KDA-DWR's review of GMD 5's February 22, 2019 LEMA plan proposal

May 30, 2019

Executive Summary

The United States Fish & Wildlife Service ("Service") has informally complained for decades that junior groundwater pumping within the Rattlesnake Creek Basin has impaired its water right for Quivira National Wildlife Refuge ("Refuge") and therefore hindered its ability to perform its mission as a refuge. After nearly two decades of working with the Kansas Department of Agriculture-Division of Water Resources ("KDA-DWR"), Big Bend Groundwater Management District No. 5 ("GMD 5") and other basin partners, the Service made a formal complaint of water right impairment in 2013. KDA-DWR investigated and in 2016, found that the Service's right is being impaired. The Service has properly pursued relief to its impairment under Kansas law and KDA-DWR is responsible to protect the Service's senior Kansas water right.

After three years of discussions on a remedy for the impairment, KDA-DWR and GMD 5 still do not agree on what is necessary to resolve the impairment. KDA-DWR communicated, starting in July 2017, that a long-term remedy of the impairment could be achieved through a combination of GMD 5's proposed augmentation project to relieve the immediate water shortages, and groundwater pumping reductions of approx. 15% to ensure the lasting effectiveness of the augmentation and slow the deterioration of streamflow in the basin. GMD 5 asserts that augmentation is by itself enough to resolve the impairment and that groundwater pumping does not need to be reduced.

Both KDA-DWR and GMD 5 are relying on detailed analyses using the GMD 5 Model. There is no disagreement regarding the validity of the model or the results of the simulations generated using the model. The differences come from the interpretation of what the model simulations show and what long-term water management policies are required to consider the impairment resolved.

GMD 5's most recent position, as communicated through the February 22, 2019 Local Enhanced Management Area ("LEMA") plan submitted by its board, seems to be that 1) augmentation will be available (at some future undetermined date), 2)

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water use reductions are needed to reduce future growth to stream depletions, but no water reduction will be required, and 3) if in ten years the impairment is not resolved, a future GMD 5 board will request an Intensive Groundwater Use Control Area ("IGUCA") (although they do not possess the legal authority to commit a future board to action).

The latest LEMA plan comes after more than 18 months of GMD 5's discussions with KDA-DWR, several public meetings, and analyses and guidance from technical and legal consultants. Following a comprehensive review of latest GMD 5 proposal, as well as the additional analysis and backup data provided by GMD 5's consultant, KDA-DWR determined that while the plan does set forth a commendable list of voluntary water-saving measures, the plan fails to guarantee, by enforceable action, that what is needed to resolve the impairment will be accomplished. Lacking any enforceable water savings, and assuming credit for an augmentation project that is early in the planning stages (there is currently no funding, no water right is secured, there is no access to land, and no engineering plan), this plan is fundamentally flawed by its insufficiency to resolve the impairment.

The proposed LEMA plan's only corrective control, the ordering of irrigators to remove end guns from their center pivot systems, is also flawed because it does not reduce those irrigators' water allocations or the acres they are authorized to irrigate.

The technical work completed during these discussions has improved KDA-DWR's understanding of the local hydrology and alternatives for resolving the impairment and their impacts. Despite clear criteria and substantial support provided by KDA-DWR, GMD 5 remains unable or unwilling to provide a solution that KDA-DWR believes solves the impairment.

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I. The impairment to Quivira National Wildlife Refuge must be resolved

The Service owns and operates Water Right File No. 7,571 which is senior in priority to 95% of water rights that are in the area. As KDA-DWR's 2016 Final Impairment Report shows, these junior water rights are depleting the flows of Rattlesnake Creek.

The Service's water right is a Kansas water right, permitted and perfected pursuant to Kansas statutes, rules and regulations, and is entitled to the same protection from impairment as any other Kansas water right.

After decades of concern that junior groundwater pumping was preventing it from fully exercising its water right to capture the flows of the Rattlesnake Creek, in April 2013 the Service on behalf of the Refuge formally lodged its complaint and requested that the KDA-DWR conduct an impairment investigation.

KDA-DWR's initial report, published in December 2015, found that the Refuge was being impaired by junior users and the final report was published in July 2016. The Service formally requested on January 17, 2017 that KDA-DWR act to secure its water right for 2018. No administration of water rights occurred in 2018. The Service formally requested on December 13, 2018 for KDA-DWR to secure its water right for 2019.

It has now been nearly six years since the Service's formal complaint and nearly three years since the final impairment report was published. The Service has requested that KDA-DWR act to protect its water right. KDA-DWR has deferred regulating the impairing rights while it worked to help GMD 5 develop a locally-driven solution. But these efforts have stalled, and the law demands that the impairment of senior water right whose owner wishes to exercise that right cannot continue.

II. The overarching plan to resolve the impairment must meet certain hydrologic criteria

In 2017, given GMD 5's stated intent to use augmentation as an element of the solution and pursuant to GMD 5's request, KDA-DWR set forth the specific criteria required to resolve the impairment. There are two elements to the solution, augmentation and pumping reductions. Per statute written expressly for this impairment case, augmentation must be offered voluntarily. Pumping reductions require state administration by way of a LEMA, IGUCA, or strict water right administration.

a. The criteria for augmentation

The GMD 5 groundwater model ("Model") shows that pumping reductions, depending on how far from the stream they occur, may take years or even decades to affect streamflow. Likewise, reductions in pumping take years or even decades to benefit streamflow. Even with significant cuts to pumping, the Refuge would suffer impairment for many years before streamflow improved enough to relieve the shortages. Augmentation can provide water precisely when it is needed. This is why KDA-DWR supports the development of augmentation.

Based on what GMD 5 has stated that it is willing and able to build and operate, KDA-DWR's criteria for augmentation are:

The capacity to deliver at least 5,000 acre-feet per year of acceptable quality water at a rate of at least 15 cubic feet per second.

Building augmentation does not require a LEMA or any other special administrative district or area. To the extent that augmentation is discussed in the LEMA plan, it must be made clear that augmentation cannot be ordered by the chief engineer. K.S.A. 82a-706b. The only reason to refer to augmentation in GMD 5's LEMA plan is to note that it exists (or will imminently) and that when it is available it must be considered by the state along with the other management actions being undertaken by the basin.

Because it is a strictly voluntary action that can be implemented at any time, KDA-DWR has over the past two years repeatedly encouraged GMD 5 and all stakeholders in the basin to commence building an augmentation project to provide immediate relief to the Refuge.

b. The criterion for groundwater pumping reductions

The Model also shows that if current groundwater pumping behavior continues, the amount of water being taken from streamflow by groundwater pumping will continue to increase into the future. Though it fluctuates significantly from year to year, on average, the stream depletion rate is growing by about 400 acre-feet per year. This means, for example, if depletions to streamflow in 2020 are on the order of 50,000 acre-feet, then depletions in 2030 are projected to be around 54,000 acre-feet, and so on for each prospective decade.

