REBUTTAL REPORT
OF EXPERT REPORT AND DIRECT TESTIMONY BY
CHRISTIAN PETRICH FOR IGWA

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 Christian Petrich of SPF Water Engineers, LLC for Idaho Ground Water Appropriators, Inc. (IGWA). This rebuttal report was prepared by John Koreny of HDR Engineering, Inc. and Charles Brockway of Brockway Engineering, Inc at the request of A&B Irrigation District (A&B). The following opinions by Dr. Petrich are addressed in this report.

A&B should not be required to modify the Unit B irrigation conveyance system.

Petrich Opinion

Dr. Petrich opines that A&B should move water from the Unit B irrigation systems without shortages to provide water to the irrigation systems with shortages. Dr. Petrich also suggests that A&B should drill additional wells to make up for systems with a water shortage. *"A&B is authorized to use additional wells and/or to interconnect its wells to provide water to its water users as it has done in some well systems"* (Petrich Direct Testimony, pg. 7, line 14-15). *"Additional wells and interconnection of existing wells could be used to supplement well systems currently producing less than 0.75 inches per acre (if supplementation is needed). Well systems producing less than 0.75 inches per acre are generally located adjacent to or in the general vicinity of well systems producing more than this amount. It would be possible to move water from systems capable of higher diversion rates to water short systems or to specific land within water short systems"* (Petrich Expert Report, pg. ii, Nos. 5, 6). "*It would be possible to shift demand (by shifting irrigated acres) from systems producing less than 0.75 inches per acre to adjoining systems producing greater amounts*" (Petrich Expert Report, pg. 15).

Rebuttal

Dr. Petrich's opinion is incorrect, for these reasons:

1. **Dr. Petrich is advocating a new standard for irrigation system efficiency that is inappropriate and would require reconstruction of the Unit B irrigation system.** Unit B is at least as efficient as other large irrigation districts operating on the ESPA and likely more efficient. Unit B has a conveyance loss on individual well systems up to 5

percent and has constructed pipelines over much of the district conveyance systems to reduce losses. Over 97 percent of Unit B is served by on-farm sprinkler systems. A&B employs eight to nine ditchriders to measure pumping rates at the pump and deliveries at the headgate and to adjust the pumping amount at individual well systems so that the supply does not exceed the demand. Water is pumped on-demand to meet the irrigation requirement when it occurs. A&B has reduced return flow losses so that the project drain wells are no longer needed for irrigation return flows. A&B maintains an extensive reporting system to document water use and to track 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 criteria of reasonable efficiency.

Dr. Petrich is advocating that the Unit B irrigation system be interconnected to share water between well systems. This would require extensive re-engineering, construction of new facilities and changes in management that are not commonly employed in irrigated agriculture. Dr. Petrich is going far beyond a criteria of reasonable efficiency.

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.

2. **It is not feasible for A&B to construct and operate an interconnected well system.** No information is presented in Dr. Petrich's Expert Report to determine the feasibility or cost of interconnecting the Unit B well systems. Dr. Petrich has not even identified which Unit B well systems (if any) have surplus capacity and could be connected to other well systems with shortages. It would take a significant engineering study just to determine the feasibility and level-of-effort needed for engineering, permitting, financing, construction, power, management and maintenance.

   Constructing an interconnected well system across the entire project is not feasible.[1] A&B is a very large irrigation system covering an area of about 200 square miles. An interconnected well pumping and delivery system would require significant modifications including a pressurized interconnected pipeline distribution system, booster pumps, storage tanks, regulating equipment, meters and other infrastructure. A&B would be required to abandon most or all of 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 costs to Unit B for operating an interconnected pipeline system would increase significantly. The maintenance requirements would increase significantly. An interconnected water conveyance system would require construction and operation of a pressurized pipeline and we understand A&B is not allowed to pressurize water under the terms of the A&B repayment contract with Reclamation.

   It is relevant to note the scale of irrigation and water delivery that occurs on Unit B. Unit B has a peak delivery rate of about 1,100 cfs. This is equivalent to about 700 million gallons per day (mgd). In comparison, the water system for the City of Boise has a peak delivery rate of about 90 mgd. Construction of an interconnected well and

[1] A&B has interconnected eight well systems (sharing between four groups of two well systems for each group) where interconnection was possible (A&B Expert Report, pg. 3-1, footnote 1).

delivery system on Unit B capable of delivering 700 mgd would involve a very large construction project with a significant cost. The type of interconnected delivery system Dr. Petrich is advocating for Unit B is typically used in municipal water supplies and is not typically used in the irrigation industry because of the cost of construction and operation.

3. **IDWR requires that A&B file an application and obtain approval for transfer of the point of diversion.** Mr. Petrich is advocating drilling new wells which would require applying for and obtaining approval for a water right transfer. A&B is not authorized to make changes as suggested by Mr. Petrich without IDWR approval.
4. **It may not be possible to increase the pumping in some wells or drill other wells to make up for the shortages.** The ground water levels are declining on the entire Unit B project. Increasing the pumping demand on some areas of the project to make up for shortages in other areas may not be a long-term sustainable solution and may result in increased ground water drawdown and dewatering of additional wells on the project. A detailed examination of the feasibility of increasing pumping would be required and Dr. Petrich has not completed such an analysis to determine if his proposed solution is feasible.
5. **New wells or well deepening will not solve the declining water supply problem on the southwest portion of Unit B.** New wells or well deepening in the vicinity of the southwest area of Unit B will not provide additional sources of water, since the ground water levels in this area have dropped into the lower part of the aquifer where the transmissivity is low and the ground water yield in this area is no longer sustainable. The independent hydrogeologic report for the A&B Delivery Call prepared by Dr. Ralston for IDWR confirmed this finding stating, "*The potential for successful well deepening is high in the northern portion of the project and relatively low in the southern portion of the project area*" (pg. 1089). New wells would have to be drilled to the northeast, and the water conveyed by pipeline over a great distance (10 to 20 miles or more). This would place an even greater strain on the ground water supply and water levels in the areas of the project that are being used to supplement the southwest area, and ground water levels are already declining in these areas.

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.

Petrich Opinion

Dr. Petrich argues that the Unit B wells were not drilled deep enough from the beginning of the construction of the project. *"Given the apparent declines that occurred from the onset of production within A&B, it is surprising that wells were not commonly deepened to greater depth" . . . "Judging by the number of deepening's over time, the target depth . . . was insufficient for many of the wells"* (Petrich Expert Report, pg. 35).

Rebuttal

This argument is without a reasonable foundation. Reclamation constructed the Unit B wells from about 1948 to 1957. Reclamation then went back and deepened about 80 wells from 1957 to 1966 as part of the construction of the project. 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 deliver at least 0.75 miner's-inch/acre, and many wells delivered over 0.8 to 0.9 miner's-inch/acre at the well head with at least 10 to 20 feet of water over the pump bowls. 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 were drilled to a similar depth and with a similar saturated interval (the depth of water in the well) as other wells in the region drilled during the same period (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, and would still be operating today without needing to be deepened if ground water levels had not declined in the aquifer.

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 or a delivery capacity limitation.

Petrich Opinion

"A&B has a delivery standard of 0.75 miner's inch" (Petrich Expert Report, pg 5). *"The primary ground water right held by A&B (36-2080) authorizes a maximum diversion rate of 1,100 cfs. However, A&B has stated that 0.75 inches per acre delivered at the field turnout is a threshold under which delivery for irrigation is insufficient to meet crop needs. By inference, a delivery of more than 0.75 inches per acre, if not ideal, is sufficient based on A&B's internal standard of 0.75 inches per acre. A 0.75 inch per acre delivery rate to the originally licensed 62,604.3 acres with an assumed average 5 percent delivery loss would require a flow rate of approximately 990 cfs" (*Petrich Expert Report, pg. 5*).*

Rebuttal

The 0.75 miner's inch/acre criteria is <u>not a measurement of the amount of water needed to meet the crop irrigation requirement</u>. A&B uses a criteria of 0.75 miner's inch/acre at the headgate to identify wells <u>that are not producing enough water and need to be rectified</u>. It is illogical for Dr. Petrich to imply that the criterion for determining that a well system needs to be rectified is also the criterion for determining when a well system is producing enough.

There currently are many wells that do not meet the rectification criteria, whereas in the past in the late 1960s and 1970s almost all wells exceeded the criteria. A&B attempts to improve these wells so they can produce more than 0.75 miner's-inch/acre. A&B has finite financial resources so there are still many wells that need to be rectified to restore their production capacity above the 0.75 miner's inch/acre criteria. Sometimes A&B is not able to restore a well to above 0.75 miner's-inch/acre if well drilling proceeds too slowly and the well cannot be deepened far enough before the irrigation season starts or if the budget for well deepening is fully expended before the well driller advances the well to the specified well deepening completion depth. There are other technical reasons why A&B is not always able to improve well production capacity during well rectification, however; A&B attempts to increase well production capacity to above 0.75 miner's-inch/acre.

Mr. Temple clearly stated 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 a delivery standard and 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 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 clearly show a per-acre allotment delivery rate and a well system capacity rate of much 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). The 2003 and 2007 daily diversion data shows that Unit B wells with the capacity to pump more than 0.75 miner's-inch/acre are pumped at rates well above 0.75 miner's inch/acre (see Tables 1 to 4) [2]. Therefore, 0.75 miner's-inch/acre is obviously insufficient to meet the Unit B irrigation requirement. If A&B did not need more than 0.75 miner's inch/acre, than they would not expend the electricity needed to pump the wells at this rate.

Dr. Petrich provides no independent analysis of the Unit B irrigation requirements to support his allegation that 0.75 miner's inch/acre supplies enough water to meet the irrigation demand. Dr. Petrich's data source for his allegation of 0.75 miner's-inch/acre as a delivery standard for Unit B is based on an incorrect understanding of the criteria used by A&B to rectify Unit B wells. Based on these facts, Dr. Petrich's opinion regarding Unit B irrigation diversion requirements is without foundation and is not justified.

