		1	EPA 200.8	06/07/2019 17:01	MLATADY
Arsenic Total	<11	ug/L		11	EPA 200.8	07/03/2019 15:57	MLATADY
Barium Total	<110	ug/L		110	EPA 200.8	07/03/2019 15:57	MLATADY
Beryllium Total	<11	ug/L		11	EPA 200.8	07/03/2019 15:57	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 17:01	MLATADY
Cadmium Total	1.8	ug/L		1.1	EPA 200.8	07/03/2019 15:57	MLATADY
Chromium Total	<55	ug/L		55	EPA 200.8	07/03/2019 15:57	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 17:01	MLATADY
Copper Total	<55	ug/L		55	EPA 200.8	07/03/2019 15:57	MLATADY
Iron Dissolved	2190	ug/L		50	EPA 200.7/200.8	06/07/2019 17:01	MLATADY
Iron Total	2709	ug/L		55	EPA 200.7/200.8	07/03/2019 15:57	MLATADY
Lead Dissolved	3	ug/L		1	EPA 200.8	06/07/2019 17:01	MLATADY
Lead Total	28	ug/L		11	EPA 200.8	07/03/2019 15:57	MLATADY
Manganese Dissolved	76	ug/L		1	EPA 200.8	06/07/2019 17:01	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:01	MLATADY
Nickel Total	<110	ug/L		110	EPA 200.8	07/03/2019 15:57	MLATADY
Selenium Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:01	MLATADY
Selenium Total	<11	ug/L		11	EPA 200.8	07/03/2019 15:57	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 17:01	MLATADY
Silver Total	<5.5	ug/L		5.5	EPA 200.8	07/03/2019 15:57	MLATADY
Thallium Total	<11	ug/L		11	EPA 200.8	07/03/2019 15:57	MLATADY
Uranium Total	13	ug/L		5.5	EPA 200.8	07/03/2019 15:57	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:01	MLATADY
Zinc Total	<110	ug/L		110	EPA 200.8	07/03/2019 15:57	MLATADY
Ammonia (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	NR	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	0.32	mg/L		0.1	SM4500-N B-2011	05/06/2019 11:06	JOHANNAHMAY
Phosphorus, Total	2.56	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	6.310	mg/L		1	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	347	mg/L		10	SM 2320-B-2011	04/30/2019 13:30	MLATADY
Fluoride	0.6	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	NR	mg/L		0.05	SM4500-S2-D	04/29/2019 13:15	MLATADY

Sample Comment: Ammonia: Results for this login batch were originally reported as "NR" due to unkown matrix interference. Results biased low. Nitrate-Nitrite: No data could be collected due to significant matrix interference for all samples marked "NR". 12/04/2019 JM. Sulfide: samples with high turbidity were analyzed using the titrimetric method by MKL. For both titrimetric and regular analysis many samples exibited unknown matrix interference and were NR. 04/26/2019 JM.
The "NR" comments here cover all applicable samples on this report. SVien 8-22-2019

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client:	WATERSHED_SWM	Report Date:	12/30/2019
Project:	WATERSHED PROTECTION PRO	Collection Date:	04/23/2019 10:11
Lab ID:	AE00491	Date Received:	4/24/19
Field ID:	MJT-19-113-2	Matrix:	WATER
Field Location:	BADWATER CREEK - SITE 2		

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	403	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	1616	mg/L		10	SM2540 C	04/24/2019 16:17	MLATADY
Chlorides	219	mg/L		10	EPA300.0 R2.1	04/26/2019 17:39	JOHANNAHMAY
Sulfates	582	mg/L		20	EPA300.0 R2.1	04/26/2019 17:39	JOHANNAHMAY
Calcium Dissolved	96	mg/L		1	EPA 200.7	06/18/2019 16:45	MLATADY
Magnesium Dissolved	40	mg/L		1	EPA 200.7	06/18/2019 16:45	MLATADY
Potassium Dissolved	12	mg/L		1	EPA 200.7	06/18/2019 16:45	MLATADY
Sodium Dissolved	426	mg/L		1	EPA 200.7	06/18/2019 16:45	MLATADY
Aluminum Dissolved	457	ug/L		50	EPA 200.8	06/07/2019 17:13	MLATADY
Antimony Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:06	MLATADY
Arsenic Dissolved	3	ug/L		1	EPA 200.8	06/07/2019 17:13	MLATADY
Arsenic Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:06	MLATADY
Barium Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:06	MLATADY
Beryllium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:06	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 17:13	MLATADY
Cadmium Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:06	MLATADY
Chromium Total	<55	ug/L		55	EPA 200.8	07/03/2019 16:06	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 17:13	MLATADY
Copper Total	<55	ug/L		55	EPA 200.8	07/03/2019 16:06	MLATADY
Iron Dissolved	602	ug/L		50	EPA 200.7/200.8	06/07/2019 17:13	MLATADY
Iron Total	4676	ug/L		55	EPA 200.7/200.8	07/03/2019 16:06	MLATADY
Lead Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:13	MLATADY
Lead Total	23	ug/L		11	EPA 200.8	07/03/2019 16:06	MLATADY
Manganese Dissolved	55	ug/L		1	EPA 200.8	06/07/2019 17:13	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:13	MLATADY
Nickel Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:06	MLATADY
Selenium Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:13	MLATADY
Selenium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:06	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 17:13	MLATADY
Silver Total	<5.5	ug/L		5.5	EPA 200.8	07/03/2019 16:06	MLATADY
Thallium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:06	MLATADY
Uranium Total	12	ug/L		5.5	EPA 200.8	07/03/2019 16:06	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:13	MLATADY
Zinc Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:06	MLATADY
Ammonia (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	NR	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	0.32	mg/L		0.1	SM4500-N B-2011	05/06/2019 10:52	JOHANNAHMAY
Phosphorus, Total	1.76	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	6.793	mg/L		1	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	383	mg/L		10	SM 2320-B-2011	04/30/2019 13:30	MLATADY
Fluoride	0.6	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	NR	mg/L		0.05	SM4500-S2-D	04/29/2019 13:15	MLATADY

Sample Comment: Ammonia: Spike recovery below acceptance limits. Results for this batch are NR. 12/04/2019 JM.

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client:	WATERSHED_SWM	Report Date:	12/30/2019
Project:	WATERSHED PROTECTION PRO	Collection Date:	04/23/2019 10:40
Lab ID:	AE00492	Date Received:	4/24/19
Field ID:	MJT-19-113-3	Matrix:	WATER
Field Location:	FIELD BLANK		

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	<10	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	<10	mg/L		10	SM2540 C	04/24/2019 16:17	MLATADY
Chlorides	<1	mg/L		1	EPA300.0 R2.1	04/26/2019 17:56	JOHANNAHMAY
Sulfates	<2	mg/L		2	EPA300.0 R2.1	04/26/2019 17:56	JOHANNAHMAY
Calcium Dissolved	<1	mg/L		1	EPA 200.7	06/18/2019 16:35	MLATADY
Magnesium Dissolved	<1	mg/L		1	EPA 200.7	06/18/2019 16:35	MLATADY
Potassium Dissolved	<1	mg/L		1	EPA 200.7	06/18/2019 16:35	MLATADY
Sodium Dissolved	<1	mg/L		1	EPA 200.7	06/18/2019 16:35	MLATADY
Aluminum Dissolved	<50	ug/L		50	EPA 200.8	06/07/2019 17:18	MLATADY
Antimony Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:10	MLATADY
Arsenic Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:18	MLATADY
Arsenic Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:10	MLATADY
Barium Total	<10	ug/L		10	EPA 200.8	07/03/2019 16:10	MLATADY
Beryllium Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:10	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 17:18	MLATADY
Cadmium Total	<0.1	ug/L		0.1	EPA 200.8	07/03/2019 16:10	MLATADY
Chromium Total	<5	ug/L		5	EPA 200.8	07/03/2019 16:10	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 17:18	MLATADY
Copper Total	<5	ug/L		5	EPA 200.8	07/03/2019 16:10	MLATADY
Iron Dissolved	<50	ug/L		50	EPA 200.7/200.8	06/07/2019 17:18	MLATADY
Iron Total	<50	ug/L		50	EPA 200.7/200.8	07/03/2019 16:10	MLATADY
Lead Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:18	MLATADY
Lead Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:10	MLATADY
Manganese Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:18	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:18	MLATADY
Nickel Total	<10	ug/L		10	EPA 200.8	07/03/2019 16:10	MLATADY
Selenium Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:18	MLATADY
Selenium Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:10	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 17:18	MLATADY
Silver Total	<0.5	ug/L		0.5	EPA 200.8	07/03/2019 16:10	MLATADY
Thallium Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:10	MLATADY
Uranium Total	<0.5	ug/L		0.5	EPA 200.8	07/03/2019 16:10	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:18	MLATADY
Zinc Total	<10	ug/L		10	EPA 200.8	07/03/2019 16:10	MLATADY
Ammonia (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	NR	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	<0.1	mg/L		0.1	SM4500-N B-2011	05/06/2019 10:53	JOHANNAHMAY
Phosphorus, Total	<0.01	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	1.220	mg/L		1	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	<10	mg/L		10	SM 2320-B-2011	04/30/2019 13:30	MLATADY
Fluoride	<0.1	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	<0.05	mg/L		0.05	SM4500-S2-D	04/26/2019 13:30	JOHANNAHMAY

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client:	WATERSHED_SWM	Report Date:	12/30/2019
Project:	WATERSHED PROTECTION PRO	Collection Date:	04/23/2019 11:30
Lab ID:	AE00493	Date Received:	4/24/19
Field ID:	MJT-19-113-4	Matrix:	WATER
Field Location:	BADWATER CREEK - SITE 3		

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	399	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	1644	mg/L		10	SM2540 C	04/24/2019 16:17	MLATADY
Chlorides	210	mg/L		10	EPA300.0 R2.1	04/26/2019 18:14	JOHANNAHMAY
Sulfates	594	mg/L		20	EPA300.0 R2.1	04/26/2019 18:14	JOHANNAHMAY
Calcium Dissolved	94	mg/L		1	EPA 200.7	06/18/2019 16:48	MLATADY
Magnesium Dissolved	41	mg/L		1	EPA 200.7	06/18/2019 16:48	MLATADY
Potassium Dissolved	11	mg/L		1	EPA 200.7	06/18/2019 16:48	MLATADY
Sodium Dissolved	443	mg/L		1	EPA 200.7	06/18/2019 16:48	MLATADY
Aluminum Dissolved	<50	ug/L		50	EPA 200.8	06/07/2019 17:22	MLATADY
Antimony Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:18	MLATADY
Arsenic Dissolved	3	ug/L		1	EPA 200.8	06/07/2019 17:22	MLATADY
Arsenic Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:18	MLATADY
Barium Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:18	MLATADY
Beryllium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:18	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 17:22	MLATADY
Cadmium Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:18	MLATADY
Chromium Total	<55	ug/L		55	EPA 200.8	07/03/2019 16:18	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 17:22	MLATADY
Copper Total	<55	ug/L		55	EPA 200.8	07/03/2019 16:18	MLATADY
Iron Dissolved	<50	ug/L		50	EPA 200.7/200.8	06/07/2019 17:22	MLATADY
Iron Total	6609	ug/L		550	EPA 200.7/200.8	07/03/2019 16:18	MLATADY
Lead Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:22	MLATADY
Lead Total	16	ug/L		11	EPA 200.8	07/03/2019 16:18	MLATADY
Manganese Dissolved	60	ug/L		1	EPA 200.8	06/07/2019 17:22	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:22	MLATADY
Nickel Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:18	MLATADY
Selenium Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:22	MLATADY
Selenium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:18	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 17:22	MLATADY
Silver Total	<5.5	ug/L		5.5	EPA 200.8	07/03/2019 16:18	MLATADY
Thallium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:18	MLATADY
Uranium Total	11	ug/L		5.5	EPA 200.8	07/03/2019 16:18	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:22	MLATADY
Zinc Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:18	MLATADY
Ammonia (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	NR	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	0.26	mg/L		0.1	SM4500-N B-2011	05/06/2019 10:54	JOHANNAHMAY
Phosphorus, Total	1.14	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	5.783	mg/L		1	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	388	mg/L		10	SM 2320-B-2011	04/30/2019 13:30	MLATADY
Fluoride	0.7	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	NR	mg/L		0.05	SM4500-S2-D	04/29/2019 13:15	MLATADY

Sample Comment: THE HARDNESS CALCULATION IS BASED ON RAW DATA THAT IS THEN ROUNDED AFTER THE CALCULATION IS COMPLETED. THIS METHOD YIELDS A MORE ACCUREATE MEASUREMENT.MKL

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client:	WATERSHED_SWM	Report Date:	12/30/2019
Project:	WATERSHED PROTECTION PRO	Collection Date:	04/23/2019 12:15
Lab ID:	AE00494	Date Received:	4/24/19
Field ID:	MJT-19-113-5	Matrix:	WATER
Field Location:	DRY CREEK - SITE 4		

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	384	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	632	mg/L		10	SM2540 C	04/24/2019 16:17	MLATADY
Chlorides	6	mg/L		1	EPA300.0 R2.1	04/26/2019 18:31	JOHANNAHMAY
Sulfates	292	mg/L		20	EPA300.0 R2.1	04/26/2019 18:31	JOHANNAHMAY
Calcium Dissolved	124	mg/L		1	EPA 200.7	06/18/2019 16:55	MLATADY
Magnesium Dissolved	18	mg/L		1	EPA 200.7	06/18/2019 16:55	MLATADY
Potassium Dissolved	3	mg/L		1	EPA 200.7	06/18/2019 16:55	MLATADY
Sodium Dissolved	54	mg/L		1	EPA 200.7	06/18/2019 16:55	MLATADY
Aluminum Dissolved	<50	ug/L		50	EPA 200.8	06/07/2019 17:26	MLATADY
Antimony Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:27	MLATADY
Arsenic Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:26	MLATADY
Arsenic Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:27	MLATADY
Barium Total	64	ug/L		10	EPA 200.8	07/03/2019 16:27	MLATADY
Beryllium Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:27	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 17:26	MLATADY
Cadmium Total	<0.1	ug/L		0.1	EPA 200.8	07/03/2019 16:27	MLATADY
Chromium Total	<5	ug/L		5	EPA 200.8	07/03/2019 16:27	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 17:26	MLATADY
Copper Total	<5	ug/L		5	EPA 200.8	07/03/2019 16:27	MLATADY
Iron Dissolved	<50	ug/L		50	EPA 200.7/200.8	06/07/2019 17:26	MLATADY
Iron Total	391	ug/L		50	EPA 200.7/200.8	07/03/2019 16:27	MLATADY
Lead Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:26	MLATADY
Lead Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:27	MLATADY
Manganese Dissolved	24	ug/L		1	EPA 200.8	06/07/2019 17:26	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:26	MLATADY
Nickel Total	<10	ug/L		10	EPA 200.8	07/03/2019 16:27	MLATADY
Selenium Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:26	MLATADY
Selenium Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:27	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 17:26	MLATADY
Silver Total	<0.5	ug/L		0.5	EPA 200.8	07/03/2019 16:27	MLATADY
Thallium Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:27	MLATADY
Uranium Total	17	ug/L		0.5	EPA 200.8	07/03/2019 16:27	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:26	MLATADY
Zinc Total	<10	ug/L		10	EPA 200.8	07/03/2019 16:27	MLATADY
Ammonia (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	0.19	mg/L		0.1	SM4500-N B-2011	05/06/2019 10:55	JOHANNAHMAY
Phosphorus, Total	0.02	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	2.524	mg/L		1	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	215	mg/L		10	SM 2320-B-2011	04/30/2019 13:30	MLATADY
Fluoride	0.5	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	0.050	mg/L		0.05	SM4500-S2-D	04/26/2019 13:30	JOHANNAHMAY

Sample Comment: Sulfide: Originally spiked this sample, but matrix interference caused approx. 40% spike recovery. 04/26/2019 JM.