As streamflow is reduced, impairment frequency and magnitude increase, thus reducing the effectiveness of the augmentation project because it would have to increase its capacity (volume and rate) to overcome the increasing continued loss of streamflow. This is the principal reason why KDA-DWR requires reductions in pumping. But there are other factors that require protecting a reasonable level of streamflow including slowing the degradation of the water quality in the stream and meeting statutory minimum desirable streamflow targets.

The KDA-DWR criterion for pumping reductions is not set to restore or even completely stabilize streamflow, but rather to slow the growth of depletions so that the augmentation project can be effective for a generation or more. The criterion is:

Reduce the stream depletion growth rate by one half.

This long-term, quantitative goal can be achieved in many ways and evaluated using annual water use reports and the GMD 5 Model. For instance, when KDA-DWR first presented this criterion it also presented a plan to achieve the goal by reducing groundwater pumping by 15% from recent historical use. GMD 5 used its groundwater model to validate its own proposal to reach the reduction goal by reducing pumping by about 10% over a wide area and by up to 25% in a targeted area close to the stream.

There is also an important water quality concern with the current groundwater pumping behavior. BGW's analysis shows that in the last decade of its 2008-2075 simulation, the modeled streamflow is about twice as dependent on runoff from precipitation events as it is now (and therefore not as reliable). And as pumping upstream continues to dry up baseflow (the contribution to streamflow from the aquifer), the remaining baseflow comes from the last few miles upstream of the Refuge where the water starts to become more saline. Given that the Refuge's mission to provide habitat is highly dependent on the chemistry of the water entering the refuge, water quality is a very serious concern.

III. KDA-DWR has provided GMD 5 a framework to enforce the water use reductions that GMD 5 acknowledges are necessary in its plan

Since August 2017 KDA-DWR and GMD 5 have negotiated how the water use reductions would be implemented and enforced.

KDA-DWR has always held that 1) the GMD 5 Model should be used to identify which water rights are impairing the refuge, 2) impairing water rights should be given multi-year (e.g. 5-year) allocations of water so that the goal of halving the depletion growth rate is met, 3) the allocations should be based on a combination of water right priority and degree of effect on the stream, 4) the allocations should be phased in assuming that augmentation is built and fully available in 3 years, and 5) if augmentation is not built, then more restrictive allocations (50%-60% cuts in historical use) will be implemented to restore streamflow.

a. GMD 5 has known what KDA-DWR requires in a LEMA since March 2018

In March 2018, KDA-DWR provided a draft LEMA plan[1] to GMD 5 that contained the elements set forth above and which would have been acceptable to the agency. GMD 5 declined to adopt the plan.

GMD 5's LEMA committee shared draft plans with KDA-DWR on July 12 and September 9 of 2018. KDA-DWR provided the committee with detailed feedback on those plans.[2]

b. KDA-DWR has compromised to allow flexibility

Through negotiation with GMD 5, KDA-DWR has agreed that instead of requiring allocations immediately, GMD 5 could be allowed to try to achieve the depletion goal with the combination of 1) significant progress on building augmentation, and a commitment to have augmentation available by 2022; and 2) a LEMA to remove end guns plus incentive-based, targeted water reductions in the high impact area. But KDA-DWR agreed to this more voluntary implementation only on the condition that the LEMA plan includes clear and enforceable controls that would be implemented in five years (2024) to achieve the goal if the incentive-based actions proved insufficient.

IV. Inadequacies of GMD 5's current plan to address the impairment

GMD 5's current proposed plan lacks clear and effective enforceable controls, and delays consideration of enforceable action until 2029, and even then, makes no enforceable commitment.

a. The plan lacks quantified goals and objectives

The plan's goal "to provide a satisfactory remedy to the impairment complaint at the Refuge", and its objective "to reduce water use in the LEMA area to a degree that will temper the growth of future streamflow losses" are only effective if those things are quantified and the plan lays out how they will be accomplished through enforceable action. But the plan includes only one action that can be ordered and enforced through the LEMA – removing end guns from center pivot systems in the LEMA area. And the only thing quantified about removing end guns is that the number of end guns in the LEMA area is known.

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[1] March 3, 2018 email from Chris Beightel [KDA-DWR] to Orrin Feril [GMD 5]

[2] https://www.agriculture.ks.gov/docs/default-source/dwr-water-appropriation-documents/kda_review_of_gmd5_9-aug-18_draft_lema_managementplan_20180823_.pdf?sfvrsn=701c87c1_0

To address the impairment, the plan needs to include the water reduction criterion that KDA-DWR has prescribed – reduce the stream depletion growth rate by one half – and the plan needs to establish how much water can be pumped by appropriators junior to the refuge in the LEMA area over some term, e.g. 781,537 acre-feet over five years.

The plan also states that "…4,000 AFY of water use or its hydrologic equivalent needs to be curtailed in the high impact area around St John…", but this statement is not tied to any quantified goal and there is no requirement that this action be taken or enforced.

b. The plan requires no reduction in water use

The plan does not reduce the acres that can be irrigated after end guns are removed. The plan does not limit the amount of water that can be used after end guns are removed, explicitly stating "the LEMA plan does not have a water use reduction requirement". Rather, the plan simply assumes that by removing end guns, "The District estimates a savings of 14,750 AFY."

Thus, the plan implicitly assumes that producers will not change their farming practices to take full advantage of their historical water supply. Of course, many options are available to the producer, such as growing a longer season variety of crop, changing crop types or patterns, or simply applying more water to gain more yield. Without setting limitations on water withdrawals, removing end guns is little more than a hope that producers will voluntarily reduce their water use. The inability to enforce or rely on a specific reduction in water use also makes it impossible to determine if the impairment has been stopped.

c. The plan relies on an augmentation project which does not exist and cannot be ordered by the chief engineer

As explained section II above, KDA-DWR supports the basin's plan to use augmentation to provide and encourages GMD 5, or whoever is willing and able, to move forward with building a functioning augmentation project as soon as possible. But as of now, there is no functioning project.

To provide a comprehensive plan to resolve the impairment, the plan needs to specify what will happen if augmentation is delayed by several years or is never available.

d. The plan relies on binding a future GMD 5 board to action if the current plan fails to resolve the impairment

In their plan, GMD 5 says that following the LEMA Order review done at the end of the 10-year period, "If… the District is not able to meet its obligations, then the District shall submit a written request to the Chief Engineer for the formation of an

Intensive Groundwater Use Control Area ("IGUCA")." This language is similar to the language in the 2000 Rattlesnake Creek Management Program[3] where, if the goals were not achieved, GMD 5 committed to "consider requesting that an Intensive Groundwater Use Control Area (IGUCA) be established." But though the 2000 management program fell far short of its goals, the board made no such IGUCA request. The language in this LEMA plan is no more enforceable on a future GMD 5 board than the management program language was.

