REBUTTAL REPORT
OF EXPERT REPORT AND DIRECT TESTIMONY BY
GREGORY SULLIVAN FOR CITY OF POCATELLO

In the Matter of the Petition for Delivery Call of A&B Irrigation District for Delivery of Ground Water and for the Creation of a Ground Water Management Area

August 27, 2008

Introduction

This is a rebuttal of the Expert Report and Direct Testimony by Gregory Sullivan of Spronk Water Engineers, Inc. for the City of Pocatello. This rebuttal report was prepared by John Koreny and Steve Thurin of HDR Engineering, Inc., Dave Shaw and Norm Young of ERO Resources, Inc. and Charles Brockway of Brockway Engineering, Inc at the request of A&B Irrigation District (A&B). The following opinions by Mr. Sullivan are addressed in this report.

Unit B meets the criteria of reasonable irrigation efficiency. A&B is not required to modify the Unit B irrigation conveyance system to increase irrigation efficiency.

Sullivan Opinion

Mr. Sullivan is advocating that the Unit B water systems needs to be modified so that the aggregate water supply can be distributed differently to reduce shortages. "*Due to the manner in which Water Right No. 36-2080 was permitted, licensed and ultimately partially decreed in the SRBA, it is reasonable that IDWR evaluated injury to A&B's water right based on whether the aggregate waters supply available to A&B for irrigation of the Unit B lands was adequate to meet the project-wide irrigation water requirements of those lands. To the extent that particular wells or well systems are not able to deliver sufficient water to meet the irrigation requirements of the lands served, if the supply is adequate on a project-wide basis, the shortages for the particular lands would appear to be a water distribution problem*" (Sullivan Expert Report, pg. 9).

Rebuttal

Mr. Sullivan has stated that there is a "*water distribution problem*" on Unit B because the well systems are not interconnected. Mr. Sullivan's opinion is that the Unit B well delivery system should be reconstructed so that the aggregate supply can be distributed across the project to reduce shortages. Mr. Sullivan is incorrect for these reasons.

1. **The terms of water right 36-2080 do not support Mr. Sullivan's opinion that A&B is required to increase the Unit B conveyance system efficiency.** A&B's diversion and beneficial use of water using its existing irrigation system has been confirmed by

IDWR and the SRBA court. The SRBA Partial Decree for the Unit B water right 36-2080 authorizes an instantaneous diversion rate up to 1,100 cfs with an annual diversion volume of up to 250,417.20 acre-feet from March 15 to November 15. A total of 178 points of diversion are listed on the Partial Decree and no interconnection is identified or required. The Place of Use is stated on the water right as "*Place of use within the boundary of A&B Irrigation District boundary in a single irrigation season*".

Mr. Sullivan is incorrect in asserting that A&B's 36-2080 water right authorizes a requirement that the Unit B well system be reconstructed to deliver the aggregate water supply to all 62,604 acres from all 178 wells, or even that individual well systems be required to be reconstructed so that they can convey water to well systems with water shortages. A&B's water right is based on individual well pumping and delivery systems serving groups of individual farms. The current Unit B conveyance system is not interconnected and in almost all cases the water from one well system cannot be used to supply water to another well system.

The delivery call should evaluate whether the Unit B irrigation demand can be satisfied according to the terms of the water right using the current well pumping and conveyance system which is composed of individual well systems delivering water to specific lands. This system was previously effective at meeting irrigation diversion requirements, but has been rendered ineffective because of ground water level declines caused (in part) by junior priority ground water users. Just because the water right is decreed with a place of use within the boundaries of Unit B with 178 points of diversion does not mean that A&B can be required to perform a massive reconstruction of the Unit B conveyance system to allow delivery of the water supply from all wells to lands with shortages.

2. **Mr. Sullivan is advocating a standard for irrigation system efficiency that goes beyond a reasonable efficiency criteria.** Unit B is very efficient compared to other irrigation projects in the region. The Unit B conveyance losses are less than 5 percent. The on-farm losses are very low because about 97 percent of the Unit B farms are served by sprinkler. These impressive operational statistics are possible because of construction of pipelines and because of the diligence of Unit B farmers in installing sprinkler systems. A&B has an extensive and thorough water recording and management system. Eight to nine ditchriders measure pumping rates at the pump and deliveries at the headgate. Water is pumped "on-demand" to meet the irrigation requirement when it occurs. The pumping amount at individual well systems is adjusted daily so that the supply does not exceed the demand. Pumping data is recorded daily at both the well and the headgate, and the data is aggregated monthly and then annually. A&B has reduced return flow losses so that the project drain wells are no longer used for irrigation return flow. A&B tracks the maintenance and performance of individual wells. A&B's operational waste is negligible. These facts all attest that A&B is more than meeting a reasonable efficiency criteria.

   Mr. Sullivan is not simply suggesting a change in management practices. To implement a different "water distribution" method so that the "aggregate water supply" can be used on the lands with shortages would involve reconstruction of the Unit B conveyance system so that the water from one well system could be delivered to lands currently served by another well system. This essentially requires A&B to make major changes to project operations and infrastructure to use water differently than is currently possible with the current Unit B system.

Based on our review it is clear that the Unit B irrigation system meets the standard of reasonable efficiency. Reconstruction of an irrigation conveyance system to improve efficiency is not required for a delivery call in Idaho.

3. **Unit B is an "on-demand" irrigation diversion and delivery system.** Unit B was designed, permitted, constructed, operated, licensed and decreed as an on-demand irrigation diversion and delivery system. Each Unit B well is designed to pump the needed maximum irrigation demand when it occurs. This is similar to the design and operation of a private well system in the area. This allows the pumps to be operated efficiently and avoids the large expense to A&B from constructing and operating an interconnected supply system.

4. **It is not feasible or cost-effective for A&B to construct and operate an interconnected well system for the entire project.** Constructing an interconnected well system across the entire project is not feasible.[1] No information is presented in Mr. Sullivan's Expert Report to determine the feasibility or cost of interconnecting the Unit B well systems. The costs are unknown and it would take a significant engineering study just to determine the feasibility and level-of-effort needed to determine the costs for design, permitting, financing, construction, power, management and maintenance of an interconnected water distribution system. An interconnected water distribution system would require significant modifications including an interconnected pipeline distribution system, booster pumps, storage tanks, regulating equipment, meters and other infrastructure. A&B would be required to abandon some or all the 51 miles of existing canals used to convey water and construct new pipelines. Right of way and property would need to be purchased for new pipelines and other infrastructure. The power and maintenance costs to Unit B for operating an interconnected pressurized pipeline system would increase significantly. An interconnected water conveyance system would require construction and operation of a pressurized pipeline system and we understand A&B is not allowed to provide pressurize water at the farm turnout under the terms of their repayment contract with Reclamation.

   A&B is a very large irrigation system covering an area of about 200 square miles. Construction of an interconnected well and delivery system on Unit B capable of delivering 1,100 cfs (about 700 mgd) would involve a very large project with a significant cost. The type of interconnected delivery system Mr. Sullivan is advocating for Unit B is usually used for municipal water systems and is not usually used for irrigation systems because of the cost of construction and operation. As a point of comparison, the City of Boise has a peak demand of about 90 mgd (compare to the Unit B peak demand of 700 mgd). Construction of an interconnected well system on Unit B would be a truly massive project that is infeasible because of costs, operation and maintenance requirements.

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[1] A&B has completed limited interconnection on about four well systems where interconnection was possible (A&B Expert Report, pg. 3-1, footnote 1).

A&B's uses a standard of 0.75 miner's inch/acre at the headgate as a criteria below which wells need to be rectified. The 0.75 miner's inch/acre delivery standard is not a measurement of the Unit B irrigation requirement.

Sullivan Opinion

"It is noted that while A&B's pleadings assert that injury occurs when A&B is not able to deliver 0.75 miner's inch per acre to lands under each well system, Dan Temple also testified that A&B is injured anytime that the A&B wells yield less than 0.88 miner's inch per acre (see Section 3.1, above). Therefore, there apparently is some inconsistency in A&B's claims about what constitutes injury" (Sullivan Expert Report, pg. 12). *"Mr. Temple's testimony seems to be inconsistent with A&B's pleadings in which it claimed that wells not receiving 0.75 miner's inch per acre were receiving inadequate water supplies"* (Sullivan Expert Report, pg. 14). *"According to paragraph 11(d) of the Motion to Proceed, if the farm headgate delivery is equal to or less than 0.75 miner's inch per acre "("0.75 Criteria"), there is not a sufficient diversion rate for proper irrigation of the acres served by the well system"* (Sullivan Expert Report, pg. 14).

