WaterSMART

Applied Science Grants

Funding Opportunity Announcement No. BOR-DO-19-F012

Precipitation modeling tools to improve water supply reliability

Boise, Idaho

Idaho Power Company
Dr. Shaun Parkinson, P.E., Meteorology and Cloud Seeding Leader
1221 West Idaho
Boise, Idaho 83702

October 30, 2019

OCT 30 '19 PM 1:50

TABLE OF CONTENTS

Technical Proposal and Evaluation Criteria

Executive Summary

The executive summary should include:

- *The date, applicant name, city, county, and state*
- *A one paragraph project summary that specifies the work proposed, including how funds will be used to accomplish specific project activities and briefly identifies how the proposed project contributes to accomplishing the goals of this FOA*
- *The length of time and estimated completion date for the proposed project*
- *Whether or not the proposed project is located on a Federal facility*

Date:	October 30, 2019
Applicant name:	Dr. Shaun Parkinson
City, County, State:	Boise, Ada, Idaho

Project Summary:

Cloud seeding is a tool used by Idaho Power Company (IPC) to augment winter precipitation and subsequent water supplies in order to achieve a reliable water supply for low cost hydropower generation. Quantifying the effects of cloud seeding has been a long-standing challenge due to the complexities of how precipitation forms and the fact that once a cloud is seeded, you cannot know what it would have done otherwise. To date, impacts have been estimated using statistical analysis of precipitation measurements and hydrologic modeling that evaluates streamflow based on changes in precipitation, yet stakeholders are asking for more robust estimates of impact. Recent advances in computing and instrumentation have given us the capability to numerically simulate the precipitation formation process and the impact of cloud seeding. Our initial use of models has shown capability, however, more work is needed to both improve the model capability to simulate winter precipitation and the impacts of seeding accurately, as well as to verify the new and improved models with observations. *The purpose of this project is to improve modeling capabilities to forecast winter precipitation and quantify the impact of cloud seeding to increase water supply reliability*. The outcome of this project will be improved modeling and forecasting capabilities for precipitation and cloud-seeding impacts that will be used by water managers in Idaho to quantify the impacts of their cloud-seeding operations on snowpack and subsequent streamflow in the targeted watersheds.

Approximate Length:	36 months
Estimated Completion Date:	April 30, 2023
Federal Facility:	No

Technical Project Description and Milestones

The technical project description should describe the work in detail, including specific activities that will be accomplished. This description shall have sufficient detail to permit a comprehensive evaluation of the proposal. Please include a preliminary project schedule that shows the stages and duration of the proposed work including major tasks, milestones, and dates. Please note, if the work for which you are requesting funding is a phase of a larger project, please only describe the work that is reflected in the budget and exclude description of other activities or components of the overall project.

Cloud seeding to enhance precipitation was first discovered by Schaefer and Vonnegut in the 1940s (Schaefer 1946, Vonnegut 1947). The concept is that wintertime orographic clouds that have supercooled liquid water and inefficient natural ice production would produce more snowfall if there were more ice to deplete the supercooled liquid. The cloud seeding material (silver iodide) is known to effectively produce ice, which grows into snow at the expense of the supercooled liquid water. More snowfall occurs as a result. Since this discovery, many research experiments were conducted to demonstrate that cloud seeding could increase precipitation and snowpack, and while many led to advances in cloud physics understanding, they failed at their ultimate objective to unambiguously attribute precipitation enhancement to cloud seeding (Garstang et al. 2003, Reynolds 2015). This is largely due to the difficulty in detecting what is assumed to be a relatively small signal (i.e., precipitation change as a result of cloud seeding) overlaid on a rather noisy field (i.e., naturally occurring precipitation) either via statistics or direct measurement. However, recently the SNOWIE (Seeded and Natural Orographic Wintertime clouds: the Idaho Experiment) project collected an unprecedented dataset in seeded and natural (non-seeded) clouds, and revealed that the technology of cloud seeding effectively promotes precipitation formation in clouds that were otherwise not producing precipitation (Tessendorf et al. 2019). This dataset includes measurements directly in clouds that were unambiguously impacted by cloud seeding (French et al. 2018), and provides unique opportunities to advance the way that impacts from cloud-seeding programs are evaluated.

Idaho Power Company (IPC) began investigating cloud seeding to augment water supply for its hydroelectric system in 1993 and began an operational program in 2003 in the Payette Basin in southwestern Idaho[1]. IPC serves more than 560,000 customers in Southern Idaho and Eastern Oregon. Approximately half of IPC's energy comes from its hydroelectric system, which is its lowest cost generation resource[2]. Hydropower is fundamental to IPC's goal of providing 100% clean energy by 2045 while continuing to keep prices low and reliability high[3]. The Eastern Snake Plain Aquifer (ESPA) Comprehensive Aquifer Management Plan (CAMP; Appendix C) adopted by the State of Idaho in 2009 calls for implementation of a 5-year pilot weather modification program. Guided by successful implementation and operation of a cloud-seeding program in the Payette River Basin, IPC initiated development of a pilot program in the Upper Snake to support CAMP. In 2012, the Idaho Water Resource Board (IWRB) updated the State Water Plan, which also includes weather modification (IWRB, 2012).

---

[1] https://www.idahopower.com/energy-environment/energy/energy-sources/hydroelectric/cloud-seeding/

[2] https://www.idahopower.com/energy-environment/energy/energy-sources/

[3] https://www.idahopower.com/energy-environment/energy/clean-today-cleaner-tomorrow/

Today, IPC operates an independent cloud-seeding program in the Payette River Basin, which they used to guide a successful pilot project in the Upper Snake for the ESPA-CAMP. Implementation of the pilot project ultimately led to IPC's operation of a cooperative cloud-seeding program to augment snowpack in the Boise, Wood, and Upper Snake Basins (see Figure 3). Operational expenses of the program are funded through a partnership between IPC, the IWRB, and various other water users[4]. There are considerable opportunities to expand seeding operations, and the resulting water supplies, in the Boise, Wood, and Upper Snake Basins. To date, benefit estimates available to inform stakeholders of program benefits are based upon statistical target-control analysis of precipitation increases and hydrologic modeling that evaluates streamflow based on changes in precipitation. This approach provides a long-term, multi-year average benefit of cloud seeding. As the program has matured, more and more stakeholders (water users) desire benefit estimates by year. The inability to provide year-to-year benefit estimates has limited the ability to increase funding support from IPC, the IWRB, and, in particular, water users. Without increased funding, expanding operations of the cloud-seeding program has not been possible, which has in turn limited the benefits that cloud seeding could provide to the watershed and each of the stakeholder groups.

Recent advancements in instrumentation and computing have led to new numerical modeling capabilities (Rasmussen et al. 2011, Xue et al. 2013a, Rasmussen et al. 2018), which have laid the foundation to accurately simulate precipitation in complex terrain and evaluate the potential of cloud seeding to enhance wintertime orographic precipitation in ways not possible in the past decades. Specifically, it led to the development of a model-based set of tools built around the Weather Research and Forecasting (WRF) model to guide cloud-seeding program operations and quantify the impact of cloud seeding. The model-based tools include: 1) an algorithm to determine the potential for cloud seeding based upon WRF weather forecasts, and 2) a "cloud-seeding parameterization" that simulates the physics of cloud seeding with silver iodide, that when run in the WRF model can simulate the seeding-enhanced precipitation (Xue et al. 2013a). The impact of the simulated cloud seeding can then be quantified and spatially mapped by taking a difference between a simulation with seeding from one without seeding included. In addition, the cloud-seeding parameterization in combination with ensemble modeling techniques have been applied to evaluate the impact of cloud seeding in a project conducted in Wyoming (Rasmussen et al. 2018). These modeling advances outline a novel way to build a robust physically-based modeling framework for use by IPC to quantify impacts of Idaho's cloud-seeding programs. This also lays the foundation for the future use of spatially-distributed, physically-based hydrologic modeling (i.e. WRF-Hydro) to represent the cloud-seeding benefits as additional runoff and streamflow.

The data from SNOWIE is invaluable to improving the numerical modeling capabilities for quantitatively estimating the impacts of cloud seeding on clouds and precipitation. For example, SNOWIE research has revealed specific areas in need of improvement in order for the WRF model to forecast atmospheric conditions important to precipitation formation in complex terrain and robustly simulate the likely impacts of cloud seeding for the variety of atmospheric conditions observed (Xue et al. 2019). The processes that need improvement in the model are

[4] Resolutions for IWRB and the various involved water districts can be found at the following URLs: https://idwr.idaho.gov/files/iwrb/2019/20190509-IWRB-Meeting-Resolutions-5-19.pdf; http://www.waterdistrict1.com/resolutions.pdf; https://idwr.idaho.gov/apps/ExtSearch/DocsImages/xrr401_.PDF

the estimation of supercooled liquid water and natural ice production, as well as the representation of the dispersion and transport of the seeding material and growth rates of the seeding-produced ice into snow (Kunkel 2019). The SNOWIE dataset provides the necessary detailed observations to improve the WRF model and cloud-seeding parameterization and ensemble modeling techniques can be utilized to account for remaining uncertainties in the model predictions, allowing us to build an improved modeling framework to provide a robust and novel physically-based way to quantify the impacts of cloud seeding.

The goal of this project is to improve WRF modeling capabilities to forecast winter precipitation and quantify the impact of cloud seeding to increase water supply reliability. Additional outcomes of this project will include improved understanding of impacts of cloud seeding as a tool for water supply reliability, and improvements to the WRF model simulation of winter clouds and precipitation will benefit forecasting and model-based studies of precipitation as well as subsequent runoff and streamflow.

Specific activities that will be conducted to achieve these outcomes include the following two tasks to be completed following the schedule in Figure 1.

- Task 1: Evaluate and improve processes in the model using observations. The model processes include:

    A. the ability of the WRF model with the cloud-seeding parameterization to produce and grow ice in seeded clouds by comparing model simulations of three cases from SNOWIE that had negligible natural precipitation with detailed SNOWIE measurements inside seeded clouds;
    B. the WRF model's ability to produce natural ice by comparing model simulations of five cases from SNOWIE with detailed SNOWIE measurements in clouds with ice;
    C. the dispersion of seeding material in the WRF model with the cloud-seeding parameterization by comparing the model to observations of how seeding lines dispersed in SNOWIE cases that had very distinct seeding line signatures (that were devoid of background natural precipitation); and
    D. the WRF model's ability to reproduce relevant observed characteristics (i.e. supercooled liquid water, ice, etc.) and its subsequent ability with the cloud-seeding parameterization to simulate seeding in SNOWIE cases with non-negligible background natural precipitation.

    Based upon the results of the evaluation compared to SNOWIE observations, parameters in the model can be adjusted to improve the model. Such parameters that may need adjustment include: ice nucleation rates, background aerosol concentrations (that influence cloud droplet activation and subsequent supercooled liquid water contents), and activation and scavenging rates of silver iodide.

- Task 2: Design, test, and demonstrate an ensemble modeling framework that quantifies the seeding impact taking into account uncertainties in the model. Specific steps to be taken in order to complete this task are listed below.

A. Design the ensemble modeling framework based upon results from Task 1 to account for any remaining uncertainties in the model. This will be achieved by varying the initial conditions and parameters in the physical parameterization representations in the model that are uncertain.
B. Test and refine the ensemble modeling framework on selected SNOWIE cases by comparing results to observations to ensure the spread of ensemble output encompasses the observations. We anticipate investigating approximately 10-20 different model configurations to be part of the ensemble set up. This process will refine the exact model configurations to be used in the ensemble, and because every model configuration adds to the computational expense of the experiment, we will aim to optimize the configuration by selecting approximately 10 that produce results which best encompass the observations.
C. Demonstrate the ensemble modeling framework by running a season-long ensemble modeling experiment that simulates all seeded storms in the Payette Basin during SNOWIE to quantify the impact of seeding over the course of a winter season by producing model storm simulations consistent with the likely spread in model bias and random errors in the system. This provides a likely estimate of the actual seeding effect taking into account uncertainties in the model simulations. Besides the heavy computational demand of this task, this task will also include analysis of the ensemble model output and comparison of the entire ensemble with observations from SNOWIE to ensure the ensemble spread captures the observed conditions adequately.

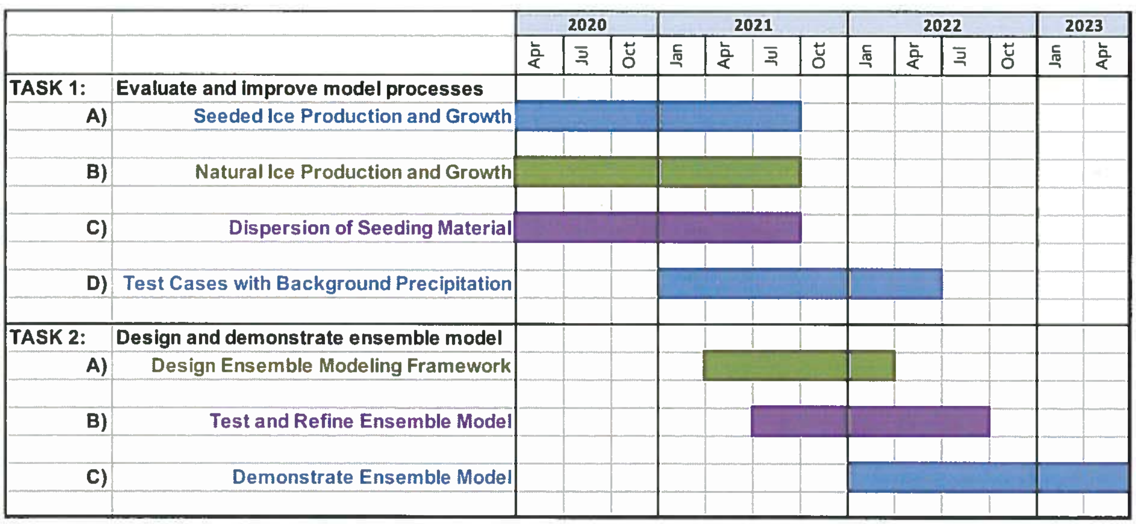


Figure 1. Gantt chart indicating the timeline for conducting the work outlined in each of the two tasks for this project in quarterly intervals.

*Please indicate whether you are a Category A applicant or a Category B applicant. If you are a Category B applicant, describe who you are partnering with, or plan to partner with, why you chose to collaborate with that specific partner, and how the partner plans to contribute to the project. (Note: Category B applicants **must** include a letter of participation with the application* *stating that the partner commits to participate in the project and supports the need for the project. Please refer to Section C.1. Eligible Applicants).*

We are a Category A applicant. Idaho Power will be working with NCAR as a subawardee.

Project Location

Provide specific information regarding the proposed applied science project's geographic area of focus (for example, the proposed project may focus on a particular watershed or basin, county, State, Territory, or other region. Include a map showing the geographic location of the project area in one of the following formats:

1. *Shapefile (.shp)*
2. *KMZ/KML (.kmz or .kml) aka Google Earth File*
3. *AutoCAD (.dwg)*
4. *PDF map (.pdf)*

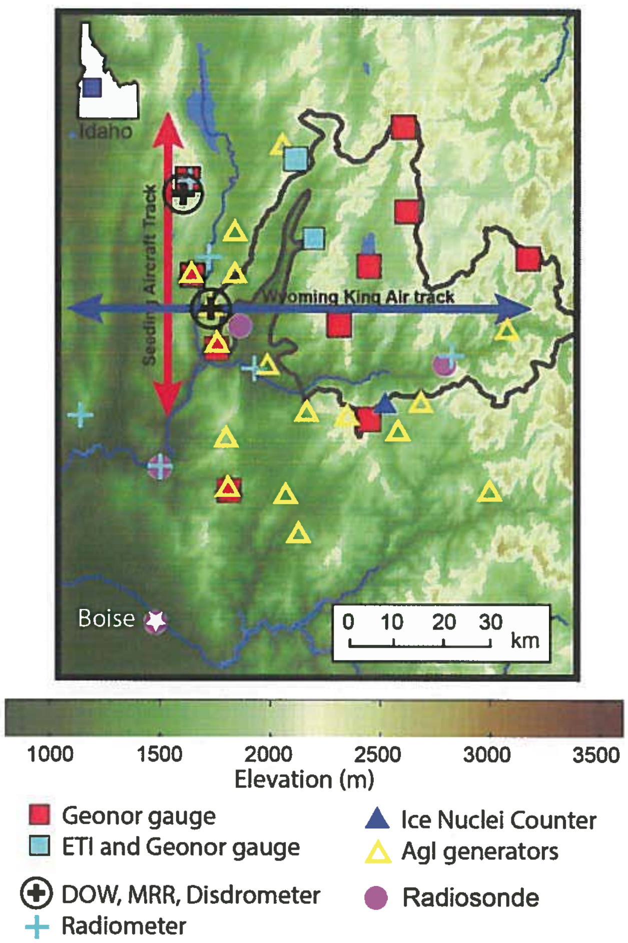


Figure 2. Map of the Payette Basin north of Boise, Idaho where the SNOWIE 2017 field campaign was conducted, indicating the sites of all facilities and instruments deployed for the project.