The idea of triggering a request for IGUCA could be realized if it was tied to quantified goals, e.g., the current board could request an IGUCA process be initiated automatically if withdrawals over ten years exceed a fixed limit. But such goals are absent from this plan.

V. KDA-DWR is still not persuaded that augmentation alone will resolve the impairment

In January 2019, KDA-DWR published its Memo on Sufficiency of GMD 5's Augmentation-Only Plan to Resolve Quivira Impairment[4]. The memo's argument was summarized as:

"…the proposed augmentation project alone is not sufficient to remedy the impairment of Quivira's water right because the current level of groundwater pumping, if not reduced, will dry up the reliable part of the streamflow that comes from the aquifer. Reliable and total streamflow will be significantly reduced to such a degree that the impairment will continue even with the proposed augmentation project, while other uses upstream are compromised and the hydrologic health of the basin continues to deteriorate."

In response, GMD 5's consultant Balleau Groundwater Inc. ("BGW") transmitted a February 20, 2019 letter[5] arguing that baseflow (the "the reliable part of the streamflow that comes from the aquifer" referred to in the passage above) does not completely disappear in model simulations of the basin's future hydrology. The letter goes on to state that cutbacks in pumping are not necessary. In Attachment 1, KDA-DWR provides inline comments to BGW's February 20, 2019 letter.

a. Baseflow, the reliable part of the stream, is still going away

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[3] https://agriculture.ks.gov/docs/default-source/bmt---rsc/rsc_management.pdf?sfvrsn=5a38e03f_2 page 20

[4] https://www.agriculture.ks.gov/docs/default-source/dwr-water-appropriation-documents/sufficiencyofaugonly_2019-01-04_final.pdf?sfvrsn=ff2885c1_0

[5] http://archive.gmd5.org/LEMA/2019-02-20_BGW_LEMA_Issues.pdf

After BGW's recent work, KDA-DWR agrees with BGW on the fact that its simulation shows that baseflow and total streamflow will be significantly diminished over the next 50 years. BGW has demonstrated that there may still be a little more than zero baseflow available to the refuge in 50 years[6], but that contention is compromised by showing only an average of the last decade of the simulation. BGW's analysis does not show what shortages occur in the middle years of the simulation between 2020-2050, and due to averaging, BGW does not show the year-to-year shortages it anticipates. KDA-DWR analyzed the yearly baseflow output from BGW's simulation and found several years, beginning in about 2021 where there was no baseflow in the stream at Zenith[7]. See Figure 1 below

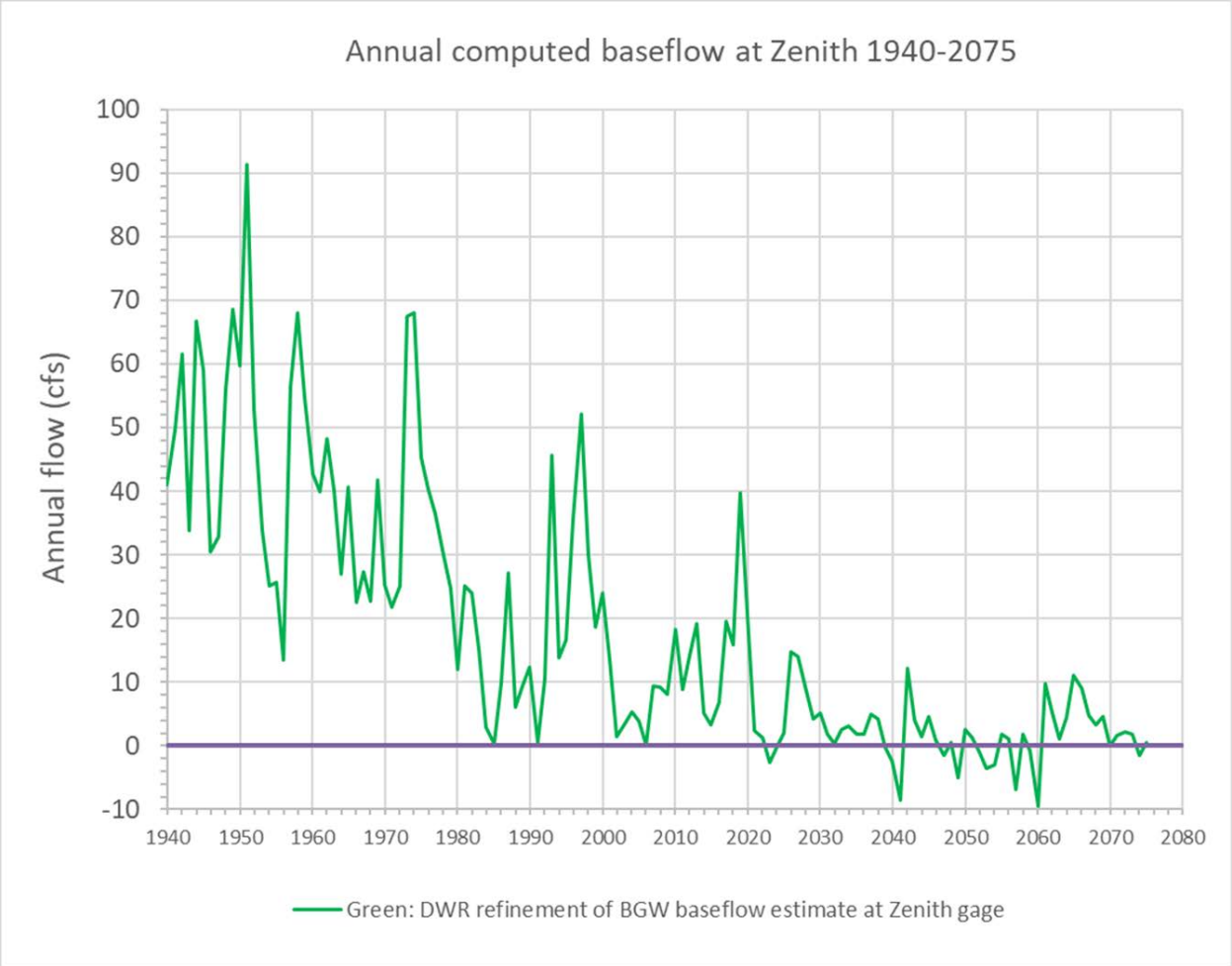

Figure 1 - Simulated Baseflow at Zenith Gage

[6] See attached KDA-DWR inline comments to BGW's February 20, 2019 note, Exhs. 1 and 2.

[7] Ibid, Figure 1.