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client: WATERSHED_SWM
Project: WATERSHED PROTECTION PRO
Lab ID: AE00495
Field ID: MJT-19-113-6
Field Location: BADWATER CREEK - SITE 5

Report Date: 12/30/2019
Collection Date: 04/23/2019 13:29
Date Received: 4/24/19
Matrix: WATER

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	422	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	1624	mg/L		10	SM2540 C	04/24/2019 16:17	MLATADY
Chlorides	234	mg/L		10	EPA300.0 R2.1	04/26/2019 18:48	JOHANNAHMAY
Sulfates	547	mg/L		20	EPA300.0 R2.1	04/26/2019 18:48	JOHANNAHMAY
Calcium Dissolved	97	mg/L		1	EPA 200.7	06/18/2019 16:58	MLATADY
Magnesium Dissolved	44	mg/L		1	EPA 200.7	06/18/2019 16:58	MLATADY
Potassium Dissolved	11	mg/L		1	EPA 200.7	06/18/2019 16:58	MLATADY
Sodium Dissolved	428	mg/L		1	EPA 200.7	06/18/2019 16:58	MLATADY
Aluminum Dissolved	<50	ug/L		50	EPA 200.8	06/07/2019 17:30	MLATADY
Antimony Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:35	MLATADY
Arsenic Dissolved	4	ug/L		1	EPA 200.8	06/07/2019 17:30	MLATADY
Arsenic Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:35	MLATADY
Barium Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:35	MLATADY
Beryllium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:35	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 17:30	MLATADY
Cadmium Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:35	MLATADY
Chromium Total	<55	ug/L		55	EPA 200.8	07/03/2019 16:35	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 17:30	MLATADY
Copper Total	<55	ug/L		55	EPA 200.8	07/03/2019 16:35	MLATADY
Iron Dissolved	<50	ug/L		50	EPA 200.7/200.8	06/07/2019 17:30	MLATADY
Iron Total	3829	ug/L		550	EPA 200.7/200.8	07/03/2019 16:35	MLATADY
Lead Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:30	MLATADY
Lead Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:35	MLATADY
Manganese Dissolved	75	ug/L		1	EPA 200.8	06/07/2019 17:30	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:30	MLATADY
Nickel Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:35	MLATADY
Selenium Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:30	MLATADY
Selenium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:35	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 17:30	MLATADY
Silver Total	<5.5	ug/L		5.5	EPA 200.8	07/03/2019 16:35	MLATADY
Thallium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:35	MLATADY
Uranium Total	8	ug/L		5.5	EPA 200.8	07/03/2019 16:35	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:30	MLATADY
Zinc Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:35	MLATADY
Ammonia (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	NR	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	0.31	mg/L		0.1	SM4500-N B-2011	05/06/2019 10:57	JOHANNAHMAY
Phosphorus, Total	0.80	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	8.765	mg/L		1	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	417	mg/L		10	SM 2320-B-2011	04/30/2019 13:30	MLATADY
Fluoride	0.6	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	NR	mg/L		0.05	SM4500-S2-D	04/29/2019 13:15	MLATADY

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client:	WATERSHED_SWM	Report Date:	12/30/2019
Project:	WATERSHED PROTECTION PRO	Collection Date:	04/23/2019 14:24
Lab ID:	AE00496	Date Received:	4/24/19
Field ID:	MJT-19-113-7	Matrix:	WATER
Field Location:	BADWATER CREEK - SITE 6		

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	382	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	1644	mg/L		10	SM2540 C	04/24/2019 16:17	MLATADY
Chlorides	249	mg/L		10	EPA300.0 R2.1	04/26/2019 19:06	JOHANNAHMAY
Sulfates	520	mg/L		20	EPA300.0 R2.1	04/26/2019 19:06	JOHANNAHMAY
Calcium Dissolved	84	mg/L		1	EPA 200.7	06/18/2019 17:03	MLATADY
Magnesium Dissolved	42	mg/L		1	EPA 200.7	06/18/2019 17:03	MLATADY
Potassium Dissolved	12	mg/L		1	EPA 200.7	06/18/2019 17:03	MLATADY
Sodium Dissolved	484	mg/L		1	EPA 200.7	06/18/2019 17:03	MLATADY
Aluminum Dissolved	<50	ug/L		50	EPA 200.8	06/07/2019 17:35	MLATADY
Antimony Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:44	MLATADY
Arsenic Dissolved	4	ug/L		1	EPA 200.8	06/07/2019 17:35	MLATADY
Arsenic Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:44	MLATADY
Barium Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:44	MLATADY
Beryllium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:44	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 17:35	MLATADY
Cadmium Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:44	MLATADY
Chromium Total	<55	ug/L		55	EPA 200.8	07/03/2019 16:44	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 17:35	MLATADY
Copper Total	<55	ug/L		55	EPA 200.8	07/03/2019 16:44	MLATADY
Iron Dissolved	<50	ug/L		50	EPA 200.7/200.8	06/07/2019 17:35	MLATADY
Iron Total	7499	ug/L		550	EPA 200.7/200.8	07/03/2019 16:44	MLATADY
Lead Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:35	MLATADY
Lead Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:44	MLATADY
Manganese Dissolved	28	ug/L		1	EPA 200.8	06/07/2019 17:35	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:35	MLATADY
Nickel Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:44	MLATADY
Selenium Dissolved	1	ug/L		1	EPA 200.8	06/07/2019 17:35	MLATADY
Selenium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:44	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 17:35	MLATADY
Silver Total	<5.5	ug/L		5.5	EPA 200.8	07/03/2019 16:44	MLATADY
Thallium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:44	MLATADY
Uranium Total	9	ug/L		5.5	EPA 200.8	07/03/2019 16:44	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:35	MLATADY
Zinc Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:44	MLATADY
Ammonia (as Nitrogen)	0.10	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	NR	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	0.50	mg/L		0.1	SM4500-N B-2011	05/06/2019 10:58	JOHANNAHMAY
Phosphorus, Total	0.71	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	10.570	mg/L		1	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	429	mg/L		10	SM 2320-B-2011	04/30/2019 13:30	MLATADY
Fluoride	0.7	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	NR	mg/L		0.05	SM4500-S2-D	04/29/2019 13:15	MLATADY

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client:	WATERSHED_SWM	Report Date:	12/30/2019
Project:	WATERSHED PROTECTION PRO	Collection Date:	04/23/2019 14:39
Lab ID:	AE00497	Date Received:	4/24/19
Field ID:	MJT-19-113-8	Matrix:	WATER
Field Location:	BRIDGER CREEK - SITE 7		

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	396	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	476	mg/L		10	SM2540 C	04/24/2019 16:17	MLATADY
Chlorides	5	mg/L		1	EPA300.0 R2.1	05/01/2019 16:56	JOHANNAHMAY
Sulfates	255	mg/L		1	EPA300.0 R2.1	05/01/2019 16:56	JOHANNAHMAY
Calcium Dissolved	93	mg/L		1	EPA 200.7	06/18/2019 17:44	MLATADY
Magnesium Dissolved	40	mg/L		1	EPA 200.7	06/18/2019 17:44	MLATADY
Potassium Dissolved	4	mg/L		1	EPA 200.7	06/18/2019 17:44	MLATADY
Sodium Dissolved	60	mg/L		1	EPA 200.7	06/18/2019 17:44	MLATADY
Aluminum Dissolved	<50	ug/L		50	EPA 200.8	06/07/2019 17:39	MLATADY
Antimony Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:52	MLATADY
Arsenic Dissolved	2	ug/L		1	EPA 200.8	06/07/2019 17:39	MLATADY
Arsenic Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:52	MLATADY
Barium Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:52	MLATADY
Beryllium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:52	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 17:39	MLATADY
Cadmium Total	<1	ug/L		1	EPA 200.8	07/03/2019 16:52	MLATADY
Chromium Total	<55	ug/L		55	EPA 200.8	07/03/2019 16:52	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 17:39	MLATADY
Copper Total	<55	ug/L		55	EPA 200.8	07/03/2019 16:52	MLATADY
Iron Dissolved	<50	ug/L		50	EPA 200.7/200.8	06/07/2019 17:39	MLATADY
Iron Total	6129	ug/L		550	EPA 200.7/200.8	07/03/2019 16:52	MLATADY
Lead Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:39	MLATADY
Lead Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:52	MLATADY
Manganese Dissolved	14	ug/L		1	EPA 200.8	06/07/2019 17:39	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:39	MLATADY
Nickel Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:52	MLATADY
Selenium Dissolved	1	ug/L		1	EPA 200.8	06/07/2019 17:39	MLATADY
Selenium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:52	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 17:39	MLATADY
Silver Total	<5.5	ug/L		5.5	EPA 200.8	07/03/2019 16:52	MLATADY
Thallium Total	<11	ug/L		11	EPA 200.8	07/03/2019 16:52	MLATADY
Uranium Total	6	ug/L		5.5	EPA 200.8	07/03/2019 16:52	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:39	MLATADY
Zinc Total	<110	ug/L		110	EPA 200.8	07/03/2019 16:52	MLATADY
Ammonia (as Nitrogen)	0.41	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	NR	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	1.0	mg/L		0.1	SM4500-N B-2011	05/06/2019 10:59	JOHANNAHMAY
Phosphorus, Total	0.49	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	3.856	mg/L		1	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	215	mg/L		10	SM 2320-B-2011	04/30/2019 13:30	MLATADY
Fluoride	0.5	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	NR	mg/L		0.05	SM4500-S2-D	04/29/2019 13:15	MLATADY

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client:	WATERSHED_SWM	Report Date:	12/30/2019
Project:	WATERSHED PROTECTION PRO	Collection Date:	04/23/2019 14:53
Lab ID:	AE00498	Date Received:	4/24/19
Field ID:	MJT-19-113-9	Matrix:	WATER
Field Location:	BADWATER CREEK - SITE 8		

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	430	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	4544	mg/L		10	SM2540 C	04/25/2019 11:37	MLATADY
Chlorides	929	mg/L		20	EPA300.0 R2.1	05/01/2019 18:05	JOHANNAHMAY
Sulfates	1187	mg/L		50	EPA300.0 R2.1	05/01/2019 18:05	JOHANNAHMAY
Calcium Dissolved	80	mg/L		10	EPA 200.7	06/18/2019 17:49	MLATADY
Magnesium Dissolved	56	mg/L		10	EPA 200.7	06/18/2019 17:49	MLATADY
Potassium Dissolved	22	mg/L		10	EPA 200.7	06/18/2019 17:49	MLATADY
Sodium Dissolved	1705	mg/L		10	EPA 200.7	06/18/2019 17:49	MLATADY
Aluminum Dissolved	247	ug/L		50	EPA 200.8	06/07/2019 17:47	MLATADY
Antimony Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:09	MLATADY
Arsenic Dissolved	10	ug/L		1	EPA 200.8	06/07/2019 17:47	MLATADY
Arsenic Total	11	ug/L		11	EPA 200.8	07/03/2019 17:09	MLATADY
Barium Total	<110	ug/L		110	EPA 200.8	07/03/2019 17:09	MLATADY
Beryllium Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:09	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 17:47	MLATADY
Cadmium Total	<1	ug/L		1	EPA 200.8	07/03/2019 17:09	MLATADY
Chromium Total	<55	ug/L		55	EPA 200.8	07/03/2019 17:09	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 17:47	MLATADY
Copper Total	<55	ug/L		55	EPA 200.8	07/03/2019 17:09	MLATADY
Iron Dissolved	289	ug/L		50	EPA 200.7/200.8	06/07/2019 17:47	MLATADY
Iron Total	7193	ug/L		550	EPA 200.7/200.8	07/03/2019 17:09	MLATADY
Lead Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:47	MLATADY
Lead Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:09	MLATADY
Manganese Dissolved	49	ug/L		1	EPA 200.8	06/07/2019 17:47	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:47	MLATADY
Nickel Total	<110	ug/L		110	EPA 200.8	07/03/2019 17:09	MLATADY
Selenium Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:47	MLATADY
Selenium Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:09	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 17:47	MLATADY
Silver Total	<5.5	ug/L		5.5	EPA 200.8	07/03/2019 17:09	MLATADY
Thallium Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:09	MLATADY
Uranium Total	14	ug/L		5.5	EPA 200.8	07/03/2019 17:09	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:47	MLATADY
Zinc Total	<110	ug/L		110	EPA 200.8	07/03/2019 17:09	MLATADY
Ammonia (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	NR	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	0.41	mg/L		0.1	SM4500-N B-2011	05/06/2019 11:01	JOHANNAHMAY
Phosphorus, Total	0.66	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	12.432	mg/L		2.00	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	972	mg/L		10	SM 2320-B-2011	05/01/2019 13:00	MLATADY
Fluoride	1.2	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	NR	mg/L		0.05	SM4500-S2-D	04/29/2019 13:15	MLATADY

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client:	WATERSHED_SWM	Report Date:	12/30/2019
Project:	WATERSHED PROTECTION PRO	Collection Date:	04/23/2019 16:20
Lab ID:	AE00499	Date Received:	4/24/19
Field ID:	MJT-19-113-10	Matrix:	WATER
Field Location:	BADWATER CREEK - SITE 9		

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	349	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	4824	mg/L		10	SM2540 C	04/25/2019 11:37	MLATADY
Chlorides	1066	mg/L		20	EPA300.0 R2.1	05/01/2019 18:23	JOHANNAHMAY
Sulfates	1103	mg/L		50	EPA300.0 R2.1	05/01/2019 18:23	JOHANNAHMAY
Calcium Dissolved	64	mg/L		10	EPA 200.7	06/18/2019 17:57	MLATADY
Magnesium Dissolved	46	mg/L		10	EPA 200.7	06/18/2019 17:57	MLATADY
Potassium Dissolved	24	mg/L		10	EPA 200.7	06/18/2019 17:57	MLATADY
Sodium Dissolved	1775	mg/L		10	EPA 200.7	06/18/2019 17:57	MLATADY
Aluminum Dissolved	<50	ug/L		50	EPA 200.8	06/07/2019 17:51	MLATADY
Antimony Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:18	MLATADY
Arsenic Dissolved	10	ug/L		1	EPA 200.8	06/07/2019 17:51	MLATADY
Arsenic Total	12	ug/L		11	EPA 200.8	07/03/2019 17:18	MLATADY
Barium Total	<110	ug/L		110	EPA 200.8	07/03/2019 17:18	MLATADY
Beryllium Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:18	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 17:51	MLATADY
Cadmium Total	<1	ug/L		1	EPA 200.8	07/03/2019 17:18	MLATADY
Chromium Total	<55	ug/L		55	EPA 200.8	07/03/2019 17:18	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 17:51	MLATADY
Copper Total	<55	ug/L		55	EPA 200.8	07/03/2019 17:18	MLATADY
Iron Dissolved	<50	ug/L		50	EPA 200.7/200.8	06/07/2019 17:51	MLATADY
Iron Total	7880	ug/L		550	EPA 200.7/200.8	07/03/2019 17:18	MLATADY
Lead Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:51	MLATADY
Lead Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:18	MLATADY
Manganese Dissolved	32	ug/L		1	EPA 200.8	06/07/2019 17:51	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:51	MLATADY
Nickel Total	<110	ug/L		110	EPA 200.8	07/03/2019 17:18	MLATADY
Selenium Dissolved	1	ug/L		1	EPA 200.8	06/07/2019 17:51	MLATADY
Selenium Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:18	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 17:51	MLATADY
Silver Total	<5.5	ug/L		5.5	EPA 200.8	07/03/2019 17:18	MLATADY
Thallium Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:18	MLATADY
Uranium Total	14	ug/L		5.5	EPA 200.8	07/03/2019 17:18	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:51	MLATADY
Zinc Total	<110	ug/L		110	EPA 200.8	07/03/2019 17:18	MLATADY
Ammonia (as Nitrogen)	0.75	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	NR	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	1.6	mg/L		0.1	SM4500-N B-2011	05/06/2019 11:08	JOHANNAHMAY
Phosphorus, Total	0.32	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	15.326	mg/L		2.00	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	1108	mg/L		10	SM 2320-B-2011	05/01/2019 13:00	MLATADY
Fluoride	1.4	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	NR	mg/L		0.05	SM4500-S2-D	04/29/2019 13:15	MLATADY

Sample Comment: Ammonia: Spike recovery below acceptance limits. Results for this batch are NR. 12/04/2019 JM.

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client:	WATERSHED_SWM	Report Date:	12/30/2019
Project:	WATERSHED PROTECTION PRO	Collection Date:	04/23/2019 16:39
Lab ID:	AE00500	Date Received:	4/24/19
Field ID:	MJT-19-113-11	Matrix:	WATER
Field Location:	ALKALI CREEK - SITE 10		

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	273	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	5568	mg/L		10	SM2540 C	04/25/2019 11:37	MLATADY
Chlorides	1318	mg/L		20	EPA300.0 R2.1	05/01/2019 18:40	JOHANNAHMAY
Sulfates	1140	mg/L		50	EPA300.0 R2.1	05/01/2019 18:40	JOHANNAHMAY
Calcium Dissolved	45	mg/L		10	EPA 200.7	06/18/2019 17:59	MLATADY
Magnesium Dissolved	39	mg/L		10	EPA 200.7	06/18/2019 17:59	MLATADY
Potassium Dissolved	28	mg/L		10	EPA 200.7	06/18/2019 17:59	MLATADY
Sodium Dissolved	2170	mg/L		10	EPA 200.7	06/18/2019 17:59	MLATADY
Aluminum Dissolved	<50	ug/L		50	EPA 200.8	06/07/2019 17:55	MLATADY
Antimony Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:26	MLATADY
Arsenic Dissolved	11	ug/L		1	EPA 200.8	06/07/2019 17:55	MLATADY
Arsenic Total	13	ug/L		11	EPA 200.8	07/03/2019 17:26	MLATADY
Barium Total	<110	ug/L		110	EPA 200.8	07/03/2019 17:26	MLATADY
Beryllium Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:26	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 17:55	MLATADY
Cadmium Total	<1	ug/L		1	EPA 200.8	07/03/2019 17:26	MLATADY
Chromium Total	<55	ug/L		55	EPA 200.8	07/03/2019 17:26	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 17:55	MLATADY
Copper Total	<55	ug/L		55	EPA 200.8	07/03/2019 17:26	MLATADY
Iron Dissolved	<50	ug/L		50	EPA 200.7/200.8	06/07/2019 17:55	MLATADY
Iron Total	7339	ug/L		550	EPA 200.7/200.8	07/03/2019 17:26	MLATADY
Lead Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 17:55	MLATADY
Lead Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:26	MLATADY
Manganese Dissolved	17	ug/L		1	EPA 200.8	06/07/2019 17:55	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:55	MLATADY
Nickel Total	<110	ug/L		110	EPA 200.8	07/03/2019 17:26	MLATADY
Selenium Dissolved	1	ug/L		1	EPA 200.8	06/07/2019 17:55	MLATADY
Selenium Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:26	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 17:55	MLATADY
Silver Total	<5.5	ug/L		5.5	EPA 200.8	07/03/2019 17:26	MLATADY
Thallium Total	<11	ug/L		11	EPA 200.8	07/03/2019 17:26	MLATADY
Uranium Total	12	ug/L		5.5	EPA 200.8	07/03/2019 17:26	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 17:55	MLATADY
Zinc Total	<110	ug/L		110	EPA 200.8	07/03/2019 17:26	MLATADY
Ammonia (as Nitrogen)	0.83	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	NR	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	1.8	mg/L		0.1	SM4500-N B-2011	05/06/2019 11:09	JOHANNAHMAY
Phosphorus, Total	0.32	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	17.454	mg/L		2.00	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	1318	mg/L		10	SM 2320-B-2011	05/01/2019 13:00	MLATADY
Fluoride	1.6	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	NR	mg/L		0.05	SM4500-S2-D	04/29/2019 13:15	MLATADY

Sample Comment: Chlorides: most dilute sample had a concentration greater than the highest calibration point but was within 105%. 05/02/2019 JM.