Rebuttal

The 0.75 miner's inch/acre criteria is not a measurement of the amount of water needed to meet the crop irrigation requirement. A&B uses a criteria of 0.75 miner's inch/acre at the headgate to identify wells that are not producing enough water and need to be rectified to provide the water to meet the demand as authorized under the water right. Because of declining ground water levels that interfere with well production, there are many wells that do not meet the 0.75 miner's-inch/acre rectification criteria, whereas in the past in the late 1960s and 1970s almost all wells exceeded the criteria. A&B has attempted to improve the yield on about 40 wells where the yield decreased below the 0.75 miner's-inch/acre rectification criteria as a result of declining ground water levels. Sometimes A&B is not able to restore a well to above 0.75 miner's-inch/acre if well drilling proceeds too slowly (or if the deepening budget has been expended) and the well needs to be used again for the next irrigation season. There are still many wells that can not meet a 0.75 miner's-inch/acre delivery criteria which currently need to be deepened. It is illogical for Mr. Sullivan to imply that the criterion for determining that a well system needs to be rectified is also the criterion for determining that a well system is producing enough.

Mr. Temple explained in his deposition (quoted below) that 0.75 miner's inch/acre is a criteria below which a well needs rectification and it is not an indication of past or current irrigation requirements.

Page 33, June 24, 2008 Deposition

Q. (By Ms. Klahn) Okay, okay. How did IDWR use gross acres in their order?

A. My recollection, in one of the findings they made reference to Item G lands, which were lands the district identified below the district's in-house rectification standard of three-quarter inch. Anything below that, we start working on.

Page 55, June 24, 2008 Deposition

Q. Before the break, we had some discussion about whether .75 of a miner's inch per acre was a threshold number for injury or whether it was a threshold number for district maintenance purposes. And that's why I ask, Dan, because this references .75 miner's inch per acres as the minimum amount necessary, but you believe that's an accurate claim -- accurate reflection of your claim?
A. Well, the .75, again, is the district's minimum. If I reread it, it's not the amount necessary to irrigate our lands without injury.

Page 78, June 24, 2008 Deposition

Q. So you've mentioned the .75 criteria a couple times. When you have a well system that falls below .75 miner's inch per acre, do you look at the water level and whether it's changed, or do you just assume that it must be related to the water level and make improvements as necessary?
A. No, we're continually monitoring the water level. We look at the water level. We look at the original design of the pumping unit that's in the well.
Q. Um-hmm.
A. I read the curves. We read the amps on the motor. We digest all that information to determine if it's a mechanical problem or a water table problem.
Q. Um-hmm.
A. And then make the determination, you know, what the fix is.

The Motion to Proceed identified wells that could not meet a minimum rectification criteria (referring to the 0.75 miner's inch/acre criteria below which wells needed to be rectified). The Motion to Proceed did not identify a threshold needed to meet the full irrigation diversion requirements. Item G of the IDWR Director's information request asked for a list of wells that did not meet the minimum (rectification) criteria identified in the Motion to Proceed. A&B provided this information and it has been incorrectly used by IDWR and now by both IGWA's and Pocatello's experts to assert that the Item G lands and the 0.75 miner's inch/acre criteria refers to a threshold needed to meet the irrigation diversion requirements.

The A&B Expert Report shows a current irrigation requirement at the well of 0.89 miner's inch/acre (see Table 4-13, A&B Expert Report). The Unit B Annual Reports lists a per-acre allotment delivery rate and a well system capacity rate of more than 0.75 miner's inch/acre at most well systems prior to the onset of declining ground water levels during the 1980s (see Appendix A, A&B Expert Report). Later in this report, we show that Unit B is actually pumping an average maximum daily demand of 0.87 miner's-inch/acre during 2003 and 2007.

These facts show that 0.75 miner's-inch/acre is not a standard that can be used to establish the Unit B irrigation requirements at the well or at the headgate.

Declining ground water levels are dewatering the Unit B wells and prevents A&B from meeting the irrigation demand. Mr. Sullivan does not recognize that well dewatering is an impact caused by declining ground water levels. Many wells still need to be deepened. Mr. Sullivan does not evaluate how many existing wells need to be deepened now and potentially in the future.

Sullivan Opinion

Mr. Sullivan only evaluates whether the combined Unit B area currently has a water shortage and he does not evaluate the dewatering impacts to Unit B wells caused by declining ground water levels.

Rebuttal

Mr. Sullivan does not acknowledge that a major part of the impact to A&B is dewatered wells caused by declining ground water levels. About 60 to 100 wells now have less than 60 to 80 feet of water in the well during operation (Page 3-11 and Appendix H, A&B Expert Report). Figures 3-26 to 3-31 of the A&B Expert Report show that many wells have less than 5 to 10 feet of water over the pump bowls during operation. Mr. Sullivan's shortage analysis disregards the fact that many wells do not have a sufficient saturated well interval. Mr. Sullivan assumes that the existing wells can be operated in the indefinite future when the actual data shows that the wells are being dewatered and need to be deepened. Mr. Sullivan has not evaluated the wells that still need to be deepened, nor does he present a criteria for minimum well depth and saturated interval for operation of wells.

Unit B is an "on-demand" irrigation system and the timing of peak demand varies from system to system. The Unit B irrigation system needs to meet the full irrigation diversion requirement at the time it is needed.

Sullivan Opinion

"The recorded low discharge rate for each well or well system does not occur on the same day, so the sum of the low discharge rates for all wells does not represent a combined project low diversion rate" (Sullivan Expert Report, pg. 7).

Rebuttal

Unit B is an "on-demand" irrigation system and each irrigation system needs to provide the full irrigation diversion requirement at the time it is needed. The amount and timing of irrigation demands varies between well systems depending on crop types, farming practices, acreage and other factors. Therefore, it is appropriate to evaluate the individual irrigation diversion requirements and peak pumping rates separately for each well system. A&B experts have completed this individual well analysis (see Expert Report, Pg. 4-7 to 4-10). The analysis shows that the peak monthly demand is about 1,100 cfs (0.89 miner's-inch/acre). Based on the monthly production records, A&B has not been able to meet this demand and has shortages up to 36 percent of total demand.

Mr. Sullivan's suggestion that the well capacity and pumping rates for the Unit B wells should be measured together at one point in time does not recognize the fact that each well system is separate and the maximum irrigation demand occurs at different times for each well system. Mr. Sullivan is incorrectly stating that Unit B pumping and irrigation requirements should be analyzed as an interconnected well system. If Mr. Sullivan's methods were adopted, the potential surplus capacity from one well system would be used to make up the shortages at another well system when, in fact, the infrastructure on the Unit B irrigation systems does not allow for interconnected delivery between well systems.

The A&B "allotment" system is based on a water delivery to the 62,604 acres under the 1948 right if there is insufficient water to meet the irrigation demand for all ~66,691 Unit B acres.

Sullivan Opinion

"The 1948 priority water right that is the subject of the delivery call water right and A&B's more junior beneficial use and enlargement water rights are all pumped from the same wells and well systems. A&B has provided no measurement or accounting to distinguish the amounts pumped under the 1948 priority versus the amounts pumped under the junior priorities. Nor has A&B distinguished water deliveries to the 62,604.3 acres associated with the 1948 priority versus deliveries to the 4,081.9 acres associated with the junior beneficial use and enlargement water rights. Analysis of the historical use of the 1948 priority is made difficult by the commingling of diversions under the various A&B water rights for irrigation of the associated irrigated lands. Analysis of A&B's delivery call needs to be limited to evaluating shortages to the 62,604.3 acres associated with the 1948 priority" (Sullivan Expert Report, pg. 7).

Rebuttal

The A&B "allotment" system ensures that, if there is insufficient water to meet the irrigation demand for all ~66,691 Unit B acres, the Unit B water delivery only meets the demand for the 62,604 acres under the 1948 right. During the middle of the irrigation season if there is not a sufficient supply to meet the demand for all project acres, the Unit B ditch rider delivers a rationed supply based on the farm acres under the 36-2080 right. When this occurs, the well system is said to be "*on allotment*". Allotment acres for each well system are based on the acres in each farm authorized to be irrigated under the 36-2080 right. Each year A&B makes adjustments to Annual Report to account for the acres under the 36-2080 right that may have been moved from one well system to another. The annual assignment of allotment acres for each well system is shown on the Unit B Annual Report, Part I under the "*Allotment Acres*" column (see Appendix A of A&B Expert Report for the Unit B Annual Report). During maximum demand periods, almost all wells are on allotment, and A&B does not deliver water for use on beneficial use and enlargement acres. Pages 4-30 to 4-31 of the A&B Expert Report show that all acres under the 36-2080 right are actually irrigated.