The Unit B irrigation diversion requirements have not decreased. The decrease in Unit B conveyance and distribution losses have been offset by an increase in crop ET requirements.

Petrich Opinion

Increases in irrigation efficiency allows A&B to make do with less water (Petrich Expert Report, pg. ii, No. 3). "*Increases in irrigation efficiency have contributed to a reduction in ground water demand, which should allow A&B to maintain adequate irrigation despite the historical decrease in the annual diversion volume*" (Petrich Expert Report, pg. 21). "*Any reduction in return flow injection should correspond with decreased ground water withdrawals- water that is not injected does not need to be pumped*" (Petrich Expert Report, pg. 21). "*The third reason that A&B has likely been able to deliver sufficient water despite a 9.7 percent decrease in annual system-wide withdrawals compared to previous years is increased conveyance efficiency*". "*. . . the reduction in overall conveyance loss within the A&B system is probably more than 58 percent*" (Petrich Expert Report, pg. 21 to 22).

Rebuttal

[2] The analysis of the Unit B daily diversion data for 2003 and 2007 is presented in the Rebuttal to the Sullivan Report on page 18 to 20.

Dr. Petrich's arguments should be rejected for these reasons:

1. **Dr. Petrich has not calculated the Unit B irrigation requirements that factors in the current Unit B crops, distribution and application system.** Dr. Petrich alleges that increases in irrigation efficiency allow Unit B to make do with less water. But Dr. Petrich has not analyzed the current irrigation requirement of the Unit B project accounting for current crop mix, crop ET and conveyance and distribution systems.
2. **Increases in irrigation efficiency on Unit B have been offset by an increase in crop ET.** Pages 4-10 to 4-11 of the A&B Expert Report explains that the current crop mix and crop ET require more water than was needed when the Unit B project was designed and constructed. The peak crop ET requirement contemplated in the 1955 Definite Plan Report is 0.55 ft/month and the current peak crop ET requirement from Agrimet data is 0.84 ft/month (see Table 4-13 from A&B Expert Report). The Agrimet data is from the Rupert, Idaho station and it shows a clear increasing trend in crop ET over the last 17 years, as shown on Figures 4-11 to 4-14 in the A&B Expert Report. The increase in crop ET for the current Unit B crop mix has offset the decrease in Unit B conveyance and on-farm losses.

The Unit B irrigation requirements should be based on the actual Unit B crop demand and conveyance and distribution system. The consideration of AFRD2, TFCC and NSCC headgate delivery in the SWC Opinion does not create a "standard" that can be applied *carte blanche* to all irrigation districts.

Petrich Opinion

"*A delivery rate of ⅝ (0.625) miner's inch/acre has been deemed a minimal full supply sufficient to raise typical crops for other nearby irrigation entities (AFRD2, NSCC, TFCC)*" (Direct Testimony, pg. 6, line 22-25). *"A standard of ⅝ (0.625) inches per acre has been established as an appropriate delivery rate for the American Falls Reservoir District #2 and North Side Canal Company in the Surface Water Coalition delivery call for the Twin Falls Canal Company. Thus, A&B can meet crop needs with a delivery rate of less than 1,100 cfs"* (Petrich Expert Report, pg. 5-6).

Rebuttal

Dr. Petrich is incorrectly using recommended headgate delivery criteria for AFRD #2, NSCC and TFCC that were discussed in the SWC Delivery Call proceedings[3]. The headgate delivery criteria for AFRD #2, NSCC and TFCC are based upon those entities' water rights and their own delivery practices, they do not establish a delivery limit for A&B's landowners pursuant to A&B's water right #36-2080. Dr. Petrich's opinion is not justified and is without foundation since the facts that the opinion is based on are incorrect. The headgate delivery criteria for AFRD #2, NSCC and TFCC should be disregarded for the A&B Delivery Call proceedings for these reasons.

[3] Note this decision is pending before IDWR and subject to contested case procedures and judicial review.

1. **The reasons for the Hearing Officer's assignment of ⅝ of a miner's-inch/acre to AFRD #2, NSCC and TFCC do not apply to A&B.**

   The factors that the Hearing Officer used to make determinations of headgate deliveries for AFRD #2, NSCC and TFCC in the SWC Delivery Call case do not apply to A&B. The water rights for Unit B are different from AFRD #2, NSCC and TFCC. The Unit B water right 36-2080 is large enough to allow for regular delivery of from 0.85 to 0.89 miner's-inch/acre at the headgate (accounting for conveyance losses ranging from 0 to 5 percent) whereas the AFRD #2 and NSCC water rights and conveyance losses generally only allow a delivery of ⅝ (or 0.625) miner's inch/acre at the headgate. Unit B historically pumped an average of 0.89 miner's inch/acre and delivered an average of 0.85 to 0.89 miner's-inch/acre at the headgate during peak demand periods prior to the decline in regional ground water levels (see Figure 3-13 in the A&B Expert Report). The individual Unit B wells that do not have shortages can and do pump this amount on a regular basis[4]. Tables 1 to 4 compiled from the 2003 and 2007 daily diversion data for Unit B shows that the average daily maximum diversion is 0.87 miner's-inch/acre for Unit B wells with the capacity to deliver more than 0.75 miner's-inch/acre. All this information shows that the customary maximum delivery for A&B is much greater than ⅝ (or 0.625) miner's-inch/acre.

   The Unit B irrigation system is also very different from the AFRD #2, NSCC and TFCC delivery system, and it is illogical to assume that the same headgate delivery criteria that applies to these surface water irrigation systems is representative for Unit B. Unit B has about 178 individual well systems that deliver water through small canals or pipelines serving farms with a few hundred to over 1,000 acres in irrigation per well system. Unit B provides water on-demand and operates each well system to meet the irrigation demand as it occurs. The Unit B crop mix is unique and different from other districts. AFRD #2, TFCC and NSCC are large surface water irrigation districts that deliver water through large canals with significant conveyance losses. Water diversions at AFRD #2, TFCC and NSCC occur well in advance of the irrigation demand because of the time needed to convey water through long canals. The AFRD #2, TFCC and NSCC irrigation efficiencies are different from Unit B. All of these factors show that Unit B has a different type of irrigation system from AFRD #2, NSCC and TFCC and so the irrigation demand analysis for Unit B needs to be based on the specific Unit B irrigation system and crop requirements.

2. **The Hearing Officer did not establish a "standard" headgate delivery of ⅝ miner's inch/acre that can be applied *carte blanche* to all irrigation districts.** The Opinion by the Hearing Officer for the SWC delivery call states that the establishment of irrigation needs should be based on the actual crop ET requirements for specific crops grown under the particular water supply conditions for a range of climate conditions and accounting for specific conveyance and distribution methods for the irrigation project (pages 48-53 of the Opinion by Hearing Officer for SWC Delivery Call). Dr. Petrich has not completed an analysis of the specific factors that affect the Unit B irrigation demand,

---

4 See Part I "Criteria Available Per Acre at Turnout" and Part II "Discharge in Inches" from the Unit B Annual Report in Appendix A of the A&B Expert Report to identify the maximum delivery capacity at the Unit B wells.

so he does not know whether ⅝ (or 0.625) miner's inch/acre will satisfy the Unit B irrigation demand accounting for site-specific current conditions on the project.

3. **Even if the headgate deliveries are reduced to ⅝ miner's inch/acre, the Unit B wells would still need to be deepened because ground water level declines are dewatering the wells**. Dr. Petrich is alleging that A&B can make do with less water, but he does not account for the impacts from declining ground water levels that cause the Unit B wells to become dewatered. Even if A&B reduces their deliveries to ⅝ (0.625) miner's-inch/acre, the Unit B wells will need to be deepened.
4. **Privately owned wells in the vicinity of Unit B need a well capacity more than ⅝ (0.625) miner's-inch/acre.** This issue is presented on pages 22 to 23 of the Rebuttal to the Sullivan Expert Report.

The A&B "allotment" system is based on a 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.

Petrich Opinion

"*A&B expanded the original irrigable acres licensed under water right 36-2080 by 4,086.9 acres through beneficial use claims and/or enlargements (with priority dates ranging from April 1, 1962 through April 1, 1984). Using the A&B minimum delivery criterion of 0.75 inches per acre, A&B likely uses at least 61.3 cfs of the 1,100 cfs authorized under water right 36-2080 to irrigate expansion acres authorized under junior rights. Again, less water than the maximum diversion rate of 1,100 cfs is required for the irrigation of the original 62,604 acres*" (Petrich Expert Report, pg. 6).

Rebuttal

Dr. Petrich is suggesting that A&B attempts to provide a full supply to all 66,691 acres associated with the original water right plus the enlargement and beneficial use rights thus shorting the supply available 62,604 acres under the 36-2080 water right. Dr. Petrich alleges that the 1,100 cfs water right for Unit B is applied to all 66,691 acres and therefore the actual supply needed for the 62,604 acres is less than 1,100 cfs.

This is not correct because A&B has instituted an "*allotment*" system that rations the delivery of water to the farmer's headgate based only on 62,604 acres served under the 36-2080 right during peak demand periods when water is short. 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 placed "*on allotment*" for the purpose of rationing out and delivering the available water supply. 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

Pg. 140

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 --

Pg. 141

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 --

Pg. 142

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

Pg. 143

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 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 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 A&B's beneficial use and enlargement water rights which 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 and the deliveries would be to 868 acres. Instead, the allotment delivery is 0.84 miner's-inch/acre to 860 acres based only on 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 primary impacts of declining ground water levels is dewatering of the Unit B wells. This causes a reduction in the

water supply available at irrigated farms which reduces crop yields or causes farmers to shift to lower-demand crops.