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client:	WATERSHED_SWM	Report Date:	12/30/2019
Project:	WATERSHED PROTECTION PRO	Collection Date:	04/23/2019 16:56
Lab ID:	AE00501	Date Received:	4/24/19
Field ID:	MJT-19-113-12	Matrix:	WATER
Field Location:	BADWATER CREEK - SITE 11		

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	758	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	1752	mg/L		10	SM2540 C	04/25/2019 11:37	MLATADY
Chlorides	38	mg/L		1	EPA300.0 R2.1	05/01/2019 18:58	JOHANNAHMAY
Sulfates	1002	mg/L		20	EPA300.0 R2.1	05/01/2019 18:58	JOHANNAHMAY
Calcium Dissolved	170	mg/L		1	EPA 200.7	06/18/2019 17:13	MLATADY
Magnesium Dissolved	81	mg/L		1	EPA 200.7	06/18/2019 17:13	MLATADY
Potassium Dissolved	12	mg/L		1	EPA 200.7	06/18/2019 17:13	MLATADY
Sodium Dissolved	280	mg/L		1	EPA 200.7	06/18/2019 17:13	MLATADY
Aluminum Dissolved	<50	ug/L		50	EPA 200.8	06/07/2019 19:03	MLATADY
Antimony Total	<1	ug/L		1	EPA 200.8	07/03/2019 18:22	MLATADY
Arsenic Dissolved	1	ug/L		1	EPA 200.8	06/07/2019 19:03	MLATADY
Arsenic Total	1	ug/L		1	EPA 200.8	07/03/2019 18:22	MLATADY
Barium Total	30	ug/L		10	EPA 200.8	07/03/2019 18:22	MLATADY
Beryllium Total	<1	ug/L		1	EPA 200.8	07/03/2019 18:22	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 19:03	MLATADY
Cadmium Total	<0.1	ug/L		0.1	EPA 200.8	07/03/2019 18:22	MLATADY
Chromium Total	<5	ug/L		5	EPA 200.8	07/03/2019 18:22	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 19:03	MLATADY
Copper Total	<5	ug/L		5	EPA 200.8	07/03/2019 18:22	MLATADY
Iron Dissolved	<50	ug/L		50	EPA 200.7/200.8	06/07/2019 19:03	MLATADY
Iron Total	390	ug/L		50	EPA 200.7/200.8	07/03/2019 18:22	MLATADY
Lead Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 19:03	MLATADY
Lead Total	<1	ug/L		1	EPA 200.8	07/03/2019 18:22	MLATADY
Manganese Dissolved	345	ug/L		1	EPA 200.8	06/07/2019 19:03	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 19:03	MLATADY
Nickel Total	<10	ug/L		10	EPA 200.8	07/03/2019 18:22	MLATADY
Selenium Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 19:03	MLATADY
Selenium Total	<1	ug/L		1	EPA 200.8	07/03/2019 18:22	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 19:03	MLATADY
Silver Total	<0.5	ug/L		0.5	EPA 200.8	07/03/2019 18:22	MLATADY
Thallium Total	<1	ug/L		1	EPA 200.8	07/03/2019 18:22	MLATADY
Uranium Total	17	ug/L		0.5	EPA 200.8	07/03/2019 18:22	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 19:03	MLATADY
Zinc Total	<10	ug/L		10	EPA 200.8	07/03/2019 18:22	MLATADY
Ammonia (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	NR	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	0.38	mg/L		0.1	SM4500-N B-2011	05/06/2019 11:10	JOHANNAHMAY
Phosphorus, Total	0.02	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	4.909	mg/L		1	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	295	mg/L		10	SM 2320-B-2011	05/01/2019 13:00	MLATADY
Fluoride	0.6	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	<0.05	mg/L		0.05	SM4500-S2-D	04/26/2019 13:30	JOHANNAHMAY

Sample Comment: Sulfide: a spike to screen for matrix interference had acceptable recovery. 04/26/2019 JM. Sulfates: most dilute sample had a concentration greater than the highest calibration point but was within 105%. 05/02/2019 JM.

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client:	WATERSHED_SWM	Report Date:	12/30/2019
Project:	WATERSHED PROTECTION PRO	Collection Date:	04/23/2019 17:58
Lab ID:	AE00502	Date Received:	4/24/19
Field ID:	MJT-19-113-13	Matrix:	WATER
Field Location:	BADWATER CREEK - SITE 12		

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	588	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	1116	mg/L		10	SM2540 C	04/25/2019 11:37	MLATADY
Chlorides	15	mg/L		1	EPA300.0 R2.1	05/01/2019 19:15	JOHANNAHMAY
Sulfates	485	mg/L		20	EPA300.0 R2.1	05/01/2019 19:15	JOHANNAHMAY
Calcium Dissolved	126	mg/L		1	EPA 200.7	06/18/2019 17:29	MLATADY
Magnesium Dissolved	67	mg/L		1	EPA 200.7	06/18/2019 17:29	MLATADY
Potassium Dissolved	11	mg/L		1	EPA 200.7	06/18/2019 17:29	MLATADY
Sodium Dissolved	137	mg/L		1	EPA 200.7	06/18/2019 17:29	MLATADY
Aluminum Dissolved	<50	ug/L		50	EPA 200.8	06/07/2019 18:41	MLATADY
Antimony Total	<1	ug/L		1	EPA 200.8	07/03/2019 18:43	MLATADY
Arsenic Dissolved	1	ug/L		1	EPA 200.8	06/07/2019 18:41	MLATADY
Arsenic Total	1	ug/L		1	EPA 200.8	07/03/2019 18:43	MLATADY
Barium Total	80	ug/L		10	EPA 200.8	07/03/2019 18:43	MLATADY
Beryllium Total	<1	ug/L		1	EPA 200.8	07/03/2019 18:43	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 18:41	MLATADY
Cadmium Total	<0.1	ug/L		0.1	EPA 200.8	07/03/2019 18:43	MLATADY
Chromium Total	<5	ug/L		5	EPA 200.8	07/03/2019 18:43	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 18:41	MLATADY
Copper Total	<5	ug/L		5	EPA 200.8	07/03/2019 18:43	MLATADY
Iron Dissolved	<50	ug/L		50	EPA 200.7/200.8	06/07/2019 18:41	MLATADY
Iron Total	132	ug/L		50	EPA 200.7/200.8	07/03/2019 18:43	MLATADY
Lead Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 18:41	MLATADY
Lead Total	<1	ug/L		1	EPA 200.8	07/03/2019 18:43	MLATADY
Manganese Dissolved	241	ug/L		1	EPA 200.8	06/07/2019 18:41	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 18:41	MLATADY
Nickel Total	<10	ug/L		10	EPA 200.8	07/03/2019 18:43	MLATADY
Selenium Dissolved	2	ug/L		1	EPA 200.8	06/07/2019 18:41	MLATADY
Selenium Total	2	ug/L		1	EPA 200.8	07/03/2019 18:43	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 18:41	MLATADY
Silver Total	<0.5	ug/L		0.5	EPA 200.8	07/03/2019 18:43	MLATADY
Thallium Total	<1	ug/L		1	EPA 200.8	07/03/2019 18:43	MLATADY
Uranium Total	10	ug/L		0.5	EPA 200.8	07/03/2019 18:43	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 18:41	MLATADY
Zinc Total	<10	ug/L		10	EPA 200.8	07/03/2019 18:43	MLATADY
Ammonia (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	0.34	mg/L		0.1	SM4500-N B-2011	05/06/2019 11:11	JOHANNAHMAY
Phosphorus, Total	0.02	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	3.108	mg/L		1	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	294	mg/L		10	SM 2320-B-2011	05/01/2019 13:00	MLATADY
Fluoride	0.4	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	<0.05	mg/L		0.05	SM4500-S2-D	04/26/2019 13:30	JOHANNAHMAY

Sample Comment: Sulfide: a spike to screen for matrix interference had acceptable recovery. 04/26/2019 JM. THE SPIKE RECOVERY FOR DISSOLVED SODIUM IS BASED ON THE USE OF THE DUPLICATE CONCENTRATION TO CALCULATE SPIKE RECOVERY. THE SPIKE RECOVERY FOR DISSOLVED CALCIUM IS BASED ON USING THE AVERAGE OF 121 MG/L TO CALCLUATE SPIKE RECOVERY. MKL THE TOTAL METALS SPIKE RECOVERIES ARE BASED ON RAW DATA. Commented by Marisa and approved by Steve V. QMDR for Mn @74% and QSPR @72% accepted due to very difficult matrix. Steve V. THE HARDNESS CALCULATION IS BASED ON RAW DATA THAT IS THEN ROUNDED AFTER THE CALCULATION IS COMPLETED. THIS METHOD YIELDS A MORE ACCUREATE MEASUREMENT.MKL

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client:	WATERSHED_SWM	Report Date:	12/30/2019
Project:	WATERSHED PROTECTION PRO	Collection Date:	04/23/2019 17:58
Lab ID:	AE00503	Date Received:	4/24/19
Field ID:	MJT-19-113-14	Matrix:	WATER
Field Location:	BADWATER CREEK - SITE 12		

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	576	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	1112	mg/L		10	SM2540 C	04/25/2019 11:37	MLATADY
Chlorides	15	mg/L		1	EPA300.0 R2.1	05/01/2019 19:32	JOHANNAHMAY
Sulfates	494	mg/L		20	EPA300.0 R2.1	05/01/2019 19:32	JOHANNAHMAY
Calcium Dissolved	122	mg/L		1	EPA 200.7	06/18/2019 17:33	MLATADY
Magnesium Dissolved	66	mg/L		1	EPA 200.7	06/18/2019 17:33	MLATADY
Potassium Dissolved	11	mg/L		1	EPA 200.7	06/18/2019 17:33	MLATADY
Sodium Dissolved	137	mg/L		1	EPA 200.7	06/18/2019 17:33	MLATADY
Aluminum Dissolved	<50	ug/L		50	EPA 200.8	06/07/2019 18:46	MLATADY
Antimony Total	<1	ug/L		1	EPA 200.8	07/03/2019 19:04	MLATADY
Arsenic Dissolved	1	ug/L		1	EPA 200.8	06/07/2019 18:46	MLATADY
Arsenic Total	1	ug/L		1	EPA 200.8	07/03/2019 19:04	MLATADY
Barium Total	71	ug/L		10	EPA 200.8	07/03/2019 19:04	MLATADY
Beryllium Total	<1	ug/L		1	EPA 200.8	07/03/2019 19:04	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 18:46	MLATADY
Cadmium Total	<0.1	ug/L		0.1	EPA 200.8	07/03/2019 19:04	MLATADY
Chromium Total	<5	ug/L		5	EPA 200.8	07/03/2019 19:04	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 18:46	MLATADY
Copper Total	<5	ug/L		5	EPA 200.8	07/03/2019 19:04	MLATADY
Iron Dissolved	<50	ug/L		50	EPA 200.7/200.8	06/07/2019 18:46	MLATADY
Iron Total	211	ug/L		50	EPA 200.7/200.8	07/03/2019 19:04	MLATADY
Lead Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 18:46	MLATADY
Lead Total	<1	ug/L		1	EPA 200.8	07/03/2019 19:04	MLATADY
Manganese Dissolved	241	ug/L		1	EPA 200.8	06/07/2019 18:46	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 18:46	MLATADY
Nickel Total	<10	ug/L		10	EPA 200.8	07/03/2019 19:04	MLATADY
Selenium Dissolved	2	ug/L		1	EPA 200.8	06/07/2019 18:46	MLATADY
Selenium Total	2	ug/L		1	EPA 200.8	07/03/2019 19:04	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 18:46	MLATADY
Silver Total	<0.5	ug/L		0.5	EPA 200.8	07/03/2019 19:04	MLATADY
Thallium Total	<1	ug/L		1	EPA 200.8	07/03/2019 19:04	MLATADY
Uranium Total	9	ug/L		0.5	EPA 200.8	07/03/2019 19:04	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 18:46	MLATADY
Zinc Total	<10	ug/L		10	EPA 200.8	07/03/2019 19:04	MLATADY
Ammonia (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	0.34	mg/L		0.1	SM4500-N B-2011	05/06/2019 11:12	JOHANNAHMAY
Phosphorus, Total	0.02	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	4.199	mg/L		1	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	294	mg/L		10	SM 2320-B-2011	05/01/2019 13:00	MLATADY
Fluoride	0.5	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	<0.05	mg/L		0.05	SM4500-S2-D	04/26/2019 13:30	JOHANNAHMAY

Sample Comment: Sulfide: a spike to screen for matrix interference had acceptable recovery. 04/26/2019 JM.

LABORATORY ANALYSIS REPORT

Prepared by Wyoming DEQ

Client:	WATERSHED_SWM	Report Date:	12/30/2019
Project:	WATERSHED PROTECTION PRO	Collection Date:	04/23/2019 18:56
Lab ID:	AE00504	Date Received:	4/24/19
Field ID:	MJT-19-113-15	Matrix:	WATER
Field Location:	BADWATER CREEK - SITE 13		

Analysis	Result	Units	Qual	RL	Method	Analysis Date	By
Hardness, Calculation (as CaCO3)	100	mg/L		10	SM2340B-2011	06/25/2019 16:40	MLATADY
Total Dissolved Solids	184	mg/L		10	SM2540 C	04/25/2019 11:37	MLATADY
Chlorides	2	mg/L		1	EPA300.0 R2.1	05/01/2019 19:50	JOHANNAHMAY
Sulfates	15	mg/L		2	EPA300.0 R2.1	05/01/2019 19:50	JOHANNAHMAY
Calcium Dissolved	30	mg/L		1	EPA 200.7	06/18/2019 17:42	MLATADY
Magnesium Dissolved	6	mg/L		1	EPA 200.7	06/18/2019 17:42	MLATADY
Potassium Dissolved	3	mg/L		1	EPA 200.7	06/18/2019 17:42	MLATADY
Sodium Dissolved	11	mg/L		1	EPA 200.7	06/18/2019 17:42	MLATADY
Aluminum Dissolved	<50	ug/L		50	EPA 200.8	06/07/2019 18:50	MLATADY
Antimony Total	<1	ug/L		1	EPA 200.8	07/03/2019 19:12	MLATADY
Arsenic Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 18:50	MLATADY
Arsenic Total	<1	ug/L		1	EPA 200.8	07/03/2019 19:12	MLATADY
Barium Total	67	ug/L		10	EPA 200.8	07/03/2019 19:12	MLATADY
Beryllium Total	<1	ug/L		1	EPA 200.8	07/03/2019 19:12	MLATADY
Cadmium Dissolved	<0.1	ug/L		0.1	EPA 200.8	06/07/2019 18:50	MLATADY
Cadmium Total	<0.1	ug/L		0.1	EPA 200.8	07/03/2019 19:12	MLATADY
Chromium Total	<5	ug/L		5	EPA 200.8	07/03/2019 19:12	MLATADY
Copper Dissolved	<5	ug/L		5	EPA 200.8	06/07/2019 18:50	MLATADY
Copper Total	<5	ug/L		5	EPA 200.8	07/03/2019 19:12	MLATADY
Iron Dissolved	<50	ug/L		50	EPA 200.7/200.8	06/07/2019 18:50	MLATADY
Iron Total	299	ug/L		50	EPA 200.7/200.8	07/03/2019 19:12	MLATADY
Lead Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 18:50	MLATADY
Lead Total	<1	ug/L		1	EPA 200.8	07/03/2019 19:12	MLATADY
Manganese Dissolved	17	ug/L		1	EPA 200.8	06/07/2019 18:50	MLATADY
Nickel Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 18:50	MLATADY
Nickel Total	<10	ug/L		10	EPA 200.8	07/03/2019 19:12	MLATADY
Selenium Dissolved	<1	ug/L		1	EPA 200.8	06/07/2019 18:50	MLATADY
Selenium Total	<1	ug/L		1	EPA 200.8	07/03/2019 19:12	MLATADY
Silver Dissolved	<0.5	ug/L		0.5	EPA 200.8	06/07/2019 18:50	MLATADY
Silver Total	<0.5	ug/L		0.5	EPA 200.8	07/03/2019 19:12	MLATADY
Thallium Total	<1	ug/L		1	EPA 200.8	07/03/2019 19:12	MLATADY
Uranium Total	1	ug/L		0.5	EPA 200.8	07/03/2019 19:12	MLATADY
Zinc Dissolved	<10	ug/L		10	EPA 200.8	06/07/2019 18:50	MLATADY
Zinc Total	<10	ug/L		10	EPA 200.8	07/03/2019 19:12	MLATADY
Ammonia (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NH3 G2011	05/06/2019 11:33	JOHANNAHMAY
Nitrate-Nitrite (as Nitrogen)	<0.05	mg/L		0.05	SM4500-NO3 F2011	05/06/2019 11:33	JOHANNAHMAY
Nitrogen, Wet Digestion	0.25	mg/L		0.1	SM4500-N B-2011	05/06/2019 11:13	JOHANNAHMAY
Phosphorus, Total	0.08	mg/L		0.01	SM4500-P.I 2011	05/10/2019 12:06	JOHANNAHMAY
Dissolved Organic Carbon Combustion	5.582	mg/L		1	SM5310 B-2011	05/13/2019 18:50	SVIEN
Alkalinity	108	mg/L		10	SM 2320-B-2011	05/01/2019 13:00	MLATADY
Fluoride	0.2	mg/L		0.1	SM4500-F-C	05/06/2019 09:45	MLATADY
Total Sulfide (S2-)	<0.05	mg/L		0.05	SM4500-S2-D	04/26/2019 13:30	JOHANNAHMAY

Sample Comment: Sulfide: a spike to screen for matrix interference hd only 58% recovery. 04/26/2019 JM.