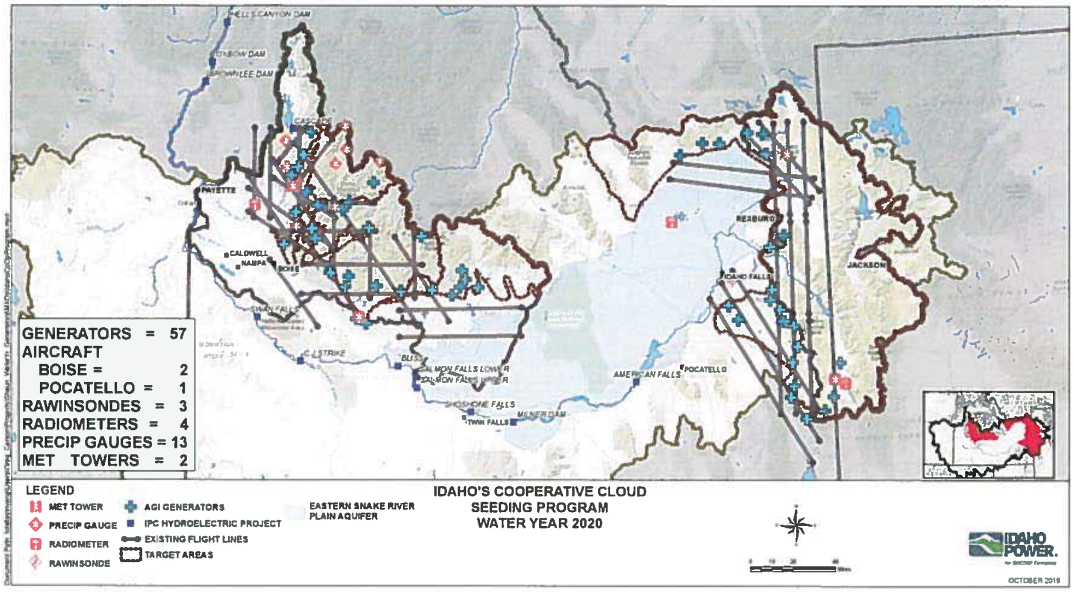


Figure 3. Map of the IPC cloud-seeding operations within the Snake River Basin.

Data Management

Please briefly describe any established project-level data management practices, data documentation, format standards, and product delivery processes that will be used throughout the project. Note: An official data management plan will not be required.

Any spatially explicit data or tools developed in the performance of an award made under this FOA must be developed in industry standard formats that are compatible with Geographic Information System (GIS) platforms.

To accomplish the computer modeling outlined in this proposal, IPC will provide in-kind services of computing operations and storage. These services would be accomplished by providing NCAR with access to the IPC and Boise State joint High-Performance Computing (HPC) cluster housed (operational 1 July 2020) at the Idaho National Labs (INL) Community Computing Center (C3) on the INL Educational Facility located in Idaho Falls, Idaho. These services would consist of up to 1000 computing cores for continuous utilization by NCAR through the project, providing roughly 27,000,000 compute hours (1000 hours x 1125 days x 24 hours). In addition to the compute capabilities, IPC will provide up to 150 TB of storage on the HPC. This storage would be in a high life-tiered storage system. The total storage available to the system is ~2.0PB and will provide a combination of fast scratch, mid and long-term storage. This type of system would only provide a single copy of any file and is not a redundant storage system designed for long-term archival. We will purchase external hard drives to create secondary backups of model configuration and input files, and a subset of the model output files.

The WRF model produces netCDF format output files, which are compatible for use with GIS software. The WRF model documentation is available online[5].

Evaluation Criteria

Evaluation Criteria A: Project Benefits

Describe how your project will benefit water supply reliability:

1. *Describe the water management issue(s) that your project will address. For example, will your project address water supply shortfalls or uncertainties, the need to meet competing demands for water, complications arising from drought, conflicts over water, or other water management issues? Describe the severity of the water management issues to be addressed through your project.*

This project will address issues related to mitigating water supply shortfalls and uncertainties. The primary driver for this proposed project is to improve the WRF model framework to allow for the development of quantitative estimates of the effect of cloud seeding by year. The improvements to the model and the ability to quantify effects will elevate the sustainability of funding for the current cloud-seeding program and work to resolve uncertainties that have limited additional funding from stakeholders (water users) necessary to expand the cloud-seeding program, and the additional water supply an expanded program can provide. The IWRB has directed its staff to evaluate the distribution of benefits of additional runoff to user groups, for the purpose of identifying beneficiaries (see IWRB resolution in Appendix D line 93). The runoff benefits from cloud seeding would be developed from quantitative estimates of precipitation increases from the WRF-based model framework. In addition, quantifying benefits on a seasonal basis will allow the IWRB to account for water supply increases from cloud seeding relative to other measures identified in the ESPA-CAMP (Appendix C and the State Water Plan (IWRB, 2012) to improve aquifer conditions. The improvements to the model framework will also be able to support project review and design of potential cloud-seeding projects by estimating benefits of seeding equipment configurations and operations with different storm conditions. This will allow quantitative review of current configurations, operational criteria for varying storm conditions, and a benefit metric when evaluating potential new projects. Sustaining, or expanding, the Idaho cooperative cloud seeding program maintains, or increases, the water supply to Idaho Power's hydropower system. The additional water increases power generation from its lowest cost generation resource, lowering energy costs for customers throughout the service territory. By quantifying benefits and increasing the sustainability of funding for the program from all parties, the additional water from the current, or expanded, program will also:

- produce additional water, which over time will increase base flows. Increased base flows benefits holders of instream rights, and benefits all instream uses including recreation, aquatic habitat and fisheries, water quality, etc.,
- increase the likelihood of the reservoir system filling, potentially reducing use of storage water in a given year, and yielding the potential for increased reservoir carryover,

[5] http://www2.mmm.ucar.edu/wrf/users/docs/user_guide_V3/contents.html

- provide opportunity and additional time for surface and ground water users to mitigate and resolve issues and conflicts that resulted in the need for the ESPA CAMP
- and, finally, the additional water from cloud seeding provides more opportunity to meet the Goals identified by the ESPA CAMP, including recharge or stabilization of the ESPA.

In addition,

- Improvements to the WRF model resulting from this effort will improve forecasts for all uses of WRF forecasts by IPC, including forecasting streamflows and water supplies, forecasting generation from renewable generation sources (including both solar and wind), and (weather-related) situational awareness for delivery system reliability. It will also improve forecasting for the operation of its cloud-seeding project.
- White sturgeon in the middle Snake are a species of concern for the State of Idaho. Successful recruitment of sturgeon is dependent upon high spring flows (Idaho Department of Fish and Game 2008, Hildebrand et al. 2016). Increased snowpack from cloud seeding increases the potential for increased runoff that will in some years increase recruitment.
- The springs along the north rim of the middle Snake that are formed from the discharge of the ESPA are home to snail species listed under the Endangered Species Act (ESA). Sustaining or increasing discharge from the ESPA through the springs benefits these snails (Department of the Interior 2009).

2. *Explain how your project will address the water management issues identified in your response to the preceding bullet. In your response, please explain how your project will contribute to one or more of the following water management objectives and provide support for your response:*

    a. *water supply reliability,*
    b. *management of water deliveries,*
    c. *water marketing activities,*
    d. *drought management activities,*
    e. *conjunctive use of ground and surface water,*
    f. *water rights administration,*
    g. *ability to meet endangered species requirements,*
    h. *watershed health,*
    i. *conservation and efficiency, or*
    j. *other improvements to water supply reliability.*

This project will address water supply reliability, as well as drought management activities, watershed health, and the ability to meet endangered species requirements (as described above) by improving a numerical weather model that predicts precipitation and snowpack accumulation, as well as by utilizing a numerical modeling parameterization that simulates how clouds respond to cloud seeding. This will result in better model-based predictions and representations of snowpack, as well as better estimates of how much snowpack is augmented by cloud seeding, and will allow for better understanding of how to mitigate water supply shortfalls, while also reducing uncertainties in water supply. The ability to produce quantitative estimates of benefits will increase the likelihood of additional funding from all parties to build the program out, further increasing water supplies. Quantifying benefits by operational season will allow the IWRB to track progress towards the ESPA-CAMP and State Water Plan goals, all of which are addressing conjunctive use issues in the Snake Basin.

3. *Describe to what extent your project will benefit one of the water management objectives listed in the preceding bullets. In other words, describe the significance or magnitude of the benefits of your project, either quantitatively or qualitatively, in meeting one or more of the listed objectives.*

In 2008, the Idaho Legislature passed legislation establishing the Comprehensive Aquifer Planning and Management Program (CAMP) to develop a planning tool for ground and surface water resources. The objectives of the ESPA-CAMP, adopted in 2009, are to incrementally achieve a net ESPA water budget change of 600 thousand acre-feet (kaf) annually. It is projected that this hydrologic goal can be achieved by the year 2030 through implementation of a mix of management actions including (https://idwr.idaho.gov/IWRB/water-planning/CAMPs/ESPA/process.html):

- Groundwater to surface water conversion
- Managed aquifer recharge,
- Demand reduction through conservation and efficiency improvement, and
- A pilot weather modification (cloud-seeding) program in the Upper Snake and Wood River Basins

The pilot weather modification project was successfully implemented and phased into an ongoing cooperative program between the IWRB, IPC, and other water users; each providing collaborative funding to support expansion and operation of the program, while also requiring improved benefit estimation methods to evaluate the impacts of the program by year. Cloud seeding is the only ESPA-CAMP activity that adds water to the system, as opposed to changing its use. The Idaho Department of Water Resources (IDWR) has an established moratorium across the ESPA region prohibiting new appropriations of water, allowing additional water from cloud seeding to increase supply reliability, increase opportunities for managed recharge, and add to the drought resilience of the watershed. The increased flows throughout the watershed will increase the health of the river system.

4. *Explain how your project complements other similar applicable to the area where the project is located. Will your project complement or add value to other, similar efforts in the area, rather than duplicate or complicate those efforts? Applicant should make a reasonable effort to explore and briefly describe related ongoing projects.*

There is a cloud-seeding program operated by the High Country Resource Conservation and Development council (HCRCD), which is comprised exclusively of manual ground-based seeding material generators. The operation of the HCRCD project is done collaboratively with IPC's program, including sharing weather observations and operational forecasts, which come from the WRF based model-framework this project would improve.

Evaluation Criteria B: Need for project and applicability of project results

Explain how your project will result in readily useful applied science tools that meet an existing need:

1. *Does your project meet an existing need identified by a water resource manager(s) within the 17 Western States?*

Yes.

a. *Explain who has expressed the need and describe how and where the need for the project was identified (even if the applicant is the primary beneficiary of the project). For example, was the need identified as part of a prior water resources planning effort, through the course of normal operations, or raised by stakeholders? Provide support for your response (e.g., identify the entities that have expressed a need or cite planning or other documents expressing a need for the project).*

The State of Idaho's ESPA CAMP recommends weather modification (cloud seeding) as a management strategy with the goal of surface water supply enhancement (Appendix C). The State of Idaho's State Water Plan lists weather modification as an Optimum Use (IWRB, 2012). The Water Plan specifically notes in the implementation strategy to 'ensure that state-funded projects are scientifically sound and include robust monitoring and evaluation components'. The SNOWIE effort has demonstrated that the project is scientifically sound. This project will significantly improve the ability to monitor and evaluate the benefits.

The 2016 SECURE Water Act report documents that weather modification is also a component of the management strategies for other basins in the Western U.S. (specifically the Colorado River and Truckee River basins; USBR 2016), which indicates that this project has broad applicability as well.

b. *Provide letters of support from any resource managers, stakeholders or partners that have stated that they will benefit from the project, or, for Category B applicants, letters of participation from partners who have committed to participate in the proposed project. Identify any contribution (e.g., cost share, staff time, or other resources) by partners other than the applicant to the non-Federal cost share requirement for the project.*

Note: *Category B applicants will be evaluated under this criterion based on the extent of demonstrated support for their project beyond meeting this minimum requirement (i.e., to what extent project partners are committed to participating in the project).*

Letters of support are provided in Appendix A.

2. *Will the project result in an applied science tool(s) or information that is readily applicable, and highly likely to be used by water resource managers in the West?*

Yes. IPC and the IWRB will both utilize the improved modeling framework that is designed and demonstrated in this project.

a. *How will the project results be used?*

The WRF model is currently being used by IPC meteorologists to forecast opportunities for cloud seeding operations, as well as to monitor precipitation and snowpack accumulation over the year. Improvements to the model to predict winter weather, especially conditions suitable for cloud seeding, will have direct benefits and utility by IPC staff with improved forecasting of winter precipitation. The WRF improvements along with the ensemble modeling framework will also allow the model to be used to develop estimates of increased precipitation resulting from cloud seeding. These results will be used to inform stakeholders of the effects of cloud seeding, and can also be used by the IWRB to account for potential benefits to the ESPA-CAMP objectives or to water users. In addition to cloud-seeding benefit estimates, the improved WRF model-based tools can be used to evaluate the current cloud-seeding program configuration as well as assess the potential for seeding in areas that do not currently have weather modification programs. The improvements to WRF will also benefit non-cloud seeding applications of WRF, including forecasting generation from renewable resources (i.e. wind and solar), forecasting energy loads, water supply, and general weather-related situational awareness.

b. *Will the results of your project inform water resource management actions and decisions immediately upon completion of the project, or will additional work be required?*

Incremental improvements to the WRF will be usable throughout the project period, and yes, the results will be used immediately upon completion of the project. At this time, there are not any known specific follow-on efforts that would be required to be able to use the results of this project immediately.

c. *Will the results of your project be transferrable to other users and locations?*

Yes. The WRF model is a publicly-available community model, and can be utilized by other users in other locations to simulate and forecast weather. The improvements to the WRF configuration determined by this project can then be utilized by other users, as relevant. The cloud-seeding modeling framework being improved in this project will also be able to be applied for other users and locations, pending minor tuning that may be needed based upon location-specific aspects of the cloud-seeding program design and/or regional environmental characteristics (i.e. background aerosol loading, etc.).

d. *If the applicant is not the primary beneficiary of the project (e.g., if the applicant is a university or research institute), describe how the project beneficiaries have been or will be involved in planning and implementing the project?*

The applicant is a primary beneficiary of this project.

Evaluation Criteria C: Project implementation

Describe your project implementation plan:

1. *Describe the objectives of the project and the methodology and approach that will be undertaken. Provide support for your methodology and approach.*

The primary objective of this project is to *improve WRF modeling capabilities to forecast winter precipitation and quantify the impact of cloud seeding to increase water supply reliability.* The methodology and approach is broken into two tasks: Task 1 includes four subtasks that involve evaluation of selected model processes by comparing detailed observations from SNOWIE with model simulation results, while Task 2 involves three subtasks that aim to design, test, and demonstrate an ensemble modeling framework to quantify the impact of cloud seeding over the course of the SNOWIE winter season. Task 1 will result in improvements to the model processes under investigation or identification of those processes that need to be targeted in the ensemble model design in Task 2. These methods are appropriate because they make use of the most current advances in observations from SNOWIE and in numerical modeling, and they utilize ensemble modeling techniques that were successfully demonstrated for the purpose of quantifying the impacts of cloud seeding for the state of Wyoming in Rasmussen et al. (2018).

2. *Describe the work plan for the project. Include an estimated project schedule that shows the stages and duration of the proposed work, including major tasks, milestones, and dates.*

The work plan is illustrated in the Gantt chart in Figure 1.

3. *Describe the availability and quality of existing data and models applicable to the project.*

This project will use observational data from SNOWIE and the WRF model with the cloud-seeding parameterization. All of these assets are readily available to the IPC and NCAR staff that will work on this project.

SNOWIE collected a high-quality dataset that has already been utilized for several scientific research papers that were published in high-profile journals (e.g., French et al. 2018, Tessendorf et al. 2019). The data include unprecedented measurements inside seeded clouds in 21 cases, along with radar observations of these cases; three of which had unambiguous seeding lines observed in clouds that were otherwise not producing precipitation, which allows for very detailed analysis inside and outside of the seeded regions to quantify the ice produced by seeding and the subsequent impacts on precipitation formation from seeding, as well as to quantify the dispersion of the seeding lines. The data also provides detailed measurements in natural clouds, of natural ice production and supercooled liquid water. The model needs to be verified for its ability to replicate the natural clouds and that in seeded clouds, so the SNOWIE dataset is ideal for this project.

The WRF model is a publicly-available, community model developed at NCAR that is widely used by the atmospheric sciences and related community[6]. It is the basis for many operational models utilized by the National Weather Service (NWS), such as the High-Resolution Rapid Refresh (HRRR). The WRF model has also been shown to have the capability to simulate precipitation over the western U.S. mountains to within error of snow gauge observations (Ikeda et al. 2010, Rasmussen et al. 2011, Liu et al. 2017). The cloud-seeding parameterization (Xue et al. 2013a) was also developed at NCAR and runs in WRF to simulate the physics of seeding with silver iodide. This parameterization has been used in published research for IPC and the state of Wyoming (Xue et al. 2013a, 2013b, Xue et al. 2014, Xue et al. 2017, Rasmussen et al. 2018). When run in an ensemble modeling experiment for Wyoming, it was able to produce a more reliable estimate of the impact of seeding than from the statistical snow gauge experiment or a single deterministic simulation alone (Rasmussen et al. 2018). Recent SNOWIE research has indicated that WRF has challenges in predicting the supercooled liquid water and ice production in winter orographic clouds over the Payette Basin of Idaho (Xue et al. 2019, Kunkel 2019). These are the factors that need to be improved with this project.