Petrich Opinion

A&B has sufficient water to meet their irrigation needs on a system-wide basis. A&B has not shifted to lower water consumption crops, has not fallowed lands, and has expanded irrigation acres (Direct Testimony, pg. 7, line 1-5). "*Reduced annual withdrawals could have resulted in crops with a lower water demand. However, this has not happened. Decreased aggregate ground water withdrawals could result in decreased crop yields. However, no data or information showing lands that could have been left fallow or crops that have gone unharvested as a result of insufficient water has been provided*" (Petrich Expert Report, pg. 20).

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. 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. The impacts to A&B from wells that cannot meet the full irrigation requirement during the high-demand period in the middle of the summer are likely to be a reduction in crop yield or quality or a shift to lower demand crops. Farmers will make these types of adjustments in order to obtain some financial benefit rather than not planting a crop or risking losing a crop because of water shortage, unless the water supply is reduced to the point that a crop can not be grown. There are also other factors that affect crop yields and crop types (market conditions, pests, other external costs such as fertilizer, seed, fuel, etc.) and A&B has been short water and has endured declining ground water levels for so many years that a sharp decline in crop yields or crop types may not be evident even if the data could be collected in a timely fashion. This does not mean that impacts are not occurring.

A&B is not required to and does not compile data on crop yields on an annual basis so that crop yields could be correlated with a reduction in water supply. A&B would have to compile crop yield data throughout the history of its project and even then complex economic analysis of the data would be required to sort out water supply availability from other factors such as the availability of better seeds, fertilizer, pesticides, herbicides and equipment and market factors that would tend to also affect crop yield. Farmers know this information because they live with it every day and so the best way to find out if crop yields are impacted by water supply shortages is to interview the Unit B farmers. Testimony from the Unit B farmers will be presented at hearing.

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 senior-priority water right. 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.

Dr. Petrich fails to acknowledge that a major part of the impact to A&B is to the well infrastructure from declining ground water levels such that the wells no longer can deliver the water. Such impacts lessen the value of a farm on the Unit B project, reduce the ability of A&B to deliver a full supply and result in A&B being required to expend vast financial resources to deepen wells, if possible.

A&B would not have a problem in the wells in the southwest area of Unit B if ground water levels did not decline.

Petrich Opinion

Dr. Petrich states that*, "Some of the ground water level declines experienced in A&B wells- especially those in the southwestern portion- reflect local hydrogeologic constraints. For example, some of the wells in the southwestern portion of the A&B area penetrate substantial thicknesses of sand and clay sediments. . . Wholesale curtailment of junior-priority ground water users throughout the ESPA would not improve the water bearing characteristics of these sediment zones*" (Petrich Expert Report, pg 28-29).

Rebuttal

Dr. Petrich fails to acknowledge that the wells in the southwest portion of Unit B operated successfully after Reclamation well deepening was completed in 1966 and continued to operate successfully for many decades until regional ground water levels declined. Figures 3-22 to 3-24 in the A&B Expert Report shows that almost all wells in the southwest area of Unit B were able to produce well 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 in the late 1960s before ground water levels began to decline in the aquifer. The reason ground water level declines impacts production of water in the southwest area of Unit B is that the aquifer transmissivity is lower deep in the aquifer. When ground water levels dropped into lower transmissivity sedimentary deposits, well yields were reduced and well drawdown during pumping increased. As this continues and wells are deepened, the problem is exacerbated. If ground water levels did not decline regionally, the wells in the southwest area of Unit B would not have drawdown and yield problems. Curtailment of junior-priority ground water pumping in the ESPA would cause an increase of about 50 feet in the ground water levels (see Figure 6-1 from A&B Expert Report) and would rectify the water yield problem in almost all of the southwest area wells.

Construction of sand packs and well screens will not solve the well yield problems in the southwest area of Unit B.

Petrich Opinion

"It is possible that some wells could produce more water if constructed to develop water from sands using filter packs and well screens" (Petrich Expert Report, pg. 36).

Rebuttal

Most ESPA wells are constructed as an open borehole in basalt to maximize well production and minimize cost and because the basalt is competent enough to withstand well operation without installing a casing and screen. Sand packs and well screens are not commonly used in ESPA basalt wells because they reduce the well yield, and because of the cost and complexity of installation. The use of a sand pack and well screen may be of limited help for the few wells that produce sand, but they will not remedy the decline in well yield in the southwest area of the project, because the well yield is limited by the aquifer transmissivity and not the well construction methods.

The fact that some Unit B wells have needed maintenance or improvements does not negate the impacts caused by ground water level declines. Ground water level declines have worsened many of the well operational problems in the southwest area wells.

Petrich Opinion

Some wells listed as abandoned or replacement wells by A&B because of declining ground water levels were actually abandoned for other reasons (Petrich Expert Report, pg. 33-35).

Rebuttal

Dr. Petrich is correct in his conclusion that there are some operational problems with wells in the southwest area of Unit B. Some wells produced sand or experienced declining well yields. However, almost all of these wells were successfully operating prior to the decline in ground water levels. Most of the problems cited by Dr. Petrich were either caused or were worsened by declining ground water levels. A well by well analysis of each of the wells that were abandoned due to declining ground water levels is presented in Appendix I of the A&B Expert Report.

Dr. Petrich presents an examination of wells that were abandoned or deepened by A&B for reasons other than declining ground water levels. A&B is not alleging that rectification at these other wells is due to declining ground water levels. Appendix I and Table 3-4 of the A&B Expert Report state which wells were deepened or abandoned due to declining ground water levels.

The impacts from declining ground water levels on A&B's water supply is severe.

Petrich Opinion

Dr. Petrich opines that the relative impacts to A&B from deepened or abandoned wells is relatively modest in comparison to the entire Unit B system. *"A&B has deepened or replaced 1.8 wells per year since 1994. This is a modest number for a well based water system of that size"* (Petrich Expert Report, pg. iii, No. 9). *"The reported rectification costs should be viewed in context of system size. For example, the costs of $152,000 per year from '95 to '05 and the more recent annual cost to $206,000, when averaged over 66,686* *acres, is equivalent to approximately $2.28 and $3.09 per acre. This compares with the current $70 per acre annual assessment cost for A&B members"* (Petrich Expert Report, pg. iii, No. 9-10). Also see Petrich Expert Report pg. 36.

Rebuttal

Dr. Petrich's opinion is not supported by the facts for these reasons.

1. **Dr. Petrich is using the wrong cost data**. He is using the cost data submitted under the Motion to Proceed in March 2007 and has not used the updated cost data submitted by A&B in response to the IDWR Director's Information Request. The updated cost data includes all costs (labor, power, etc.) and are more detailed and comprehensive than the initial estimates submitted for the Motion to Proceed. The updated cost estimates are part of the administrative record for this matter and have been available to all parties since it was submitted in January 2008.
2. **Dr. Petrich is not accounting for the wells that still need to be deepened.** Dr. Petrich is only accounting for the wells that have been deepened or replaced by A&B to date. There are a large number of wells that still need to be deepened, if it is possible to deepen them. The costs for wells that have not yet been deepened were not reported by A&B and are not included on Dr. Petrich's calculations on page 36 of his Expert Report. We have estimated that a minimum of about 60 to 100 wells still need to be deepened to achieve a saturated well interval of 60 to 80 feet (see A&B Expert Report, pgs. 3-11 to 3-12). This assumes that a 60 to 80 feet level of well saturation is adequate to meet the irrigation demand needed to be supplied by the well. This is in addition to the ~40 wells that have already been deepened. We have provided a rough cost estimate of $2 to $3 million to conduct this deepening.
3. **Dr. Petrich does not present costs in terms of 2008 dollars.** Dr. Petrich has not inflated the annual costs he cites on page 36 of his Expert Report to 2008 dollars. The cost would be considerably larger if he cited the costs in today's dollars to account for inflation.
4. **Dr. Petrich incorrectly states that A&B included drain well rectification in costs from declining ground water levels.** Dr. Petrich is incorrect in his statement that drain well rectification was included as a cost attributed by A&B as being caused by ground water levels. A&B has separated out costs for rectification needed due to decreased well yield or falling ground water levels in wells (improving conveyance to reduce losses, rectifying some production wells, etc.) from removal of drain wells. The costs for drain well removal was not included in the costs reported as being caused by declining ground water levels under Account 472 (see Appendix J of A&B Expert Report for cost summary reported by A&B).
5. **Dr. Petrich has not accounted for interest costs that may be incurred by A&B to finance current and future well deepening.** The current and future needed well improvements represent such a significant cost that it is unlikely that A&B could pay for them within their operating budget and financing would be required. Interest charges associated with would drive up the costs even further.
6. **Dr. Petrich has not accounted for the costs from a lost ground water supply and a potential dry-up of acres in the southwest area.** Dr. Petrich has not accounted for the

cost of a lost ground water supply in the southwest area of Unit B where additional well deepening is unlikely to be successful. Dr. Petrich does not account for the cost of providing a replacement water supply for the southwest area wells or for compensating individual farmers for lands dried up as a result of losing a ground water supply. As a rough estimate, there are about 12,000 acres of land under irrigation in the southwest of Unit B. Assuming an approximate value of about $3,000 to $4,000 per acre this represents about $36 to $48 million. These are rough estimates, and are only provided to illustrate the scale of financial hardship that would be endured by Unit B farmers if the water supply situation is not resolved in the southwest area.

7. **Dr. Petrich misrepresents the relative impact of the current costs expended by A&B.** The costs currently expended by A&B to date because of declining ground water levels is about $8 million in 2008 dollars (A&B Expert Report, pg. 3-13). As a rough planning guide we estimated a minimum of an additional $2 to $3 million for well deepening for existing wells that need to be deepened (A&B Expert Report, pg. 3-13 to 3-14). Future well deepening could range from $3 to $4 million or more if ground water levels continue to decline (A&B Expert Report, pg. 6-8). This represents a total of $13 to $15 million or more in 2008 dollars. On a per-acre basis, that ranges from about $200 to $230/acre or more, which is a significant cost given that A&B's current annual assessment is about $70/acre. This does not account for the costs of wells that may not be able to be deepened, or require further deepening. This also does not include costs associated with a lost ground water supply in the southwest or for future financing interest charges. Including all of these costs would drive up the total relative costs.

