Idaho Water Resource Board, Work Session
ESRPA Ground Water Model
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1. **Impetus for Ground Water Model Development**

The nature of the flow system in the Eastern Snake River Plain Aquifer was recognized early as evidenced by the early recognition of the response of springs to tributary underflow and surface irrigation. As early as 1977, the University of Idaho developed the first ground water model funded by the Idaho Department of Water Resources. The hydraulic connection between the aquifer and Snake River was modeled but the quantification of the relationship was not as well known as it is today.

Irrigation companies diverting at and above Milner recognized that natural flow, particularly late season natural flow, furnished by reach gains above Milner were declining. These companies petitioned for a moratorium on new consumptive uses from the ESRPA in 1992. Similarly, spring flows in the Thousand Springs reach of the Snake River were identified as declining as early as the 1970's and protests by Clear Springs foods and others were lodged with IDWR Ground water monitoring within the A & B Irrigation District showed declining trends in water levels in the 1970's. Ground water development continued through undeveloped permits without corresponding administration.

It was recognized as early as 1983 during the Swan Falls deliberations that additional data and a better understanding of river/aquifer relationships was needed to plan and manage the system. This was identified as a priority item for IDWR. Funding was solicited and secured from the Legislature and from cooperating entities including Idaho Power and the Twin Falls and Northside Canal Companies who recognized the need. It was expressed by all entities involved that a better tool for assisting in water management was needed and it was expected that updated administration of the aquifer and river would commence when the ground water model was updated.

2. **Model Development Protocol:**

The Upper Snake River Hydrologic Modeling Committee was formed to provide advice to the Department and the contractors for the model development (Idaho Water Resources Research Institute). The stated objective and goal of the model development was "--- enhancing and rebuilding the ground-water model used to support management decisions on the eastern Snake River plain." This Committee met frequently to review data, procedures, and assumptions recommended by the Institute and review constraints on data availability and quality, calibration procedures, and utilization of results. The operation of the

Committee was on a consensus basis and no formal Rules of Order were followed. The model calibration was performed using recognized calibration tools such as the PEST code and reach-gains (spring flows) in smaller reaches of the Snake River were identified to assist in more specific aerial simulation of responses. Calibration to some reaches in the Milner to King Hill (1000 Springs) area were more difficult because of the variability in elevation of spring outflow from the basalt aquifer.

There was not unanimity among Committee members on all aspects of the model development. However, I believe there was consensus that the ground water model, as developed, is substantially better than the previous version, but that programs for additional data acquisition, and response monitoring should be pursued and periodic model review and/or recalibration performed as necessary. As with all model development, the desire for verification of model output was expressed, and future data acquisition and output monitoring should be directed toward development of a data set which will allow model verification. The question might be asked "Is the current model the 'best science available'"? Certainly at the present time there is no better model out there. However, additional calibration efforts in certain areas are necessary before a modified version of this model can be used for long –term planning throughout the ESPA.

3. **What is the Current Status of the Aquifer or Specific Areas of the Aquifer?**

The ESPA is not in equilibrium with all inputs. Compared to historical levels, the ESPA water balance is 2 MAF negative due to ground water pumping for irrigation and the aquifer has not completely come to equilibrium with historical and current pumping. Improvements in water management, including conversion to sprinkler irrigation, have decreased net recharge and drought has decreased net recharge. These decreases in net recharge since the 1950's have resulted in decreasing spring flows, water levels, and Snake River reach gains. Declines are aquifer wide with water level declines higher in the western and central part of the ESPA compared to the eastern part. Spring declines are occurring throughout the Snake River and are reach specific depending on elevations of specific springs in each reach. Total increased depletion by pumping is manifested in springs and changes in reach-gains. 2.1 MAF shows up at steady state.

Hydrographs of USGS observation wells throughout the ESPA continue to show declining trends and seasonal reach-gains are declining. Reach gains in the above-Milner reach of the Snake River, which provide the natural flow water rights of the Minidoka canals and canals diverting from Milner, have declining trends.