Identify staff with appropriate credentials and experience and describe their qualifications. Describe the process and criteria that will be used to select appropriate staff members for any positions that have not yet been filled. Describe any plans to request additional technical assistance from Reclamation or via a contract.

All staff to work on this project have been identified. IPC staff will oversee the overall project and collaborate in and guide the work done by NCAR. NCAR is a subawardee to IPC for this project and NCAR staff will provide valuable and required expertise relevant to this project. The NCAR staff work in NCAR's Research Applications Laboratory (RAL), which is a lab experienced in conducting applied science for a variety of stakeholder and sponsor needs.

IPC staff include:

- Dr. Shaun Parkinson- Idaho Power Meteorology & Cloud Seeding Leader. Over 30 years of water resources engineering and management experience, over 25 years managing and operating cloud seeding operations for Idaho Power Company.
- Derek Blestrud- Senior Atmospheric Scientist. Over 20 years' experience in meteorology and 17 years in cloud seeding operations.
- Mel Kunkel- Senior Atmospheric Scientist. Over 35 years' experience in meteorology and water resources, 8 years' experience in cloud seeding operations.
- Dr. Nick Dawson- Senior Atmospheric Scientist. 11 years' experience in meteorology and 4 years' experience in cloud seeding operations.

NCAR staff include:

- Dr. Sarah Tessendorf–A Principal Investigator (PI) of the SNOWIE project, Dr. Tessendorf has 15 years of experience as a research scientist, and over 10 years of experience as a scientific project manager at NCAR. She also has a broad range of

[6] https://www.mmm.ucar.edu/weather-research-and-forecasting-model

experience analyzing atmospheric observations from weather radar, aircraft, and ground-based sensors, as well as analyzing model output and working to improve model parameterizations.

- Dr. Roy Rasmussen–The Director of the Hydrometeorological Applications Program in RAL since 2004, and also a co-PI of the SNOWIE project, Dr. Rasmussen has over 35 years of experience conducting and leading winter weather and cloud microphysical research projects, including early cloud-seeding research as a former Research Physical Scientist at the U.S. Bureau of Reclamation in the mid-1980s, before coming to NCAR as a Scientist in 1988.
- Dr. Lulin Xue–The lead developer of the cloud-seeding parameterization, and a co-PI of the SNOWIE project, Dr. Xue is a world-leading expert in cloud microphysical modeling with over 10 years of experience working at NCAR on model improvement and development projects.
- Kyoko Ikeda–With an M.S. in Atmospheric Science and over 20 years of experience as a data analyst, Ms. Ikeda is an expert in snow gauge analysis, winter weather microphysics, and radar analysis.
- Courtney Weeks–With an M.S. in Statistics, Ms. Weeks is an expert in statistical and objective analysis, with over 10 years of experience conducting analysis comparing a variety of atmospheric observations, such as aircraft, radiometer, and satellite data, with model output.
- Hans Mohling–System administrator, with over 20 years of experience managing computing environments at NCAR.

a. Have the project team members accomplished projects similar in scope to the proposed project in the past either as a lead or team member?

Yes. This IPC-NCAR team has worked together since 2011 on cloud-seeding research projects, and recently completed the SNOWIE field project together. They have also published several research papers together, such as Xue et al. (2013a, 2013b, 2017), and Tessendorf et al. (2019).

b. Is the project team capable of proceeding with tasks within the proposed project immediately upon entering into a financial assistance agreement? If not, please explain the reason for any anticipated delay.

Yes, the team can proceed with tasks in the proposed project immediately upon entering into a financial assistance agreement. Based on the work history of the team initiating in 2011, the team is comfortable with the tasks that have been identified and scoped.

4. Provide a summary description of the products that are anticipated to result from the project. These may include data, metadata, digital or electronic products, reports and publications.

Annual reports will be produced that summarize the results of this project, as well as scientific publications will be written and submitted for publication in peer-reviewed journals. These written works will identify model configuration improvements that are determined in this project. The other product of this project will be the WRF model output from the ensemble model demonstration. The WRF model output will be in the form of gridded netCDF files.

Evaluation Criteria D: Dissemination of results

Explain how project results will be disseminated, including:

1. Describe how the tools, frameworks, or analyses being developed will be disseminated, communicated, or made available to water resources managers who may be interested in the results.

The results of how to optimally configure WRF and the ensemble modeling framework will be disseminated via written reports and scientific publications that will be made publicly available, especially within the WRF community, as well as via presentations at national scientific conferences and meetings with water managers. If findings are relevant to update WRF model codebases, then those upgrades would be shared publicly with the WRF community.

a. If the applicant is the primary beneficiary of the project, explain how the project results will be communicated internally, and to interested stakeholders and interested water resources managers in the area, if appropriate.

IPC and NCAR have worked closely throughout the development of the current modeling framework, and will continue to do so through this project. As such, much of the dissemination to IPC's internal Atmospheric Science Group will be direct communication via meetings and in-person discussions. The written reports and publications will be made available to the staff of IPC's Atmospheric Science Group and highlights of presentations shared with IPC leadership. Written reports and publications will also be shared with the IWRB and the Idaho Department of Water Resources (IDWR) staff working with the cloud-seeding program and evaluating the benefits relating to water users and the ESPA.

b. If the applicant is not the primary beneficiary of the project (e.g., universities or research institutes) describe how project results will be communicated to project partners and interested water resources managers in the area.

Not applicable, because the applicant is the primary beneficiary.

c. Explain why the chosen approach is the most effective way to disseminate the information to end users in a usable manner.

IPC will be in communication with NCAR throughout the project, making direct communication a cost-effective means of delivering information while maintaining appropriate context. The reports and publications will serve as a record of project accomplishments, and publications will vet the findings with the scientific community.

Evaluation Criteria E: Department of the Interior priorities

Explain how your project supports Department of the Interior Priorities (or at least one priority):

1. ***Creating a conservation stewardship legacy second only to Teddy Roosevelt***

    a. *utilize science to identify best practices to manage land and water resources and adapt to changes in the environment;*

This project will utilize key findings from the SNOWIE project to enhance the WRF model's ability to forecast precipitation, to guide cloud-seeding operations, as well as determine benefits from cloud-seeding operations and evaluate the potential for new cloud-seeding projects that could expand the project to produce even greater impacts. The purpose of the cloud-seeding program is to increase winter snowpack, and ultimately runoff to the rivers. The additional water provides additional fuel for IPC's hydropower system on the Snake River, as well as meet goals and objectives of the ESPA-CAMP and Idaho's State Water Plan for water supply enhancement to address State issues relating to water supply. This project will allow benefit estimates to be quantified, and the estimates shared with stakeholders.

   b. *examine land use planning processes and land use designations that govern public use and access;*
   c. *revise and streamline the environmental and regulatory review process while maintaining environmental standards;*
   d. *review DOI water storage, transportation, and distribution systems to identify opportunities to resolve conflicts and expand capacity;*
   e. *foster relationships with conservation organizations advocating for balanced stewardship and use of public lands;*

With the State of Idaho's moratorium prohibiting new appropriations of water, the additional water from cloud seeding, will provide additional water in headwater streams, and additional water for the aquifer or rivers below regulation. The additional water in the system, benefiting aquifers and rivers, aligns closely with objectives of conservation organizations to have more water in the river. This last spring, IPC was invited to present its program at a Conservation Summit organized by the Henry's Fork Foundation (HFF) and Trout Unlimited.

   f. *identify and implement initiatives to expand access to DOI lands for hunting and fishing;*
   g. *shift the balance towards providing greater public access to public lands over restrictions to access.*

2. ***Utilizing our natural resources***

    a. *ensure American Energy is available to meet our security and economic needs;*

Additional water from cloud seeding increases the fuel supply for IPC's hydropower system on the Snake, as well as the Federal Power System downstream of IPC's Hells Canyon Complex. The additional generation from hydropower keeps energy rates low for IPC's customers, customers benefiting from generation increases downstream from IPC's Hells Canyon Complex, and offsets the need to acquire generation from other resources. This project will allow better quantification of the benefits, as well as increase the sustainability of funding for the current, or an expanded program.

b. *ensure access to mineral resources, especially the critical and rare earth minerals needed for scientific, technological, or military applications;*
c. *refocus timber programs to embrace the entire 'healthy forests' lifecycle;*
d. *manage competition for grazing resources.*

3. ***Restoring trust with local communities***

a. *Be a better neighbor with those closest to our resources by improving dialogue and relationships with persons and entities bordering our lands;*

The improvements to WRF will allow presenting benefits of the cloud-seeding program by year, which will increase the ability to communicate benefits with stakeholders. Building confidence in the models and sharing more detailed results of benefits will at least maintain, and likely improve, relationships among stakeholders.

b. *Expand the lines of communication with Governors, state natural resource offices, Fish and Wildlife offices, water authorities, county commissioners, Tribes, and local communities.*

4. ***Striking a regulatory balance***

a. *Reduce the administrative and regulatory burden imposed on U.S. industry and the public;*

The additional water from cloud seeding allows for better utilization of the existing hydropower system on the Snake River, and the downstream Federal Power System on the Lower Snake and Columbia. The additional electricity resulting from cloud seeding defers the need to add generation resources.

The intent of cloud seeding in the ESPA-CAMP and State Water Plan is to increase water supplies, ultimately providing opportunities to address conjunctive use issues that resulted in formation of the CAMP.

b. *Ensure that Endangered Species Act decisions are based on strong science and thorough analysis.*

5. Modernizing our infrastructure

a. support the White House Public/Private Partnership Initiative to modernize U.S. infrastructure;
b. remove impediments to infrastructure development and facilitate private sector efforts to construct infrastructure projects serving American needs;
c. prioritize DOI infrastructure needs to highlight:

1. construction of infrastructure, 2. cyclical maintenance, and
3. deferred maintenance.

Does not apply

Project Budget

Funding Plan and Letters of Funding Commitment

Describe how the non-Federal share of project costs will be obtained. Reclamation will use this information in making a determination of financial capability.

Project funding provided by a source other than the applicant shall be supported with letters of funding commitment from these additional sources. Letters of funding commitment shall identify the following elements:

- *The amount of funding commitment*
- *The date the funds will be available to the applicant.*
- *Any time constraints on the availability of funds*
- *Any other contingencies associated with the funding commitment*

  Commitment letters from third party funding sources should be submitted with your application. If commitment letters are not available at the time of the application submission, please provide a timeline for submission of all commitment letters. Cost share funding from sources outside the applicant's organization (e.g., loans or State grants), should be secured and available to the applicant prior to award.

  Reclamation will not make funds available for an award under this FOA until the recipient has secured non-Federal cost share. Reclamation will execute a financial assistance agreement once non-Federal funding has been secured or Reclamation determines that there is sufficient evidence and likelihood that non-Federal funds will be available to the applicant subsequent to executing the agreement.

  Please identify the sources of the non-Federal cost share contribution for the project, including:

- *Any monetary contributions by the applicant towards the cost share requirement and source of funds (e.g., reserve account, tax revenue, and/or assessments).*

IPC and IWRB will contribute $922,966 in monetary contributions. This covers the total project costs ($1,357,966), including all costs to NCAR, minus the Federal portion ($300,000) and in-kind support for computing ($135,000). IPC's funding is an operating expense, and funding from the IWRB is part of their budget appropriated by the legislature.

- *Any costs that will be contributed by the applicant.*

IPC costs are $646,127, which account for personnel time to manage the project, and in-kind and other computing costs. These costs will be paid by IPC.

- *Any third-party in-kind costs (i.e., goods and services provided by a third* *party).*

None.

- *Any cash requested or received from other non-Federal entities.*

IWRB will contribute $411,839 as part of this collaborative effort.

- *Any pending funding requests (i.e., grants or loans) that have not yet been approved and explain how the project will be affected if such funding is denied.*

No known pending funding requests at the time of application.

Budget Proposal

The total project cost is the sum of all allowable items of costs, including all required cost sharing and voluntary committed cost sharing, including third-party contributions, that are necessary to complete the project.

Table 1. Total project cost table.

SOURCE	AMOUNT
Costs to be reimbursed with the requested Federal funding	$300,000
Costs to be paid by the applicant	$646,127
Value of third-party contributions	$411,839
TOTAL PROJECT COST	**$1,357,966**

The budget proposal should include detailed information on the categories listed below and must clearly identify **all** *items of cost, including those that will be contributed as non-Federal cost share by the applicant (required and voluntary), third-party in-kind contributions, and those that will be covered using the funding requested from Reclamation, and any requested pre-award costs. Unit costs must be provided for all budget items, including the cost of services or other work to be provided by consultants and contractors. Applicants are strongly encouraged to review the procurement standards for Federal awards found at 2 CFR §200.317 through §200.326 before developing their budget proposal. If you have any questions regarding your budget proposal or eligible costs, please contact the grants management specialist identified in Section G. Agency Contacts.*

It is also strongly advised that applicants use the budget proposal format shown below in Table 2 or a similar format that provides this information. If selected for award, successful applicants must submit detailed supporting documentation for all budgeted costs. It is not necessary to include separate columns indicating which cost is being contributed as non-Federal cost share or which costs will be reimbursed with Federal funds.

Table 2. Project costs for Task 1.

BUDGET ITEM DESCRIPTION	COMPUTATION $/Unit YR1, YR2	Quantity YR1, YR2	Quantity Type	TOTAL COST
Salaries and Wages				
Employee #1	67.61, 69.64	62, 31	Hours	$6,350.66
#2	54.09, 55.71	80, 40	Hours	$6,555.60
#3	54.09, 55.71	68, 34	Hours	$5,572.26
#4	54.09, 55.71	68, 34	Hours	$5,572.26
Total				$24,050.78
Fringe Benefits				
Full-time employees (21% salary)				$5,050.66
Part-time employees				$0.00
Equipment				
				$0.00
Supplies and Materials				
				$0.00
Contractual				
NCAR subaward				$487,513.00
Third-party in-kind contributions				
				$0.00
Other				
Travel				$18,004.50
Computer Services				$73,027.50
In-kind cost related to computing				$67,500
Total				$158,532.00
TOTAL DIRECT COSTS				$675,146.44
Indirect costs				
Type of rate	Percentage	$base		$
Full-time employees Salary	8%	$24,050.78		$1,924.06
TOTAL ESTIMATED PROJECT COSTS				$677,070.50

Table 3. Project costs for Task 2.

BUDGET ITEM DESCRIPTION	COMPUTATION		Quantity Type	TOTAL COST
	$/Unit YR2, YR3	Quantity YR2, YR3		
Salaries and Wages				
Employee #1	69.64, 71.67	31, 62	Hours	$6,602.38
#2	55.71, 57.34	40, 80	Hours	$6,815.60
#3	55.71, 57.34	34, 68	Hours	$5,793.26
#4	55.71, 57.34	34, 68	Hours	$5,793.26
Total				$25,004.50
Fringe Benefits				
Full-time employees (21% salary)				$5,250.95
Part-time employees				$0.00
Equipment				
				$0.00
Supplies and Materials				
				$0.00
Contractual				
NCAR subaward				$490,108.00
Third-party in-kind contributions				
				$0.00
Other				
Travel				$18,004.50
Computer Services				$73,027.50
In-kind cost related to computing				$67,500
Total				$158,532.00
TOTAL DIRECT COSTS				$678,895.45
Indirect costs				
Type of rate	Percentage	$base		$
Full-time employees Salary	8%	$25,004.50		$2,000.36
TOTAL ESTIMATED PROJECT COSTS				$680,895.81

Budget Narrative

Submission of a budget narrative is mandatory. An award will not be made to any applicant who fails to fully disclose this information. The budget narrative provides a discussion of, or explanation for, items included in the budget proposal. The types of information to describe in the narrative include, but are not limited to, those listed in the following subsections. Costs, including the valuation of third-party in-kind contributions, must comply with the applicable cost principles contained in 2 CFR Part §200, available at the Electronic Code of Federal Regulations (www.ecfr.gov).

Salaries and Wages

Indicate the project manager and other key personnel by name and title. The project manager must be an employee or board member of the applicant. Other personnel should be indicated by title alone. For all positions, indicate salaries and wages, estimated hours or percent of time, and rate of compensation. The labor rates must identify the direct labor rate separate from the fringe rate or fringe cost for each position. All labor estimates must be allocated to specific tasks as outlined in the applicant's technical project description. Labor rates and proposed hours shall be displayed for each task.

The budget proposal and narrative should include estimated hours for compliance with reporting requirements, including the final financial and performance reports. Please see Section F.3. Reporting Requirements and Distribution information on types and frequency of reports required.

Generally, salaries of administrative and/or clerical personnel will be included as a portion of the stated indirect costs. If these salaries can be adequately documented as direct costs, they should be included in this section; however, a justification should be included in the budget narrative.

Personnel: $49,055
Senior / Key Personnel ($49,055)
Meteorology and Cloud Seeding Leader, Dr. Shaun Parkinson, will serve as Project Manager and IPC Principal Investigator and will work approximately 4 hours per month of the project. Travel for meetings and conferences will add an additional 134 hours across the project. The time commitment by task will be approximately:

- Task 1: 62 hours in YR1, 31 hours in YR2
- Task 2: 31 hours in YR2, and 62 Hours in YR3

This time commitment is required to manage the project budget and staff, overseeing the completion of the project tasks, and to guide and participate in the project analysis.