And even with the critical dry years masked by averaging, in the last decade (2050-2060) BGW's analysis of its simulation shows that the only available baseflow (0-8 cfs) comes from the last few miles above the refuge where the water becomes more saline. Without the fresher water coming from upstream, the water quality at the refuge risks becoming unsuitable for maintaining habitat in the refuge, and therefore unacceptable[8].

b. Little Salt Marsh is habitat and the Service has the right to manage it for that purpose

In making its case for the sufficiency of augmentation only, BGW assumes that the storage capacity of Little Salt Marsh will be used to optimize delivery to the other refuge management areas. This assumption fails to consider that LSM is part of the Refuge and its use as habitat will at times conflict with what BGW assumes as optimal storage use.

c. Increasing augmentation capacity is not trivial, and reductions to pumping will help the stream

BGW also makes a two-pronged argument that even if the proposed augmentation is found to be insufficient 1) pumping reductions are unwise because only about 10% of the reduction helps streamflow, and only half of what helps streamflow helps the refuge (because the other half happens at times that the refuge doesn't need water); and 2) the augmentation project can easily be increased to provide the same or greater benefit that pumping reductions would produce.

The first point is difficult to accept since the "high impact area" referenced in several places in GMD 5's plan is defined as the area where 40% or more of the groundwater pumped comes from streamflow as determined by the GMD 5 Model. The remainder of the LEMA area is defined as the area where 10% or more of groundwater pumped comes from streamflow.

If BGW is describing the effects of only the 2020-2029 period when the GMD 5 LEMA is proposed to be in place, then the statement may be technically true, but it hides the long-term benefit of the reductions which at the end of the simulation are over 33%. That is, for every 100 acre-feet of reduction, the stream will benefit 33 acre-feet.

Based on the data currently available, the Kansas Department of Health and Environment believes GMD 5's concept of augmentation can be implemented within

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[8] See table at page 16 of https://agriculture.ks.gov/docs/default-source/dwr-water-appropriation-documents/kdhe_2018_initial_water_quality_analysis_of_augmentation_at_quivira_national_wildlife_refuge_wtl.pdf?sfvrsn=3b2985c1_4

required water quality constraints, but the project will require careful monitoring to ensure this[9]. Thus, the level (rate and quantity) of augmentation allowed under GMD 5's concept will only be known with operational experience.

d. Drying up the stream is bad for the basin and may lead to water quality problems at the refuge

Given that the currently proposed location of GMD 5's augmentation wellfield is in an area with elevated chlorides and given that BGW's analysis demonstrates that in a few decades streamflow will diminish significantly and the only remaining baseflow will be more saline, it does not seem reasonable to assume that decreasing the quality of the water supporting the refuge will be acceptable.

Furthermore, drying up the stream above the refuge puts more pressure on the augmentation project which, even as designed, relies on marginal-quality water[10]. As stated previously, when the fresher water from upstream goes away, depleted by groundwater pumping, only the remaining saltier streamflow a few miles above the refuge will be available to dilute the augmentation water.

e. Conclusion

BGW's arguments understate the dire condition of Rattlesnake Creek streamflow for most of its simulation, understate or omit the challenges of simply increasing augmentation capacity, overstate the ability to use Little Salt Marsh for storage and delivery of water to the rest of the Refuge, and understate the positive effects that reducing groundwater pumping will have on streamflow.

KDA-DWR continues to hold that a reasonable augmentation project accompanied by reasonable reductions in groundwater pumping are necessary to resolve the impairment for the long term.

VI. Current status

After KDA-DWR provided clear and specific criteria to resolve the impairment, in August 2017, GMD 5 informed KDA that it would pursue using a LEMA to meet the criteria. KDA-DWR met with GMD 5, its LEMA committee, its counsel, and its technical consultant numerous times to work through how to develop a LEMA plan to meet KDA-DWR's requirements for resolving the impairment. The main points of contention between KDA-DWR and GMD 5 are that 1) GMD 5 argues that it can provide enough augmentation to resolve the impairment for the long term, and 2)

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[9] Ibid. pages 15-18

[10] Ibid. pages 10-15

reductions in pumping are not necessary to resolve the impairment. As set forth above, KDA-DWR disagrees with both of these assertions by GMD 5.

So now, some 20 months after it committed to resolving the impairment with a LEMA, GMD 5's second formally submitted plan is unacceptable because it makes no commitments to reduce water use and relies solely on an augmentation project that remains in the conceptual design stage. GMD 5 has repeatedly and consistently resisted making any commitments to reducing water use, and though it has repeatedly and consistently committed to building augmentation which, thanks to K.S.A. 82a-706b (2015) it could have been doing for the last two years, GMD 5 has not yet even retained technical consultants to design the project, much less secured access to the land, the water right, and most significantly, funding.

KDA-DWR's 2016 final impairment report quantified the impairment to the Refuge and Service as required pursuant to KDA-DWR regulations. Further, the Service properly requested that junior appropriators be administered in 2018 and 2019 to protect the Service's senior Kansas water right. However, citing progress towards resolving the impairment through a LEMA, KDA-DWR has not regulated junior users.

Through the course of our work together, KDA-DWR and GMD 5 have explored several ways to accomplish the goal to reduce the growth rate of streamflow depletions. KDA-DWR has developed response maps, used the GMD 5 Model to evaluate several possible solutions, and has developed sophisticated allocation tools that would distribute the necessary pumping reductions as allocations of allowable withdrawals to junior water users based on their relative priority and to some degree, their relative effect on streamflow (closer to stream has more effect).

GMD 5's latest LEMA plan is a clear indication that GMD 5 is not moving towards meeting the criteria that KDA-DWR has set forth as requirements to resolve the impairment.

Attachment 1 – KDA-DWR's in-line responses to BGW letter of Feb 20,2019

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February 20, 2019

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Feril Manager
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Subject: Hydrologic Issues Pending for LEMA (Local Enhanced Management Area) to Remedy Quivira Impairment

Dear Mr. Feril:

Several hydrologic questions remain to be clarified to support administrative approvals in remedying the impairment at Quivira National Wildlife Refuge. This letter outlines some pending issues and the hydrologic rationale for proceeding on the Big Bend Groundwater Management District 5 (GMD5) management plan presented as a LEMA. The Quivira water right is certified at 14,632 acre-feet of water per calendar year, with the water to be stored and accumulated in marsh areas within the Refuge. The priority date is 1957 and is senior to many of the Rattlesnake Creek basin's farm-well dates. The Refuge has released a demand schedule calling for that volume to be diverted from the watercourse to the Refuge facilities at rates ranging up to 30 cubic feet per second (cfs) in spring and fall seasons or lesser rates of 8 to 12 cfs in winter.