QA/QC Summary Report

ALKALINITY-3461	Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Sample Duplicate RPD for Alkalinity									
AE00494 04/30/2019 13:30									
	215	mg/L	10				0.00	10	
Lab Reagent Blank for Alkalinity									
AE00560 04/30/2019 13:30									
	<10	mg/L	10						
Quality Control Sample Recovery for Alk									
AE00561 04/30/2019 13:30				106	90	110			
	107	mg/L	10						

ALKALINITY-3463	Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Sample Duplicate RPD for Alkalinity									
AE00502 05/01/2019 13:00									
	294	mg/L	10				0.00	10	
AE00529 05/01/2019 13:00									
	118	mg/L	10				0.00	10	
Lab Reagent Blank for Alkalinity									
AE00569 05/01/2019 13:00									
	<10	mg/L	10						
Quality Control Sample Recovery for Alk									
AE00570 05/01/2019 13:00				109	90	110			
	110	mg/L	10						

AMMONIA-3459	Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Cont Cal Control Rec Ammonia									
AE00548 05/06/2019 11:33				88.9	85	115			
	0.89	mg/L	0.05						
AE00549 05/06/2019 11:33				94.1	85	115			
	0.94	mg/L	0.05						
Continuing Calib. Control Rec NO3+NO2									
AE00548 05/06/2019 11:33				98.0	85	115			
	0.98	mg/L	0.05						
AE00549 05/06/2019 11:33				99.0	85	115			
	0.99	mg/L	0.05						
Sample Duplicate RPD for Ammonia									
AE00491 05/06/2019 11:33									
	<0.05	mg/L	0.05				0	15	
AE00499 05/06/2019 11:33									
	0.79	mg/L	0.05				0.77	15	
Sample Duplicate RPD for Nitrate-Nitrite									
AE00491 05/06/2019 11:33									
	NR	mg/L	0.05				NR	15	
AE00499 05/06/2019 11:33									
	NR	mg/L	0.05				NR	15	
Initial Cal. Control Recovery Ammonia									
AE00546 05/06/2019 11:33				102	85	115			
	1.0	mg/L	0.05						

Initial Calibration Control Rec. NO3+NO2										
AE00546	05/06/2019	11:33				97.0	85	115		
			0.97	mg/L	0.05					
Lab Reagent Blank for Ammonia										
AE00545	05/06/2019	11:33								
			<0.05	mg/L	0.05					
Lab Reagent Blank NO3+NO2										
AE00545	05/06/2019	11:33								
			<0.05	mg/L	0.05					
Sample Matrix Dup Recovery for Ammonia										
AE00491	05/06/2019	11:33				73.8	85	115		
			1.49	mg/L	0.05				7.00	15
AE00499	05/06/2019	11:33				70.5	85	115		
			2.16	mg/L	0.05				1.30	15
Sample Matrix Duplicate Rec. NO3+NO2										
AE00491	05/06/2019	11:33				NR	85	115		
			NR	mg/L	0.05				NR	15
AE00499	05/06/2019	11:33				NR	85	115		
			NR	mg/L	0.05				NR	15
Sample Matrix Spike Recovery for Ammonia										
AE00491	05/06/2019	11:33				79.2	85	115		
			1.60	mg/L	0.05					
AE00499	05/06/2019	11:33				69.1	85	115		
			2.14	mg/L	0.05					
Sample Matrix Spike Recovery for NO3+NO2										
AE00491	05/06/2019	11:33				NR	85	115		
			NR	mg/L	0.05					
AE00499	05/06/2019	11:33				NR	85	115		
			NR	mg/L	0.05					
QC % Rec Ammonia Calc										
AE00547	05/06/2019	11:33				96.1	85	115		
			16.7	mg/L	0.05					
QCS Rec. NO3+NO2 P230-505										
AE00547	05/06/2019	11:33				98.4	85	115		
			18.4	mg/L	0.05					

DOC-3515			Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Continuing Calibration Control Recovery											
AE00805	05/13/2019	18:50				89.6	80	120			
			20.000	mg/L							
DOC Sample Duplicate Value											
AE00497	05/24/2019	15:08									
			4.037	mg/L					4.59	15	
DOC Initial Calibration Control Recovery											
AE00804	05/13/2019	18:50				100	80	120			
			20.000								
Lab Reagent Blank DOC Combustion											
AE00803	05/13/2019	18:50									
			<RL	mg/L	1						
DOC Sample Matrix Duplicate Recovery											
AE00497	05/24/2019	15:11				115	80	120			
			14.295	mg/L					1.80	15	
DOC Sample Matrix Spike Recovery											
AE00497	05/13/2019	18:50				118	80	120			
			14.554	mg/L							

FLUORIDE-3472		Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Cont Cal Cont Rec Fluoride										
AE00596	05/06/2019 9:45				106	80	120			
		2.1	mg/L	0.1						
Sample Duplicate RPD for Flouride										
AE00490	05/06/2019 9:45									
		0.6	mg/L	0.1				0	20	
AE00501	05/06/2019 9:45									
		0.6	mg/L	0.1				0	20	
Initial Cal. Control Recovery Fluoride										
AE00594	05/06/2019 9:45				104	80	120			
		2.1	mg/L	0.1						
Lab Reagent Blank for Flouride										
AE00593	05/06/2019 9:45									
		<0.1	mg/L	0.1						
Sample Matrix Dup. Recovery Fluoride										
AE00490	05/06/2019 9:45				104	80	120			
		2.7	mg/L	0.1				0.4	20	
AE00501	05/06/2019 9:45				98.5	80	120			
		2.6	mg/L	0.1				1.2	20	
Sample Matrix Spike Recovery Flouride										
AE00490	05/06/2019 9:45				103	80	120			
		2.7	mg/L	0.1						
AE00501	05/06/2019 9:45				97.0	80	120			
		2.5	mg/L	0.1						
QCS Recovery for Flouoride										
AE00595	05/06/2019 9:45				104	80	120			
		3.3	mg/L	0.1						

ICP_IONS_DISSOLVED-3586		Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Continuing Calibration Control Recovery										
Calcium										
AE01102	06/18/2019 18:12				98	85	115			
		4.9	mg/L	1						
Magnesium										
AE01102	06/18/2019 18:12				100	85	115			
		5.0	mg/L	1						
Potassium										
AE01102	06/18/2019 18:12				110	85	115			
		5.5	mg/L	1						
Sodium										
AE01102	06/18/2019 18:12				110	85	115			
		5.5	mg/L	1						
Sample Relative Percent Difference										
Calcium										
AE00502	06/18/2019 17:21									
		117	mg/L	10				7	15	
Magnesium										
AE00502	06/18/2019 17:21									
		65	mg/L	10				3	15	
Potassium										
AE00502	06/18/2019 17:21									
		11	mg/L	1				0	20	
Sodium										

AE00502	06/18/2019 17:21								
		146	mg/L	10				6	20
Calcium									
AE00578	06/18/2019 16:27								
		61	mg/L	1				0	15
Magnesium									
AE00578	06/18/2019 16:27								
		16	mg/L	1				0	15
Potassium									
AE00578	06/18/2019 16:27								
		2	mg/L	1				0	20
Sodium									
AE00578	06/18/2019 16:27								
		7	mg/L	1				0	20
Initial Cal. Control Value ICP_IONS_DISS									
Calcium									
AE01100	06/18/2019 16:05				96	85	115		
		4.8	mg/L	1					
Magnesium									
AE01100	06/18/2019 16:05				100	85	115		
		5.0	mg/L	1					
Potassium									
AE01100	06/18/2019 16:05				98	85	115		
		4.9	mg/L	1					
Sodium									
AE01100	06/18/2019 16:05				110	85	115		
		5.5	mg/L	1					
Lab Reagent Blank for ICP_IONS_DISS									
Calcium									
AE01099	06/18/2019 16:02								
		<1	mg/L	1					
Magnesium									
AE01099	06/18/2019 16:02								
		<1	mg/L	1					
Potassium									
AE01099	06/18/2019 16:02								
		<1	mg/L	1					
Sodium									
AE01099	06/18/2019 16:02								
		<1	mg/L	1					
Sample Matrix Spike RPD ICP_IONS_DISS									
Calcium									
AE00502	06/18/2019 17:26				93	85	115		
		168	mg/l	10				4	15
Magnesium									
AE00502	06/18/2019 17:26				102	85	115		
		118	mg/l	10				2	15
Potassium									
AE00502	06/18/2019 17:26				112	85	115		
		67	mg/l	10				3	20
Sodium									
AE00502	06/18/2019 17:26				103	85	115		
		198	mg/l	10				3	20
Calcium									
AE00578	06/18/2019 16:27				98	85	115		
		110	mg/l	1				4	15

Magnesium										
AE00578	06/18/2019 16:27				102	85	115			
		67	mg/l	1				0	15	
Potassium										
AE00578	06/18/2019 16:27				100	85	115			
		52	mg/l	1				4	20	
Sodium										
AE00578	06/18/2019 16:27				106	85	115			
		60	mg/l	1				4	20	
Sample Matrix Spike Recovery										
Calcium										
AE00502	06/18/2019 17:24				106	85	115			
		174	mg/L	10						
Magnesium										
AE00502	06/18/2019 17:24				106	85	115			
		120	mg/L	10						
Potassium										
AE00502	06/18/2019 17:24				108	85	115			
		65	mg/L	10						
Sodium										
AE00502	06/18/2019 17:24				92	85	115			
		192	mg/L	10						
Calcium										
AE00578	06/18/2019 16:27				90	85	115			
		106	mg/L	1						
Magnesium										
AE00578	06/18/2019 16:27				102	85	115			
		67	mg/L	1						
Potassium										
AE00578	06/18/2019 16:27				96	85	115			
		50	mg/L	1						
Sodium										
AE00578	06/18/2019 16:27				111	85	115			
		67	mg/L	1						
QCS Recovery for ICP_IONS_DISS										
Calcium										
AE01101	06/18/2019 16:07				103	85	115			
		21	mg/L	1						
Magnesium										
AE01101	06/18/2019 16:07				107	85	115			
		14	mg/L	1						
Potassium										
AE01101	06/18/2019 16:07				108	85	115			
		66.7	mg/L	1						
Sodium										
AE01101	06/18/2019 16:07				108	85	115			
		38.7	mg/L	1						

ICPMS_ALL_DISS-3526		Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Continuing Calibration Control Value										
Aluminum										
AE00841	06/07/2019 16:52				104	85	115			
		51.8	ug/L	50						
Antimony										
AE00841	06/07/2019 16:52				106	80	120			
		53.0	ug/L	1						

Arsenic								
AE00841	06/07/2019	16:52				101	85	115
			50.6	ug/L	1			
Barium								
AE00841	06/07/2019	16:52				103	85	115
			51.6	ug/L	10			
Beryllium								
AE00841	06/07/2019	16:52				98	85	115
			48.9	ug/L	1			
Boron								
AE00841	06/07/2019	16:52				108	85	115
			54.0	ug/L	10			
Cadmium								
AE00841	06/07/2019	16:52				106.2	90	110
			53.1	ug/L	0.1			
Chromium								
AE00841	06/07/2019	16:52				105	85	115
			52.6	ug/L	5			
Cobalt								
AE00841	06/07/2019	16:52				109	85	115
			54.3	ug/L	5			
Copper								
AE00841	06/07/2019	16:52				110	85	115
			54.9	ug/L	5			
Iron								
AE00841	06/07/2019	16:52				103	85	115
			51.6	ug/L	50			
Lead								
AE00841	06/07/2019	16:52				105	85	115
			52.3	ug/L	1			
Manganese								
AE00841	06/07/2019	16:52				102	85	115
			51.1	ug/L	1			
Molybdenum								
AE00841	06/07/2019	16:52				101	85	115
			50.4	ug/L	1			
Nickel								
AE00841	06/07/2019	16:52				108	85	115
			54.0	ug/L	10			
Selenium								
AE00841	06/07/2019	16:52				102	85	115
			51.0	ug/L	1			
Silver								
AE00841	06/07/2019	16:52				108	80	120
			53.9	ug/L	0.1			
Strontium								
AE00841	06/07/2019	16:52				95	85	115
			47.4	ug/L	1			
Thallium								
AE00841	06/07/2019	16:52				108	85	115
			53.9	ug/L	1			
Uranium								
AE00841	06/07/2019	16:52				105.4	85	115
			52.7	ug/L	0.5			
Vanadium								
AE00841	06/07/2019	16:52				103	85	115
			51.7	ug/L	10			

Zinc										
AE00841	06/07/2019	16:52				103	85	115		
			51.6	ug/L	10					
RPD FOR ICPMS_ALL_DISS										
Aluminum										
AE00447	06/07/2019	16:01								
			<10	ug/L	50				0	15
Antimony										
AE00447	06/07/2019	16:01								
			<1	ug/L	1				0	15
Arsenic										
AE00447	06/07/2019	16:01								
			<1	ug/L	1				0	15
Barium										
AE00447	06/07/2019	16:01								
			40	ug/L	10				0.7	15
Beryllium										
AE00447	06/07/2019	16:01								
			<1	ug/L	1				0	15
Boron										
AE00447	06/07/2019	16:01								
			19	ug/L	10				2	15
Cadmium										
AE00447	06/07/2019	16:01								
			<0.1	ug/L	0.1				0	15
Chromium										
AE00447	06/07/2019	16:01								
			<5	ug/L	5				0	15
Cobalt										
AE00447	06/07/2019	16:01								
			<5	ug/L	5				0	15
Copper										
AE00447	06/07/2019	16:01								
			<5	ug/L	5				0	15
Iron										
AE00447	06/07/2019	16:01								
			<50	ug/L	50				0	15
Lead										
AE00447	06/07/2019	16:01								
			<1	ug/L	1				0	15
Manganese										
AE00447	06/07/2019	16:01								
			11	ug/L	1				0	15
Molybdenum										
AE00447	06/07/2019	16:01								
			<5	ug/L	5				2	15
Nickel										
AE00447	06/07/2019	16:01								
			<10	ug/L	10				0	15
Selenium										
AE00447	06/07/2019	16:01								
			<1	ug/L	1				0	15
Silver										
AE00447	06/07/2019	16:01								
			<0.5	ug/L	0.5				0	15
Strontium										