Senior Atmospheric Scientist, Derek Blestrud, will serve as a Co-Principal Investigator and will work approximately 8 hours per month in each year on this project. Travel for meetings and conferences will add an additional 134 hours across the project. The time commitment by task will be approximately:

- Task 1: 80 hours in YR1, 40 hours in YR2
- Task 2: 40 hours in YR2, and 80 hours in YR3

This time commitment is required to guide and participate in the project analysis.

Senior Atmospheric Scientist, Mel Kunkel, will serve as a Co-Principal Investigator and will work approximately 5 hours per month in each year on this project. Travel for meetings and conferences will add an additional 134 hours across the project. The time commitment by task will be approximately:

- Task 1: 68 hours in YR1, 34 hours in YR2
- Task 2: 34 hours in YR2, and 68 hours in YR3

This time commitment is required to guide and participate in the project analysis.

Senior Atmospheric Scientist, Dr. Nick Dawson, will serve as a Co-Principal Investigator and will work approximately 5 hours per month in each year on this project. Travel for meetings and conferences will add an additional 134 hours across the project. The time commitment by task will be approximately:

- Task 1: 68 hours in YR1, 34 hours in YR2
- Task 2: 34 hours in YR2, and 68 hours in YR3

This time commitment is required to guide and participate in the project analysis.

An annual salary increase has been included for all personnel.

Other Personnel: N/A
No other IPC Personnel will be considered for this proposal.

Fringe Benefits

Identify the rates/amounts, what costs are included in this category, and the basis of the rate computations. Federally approved rate agreements are acceptable for compliance with this item.

Fringe Benefits: $10,302
The full-time employee fringe benefit of 21% includes non-work time of vacation and holidays. Worked hours are based 2080 work hours in a year.

Total Salaries, Wages and Fringe Benefits: $59,357

Travel

For each anticipated trip, identify the purpose of each anticipated trip, destination, number of persons traveling, length of stay, and all travel costs, including: airfare (basis for rate used), per diem, lodging, and miscellaneous travel expenses. For local travel, include mileage and rate of compensation.

Travel: $36,009

Domestic Travel: The budget is for domestic travel over the period of the project.
This includes:
One trip in each Year 1, 2 and 3 for four people for 4 days/3 nights to Boulder Co to attend semi-annual progress review meeting.
One trip in each Year 1, 2 and 3 for 2 people for 5 days/4 nights to the American Meteorological Society Annual Meeting.
One trip in each Year 1, 2 and 3 for 2 people for 5 days/4 nights to the American Geophysical Union Annual Meeting.

Duration	Purpose	# of Travelers	Aircraft	PerDiem	Car	Hotel	Conf Reg & Msic	Total Trip Cost
Year 1 - Travel 1	NCAR Semi Annual progress review meeting	4	$2,000	$800	$250	$1,800	$0	$4,850
Year 1 - Travel 2	American Meteorological Society Annual Meeting	2	$1,000	$500	$0	$1,200	$700	$3,400
Year 1 - Travel 3	American Geophysical Union Annual Meeting	2	$1,000	$500	$0	$1,200	$700	$3,400
Year 2 - Travel 1	NCAR Semi Annual progress review meeting	4	$2,060	$824	$258	$1,854	$0	$4,996
Year 2 - Travel 2	American Meteorological Society Annual Meeting	2	$1,030	$515	$0	$1,236	$721	$3,502
Year 2 - Travel 3	American Geophysical Union Annual Meeting	2	$1,030	$515	$0	$1,236	$721	$3,502
Year 3 - Travel 1	NCAR Semi Annual progress review meeting	4	$2,122	$849	$265	$1,910	$0	$5,145
Year 3 - Travel 2	American Meteorological Society Annual Meeting	2	$1,061	$530	$0	$1,273	$743	$3,607
Year 3 - Travel 3	American Geophysical Union Annual Meeting	2	$1,061	$530	$0	$1,273	$743	$3,607
Total								$36,009

All costs include airfare, lodging, car rental, IPC-approved per diem rates, and registration costs and are escalated by 3% per year. The basis is historic travel expenses associated with attending these meetings.

Equipment

If equipment will be purchased, itemize all equipment valued at or greater than $5,000. For each item, identify why it is needed for the completion of the project and how the equipment was priced. Note: if the value is less than $5,000, the item should be included under materials and supplies.

If equipment is being rented, specify the number of hours and the hourly rate. Local rental rates are only accepted for equipment actually being rented or leased.

The applicant is not requesting equipment.

Materials and Supplies

Itemize supplies by major category, unit price, quantity, and purpose, such as whether the items are needed for office use, research, etc. Identify how these costs were estimated (i.e., quotes, previous similar project, or other methodology).

The applicant is not requesting materials and supplies.

Contractual

Identify all work that will be accomplished by consultants or contractors, including a breakdown of all tasks to be completed, and a detailed budget estimate of time, rates, supplies, and materials that will be required for each task. For each proposed contract, identify the procurement method that will be used to select the consultant or contractor and the basis for selection. Please note that all procurement transactions with an anticipated aggregate value that exceed the Micro-Purchase Threshold (currently $10,000) must use a competitive procurement method (see 2 CFR §200.320 – Methods of procurement to be followed). Qualifications-based procurement methods (i.e., only the competitors' qualifications are valuated, and the most qualified competitor is selected) cannot be used for projects funded under this FOA. See 2 CFR §200.317 through

§200.326 for additional information regarding procurements, including required contract content. Note: A modification to an existing contract for services without first obtaining multiple quotes or proposals is considered a noncompetitive procurement, regardless of the method used to award the existing contract.

Subawards: $977,621
NCAR will function as a subaward to Idaho Power for this proposed project. Costs are provided in Appendix B.

Third-Party In-Kind Contributions

Identify all work that will be accomplished by third-party contributors, including a breakdown of all tasks to be completed, and a detailed budget estimate of time, rates, supplies, and materials that will be required for each task. Third-party in- kind contributions, including contracts, must comply with all applicable administrative and cost principles criteria, established in 2 CFR Part 200, available at www.ecfr.gov, and all other requirements of this FOA.

None.

Environmental and Regulatory Compliance Costs (as applicable to the project)

If the proposed project includes pilot activities, including monitoring, measurement, or other field work, the applicant must include a line item in the budget to cover environmental compliance costs. Note that pilot projects can incur relatively high environmental compliance costs (e.g., between $30,000 and $50,000 per project).

"Environmental compliance costs" refer to costs incurred by Reclamation and the recipient in complying with environmental regulations applicable to an award under this FOA, including costs associated with any required documentation of environmental compliance, analyses, permits, or approvals. Applicable Federal environmental laws could include National Environmental Policy Act (NEPA), Endangered Species Act (ESA), National Historic Preservation Act (NHPA), Clean Water Act (CWA), and other regulations depending on the project. Such costs may include, but are not limited to:

- *The cost incurred by Reclamation to determine the level of environmental compliance required for the project*
- *The cost incurred by Reclamation, the recipient, or a consultant to prepare any necessary environmental compliance documents or reports*
- *The cost incurred by Reclamation to review any environmental compliance documents prepared by a consultant*
- *The cost incurred by the recipient in acquiring any required approvals or permits, or in implementing any required mitigation measures*

  In order to estimate environmental compliance costs, please contact compliance staff at your local Reclamation Office for additional details regarding the type and costs of compliance that may be required for your project. Note, support for your compliance *costs estimate will be considered during review of your application. Contact the Program Coordinator (see Section G. Agency Contacts) for Reclamation contact information regarding compliance costs and requirements.*

These are not applicable to this project. It is a computer modeling project only.

Other Expenses

Any other expenses not included in the above categories shall be listed in this category, along with a description of the item and why it is necessary. No profit or fee will be allowed.

Other Direct Costs: $281,055

Publication Costs: None

Consultant Services: None

Computer Services: $146,055
Scientific, computing and networking support costs have been allocated to this project through contractual agreements with the University of Arizona and Boise State University.

Equipment or Facility Rental: None

Alterations and Renovations: None

Other Applicable Costs: $135,000
In-kind computing, IPC-BSU HPC system $135,000 (27,000,000 compute hours * $0.005 / hour)

Indirect Costs

Applicants with a federally approved indirect cost rate agreement may include indirect costs as part of the project budget. Show the agreed upon rate, cost base, and proposed amount for allowable indirect costs. It is not acceptable to simply incorporate indirect rates within other direct cost line items.

If the applicant has never received a Federal negotiated indirect cost rate, the budget may include a de minimis rate of up to 10 percent of modified total direct costs. For further information on modified total direct costs, refer to 2 CFR §200.68 available at www.ecfr.gov.

If the applicant does not have a federally approved indirect cost rate agreement and is proposing a rate greater than the de minimis 10 percent rate, include the computational basis for the indirect expense pool and corresponding allocation base for each rate. Information on "Preparing and Submitting Indirect Cost Proposals" is available from the Department's Interior Business Center, Office of Indirect Cost Services, at www.doi.gov/ibc/services/finance/indirect-cost- services.

If selected for award, the applicant will be required to submit an indirect cost rate proposal with their cognitive within 3 months of award. Reimbursement of indirect costs will not be allowable until the recipient enters into the indirect cost rate agreement.

Indirect Costs: $3,924
Indirect Costs rate is set at 8% of salary

<u>IPC and IWRB Standard Information:</u>
1) IPC's budgets are proposed and approved on an annual basis with a fiscal year of 1 January through 31 December.

2) IWRB's budgets are proposed and approved on an annual basis with fiscal year of 1 July to 30 June.

Environmental and Cultural Resources Compliance

Please answer the questions from Section H.1. Environmental and Cultural Resource Considerations in this section.

- *Will the proposed project impact the surrounding environment (e.g., soil [dust], air, water [quality and quantity], animal habitat)? Please briefly describe all earth-disturbing work and any work that will affect the air, water, or animal habitat in the project area. Please also explain the impacts of such work on the surrounding environment and any steps that could be taken to minimize the impacts.*

This project is a computer modeling project and will not impact the surrounding environment.

- *Are you aware of any species listed or proposed to be listed as a Federal threatened or endangered species, or designated critical habitat in the project area? If so, would they be affected by any activities associated with the proposed project?*

This question is not applicable because this is a computer modeling project.

- *Are there wetlands or other surface waters inside the project boundaries that potentially fall under CWA jurisdiction as "Waters of the United States?" If so, please describe and estimate any impacts the proposed project may have.*

This question is not applicable because this is a computer modeling project.

- *When was the water delivery system constructed?*

This question is not applicable because this is a computer modeling project.

- *Will the proposed project result in any modification of or effects to, individual features of an irrigation system (e.g., headgates, canals, or flumes)? If so, state when those features were constructed and describe the nature and timing of any extensive alterations or modifications to those features completed previously.*

This question is not applicable because this is a computer modeling project.

- *Are any buildings, structures, or features in the irrigation district listed or eligible for listing on the National Register of Historic Places? A cultural resources specialist at your local Reclamation office or the State Historic Preservation Office can assist in answering this question.*

This question is not applicable because this is a computer modeling project.

- *Are there any known archeological sites in the proposed project area?*

This question is not applicable because this is a computer modeling project.

- *Will the proposed project have a disproportionately high and adverse effect on low income or minority populations?*

This is a computer modeling project, and will not have an adverse effect on any populations.

- *Will the proposed project limit access to and ceremonial use of Indian sacred sites or result in other impacts on tribal lands?*

This is a computer modeling project, and will not limit access to any lands.

- *Will the proposed project contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area?*

This question is not applicable, because this is a computer modeling project.

Required Permits or Approvals

Applicants must state in the application whether any permits or approvals are required and explain the plan for obtaining such permits or approvals.

Note that improvements to Federal facilities that are implemented through any project awarded funding through this FOA must comply with additional requirements. The Federal government will continue to hold title to the Federal facility and any improvement that is integral to the existing operations of that facility. Please see P.L. 111-11, Section 9504(a)(3)(B). Reclamation may also require additional reviews and approvals prior to award to ensure that any necessary easements, land use authorizations, or special permits can be approved consistent with the requirements of 43 CFR Section 429, and that the development will not impact or impair project operations or efficiency.

There are no permits or approvals required, because this is a computer modeling project.

[redacted]

[redacted]

Unique Entity Identifier and System for Award Management

The applicant received internal approval to apply for this grant within two weeks of the application deadline, and is currently in the process of applying for SAM registration.

LIST OF ACRONYMS

C3 – Community Computing Center
CAMP – Comprehensive Aquifer Management Plan
ESA – Endangered Species Act
ESPA – Eastern Snake Plain Aquifer
HCRCD – High Country Resource Conservation and Development council
HPC – High-performance computing
HRRR – High-resolution Rapid Refresh model
IDWR – Idaho Department of Water Resources
INL – Idaho National Labs
IPC – Idaho Power Company
IWRB – Idaho Water Resource Board
NCAR – National Center for Atmospheric Research
NWS – National Weather Service
RAL – Research Applications Laboratory
SNOWIE – Seeded and Natural Orographic Wintertime clouds: the Idaho Experiment
USBR – U.S. Bureau of Reclamation
WRF – Weather Research and Forecasting model

REFERENCES

Department of the Interior, 2009: Endangered and threatened wildlife and plants; 12-month finding on a petition to remove the Bliss Rapids Snail (Taylorconcha serpenticola) from the list of endangered and threatened wildlife. *Federal Register*, Volume 74, Issue 178, pp. 47536-47545. Available at: https://www.govinfo.gov/app/details/FR-2009-09-16/E9-21949/summary

French, J.R., K. Friedrich, S.A. Tessendorf, R.M. Rauber, B. Geerts, R.M. Rasmussen, L. Xue, M.L. Kunkel, D.R. Blestrud, 2018: Precipitation formation from orographic cloud seeding. *Proc. Nat. Acad. Sci.*, January 22, 2018, https://doi.org/10.1073/pnas.1716995115

Garstang, M. and Coauthors, 2003: *Critical Issues in Weather Modification Research*. Natl. Acad. Press. Washington, DC., 123 pp.

Hildebrand, L.R., A.D. Schreier, K. Lepla, S.O. McAdam, J. McLellan, M.J. Parsley, V.L. Paragamian, and S.P. Young, 2016: Status of White Sturgeon (*Acipenser transmontanus* Richardson, 1863) throughout the species range, threats to survival, and prognosis for the future. *J. Applied Ichthyology*, doi:10.1111/jai.13243.

Idaho Department of Fish and Game, 2008: Management plan for the conservation of Snake River White Sturgeon in Idaho. Available at: https://idfg.idaho.gov/old-web/docs/fish/planSnakeWhiteSturgeon

Ikeda, K., R. Rasmussen, C. Liu, D. Gochis, D. Yates, F. Chen, M. Tewari, M. Barlage, J. Dudhia, W. Yu, K. Miller, K. Arsenault, V. Grubišić, G. Thompson, and E. Gutmann, 2010: Simulation of seasonal snowfall over Colorado. *Atmos. Res.*, 97,462-477.

IWRB, 2012: Idaho State Water Plan. Available from: https://idwr.idaho.gov/files/iwrb/2012/2012-State-Water-Plan.pdf

Kunkel, M., 2019: Modeling for cloud seeding operations and benefit estimation. *Presentation to the IWRB summarizing IPC internal research reports*, Available at: https://idwr.idaho.gov/files/iwrb/2019/20190726-IWRB-Board-Meeting-Materials-7-19.pdf (pp. 89-101).

Liu, C., and Coauthors, 2017: Continental-scale convection-permitting modeling of the current and future climate of North America. *Clim. Dyn.*, **23**, 91-105.

Rasmussen, R.M., C. Liu, K. Ikeda, D. Gochis, D. Yates, F. Chen, M. Tewari, M. Barlage, J. Dudhia, W. Yu, K. Miller, K. Arsenault, V. Grubišić, G. Thompson, and E. Gutmann, 2011: High-Resolution Coupled Climate Runoff Simulations of Seasonal Snowfall over Colorado: A Process Study of Current and Warmer Climate. *J. Climate*, **24**, 3015–3048.

Rasmussen, R.M., S.A. Tessendorf, L. Xue, C. Weeks, K. Ikeda, S. Landolt, D. Breed, T. Deshler, B. Lawrence, 2018: Evaluation of the Wyoming Weather Modification Pilot Project using two approaches: Traditional Statistics and Ensemble Modeling. *J. Appl. Meteor. Climatol.,* **57**, 2639–2660.

Reynolds, D.W., 2015: Literature Review and Scientific Synthesis on the Efficacy of Winter Orographic Cloud Seeding. Report to the U.S. Bureau of Reclamation. Available from https://www.usbr.gov/main/qoi/docs/Literature_Review_and_Scientific_Synthesis_of_the_Efficacy_of_Winter_Orographic_Cloud_Seeding_Peer_Review.pdf. Accessed December 9, 2017.

Schaefer, V. J., 1946: The production of ice crystals in a cloud of supercooled water droplets. *Science*, **104**, 457–459.