   It is not reasonable for Dr. Petrich to argue that a cost of many millions of dollars for well deepening, increased power, conveyance improvements and other costs associated with well deepening are not significant. The costs are significant to A&B because they must pay for them and they are above and beyond normal operational, maintenance and equipment repair costs. The costs are also significant because the total future costs and sum of the total impact to A&B from declining ground water levels is unknown and threatens the viability of the irrigation project.

Drought is not a reason for the long-term decline of ground water levels on the ESPA and in the vicinity of Unit B.

Petrich Opinion

Dr Petrich states that ground water levels in the A&B area have declined as a result of 1) conversions from flood irrigation to sprinkler irrigation *methods throughout the ESPA, 2) drought conditions, and 3) ground water pumping. "Based on numerical simulations, approximately ⅓ of the decline has been caused by drought, ⅓ by reduced incidental recharge, and ⅓ from ground water pumping. The magnitude of the impact from junior ground water pumping in the greater ESPA can therefore not be more than a portion (e.g. ⅓) of the minimum local declines observed in the A&B area*" (Petrich Expert Report pg. 29).

Rebuttal

Dr. Petrich incorrectly alleges that one-third of the decline on the ESPA is due to recent drought. This is incorrect for the following 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 requested administration of junior priority ground water rights 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 reduction in aquifer recharge during a drought would be much less.
5. **The Drought Scenario is draft and was not finalized**. Dr. Petrich refers to information from Alan Wylie's deposition (pg. 106, lines 16-19) to support the conclusion that ⅓ of the decline in ground water levels is from drought. A memo released by Bryce Contor of IWRRI on July 12, 2007 indicates that the Drought Scenario was released as a draft and was not finalized. Therefore, the results of the scenario should not be used.
6. **The fact that there have been droughts does not excuse junior-priority ground water pumpers from their impacts**. 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 not relevant to determining the impacts from junior-priority ground water pumpers. In fact, water right administration during periods of shortage is the purposes of the prior appropriation doctrine.

Curtailment would be an effective way to remedy the impacts to A&B from junior-priority ground water pumping.

Petrich Opinion

Dr. Petrich opines that A&B is requesting that water levels be restored to historical levels, curtailment of ground water pumping will not restore water levels to the 1950s or 1960s levels and aquifer heterogeneity makes it difficult to predict potential water levels responses from curtailment (Petrich Expert Report, pg 29-30).

Rebuttal

Dr. Petrich has mis-stated A&B's position with regards to the request for administrative action. A&B has only requested administration to remedy the impacts from junior-priority ground water pumping (see March 16, 2007 A&B Motion to Proceed, No. 11(f), pgs. 8 to 9). The Direct Testimony of A&B Experts Brockway and Koreny evaluate the impacts of junior-priority ground water pumping on ESPA ground water levels and acknowledges that junior-priority ground water pumpers are not responsible for the other factors (i.e., reduced incidental recharge) contributing to ground water level decline (Brockway Direct Testimony, Nos. 32-34; Koreny Direct Testimony, Nos. 33 to 37). Curtailment is a feasible option to remove the impacts from junior-ground water pumping on A&B if junior-priority users cannot remedy A&B's impacts through other mitigation alternatives.

The Curtailment Scenario by IWRRI using the ESPAM ground water model shows that curtailment of ground water pumpers with a priority date junior to 1949 (near the A&B priority date of 1948) will result in an increase in ground water levels in the vicinity of A&B by about 50 feet, and about half of this increase in ground water levels will occur within about 10 years (see A&B Expert Report, Figure 6-1, pg. 6-13). Curtailment of junior-priority ground water pumping would restore ground water levels in almost all of the Unit B wells so that the wells could operate properly, including the wells in the southwest area of Unit B.

Ground water levels are not likely to moderate and stabilize in the near future.

Petrich Opinion

Dr. Petrich asserts that the ESPA ground water level declines will moderate and stabilize in the near future due to the following reasons (Petrich Expert Report, pg. 30-31).

- A moratorium on pumping in May 15, 1992
- Most conversions from gravity to sprinkler on-farm application methods have already occurred and will reach equilibrium at some point soon in the future
- Improvements in irrigation efficiency will reduce ground water pumping.
- The recent drought will abate and the downward water level trend will moderate and reverse
- Current administrative efforts to stabilize ground water levels
- The CAMP process to develop an aquifer management plan will help to stabilize ground water levels in the aquifer

Rebuttal

Dr. Petrich contends that ground water levels will moderate and stabilize in the near future. A variety of reasons are presented in page 30 and 31 of his Expert Report to support this opinion. There are stronger and more compelling reasons to believe that ground water levels will continue to decline before they stabilize.

1. **The decline in ground water levels has become worse.** If Dr. Petrich's opinion were correct, we would expect to see the decline in ground water levels over the last several decades becoming less severe. The opposite has occurred and ground water level declines have become more severe, as shown in Figure 3-7 in the A&B Expert Report (also reproduced in Figure 1 below). Similar patterns of decline are noted for key indicator springs, such as Spring Creek and Box Canyon Springs (Figures 2 and 3). The synoptic mass measurements on the ESPA conducted during the spring of 2008 show that ground water levels have decreased significantly since the onset of ground water pumping and the decline has continued over the last three years (see Figures 4 to 6). Also, the ground water levels in Unit B wells from 2007 to 2008 have not increased and have actually declined by an average of 1.8 feet.

2. **Drought may have reduced ground water levels in the last few years, but it is not a cause of long-term ground water level declines.** Dr. Petrich emphasizes the effects of the recent drought as a cause for the decline in ground water levels. We have described above that drought is not a factor for the long-term decline in ground water levels.

3. **Increased ground water irrigation efficiency does not reduce the impacts of ground water pumping.** Dr. Petrich states incorrectly that increases in efficiency of ground water irrigation system on the ESPA will reduce ground water pumping effects on the aquifer. The ground water depletion on the aquifer is caused by crop ET demands, not the efficiency of the irrigation systems. This is because increasing the efficiency of a ground water irrigation system may reduce the pumping requirement, but it also reduces the recharge to the aquifer from irrigation losses. In other words, an increase in efficiency that decreases the pumping requirements of an irrigation system by 500 gallons per minute also results in 500 gallons per minute less in delivery losses and recharge to the aquifer.

4. **Crop ET requirements are increasing.** As demonstrated on pages 4-10 and 4-11 and Figures 4-11 to 4-14 of the A&B Expert Report, Crop ET is increasing due to hotter weather and irrigators choosing to grow crops with a higher water demand.

5. **Voluntary actions have not been successful.** The Comprehensive Aquifer Management Plan (CAMP) is based on voluntary efforts and does not provide a defined funding source or mechanism to remedy the depletions from junior-priority ground water pumping. For example, enrollment of actual ground water-irrigated acres in CREP has been less than 20,000 acres. 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. Finally, although the CAMP process is aimed at improving water supplies in the ESPA, no formal goals or actions have been defined to date, therefore there is no current basis to rely upon it for an opinion that CAMP will "moderate and stabilize" ground water level declines in the

future. Until a plan is approved, funded and implemented, Dr. Petrich's opinion is nothing more than speculation.

A&B allowed its priority call filed in 1994 to be stayed based upon assurances in the 1995 Order adopting the provisions of a proposed stipulated agreement that actions set forth in the proposed stipulation would be voluntarily completed by the state and holders of junior priority ground water rights. More than 13 years later, IDWR's Order has not been fully and adequately implemented and ground water conditions continue to deteriorate, therefore A&B filed a Motion to Proceed in the spring of 2007. 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.

6. **The aquifer is not at equilibrium.** As noted on page 12 of the Opinion by the Hearing Examiner for the SWC Delivery Call Case[5], the effects of past pumping have not been yet fully realized and will result in future increased ground water level declines and declining Snake River reach gains. This is documented in Appendix Y of A&B Expert Report. The reductions in incidental recharge that occurred from increases in irrigation efficiency over the last 20 to 30 years have yet to be fully manifested in the aquifer. These combined factors mean that ground water levels will continue to decline, even if no further reductions in incidental recharge occur.

7. **Incidental recharge is likely to be reduced even more in the future.** Surface water irrigation diversions are likely to decrease and surface water irrigation is likely to become more efficient. Dr. Petrich only discusses the conversions from on-farm gravity to sprinkler methods that have already occurred and does not consider other factors that may increase efficiency. There are still many ways that irrigation entities can reduce surface water irrigation losses (and thereby reduce incidental recharge), including converting the remaining acres in gravity on-farm delivery method to sprinkler and lining canals and laterals or installing pipelines to reduce conveyance losses. Surface water irrigation entities have a strong incentive to increase efficiency because there is a strong and increasing demand for water, a scarcity of supply and a robust agricultural commodity market. Canal lining and pipeline installation is common throughout Idaho and the Western U.S. and is encouraged and funded through grants available from the Bureau of Reclamation and the Department of Agriculture. The combined factors of increased surface water irrigation efficiency, decreased availability of supply and increased crop demand are likely to continue drive incidental recharge down in the ESPA.

8. **The existing moratorium is not universal and does not prevent all new consumptive uses.** A discussion of this issue is presented on page 15 in the Rebuttal to the Sullivan Expert Report.

The ESPAM model is an appropriate tool and provides valuable information that can be used for administration.

---

[5] June 10, 2008, Opinion Constituting Findings of Fact, Conclusion of Law and Recommendation, In the Matter of Distribution of Water to Various Water Rights Held by or for the Benefit of A&B ID, AFRD2, BID, MIL ID, BID, MID, NSCC and TFCC.