Declines in specific spring flows may be showing signs of leveling off. However there is not enough data to predict any trend (examples. Box Canyon, Spring Creek, Blue Lakes). Based on the V1.1 ground water model, there may be 12-15% of the impact of pumping yet to be seen. The change per year will be small and could take 50 more years to reach a steady state if nothing changes on the average.

4. **How Can the Model Assist in Developing a Comprehensive Aquifer Management Plan for the Eastern Snake Plain?**

First of all, the quantification of the magnitude and spatial distribution of input to and output from the aquifer profoundly illustrates the magnitude of the management problem. For instance, acreage and consumptive use determinations on surface and ground water irrigated areas documented the water balance components within the aquifer and identified that 2.1 million acre feet(MAF) are depleted from the aquifer each year as a result of irrigation from ground water. This is a depletion from the aquifer which was not occurring prior to about 1950. Data collected on Snake River reach-gains documented decreases in inflow to the river in both the above-Milner reach and the Thousand Springs reach. Water levels in wells in the ESRPA were measured and showed significant declines over the 22 year calibration period as compared to the 1980 USGS measurements. During the period 1980 through 2001, water levels across the plain declined between 5 and 15 feet with some areas experiencing declines as great as 20-25 feet.

Compilation of a water budget for the ESRPA, which is a product of model development and calibration, provides insight into the relative magnitude of the components of input and output from the aquifer. The water budget also assists planners with an understanding of changes in net recharge which have occurred and insight into the causes for those changes. For instance, the water budget utilized for the enhanced ESPAM Version 1.1 model shows that incidental recharge from irrigation has historically accounted for at least 50 percent of the total input the aquifer and that changes in irrigation water management practices as well as ground water pumping have significantly decreased net recharge.

The current ESPAM V1.1 ground water model is not suitable for use in long term planning in all areas across the ESPA or in specific reaches of the Snake River without additional refinements It was contemplated in development of the model that continued refinement would be performed as new and better data became available or new calibration procedures or data became available. There are some areas, specifically in calibration of some short reaches in the Milner-King Hill reach, which warrant review and analysis. These problem areas could be reviewed and revised as necessary in a reasonable time, perhaps six to nine months. Longer term simulations warrant special consideration since confidence levels generally decrease with longer-term simulations.

Caution is warranted in using the ESPAM model for simulation of site specific impacts. It should not be used for simulation of impacts on single nodes (springs) or short reaches.

Use of the ground water model is not imperative in developing general long term plans for management of the ESPA. It is certainly capable of use as a guide in the planning effort and can be more useful evaluating specific elements during implementation of the plan.

5. **Development of a Comprehensive Management Plan for the Eastern Snake River Plain Aquifer:**

The Idaho Water Resource Board is charged with developing a comprehensive aquifer management plan for the Eastern Snake River Plain Aquifer to include a framework for the plan and appropriate interim goals and objectives in accordance with state water law, a method to fund implementation of the plan and a time schedule for finalization of the plan. Development of goals and objectives for this task does not require the use of the enhanced ESPAM ground water model. Definition of recommended public policy relative to the management of the aquifer should precede development of goals and objectives. The goals should then define the expectation of what the resource is required to provide for the water user community and the state. Objectives should then be defined to identify specific target levels of spring flows, reach gains, and water levels necessary to reach those goals. This process can proceed without the use of the ground water model.

Determination of specific management alternatives to meet the defined objectives will require the use of the ground water model as a tool. The model is useful in estimating or predicting the benefits of specific on-the-ground alternatives to be implemented to reach the objectives of aquifer restoration programs. Development of aquifer/ spring responses to these "what-if" estimates should be the primary use of the model. The model capabilities will not be taxed if used in this mode.

The model can be used for predicting the effectiveness of broad scale managed recharge programs and for determining benefits to spring reaches of integrated long term programs such as CREP with documented changes in recharge (flux).or regional ground water pumping curtailment. Simulated benefits of any aquifer renovation or mitigation plan should not be the sole criteria for determining performance or benefits. Monitoring of aquifer and spring response needs to be implemented to verify results. Again, caution should be exercised in not utilizing the model beyond its capabilities. It should not be used as the only indicator of effectiveness of recharge programs for short term programs targeting specific springs, nor should it be used for node to node estimates of water level response or individual spring response.