Tessendorf, S.A., and coauthors, 2019: Transformational approach to winter orographic weather modification research: The SNOWIE Project. Bull. Amer. Meteor. Soc., **100** (1), 71–92.
USBR, 2016: SECURE Water Act Section 9503(c) – Reclamation Climate Change and Water 2016. USBR report to Congress. Available at: https://www.usbr.gov/climate/secure/docs/2016secure/2016SECUREReport.pdf
Vonnegut, B., 1947: The nucleation of ice formation by silver iodide. *J. Appl. Phys.*, **18**, 593–595.
Xue, L., A. Hashimoto, M. Murakami, R. Rasmussen, S.A. Tessendorf, D. Breed, S. Parkinson, P. Holbrook, and D. Blestrud, 2013a: Implementation of a Silver Iodide Cloud Seeding Parameterization in WRF: Part 1: Model Description and Idealized 2D Sensitivity Tests. *J. Appl. Meteor. Climatol.*, **52**, 1433-1457.
Xue, L., S.A. Tessendorf, E. Nelson, R. Rasmussen, D. Breed, S. Parkinson, P. Holbrook, and D. Blestrud, 2013b: AgI cloud seeding effects as seen in WRF simulations. Part II: 3D real case simulations and sensitivity tests. *J. Appl. Meteor. Climatol.,* **52**, 1458-1476.
Xue, L., X. Chu, R. Rasmussen, D. Breed, B. Boe, and B. Geerts, 2014: The dispersion of silver iodide particles from ground-based generators over complex terrain, Part 2: WRF Large-Eddy Simulations vs. Observations. *J. Appl. Meteor. Climatol.*, **53**, 1342-1361.
Xue, L., R. Edwards, A. Huggins, X. Lou, R. Rasmussen, S. Tessendorf, P. Holbrook, D. Blestrud, M. Kunkel, B. Glenn, and S. Parkinson, 2017: WRF Large-Eddy simulations of chemical tracer deposition and seeding effect over complex terrain from ground- and aircraft-based AgI generators. *Atmos. Res,* **190**, 89-103.
Xue, L., Sarkadi, N., R.M. Rasmussen, S.A. Tessendorf, W.W. Grabowski, I. Geresdi, 2019: Separating microphysical impacts from dynamic feedbacks in a winter orographic seeding case from SNOWIE. 11th Symp. Aerosol-Cloud-Climate Interactions, Amer. Meteorol. Soc., Phoenix, AZ. https://ams.confex.com/ams/2019Annual/meetingapp.cgi/Paper/353419

APPENDIX B –

NCAR Budget

UCAR

UCAR Proposal Budget Detail - Task 1

Proposal #	2020-0078
Proposal Title:	Precipitation modeling tools to improve water supply reliability
UCAR Entity:	NCAR
Period of Performance:	05-01-2020 - 04-30-2023
Principal Investigator	Sarah Tessendorf

			Unit / Rate	Effort Year 1	Effort Year 2	Effort Year 3	Year 1 Idaho Power Company	Year 2 Idaho Power Company	Year 3 Idaho Power Company	Cumulative Grand Total
Salaries	Regular Salaries	Assoc Scientist II	Hours	440.00	200.00	0.00	16,381	7,744	0	24,125
		Systems Adr IV	Hours	20.00	10.00	0.00	1,340	697	0	2,037
		Proj Scientist II	Hours	700.00	300.00	0.00	38,017	16,944	0	54,961
		Sr Scient Sect Head	Hours	50.00	25.00	0.00	5,043	2,622	0	7,666
		Proj Scientist II	Hours	440.00	220.00	0.00	24,829	12,912	0	37,741
		Assoc Scientist IV	Hours	440.00	300.00	0.00	24,006	17,022	0	41,028
	Subtotal Salaries						109,616	57,941	0	167,557
Fringe Benefits		Regular Benefits @	54.50 %				59,740	31,577	0	91,317
	Subtotal Fringe Benefits						59,740	31,577	0	91,317
	Total Salaries and Benefits						169,356	89,518	0	258,874
Materials and Supplies		General Materials					500	500	0	1,000
		Computer Supplies & Peripherals					2,373	2,373	0	4,746
	Subtotal Materials and Supplies						2,873	2,873	0	5,746
Travel		Domestic - Collaboration meetings with IPC					4,214	4,513	0	8,727
		Domestic - Conference presentation of results					4,333	3,906	0	8,239
	Subtotal Travel						8,547	8,419	0	16,966
	Modified Total Direct Costs (MTDC)						180,776	100,810	0	281,586
Indirect Costs		NCAR Indirect Cost Rate (MTDC)	56.70 %				102,500	57,159		159,659
	Total Indirect Costs						102,500	57,159	0	159,659
MTDC Costs that Include Indirect Costs	EOL Facility Use	Other SUR	$0.00 / hr				0	0	0	0
	Computing Service Center	Computing Service Center	$7.33 / hr				15,320	7,733	0	23,053
	Subtotal MTDC Costs that Include Indirect Costs						15,320	7,733	0	23,053
	Total MTDC + Applied Indirect Costs						298,596	166,702	0	464,298

UCAR Proposal Budget Detail - Task 1

			Unit / Rate		Effort Year 1	Effort Year 2	Effort Year 3	Year 1 Idaho Power Company	Year 2 Idaho Power Company	Year 3 Idaho Power Company	Cumulative Grand Total
Management Fee		UCAR Management Fee	5 00 %					14,930	8,285	0	23,215
	Total Funding To UCAR							313,526	173,987	0	487,513

UCAR

UCAR Proposal Budget Detail - Task 2

Proposal #	2020-0078
Proposal Title:	Precipitation modeling tools to improve water supply reliability
UCAR Entity:	NCAR
Period of Performance:	05-01-2020 - 04-30-2023
Principal Investigator	Sarah Tessendorf

			Unit / Rate	Effort Year 1	Effort Year 2	Effort Year 3	Year 1 Idaho Power Company	Year 2 Idaho Power Company	Year 3 Idaho Power Company	Cumulative Grand Total
Salaries	Regular Salaries	Systems Adr IV	Hours	0.00	10.00	20.00	0	697	1,449	2,146
		Proj Scientist II	Hours	0.00	400.00	700.00	0	22,592	41,118	63,710
		Assoc Scientist IV	Hours	0.00	140.00	440.00	0	7,944	25,964	33,908
		Proj Scientist II	Hours	0.00	220.00	440.00	0	12,912	26,858	39,770
		Assoc Scientist II	Hours	0.00	240.00	440.00	0	9,293	17,719	27,012
		Sr Scient Sect Head	Hours	0.00	25.00	50.00	0	2,622	5,455	8,077
	Subtotal Salaries						0	56,060	118,563	174,623
Fringe Benefits		Regular Benefits @	54.50 %				0	30,553	64,617	95,170
	Subtotal Fringe Benefits						0	30,553	64,617	95,170
	Total Salaries and Benefits						0	86,613	183,180	269,793
Materials and Supplies		General Materials					0	0	500	500
		Computer Supplies & Peripherals					0	0	4,446	4,446
	Subtotal Materials and Supplies						0	0	4,946	4,946
Travel		Domestic - Collaboration meetings with IPC					0	0	4,694	4,694
		Domestic - Conference presentation of results					0	0	3,824	3,824
	Subtotal Travel						0	0	8,518	8,518
	Modified Total Direct Costs (MTDC)						0	86,613	196,644	283,257
Indirect Costs		NCAR Indirect Cost Rate (MTDC)	56.70 %					49,110	111,497	160,607
	Total Indirect Costs							49,110	111,497	160,607
MTDC Costs that Include Indirect Costs	EOL Facility Use	Other SUR	$0.00 / hr				0	0	0	0
	Computing Service Center	Computing Service Center	$7.33 / hr				0	7,586	15,320	22,906
	Subtotal MTDC Costs that Include Indirect Costs						0	7,586	15,320	22,906
	Total MTDC + Applied Indirect Costs						0	143,309	323,461	466,770

UCAR Proposal Budget Detail - Task 2

			Unit / Rate		Effort Year 1	Effort Year 2	Effort Year 3	Year 1 Idaho Power Company	Year 2 Idaho Power Company	Year 3 Idaho Power Company	Cumulative Grand Total
Management Fee		UCAR Management Fee	5.00 %					0	7,165	16,173	23,338
	Total Funding To UCAR							0	150,474	339,634	490,108

A. Personnel: $342,180
Senior / Key Personnel ($211,924)
A Project Scientist II, Dr. Sarah Tessendorf, will serve as the Principal Investigator and will work approximately 2.54 months in each year on this project. The time commitment by task will be approximately:

- Task 1: 2.54 months in YR1, 1.27 months in YR2
- Task 2: 1.27 months in YR2, and 2.54 months in YR3

This time commitment is required to manage the project budget and staff, overseeing the completion of the project tasks, and to guide and participate in the project analysis.

A Senior Scientist Section Head, Dr. Roy Rasmussen, will serve as the Co-Principal Investigator and will work approximately 0.29 months in each year on this project. The time commitment by task will be approximately:

- Task 1: 0.29 months in YR1, 0.14 months in YR2
- Task 2: 0.14 months in YR2, and 0.29 months in YR3

This time commitment is required to provide high-level project guidance and expertise.

A Project Scientist II, Dr. Lulin Xue, will serve as the Co-Investigator and will work approximately 4.04 months in each year on this project. The time commitment by task will be approximately:

- Task 1: 4.04 months in YR1, 1.73 months in YR2
- Task 2: 2.31 months in YR2, and 4.04 months in YR3

This time commitment is required to to conduct model simulations and analysis, including pre-processing requisite initialization data and designing model configuration/set up, executing the model simulations, verifying completion of all model simulations, and conducting analysis of model output.

B. Other Personnel: ($130,256)
An Associate Scientist IV, Kyoko Ikeda, will work approximately 2.54 months in each year on this project. The time commitment by task will be approximately:

- Task 1: 2.54 months in YR1, 1.73 months in YR2
- Task 2: 0.81 months in YR2, and 2.54 months in YR3

This time commitment is required to conduct detailed analysis of SNOWIE aircraft, radar, and ground-based sensor data for cases under investigation in this project, as well as to conduct snow gauge data quality control and analysis for comparison with the ensemble model simulation.

An Associate Scientist II, Courtney Weeks Karkkainen, will work approximately 2.54 months in each year of the project. The time commitment by task will be approximately:

- Task 1: 2.54 months in YR1, 1.15 months in YR2

- Task 2: 1.38 months in YR2, and 2.54 months in YR3

This time commitment is required to conduct analysis of SNOWIE data for cases under investigation in this project for comparison with the model output, as well as to assist Dr. Xue with model output analysis.

A Systems Administrator IV, Hans Mohling, will work approximately 0.12 months in each year on this project. The time commitment by task will be approximately:

- Task 1: 0.12 months in YR1, 0.06 months in YR2
- Task 2: 0.06 months in YR2, and 0.12 months in YR3

This time commitment is required to maintain local computers used by NCAR staff to conduct the project tasks.

An annual salary increase has been included for all personnel.

Fringe Benefits: $186,487

The full time employee fringe benefit of 54.5% includes non-work time of vacation, sick leave, holidays and other paid leave, as well as standard staff benefits. Worked hours are based on 86% of 2080 hours in a year.

Total Salaries, Wages and Fringe Benefits: $528,667

C. Equipment: None

D. Travel: $25,484

Domestic Travel: The budget is for domestic travel over the period of the project.
This includes:
One trip in Year 1 for two people for 5 days/4 nights to New Orleans, LA to attend the AMS conference.
One trip in Year 1 for 3 people for 3 days/3 nights to Boise, ID to meet with the sponsor.
One trip in Year 2 for two people for 5 days/4 nights to Houston, TX to attend the AMS conference.
One trip in Year 2 for 3 people for 3 days/3 nights to Boise, ID to meet with the sponsor.
One trip in Year 3 for two people for 5 days/4 nights to Denver, CO to attend the AMS conference.
One trip in Year 3 for 3 people for 3 days/3 nights to Boise, ID to meet with the sponsor.

PROPOSAL NUMBER:	2020-0078- USBR Watersmart- Tessendorf							
PI: Sarah Tessendorf								
Destination	**Purpose**	**# of Travelers**	**Airfare**	**Per Diem**	**Car**	**Hotel**	**Conf. Reg & Misc**	**Total Trip Cost**
Year 1 - Travel 1								
New Orleans, LA	AMS Annual Meeting	2	$790	$639	$0	$1,507	$1,396	**$4,333**
Year 1 - Travel 2								
Boise, ID	Idaho Power meeting	3	$1,560	$746	$284	$1,480	$144	**$4,214**
Total for Yr 1 Travel								**$8,546**
Year 2 - Travel 1								
Houston, TX	AMS annual conference	2	$634	$571	$0	$1,248	$1,452	**$3,906**
Year 2 - Travel 2								
Boise, ID	Idaho Power meeting	3	$1,597	$775	$295	$1,539	$306	**$4,513**
Total for Yr 2 Travel								**$8,419**
Year 3 - Travel 1								
Denver, CO	AMS annual meeting	2	$0	$740	$0	$1,682	$1,402	**$3,825**
Year 3 - Travel 2								
Boise, ID	Idaho Power meeting	3	$1,661	$806	$307	$1,600	$318	**$4,695**
Total for Yr 3 Travel								**$8,520**
Total All Years								**$25,484**

All costs (based on NCAR travel rates) include airfare, lodging, car rental, IRS-approved per diem rates, and registration costs and are escalated by 4% per year.

E. Participant Support Costs: None

F. Other Direct Costs:

Materials and Supplies: $10,692

- Task 1: Budget in YR1 for 1 Surface Laptop equivalent for $1,899 and other miscellaneous computer items such as a mouse, keyboard, cords, etc.
- Task 1: Budget in YR2 for 1 Surface Laptop equivalent for $1,899 and other miscellaneous computer items such as a mouse, keyboard, cords, etc.
- Task 2: Budget for 2 Surface Laptop equivalents for $1,899 each and for external hard drives to back up data.
- Task 1: Budget $500 for YR1 and YR2 for miscellaneous expenses related to communication/conference fees, office supplies and other general expenses.
- Task 2: Budget $500 for YR1 and YR2 for miscellaneous expenses related to communication/conference fees, office supplies and other general expenses.

Publication Costs: None

Consultant Services: None

Computer Services (CSC): $45,959

Scientific, computing and networking support costs have been allocated to this project through the Computer Service Center (CSC), in accordance with OMB circulars and NCAR management policy. The NCAR CSC rate for FY2019 is $7.33 per labor hour.

Subawards: None

Equipment or Facility Rental: None

Alterations and Renovations: None

Other Applicable Costs: None

H. Total Direct Costs: $610,802

I. Indirect Costs: $320,266
Indirect Costs are applied to all modified total direct costs (MTDC). Excluded from MTDC are items of equipment costing $5,000 or more, CSC costs, and individual subcontract amounts in excess of at least $25,000 per fiscal year. Cognizant Agency: National Science Foundation. Budgets include provisional rates, which are subject to review and approval of NSF. Out year rates are estimated based on current provisional rates and are subject to change.

The approved FY2019 rate for Indirect Costs is 56.7% and total amounts cover the period of the project.

J. Fixed Fee: $46,553
A 5% UCAR management fee has also been included. The UCAR management fee is a fixed fee, calculated as a percent of proposed MTDC and NCAR applied Indirect Costs.

K. Total Direct, Indirect, and Fixed Fee: $977,621

NCAR Standard Information:

1. The National Center for Atmospheric Research (NCAR) is operated by the University Corporation for Atmospheric Research (UCAR), DUNS# 078339587, under the sponsorship of the National Science Foundation (NSF). NSF, our cognizant audit agency, approves UCAR rates annually. Budgets include provisional rates, which are subject to review and approval of NSF. Out year rates are estimated based on current provisional rates and are subject to change.

2. The salary budget includes direct labor charges only for time worked. The employee benefit rate includes direct charges for non-work time of vacation, sick leave, holidays and other paid leave, as well as standard staff benefits. The casual benefit rate applies to casual employees who do not receive the full benefit package.

3. Indirect Costs are applied to all modified total direct costs (MTDC). Items excluded from MTDC are equipment costing $5,000 or more, participant costs, and individual subcontract amounts in excess of $25,000 per fiscal year.

4. The budget may include a charge for scientific computing and networking support in accordance with 2 CFR 200, OMB Uniform Guidance and NCAR management policy allocating the costs of scientific computing system infrastructure.

5. NSF Co-sponsorship is defined as the value of resources funded by NSF to NCAR through the UCAR cooperative agreement that contribute to the performance of research sponsored by another organization. NSF Co-sponsorship should not be viewed as cost sharing, as defined in 2 CFR 200, OMB Uniform Guidance, as it is borne by the Federal Government.

6. Non-NSF and NSF Grant research at NCAR is monitored by our sponsor, the National Science Foundation, in accordance with criteria and guidelines approved by NSF/Division of Atmospheric and Geospace Sciences (AGS).

7. For Federal Interagency Agreement Fund Transfers, NSF Administrative Cost recovery is applied at the current rate to total transfers. NSF will implement the agreement by awarding a Cooperative Support Agreement (CSA), or by amendment to an existing, applicable CSA issued to the University Corporation for Atmospheric Research under Cooperative Agreement (CA) No. 0753581, or any successor agreement.