Petrich Opinion

Dr. Petrich opines that the ESPAM ground water model is not appropriate for administration due to "*limiting factors*" such as single layer versus multiple layers, lack of ability to simulate vertical hydraulic gradients, one-mile uniform grids that can not simulate local-scale variability and lack of quantification of uncertainty in the model (Petrich Expert Report, pg. 38-39).

Rebuttal

Dr. Petrich suggests several factors that would limit the use of the ESPAM model. Each of these are rebutted below.

1. **The ESPAM model is well constructed, robust and adequately calibrated.** Dr. Petrich is incorrect in his opinion that the Eastern Snake Plain Aquifer Model (ESPAM) ground water model does not adequately simulate the flow of ground water in the aquifer. The model was constructed and calibrated by a qualified team lead by IWRRI. The Eastern Hydrologic Modeling Committee, which includes one of IGWA's experts Dr. Brendecke, provided input on the model development. The model development meets the standards set forth in the ASTM standards, standard texts and USGS guidelines for ground water modeling[6]. The adequacy of the model calibration and the ability of the model to simulate ground water flow in the aquifer and to the river is shown in the good fit of simulated ground water levels and river reach gains on Figures 7 and 8. It is our opinion that, although the model calibration could always be improved, the model adequately simulates the flow of ground water in the aquifer and the effects of ground water pumping on river flow and the model meets the accepted standards for this type of analysis.

2. **The model resolution is appropriate and is not a limiting factor.** Dr. Petrich suggests that the one-mile^2 grid cells in the model cannot simulate local-scale variability and smaller grid cells are needed because administration could include potential curtailment of junior-priority wells within A&B lands. Dr. Petrich argues that the model needs to separate the A&B project wells from private wells. This line of argument is not compelling for three reasons.

   First, the ESPAM model is a regional-scale model constructed to simulate pumping by groups of wells on ground water levels in areas of the aquifer and gains/losses at Snake River reaches. To accomplish this goal, the model includes enough resolution to represent varying hydrogeologic properties across the aquifer. The model includes one-mile^2 grid cells. This level of refinement is appropriate for a regional-scale model. Smaller grid sizes or more refinement would not result in a better model. Even if the model used finer-scale resolution with smaller gird sizes, the hydrogeologic property data to populate a more-refined model grid is not available.

---

6 Reilly, T.E. and A.W. Harbaugh, 2004. Guidelines for Evaluating Ground-Water Flow Models USGS, Scientific Investigations Report 2004-5038.

ASTM Standards describing the standard of practice for the development, calibration and reporting of ground water models are presented in ASTM Standards D5718, 5477, 5490, 5690, 5610 and 5611.

Anderson, M. and W. Woosner, 1991. Applied Ground Water Modeling, Simulation of Flow and Advective Transport. Academic Press, New York.

Second, the ESPAM model development process included an innovative feature whereby the aquifer properties in the model were varied in individual cells to represent changes in transmissivity and storage, as shown in Figure 9. So the model does include a high level of variability in hydraulic properties.

Third, Dr. Petrich cites a concern that the model needs to be able to distinguish and simulate private wells versus A&B wells operating on Unit B lands. This is a non-starter. Page 4-26 of the A&B Expert Report shows that there are only about 1,722 acres (or less than 3 percent of the total 62,604 Unit B acres under the 1948-priority A&B water right) that could be served by private rights, and the actual amount of land that could be served by private rights is likely even smaller since well systems may not be working or may not have been constructed at some of these lands. The fact that a mere 3 percent of the Unit B lands *may* be able to be served by private wells is not an issue, because A&B is obligated to serve all Unit B lands with Project water, whether they may or may not have overlapping private rights. If wells with private rights need to be distinguished from A&B wells, it would be simple to reduce the consumptive use in the ESPAM model cells that cover these areas to evaluate the impacts of private wells.

3. **Simulation of vertical gradients is not necessary for regional-scale simulation of ground water flow in the ESPA.** Dr. Petrich claims that the model is limited because it cannot simulate vertical gradients. Dr. Petrich argues that the current one-layer model is invalid and the model needs to have multiple layers. This would be an issue if vertical gradients were important in the simulation of regional-scale ground water flow in the ESPA. Vertical gradients are not an issue for regional-scale simulation of ground water flow in the ESPA because ground water flow and pumping and river connections are primarily through the upper portion of the aquifer. The ESPA does not have regional confining units due to the relatively thin and spatially discontinuous nature of individual basalt flow units. Therefore, the ESPA can be simulated using a two-dimensional flow model and has proven to be well calibrated with only one model layer. This issue was examined by the ESHMC modeling committee and IWRRI and IDWR and a decision was made that a two-dimensional flow model would be adequate.

4. **Uncertainty can be addressed using the 10 percent uncertainty factor as an interim measure. An evaluation of numerical uncertainty in the model will be included in Version 2 and will be available in time for implementation of administrative actions.** Dr. Petrich incorrectly asserts that calibration with PEST limits the assessment of uncertainty in the model. The lack of numerically-rigorous uncertainty data does not preclude the use of a well-calibrated model. The model has been previously used as a tool to provide information for administration and uncertainty has been already addressed in the previous delivery call Orders for the ESPA through the 10 percent uncertainty factor. Model uncertainty is proposed to be addressed as part of the Version 2 refinement of the model which is currently being completed. The numerical data from the uncertainty analysis will be completed in time to for administrative actions in the near future.

The A&B Scenario also provides valuable information that can be used for administration.

Petrich Opinion

It is Dr. Petrich's opinion that the A&B Scenario should not be used for administration. (Petrich Expert Report, pg. 38-39).

Rebuttal

Dr. Petrich asserts that the A&B Scenario can not be used to provide information for administration because the A&B Scenario does not address private well users within A&B. We have already shown that the private well argument is not a factor for the A&B delivery call. Dr. Petrich also asserts that the A&B Scenario does not provide information on the amount of ground water level recovery that would result from curtailment of junior-priority ground water users and the length of time for recovery. Dr. Petrich is incorrect in his assertions regarding the information available from the A&B Scenario because ground water level output can be developed from the scenario. In addition, ground water level recovery data showing the benefits of curtailment of junior-priority ground water rights is available through the Curtailment Scenario (the data is shown on the A&B Expert Report on Figure 6-1, page 6-13).

Table 1 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 2 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 3 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:

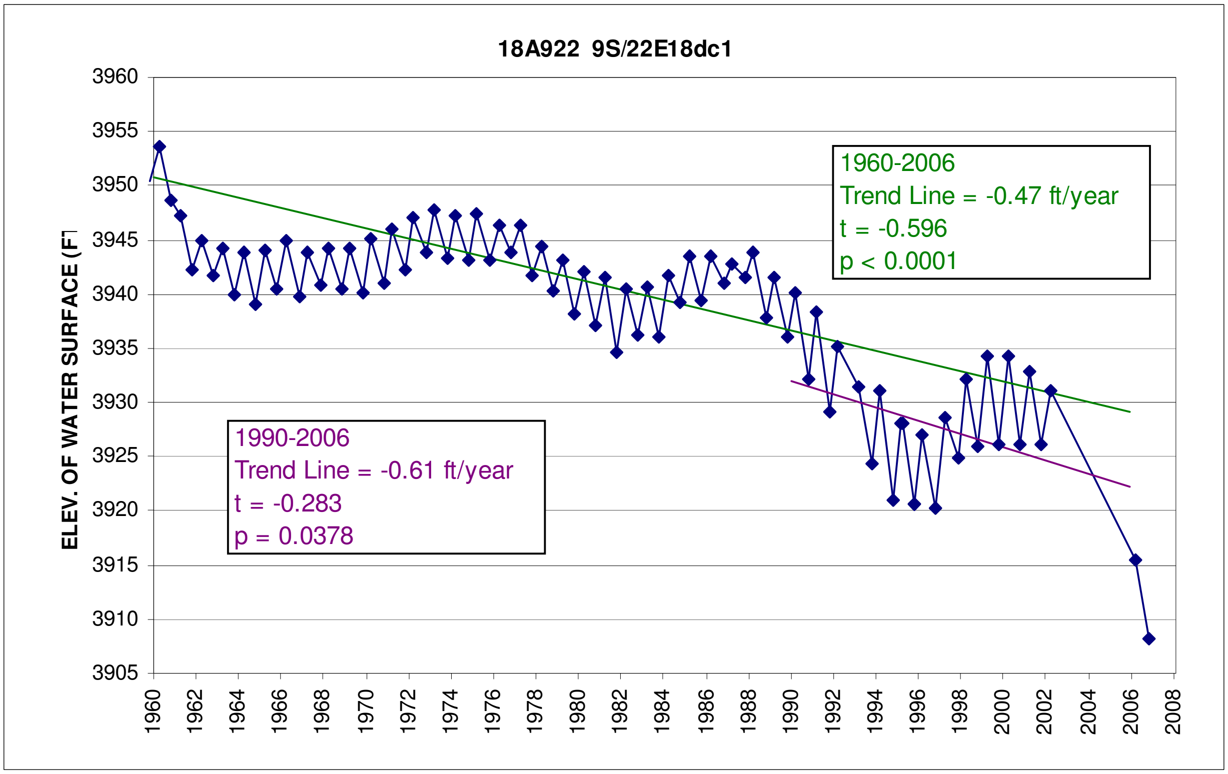
1. The max average daily miners-inches/acre pumped at well was calculated from the Water and Power daily diversion records.
2. Wells with capacity to deliver at least 0.75 miner's inch/ acre were calc. from "Criteria Avail. per Acre at Turnout" in Annual Report.

Table 4 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.