The beneficial use or enlargement acres on a well system that have a junior-priority date to the 36-2080 right may be served by private rights during allotment periods, or a farmer may choose to use a portion of his allotment distribution to serve his other project acres. However, A&B is only serving enough water to meet the demand on the 36-2080 acres with the 1948 water right and is not serving water to meet the demand on other project acres. How a farmer chooses to use the water after it is delivered to the headgate is a decision made by the farmer. The fact that beneficial use/enlargement acres may be located on a farm does not increase the amount of water that is served to the headgate during allotment, since the allotment delivery is based solely on the acreage under the 36-2080 right. A&B's Manager, Dan Temple, explained this delivery schedule and process at his deposition:

Explanation of Allotment Acres During Dan Temple Deposition, June 24, 2008

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Q. (BY MS. KLAHN) Okay. Sorry about that. So in that column on Exhibit 64, Lowest Verified Allotment, that's the -- I just want to make sure I understand. That's the amount of the highest demand -- I'm not sure.
A. No.
Q. Tell me what that column is.
A. Lowest Verified Allotment is the lowest measured pump discharge --

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Q. Okay.
A. -- that was recorded and documented to compute the criteria to the water users.
Q. Okay. And if computing the criteria to the water users using that lowest verified allotment had involved only the acres served under A & B senior water right 36-2080, would the discharge rate have been different?
A. That's all that it is based on is the 36-2080 right. The enlargement acres are not shown in here, or it would have further reduced these criteria. They're not given a flow rate for those enlargement acres. If they can spread what they are entitled to or are getting, then they do it, but the district does not compute those into these computations.
Q. Are there enlargement acres being irrigated by the system -- by any of these systems in question, though, on Exhibit 64? Are the enlargement acres also irrigated by these well systems?
A. Yes.
Q. Okay.
A. Some of them, potentially, are being irrigated by these --

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Q. Okay.
A. -- pumps.
Q. These pumps?
A. Or well systems.
Q. Okay.
A. Yes.
Q. So just as a hypothetical, I don't know

if this is accurate, but as a hypothetical, if you look at 1B823, if that well system were serving both enlargement acres and A & B senior water rights, that water would have to be spread further, wouldn't it, using more --

A. For the enlargement acres?

Q. Um-hmm.

A. Yes, yes. That's hence our term "water spreading." They have to spread it further, yes.

Q. So if you didn't serve those acres from this well system, if you only served your senior acres from the well system, wouldn't the criteria be different, the criteria calculation?

A. No, because the criteria calculation is based only on 36-2080 acres.

Q. Okay.

A. If we computed the enlargement claims into it, it would make the acres greater, the

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criteria less.

Take the example of well system 1AB823 discussed during Mr. Temple's deposition (the deposition transcript references 1B823 but the actual well system name is 1AB823 since the well system includes two wells, 1A823 and 1B823). Based on the data in the 2007 Unit B Annual Report, there are 860.4 acres on this well system under the 1948-priority water right 36-2080. Based on the well capacity data on the 2007 Annual Report, the well can pump 720 miner's-inch/acre. Water is conveyed through this system by pipeline and there are no conveyance losses, so the well can pump and deliver 720 miner's-inches, and over the 860.4 acres the well system can pump about 0.84 miner's-inch/acre. So the amount of 0.84 miner's-inch/acre would be conveyed to each of the farms at the headgate when well system 1AB823 is on allotment.

There also are about 8 acres in well system 1AB823 that are associated with the beneficial use and enlargement water rights that are junior to the 36-2080 rights. These junior-rights increase the total acreage on the well system to about 868 acres and if the deliveries during allotment were based on all acres, the delivery rate per acre would be 0.83 miner's-inch/acre instead of 0.84 miner's-inch/acre. However, the delivery rate of 0.84 miner's-inch/acre is not adjusted to reflect the beneficial use or enlargement acres since the allotment system only delivers water based on the acres served under the 36-2080 water right.

This shows that the Unit B "*allotment*" system rations the delivery of water to the farmer's headgate based only on the land served under the 36-2080 right during peak demand periods when water is short.

The 1985 Hydrology Appendix by Reclamation is not relevant to the A&B delivery call.

Sullivan Opinion

"*The July 1985 Hydrology Appendix for the Minidoka Northside Pumping Division Extension project study describes a 0.75 miner's inch per acre rate: In a letter to the Bureau of Reclamation dated May 24, 1984, the district states that they cannot support a* *peak net farm delivery in excess of 0.357 inch per day, which is the rate at which the current project is designed and operated. Therefore, a peak farm delivery of 0.357 inch per day was adopted for use in this study. (USBR, 1985 at p. 43)*" (Sullivan Expert Report, pg. 13).

Rebuttal

The 1985 Hydrology Appendix by Reclamation is not relevant to this proceeding for the following reasons.

1. **The 1985 Hydrology Appendix is a draft document for an expansion project that was not authorized or constructed.** It is a draft Appendix to an Environmental Statement document that was not adopted by Reclamation for an expansion project on Unit B that was not authorized and not constructed. The Environmental Statement Report (which includes the Hydrology Appendix) is stamped, "Preliminary, Subject to Revision". The Hydrology Appendix only applies to expansion acres, and not to the existing project acres.
2. **The 1985 Hydrology Appendix can not be used to estimate the current Unit B irrigation requirements.** The 1985 Hydrology Appendix only addresses proposed additional acres and does not evaluate irrigation demand on the actual project. The 1985 Hydrology Appendix does not take into account the current site specific factors on the Unit B project (crop ET, conveyance and on-farm application methods) that would allow for a determination of current irrigation diversion requirements and the Order fails to provide sufficient water to Unit B to provide a full supply for hot and dry years under peak demand periods in the middle of the irrigation season.
3. **Even if the 1985 Hydrology Appendix was relevant, the technical analysis presented in the document does not support the finding that the Unit B irrigation requirement is 0.75 miner's-inch/acre.** The first sentence of the section on page 43 of the draft Hydrology Appendix discussing the expansion project irrigation requirements presents Reclamation's technical analysis, "*A peak farm delivery rate of 0.434 inch per day* [<u>0.90 miner's-inch/acre</u>] *was estimated during the course of this study*". The IDWR A&B Order uses a letter from the A&B manager cited in the 1985 Hydrology Appendix which incorrectly states that the Unit B peak design rate is 0.75 miner's-inch/acre <u>at the farm</u>. IDWR incorrectly used 0.75 miner's-inch/acre as the <u>well pumping requirement</u> without understanding that the delivery rate cited in the letter was referenced as an <u>on-farm delivery rate</u>. The letter is further contradicted by the technical analysis in the 1985 Hydrology Appendix which recommends a peak farm delivery rate of 0.90 miner's-inch/acre. The Order inappropriately uses information with no supporting technical analysis to incorrectly determine that 0.75 miner's-inch/acre meets the Unit B irrigation requirement at the wellhead. The Unit B Annual Reports from the 1970s and 1980s show that the A&B delivered more than 0.75 miner's-inch/acre at most well systems.

A&B will provide evidence of declining crop yields from farmers at hearing.

Sullivan Opinion

"As of the date of this report, A&B has not provided evidence of land fallowing, crop losses, or crop water shortages to support its delivery call in its pleadings, responses to requests for information from IDWR, nor in deposition testimony" (Sullivan Expert Report, pg. 8).

Rebuttal

It is a well-established principle in irrigated agriculture that shorting water to crops during critical growing periods causes a reduction in yield and in the quality of the crop produced. For example, a shortage of water at a critical time in the growth cycle of a potato crop may not only reduce yield, but also make the crop less valuable by reducing the percentage of tubers that can be sold as "No. 1.". If farmers are not assured of a full water supply, they may choose not to grow a high yield cash crop with a large irrigation demand and they may choose to shift to a lower value crop with a lower irrigation demand. A&B does not regularly collect information on crop yields from the Unit B farmers. Even if crop yield data were available, an analysis would need to be conducted to account for other factors such as the quality of the crop, market factors, fuel, seed and fertilizer costs, etc. to separate out the effects of a reduced water supply on the crop. The best method to account for all of these factors and to evaluate the effects of a water supply shortage is to talk with farmers that deal with these issues every day. A&B will provide evidence at hearing from the farmers regarding the impacts to crop production from water shortage.

The extensive efforts (detailed in the expert report and elsewhere in this rebuttal report) of A&B and its member water users to stretch the available water supplies mask the injury that has occurred to A&B's water rights. For example, when A&B's ground water source to the southwest area of Unit B was dried up, more than 1,300 acres of productive irrigated farms would have been fallowed, except that A&B took the extraordinary step of temporarily serving the affected farm units using storage water delivered though Unit A facilities until the Unit B shortages are remedied. This places a strain on the Unit A water supply. To the extent that diversion of ground water under junior priority rights caused the loss of the ground water supply to this area, the holders of the junior priority rights have the responsibility to resolve this injury, rather than A&B and its member water users having to self mitigate for injury caused by other water users.

The Unit B wells were drilled deep enough at the time of well construction after initial deepening was completed by Reclamation in 1966. The wells were operated successfully until the 1980s when ground water levels across the ESPA began to decline.

Sullivan Opinion

"Aquifer water levels were at an all time high when the B-Unit project was undergoing initial development. The onset of pumping by A&B wells and private wells in the Unit B service area are likely a significant cause of the initial water declines that were experienced

early in the project development. Other causes were climate variations and changes in surface water irrigation practices. As a result of the initial water level declines, approximately one-half of the project wells needed to be deepened early on. The hydrogeology in certain areas of Unit B is such that well construction and deepening caused considerable difficulties and desired discharge rates were not always achieved. It also appears that project wells experienced well caving and sand pumping problems also related to the hydrogeology of the area. It is likely that the circumstances of the project and hydrogeology of the area have contributed to the operation and maintenance costs experienced by A&B" (Sullivan Expert Report, pgs. 31-32).