As a condition of NSF's entering into an interagency agreement or funds transfer, other Federal agencies must agree to the following conditions:

- NSF will not itself be directly responsible for the provision of goods or services contemplated under NCAR's proposal to the other Federal agency.
- It is NCAR's responsibility to provide the necessary financial and technical reports to the sponsoring agency in accordance with the terms and conditions of the other agency's agreement.
- NSF assumes no liability for any costs above the funds obligated against this CSA.
- In accordance with NSF Policy, a portion of the incoming fund transfer will be set aside to recover costs that NSF incurs in the management, administration and oversight of the funded activities at a rate predetermined by NSF.
- All fund transfers will be accepted and work performed under the terms and conditions of this CA.

For funds provided by federal interagency agreement or fund transfer with NSF, the contact is Ms. Kristin Spencer, Grant and Agreement Specialist, Division of Acquisition and Cooperative Support, National

NCAR
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

OFFICE OF THE DIRECTOR

October 29, 2019

Mr. Shuan Parkinson
Idaho Power
Water Resources
1221 West Idaho St.
Boise, ID 83702

Dear Mr. Parkinson:

I am pleased to submit for your consideration NCAR proposals 2020-0078 and 2020-0087 entitled, "Precipitation modeling tools to improve water supply reliability." Dr. Sarah Tessendorf is NCAR's Principal Investigator on this project. The total Cost Reimburseable amount requested for NCAR is $977,619. NCAR is requesting $300,000 as a subawardee for Idaho Powers proposal to the Bureau of Reclamation and $677,619 directly from Idaho Power. Please note that UCAR/NCAR participation in this project is contingent upon mutually agreed upon terms and conditions.

This proposal is submitted with the understanding that NCAR will not provide any cost share towards this project. The full cost share will be borne by the lead organization.

Should Idaho Power choose to award the proposal, funds for NCAR (DUNS# 078339587) should be provided by direct agreement with the University Corporation for Atmospheric Research. Arrangements can be made with:

Ms. Amy Smith
Manager, UCAR Contracts
University Corporation for Atmospheric Research
3090 Center Green Drive
Boulder, CO 80301-2252
Telephone (303) 497-8872
Email: fedaward@ucar.edu

Please refer to the NCAR proposal number on all correspondence with UCAR.

Should you have questions regarding the proposal, please contact Dr. Tessendorf at (303) 497-2708 or, on administrative matters, contact the NCAR Budget and Planning Office, Ms. Martinez at (303) 497-1106.

Sincerely,

Andrea Martinez

Andrea Martinez
Contract Management Analyst
NCAR Budget and Planning

Enclosure

cc: NCAR B&P
M. Feng, RAL

NON-PROFIT ORGANIZATION
NEGOTIATED INDIRECT COST RATE AGREEMENT (NICRA)

EIN #: 84-0412668

NSF INS CODE: 4062600000

ORGANIZATION:
University Corporation for Atmospheric Research (UCAR)
P.O. Box 3000
Boulder, CO 80307-3000

DATE: March 25, 2019

FILING REF: The preceding agreement was dated October 10, 2018.

The rates approved in this agreement are for use on grants, contracts and other agreements with the Federal Government, subject to the conditions in Section II.

SECTION I: RATES

FY 2017 - FINAL

Description	Effective Period	Rate	Base
UCAR			
UCAR G&A	10/01/16 – 09/30/17	15.798%	(a)
UCAR Community Programs (UCP) G&A			
Onsite	10/01/16 – 09/30/17	33.504%	(b)
Offsite	10/01/16 – 09/30/17	23.017%	(b)
NCAR			
NCAR G&A			
Onsite	10/01/16 – 09/30/17	55.796%	(b)
Offsite/NWSC	10/01/16 – 09/30/17	41.837%	(b)
Fringe Benefits			
Full Benefits	10/01/16 – 09/30/17	53.294%	(c)
Reduced Benefits	10/01/16 – 09/30/17	9.326%	(c)

FY 2019 - PROVISIONAL

Description	Effective Period	Rate	Base
UCAR G&A	10/01/18 – 09/30/19	15.90%	(a)
UCAR Community Programs (UCP) G&A			
Onsite	10/01/18 – 09/30/19	34.50%	(b)
Offsite	10/01/18 – 09/30/19	24.50%	(b)
NCAR			
NCAR G&A			
Onsite	10/01/18 – 09/30/19	56.70%	(b)
Offsite	10/01/18 – 09/30/19	43.40%	(b)
Fringe Benefits			
Full Benefits	10/01/18 – 09/30/19	54.50%	(c)
Reduced Benefits	10/01/18 – 09/30/19	9.40%	(c)

Rate Application Bases

(a) Total direct costs of each entity, excluding equipment, participant support, Intergovernmental Personnel Assignments (IPAs), and subaward or subcontract costs in excess of $25,000 per year, plus entity G&A before UCAR G&A. The UCAR G&A rate is part of the National Center for Atmospheric Research (NCAR) and UCAR Community Program (UCP) rates and is generally not proposed separately on grant, contract, or cooperative agreement proposal budgets.

(b) Total direct costs, excluding equipment, participant support, Intergovernmental Personnel Assignments (IPAs), and subaward or subcontract costs in excess of $25,000 per year.

(c) Direct salaries and wages excluding paid absences. The Reduced Benefit rate is applicable to the salaries of student assistants, student visitors and other hourly staff that work "on call." The Full Benefit rate is applicable to the salaries of "regular" employees.

Fringe Benefits: Fringe benefits consist of: Payroll Taxes, Group Life and Major Medical Insurances, Retirement Contributions (TIAA/CREF), Unemployment Insurance, Worker's Compensation, Disability Insurance, Severance, Educational Assistance, Travel Accident Insurance, Transportation Benefits (RTD Bus Passes), and Employee Wellness. Fringe Benefits also include the costs of Paid Time Off (holiday, vacation, sick leave and other "non-work" time).

SECTION II: GENERAL TERMS

A. LIMITATIONS: Use of the rates contained in this agreement is subject to any applicable contractual or grant limitations. Acceptance of these rates agreed to herein is predicated upon the conditions: (1) that no costs other than those incurred by the contractor or grantee were included in its indirect cost proposal and that such costs are legal obligations of the contractor or grantee, (2) that the same costs that have been treated as indirect costs have not been claimed as direct costs, and (3) that similar types of costs have been accorded consistent treatment.

B. AUDIT: All costs, direct and indirect, Federal and non-Federal are subject to audit. Adjustments to amounts resulting from audit of cost allocation plan or indirect rate proposal upon which the negotiation of this agreement was based will be compensated for in subsequent negotiation.

C. ACCOUNTING CHANGES: The rates contained in this agreement are based on the accounting system in effect at the time the proposal was prepared and the rates were negotiated. Changes to the method of accounting which effect the amount of reimbursement resulting from the use of these rates require the prior approval of this office. Failure to obtain such approval may result in subsequent cost disallowances.

D. RATE TYPES:

1. Provisional/Final Rate: Within six (6) months after fiscal year end, a final indirect cost rate proposal must be submitted based on actual costs. Billings and charges to federal grants and contracts must be adjusted if the final rate varies from the provisional rate. If the final rate is greater than the provisional rate and there are no funds to cover the additional indirect costs, the organization may not recover all indirect costs. Conversely, if the final rate is less than the provisional rate, the organization will be required to pay back the difference to the funding agency.

2. Predetermined Rate: Predetermined rates are applicable to a current or future period, and are based upon an estimate of the costs to be incurred during the period. A predetermined rate is not subject to adjustment.

E. NOTIFICATION TO FEDERAL AGENCIES: Copies of this document may be provided to other Federal offices as a means of notifying them of the rates agreed to herein.

ORGANIZATION:
University Corporation for Atmospheric Research (UCAR)

SECTION III: ACCEPTANCE

BY THE ORGANIZATION:

University Corporation for Atmospheric Research (UCAR)
(Organization)

Patricia A. Leslie
(Signature)

PATRICIA A. LESLIE
(Name)

Chief Financial Officer
(Title)

4-5-19
(Date)

ON BEHALF OF THE FEDERAL GOVERNMENT:

National Science Foundation
(Agency)

Meghan A. Benson
(Signature)

Meghan A. Benson
(Name)

Lead Analyst, Indirect Cost Rates
Cost-Analysis and Pre-Award Branch
(Title)

3/25/19
(Date)

NSF Negotiator: Christi Whittredge
Telephone: (703) 292-2540

NCAR
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

OFFICE OF THE DIRECTOR

March 26, 2018

Ms. Meghan Benson
Lead Analyst, Indirect Cost - Rate Negotiations
National Science Foundation
Division of Institution and Award Support
Attn: CAP Branch – Indirect Cost
2415 Eisenhower Avenue
Alexandria, VA 22314

Dear Ms. Benson,

Enclosed for review and approval are UCAR's proposed **FY 2019 Aircraft Maintenance Rates (AMR), Service Center Rates** (Computer Service Center (CSC) and Machine Shop) and **User Rates** (System User Rates (SUR) and Core Hour Rate).

Rates have either stayed the same as proposed in FY 2018, or had slight increases or decreases. As with previous rate submissions, the attached summary page has an approval line for the NCAR/Facilities Section Head signature. If you have any questions regarding the FY 2019 proposed rates, please call Rena Brasher-Alleva at (303) 497-1116 or by email at rena@ucar.edu.

Sincerely,

Rena B Al

Rena Brasher-Alleva
NCAR Budget & Planning Director

cc: L. Avallone, S. Ahmed, S. Ruth, K. Spencer; NSF
UCAR President's Council
Center Administrators
G. Cheeseman, R. Lovell, G. Taberski, J. Young

National Center for Atmospheric Research
Boulder, Colorado
FY 2019 Proposed Rate Summary

1. Aircraft Maintenance Rate

Aircraft Maintenance Rate (AMR)	FY 2017 Actual	FY 2018 Submitted	FY 2019 Proposed
C-130 Aircraft	$22 /Hour	$564 /Hour	$575 /Hour
GV Aircraft (Gulfstream HIAPER)	$6,303 /Hour	$1,412 /Hour	$1,568 /Hour

2. Service Center Rates

Computing Service Centers	FY 2017 Actual	FY 2018 Submitted	FY 2019 Proposed
Climate and Global Dynamics (CGD)	$6.44 /Hour	$6.65 /Hour	$6.85 /Hour
Atmospheric Chemistry Observations & Modeling (ACOM)	$7.66 /Hour	$7.00 /Hour	$7.25 /Hour
High Altitude Observatory (HAO)	$7.38 /Hour	$7.21 /Hour	$8.24 /Hour
Mesoscale & Microscale Meteorology (MMM)	$6.57 /Hour	$6.70 /Hour	$6.70 /Hour
Research Applications Laboratory (RAL)	$7.32 /Hour	$7.33 /Hour	$7.33 /Hour
Machine Shop			
Machine Shop Rate	$80 /Hour	$83 /Hour	$83 /Hour

3. System User Rates

Earth Observing Laboratory (EOL)	FY 2017 Actual	FY 2018 Submitted	FY 2019 Proposed
Systems User Rates (SUR)			
ISFS	$706 /Day	$557 /Day	$557 /Day
ISS	$608 /Day	$608 /Day	$608 /Day
Dropsonde Data System	$1,233 /Day	$1,673 /Day	$1,673 /Day
ELDORA	$0 /Day	$2,135 /Day	$2,135 /Day
S-Pol Radar	$6,308 /Day	$9,132 /Day	$9,132 /Day
HCR	$3,344 /Day	$5,313 /Day	$5,313 /Day
HAIS	$750 /Day	$599 /Day	$599 /Day
C-130 Aircraft	$11,289 /Day	$11,738 /Day	$11,738 /Day
Gulfstream Aircraft (HIAPER)	$16,002 /Day	$10,759 /Day	$10,759 /Day
Mechanical Design	$1,364 /Day	$923 /Day	$923 /Day
Machine Shop	$233 /Day	$106 /Day	$106 /Day

Comp. & Information Systems Lab (CISL)	FY 2017 Actual	FY 2018 Submitted	FY 2019 Proposed
Rate Per Core Hour	$0.0039 /Hour	$0.0049 /Hour	$0.0049 /Hour
Rate per 100 Core Hours	$0.39 /100 Hours	$0.49 /100 Hours	$0.49 /100 Hours

APPROVED:

Sarah L. Ruth, Ph.D.   Date
Section Head, NCAR and Facilities Section

University Corporation for Atmospheric Research
National Center for Atmospheric Research
FY 2019 Proposed Aircraft Maintenance Rates (AMR)

Aircraft Maintenance Rates (AMR)	**Actual FY 2017**	**Submitted FY 2018**	**Proposed FY 2019**
C-130 Aircraft			
Operating Expenses	$633	$112,726	$115,093
Number of Hours	29	200	200
C-130 AMR Rate/Hour	**$22**	**$564**	**$575**

C-130 Notes: (1) Actual aircraft flight hours are dependent on OFAP approved deployments and the deployment schedule. (2) AMR revenue and associated expenditures are not always realized in the same fiscal year.

GV Aircraft Maintenance Rate (AMR)	**Actual FY 2017**	**Submitted FY 2018**	**Proposed FY 2019**
Operating Expenses	$465,245	$303,580	$313,600
Number of Hours	74	215	200
GV Rate/Hour	**$6,303**	**$1,412**	**$1,568**

GV Notes: (1) Many of these hourly expenses have a lifecycle in excess of a year; therefore, yearly actual rates are not relevant. (2) Beginning in FY 2012, an engine service contract was initiated so that virtually all engine costs are covered, not just the hot-section and full overhaul. This accounts for the increase in this component and the overall rate. (3) The GV's component AMRs have been updated with the latest cost information from industry and incorporate EOL's growing experience with operating the aircraft.

University Corporation for Atmospheric Research
National Center for Atmospheric Research
FY 2019 Proposed Service Center Rates

Computing Service Centers (CSC)	Actual FY 2017	Submitted FY 2018	Proposed FY 2019
Climate & Global Dynamics			
Operating Expenses	$1,145,890	$1,291,303	$1,172,089
Worktime Hours	177,993	194,285	171,195
CGD CSC Rate/Hour	**$6.44**	**$6.65**	**$6.85**
Atmospheric Chemistry Observations & Modeling			
Operating Expenses	$794,696	$719,184	$702,025
Worktime Hours	103,761	102,690	96,815
ACOM CSC Rate/Hour	**$7.66**	**$7.00**	**$7.25**
High Altitude Observatory			
Operating Expenses	$652,435	$587,394	$665,472
Worktime Hours	88,405	81,469	80,780
HAO CSC Rate/Hour	**$7.38**	**$7.21**	**$8.24**
Mesoscale & Microscale Meteorology			
Operating Expenses	736,234	742,906	701,229
Worktime Hours	112,024	110,841	104,669
MMM CSC Rate/Hour	**$6.57**	**$6.70**	**$6.70**
Research Applications Laboratory			
Operating Expenses	$1,929,455	$2,036,974	$1,911,494
Worktime Hours	263,477	277,837	260,663
RAL CSC Rate/Hour	**$7.32**	**$7.33**	**$7.33**
Machine Shop			
Operating Expenses	$780,476	$793,595	$876,448
Number of Hours	9,812	9,520	10,523
Machine Shop Rate/Hour	**$80**	**$83**	**$83**

University Corporation for Atmospheric Research
National Center for Atmospheric Research
FY 2019 Proposed System User Rates

Earth Observing Laboratory (EOL)	Actual FY 2017	Submitted FY 2018	Proposed FY 2019
Systems User Rates (SUR)			
ISFS			
Operating Expenses	$1,651,008	$1,736,385	$1,736,385
Number of Systems	9	12	12
Number of Days[2]	260	260	260
ISFS Rate/Day[3]	**$706**	**$557**	**$557**
ISS/MISS/GAUS/MGAUS			
Operating Expenses	$1,264,990	$1,265,074	$1,265,074
Number of Systems	8	8	8
Number of Days[2]	260	260	260
ISS Rate/Day[3]	**$608**	**$608**	**$608**
ISS / GAU combined in FY 2007			
Dropsonde Data System			
Operating Expenses	$962,120	$1,305,001	$1,305,001
Number of Systems	3	3	3
Number of Days[2]	260	260	260
Dropsonde Data System Rate/Day[3]	**$1,233**	**$1,673**	**$1,673**
ELDORA[4]			
Operating Expenses	$0	$555,001	$555,001
Number of Systems	1	1	1
Number of Days[2]	260	260	260
ELDORA Rate/Day[3]	**$0**	**$2,135**	**$2,135**
S-Pol Radar[1]			
Operating Expenses	$1,639,963	$2,374,284	$2,374,284
Number of Systems	1	1	1
Number of Days[2]	260	260	260
S-Pol Rate/Day[3]	**$6,308**	**$9,132**	**$9,132**
HIAPER Cloud Radar (HCR)			
Operating Expenses	$869,474	$1,381,322	$1,381,322
Number of Systems	1	1	1
Number of Days[2]	260	260	260
HCR Rate/Day[3]	**$3,344**	**$5,313**	**$5,313**
HIAPER Aircraft Solicitation Instrumentation (HAIS)			
Operating Expenses	$2,729,410	$2,178,928	$2,178,928
Number of Systems	14	14.0	14.0
Number of Days[2]	260	260	260
HAIS Rate/Day[3]	**$750**	**$599**	**$599**
C-130 Aircraft			
Operating Expenses	$2,935,266	$3,051,858	$3,051,858
Number of Days[2]	260	260	260
C-130 Aircraft Rate/Day[3]	**$11,289**	**$11,738**	**$11,738**
GV (HIAPER) Gulfstream Aircraft			
Operating Expenses	$4,160,612	$2,797,322	$2,797,322
Number of Days[2]	260	260	260
GV Aircraft Rate/Day[3]	**$16,002**	**$10,759**	**$10,759**
Mechanical Design			
Operating Expenses	$627,876	$754,829	$754,829
Number of FTEs	1.8	2.6	2.6
Number of Days[2]	260	260	260
Mechanical Design Rate/Day[3]	**$1,364**	**$923**	**$923**
Machine Shop			
Operating Expenses	$322,816	$346,246	$346,246
Number of FTEs	5.3	5.9	5.9
Number of Days[2]	260	260	260
Machine Shop Rate/Day[3]	**$233**	**$106**	**$106**
This represents an add on user rate for non-NSF users, for recovery of base funded supervisory and support			

[1] Changes in S-Pol SURs primarily driven by fluctuations in OFAP approved yearly deployment and planned usage of the facility

[2] For all SUR rates, the number of working days in a year is 5 days per week for 52 weeks in a year, per NSF-AGS

[3] For all SUR rates, duration and complexity of field programs may affect the required size of the base funded field crew. Subject to NSF Program Official approval, the SUR can be adjusted to reflect lower or higher labor requirements.