6. **Verification and Response Documentation and Recommended Model Improvement:**

Verification of a ground water model is always a goal of model developers because it enhances the confidence in model simulation. Verification requires development of an independent data base of measured input and output to 'test' the ability of the calibrated model to simulate the model output response to input 'different' from the calibration data input. Development of a verification data base requires monitoring of specific input and output over longer periods of time. For verification of the ESPAM model and for verification of predicted response to implemented aquifer restoration programs, a long term monitoring program of strategic input and output must be developed and operated by the State. This data base provides the ability for continued refinement of the model and developed confidence in the model for planning purposes.

Questions relative to the accuracy of the model simulations need to be addressed. A re-evaluation of the shorter Thousand Springs reach responses should be evaluated, ie: Curren Tunnel/Rangen. Some estimates, statistically, of the operational accuracy of the reach-gain simulations should be performed. A better estimate of confidence limits for simulated output needs to be offered to assist planners in risk analysis since the model will be used for management

7. **Recommended Components of a Comprehensive Aquifer Management Plan:**

a. The initial efforts should be directed toward setting some rational, quantified goals and objectives for management of the aquifer.
b. A definitive time goal for stopping the decrease in spring flows,
c. Definitive time and discharge goals for restoring spring flows and water levels,
d. Implementable programs for verification of results of enhancement measures,
e. Effective means for verification of depletion reductions and/or recharge,
f. Assurance of adequate staffing and budget to carry out effective programs.
g. Feedback mechanisms to provide timely course changes in programs,
h. Administrative structure changes to assure continuity of management and regulation and hydrologic continuity (ESPA ground water management area, single water district, aquifer wide or basin wide water conservation district etc),
i. An independent technical advisory committee (independent of IDWR).

Eastern Snake River Plain Aquifer
Use of the ESPAM Ground Water Model

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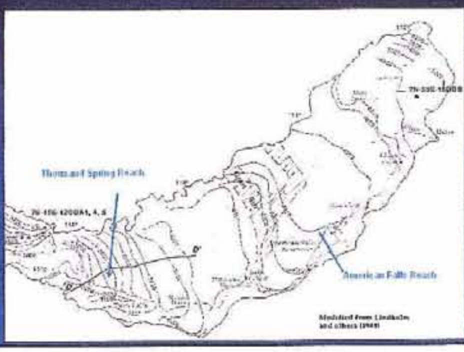
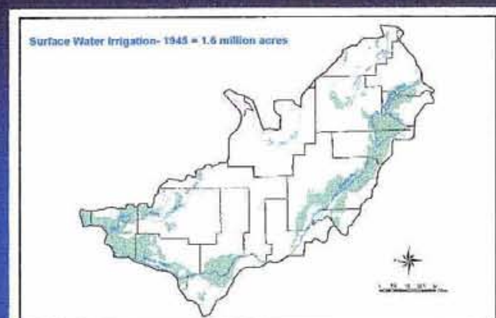
Summary of Presentation

- Historical Impetus for Aquifer Management
- ESPA/Upper Snake water supply is declining
  - Ground water levels, spring flow, reach gains, and river flow- all are dropping. This is a long-term problem- not from recent droughts
- Aquifer management is needed now
- ESPAM ground water model is adequate to provide guidelines for management
- Model improvements are required- but may not significantly change predictions
- Long term, sustained monitoring program is necessary

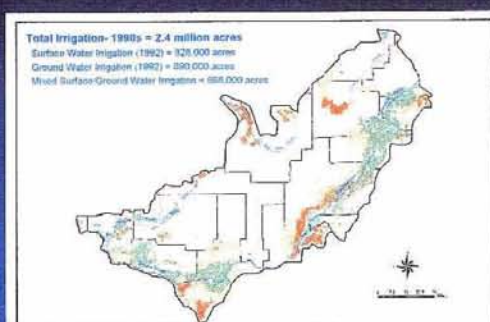
Ground Water, Springs, and River Reach Gains from Aquifer- all a Common Water Supply