Rebuttal

Well drilling and well deepening was completed as part of Reclamation's development of the project. There was an iterative process of constructing, testing, operating and examining the project wells and performing well deepening if necessary. Once deepening was finalized, A&B's wells operated without problems for nearly three decades until further development on the ESPA reduced regional water tables. The Unit B wells were adequate and operated successfully for many years prior to having problems that led to wells needing to be deepened and/or abandoned. This only occurred after the severe ground water declines that occurred after the 1980s, which are due in part to the effects of ground water pumping on the aquifer.

Mr. Sullivan states that ground water level declines were likely caused by Unit B pumping, but he has not acknowledged the larger impacts to Unit B wells from ground water level declines caused by junior priority ground water users. Unit B pumping averages about 173,000 acre-feet per year and average consumptive use associated with this pumping may be about 130,000 acre-feet/year (factoring in 20 percent field losses and 5 percent conveyance loss from total pumping. The consumptive use associated with pumping by ground water users with a water right junior to the Unit B 1948 water right averages about 1.8 million acre-feet per year (A&B Expert Report, Table 6-1). The Unit B wells would still be operational and would not have had to be deepened except for the problems caused by these junior-priority ground water uses and the ground water level declines. There may have been other problems in a few wells, but these would not have caused the Unit B wells to need to be deepened or to become in-operational.

Reclamation constructed the Unit B wells from about 1948 to 1957. Reclamation found that the ground water level decline from operation of the project was slightly greater than anticipated and some wells needed to be deepened. Reclamation then went back and deepened about 80 wells from 1957 to 1966 as part of the construction of the project. By the early 1960s the ground water level decline from the operation of the project stabilized and no further declines were anticipated. Figures 3-19 to 3-21 in the A&B Expert Report shows that after Reclamation completed well deepening in the late 1960s, almost all Unit B wells were able to produce from 0.75 to over 0.9 miner's inch/acre at the well head with at least 10 to 20 feet of water over the pump bowls. Of the 175 A&B wells only 16 had less than 60 feet of saturated well interval. See pages 3-7 to 3-10 in A&B Expert Report. Ground water level declines across the ESPA were not evident in the hydrograph records until the 1980s. There was no reason for the Unit B wells to have been drilled deeper during the construction of the project, since they were operating effectively and there was no evidence of long-term ground water level decline.

A&B's wells met or exceeded the depth and saturated interval as other wells constructed at the same period and in the same area (see pages 3-17 and 3-18 of the A&B Expert Report). Data from a review of irrigation well logs in the counties surrounding Unit B shows that wells constructed prior to 1970 have a median saturated interval of about 88 feet as compared to 86 feet for Unit B wells. Table 8 in the report by Crosthwaite and Scott (1956) show that the average saturated interval for wells in Minidoka County in the 1950s was 101 feet, as compared to 117 feet for Unit B wells (median statistics are not available in the Crosthwaite and Scott report). Table 3 in the Nace (1948) report shows an average saturated well interval of 73 feet and a median saturated well interval of 26 feet, which is much less than the Unit B wells.

These facts show that the Unit B wells were constructed adequately to meet the intended purpose. Without the ~50 ft decline caused by junior-priority ground water pumping as predicted by the ESPAM Curtailment Scenario (Figure 6-1, A&B Expert Report), the Unit B wells would still be operating today without needing to be deepened.

Drought is not a reason for the long-term decline of ground water levels on the ESPA and in the vicinity of Unit B. The long-term decline in ground water levels occurring since the 1980s is the problem for A&B, not just short-term declines occurring during the 2000s. A&B had a problem with declining ground water levels prior to the 2000s drought and will continue to have a problem after the 2000s drought is over unless declining ground water levels are remedied.

Sullivan Opinion

"Drought has had a profound effect on the water levels within the ESPA. One of the primary causes of the steep declines in the water levels seen in the 2000's is related to drought conditions. The water level trends seen in the A&B area have responded to wetter climatic periods. Historical climate variations have been cyclical, and have not shown persistent long-term trends" (Sullivan Expert Report, pg. 35).

Rebuttal

Mr. Sullivan's opinion is incorrect for these reasons:

1. **Mr. Sullivan states that the 2000's drought is a reason for the ground water level declines. A drought over 5 years in the early 2000s can not explain a ground water level decline occurring over a period of about 30 years.** We agree that there have been droughts during the 2000s. In fact, there have been dry and wet periods during every decade since the Unit B project was constructed. However, the ground water levels in the ESPA have been on a persistent, declining trend since at least the 1980s, well before the 2000s drought. Droughts are short-term reductions in precipitation during dry years that are offset by other short-term increases in precipitation during wet years. Five years of drought at the end of a 30 year period of ground water level declines can not be the cause for the long-term, persistent decline in ground water levels.

2. **A&B had a problem with dewatered wells from ground water level declines before the 2000s drought.** A&B called for administration of the aquifer in 1994 because of concerns for injury to its water right prior to the 2000s drought. Similarly A&B will continue to have a problem after the 2000s drought unless declining ground water levels are remedied.
3. **Ground water levels did not decline during previous droughts before ground water pumping**. An examination of the ground water hydrographs presented in Appendix S of the A&B Expert Report shows that the ground water levels did not decline during the 1930s drought, which was a very severe drought of similar magnitude to the current drought.
4. **Ground water pumping increases during a drought**. During a drought the consumptive use by ground water pumping increases from a long-term average of about 2.2 MAF/yr to up to 3.0 MAF/yr (Figure 5-5, A&B Expert Report). If junior-priority ground water pumpers did not increase their pumping during droughts, the imbalance between aquifer recharge and withdrawal would be much less.
5. **The fact that there have been droughts does not excuse junior-priority ground water pumpers from their injury to senior priority rights**. Drought causes a reduction in the amount of supply. For the purpose of water rights administration, the fact that the reduction in supply is due to a drought is of no relevance. In fact, water rights administration during periods of shortage is the purpose of the priority-doctrine.

The ESPA ground water level decline has accelerated and ground water levels are not stabilizing.

Sullivan Opinion

Because ground water use has been relatively stable during the last 15 years since the 1992 moratorium against additional pumping, any significant additional declines in aquifer water levels will likely be due to changes in surface water irrigation practices or extended drought. In addition, the goal of aquifer management efforts that are currently under way seek to modify the aquifer water budget to increase the aquifer supply (Sullivan Expert Report, pg. 33). *IDWR enacted a moratorium against new well construction in 1992 and this moratorium continues to preclude construction of new non-domestic wells unless the effects of pumping are mitigated. As a result, there has been relatively little well development during the last 15 + years. Consequently, the impacts of ground water use on ESPA water levels have been largely expressed* (Sullivan Expert Report, pg 33).

Rebuttal

If Mr. Sullivan were correct, we would expect to see the decline in ESPA ground water elevations and the decline in the discharge of interconnected surface water sources moderating and leveling off. This is not happening. There is a severe declining trend that has become worse. Spring Creek, a key component of the monitoring system used to estimate reach gains to Snake River in the American Falls Reservoir area, is at an all time record low. Many of the Thousand Springs have not recovered. Figures 1 to 6 in the rebuttal to the Petrich Expert Report and Direct Testimony provides the data to support these conclusions.

Mr. Sullivan does not account for effects from ground water pumping that is yet to be realized in the aquifer ground water levels and Snake River reach gains. Mr. Sullivan also does not explain that because much of the incidental recharge depletions from increased surface water efficiency have yet to be realized in the aquifer ground water levels and Snake River reach gains, the overall available supply is decreased and will result in further impacts to A&B. The junior-priority ground water pumpers are not responsible for the impacts from declining incidental recharge. However, this does not in any way lessen the impacts caused by junior ground water pumping. The fact that the overall water supply in the aquifer is declining only emphasizes the need for administrative action. During a time of shortage, the junior should bear the impact of the shortage.

Mr. Sullivan mischaracterizes the moratorium on permitting new consumptive uses in the Snake River Basin above King Hill. The moratorium is not universal and has not been administered to stop additional diversion and use of water in the moratorium area. The existing moratorium does not prevent construction of wells used for purposes exempted from water right permit requirements under §42-111, Idaho Code. IDWR's well construction files indicate that approximately 1,000 exempt wells have been constructed each year since the moratorium was established in 1992 (i.e. approximately 15,000 total). The moratorium allows water right permits to be issued for municipal and multiple domestic uses for which each individual housing unit in the project complies with the requirements for exemption under §42-111, Idaho Code. Based upon this provision, IDWR has issued water right permits to cities, developers of residential subdivisions and other municipal providers for a total diversion rate of 194 cfs within the moratorium area. Applications for water right permits for these purposes total another 195 cfs from sources within the moratorium area.

There also is an issue of unauthorized diversions and diversions in excess of authorized rights also occurring within the moratorium area. For example, records collected for ground water irrigation diversions in the Magic Valley Ground Water District (the district encompassing the A&B area and therefore having the most direct affect on A&B) show that 49% of the privately-owned ground water well pumping capacity rates were calibrated by IDWR and Water District 130 personnel and show well pumping capacity in excess of the authorized diversion rate (**Figure 1**). About 9% of the diversions were recorded as having diverted more than the authorized annual diversion volume in one or more years of the period of record (**Figure 2**).