[4] The ELDORA system is not currently available for deployment. The FY 2019 ELDORA rate will be used if ELDORA is made available to the community.

Comp. & Information Systems Laboratory (CISL)	Actual FY 2017	Submitted FY 2018	Proposed FY 2019[5]
Core Hours			
Operating Expenses	$ 18,274,222	$16,334,653	$16,334,653
Estimated Core Hours	4,660,000,000	3,300,000,000	3,300,000,000
CISL Core Hour Rate	$0.0039	$0.0049	$0.0049
CISL Core Hour Rate per 100 Core Hours	$0.39	$0.49	$0.49

[5] In FY18, the procurement NWSC-2 Cheyenne will be in production with 3,300,000,000 core hours available. In FY17 the core hours were more because it included NWSC-1 Yellowstone which was decomissioned by the end of CY2017. FY19 proposed budget will remain flat, no changes to the rate

APPENDIX C –

Eastern Snake Plain Aquifer (ESPA) Comprehensive Aquifer Management Plan (CAMP)

Eastern Snake Plain Aquifer (ESPA)

Comprehensive Aquifer Management Plan

ADOPTED BY Idaho Water Resource Board

JANUARY 2009

BEFORE THE IDAHO WATER RESOURCE BOARD

IN THE MATTER OF THE EASTERN SNAKE PLAIN AQUIFER COMPREHENSIVE AQUIFER MANAGEMENT PLAN	)))))	RESOLUTION

WHEREAS, the Idaho Water Resource Board (IWRB), pursuant to its planning authorities in Article XV, Section 7 of the Idaho Constitution, and Idaho Code 42-1734A, has completed a Comprehensive Aquifer Management Plan for the Eastern Snake Plain Aquifer as requested by Senate Concurrent Resolution 136 passed and approved by the 2006 Idaho Legislature; and

WHEREAS, the Board is directed to identify goals and objectives, as well as make recommendations for improving, managing, developing or conserving the water resources of the aquifer in the public interest; and

WHEREAS, the Board has sought and received substantial public participation and comment throughout the planning process.

NOW, THEREFORE, BE IT RESOLVED that the IWRB hereby adopts the attached Comprehensive Aquifer Management Plan and directs that it be submitted to the Idaho Legislature.

DATED this 29h day of January, 2008.

TERRY T. UHLING, Chairman
Idaho Water Resource Board

ATTEST
BOB GRAHAM, Secretary

Attachment 1 to Meeting 3-09
Date 1-29-09
Idaho Water Resource Board

TABLE OF CONTENTS

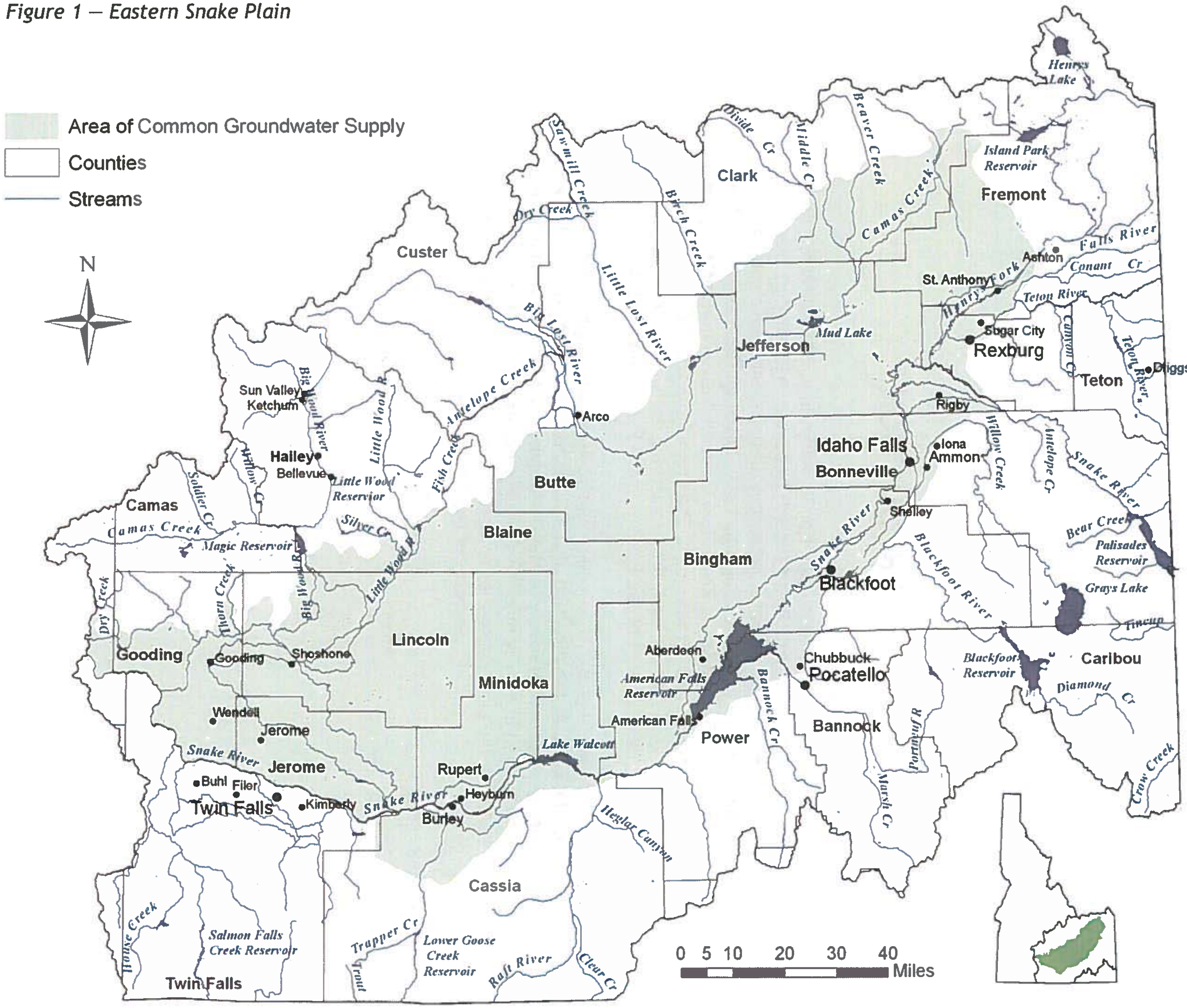
List of Tables & Figures

ACRONYMS & KEY TERMS

Table 1 — Acronyms & Key Terms

Committee	Eastern Snake Plain Aquifer Comprehensive Aquifer Management Plan Advisory Committee
BOR	United States Department of Interior Bureau of Reclamation
CAMP	Comprehensive Aquifer Management Plan
cfs	Cubic feet per second
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
ESPA	Eastern Snake River Plain Aquifer or Eastern Snake Plain Aquifer
EQIP	Environmental Quality Incentive Program
IDWR	Idaho Department of Water Resources (also abbreviated as "Department")
IWRB	Idaho Water Resource Board (also abbreviated as "Board")
kaf	Thousand acre-feet
M&E	Monitoring and Evaluation
Plan	Eastern Snake Plain Comprehensive Aquifer Management Plan
TEMP	Temperature Enhancement Management Program

Figure 1 – Eastern Snake Plain



INTRODUCTION

House Concurrent Resolution No. 28, adopted in 2007, directed the Idaho Water Resource Board (Board) to pursue, with support from the Idaho Department of Water Resources (Department), development of a comprehensive aquifer management plan based on the recommendations made in the Eastern Snake River Plain Comprehensive Aquifer Management Plan Framework (Framework). The Framework was adopted by the Board in 2006 and set forth the overarching goals and objectives for the management of the Eastern Snake Plain Aquifer (ESPA).

This document presents a Comprehensive Aquifer Management Plan (Plan) for the ESPA. At the direction of the Governor and the Board, the Plan was developed collaboratively by the ESPA Advisory Committee (Committee). This Plan in no way modifies or diminishes existing state water law, including the prior appropriation doctrine, or the power and duties of the Director of the Department.

1.0 EXECUTIVE SUMMARY

The ESPA region produces approximately 21 percent of all goods and services within the State of Idaho resulting in an estimated value of $10 billion annually. Water is the critical element for this productivity.

The Plan establishes a long-term program for managing water supply and demand in the ESPA through a phased approach to implementation, together with an adaptive management process to allow for adjustments or changes in management techniques as implementation proceeds. Due to the inherent complexities in the management and responses of the river and aquifer to water budget changes, a very deliberate choice was made to incrementally implement the various mechanisms proposed in this Plan. The long-term objective of the Plan is to incrementally achieve a net ESPA water budget change of 600 thousand acre-feet (kaf) annually. It is projected that this hydrologic goal can be achieved by the year 2030 through implementation of a mix of management actions including, but not limited to, aquifer recharge, ground-to-surface water conversions, and demand reduction strategies. The Plan sets forth actions which stabilize and improve spring flows, aquifer levels, and river flows across the Eastern Snake Plain.

The goal of the Plan is to:
"Sustain the economic viability and social and environmental health of the Eastern Snake Plain by adaptively managing a balance between water use and supplies."

The objectives of the Plan are to:

1. Increase predictability for water users by managing for a reliable supply.
2. Create alternatives to administrative curtailment.
3. Manage overall demand for water within the Eastern Snake Plain.
4. Increase recharge to the aquifer.
5. Reduce withdrawals from the aquifer.

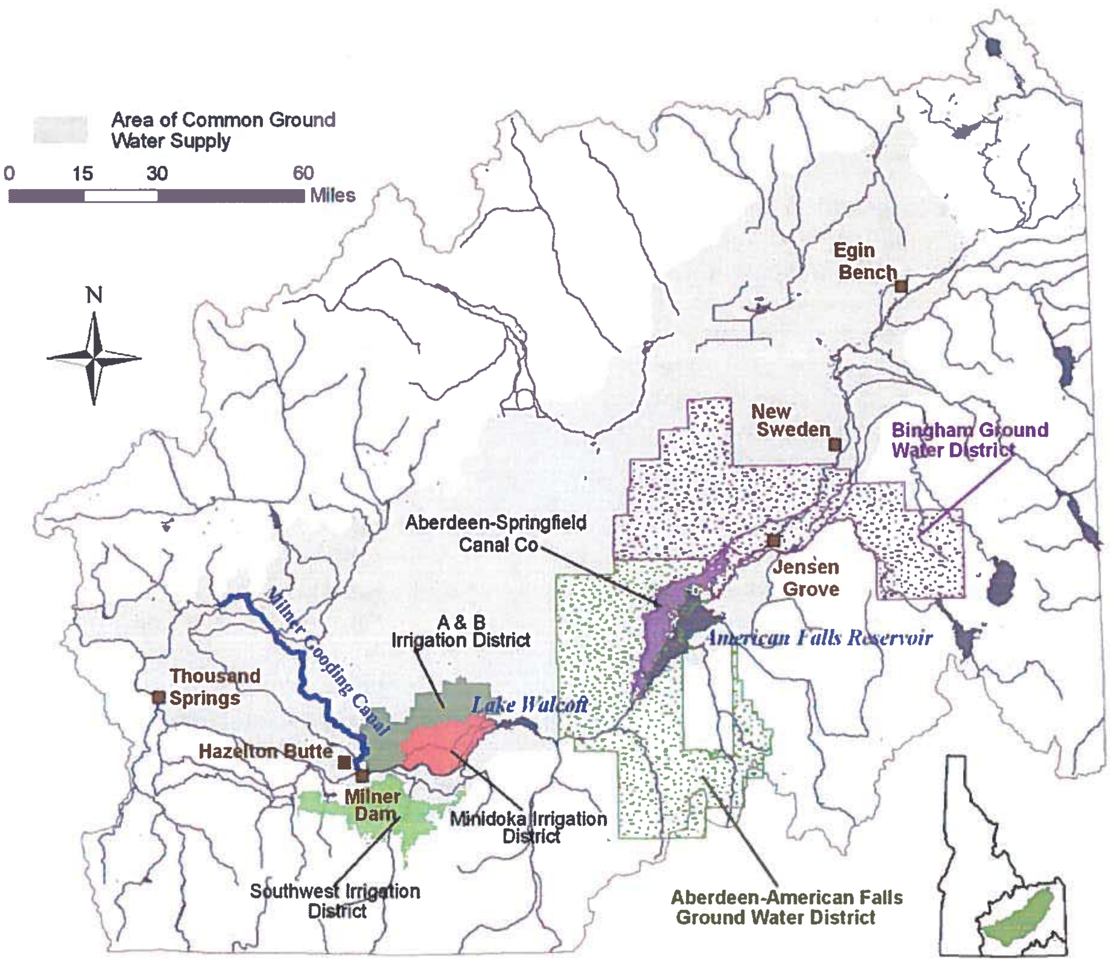
Immediate implementation of the Plan is necessary to achieve the stated goal and objectives.

The Plan approaches the 600 kaf target in phases. The Plan Phase I (1-10 years) hydrologic target is a water budget change between 200 kaf and 300 kaf. Phase I includes site-specific implementation actions based on the anticipated hydrologic effect of those actions, as outlined in Section 3.2.1. The water budget adjustment mechanisms include:

A. Ground water to surface water conversions.
B. Managed aquifer recharge.
C. Demand reduction, including:
    1. Surface water conservation.
    2. Crop mix modification in the Aberdeen/Bingham groundwater district.
    3. Buyouts, buy-downs, and/or subordination agreements.
    4. Rotating fallowing, dry-year lease agreements, and Conservation Reserve Enhancement Program (CREP) enhancements.
D. Pilot weather modification program.
E. Minimizing loss of incidental recharge.

To ensure that the valuable input of stakeholders continues during the implementation of Phase I and the design and implementation of subsequent phases, this Plan establishes an Implementation Committee. This committee will provide recommendations to the Board concerning Phase I implementation, assessment of Phase I effectiveness, definition of subsequent phases, and coordination of activities necessary for implementation. This committee will also evaluate the effectiveness and viability of continuing Plan implementation during Phase I. The Implementation Committee will include representation, at a minimum, from all interest groups currently represented on the ESPA Advisory Committee.

Figure 2 — Eastern Snake Plain Aquifer Region Key Locations



Although the Plan is built upon a substantial base of technical information and knowledge, it is recognized that present-day solutions may be refined and improved as new information and technologies are developed. Accordingly, the Plan includes an adaptive management component which requires ongoing coordination between the Board's staff and the Implementation Committee. The Plan provides for continued effort to identify and address all water use needs affected by this Plan, including the integration of environmental considerations in decision making.