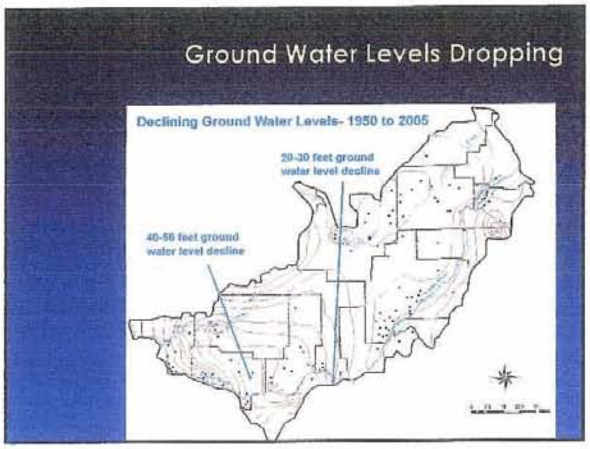
Surface Water Irrigation in 1945

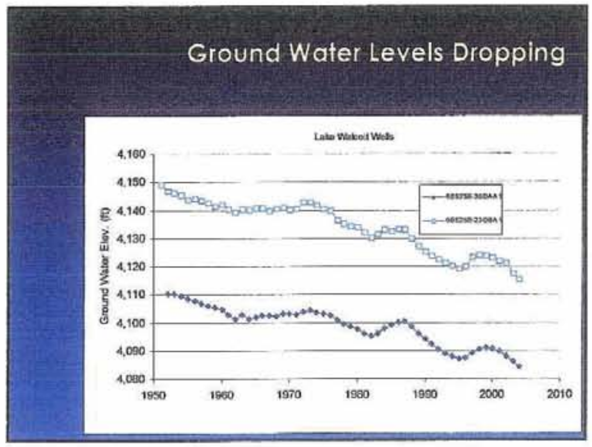


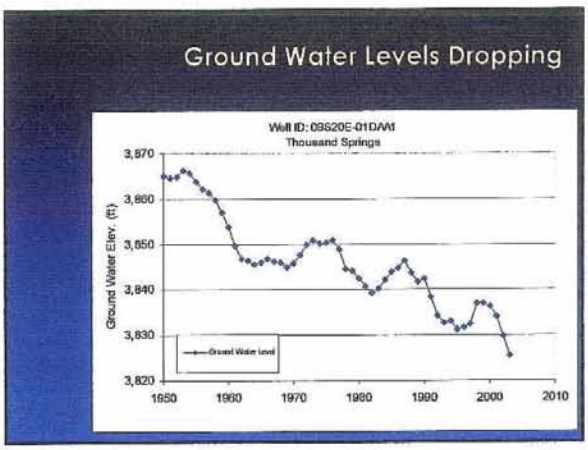
Increased Ground Water Irrigation- 1990s