AE00447	06/07/2019 16:01						
		798	ug/L	1		2	15
Thallium							
AE00447	06/07/2019 16:01						
		<1	ug/L	1		0	15
Uranium							
AE00447	06/07/2019 16:01						
		1.0	ug/L	0.5		0	15
Vanadium							
AE00447	06/07/2019 16:01						
		<10	ug/L	10		0	15
Zinc							
AE00447	06/07/2019 16:01						
		<10	ug/L	10		0	15
Aluminum							
AE00501	06/07/2019 18:12						
		<50	ug/L	50		0	15
Antimony							
AE00501	06/07/2019 18:12						
		<1	ug/L	1		0	15
Arsenic							
AE00501	06/07/2019 18:12						
		1	ug/L	1		0	15
Barium							
AE00501	06/07/2019 18:12						
		28	ug/L	10		1.3	15
Beryllium							
AE00501	06/07/2019 18:12						
		<1	ug/L	1		0	15
Boron							
AE00501	06/07/2019 18:12						
		128	ug/L	10		4.9	15
Cadmium							
AE00501	06/07/2019 18:12						
		<0.1	ug/L	0.1		0	15
Chromium							
AE00501	06/07/2019 18:12						
		<5	ug/L	5		0	15
Cobalt							
AE00501	06/07/2019 18:12						
		<5	ug/L	5		0	15
Copper							
AE00501	06/07/2019 18:12						
		<5	ug/L	5		0	15
Iron							
AE00501	06/07/2019 18:12						
		<50	ug/L	50		0	15
Lead							
AE00501	06/07/2019 18:12						
		<1	ug/L	1		0	15
Manganese							
AE00501	06/07/2019 18:12						
		342	ug/L	10		1.9	15
Molybdenum							
AE00501	06/07/2019 18:12						
		4	ug/L	5		0	15
Nickel							

AE00501	06/07/2019 18:12								
		<10	ug/L	10				0	15
Selenium									
AE00501	06/07/2019 18:12								
		<1	ug/L	1				0	15
Silver									
AE00501	06/07/2019 18:12								
		<0.5	ug/L	0.5				0	15
Strontium									
AE00501	06/07/2019 18:12								
		2266	ug/L	10				1.8	15
Thallium									
AE00501	06/07/2019 18:12								
		<1	ug/L	1				0	15
Uranium									
AE00501	06/07/2019 18:12								
		20.1	ug/L	0.5				0	15
Vanadium									
AE00501	06/07/2019 18:12								
		<10	ug/L	10				0	15
Zinc									
AE00501	06/07/2019 18:12								
		<10	ug/L	10				0	15
Initial Cal Control Value ICPMS_ALL_DISS									
Aluminum									
AE00839	06/07/2019 15:32				100	85	115		
		50.0	ug/L	50					
Antimony									
AE00839	06/07/2019 15:32				100	80	120		
		50.1	ug/L	1					
Arsenic									
AE00839	06/07/2019 15:32				100	85	115		
		50.1	ug/L	1					
Barium									
AE00839	06/07/2019 15:32				99	85	115		
		49.5	ug/L	10					
Beryllium									
AE00839	06/07/2019 15:32				101	85	115		
		50.5	ug/L	1					
Boron									
AE00839	06/07/2019 15:32				101	85	115		
		50.5	ug/L	10					
Cadmium									
AE00839	06/07/2019 15:32				100.0	90	110		
		50.0	ug/L	0.1					
Chromium									
AE00839	06/07/2019 15:32				100	85	115		
		50.1	ug/L	5					
Cobalt									
AE00839	06/07/2019 15:32				101	85	115		
		50.7	ug/L	5					
Copper									
AE00839	06/07/2019 15:32				102	85	115		
		51.1	ug/L	5					
Iron									

AE00839	06/07/2019 15:32				98	85	115
		48.8	ug/L	50			
Lead							
AE00839	06/07/2019 15:32				100	85	115
		49.9	ug/L	1			
Manganese							
AE00839	06/07/2019 15:32				98	85	115
		48.9	ug/L	1			
Molybdenum							
AE00839	06/07/2019 15:32				101	85	115
		50.6	ug/L	1			
Nickel							
AE00839	06/07/2019 15:32				101	85	115
		50.4	ug/L	10			
Selenium							
AE00839	06/07/2019 15:32				99	85	115
		49.5	ug/L	1			
Silver							
AE00839	06/07/2019 15:32				101	80	120
		50.4	ug/L	0.1			
Strontium							
AE00839	06/07/2019 15:32				98	85	115
		49.2	ug/L	1			
Thallium							
AE00839	06/07/2019 15:32				100	85	115
		50.2	ug/L	1			
Uranium							
AE00839	06/07/2019 15:32				101.8	85	115
		50.9	ug/L	0.5			
Vanadium							
AE00839	06/07/2019 15:32				98	85	115
		49.2	ug/L	10			
Zinc							
AE00839	06/07/2019 15:32				101	85	115
		50.4	ug/L	10			
Lab Reagent Blank for ICPMS_ALL_DISS							
Aluminum							
AE00838	06/07/2019 15:28						
		<50	ug/L	50			
Antimony							
AE00838	06/07/2019 15:28						
		<1	ug/L	1			
Arsenic							
AE00838	06/07/2019 15:28						
		<1	ug/L	1			
Barium							
AE00838	06/07/2019 15:28						
		<10	ug/L	10			
Beryllium							
AE00838	06/07/2019 15:28						
		<1	ug/L	1			
Boron							
AE00838	06/07/2019 15:28						
		<10	ug/L	10			
Cadmium							

AE00838	06/07/2019 15:28								
		<0.1	ug/L	0.1					
Chromium									
AE00838	06/07/2019 15:28								
		<5	ug/L	5					
Cobalt									
AE00838	06/07/2019 15:28								
		<5	ug/L	5					
Copper									
AE00838	06/07/2019 15:28								
		<5	ug/L	5					
Iron									
AE00838	06/07/2019 15:28								
		<50	ug/L	50					
Lead									
AE00838	06/07/2019 15:28								
		<1	ug/L	1					
Manganese									
AE00838	06/07/2019 15:28								
		<1	ug/L	1					
Molybdenum									
AE00838	06/07/2019 15:28								
		<5	ug/L	5					
Nickel									
AE00838	06/07/2019 15:28								
		<10	ug/L	10					
Selenium									
AE00838	06/07/2019 15:28								
		<1	ug/L	1					
Silver									
AE00838	06/07/2019 15:28								
		<0.5	ug/L	0.5					
Strontium									
AE00838	06/07/2019 15:28								
		<1	ug/L	1					
Thallium									
AE00838	06/07/2019 15:28								
		<1	ug/L	1					
Uranium									
AE00838	06/07/2019 15:28								
		<0.5	ug/L	0.5					
Vanadium									
AE00838	06/07/2019 15:28								
		<10	ug/L	10					
Zinc									
AE00838	06/07/2019 15:28								
		<10	ug/L	10					
SAMPLE SPIKE RPD FOR ICPMS_ALL_DISS									
Aluminum									
AE00447	06/07/2019 16:27				106	85	115		
		53	ug/L	50				0	15
Antimony									
AE00447	06/07/2019 16:27				102	85	115		
		51	ug/L	1				0	15
Arsenic									

AE00447	06/07/2019 16:27				100	85	115			
		50	ug/L	1				1	15	
Barium										
AE00447	06/07/2019 16:27				104	85	115			
		91	ug/L	10				0	15	
Beryllium										
AE00447	06/07/2019 16:27				98.0	85	115			
		49	ug/L	1				0	15	
Boron										
AE00447	06/07/2019 16:27				100	85	115			
		68	ug/L	10				0	15	
Cadmium										
AE00447	06/07/2019 16:27				103	90	110			
		51.5	ug/L	0.1				0.5	15	
Chromium										
AE00447	06/07/2019 16:27				102	85	115			
		51	ug/L	5				0	15	
Cobalt										
AE00447	06/07/2019 16:27				102	85	115			
		51	ug/L	5				0	15	
Copper										
AE00447	06/07/2019 16:27				106	85	115			
		53	ug/L	5				0	15	
Iron										
AE00447	06/07/2019 16:27				100	85	115			
		63	ug/L	50				0	15	
Lead										
AE00447	06/07/2019 16:27				106	85	115			
		53	ug/L	1				0	15	
Manganese										
AE00447	06/07/2019 16:27				100	85	115			
		60	ug/L	1				1	15	
Molybdenum										
AE00447	06/07/2019 16:27				104	85	115			
		52	ug/L	1				0	15	
Nickel										
AE00447	06/07/2019 16:27				100	85	115			
		50	ug/L	10				0	15	
Selenium										
AE00447	06/07/2019 16:27				104	85	115			
		52	ug/L	1				0	15	
Silver										
AE00447	06/07/2019 16:27				101	85	115			
		50.5	ug/L	0.5				0.8	15	
Strontium										
AE00447	06/07/2019 16:27				95.4	85	115			
		1259	ug/L	1				0	15	
Thallium										
AE00447	06/07/2019 16:27				108	85	115			
		54	ug/L	1				0	15	
Uranium										
AE00447	06/07/2019 16:27				110	85	115			
		56.0	ug/L	0.5				1.6	15	
Vanadium										
AE00447	06/07/2019 16:27				102	85	115			
		51	ug/L	10				0	15	
Zinc										

AE00447	06/07/2019	16:27				102	85	115		
			51	ug/L	10				0	15
Aluminum										
AE00501	06/07/2019	18:37				110	85	115		
			55	ug/L	50				0	15
Antimony										
AE00501	06/07/2019	18:37				104	85	115		
			52	ug/L	1				0	15
Arsenic										
AE00501	06/07/2019	18:37				102	85	115		
			52	ug/L	1				2	15
Barium										
AE00501	06/07/2019	18:37				104	85	115		
			80	ug/L	10				0	15
Beryllium										
AE00501	06/07/2019	18:37				96.0	85	115		
			48	ug/L	1				4	15
Boron										
AE00501	06/07/2019	18:37				114	85	115		
			179	ug/L	10				0	15
Cadmium										
AE00501	06/07/2019	18:37				96.8	90	110		
			48.4	ug/L	0.1				0.4	15
Chromium										
AE00501	06/07/2019	18:37				96.0	85	115		
			48	ug/L	5				0	15
Cobalt										
AE00501	06/07/2019	18:37				94.0	85	115		
			47	ug/L	5				0	15
Copper										
AE00501	06/07/2019	18:37				90.0	85	115		
			45	ug/L	5				0	15
Iron										
AE00501	06/07/2019	18:37				112	85	115		
			56	ug/L	50				0	15
Lead										
AE00501	06/07/2019	18:37				108	85	115		
			54	ug/L	1				0	15
Manganese										
AE00501	06/07/2019	18:37				99.2	85	115		
			841	ug/L	10				0	15
Molybdenum										
AE00501	06/07/2019	18:37				113	85	115		
			59	ug/L	1				0	15
Nickel										
AE00501	06/07/2019	18:37				92.0	85	115		
			46	ug/L	10				0	15
Selenium										
AE00501	06/07/2019	18:37				100	85	115		
			50	ug/L	1				0	15
Silver										
AE00501	06/07/2019	18:37				87.8	85	115		
			43.9	ug/L	0.5				0.7	15
Strontium										
AE00501	06/07/2019	18:37				95.6	85	115		
			2824	ug/L	10				0	15
Thallium										

AE00501	06/07/2019 18:37				110	85	115		
		55	ug/L	1				0	15
Uranium									
AE00501	06/07/2019 18:37				114	85	115		
		77	ug/L	0.5				0.8	15
Vanadium									
AE00501	06/07/2019 18:37				102	85	115		
		51	ug/L	10				0	15
Zinc									
AE00501	06/07/2019 18:37				96.0	85	115		
		48	ug/L	10				0	15
DISSOLVED MATRIX SPIKE RECOVERY									
Aluminum									
AE00447	06/07/2019 16:23				108	85	115		
		54	ug/L	50					
Antimony									
AE00447	06/07/2019 16:23				102	85	115		
		51	ug/L	1					
Arsenic									
AE00447	06/07/2019 16:23				102	85	115		
		51	ug/L	1					
Barium									
AE00447	06/07/2019 16:23				102	85	115		
		90	ug/L	10					
Beryllium									
AE00447	06/07/2019 16:23				96.0	85	115		
		48	ug/L	1					
Boron									
AE00447	06/07/2019 16:23				104	85	115		
		70	ug/L	10					
Cadmium									
AE00447	06/07/2019 16:23				102	90	110		
		51.2	ug/L	0.1					
Chromium									
AE00447	06/07/2019 16:23				102	85	115		
		51	ug/L	5					
Cobalt									
AE00447	06/07/2019 16:23				102	85	115		
		51	ug/L	5					
Copper									
AE00447	06/07/2019 16:23				106	85	115		
		53	ug/L	5					
Iron									
AE00447	06/07/2019 16:23				100	85	115		
		63	ug/L	50					
Lead									
AE00447	06/07/2019 16:23				106	85	115		
		53	ug/L	1					
Manganese									
AE00447	06/07/2019 16:23				102	85	115		
		61	ug/L	1					
Molybdenum									
AE00447	06/07/2019 16:23				102	85	115		
		51	ug/L	1					
Nickel									

AE00447	06/07/2019 16:23				100	85	115
		50	ug/L	10			
Selenium							
AE00447	06/07/2019 16:23				104	85	115
		52	ug/L	1			
Silver							
AE00447	06/07/2019 16:23				102	85	115
		50.9	ug/L	0.5			
Strontium							
AE00447	06/07/2019 16:23				101	85	115
		1285	ug/L	1			
Thallium							
AE00447	06/07/2019 16:23				108	85	115
		54	ug/L	1			
Uranium							
AE00447	06/07/2019 16:23				108	85	115
		55.1	ug/L	0.5			
Vanadium							
AE00447	06/07/2019 16:23				102	85	115
		51	ug/L	10			
Zinc							
AE00447	06/07/2019 16:23				102	85	115
		51	ug/L	10			
Aluminum							
AE00501	06/07/2019 16:10				110	85	115
		55	ug/L	50			
Antimony							
AE00501	06/07/2019 16:10				104	85	115
		52	ug/L	1			
Arsenic							
AE00501	06/07/2019 16:10				100	85	115
		51	ug/L	1			
Barium							
AE00501	06/07/2019 16:10				106	85	115
		81	ug/L	10			
Beryllium							
AE00501	06/07/2019 16:10				92.0	85	115
		46	ug/L	1			
Boron							
AE00501	06/07/2019 16:10				104	85	115
		174	ug/L	10			
Cadmium							
AE00501	06/07/2019 16:10				97.2	90	110
		48.6	ug/L	0.1			
Chromium							
AE00501	06/07/2019 16:10				98.0	85	115
		49	ug/L	5			
Cobalt							
AE00501	06/07/2019 16:10				94.0	85	115
		47	ug/L	5			
Copper							
AE00501	06/07/2019 16:10				90.0	85	115
		45	ug/L	5			
Iron							
AE00501	06/07/2019 16:10				110	85	115
		55	ug/L	50			
Lead							

AE00501	06/07/2019	16:10				108	85	115
			54	ug/L	1			
Manganese								
AE00501	06/07/2019	16:10				99.6	85	115
			843	ug/L	10			
Molybdenum								
AE00501	06/07/2019	16:10				108	85	115
			59	ug/L	1			
Nickel								
AE00501	06/07/2019	16:10				94.0	85	115
			47	ug/L	10			
Selenium								
AE00501	06/07/2019	16:10				100	85	115
			50	ug/L	1			
Silver								
AE00501	06/07/2019	16:10				87.2	85	115
			43.6	ug/L	0.5			
Strontium								
AE00501	06/07/2019	16:10				95.4	85	115
			2823	ug/L	10			
Thallium								
AE00501	06/07/2019	16:10				110	85	115
			55	ug/L	1			
Uranium								
AE00501	06/07/2019	16:10				113	85	115
			76.4	ug/L	0.5			
Vanadium								
AE00501	06/07/2019	16:10				102	85	115
			51	ug/L	10			
Zinc								
AE00501	06/07/2019	16:10				96.0	85	115
			48	ug/L	10			
QCS Value for ICPMS_ALL_DISS								
Aluminum								
AE00840	06/07/2019	15:36				107	85	115
			2164	ug/L	50			
Antimony								
AE00840	06/07/2019	15:36				104	80	120
			610	ug/L	1			
Arsenic								
AE00840	06/07/2019	15:36				100	85	115
			274	ug/L	1			
Barium								
AE00840	06/07/2019	15:36				103	85	115
			389	ug/L	10			
Beryllium								
AE00840	06/07/2019	15:36				105	85	115
			420	ug/L	1			
Boron								
AE00840	06/07/2019	15:36				104	85	115
			1781	ug/L	10			
Cadmium								
AE00840	06/07/2019	15:36				102.0	90	110
			171.5	ug/L	0.1			
Chromium								