The ESPA cannot meet all of the water use demands at all times and at all locations. Administrative action is needed so the available supply is distributed by priority of right.

Sullivan Opinion

The net pumping of all ground water users from the ESPA represents only 28 percent of total aquifer recharge. A&B's contention that there is not enough physical supply for all ground water users is not supported by the aquifer water budget figures (Sullivan Expert

Report, pg. 35). *Aquifer recharge that is in excess of the net pumping eventually discharges to the river. Conceptually, the aquifer is like a bathtub. The recharge is the inflow to the tub; the wells are straws that suck water from the tub; and the aquifer discharge to the river is the overflow from the tub. As the pumping increases, the aquifer discharge (overflow) will decline over time to balance the water budget. Changes in recharge or changes in pumping also affect the water levels in the aquifer. When there is a change in the aquifer budget, the ground water levels will move in response to the change and eventually stabilize when a new equilibrium is reached. In other words, there is no aquifer mining occurring in the ESPA, water level changes are a response to changes in the aquifer water budget* (Sullivan Expert Report, pg. 35).

Rebuttal

Mr. Sullivan does not mention that the aquifer water budget also shows that 28 percent or more of the total aquifer discharge is due to ground water pumping. Mr. Sullivan does not account for the fact that much of the remaining 72 percent of aquifer discharge has been allocated to surface water users (reach gains or spring flows) or reservoir storage accounts with senior rights and the aquifer is not able to reliably supply these senior rights. Reducing the available supply by almost one-third (from ground water pumping) places a burden on the seniors water supply and reduces the reliability and amount of water that can be used to meet their water use demands. The pumping by junior-priority ground water users is significant and is reducing ground water levels and dewatering the Unit B wells thereby impacting A&B's ability to receive a full supply under its senior-priority water right.

The ESPA is not "like a bathtub". Water levels and water level changes are not uniform across the ESPA. Shortages in one part of the aquifer are not automatically remedied by water from other parts of the aquifer. The aquifer cannot self mitigate the impacts to water users with senior-priority rights caused by declining ground water levels. Such simple characterizations without an examination of the impacts of ground water use on reach gains, spring flows and ground water levels and the related impacts on senior water users does little to provide an understanding of the ability of the aquifer to reliably meet water demands. Declining ground water levels cause a problem for well users, reach gain users and spring flow users. Mr. Sullivan's logic is that declining ground water levels are not a problem now because the aquifer levels will eventually reach equilibrium. Under Mr. Sullivan's logic, as long as the declines eventually reach equilibrium, there is no problem, even if the equilibrium is such that reach gains and spring flows are depleted and wells are dewatered. Mr. Sullivan fails to provide any criteria beyond which further declines are a problem that requires a remedy.

Mr. Sullivan has provided no analysis of the final equilibrium state of the aquifer beyond speculation. Mr. Sullivan has not evaluated the possible outcomes of future declining incidental recharge, increased irrigation efficiency, canal lining or increased crop ET. Yet these factors are likely to be the strongest influence on the future ground water levels in the aquifer.

Voluntary efforts have been unsuccessful at remedying the impacts from junior-priority ground water level pumping to senior rights on the Eastern Snake Plain.

Sullivan Opinion

Mr. Sullivan describes voluntary mitigation efforts and required mitigation (Sullivan Expert Report, pgs 35 to 37).

Rebuttal

Voluntary efforts have been unsuccessful at remedying the impacts from junior-priority ground water level pumping on senior rights on the Eastern Snake Plain. CREP enrollment is only about 36,000 acres and enrollment is actually decreasing, not increasing. The aquifer recharge project contemplated in the CAMP framework does not have a methodology to reliably obtain water and does not have sufficient funding to construct a recharge project in the near future. Mitigation by IGWA and Idaho Dairyman's Association to date is only for a portion of the impacts to only two spring flow users (Blue Lakes Trout Farm and Clear Springs Foods) and does not address the impacts to other water users with senior priority rights.

A&B allowed its priority call filed in 1994 to be held without pressing for formal protection of its senior water right based upon assurances in IDWR's 1995 Order adopting a proposed stipulation that actions set forth in the proposed stipulation would be taken voluntarily by the State and holders of junior priority ground water rights. More than 13 years later, the Order has not been fully and adequately implemented and ground water conditions continue to deteriorate. A&B finds that voluntary action cannot be relied upon and it must seek formal protection of its water right in accordance with state law.

Mr. Sullivan's irrigation requirement analysis uses inappropriate methods and recommends an irrigation rate that is insufficient to meet the Unit B irrigation demand.

Sullivan Opinion

The method used by Mr. Sullivan assumes a uniform irrigation rate at the headgate of 0.65 miner's-inch/acre based on 2003 dry-year conditions. The method assumes that irrigators will be able to over-water in May and June to put water into soil moisture up to the maximum field capacity. (**Figure 3** explains the definitions of soil moisture at field capacity, maximum allowable depletion and available water.) The method then assumes that soil moisture will be used in June and July to make up for shortages that would occur by only irrigating 0.65 miner's-inch/acre during these months. Mr. Sullivan is assuming that soil moisture will be used down to the maximum allowable depletion. **Figure 4** summarizes the resulting monthly water balance for irrigation application, soil moisture and crop utilization calculated by Mr. Sullivan. Mr. Sullivan compares the recommended irrigation delivery rate of 0.65 miner's-inch/acre to the current capacity of the Unit B wells and concludes that most well systems can deliver this rate and there is no shortage.

Rebuttal

Mr. Sullivan's irrigation requirement analysis method is flawed and the results are not reasonable, for the following reasons.

1. **Sullivan's assumption that water can be stored in soil moisture early in the season to be used to offset shortages later in the season is an incorrect assumption because of these reasons:**

   a. **Over-watering early in the irrigation season (April to June) to put water into soil moisture is not practical on Unit B because of constraints related to fertilizer application, planting, potential water logging of soils, crop health and harvest.** The Unit B farmers (and to our knowledge all farmers on the Eastern Snake Plain) irrigate to meet the crop demand when it occurs. Farmers may irrigate early in the spring (April to early May) during dry years if there was not enough winter precipitation to soften soil or to have adequate soil moisture for seed germination. This early season irrigation, if necessary, is done prior to planting and prior to application of fertilizer and only enough water is applied for the intended purpose (seed germination and support of the crop during emergence and shoot growth).

      After fertilizer application and planting (which occurs for most crops in early- to mid-May), Unit B farmers typically do not irrigate again or irrigate only infrequently until late May or early June after the seed has germinated and has emerged and is growing as a shoot. Farmers do not irrigate heavily and they do not want to fill the soil to field capacity in May and early June for good reasons. Saturated soil is much more difficult to till and plant. Irrigating after the seed is planted cools the soil and reduces germination. Filling the soil to field capacity[2] causes fertilizer to be lost through denitrification and/or be washed below the root zones. Many crops, especially potatoes, are prone to disease if the soil profile is kept full to field capacity. In the effort to maintain a full soil moisture profile, it is likely that over-watering would occur which would place a risk to early crop growth. It is also not practical to over-water to full field capacity because of the demands of early harvest of some crops. For example, alfalfa and pasture grass usually requires dry fields during the end of May and the beginning of June and then again at the end of June and beginning of July to allow for the first and second cutting, curing and baling of hay. If fields can not be irrigated during these periods, then it would not be possible to keep a full soil moisture profile coming into June so it can be used in June and July.

      Page 4 of the IDWR publication, <u>Guidelines for the Design of Irrigation Diversion Rates</u>, dated 1991, supports these conclusions and states, "*It is not necessary, feasible or even desirable to maintain soil moisture at the root zone at field capacity. The objective for irrigation is to provide adequate moisture for crop production*". Mr. Sullivan is advocating a method of irrigation that is impractical and would likely cause problems with normal farming practices (fertilizing, planting, harvesting).

   b. **Operating Unit B to put water into soil moisture early in the season and to reduce the well capacity to meet peak irrigation demand in June to August is inefficient and contrary to the design and operation of Unit B as an efficient on-demand irrigation system.** Unit B is designed as an on-demand application system. This is the most-efficient method of operation because only the amount of water

[2] See Figure 3 for an explanation of soil moisture and field capacity, maximum allowable depletion and permanent wilting point.

needed is pumped and there is little risk that the water will be wasted. Requiring Unit B farmers to over-water crops from April to June is inefficient because it requires extra labor and management attention, results in extra potential costs from lost fertilizer and impacted crops from over-watering and may result in a waste of water.

Putting water into the soil moisture profile up to field capacity requires careful monitoring of the soil moisture at individual fields so that extra water is not applied that may be lost to percolation below the root zone. If a farmer is expecting dry weather and it rains after water is put into the ground to build up the soil moisture profile, then that water will be lost below the root zone (resulting in inefficient application of water). Accidental overwatering may cause water-logged soils that will damage the crop or reduce fertilizer application efficiency. Alternatively, underwatering of the soil early in the season will result in a less than full soil moisture profile coming into the peak demand period in the middle of the irrigation season. Because the farmer can only apply 0.65 miner's-inch/acre under Mr. Sullivan's proposed method, it would not be possible to meet the peak irrigation demand in the middle of the irrigation season to make up for the failure to store adequate water in soil moisture early in the irrigation season and crop stress and reduced yields would occur. Adopting such a system would place Unit B at a greater risk for shortages. Also, A&B and the Unit B farmers are not set up to monitor soil moisture with lysimeters and other instrumentation at many farm units.