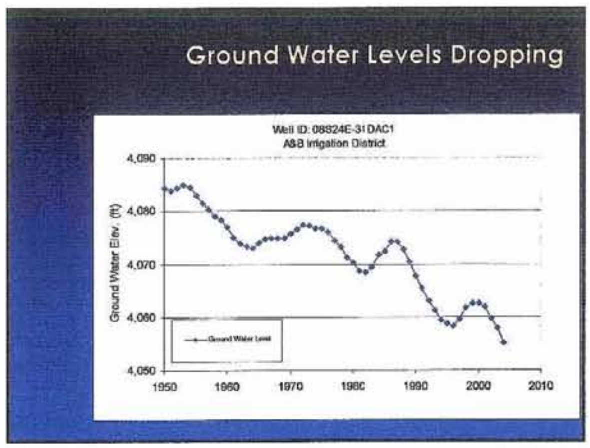


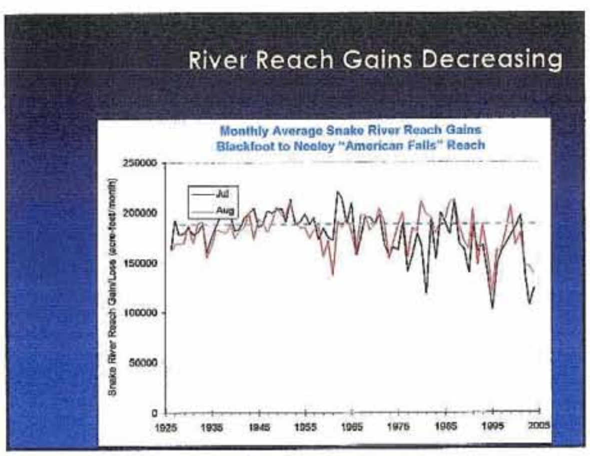
Water Rights and Priority

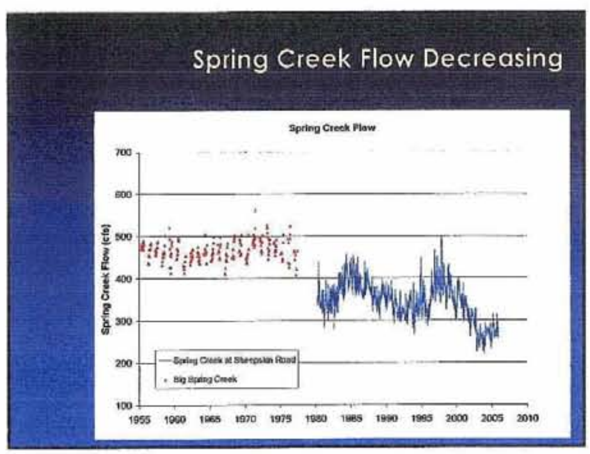

Ground Water Levels Dropping
Declining Ground Water Levels- 1950 to 2005
20-30 feet ground water level decline
40-56 feet ground water level decline


Ground Water Levels Dropping
Lake Walcott Wells
Ground Water Elev. (ft)

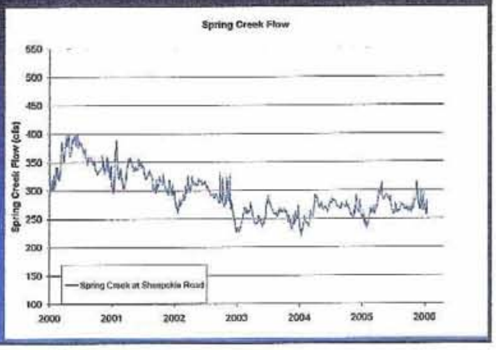

Ground Water Levels Dropping
Well ID: 09S20E-01DAA1
Thousand Springs
Ground Water Elev. (ft)
Ground Water Level


Ground Water Levels Dropping
Well ID: 08S24E-31DAC1
A&B Irrigation District
Ground Water Elev. (ft)

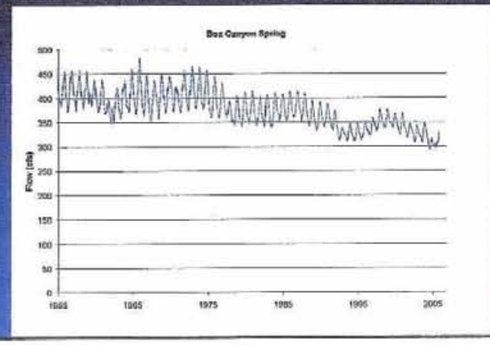

River Reach Gains Decreasing
Monthly Average Snake River Reach Gains
Blackfoot to Neeley "American Falls" Reach
Jul
Aug


Spring Creek Flow Decreasing
Spring Creek Flow
Spring Creek Flow (cfs)
Spring Creek at Sheepskin Road
Big Spring Creek