AE00840	06/07/2019 15:36				104	85	115			
		896	ug/L	5						
Cobalt										
AE00840	06/07/2019 15:36				102	85	115			
		567	ug/L	5						
Copper										
AE00840	06/07/2019 15:36				105	85	115			
		842	ug/L	5						
Iron										
AE00840	06/07/2019 15:36				101	85	115			
		370	ug/L	50						
Lead										
AE00840	06/07/2019 15:36				103	85	115			
		274	ug/L	1						
Manganese										
AE00840	06/07/2019 15:36				103	85	115			
		763	ug/L	1						
Molybdenum										
AE00840	06/07/2019 15:36				111	85	115			
		124	ug/L	1						
Nickel										
AE00840	06/07/2019 15:36				104	85	115			
		1040	ug/L	10						
Selenium										
AE00840	06/07/2019 15:36				104	85	115			
		816	ug/L	1						
Silver										
AE00840	06/07/2019 15:36				103	80	120			
		491.8	ug/L	0.1						
Strontium										
AE00840	06/07/2019 15:36				101	85	115			
		348	ug/L	1						
Thallium										
AE00840	06/07/2019 15:36				105	85	115			
		518	ug/L	1						
Uranium										
AE00840	06/07/2019 15:36				103.0	85	115			
		96.3	ug/L	0.5						
Vanadium										
AE00840	06/07/2019 15:36				103	85	115			
		1911	ug/L	10						
Zinc										
AE00840	06/07/2019 15:36				103	85	115			
		473	ug/L	10						

ICPMS_ALL_TOTAL-3493	Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Continuing Calibration Control Value									
Aluminum									
AE00703 07/03/2019 14:41				105	85	115			
	52	ug/L	50						
Antimony									
AE00703 07/03/2019 14:41				104	80	120			
	52	ug/L	1						
Arsenic									
AE00703 07/03/2019 14:41				104	85	115			
	52	ug/L	1						

Barium								
AE00703	07/03/2019	14:41				104	85	115
			52	ug/L	10			
Beryllium								
AE00703	07/03/2019	14:41				100	85	115
			50	ug/L	1			
Boron								
AE00703	07/03/2019	14:41				114	85	115
			57	ug/L	10			
Cadmium								
AE00703	07/03/2019	14:41				104.2	90	110
			52.1	ug/L	0.1			
Chromium								
AE00703	07/03/2019	14:41				107	85	115
			53	ug/L	5			
Cobalt								
AE00703	07/03/2019	14:41				108	85	115
			54	ug/L	5			
Copper								
AE00703	07/03/2019	14:41				108	85	115
			54	ug/L	5			
Iron								
AE00703	07/03/2019	14:41				104	85	115
			52	ug/L	50			
Lead								
AE00703	07/03/2019	14:41				109	85	115
			54.3	ug/L	1			
Manganese								
AE00703	07/03/2019	14:41				103	85	115
			52	ug/L	1			
Molybdenum								
AE00703	07/03/2019	14:41				103	85	115
			52	ug/L	1			
Nickel								
AE00703	07/03/2019	14:41				108	85	115
			54	ug/L	10			
Selenium								
AE00703	07/03/2019	14:41				105	85	115
			52	ug/L	1			
Silver								
AE00703	07/03/2019	14:41				107.4	80	120
			53.7	ug/L	0.1			
Strontium								
AE00703	07/03/2019	14:41				97	85	115
			49	ug/L	10			
Thallium								
AE00703	07/03/2019	14:41				112	85	115
			56	ug/L	1			
Uranium								
AE00703	07/03/2019	14:41				99.6	85	115
			49.8	ug/L	0.5			
Vanadium								
AE00703	07/03/2019	14:41				107	85	115
			54	ug/L	10			
Zinc								
AE00703	07/03/2019	14:41				107	85	115
			53	ug/L	10			

Aluminum								
AE00704	07/03/2019	20:15				116	85	115
			58	ug/L	50			
Antimony								
AE00704	07/03/2019	20:15				108	80	120
			54	ug/L	1			
Arsenic								
AE00704	07/03/2019	20:15				104	85	115
			52	ug/L	1			
Barium								
AE00704	07/03/2019	20:15				110	85	115
			55	ug/L	10			
Beryllium								
AE00704	07/03/2019	20:15				104	85	115
			52	ug/L	1			
Boron								
AE00704	07/03/2019	20:15				138	85	115
			69	ug/L	10			
Cadmium								
AE00704	07/03/2019	20:15				106.0	90	110
			53.0	ug/L	0.1			
Chromium								
AE00704	07/03/2019	20:15				110	85	115
			55	ug/L	5			
Cobalt								
AE00704	07/03/2019	20:15				112	85	115
			56	ug/L	5			
Copper								
AE00704	07/03/2019	20:15				112	85	115
			56	ug/L	5			
Iron								
AE00704	07/03/2019	20:15				108	85	115
			54	ug/L	50			
Lead								
AE00704	07/03/2019	20:15				110	85	115
			55.0	ug/L	1			
Manganese								
AE00704	07/03/2019	20:15				110	85	115
			55	ug/L	1			
Molybdenum								
AE00704	07/03/2019	20:15				106	85	115
			53	ug/L	1			
Nickel								
AE00704	07/03/2019	20:15				110	85	115
			55	ug/L	10			
Selenium								
AE00704	07/03/2019	20:15				104	85	115
			52	ug/L	1			
Silver								
AE00704	07/03/2019	20:15				109.4	80	120
			54.7	ug/L	0.1			
Strontium								
AE00704	07/03/2019	20:15				106	85	115
			53	ug/L	10			
Thallium								
AE00704	07/03/2019	20:15				114	85	115
			57	ug/L	1			

Uranium										
AE00704	07/03/2019	20:15					89.8	85	115	
			44.9	ug/L	0.5					
Vanadium										
AE00704	07/03/2019	20:15					112	85	115	
			56	ug/L	10					
Zinc										
AE00704	07/03/2019	20:15					108	85	115	
			54	ug/L	10					
Sample Duplicate Value for ICPMS_ALL_TOT										
Aluminum										
AE00447	07/03/2019	14:04								
			74	ug/L	550				2	20
Antimony										
AE00447	07/03/2019	14:04								
			<1	ug/L	1				0	20
Arsenic										
AE00447	07/03/2019	14:04								
			<1	ug/L	1				0	20
Barium										
AE00447	07/03/2019	14:04								
			40	ug/L	10				1	15
Beryllium										
AE00447	07/03/2019	14:04								
			<1	ug/L	1				0	15
Boron										
AE00447	07/03/2019	14:04								
			22	ug/L	10				0.1	15
Cadmium										
AE00447	07/03/2019	14:04								
			<0.1	ug/L	0.1				0	15
Chromium										
AE00447	07/03/2019	14:04								
			<5	ug/L	5				0	15
Cobalt										
AE00447	07/03/2019	14:04								
			<5	ug/L	5				0	15
Copper										
AE00447	07/03/2019	14:04								
			<5	ug/L	5				0	15
Iron										
AE00447	07/03/2019	14:04								
			184	ug/L	550				2	15
Lead										
AE00447	07/03/2019	14:04								
			<1	ug/L	1				0	15
Manganese										
AE00447	07/03/2019	14:04								
			20	ug/L	1				0.1	15
Molybdenum										
AE00447	07/03/2019	14:04								
			<5	ug/L	5				0.4	20
Nickel										
AE00447	07/03/2019	14:04								
			<10	ug/L	10				0.0	20
Selenium										

AE00447	07/03/2019 14:04					
		<1	ug/L	1	0	20
Silver						
AE00447	07/03/2019 14:04					
		<0.5	ug/L	0.5	0	20
Strontium						
AE00447	07/03/2019 14:04					
		760	ug/L	110	0.50	20
Thallium						
AE00447	07/03/2019 14:04					
		<1	ug/L	1	0	20
Uranium						
AE00447	07/03/2019 14:04					
		1.0	ug/L	0.5	0	15
Vanadium						
AE00447	07/03/2019 14:04					
		<10	ug/L	10	0.0	15
Zinc						
AE00447	07/03/2019 14:04					
		<10	ug/L	10	0.0	15
Aluminum						
AE00502	07/03/2019 18:47					
		<50	ug/L	50	0	20
Antimony						
AE00502	07/03/2019 18:47					
		<1	ug/L	1	0	20
Arsenic						
AE00502	07/03/2019 18:47					
		1	ug/L	1	0	20
Barium						
AE00502	07/03/2019 18:47					
		75	ug/L	10	7	15
Beryllium						
AE00502	07/03/2019 18:47					
		<1	ug/L	1	0	15
Boron						
AE00502	07/03/2019 18:47					
		95	ug/L	10	6	15
Cadmium						
AE00502	07/03/2019 18:47					
		<0.1	ug/L	0.1	0	15
Chromium						
AE00502	07/03/2019 18:47					
		<5	ug/L	5	0	15
Cobalt						
AE00502	07/03/2019 18:47					
		<5	ug/L	5	0	15
Copper						
AE00502	07/03/2019 18:47					
		<5	ug/L	5	0	15
Iron						
AE00502	07/03/2019 18:47					
		128	ug/L	50	3	15
Lead						
AE00502	07/03/2019 18:47					
		<1	ug/L	1	0	15
Manganese						

AE00502	07/03/2019 18:47					
		258	ug/L	1	5	15
Molybdenum						
AE00502	07/03/2019 18:47					
		<5	ug/L	5	0	20
Nickel						
AE00502	07/03/2019 18:47					
		<10	ug/L	10	0.0	20
Selenium						
AE00502	07/03/2019 18:47					
		2	ug/L	1	0	20
Silver						
AE00502	07/03/2019 18:47					
		<0.5	ug/L	0.5	0	20
Strontium						
AE00502	07/03/2019 18:47					
		1005	ug/L	10	0.80	20
Thallium						
AE00502	07/03/2019 18:47					
		<1	ug/L	1	0	20
Uranium						
AE00502	07/03/2019 18:47					
		9.1	ug/L	0.5	4.0	15
Vanadium						
AE00502	07/03/2019 18:47					
		<10	ug/L	10	0.0	15
Zinc						
AE00502	07/03/2019 18:47					
		<10	ug/L	10	0.0	15
Aluminum						
AE00744	07/03/2019 15:15					
		146	ug/L	50	0.1	20
Antimony						
AE00744	07/03/2019 15:15					
		<1	ug/L	1	0	20
Arsenic						
AE00744	07/03/2019 15:15					
		<1	ug/L	1	0	20
Barium						
AE00744	07/03/2019 15:15					
		41	ug/L	10	2	15
Beryllium						
AE00744	07/03/2019 15:15					
		<1	ug/L	1	0	15
Boron						
AE00744	07/03/2019 15:15					
		19	ug/L	10	5	15
Cadmium						
AE00744	07/03/2019 15:15					
		<0.1	ug/L	0.1	0	15
Chromium						
AE00744	07/03/2019 15:15					
		<5	ug/L	5	0	15
Cobalt						
AE00744	07/03/2019 15:15					
		<5	ug/L	5	0	15
Copper						

AE00744	07/03/2019 15:15								
		<5	ug/L	5				0	15
Iron									
AE00744	07/03/2019 15:15								
		<50	ug/L	50				2	15
Lead									
AE00744	07/03/2019 15:15								
		<1	ug/L	1				0	15
Manganese									
AE00744	07/03/2019 15:15								
		29	ug/L	1				5	15
Molybdenum									
AE00744	07/03/2019 15:15								
		<5	ug/L	5				0	20
Nickel									
AE00744	07/03/2019 15:15								
		<10	ug/L	10				0.0	20
Selenium									
AE00744	07/03/2019 15:15								
		<1	ug/L	1				0	20
Silver									
AE00744	07/03/2019 15:15								
		<0.5	ug/L	0.5				0	20
Strontium									
AE00744	07/03/2019 15:15								
		322	ug/L	110				1.7	20
Thallium									
AE00744	07/03/2019 15:15								
		<1	ug/L	1				0	20
Uranium									
AE00744	07/03/2019 15:15								
		0.7	ug/L	0.5				0	15
Vanadium									
AE00744	07/03/2019 15:15								
		<10	ug/L	10				0.0	15
Zinc									
AE00744	07/03/2019 15:15								
		<10	ug/L	10				0.0	15
Initial Cal Control Value ICPMS_ALL_TOTA									
Aluminum									
AE00701	07/03/2019 13:30				103	85	115		
		51	ug/L	50					
Antimony									
AE00701	07/03/2019 13:30				101	80	120		
		51	ug/L	1					
Arsenic									
AE00701	07/03/2019 13:30				101	85	115		
		50	ug/L	1					
Barium									
AE00701	07/03/2019 13:30				101	85	115		
		50	ug/L	10					
Beryllium									
AE00701	07/03/2019 13:30				102	85	115		
		51	ug/L	1					
Boron									

AE00701	07/03/2019	13:30				103	85	115
			51	ug/L	10			
Cadmium								
AE00701	07/03/2019	13:30				101.0	90	110
			50.5	ug/L	0.1			
Chromium								
AE00701	07/03/2019	13:30				101	85	115
			51	ug/L	5			
Cobalt								
AE00701	07/03/2019	13:30				103	85	115
			52	ug/L	5			
Copper								
AE00701	07/03/2019	13:30				103	85	115
			52	ug/L	5			
Iron								
AE00701	07/03/2019	13:30				100	85	115
			<50	ug/L	50			
Lead								
AE00701	07/03/2019	13:30				102	85	115
			51.2	ug/L	1			
Manganese								
AE00701	07/03/2019	13:30				100	85	115
			50	ug/L	1			
Molybdenum								
AE00701	07/03/2019	13:30				101	85	115
			50	ug/L	1			
Nickel								
AE00701	07/03/2019	13:30				103	85	115
			52	ug/L	10			
Selenium								
AE00701	07/03/2019	13:30				100	85	115
			50	ug/L	1			
Silver								
AE00701	07/03/2019	13:30				103.4	80	120
			51.7	ug/L	0.1			
Strontium								
AE00701	07/03/2019	13:30				97	85	115
			49	ug/L	10			
Thallium								
AE00701	07/03/2019	13:30				104	85	115
			52	ug/L	1			
Uranium								
AE00701	07/03/2019	13:30				100.4	85	115
			50.2	ug/L	0.5			
Vanadium								
AE00701	07/03/2019	13:30				103	85	115
			51	ug/L	10			
Zinc								
AE00701	07/03/2019	13:30				102	85	115
			51	ug/L	10			
Lab Reagent Blank fortotal elements								
Aluminum								
AE00700	07/03/2019	13:26						
			<50	ug/L	50			
Antimony								

AE00700	07/03/2019 13:26			
		<1	ug/L	1
Arsenic				
AE00700	07/03/2019 13:26			
		<1	ug/L	1
Barium				
AE00700	07/03/2019 13:26			
		<10	ug/L	10
Beryllium				
AE00700	07/03/2019 13:26			
		<1	ug/L	1
Boron				
AE00700	07/03/2019 13:26			
		<10	ug/L	10
Cadmium				
AE00700	07/03/2019 13:26			
		<0.1	ug/L	0.1
Chromium				
AE00700	07/03/2019 13:26			
		<5	ug/L	5
Cobalt				
AE00700	07/03/2019 13:26			
		<5	ug/L	5
Copper				
AE00700	07/03/2019 13:26			
		<5	ug/L	5
Iron				
AE00700	07/03/2019 13:26			
		<50	ug/L	50
Lead				
AE00700	07/03/2019 13:26			
		<1	ug/L	1
Manganese				
AE00700	07/03/2019 13:26			
		<1	ug/L	1
Molybdenum				
AE00700	07/03/2019 13:26			
		<5	ug/L	5
Nickel				
AE00700	07/03/2019 13:26			
		<10	ug/L	10
Selenium				
AE00700	07/03/2019 13:26			
		<1	ug/L	1
Silver				
AE00700	07/03/2019 13:26			
		<0.5	ug/L	0.5
Strontium				
AE00700	07/03/2019 13:26			
		<10	ug/L	10
Thallium				
AE00700	07/03/2019 13:26			
		<1	ug/L	1
Uranium				
AE00700	07/03/2019 13:26			
		<0.5	ug/L	0.5
Vanadium				

AE00700	07/03/2019 13:26								
		<10	ug/L	10					
Zinc									
AE00700	07/03/2019 13:26								
		<10	ug/L	10					
TOTAL SAMPLE MATRIX DUP SPIKE RECOVERY									
Aluminum									
AE00447	07/03/2019 14:04				104	85	115		
		648	ug/L	550				0.2	20
Antimony									
AE00447	07/03/2019 14:04				101	80	120		
		52	ug/L	1				1	20
Arsenic									
AE00447	07/03/2019 14:04				102	85	115		
		51	ug/L	1				0.1	20
Barium									
AE00447	07/03/2019 14:04				104	85	115		
		91	ug/L	10				1	15
Beryllium									
AE00447	07/03/2019 14:04				94	85	115		
		47	ug/L	1				2	15
Boron									
AE00447	07/03/2019 14:04				112	85	115		
		79	ug/L	10				3	15
Cadmium									
AE00447	07/03/2019 14:04				99.0	90	110		
		49.5	ug/L	0.1				0.6	15
Chromium									
AE00447	07/03/2019 14:04				104	85	115		
		52	ug/L	5				0.5	15
Cobalt									
AE00447	07/03/2019 14:04				102	85	115		
		51	ug/L	5				1	15
Copper									
AE00447	07/03/2019 14:04				102	85	115		
		51	ug/L	5				1	15
Iron									
AE00447	07/03/2019 14:04				102	85	115		
		740	ug/L	550				0.1	15
Lead									
AE00447	07/03/2019 14:04				108	85	115		
		54	ug/L	1				1	15
Manganese									
AE00447	07/03/2019 14:04				102	85	115		
		71	ug/L	1				0.8	15
Molybdenum									
AE00447	07/03/2019 14:04				106	85	115		
		53	ug/L	1				0.5	20
Nickel									
AE00447	07/03/2019 14:04				102	85	115		
		51	ug/L	10				0.10	20
Selenium									
AE00447	07/03/2019 14:04				100	85	115		
		50	ug/L	1				3	20
Silver									