Requiring A&B to short the Unit B farmers during their peak demand period and requiring them to over-irrigate in the spring goes beyond an examination of whether Unit B is reasonably efficient.

c. **Sullivan's method to compute the amount of water that can be put into soil moisture and taken out of soil moisture is based on flawed assumptions about maximum rooting depth and maximum allowable depletion.** Mr. Sullivan assumed a maximum crop rooting depth[3] to determine the amount of water that can be placed into soil moisture and later used by crops. This is an incorrect assumption because the soil moisture water is used in early July when crop roots are not at the maximum (crop roots reach maximum later in the irrigation season). Also, individual crop types may have shallower roots than the maximum rooting depth computed by an average crop mix. Therefore some crop types with shallow roots will not have enough water stored in the soil moisture profile to withstand application at a 0.65 miner's-inch/acre application as recommended by Mr. Sullivan in June and July when this rate is insufficient to meet the crop demand.

It also may be necessary during hot and dry years, depending on the crop type, to have more soil moisture applied with a greater frequency within the upper part of the root zone. Crops like potatoes and sugar beets have shallow roots and need more frequent watering. The IDWR publication, <u>Guidelines for the Design of Irrigation Diversion Rates</u>, dated 1991, states on page 5, "*Plants, however do not use water at a uniform rate from all parts of the root zone. Water is used more slowly from the lower part of the root zone than from the upper part. Under normal irrigation* *conditions, plants obtain about 40 percent of their water from the upper quarter of the root zone, 30 percent from the second quarter, 20 percent from the third quarter and about 10 percent from the bottom quarter. Thus, the upper part of the root zone may be approaching the wilting point while moisture is available at the lower depths*".

Mr. Sullivan also assumes that crops can take water out of the soil moisture down to the maximum allowable depletion, which he assigns at 50 percent of available water capacity. In reality, crops can not efficiently use all of the water to maximum allowable depletion during hot and dry years because the water is being used quickly and plants will become stressed at the maximum allowable depletion point. During hot and dry years, it is common to increase the amount of water needed to remain in the soil during peak demand periods to provide a margin of safety to avoid stressing the crop (Allen et al, 1996)[4]. Jensen states that "*Many farmers irrigate when the available water has been depleted a certain amount, depending on the crop. For high-water-requiring crops such as potatoes, irrigation may be scheduled at 15 to 25 percent depletion (75 to 85 percent available water remaining in the soil); for many other crops the depletion may go to 50 to 75 percent before irrigation*" Jensen, 1983, pg. 87[5].

Finally, Mr. Sullivan's entire soil moisture analysis is based on the assumption that water placed into soil moisture up to the field capacity will remain in the soil until it is needed. Soil moisture at the field capacity can be lost from evaporation at the top of the soil column or it can be transported below the root zone by capillary forces or soil vapor if the lower portions of the soil column are below field capacity. It is doubtful whether all of the water that is stored in soil moisture in April and May will actually be available in June and July.

d. **Sullivan is incorrectly calculating the peak demand needed to be met using soil moisture.** Mr. Sullivan does not calculate the peak irrigation demand based on the 30-day peak demand. Instead, he uses the monthly demand based on the beginning and end of the calendar month. If Mr. Sullivan would have computed the 30-day peak demand, the demand would be much higher and there would not be sufficient soil moisture stored to meet the demand. This error causes Mr. Sullivan to recommend a delivery rate that is not sufficient to meet the demand and which would actually cause shortages.

During 2003 (the year Mr. Sullivan chooses for his analysis), the 30-day period of maximum demand is from June 25, 2003 to July 24, 2003. During this period the total on-farm irrigation demand is 10.6 inches. This is calculated using the daily crop irrigation requirement data from Allen and Robinson (the same data source used by Mr. Sullivan). Mr. Sullivan's total monthly delivery over the same period is 6.6 inches (assuming the 0.65 miner's-inch/acre delivery rate recommended in Table A-2

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4 Allen, R.G., L.S. Pereira, D. Raes, M. Smith, 1998. Crop evapotranspiration - Guidelines for computing crop water requirements - FAO Irrigation and Drainage Paper 56, Food and Agriculture Organization of the United Nations, Chapter 8, pg. 3. United Nations, New York.

5 Jensen, , ME, 1983, ASCE, Design and Operation of Farm Irrigation Systems, ASCE, St. Joseph, Michigan, pg. 87.

in Mr. Sullivan's report and accounting for Mr. Sullivan's recommended 71% farm application loss factor). Therefore, the shortage that needs to be made up from soil moisture storage for this period is about 4.0 inches. The values summarized above are shown on Table 1.

Even assuming that his computation of soil moisture of 3.25 inches recommended by Mr. Sullivan is available on June 25, 2003 and can be fully used to the point of maximum allowable depletion, Mr. Sullivan's recommend 0.65 miner's-inch/acre delivery rate during this 30 day period would result in about 0.75 inch of shortage Since most crops can not tolerate drawing down the soil moisture to the maximum allowable depletion and many crops have not yet reached full rooting depth by June or will never reach the rooting depth specified by Mr. Sullivan and since some of the water placed into the soil moisture column may be lost to evaporation and percolation, it is likely that the shortages using Mr. Sullivan's method would be much more than 0.75 inches. Therefore, it is our opinion that Mr. Sullivan's analysis and his recommended 0.65 miner's-inch/acre application rate does not provide sufficient water to meet the irrigation diversion requirement during hot and dry years.

2. **Mr. Sullivan's recommended headgate delivery rate of 0.65 miner's-inch/acre cannot be accurate because Unit B currently pumps far more than this amount during peak demand periods.** Mr. Sullivan is recommending a headgate delivery rate of 0.65 miner's-inch/acre. Accounting for an average 3 percent conveyance loss on Unit B, this would equate to 0.67 miner's-inch/acre irrigation requirement at the wellhead. The SWC Expert Report computes a peak irrigation requirement of about 0.89 miner's-inch/acre at the wellhead. An analysis was completed to evaluate how much water A&B currently pumps during peak demand periods to see if Mr. Sullivan's analysis is reasonable. Comparing pumping rates to irrigation diversion requirements is a good test of the reasonableness of a recommended irrigation diversion rate because A&B has a significant incentive to only use the water needed to meet the crop demand because of the large cost expended for pumping water out of deep wells (i.e. power costs, etc). There also is an incentive to individual farmers to avoid wasting water because of the cost to pressurize water for on-farm delivery. Pumping and application of water in excess of the irrigation diversion requirements does not increase the crop yield and is a waste of money. Therefore, Unit B should only be pumping the water that is needed to meet the irrigation diversion requirement.

   The Water and Power Report shows the daily pumping record for each well system. These reports are on-file at the A&B office. The 2003 and 2007 daily pumping rates during the middle of the irrigation season (mid-June to mid-August) were entered into a spreadsheet. The mid-irrigation season was selected because it is the critical time when crop irrigation demand is highest. The 2003 and 2007 years were selected because they were hot and dry years and were the years used by Sullivan (2003) and the A&B Experts (2007) to make a recommendation for the Unit B irrigation diversion requirements. The 2003 and 2007 daily pumping data was sorted to identify and remove wells from the analysis that could not produce 0.75 miner's inch/acre. Wells that cannot meet 0.75 miner's-inch/acre are limited by well capacity and their pumping records do not reflect the actual irrigation demand. Although this process still retains some wells that are capacity-limited due to declining ground water levels, it can be used to evaluate the reasonableness of irrigation diversion requirements by Mr. Sullivan and in the A&B Expert Report.

The 2003 mid-June to mid-August daily pumping data shows that the average maximum daily pumping demand is 0.87 miner's inch/acre and this amount of water is pumped on average for 8 days during this period (see **Table 2** and **Table 3**). Lesser pumping rates were pumped for more days (0.85 miner's-inch/acre for 12 days, 0.80 miner's-inch/acre for 20 days and 0.75 miner's inch/acre for 28 days).

The 2007 mid-June to mid-August daily pumping data shows that the average maximum daily pumping demand is 0.87 miner's inch/acre and this amount of water is pumped on average for 5 days during this period (see **Table 4** and **Table 5**). Lesser pumping rates were pumped for more days (0.85 miner's-inch/acre for 7 days, 0.80 miner's-inch/acre for 14 days and 0.75 miner's inch/acre for 21 days).

The recommended irrigation diversion requirement in Chapter 4 of the A&B Expert Report is 0.89 miner's-inch/acre. This is reasonably close to the current average daily maximum pumping rate at the Unit B well systems of 0.87 miner's-inch/acre. Some of the wells that are above or close to the 0.75 miner's-inch/acre criteria are likely capacity limited which may explain why the daily pumping rate was slightly less than the recommended peak irrigation diversion requirement rate in the A&B Expert Report.