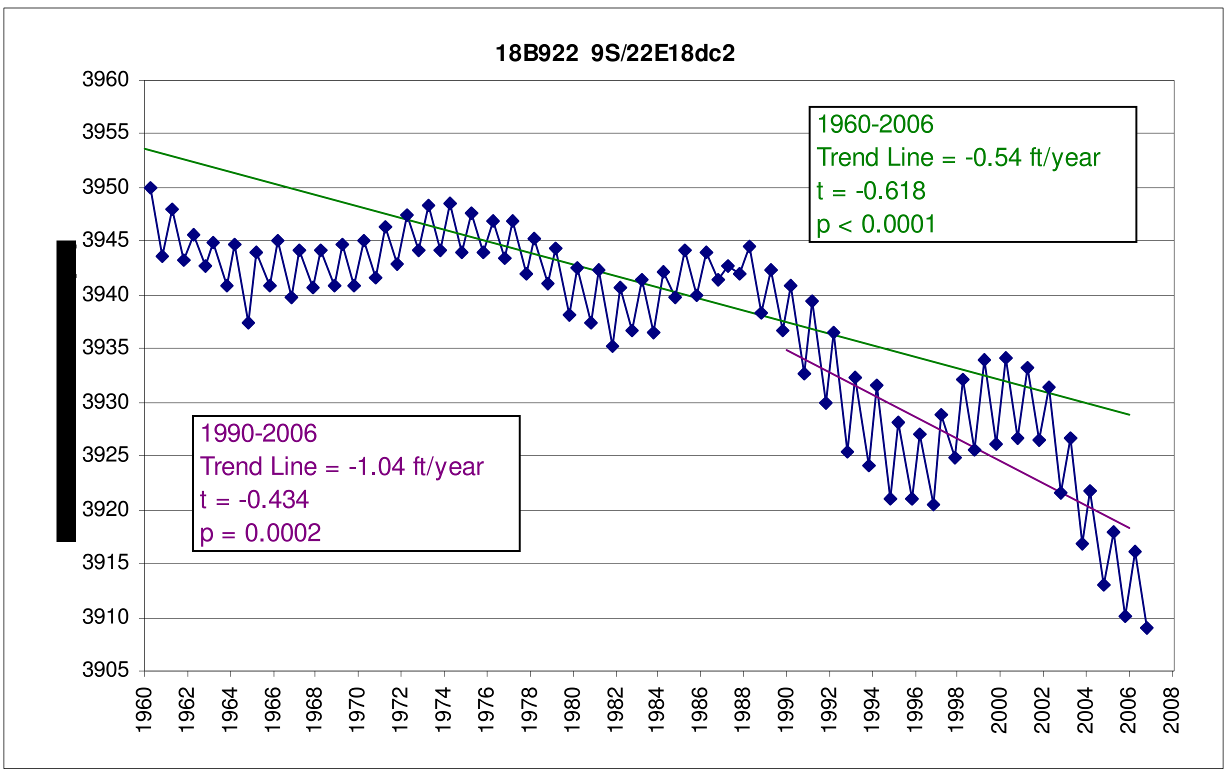


Figure 1 **(Figure 3-1 from A&B Expert Report) Hydrographs of ground water levels in the west area of Unit B with showing a statistically-significant downward trend in ground water levels that is becoming increasingly severe in the last decade.** (see Figure 3-8 and 3-9 and Appendix D in A&B Expert Report for other ground water hydrographs)

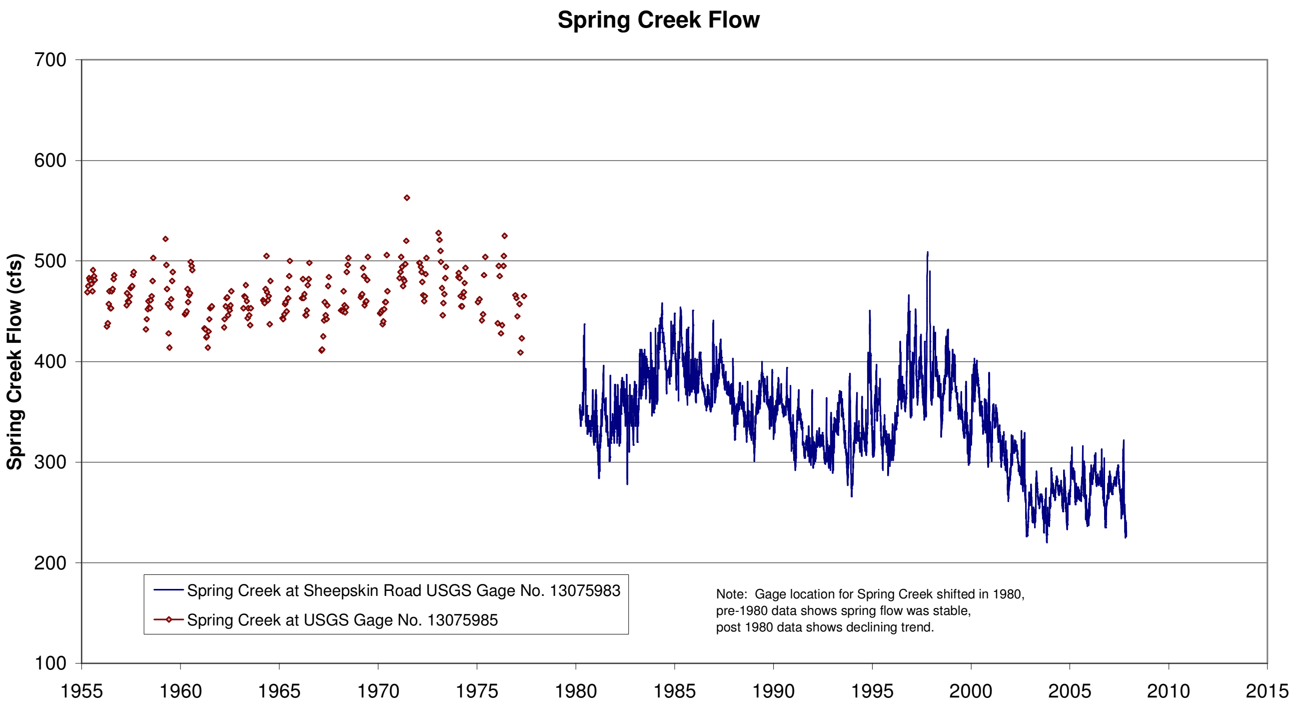


Figure 2 **Spring Creek flow gaging data showing declining spring flow trend without recovery in the last decade.**

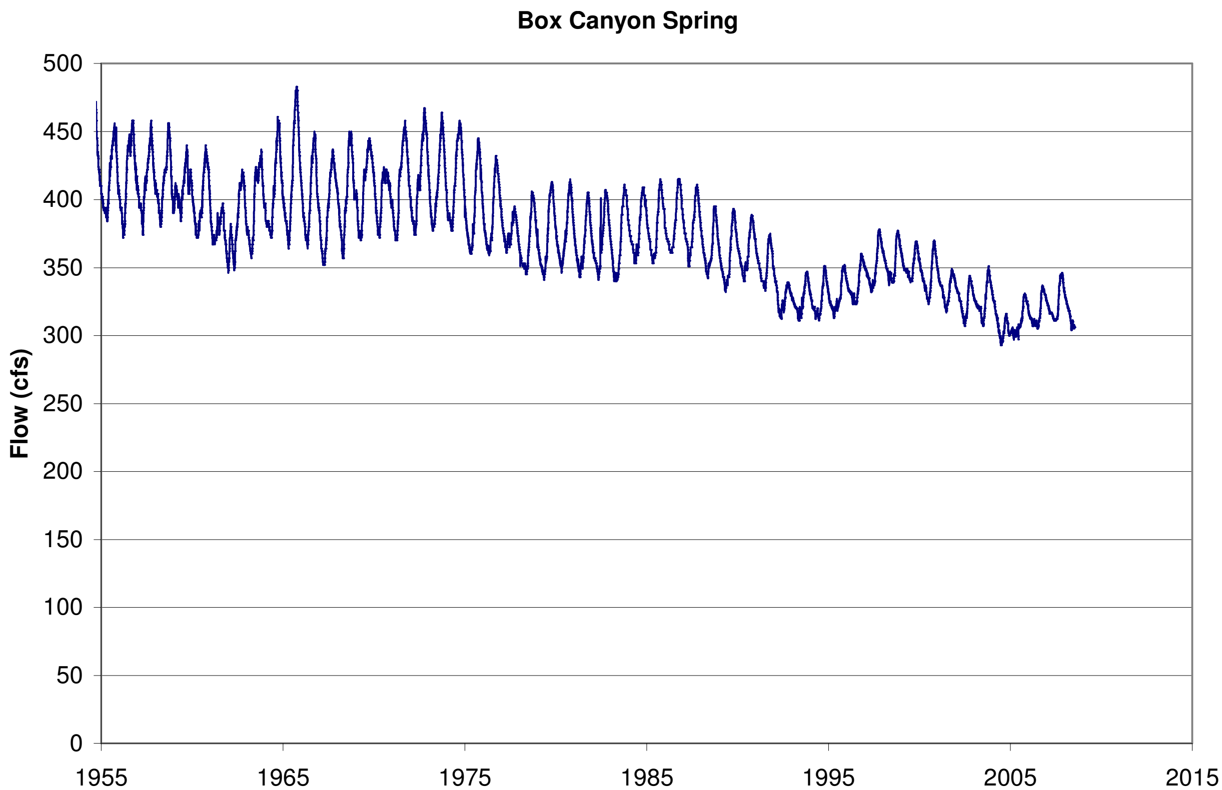


Figure 3 **Box Canyon Spring flow gaging data showing declining spring flow trend without recovery in the last decade.**