AE00447	07/03/2019	14:04				101.8	80	120		
			50.9	ug/L	0.1				0.9	20
Strontium										
AE00447	07/03/2019	14:04				104	85	115		
			1327	ug/L	110				1.7	20
Thallium										
AE00447	07/03/2019	14:04				106	85	115		
			53	ug/L	1				5	20
Uranium										
AE00447	07/03/2019	14:04				103.4	85	115		
			52.7	ug/L	0.5				1.6	15
Vanadium										
AE00447	07/03/2019	14:04				106	85	115		
			53	ug/L	10				0.70	15
Zinc										
AE00447	07/03/2019	14:04				100	85	115		
			50	ug/L	10				0.0	15
Aluminum										
AE00502	07/03/2019	18:55				91	85	115		
			87	ug/L	50				0.09	20
Antimony										
AE00502	07/03/2019	18:55				108	80	120		
			54	ug/L	1				0.05	20
Arsenic										
AE00502	07/03/2019	18:55				106	85	115		
			54	ug/L	1				0	20
Barium										
AE00502	07/03/2019	18:55				90	85	115		
			125	ug/L	10				0.2	15
Beryllium										
AE00502	07/03/2019	18:55				98	85	115		
			49	ug/L	1				0	15
Boron										
AE00502	07/03/2019	18:55				104	85	115		
			152	ug/L	10				0.1	15
Cadmium										
AE00502	07/03/2019	18:55				101.6	90	110		
			50.8	ug/L	0.1				0.07	15
Chromium										
AE00502	07/03/2019	18:55				108	85	115		
			54	ug/L	5				0	15
Cobalt										
AE00502	07/03/2019	18:55				110	85	115		
			55	ug/L	5				0.05	15
Copper										
AE00502	07/03/2019	18:55				106	85	115		
			53	ug/L	5				0	15
Iron										
AE00502	07/03/2019	18:55				90	85	115		
			177	ug/L	50				0.04	15
Lead										
AE00502	07/03/2019	18:55				110	85	115		
			55.0	ug/L	1				0.05	15
Manganese										
AE00502	07/03/2019	18:55				74	85	115		
			309	ug/L	1				0.04	15
Molybdenum										

AE00502	07/03/2019	18:55				110	85	115		
			59	ug/L	1				0.05	20
Nickel										
AE00502	07/03/2019	18:55				110	85	115		
			55	ug/L	10				0.0	20
Selenium										
AE00502	07/03/2019	18:55				100	85	115		
			52	ug/L	1				0.05	20
Silver										
AE00502	07/03/2019	18:55				102.2	80	120		
			51.1	ug/L	0.1				0.08	20
Strontium										
AE00502	07/03/2019	18:55				115	85	115		
			1632	ug/L	10				0.077	20
Thallium										
AE00502	07/03/2019	18:55				110	85	115		
			55	ug/L	1				0.05	20
Uranium										
AE00502	07/03/2019	18:55				90.8	85	115		
			54.9	ug/L	0.5				0.04	15
Vanadium										
AE00502	07/03/2019	18:55				111	85	115		
			58	ug/L	10				0.0	15
Zinc										
AE00502	07/03/2019	18:55				100	85	115		
			50	ug/L	10				0.048	15
Aluminum										
AE00744	07/03/2019	15:35				106	85	115		
			730	ug/L	550				0.4	20
Antimony										
AE00744	07/03/2019	15:35				104	80	120		
			52	ug/L	1				0.2	20
Arsenic										
AE00744	07/03/2019	15:35				104	85	115		
			52	ug/L	1				0.4	20
Barium										
AE00744	07/03/2019	15:35				88	85	115		
			86	ug/L	10				0.7	15
Beryllium										
AE00744	07/03/2019	15:35				96	85	115		
			48	ug/L	1				3	15
Boron										
AE00744	07/03/2019	15:35				112	85	115		
			74	ug/L	10				1	15
Cadmium										
AE00744	07/03/2019	15:35				101.4	90	110		
			50.7	ug/L	0.1				0.6	15
Chromium										
AE00744	07/03/2019	15:35				110	85	115		
			55	ug/L	5				2	15
Cobalt										
AE00744	07/03/2019	15:35				108	85	115		
			54	ug/L	5				2	15
Copper										
AE00744	07/03/2019	15:35				110	85	115		
			55	ug/L	5				1	15
Iron										

AE00744	07/03/2019 15:35				106	85	115		
		821	ug/L	550				0.8	15
Lead									
AE00744	07/03/2019 15:35				110	85	115		
		55	ug/L	1				1	15
Manganese									
AE00744	07/03/2019 15:35				94	85	115		
		78	ug/L	1				2	15
Molybdenum									
AE00744	07/03/2019 15:35				108	85	115		
		54	ug/L	1				0.1	20
Nickel									
AE00744	07/03/2019 15:35				110	85	115		
		55	ug/L	10				0.60	20
Selenium									
AE00744	07/03/2019 15:35				102	85	115		
		51	ug/L	1				2	20
Silver									
AE00744	07/03/2019 15:35				105.4	80	120		
		52.7	ug/L	0.1				0.1	20
Strontium									
AE00744	07/03/2019 15:35				99	85	115		
		873	ug/L	110				1.2	20
Thallium									
AE00744	07/03/2019 15:35				106	85	115		
		53	ug/L	1				2	20
Uranium									
AE00744	07/03/2019 15:35				100.0	85	115		
		50.7	ug/L	0.5				0.2	15
Vanadium									
AE00744	07/03/2019 15:35				112	85	115		
		56	ug/L	10				0.80	15
Zinc									
AE00744	07/03/2019 15:35				104	85	115		
		52	ug/L	10				0.60	15
SAMPLE MATRIX SPIKE RECOVERY									
Aluminum									
AE00447	07/03/2019 14:25				104	85	115		
		647	ug/L	550					
Antimony									
AE00447	07/03/2019 14:25				102	80	120		
		51	ug/L	1					
Arsenic									
AE00447	07/03/2019 14:25				102	85	115		
		51	ug/L	1					
Barium									
AE00447	07/03/2019 14:25				102	85	115		
		90	ug/L	10					
Beryllium									
AE00447	07/03/2019 14:25				92	85	115		
		46	ug/L	1					
Boron									
AE00447	07/03/2019 14:25				114	85	115		
		81	ug/L	10					
Cadmium									

AE00447	07/03/2019 14:25				98.4	90	110
		49.2	ug/L	0.1			
Chromium							
AE00447	07/03/2019 14:25				104	85	115
		52	ug/L	5			
Cobalt							
AE00447	07/03/2019 14:25				102	85	115
		51	ug/L	5			
Copper							
AE00447	07/03/2019 14:25				100	85	115
		50	ug/L	5			
Iron							
AE00447	07/03/2019 14:25				102	85	115
		740	ug/L	550			
Lead							
AE00447	07/03/2019 14:25				106	85	115
		53	ug/L	1			
Manganese							
AE00447	07/03/2019 14:25				100	85	115
		70	ug/L	1			
Molybdenum							
AE00447	07/03/2019 14:25				106	85	115
		53	ug/L	1			
Nickel							
AE00447	07/03/2019 14:25				102	85	115
		51	ug/L	10			
Selenium							
AE00447	07/03/2019 14:25				98	85	115
		49	ug/L	1			
Silver							
AE00447	07/03/2019 14:25				100.8	80	120
		50.4	ug/L	0.1			
Strontium							
AE00447	07/03/2019 14:25				100	85	115
		1304	ug/L	110			
Thallium							
AE00447	07/03/2019 14:25				100	85	115
		50	ug/L	1			
Uranium							
AE00447	07/03/2019 14:25				101.8	85	115
		51.9	ug/L	0.5			
Vanadium							
AE00447	07/03/2019 14:25				106	85	115
		53	ug/L	10			
Zinc							
AE00447	07/03/2019 14:25				100	85	115
		50	ug/L	10			
Aluminum							
AE00502	07/03/2019 18:51				96	85	115
		85	ug/L	50			
Antimony							
AE00502	07/03/2019 18:51				110	80	120
		55	ug/L	1			
Arsenic							
AE00502	07/03/2019 18:51				106	85	115
		54	ug/L	1			
Barium							

AE00502	07/03/2019	18:51				98	85	115
			129	ug/L	10			
Beryllium								
AE00502	07/03/2019	18:51				98	85	115
			49	ug/L	1			
Boron								
AE00502	07/03/2019	18:51				110	85	115
			155	ug/L	10			
Cadmium								
AE00502	07/03/2019	18:51				104.6	90	110
			52.3	ug/L	0.1			
Chromium								
AE00502	07/03/2019	18:51				108	85	115
			54	ug/L	5			
Cobalt								
AE00502	07/03/2019	18:51				108	85	115
			54	ug/L	5			
Copper								
AE00502	07/03/2019	18:51				106	85	115
			53	ug/L	5			
Iron								
AE00502	07/03/2019	18:51				88	85	115
			176	ug/L	50			
Lead								
AE00502	07/03/2019	18:51				112	85	115
			56.0	ug/L	1			
Manganese								
AE00502	07/03/2019	18:51				72	85	115
			308	ug/L	1			
Molybdenum								
AE00502	07/03/2019	18:51				111	85	115
			60	ug/L	1			
Nickel								
AE00502	07/03/2019	18:51				110	85	115
			55	ug/L	10			
Selenium								
AE00502	07/03/2019	18:51				102	85	115
			53	ug/L	1			
Silver								
AE00502	07/03/2019	18:51				105.4	80	120
			52.7	ug/L	0.1			
Strontium								
AE00502	07/03/2019	18:51				112	85	115
			1614	ug/L	10			
Thallium								
AE00502	07/03/2019	18:51				108	85	115
			54	ug/L	1			
Uranium								
AE00502	07/03/2019	18:51				92.6	85	115
			55.8	ug/L	0.5			
Vanadium								
AE00502	07/03/2019	18:51				111	85	115
			58	ug/L	10			
Zinc								
AE00502	07/03/2019	18:51				102	85	115
			51	ug/L	10			
Aluminum								

AE00744	07/03/2019 15:19				106	85	115
		727	ug/L	550			
Antimony							
AE00744	07/03/2019 15:19				106	80	120
		53	ug/L	1			
Arsenic							
AE00744	07/03/2019 15:19				104	85	115
		52	ug/L	1			
Barium							
AE00744	07/03/2019 15:19				88	85	115
		86	ug/L	10			
Beryllium							
AE00744	07/03/2019 15:19				100	85	115
		50	ug/L	1			
Boron							
AE00744	07/03/2019 15:19				114	85	115
		75	ug/L	10			
Cadmium							
AE00744	07/03/2019 15:19				108.8	90	110
		54.4	ug/L	0.1			
Chromium							
AE00744	07/03/2019 15:19				108	85	115
		54	ug/L	5			
Cobalt							
AE00744	07/03/2019 15:19				108	85	115
		54	ug/L	5			
Copper							
AE00744	07/03/2019 15:19				108	85	115
		54	ug/L	5			
Iron							
AE00744	07/03/2019 15:19				105	85	115
		814	ug/L	550			
Lead							
AE00744	07/03/2019 15:19				110	85	115
		55	ug/L	1			
Manganese							
AE00744	07/03/2019 15:19				92	85	115
		77	ug/L	1			
Molybdenum							
AE00744	07/03/2019 15:19				106	85	115
		53	ug/L	1			
Nickel							
AE00744	07/03/2019 15:19				108	85	115
		54	ug/L	10			
Selenium							
AE00744	07/03/2019 15:19				100	85	115
		50	ug/L	1			
Silver							
AE00744	07/03/2019 15:19				105.2	80	120
		52.6	ug/L	0.1			
Strontium							
AE00744	07/03/2019 15:19				97	85	115
		862	ug/L	110			
Thallium							
AE00744	07/03/2019 15:19				104	85	115
		52	ug/L	1			
Uranium							

AE00744	07/03/2019 15:19				99.8	85	115
		50.6	ug/L	0.5			
Vanadium							
AE00744	07/03/2019 15:19				110	85	115
		55	ug/L	10			
Zinc							
AE00744	07/03/2019 15:19				104	85	115
		52	ug/L	10			
QCS Value for ICPMS_ALL_TOTAL							
Aluminum							
AE00702	07/03/2019 17:26				107	85	115
		2163	ug/L	50			
Antimony							
AE00702	07/03/2019 17:26				104	85	115
		609	ug/L	1			
Arsenic							
AE00702	07/03/2019 17:26				102	85	115
		278	ug/L	1			
Barium							
AE00702	07/03/2019 17:26				103	85	115
		391	ug/L	10			
Beryllium							
AE00702	07/03/2019 17:26				104	85	115
		415	ug/L	1			
Boron							
AE00702	07/03/2019 17:26				109	85	115
		1867	ug/L	10			
Cadmium							
AE00702	07/03/2019 17:26				101.0	90	110
		170.3	ug/L	0.1			
Chromium							
AE00702	07/03/2019 17:26				105	85	115
		905	ug/L	5			
Cobalt							
AE00702	07/03/2019 17:26				103	85	115
		573	ug/L	5			
Copper							
AE00702	07/03/2019 17:26				103	85	115
		833	ug/L	5			
Iron							
AE00702	07/03/2019 17:26				103	85	115
		374	ug/L	50			
Lead							
AE00702	07/03/2019 17:26				101	85	115
		269	ug/L	1			
Manganese							
AE00702	07/03/2019 17:26				104	85	115
		770	ug/L	1			
Molybdenum							
AE00702	07/03/2019 17:26				106	85	115
		118	ug/L	5			
Nickel							
AE00702	07/03/2019 17:26				105	85	115
		1052	ug/L	10			
Selenium							

AE00702	07/03/2019 17:26				103	85	115			
		808	ug/L	1						
Silver										
AE00702	07/03/2019 17:26				102.0	85	115			
		488.8	ug/L	0.5						
Strontium										
AE00702	07/03/2019 17:26				100	85	115			
		345	ug/L	10						
Thallium										
AE00702	07/03/2019 17:26				104	85	115			
		513	ug/L	1						
Uranium										
AE00702	07/03/2019 17:26				99.8	85	115			
		93.5	ug/L	0.5						
Vanadium										
AE00702	07/03/2019 17:26				109	85	115			
		2020	ug/L	10						
Zinc										
AE00702	07/03/2019 17:26				104	85	115			
		478	ug/L	10						

ICS900-3453		Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Continuing Calibration Control Recovery										
Chlorides										
AE00525	04/26/2019 22:17				96.1	90				
		19.2270	mg/L	1						
Sulfates										
AE00525	04/26/2019 22:17				97.3	85				
		38.9253	mg/L	2						
Sample Duplicate Value for ICS900										
Chlorides										
AE00447	04/26/2019 19:41									
		1.4235	mg/L	1				3	10	
Sulfates										
AE00447	04/26/2019 19:41									
		133.3002	mg/L	10				5	15	
Initial Calibration Control Value for IC										
Chlorides										
AE00523	04/29/2019 10:39				99.1	90	110			
		39.6446	mg/L	1						
Sulfates										
AE00523	04/29/2019 10:39				99.1	85	115			
		39.6432	mg/L	2						
Lab Reagent Blank for ICS900										
Chlorides										
AE00522	04/26/2019 15:03									
		<1	mg/L	1						
Sulfates										
AE00522	04/26/2019 15:03									
		<2	mg/L	2						
Sample Matrix Duplicate Value for ICS900										
Chlorides										
AE00447	04/26/2019 19:58				93.3	90	110			
		20.1311	mg/L	1				0.6	10	
Sulfates										

AE00447	04/26/2019 19:58				99	85	115			
		337.2087	mg/L	10				0.2	15	
Sample Matrix Spike Value for ICS900										
Chlorides										
AE00447	04/26/2019 19:58				94	90	110			
		20.2445	mg/L	1						
Sulfates										
AE00447	04/26/2019 19:58				99	85	115			
		338.0054	mg/L	10						
Quality Control Sample Value for ICS900										
Chlorides										
AE00524	04/26/2019 15:37				96.2	90	110			
		68.3674	mg/L	2						
Sulfates										
AE00524	04/26/2019 15:37				104	85	115			
		12.7290	mg/L	4						