<u>Agency Guidance on Impairment and Basin Health</u>

In January, the KDA (Kansas Department of Agriculture) summarized their views on this matter in a paper "Resolving the Quivira Impairment, Q&A"[1], where KDA found that *"… an augmentation project, along with modest reductions in groundwater use… will resolve the impairment…"*. Impairment means *"diminished in value or utility"* the test for which is *"whether the Refuge could have more fully exercised its water right…"*.[2] KDA supports augmentation of streamflow with wellfield discharge to relieve the impairment, but holds that cutbacks in farm pumping to maintain lower levels of water use are also necessary,

[1] Resolving the Quivira Impairment, KDA, January 11, 2019

[2] Final Impairment Report, KDA-DWR (Division of Water Resources), July 15, 2016

based on reasons given in a technical memorandum, *"because the current level of groundwater pumping, if not reduced, will dry up the reliable part of the streamflow that comes from the aquifer…and the hydrologic health of the basin continues to deteriorate."*[3] The KDA projects (absent any cutbacks in farm pumping) that the LEMA proposed 15 cfs nominal augmentation rate would be inadequate to remedy over 3000 of the 14,632 acre-feet Refuge demand in some future dry years, while most years would have a lesser shortfall, and in some wetter years Refuge demand would be fully satisfied. The LEMA proposal by GMD5 includes a measure of cutbacks in pumping that would reduce that reported shortage for Refuge demand.

KDA-DWR: We agree that if pumping reductions occur, shortages to the Refuge are reduced. However, the LEMA plan provides no certainty as to whether, amount, or when claimed water use reductions from the voluntary actions envisioned in the plan will occur.

The LEMA plan does not set quantitative goals to reduce water use, e.g. limit pumping withdrawals to some specific amount, or reduce the rate of growth of depletions to streamflow by some certain amount as determined by the model. Since there are no quantitative goals, there are also no means to enforce that quantitative goals are met. This is the fundamental inadequacy of the LEMA plan.

Effect of End-Gun Removal

Another hydrologic matter of concern is the accounting of water from end guns on center-pivot sprinkler systems. The LEMA proposes to remove end guns in the enhanced management area. Based on acreage reduction, a saving of water is estimated by GMD5 at about 14,750 acre-feet per year. The savings on farms show up in two ways, mostly as a relative rise in water-levels in the aquifer, and secondly as a much-reduced fraction of the

savings that appears in the flow of Rattlesnake Creek in response to the rising water levels. The DWR responds that water might be saved by removing end guns, but not necessarily so if the acreage reduction is less and if equivalent use is added as water applied and consumed on remaining center-pivot water-deficit acreage. On the other hand, the historical farm- water application has been shown to be explained 98 percent by a match with consumptive- irrigation requirements, which suggests both that additional water on existing acreage would not be much consumed and that historical farm-water operations are highly efficient.

KDA-DWR: First, the assumption that removing the 1,306 end guns will save 14,750 AFY has little technical basis. Our analysis of amounts of water used by the participants in the AWEP program showed that the participants used as much or more water after they got paid to remove their end guns as they did before the program when adjusted for rainfall and crop water need.

GMD 5's LEMA plan would require removal of end guns but does not reduce irrigable acres, nor does it reduce the water available to the producer. While some waterusers may continue with exactly the same cropping as before on reduced acres leading to reduced wateruse and profits, available data evaluated by KDA-DWR supports the contention that given no other restriction than the loss of an end gun, producers have the capability to adjust farming practices to maximize the benefits the water available. GMD 5 consistently refuses to commit to the savings that it claims from end gun removal.

Finally, BGW's point in this section is a misunderstanding of our analysis. Our analysis found a 98% correlation between pumping and climate factors, not consumptive irrigation requirements. In applying these same methods to water-short counties and water-long counties we found strong correlations in all cases; the water-long counties averaging greater than NIR; the water-short counties at less than NIR.