The daily pumping data from 2003 and 2007 shows that Mr. Sullivan's irrigation diversion requirement of 0.65 miner's-inch/acre (0.67 miner's-inch/acre at the headgate including conveyance loss) <u>is much less than the actual amount pumped</u> by Unit B during peak diversion periods. A diversion rate recommendation for Unit B should include the amount needed to meet the peak demand, since Unit B is an on-demand system that does not have storage. Mr. Sullivan's recommended irrigation requirement does not meet the peak demand on Unit B and is therefore insufficient to meet the Unit B irrigation demand.

3. **Mr. Sullivan's recommended headgate delivery rate of 0.65 miner's-inch/acre is much less than the average diversion capacity rates of private ground water wells in Water District 130 located in the vicinity of Unit B.**

Mr. Sullivan's recommended headgate delivery rate of 0.65 miner's-inch/acre was compared to the average well pumping capacity rate at private wells in the vicinity of Unit B to determine if it is reasonable. Private wells almost always use pipeline distribution systems that do not have losses, so therefore we can assume that a Unit B headgate delivery rate of 0.65 miner's-inch/acre recommended by Sullivan is equivalent to a 0.65 miner's-inch/acre diversion rate at the well.

An analysis was completed to determine the pumping capacity rate of private wells within Water District 130 that are outside the Unit B boundary but still within the general vicinity of Unit B. The analysis consisted of requesting the Water District 130 records for the Magic Valley area of the district and included the well location, the associated water right number, measurement data to determine well discharge capacity and annual volumes of water diverted. Power records were not included or requested due to privacy concerns for those records.

Well records were matched to water rights (where possible) and the water right information was compared to the water use data contained in the Water District 130 records. The diversion rate per acre shown in **Figure 5** was calculated by dividing the diversion rate measurement from the water district records by the acres shown in the water right.

This analysis showed an average well pumping capacity rate of 0.89 miner's-inch/acre for private wells within Water District 130, with about 59 percent greater than 0.75 miner's-inch/acre, 44 percent greater than 0.85 miner's-inch/acre and 25 percent greater than 1 miner's-inch/acre. The data are shown in **Figure 5**. This shows that Mr. Sullivan's recommended delivery rate of 0.65 miner's-inch/acre is much less than the average delivery rate for private ground water irrigators in the same area as Unit B. This shows that the 0.65 miner's-inch/acre recommended by Mr. Sullivan will not provide sufficient water to meet the Unit B irrigation demand.

Table 1 Summary of data showing Mr. Sullivan's irrigation requirement analysis does not provide for peak irrigation requirements during 30 day periods.

30-day Period of Maximum Demand in 2003	Total Crop Demand [inches/month]	Amount Needed on Farm Accounting for Field Losses [inches/month]	Farm Delivery Assuming Sullivan's 0.65 Miner's-Inch/Month Delivery [inches/month]	Actual Water Applied Assuming Sullivan's 0.65 Miner's-Inch/Month Delivery [inches/month]	Deficit [inches/month]
Table Explanations	*A*	*B*	*C*	*D*	*E*
6/25/2003 to 7/24/2003	10.59	14.90	9.29	6.61	3.99

Notes:

A The Allen and Robison Crop Demand with Sullivan's Crop Distribution Less Effective Precipitation
B Column A / 0.711 to account for field efficiency
C Sullivan's Farm delivery (0.65 miner's in/acre)
D Column C * 0.711 to account for field efficiency
E Column A - Columne D

Table 2 **Average daily maximum pumping rate from June 16 to August 15, 2003 at specified time duration intervals (1, 3, 5, 7 and 30-day).** (Statistics do not include wells that can not produce 0.75 miner's-inch/acre at the headgate since these wells require rectification due to declining ground water levels).

	1-Day Ave. Daily Max.	3-Day Ave. Daily Max.	5-Day Ave. Daily Max.	7-Day Ave. Daily Max.	30-Day Ave. Daily Max.
Average Daily Max. Pumped at Well (Miner's Inch/Acre) in June 16 to August 15, 2007[1]	0.87	0.86	0.85	0.84	0.76

Note:

1. The max average daily miners-inches/acre pumped at well was calculated from the Water and Power daily diversion records.
2. Wells with capacity to deliver at least 0.75 miner's inch/ acre were calc. from "Criteria Avail. per Acre at Turnout" in Annual Report.

Table 3 **Number of days from June 16 to August 15, 2003 when wells pumped the specified delivery rate.** (Statistics do not include wells that can not produce 0.75 miner's-inch/acre at the headgate since these wells require rectification due to declining ground water levels).

	0.75 miner's-inch/acre	0.80 miner's-inch/acre	0.82 miner's-inch/acre	0.85 miner's-inch/acre	0.87 miner's-inch/acre
Average Count of Days When Wells Were Pumped at the Specified Rate from June 16 to August 15, 2007[1]	28	20	17	12	8

Note:

1. The average count of days wells were pumped at the specified rate was determiend from the Water and Power daily diversion records.
2. Wells with capacity to deliver at least 0.75 miner's inch/ acre were calc. \from "Criteria Avail. per Acre at Turnout" in Annual Report.

Table 4 Average daily maximum pumping rate from June 16 to August 15, 2007 at specified time duration intervals (1, 3, 5, 7 and 30-day). (Statistics do not include wells that can not produce 0.75 miner's-inch/acre at the headgate since these wells require rectification due to declining ground water levels).

	1-Day Ave. Daily Max.	3-Day Ave. Daily Max.	5-Day Ave. Daily Max.	7-Day Ave. Daily Max.	30-Day Ave. Daily Max.
Average Daily Max. Pumped at Well (Miner's Inch/Acre) in June 16 to August 15, 2007[1]	0.87	0.84	0.83	0.81	0.73

Note:

1. The max average daily miners-inches/acre pumped at well was calculated from the Water and Power daily diversion records.
2. Wells with capacity to deliver at least 0.75 miner's inch/ acre were calc. from "Criteria Avail. per Acre at Turnout" in Annual Report.

Table 5 Number of days from June 16 to August 15, 2007 when wells pumped the specified delivery rate. (Statistics do not include wells that can not produce 0.75 miner's-inch/acre at the headgate since these wells require rectification due to declining ground water levels).

	0.75 miner's-inch/acre	0.80 miner's-inch/acre	0.82 miner's-inch/acre	0.85 miner's-inch/acre	0.87 miner's-inch/acre
Average Count of Days When Wells Were Pumped at the Specified Rate from June 16 to August 15, 2007[1]	21	14	11	7	5

Note:

1. The average count of days wells were pumped at the specified rate was determiend from the Water and Power daily diversion records.
2. Wells with capacity to deliver at least 0.75 miner's inch/ acre were calc. \from "Criteria Avail. per Acre at Turnout" in Annual Report.

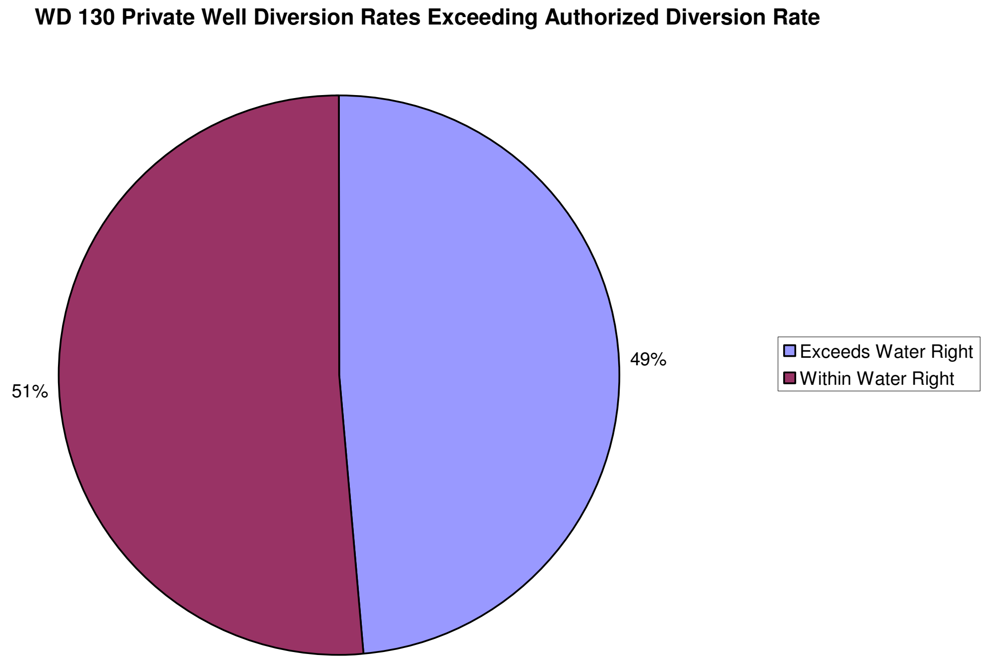


Figure 1 **WD 130 (Magic Valley GWD) private well capacity diversion rates exceeding authorized diversion rate of the water right**. Data is based on WD 130 records.