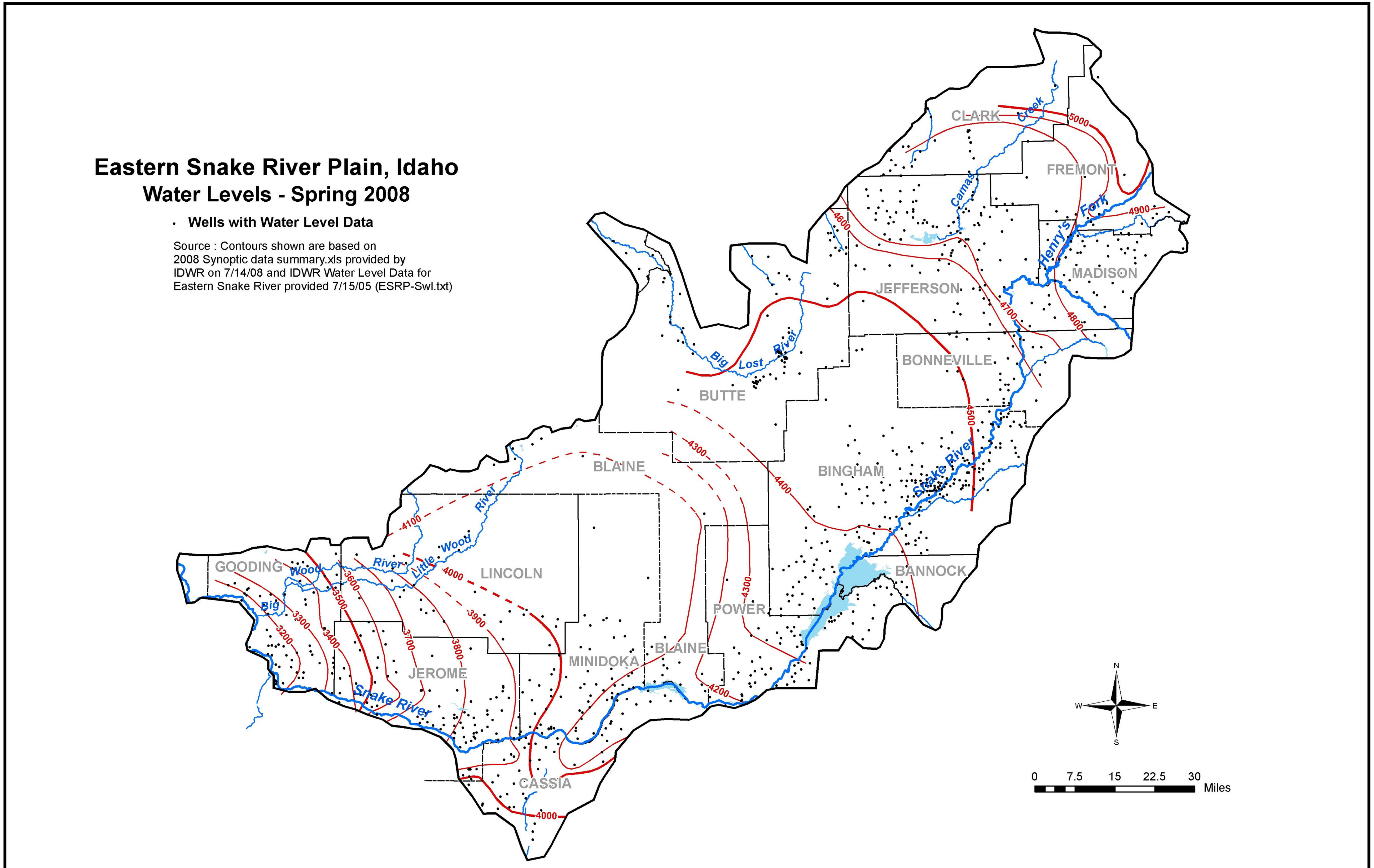


Figure 4 Ground water level measurements collected during Spring 2008

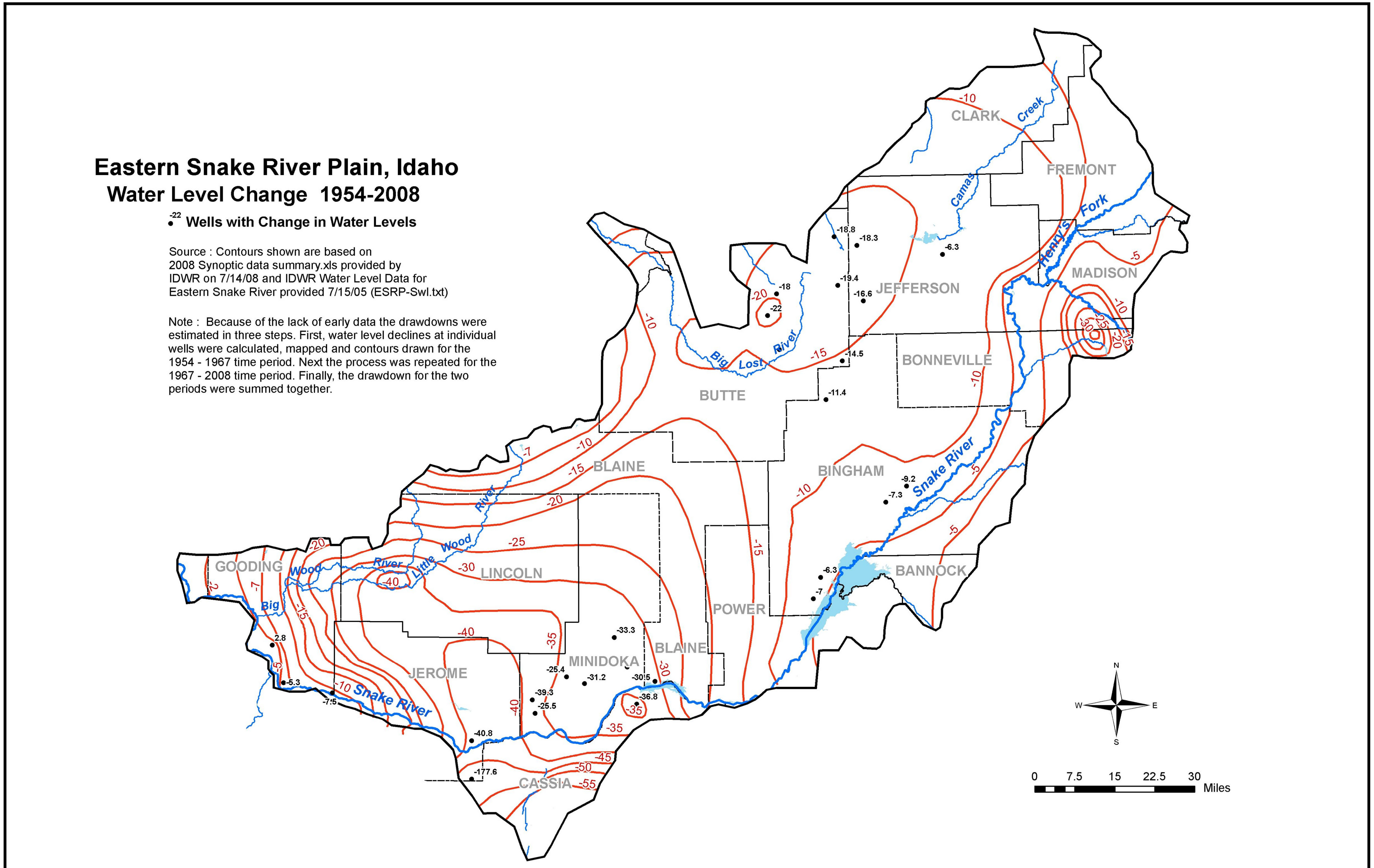


Figure 5 Ground water level decline from 1954 to 2008

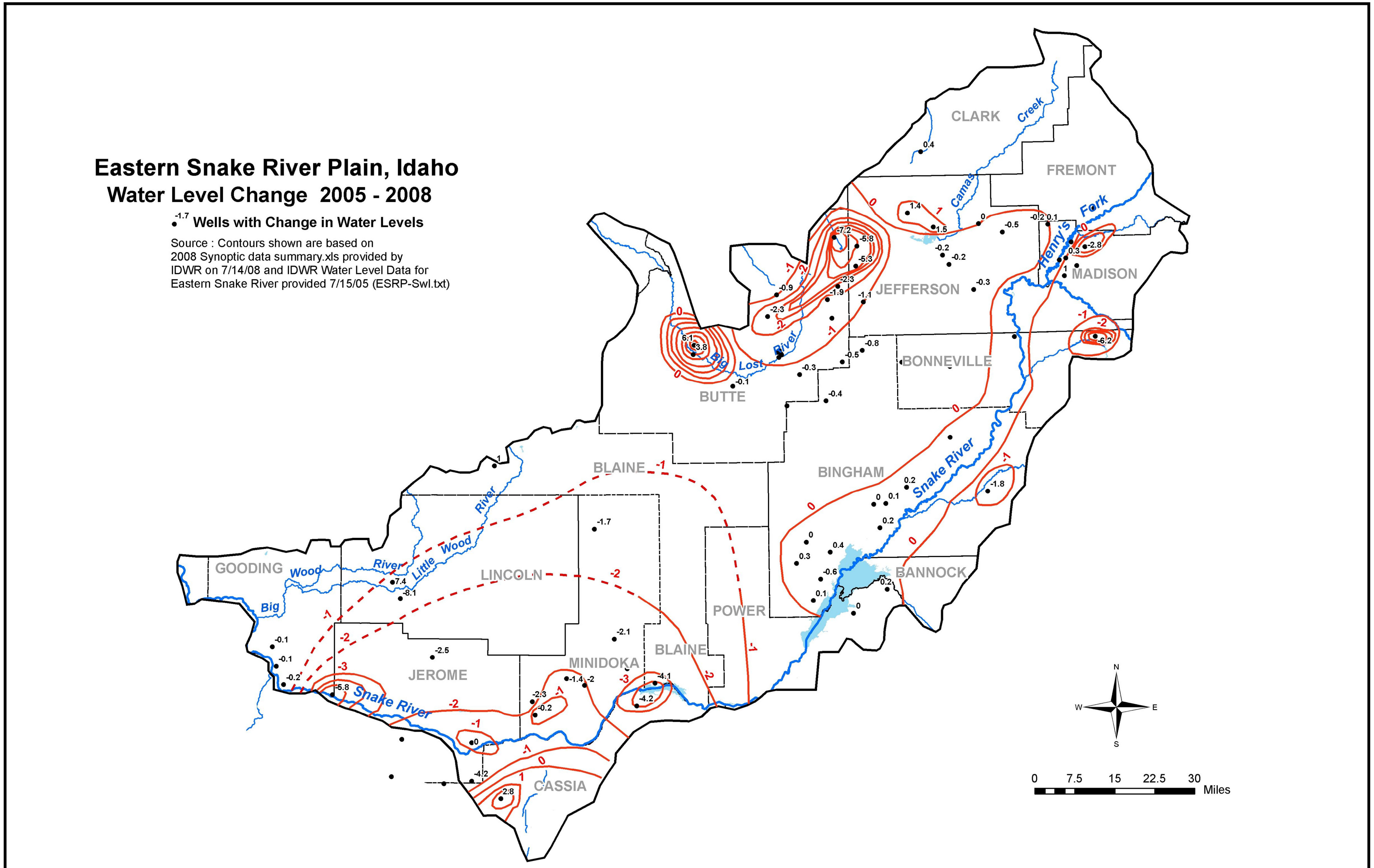
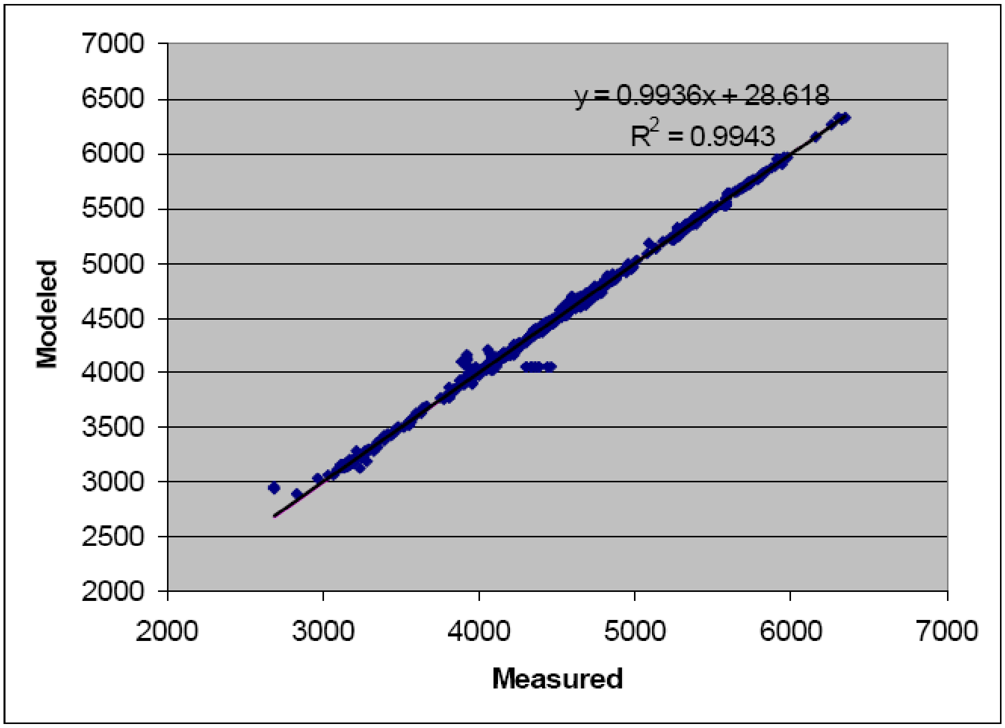
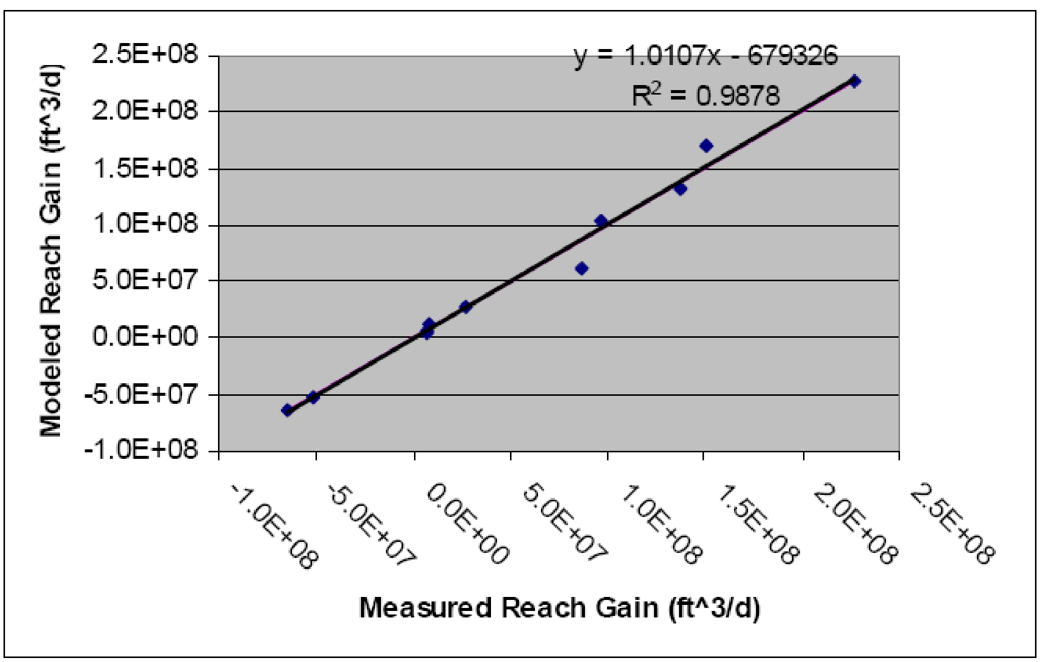


Figure 6 Ground water level decline from 2005 to 2008



Source: ESPAM model report, Cosgrove et al, 2006, Figure 58