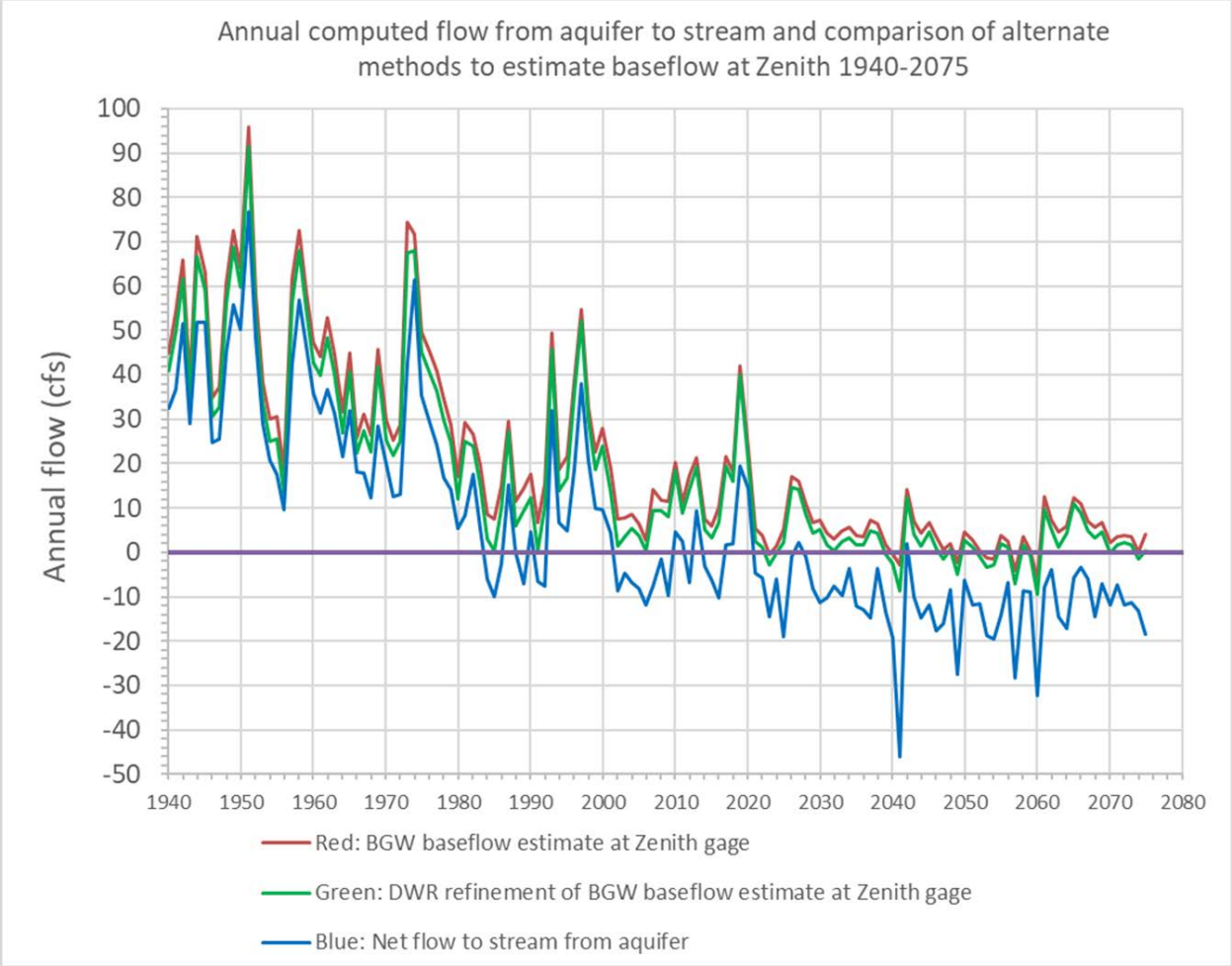
GMD5 Information on Baseflow

Information has been exchanged between KDA and GMD5 on these points and GMD5 has the pertinent technical exhibits that display the data. As GMD5's consultant, my office has looked more closely at the streamflow pattern from the headwaters of Rattlesnake Creek to the Zenith gaging station near the Refuge boundary. We re-examined future baseline conditions using the groundwater model applied by all parties for making such projections. The model details show that Rattlesnake Creek loses water to the ground as reported in the DWR technical memorandum above, but shows also that some of that groundwater returns to feed the Creek above Zenith station, with the result that the reliable part of the streamflow that comes from the aquifer is not dried up in the future. Baseflow remains available to support Refuge diversions.

KDA-DWR: We have reviewed the matter further including discussions with BGW on its work to evaluate future baseflow including BGW's Exhibits 1 and 2 attached. Both KDA-DWR and BGW agree that baseflow and total streamflow are significantly diminished into the future. BGW's work shows that over the course of its simulation, about 20 miles of live stream are dried up, though some baseflow remains in the last few miles before RSC enters the Refuge.

On this issue, there seems little disagreement over the modeling. But we do differ on outputs that best characterize the matter and what the data means. KDA-DWR was able to replicate BGW's method of evaluating baseflow and produced KDA-DWR Figure 1below, an annual series of average baseflow at Zenith, showing periods of little to no baseflows dominating the future of the Rattlesnake at Zenith, with wetter periods temporarily producing a bit more baseflow.

KDA-DWR work shows that by the end of BGW's model simulation approximately 70 cfs of baseflow (flow from aquifer to stream) is depleted by groundwater pumping.



KDA-DWR Figure 1– BGW Simulated future baseflow at Zenith Gage

Our additional review does not change our fundamental conclusions on the matter of future baseflows.

[3] Memo on Sufficiency of GMD 5's Augmentation-Only Plan to Resolve Quivira Impairment, KDA, January 7, 2019

GMD5 Information on the Effect of Cutbacks in Farm Pumping

The LEMA scenario includes end gun and focused-area curtailment of almost 19,000 acre-feet per year in terms of reduced use of farm water. Some of that estimated saving is doubted by DWR, so we examined the model again to see how sensitive the total flow at Zenith is to that factor. The LEMA pumping cutback causes about a 10 percent response at Zenith station in the future, so around 2000 acre-feet per year appears as increased streamflow due to the simulated LEMA cutback. But only half of that is helpful to the supply for Refuge demand because the rest is bypassed during times of no shortage and no need on the Refuge. Thus, the proposed 19,000 acre-feet per year of cutbacks in farm pumping generate only about 1000 acre-feet per year of help to offset impairment. Cutbacks are the least effective way to aid the remedy for impairment. If the scenario were to model less-effective cutbacks as DWR presumes them to be, then we would expect that a roughly proportional less-helpful response would be seen at Zenith. Baseflow, though, would remain characteristically positive.

BGW's response estimate is inconsistent with our analysis which shows pumping reductions have a much more significant effect.

The principal benefits of the reductions are long-term. The cuts help to maintain the viability of the augmentation project and some level of baseflow. The remaining streamflow helps to dilute the lower quality water (the remaining baseflow) originating east of US 281.

In August 2017 we provided Zone maps that showed the pumping impacts to streamflow geographically. GMD 5 nor BGW have expressed no concerns with the validity of the Zone maps. That work supports the following conclusions on stream responses from pumping reductions, generally, targeted and overall:

- 4,002 AF of stream response from 15,000 AF of general (Zone A) cuts, 26.7%;
- 2,481 AF of stream response from 4,408 AF of targeted (Zone D) cuts, 56.3%; and
- 6,484 AF of stream response overall, 33.4% (approx. 9 cfs vs. the 1.5-3 cfs estimated by BGW).

See https://agriculture.ks.gov/docs/default-source/dwr-water-appropriation-documents/quivira_response_22x34_20170804.pdf?sfvrsn=e12482c1_0

Status of the Basin Health

On the question of the deteriorating long-term health of the basin hydrology, the DWR has received model runs that show conditions stabilize without progressive depletion of Rattlesnake Creek after about year 2050. Depletion of Rattlesnake Creek streamflow results from the water table being lowered by farm wells and feeding less water to the stream. Thus, a LEMA plan that accommodates depletion for another 30 years, would also be expected to perform satisfactorily in the longest term. The LEMA as proposed can reasonably perform in that way.

KDA-DWR: As is noted above, our additional baseflow analysis based on BGW's method above shows periods of little to no baseflows dominate the future of the Rattlesnake at Zenith, with wetter periods temporarily producing a bit more baseflow. Again, BGW's modeling shows that the remaining baseflow in the later portions of the future simulation is dominated by poorer quality water upwelling in the last 10 miles or so above the refuge. These factors are cause for great concern for the health of the basin and appear inconsistent with Legislative intent for the basin reflected in the MDS values it adopted.

Cutbacks Not Critical

Calculations of future hydrologic conditions involve assumptions about scenarios to be played out and assumptions of standards of performance to be met. Model calculations have inherent error which can cut either way, but must be allowed-for in planning. In this case, the degree of benefit from end-gun removal is estimated at different levels by GMD5 and by DWR, but is found not to be critical to the action because of its relatively small contribution (up to 1000 acre-feet per year) to the impairment offset. A similarly small- proportional impact would be seen under mandatory cuts in pumping rates. Augmentation pumping has sufficient flexibility to make up the small benefit that cutbacks generate under either assumption. A moderate increase above the nominal 15 cfs wellfield capacity could produce thousands of acre-feet per year to deal with any such remedial gaps.

KDA-DWR: As is noted above, the value of pumping reductions should be evaluated over a longer term and are much more significant than characterized above, both for the impairment and other instream needs. Further, while we believe BGW has done sufficient evaluation of the augmentation project concept (induced capture of evapotranspiration from adjacent water-logged soils and wetland vegetation, in addition to sources captured from formerly-rejected recharge) to support moving forward with the project, it is unknown if it will perform at the envisioned design capacity, much less any expanded capacity, without inducing upwelling of poor quality waters from the lower geologic

formation. Running the project for longer periods in many cases will not be effective in meeting the needs of the Refuge.