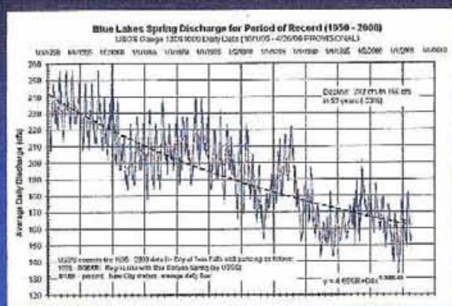
. . . Spring Creek flow has not recovered during wet 2006 season



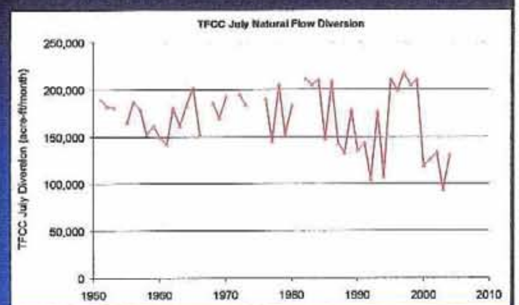
Box Canyon Spring Declining



Blue Lakes Spring Declining



Natural Flow Water Supply Dropping



Aquifer Management is Needed Now

- Senior priority surface water rights are not being fully satisfied, while junior groundwater rights are
- WDs 120 and 130 were created recognizing that the ESPA is hydraulically connected to surface supplies. An aquifer-wide planning and management entity is required.
- If pumping is not managed, continuing declines in groundwater levels and reach gains will only make the impacts worse

ESPA Ground Water Model

- Designed to evaluate impacts from ground water pumping and surface water recharge practices on aquifer supply
- Calibrated to 1980 – 2002 data
- Model results provided to ESPA Modeling Committee for review. Consensus not always achieved.
- Most-comprehensive model developed to date
- Provides information necessary to identify river/aquifer relationships and potential management solutions

ESPA Ground Water Model

Opportunities for Model Refinement:

- Simulation of water supply shortage during irrigation period (July-August) by shorter time steps
- Calibration to longer record (1950-2006)
- Finer grid resolution near springs
- Improved consumptive use estimates

All of these are just refinements- adequate information is already available to begin to make decisions and explore solutions now

Historical Perspective

- 1870-1905 Most natural flow rights allocated
- 1905 Water shortage evidenced at Blackfoot
- 1910 Rexburg decree
- 1910-1920 Surface water "flood rights" allocated
- 1915-1956 Construction of reservoirs
- 1945-1995 Expansion of ground water pumping
- 1920-1950 IDWR/USGS/IDs study aquifer
- 1980s USGS gw model
- 1980s UI/IDWR gw model
- Early 1990s UI model & aquifer management study
- 2000-2005 ESPA model & aquifer management study
- 2005-2010 More study- or action???????

Conclusions

- ESPA/Upper Snake water supply is declining
- This is a long-term problem
- Aquifer management is needed now
- ESPAM ground water model is provides information to assist in developing remedies
- Model improvements may or may not significantly change predictions

Questions?

Components of a Comprehensive Aquifer Management Plan

- The initial efforts should be directed toward setting some rational, quantified goals and objectives for management of the aquifer
- A definitive time goal for stopping the decrease in spring flows.
- Definitive time and discharge goals for restoring spring flows and water levels.
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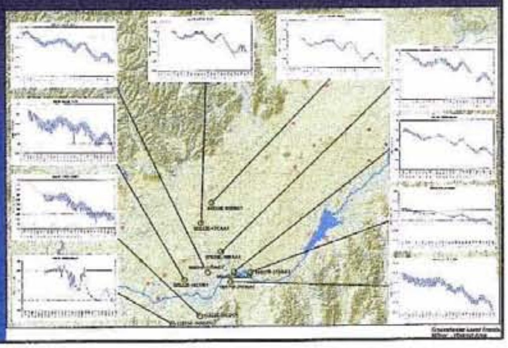
- An independent technical advisory committee

Declining Regional Ground Water Levels



Declining Regional Ground Water Levels