Figure 7 Modeled and observed ground water levels from ESPAM model calibration.



Source: ESPAM model report, Cosgrove et al, 2006, Figure 60.

Figure 8 Modeled and observed reach gains from ESPAM model calibration.

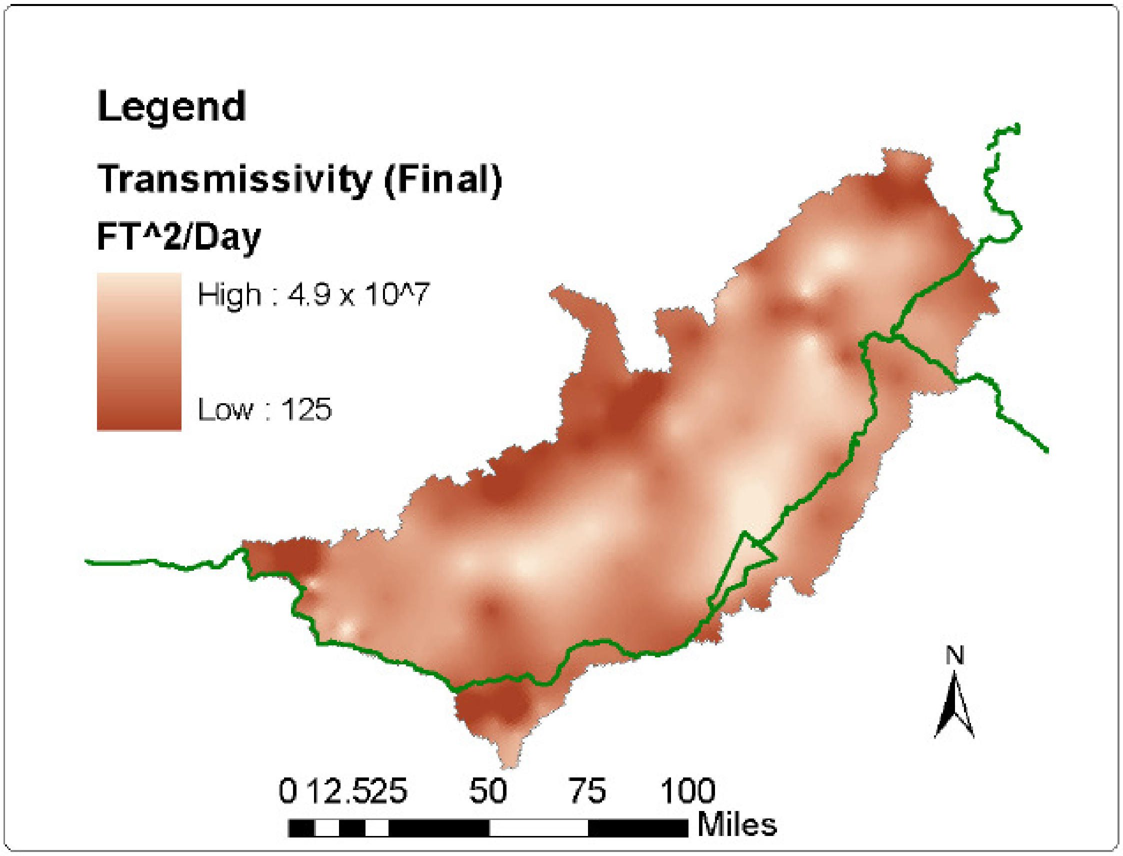


Figure 9 **Transmissivity distribution in ESPAM model showing cell-by-cell variations in transmissivity to account for varying hydraulic properties in the aquifer.**