GMD5 on Drought, Storage, and Need

The standard of performance for an acceptable remedy is not clear cut. Further consideration of the role of drought, storage, and need leads GMD5 to the view that an effective full supply will be available to the Refuge with the LEMA in place, offsetting any future impairment.

KDA-DWR: There is no ambiguity here. We provided clear cut criteria for an acceptable remedy and have communicated these criteria to GMD 5 on several occasions.

- GMD 5 has offered to build an augmentation project capable of delivering at least 5,000 AFY at a minimum rate of 15 cfs.

Assuming the augmentation project gets built and operates as envisioned, KDA-DWR set the standard of performance as:

- Reduce the growth rate of streamflow depletion by half.

To accomplish this by managing the geographic area significantly affecting RSC streamflow, and following GMD 5/BGW's analysis of general and focused groundwater pumping reductions, KDA-DWR used the model to find that the criteria require:

- Allowable junior use inside Zone A but outside of Zone D: 134,108 AFY (avg)
- Allowable junior use in Zone D: 22,200 AFY (avg)

Natural supply (without farm pumping) has in the past and necessarily will in the future include drought times of insufficient supply for the Refuge's modern demand curve. Such a shortage is not due to impairment and reasonably would not require augmentation.

The Refuge water-right impairment analysis authored by the Chief Engineer[4] was quantified by including filling Little Salt Marsh with 1865 acre-feet per year (about 13 percent of the total right). Storage provides some flexibility in timing for Refuge operations and can soften the peak rate requirement for augmentation. That volume is equivalent to a large part of the peak period of demand scheduled for Refuge use, thus release from storage added to 15 cfs of wellfield augmentation would be able to make up peak demands for 2 months with no other sources. We expect that augmentation will serve direct uses, but will not be called upon to fill storage, under the principle that the

senior right should utilize its own sources, including storage, before calling for augmentation. Filling storage is best done by natural flows. (If not filled and released, storage might be not an operating demand at all, since an additional right serves lake evaporation.) One scenario of the future with storage and drought operated this way shows that 15 cfs of wellfield capacity remedies the impairment even to a betterment of the natural supply.

KDA-DWR: Little Salt Marsh is essential habitat. While in periods of short supply the Service does release water from LSM to downstream marshes, we cannot constrain them to reduce their habitat function.

The LEMA proposal provides that the real-time operation of Refuge diversions is to be met by augmentation, but it is not firmly-known what those rates and amounts may be in practice. Actual future diversions might be either more or less than anticipated. Past diversion reports compared to gaged flow shows that the Refuge's historical exercise of diversion is appreciably under 100 percent of available supply. The Refuge operations have not availed themselves of the full amount of the supply. Refuge operations are pertinent to the test for impairment given above as to whether the Refuge could (or would) have more fully exercised its water right. It is plausible that the available water was not needed. The practical need for water has been and might in future be less than scheduled. Nevertheless, the LEMA pledges to *"…deliver a make-up flow to the stream depending on conditions of streamflow and diversion requirement as observed…* and…*proposes that the delivery rate be set weekly in coordination with Refuge requests and KDA-DWR staff review…".* GMD5 has the means to match augmentation deliveries to reviewed and agreed requirements as they may prove to be.

KDA-DWR: The math and the concept of remedying impairment are both straightforward here. The augmentation project is expected to provide 15 cfs. Peak demand at the refuge is 30 cfs, so the water that is not provided by the augmentation project must come from the stream. Reducing the rate at which streamflow depletions are growing, as required by KDA-DWR, ensures that there will be enough streamflow to compliment the augmentation and meet the Refuge's needs. The Refuge is entitled to have its full right protected from impairment by junior appropriators.

<u>Hydrologic Uncertainties</u>

These uncertainties in hydrologic planning are usually addressed by a factor of

[4] Final Impairment Report, DWR, July 15, 2016

safety. The nominal 15cfs of augmentation wellfield capacity is reported by DWR to be inadequate, but with allowance for historic drought, storage operations, and consideration of past practice regarding need, it is thought by GMD5 to be fully adequate. The shortfall foreseen by DWR is a few thousand acre-feet in some years and nil in other years. The nominal 15cfs can deliver up to 10800 acre-feet per year. Some redundancy necessarily will be part of the wellfield capacity. If called upon to do so, an incremental increase in wellfield cfs and acre-feet is practical. On the other hand, over-building capacity that is finally unused constitutes waste. Thus, an augmentation project staged to deliver the water required as pledged in the LEMA is hydrologically reasonable and is thought by GMD5 to be better insurance of performance than are pumping cutbacks or rate controls. The DWR preference for modest reductions in groundwater use would produce less benefit to the Refuge at greater cost to farms. Although, I understand that there may be considerations distinct from Refuge impairment, such as regional hydrologic status of the basin, in the DWR position.

KDA-DWR: see above concerns regarding the challenges to increasing the capacity of GMD 5's conceptual augmentation project

Conclusion

Thank you for requesting this summary statement of the hydrologic factors in current consideration as I understand them. I conclude that flexible augmentation would be a preferred means of satisfying impaired supply at the Refuge. Please let me know if more information or discussion is needed.[5]

Very truly yours,

BALLEAU GROUNDWATER, INC.