ICS900-3462	Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Continuing Calibration Control Recovery									
Chlorides									
AE00565 05/01/2019 23:18				93.5	90				
	18.7014	mg/L	1						
Sulfates									
AE00565 05/01/2019 23:18				96	85				
	38.3875	mg/L	2						
Sample Duplicate RPD for ICS900									
Chlorides									
AE00497 05/01/2019 17:13									
	5.0270	mg/L	1				0.6	10	
Sulfates									
AE00497 05/01/2019 17:13									
	254.1875	mg/L	20				0.2	15	
Initial Calibration Control Recovery									
Chlorides									
AE00563 05/01/2019 16:21				99	90	110			
	39.6019	mg/L	1						
Sulfates									
AE00563 05/01/2019 16:21				98.7	85	115			
	39.4612	mg/L	2						
Lab Reagent Blank for ICS900									
Chlorides									
AE00562 05/01/2019 16:04									
	<1	mg/L	1						
Sulfates									
AE00562 05/01/2019 16:04									
	<2	mg/L	2						
Spike Relative Percent Difference									
Chlorides									
AE00497 05/01/2019 17:48				94.1	90	110			
	23.8785	mg/L	1				1	10	
Sulfates									
AE00497 05/01/2019 17:48				100	85	115			
	653.9468	mg/L	20				0.4	15	
Sample Matrix Spike Value for ICS900									
Chlorides									

AE00497	05/01/2019 20:59				93	90	110			
		23.6006	mg/L	1						
Sulfates										
AE00497	05/01/2019 20:59				99	85	115			
		651.2655	mg/L	20						
Quality Control Sample Recovery for ICS9										
Chlorides										
AE00564	05/01/2019 16:39				96.1	90	110			
		68.3019	mg/L	2						
Sulfates										
AE00564	05/01/2019 16:39				104	85	115			
		12.6989	mg/L	4						

NITROGEN_DIGEST-3471		Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Cont Cal Cont Rec Total Nitrogen										
AE00591	05/06/2019 11:00				98.8	85	115			
		0.99	mg/l	0.1						
AE00592	05/06/2019 11:17				95.2	85	115			
		0.95	mg/l	0.1						
Sample Duplicate RPD for Nitrogen, Wet										
AE00490	05/06/2019 11:07									
		0.36	mg/l	0.1				10.7	15	
AE00498	05/06/2019 11:02									
		0.39	mg/l	0.1				5.2	15	
Initial Cal. Control Recovery Nitrogen										
AE00589	05/06/2019 10:45				101	85	115			
		1.0	mg/L	0.1						
Lab Reagent Blank for Nitrogen, Wet Dige										
AE00588	05/06/2019 10:44									
		<0.1	mg/l	0.1						
Sample Matrix Dup. Recovery Nitrogen										
AE00490	05/06/2019 10:51				95.0	85	115			
		2.2	mg/L	0.1				0.00	15	
AE00498	05/06/2019 11:05				92.4	85	115			
		2.3	mg/L	0.1				0.889	15	
Sample Matrix Spike Recovery for Nitroge										
AE00490	05/06/2019 10:50				95.0	85	115			
		2.2	mg/L	0.1						
AE00498	05/06/2019 11:03				91.4	85	115			
		2.2	mg/L	0.1						
Quality Control Sample Recovery										
AE00590	05/06/2019 10:46				107	85	115			
		4.2	mg/L	0.1						

PHOSPHORUS_TOTAL-3483		Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Cont Cal Cont Rec Total Phosphorus										
AE00647	05/10/2019 12:06				104	85	115			
		0.10	mg/L	0.01						
AE00648	05/10/2019 12:06				107	85	115			
		0.11	mg/L	0.01						
Sample Dup RPD for Phosphorus, Total										
AE00493	05/10/2019 12:06									
		1.13	mg/L	0.01				0.88	15	

AE00501	05/10/2019 12:06								
		0.02	mg/L	0.01				5.3	15
Init Cal Cont Rec Phosphorus Total									
AE00645	05/10/2019 12:06				101	85	115		
		0.10	mg/L	0.01					
Lab Reagent Blank for Phosphorus, Total									
AE00644	05/10/2019 12:06								
		<0.01	mg/L	0.01					
Sample Matrix Dup Rec Phosphorus Total									
AE00493	05/10/2019 12:06				96.0	85	115		
		2.10	mg/L	0.01				0.957	15
AE00501	05/14/2019 16:00				91.5	85	115		
		0.11	mg/L	0.01				2.82	15
Sample Matrix Spike Phosphorus Total									
AE00493	05/10/2019 12:06				94.0	85	115		
		2.08	mg/L	0.01					
AE00501	05/10/2019 12:06				88.5	85	115		
		0.10	mg/L	0.01					
QCS Recovery for Phosphorus Total									
AE00646	05/10/2019 12:06				112	85	115		
		5.75	mg/L	0.01					

SULFIDE-3452	Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Cont. Calib. Control Value for Sulfide									
AE00521 04/26/2019 13:30				115.38		130			
	0.60	mg/L	0.05						
Sample Duplicate RPD for Sulfide									
AE00492 04/26/2019 13:30									
	<0.05	mg/L	0.05				0	30	
Initial Cal. Cont. Recovery for Sulfide									
AE00520 04/26/2019 13:30				119.23		130			
	0.62	mg/L	0.05						
Laboratory Blank for Sulfide									
AE00519 04/26/2019 13:30									
	<0.05	mg/L	0.05						
Duplicate Spike Recovery for Sulfide									
AE00492 04/26/2019 15:12				119.23	70	130			
	0.62	mg/L					0	30	
Spike Recovery for Sulfide									
AE00492 04/26/2019 13:30				119.23	70	130			
	0.62	mg/L							

SULFIDE-3458	Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Cont. Calib. Control Value for Sulfide									
AE00544 04/29/2019 13:15				102		130			
	0.56	mg/L	0.05						
Sample Duplicate RPD for Sulfide									
AE00499 04/29/2019 13:15									
	NR	mg/L	0.05				NR	30	
Initial Cal. Cont. Recovery for Sulfide									
AE00543 04/29/2019 13:51				105		130			
	0.58	mg/L	0.05						
Laboratory Blank for Sulfide									

AE00542	04/29/2019 13:51									
		<0.05	mg/L	0.05						
Duplicate Spike Recovery for Sulfide										
AE00499	04/29/2019 13:15				NR	70	130			
		NR	mg/L					NR	30	
Spike Recovery for Sulfide										
AE00499	04/29/2019 13:15				NR	70	130			
		NR	mg/L							

TDS-3445		Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Sample Duplicate RPD TDS										
AE00494	04/24/2019 16:17									
		628	mg/L	10				0.635	15	
TDS Lab Blank										
AE00509	04/24/2019 16:17									
		<10	mg/L	10						
Martix Spike RPD Total Dissolved Solids										
AE00494	04/24/2019 16:17				101.2	69	131			
		1644	mg/L	10				0.727	15	
Sample Matrix Spike Recovery for TDS										
AE00494	04/24/2019 16:17				102.4	69	131			
		1656	mg/L	10						

TDS-3450		Result	Unit	RL	%REC	Lower Limit %	Upper Limit %	RPD	RPD Limit %	Qualifier
Sample Duplicate RPD TDS										
AE00504	04/25/2019 11:37									
		188	mg/L	10				2.15	15	
TDS Lab Blank										
AE00516	04/25/2019 11:37									
		<10	mg/L	10						
Martix Spike RPD Total Dissolved Solids										
AE00504	04/25/2019 11:37				101.6	69	131			
		1200	mg/L	10				0.66	15	
Sample Matrix Spike Recovery for TDS										
AE00504	04/25/2019 11:37				102.4	69	131			
		1208	mg/L	10						

Login Completed by:	Johannah Mayhew
Reviewed by:	
Shipping container/cooler in good condition?	Yes
Custody seals intact on shipping container/cooler?	Not Present
Custody seals intact on sample bottles?	Not Present
Chain of custody present?	Yes
Chain of custody signed when relinquished and received?	Yes
Chain of custody agrees with sample labels?	Yes
Samples in proper container/bottle?	Yes
Sample containers intact?	Yes
Sufficient sample volume for indicated test?	Yes
All samples received within holding time?	Not Present
Temp. Blank Received?	Not Applicable
Errors in Chain-of-custody?	No
Container or Temp Blank temperature 0.0-6.0C on Ice	0.5/1.2/1.6/-1.3
Water- VOA vials have zero headspace?	No VOA vials submitted
Water- pH acceptable upon receipt?	Yes
Contact and Corrective Action Comments:	Hand-delivered

Watershed Section Chain of Custody and Analytical Request Record (revision date: 4-4-2012)

Program Name/Project Name: WATERSHED PROTECTION / BADWATER CREEK

Contact Name: MICHAEL THOMAS

Page 1 of 2

Contact Address: 200 W. 17th ST, CHEYENNE WY 82001

Contact Phone/Email: 777-2073/michael.thomas@wyo.gov

Custody Seal Y / (N)

Comments:
- ALL PRESERVED SAMPLES CHECKED FOR pH
- DISSOLVED METALS/DOC FILTERED IN FIELD

Hand-delivered 2019-04-24-001 PGL

Cooler Temperature: 0.5/#1 | 1.2/2 | 1.6/3 | -1.3/4

On Ice (Y) / N

Analysis Requested

	Sample Name	Sample ID	Date	Time	# Containers	ALKALINITY	TDS, Cl, SO_4, F	DISSOLVED METALS	TOTAL METALS	DOC	NH_4, NO_3-NO_2, TN/P	SULFIDE	For Laboratory Use Only
1	BADWATER CREEK - SITE 1	MJT-19-113-1	4/23/19	0908	7	X	X	X	X	X	X	X	
2	BADWATER CREEK - SITE 2	MJT-19-113-2	4/23/19	1011	7	X	X	X	X	X	X	X	
3	FIELD BLANK	MJT-19-113-3	4/23/19	1040	7	X	X	X	X	X	X	X	
4	BADWATER CREEK - SITE 3	MJT-19-113-4	4/23/19	1130	7	X	X	X	X	X	X	X	
5	DRY CREEK - SITE 4	MJT-19-113-5	4/23/19	1215	7	X	X	X	X	X	X	X	
6	BADWATER CREEK - SITE 5	MJT-19-113-6	4/23/19	1329	7	X	X	X	X	X	X	X	
7	BADWATER CREEK - SITE 6	MJT-19-113-7	4/23/19	1424	7	X	X	X	X	X	X	X	
8	BRIDGER CREEK - SITE 7	MJT-19-113-8	4/23/19	1439	7	X	X	X	X	X	X	X	
9	BADWATER CREEK - SITE 8	MJT-19-113-9	4/23/19	1453	7	X	X	X	X	X	X	X	
10	BADWATER CREEK - SITE 9	MJT-19-113-10	4/23/19	1620	7	X	X	X	X	X	X	X	
11	ALKALI CREEK - SITE 10	MJT-19-113-11	4/23/19	1639	7	X	X	X	X	X	X	X	
12	BADWATER CREEK - SITE 11	MJT-19-113-12	4/23/19	1656	7	X	X	X	X	X	X	X	
13	BADWATER CREEK - SITE 12	MJT-19-113-13	4/23/19	1758	7	X	X	X	X	X	X	X	
	Preservation: 1=ice, 2=H_2SO_4, 3=HCL, 4=HNO_3, 5=NaOH, 6=other ZnAc, 7=other____					1	1	4/1	4/1	3/1	2/1	5&6/1	

Custody Record MUST Be Signed

Relinquished by (name/date/time): MICHAEL THOMAS 4/24/19 @ 12:26

Relinquished by (name/date/time):

Received by (name/date/time):

Received by Laboratory (name/date/time): Johannah Mayhew 4/24/2019 12:26

Watershed Section Chain of Custody and Analytical Request Record (revision date: 4-4-2012)

Program Name/Project Name: WATERSHED PROTECTION / BADWATER CREEK

Contact Name: MICHAEL THOMAS

Contact Address: 200 W. 17th St, CHEYENNE WY 82001

Contact Phone/Email: 777-2073 / michael.thomas@wyo.gov

Comments:

SEE PAGE 1

Hand-delivered 2019-04-24-001 PG2

	Sample Name	Sample ID	Date	Time	# Containers	Analysis Requested: ALKALINITY	TDS, Cl, SO_4, F	DISSOLVED METALS	TOTAL METALS	DOC	NH_4, NO_3-NO_2, TNP	SULFIDE
1	BADWATER CREEK - SITE 12	MJT-19-113-14	4/23/19	1758	7	X	X	X	X	X	X	X
2	BADWATER CREEK - SITE 13	MJT-19-113-15	4/23/19	1856	7	X	X	X	X	X	X	X
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												

Preservation: 1=ice, 2=H_2SO_4, 3=HCL, 4=HNO_3, 5=NaOH, 6=other ____, 7=other____

Custody Record MUST Be Signed

Relinquished by (name/date/time): MICHAEL THOMAS 4/24/19 @ 12:26

Relinquished by (name/date/time):

Received by (name/date/time):

Received by Laboratory (name/date/time): Shannon Mayhew 4/24/19

Department of Environmental Quality

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

Mark Gordon, Governor

Todd Parfitt, Director

December 17, 2019

Ms. Andrea Taylor
Aethon Energy Operating LLC
450 S. Federal
Riverton, WY 82501

RE: Letter of Violation: WYPDES Permit WY0002062

Dear Ms. Taylor:

Since April 2019, the Wyoming Department of Environmental Quality (DEQ) has been collecting water quality data on Alkali, Badwater, Bridger, and Dry Creeks on an approximately monthly basis to determine whether the designated uses and water quality criteria applicable to Badwater Creek are appropriate and attainable. At DEQ's request, Aethon has also collected and submitted water quality data as part of this effort. Throughout the 2019 sampling season, WDEQ personnel documented the presence of black sediment on the bottom of the stream channel of Alkali Creek near its confluence with Badwater Creek, as well as Badwater Creek downstream of Alkali Creek. Staff also noted the presence of foam on the water surface at these locations. On August 27, 2019 and September 24, 2019, samples of foam as well as black sediment were collected by the DEQ to determine their chemical makeup and potential origin. Staff also collected samples from the three primary Aethon outfalls (001, 006, and 009) on August 27. At that time, foam was observed in the channels below each outfall and free oil accumulations were observed in wire weirs below outfall 006.

The DEQ has evaluated the currently available data and our analyses have identified the following violations:

Black sediment deposits are present in channels below outfalls 001, 006, and 009; Alkali Creek below the Moneta Divide oil and gas field, and; Badwater Creek for approximately seven miles downstream of its confluence with Alkali Creek. These deposits were identified as iron sulfide by applying hydrogen peroxide and watching the color disappear as FeS is converted to aqueous FeSO4 and by applying hydrochloric acid and noting the release of H2S gas. The deposits were not observed elsewhere in the Badwater Creek watershed and appear to be created when sulfide reacts with iron. In addition, precipitate mineral deposits covering the substrate materials were identified below the outfalls and in Alkai and Badwater Creeks.

Part I A.1 of Permit WY0002062 states that "There shall be no deposition of substances in quantities that could result in significant aesthetic degradation, or degradation of habitat for aquatic life, plant life or wildlife; or which could adversely affect public water supplies or those intended for agricultural or industrial use."

Foam was observed on the water surface below outfalls 001, 006 and 009; in Alkali Creek above its confluence with Badwater Creek, and; in Badwater Creek downstream of Alkali Creek. The foam was confirmed to be an anionic surfactant using a methylene blue activated substances (MBAS) colorimetric test. Water surface foams were not observed elsewhere in the Badwater Creek watershed. Free oil accumulations were observed in wire

weirs below outfall 006. In addition, petroleum hydrocarbons were identified in Alkali Creek sediments below outfall 6 and at the Downstream Monitoring Point (DMP).

Part I A.1 of Permit WY0002062 also states that "There shall be no discharge of floating solids or visible foam in other than trace amounts, nor shall the discharge cause formation of a visible sheen or visible hydrocarbon deposits on the bottom or shoreline of the receiving water."

The DEQ's review of currently available data indicates the following water quality criteria may have also been impacted by the permitted discharge: chloride concentrations, temperature changes, dissolved oxygen concentrations, and turbidity in Badwater Creek below its confluence with Alkali Creek. The DEQ will continue to evaluate these parameters as part of its ongoing investigation into designated uses and water quality criteria applicable to Badwater Creek. The department noted the presence of benzene, ethylbenzene, toluene and xylene in outfall samples collected by Aethon, however, samples collected at the DMP indicate the concentrations were within allowable limits.

The Water Quality Division is attempting to resolve these violations through conference and conciliation. Aethon should provide a written response within 30 days of the date of this letter presenting its plans and schedule to implement corrective measures to resolve these violations.

The intent of this letter is to provide an opportunity for your company to show good faith efforts toward resolving the problem and to prevent the need for more formal enforcement action by this office. I am requesting that Aethon provide a written response within 30 days of the date of this letter presenting its plans and schedule to implement corrective measures to resolve these violations. Failure to provide a written response may result in elevated enforcement actions and may include penalties.

Should you have any questions concerning this letter, please contact Kevin Wells at 307-777-8669 or Kevin.Wells@wyo.gov.

Thank you for your time and attention to this matter.

Sincerely,

Kevin Frederick
Administrator
Water Quality Division

KF/SG

cc: Todd Parfitt, Director
Kevin Wells, WYPDES Inspections and Compliance Supervisor
David Waterstreet, Watershed Section Manager
Jason Thomas, WYPDES Section Manager (Acting)