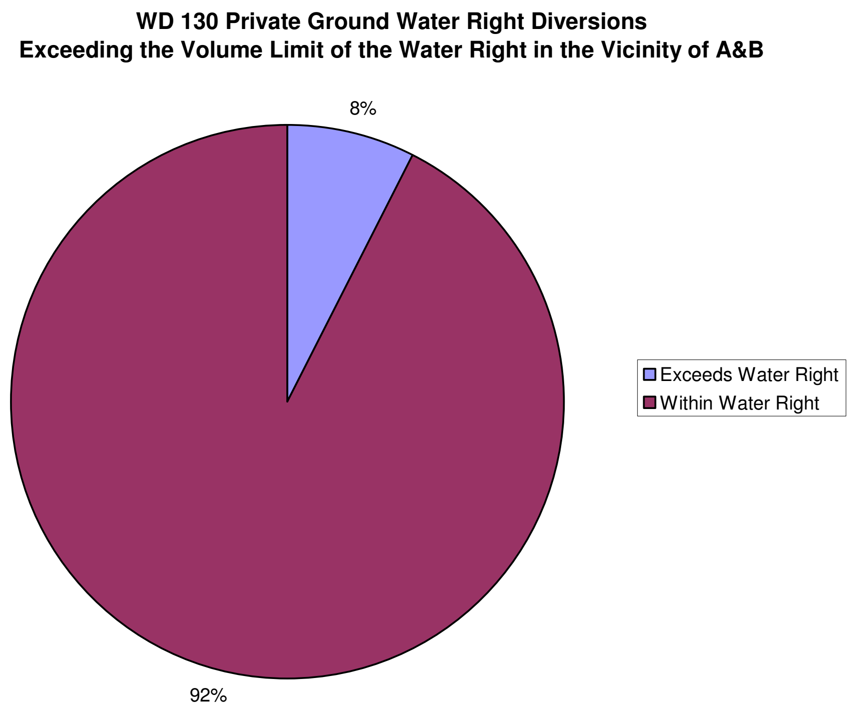
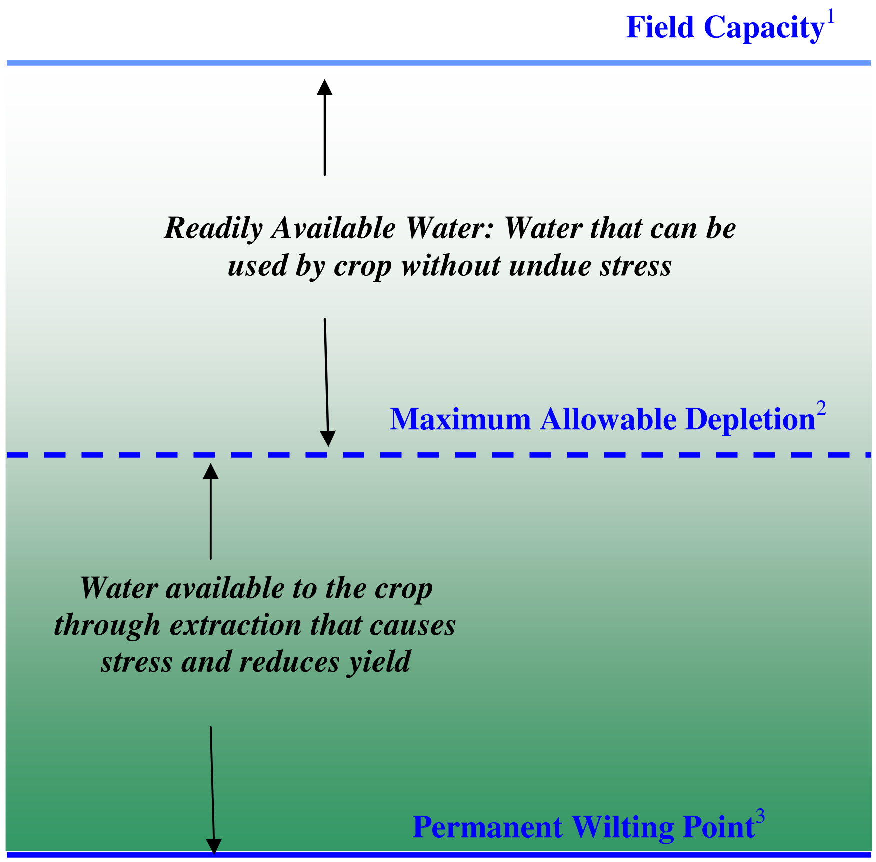


Figure 2 **WD 130 (Magic Valley GWD) private well capacity diversions exceeding the volume limit of the water right.** Data is based on WD 130 records.

Figure 3 **Explanation of soil moisture terminology and relationships between field capacity, available water, maximum allowable depletion**.



[1] ***Field Capacity*** is the amount of water the soil can hold within the root zone or to some predefined depth without losing water to deep percolation. When the soil is irrigated to more than this amount (saturated) the excess will primarily be lost to seepage (deep percolation beyond the root zone) or surface runoff before it can be beneficially used by the plant.

[2] ***Maximum Allowable Depletion*** is the amount of water extractable by the plants without undue stress that reduces crop yield or quality. This amount varies by crop, crop stage and weather conditions. During periods of high water demand, crops will begin to stress with higher moisture levels remaining than during lower demand periods because the moisture cannot move quickly enough from the soil to the crop roots. The amount of *field capacity* that can be used varies from 15% for high water demand crops during high demand periods to 75% for some crops during periods of lower demand[6].

[3] ***Permanent Wilting Point*** is the amount of water remaining in the soil when the plant can no longer take water from it at a rate sufficient to maintain plant vigor even when transpiration is nearly eliminated. If the soil moisture is at or below this level, the plants will cease to grow.

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[6] Jensen, , ME, 1983, ASCE, Design and Operation of Farm Irrigation Systems, ASCE, St. Joseph, Michigan, pg. 87.

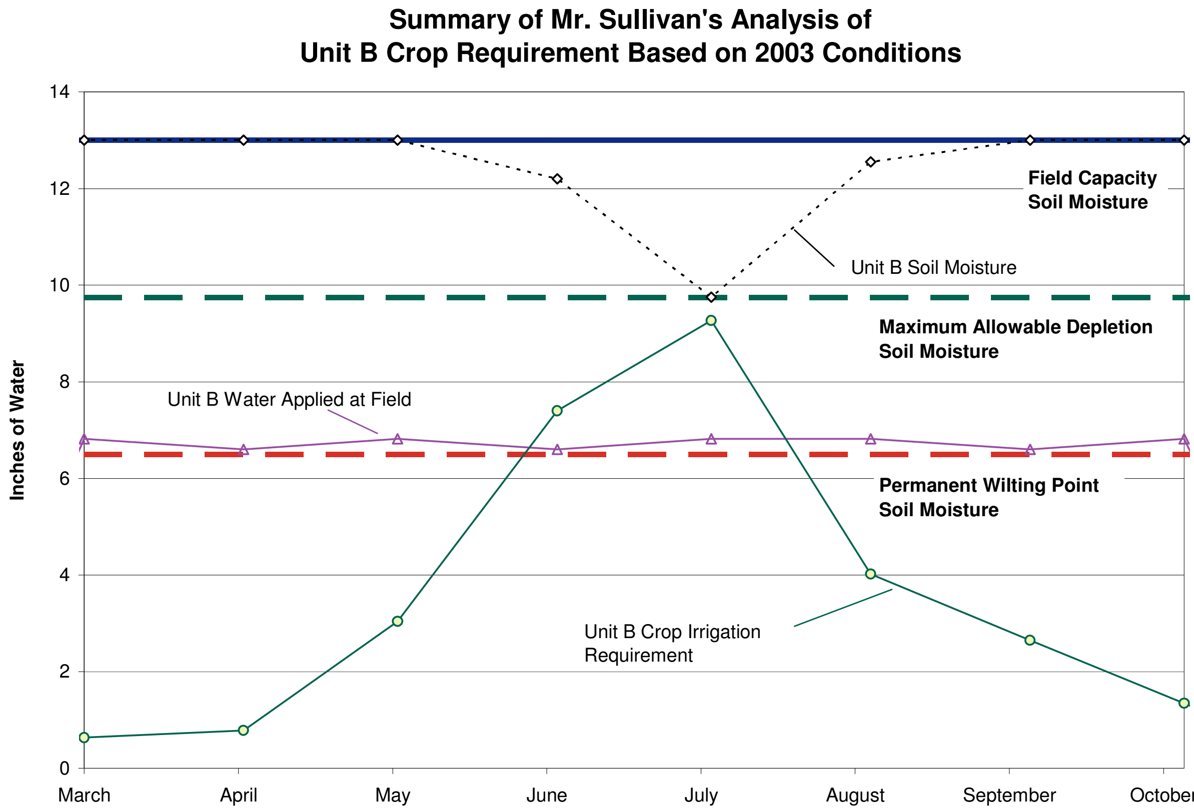

Figure 4 Summary of Mr. Sullivan's irrigation requirement analysis components.

Figure 5 **Summary of well pumping capacity diversion rates for private wells located in WD 130 (Magic Valley GWD) in the vicinity of Unit B.**