W. Peter Balleau, CPG, P.Hg.

Mr. Orrin Feril
February 20, 2019

WPB/tb

Attachments made by DWR: BGW's Exhibits 1-2, provided via email on March 8, 2019

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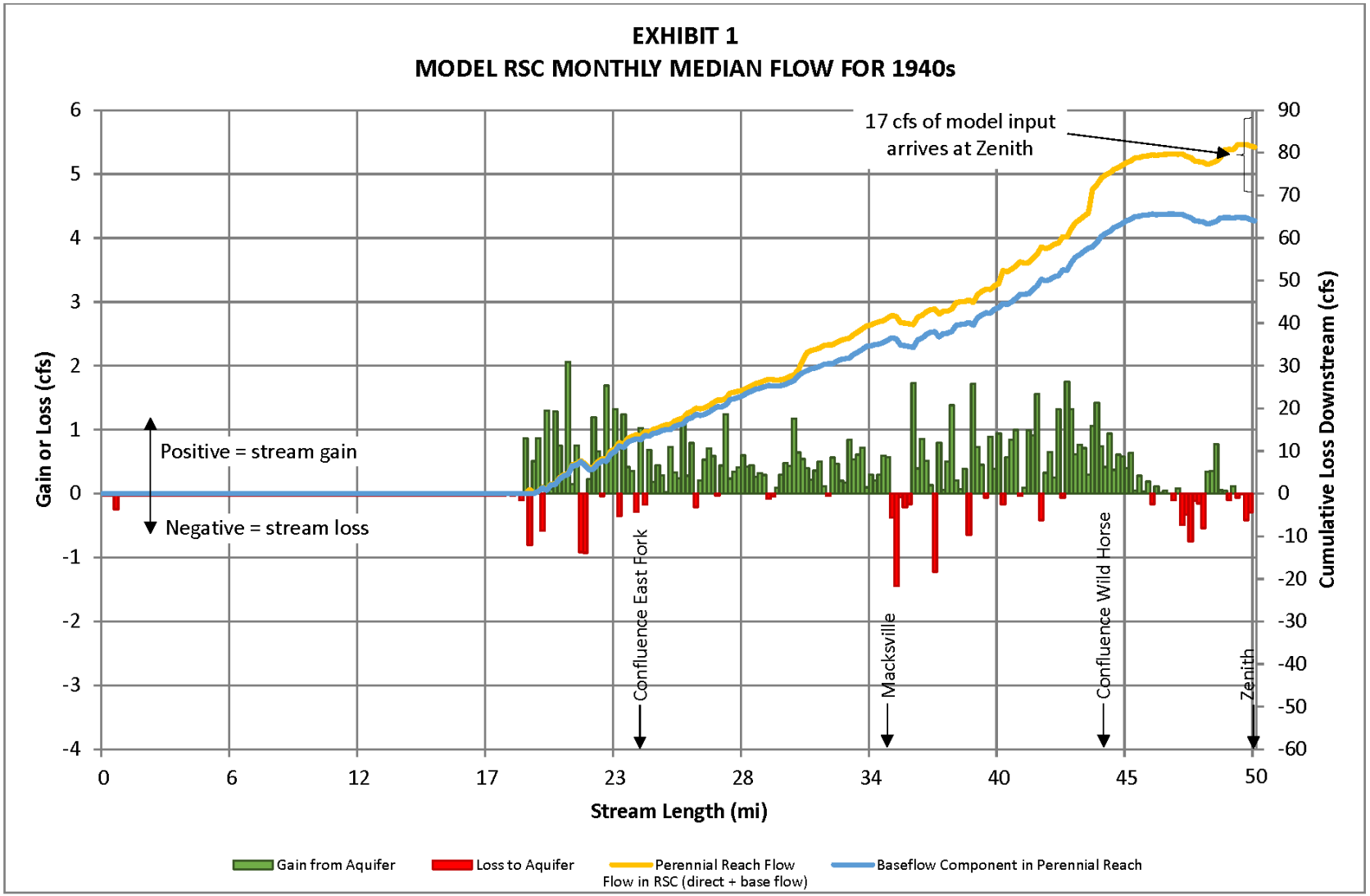
[5] W. Peter Balleau is a career ground-water geologist, a licensed Geologist in Kansas (686), certified by the American Institute of Hydrology, with over 10 years of study in the Rattlesnake Creek Basin.

EXHIBIT 1
MODEL RSC MONTHLY MEDIAN FLOW FOR 1940s



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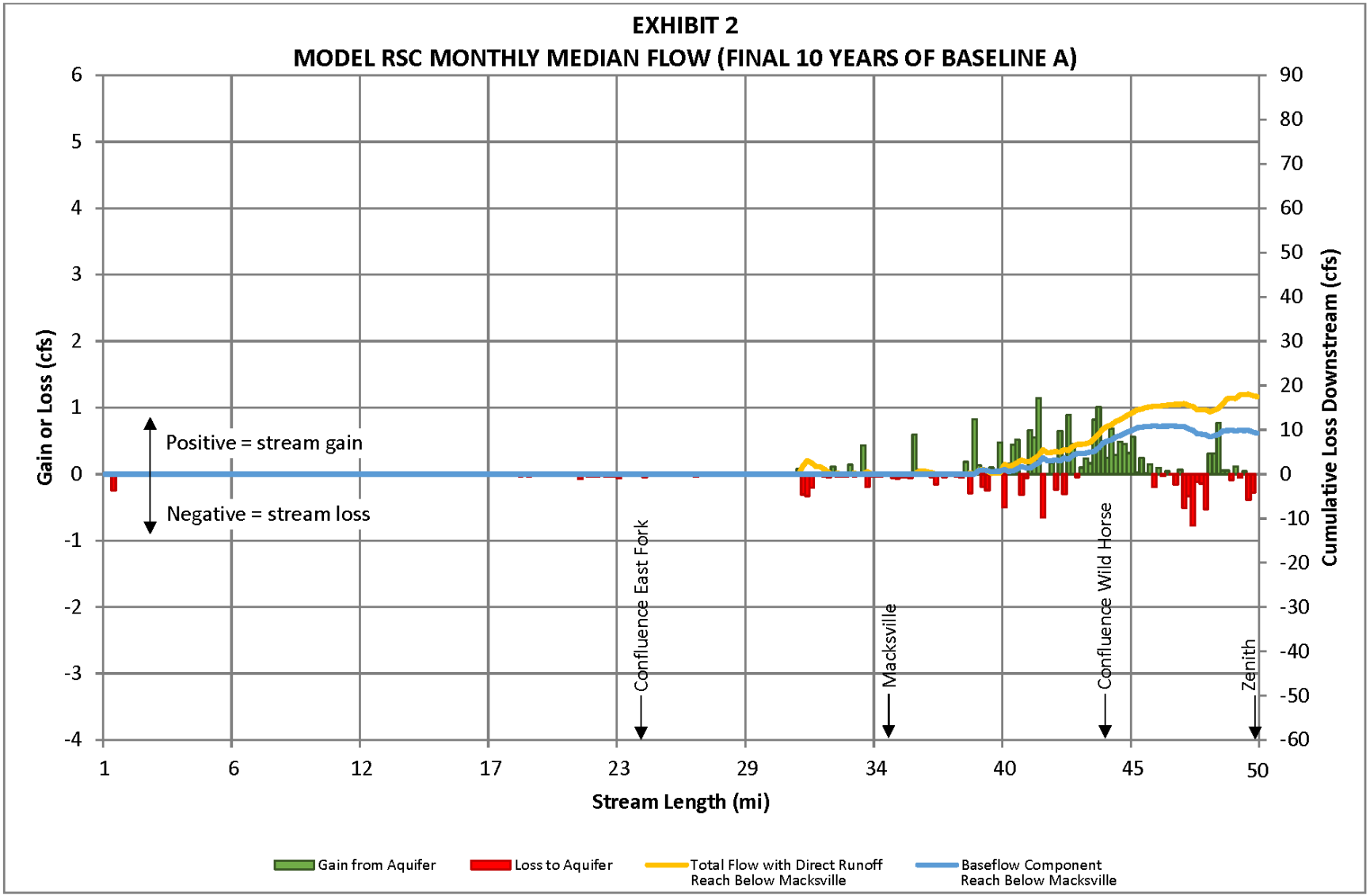

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