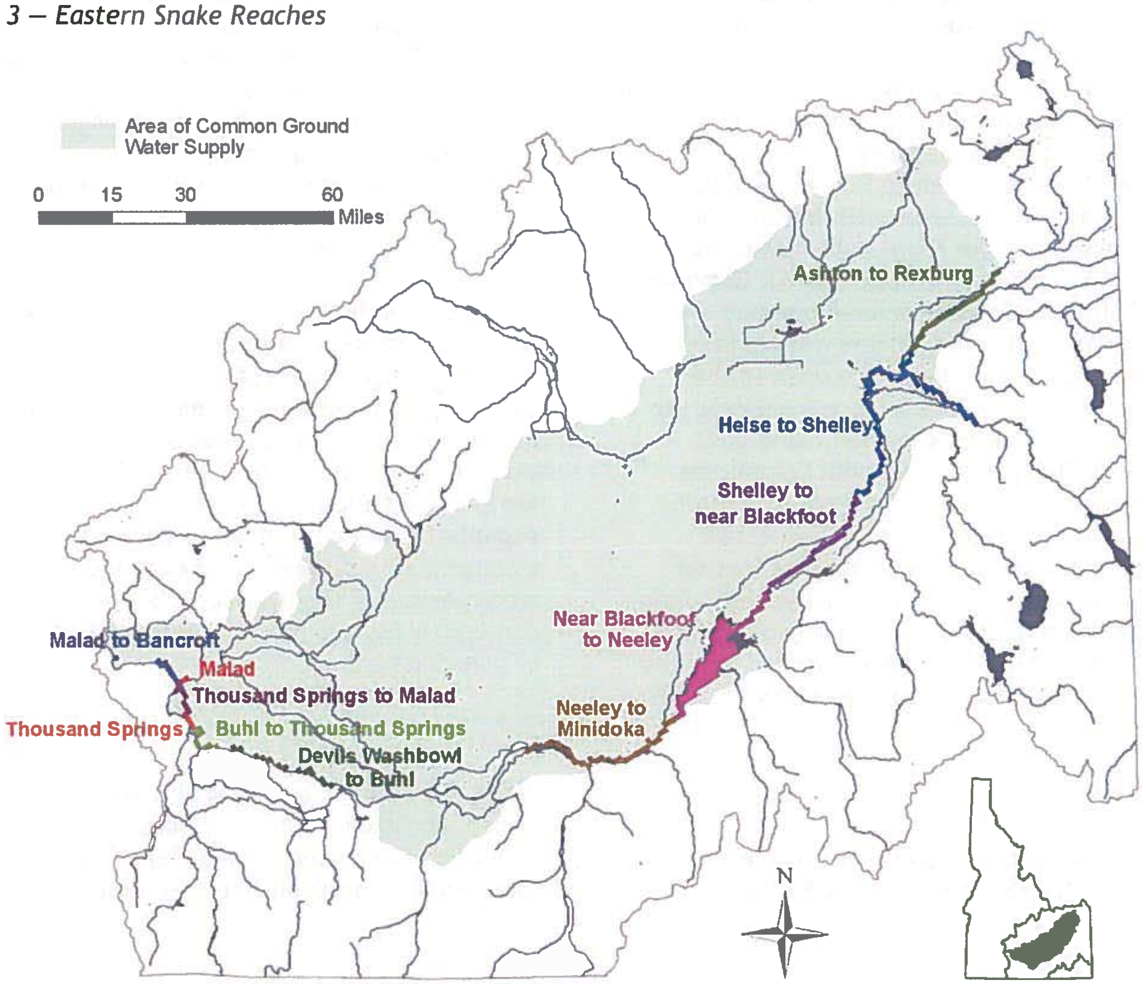
Full implementation of Phase I (10 years) is estimated to cost between $70 million - $100 million, or an estimated cost of $7 - $10 million annually. Subsequent phases and funding needs will be recommended by the Implementation Committee to the Board. Implementation funding will come from ESPA water users, state, federal, and private sources. This Plan is not designed to provide mitigation credit for any individual group, although it is expected that Plan implementation should reduce the demand for administrative solutions.

2.0 BACKGROUND

In response to declining aquifer levels and spring discharges and changing Snake River flows that resulted in insufficient water supplies to satisfy existing beneficial uses, the Idaho Legislature passed Idaho Senate Concurrent Resolution No. 136 in April 2006, and requested that the Board prepare and submit a comprehensive aquifer management plan for the ESPA. From the beginning, plan development took place in a public forum. After a series of public meetings with stakeholders, the Board presented the ESPA Plan Framework (Framework) to the Legislature on February 14, 2007.

The Framework recognized that supply of, and demands for, water are out of balance in the Eastern Snake River Plain and the connected Snake River, making more deliberate and coordinated management of surface waters of the Snake River and the underground waters of the ESPA a necessity. The Framework sets forth the overarching goal and objectives adopted by the Board for the management of the ESPA.

Figure 3 — Eastern Snake Reaches



As stated in the Framework, the goal of the Plan is to:
"Sustain the economic viability and social and environmental health of the Eastern Snake Plain by adaptively managing a balance between water use and supplies."

The objectives of the Plan are to:

1. Increase predictability for water users by managing for a reliable supply.
2. Create alternatives to administrative curtailment.
3. Manage overall demand for water within the Eastern Snake Plain.
4. Increase recharge to the aquifer.
5. Reduce withdrawals from the aquifer.

The Framework outlined a process for development of the Plan that called for an advisory committee to prepare and recommend a plan to the Board. To that end, and pursuant to House Bill 320, the Board, in collaboration with the Governor, appointed stakeholder representatives to the ESPA Advisory Committee (see **Appendix A**). Beginning in May 2007, the Committee held monthly meetings. To ensure the process was transparent and inclusive, all meetings were open to the public and all related materials were posted on the ESPA website (www.espaplan.idaho.gov). In February 2008, the Board, with Committee recommendations, provided a Progress Report to the Natural Resources Interim Legislative Committee and outlined recommendations for initial water management actions (see **ESPA Plan technical documents at www.espaplan.idaho.gov**). The Board and Committee worked together to complete this Plan for submission to the 2009 Legislature.

2.1 Management Alternative Analysis

Guided by the goal and objectives in the Framework, the Committee identified and considered opportunities for managing available water supply and demand to address current and future water use needs including, but not limited to, those for irrigated agriculture, aquaculture, industry, hydropower, municipalities, real estate development, and domestic users and to protect environmental values. The Committee conducted a comparative analysis to assess the potential effects of a range of management options, including:

- Managed and incidental recharge.
- Groundwater to surface water conversions.
- Demand reduction strategies including but not limited to:
  - CREP.
  - Dry-year leasing and rotating fallowing.
  - Crop mix changes.
  - Buy-outs and subordination agreements.
  - Water conservation measures.
- Additional surface water storage.[1]
- Weather modification.
- Acquisition of water supplies below Milner Dam to meet Upper Snake River salmon flow augmentation obligations.

Working with the Committee, the Department developed alternative packages comprising a mix of these management options and analyzed each to ascertain the effects on reach gains and aquifer levels. The Department studied a range of potential water budget changes between 300 kaf and 900 kaf (see **ESPA Plan technical documents at www.espaplan.idaho.gov**). In addition, six packages of management strategies were examined to provide a comparison of the hydrologic benefit, economic consequences, and potential environmental impact of pursuing such actions.

2.2 Plan Implementation Benefits

Water is a unifying and critical feature of the region. About one-third of Idaho's population resides on the Eastern Snake Plain. The ESPA is the sole source of drinking water for both cities and

[1]The Idaho Legislature and Board are evaluating the feasibility of additional surface water storage across the state in order to increase available water supply. Ongoing studies will outline the benefits, costs, alternatives and impacts of such projects.

most rural residents. Agriculture is the largest segment of the local economy and the largest consumptive user of water. There are roughly 2.1 million irrigated acres on the ESPA (about 60% of Idaho's total). Of the 2.1 million irrigated acres, 871,000 acres are irrigated from surface water, 889,000 acres are irrigated from ground water, and 348,000 acres are irrigated from both sources. Beyond irrigated agriculture, food processing and aquaculture facilities (both public and private) depend on an ample supply of ground water. Springs discharging from the ESPA also sustain fish and wildlife habitat and provide water quality benefits. Hydroelectric power generation, recreation, and fisheries are also dependent on river flows. Though small relative to agricultural uses, DCMI (domestic, commercial, municipal, industrial) water use is also increasing. Providing for these DCMI uses is vital to the future growth of state and local economies. The value of the goods and services produced in the ESPA region was estimated at $10 billion in 2006.[2] This amounts to approximately 21 percent of all the goods and services produced in the State of Idaho.

Implementation of the Plan will meet the goal and objectives outlined in the Framework by:

- Improving aquifer levels (stabilization and potential enhancement).
- Increasing gains in some river reaches.
- Increasing water supply certainty for all users.
- Decreasing demand for litigation and administrative remedies.
- Allowing for municipal and industrial growth.
- Providing an ongoing public process for assessing the hydrologic, economic, and environmental issues related to the implementation of aquifer management strategies.

Implementation of the ESPA Plan will also provide a template of a collaborative planning process that can be used in other regions in Idaho. In addition, proactive management of water supplies will help address variability in climatic conditions, including drought. The expected changes in the water budget, resulting from implementation of the management plan, should provide flexibility for future water management.

2.3 Consequences of Inaction

The continued viability of irrigated agriculture, aquaculture, industry, hydropower, municipalities, future development, domestic uses and environmental resources will be adversely impacted if the current water supply trends continue on the ESPA. Implementation of the Plan is expected to change these trends and help protect the economic viability of Idaho as a whole.

Without increased precipitation and an adaptive plan to manage a balance between water use and supply in the ESPA, the following scenarios are expected:

- An escalation of conflict between water users.
- Increased litigation.
- Increased likelihood of ground water curtailment.
- Limited opportunities for community growth.
- More expensive water for industries and increased power costs, resulting in limited opportunities for economic and community growth.
- Adverse impact to the health of the state economy.

Inaction will result in continued uncertainty and instability for water users, increased vulnerability to changes in yearly supply, and less water for the expansion of municipal, industrial and commercial uses. Implementation of the Plan will provide certainty and stability and also provide a

[2]This figure was approximated by subtracting transfer payments from personal income on a county-level basis, using data published by the Bureau of Economic Analysis. This approach was recommended by Michael Ferguson, Idaho Chief Economist. Using this approach, the estimated value of goods and services produced in the ESPA region was $10 billion in 2006.

mechanism for taking advantage of periodic wet years and high flow events when surplus water may be available. Without the additional infrastructure recommended by the Plan, the region will not have the ability to take advantage of wet years and high flow. This could mean lost opportunities for municipal, industrial, and commercial growth. It could also mean increased vulnerability to changes in yearly supply, especially a problem as available water is stretched to cover more needs.

The State of Idaho and the Board, by implementing a collaborative approach to water management, have demonstrated that different interests that depend on the aquifer, springs, and the river can work together to develop a comprehensive water management plan. Therefore, it is essential that the State and the Board continue to provide direction and financial support to implement the Plan. Those involved in the Plan process devoted significant time and effort toward educating each other about their concerns and the ways in which different interests are affected by water management decisions. This process was vital to the development of the Plan and will continue through the establishment of an Implementation Committee that will assist the Board as it moves forward.

3.0 RECOMMENDATIONS

3.1 Long-Term Hydrologic Goal

The Plan establishes a long-term goal of 600 kaf average annual change to the aquifer water budget with implementation occurring over a 20-year period. A 600 kaf water budget change is considered an appropriate long-term goal considering present and future water needs, hydrologic impacts, and cost. It is currently estimated that achieving the long-term 600 kaf goal will cost more than $600 million. Full implementation of the long-term goal is dependent on many variables including water availability and funding. As such, specific actions will need to be developed by the Board after consideration of the recommendations submitted by the Implementation Committee. The Plan, by adopting a mix of strategies, represents a balanced approach to modifying the water budget. Specifically, the Plan includes aquifer recharge, groundwater to surface water conversions, and demand reduction efforts. Careful consideration was given to the following factors in the development of the long-term goal:

- Ability to target actions to accomplish specific hydrologic goals in specific locations.
- Time frame and ease of implementation.
- Environmental and economic impacts.
- Practicality, including financing and public and political acceptance.

The Plan provides for the implementation of the following management strategies:

Ground Water to Surface Water Conversions	Approximately 100 kaf/year annual average (by acquiring water supplies below Milner Dam to replace water required from the Upper Snake River for salmon flow augmentation).
Aquifer Recharge	Approximately 150-250 kaf/year (using the Board's natural flow water permit and storage water when available).
Demand Reduction	Approximately 250-350 kaf/year (using voluntary mechanisms based on the principle of willing seller/willing buyer to reduce aquifer and spring flow demands, including CREP, purchases, subordination agreements, fallowing and crop mix changes, and other mechanisms).
Pilot Weather Modification Program	Implement a 5-year pilot weather modification project in the Upper Snake River Basin and potentially the Wood River system, with state, local and other agency support. Include a detailed monitoring program for the weather modification program.

Table 2 — Plan Hydrologic Targets

PLAN HYDROLOGIC TARGETS		
ACTION	PHASE I TARGET (KAF)	LONG-TERM TARGET (KAF)
Ground Water to Surface Water Conversion	100	100
Managed Aquifer Recharge	100	150-250
Demand Reduction		250-350
Surface Water Conservation	*50*	
Crop Mix Modification	*5*	
Rotating Fallowing, Dry-Year Lease Agreements and CREP Enhancements.	*40*	
Buy Outs, Buy Downs, and/or Subordination Agreements	*No Target (Opportunity-Based)*	
Weather Modification	50*	No Target
TOTAL	200-300	600

*50 KAF was used in hydrologic modeling, based on a conservative estimate provided in the Upper Snake Weather Modification Feasibility Study.

3.2 Phase I Hydrologic Targets

The Phase I (1 - 10 years) hydrologic target is an average annual water budget change between 200 kaf and 300 kaf. Hydrologic analysis of Phase I implementation demonstrates significant hydrologic benefit across the ESPA. Phase I recommendations include site-specific implementation actions and the expected hydrologic effect of those actions. While implementing Phase I, it will be important to identify any unintended adverse consequences of such actions.

The following hydrographs provide an example of the benefits of Phase I actions. These hydrographs simulate the river reach gains and ground water level changes that would have occurred had Phase I actions been implemented in water years 1980 through 2005. Actual changes in the water budget will vary depending upon future climatic conditions and when the actions are implemented.

Monitoring and evaluation is an important component of each action. Monitoring and evaluation is required to assess the progress and effectiveness of each action and will assist in the development and implementation of future actions. In implementing Phase I, the Board will continue to solicit advice and recommendations from the Implementation Committee and the public.

Figure 4 — Snake River: Ashton to Minidoka Reach

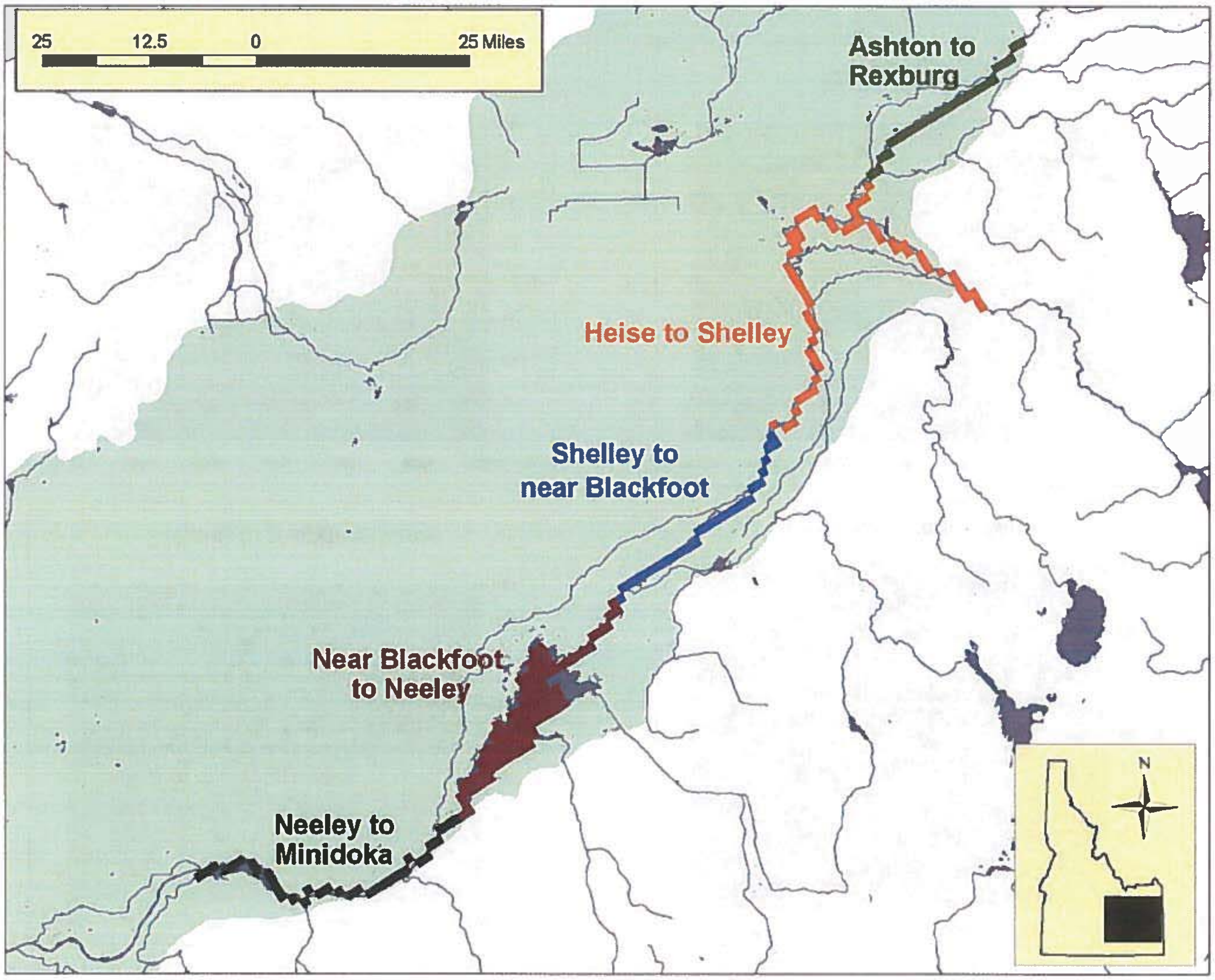


Figure 5 – Hydrographs of Simulated River Reach Gains Resulting from Phase I Implementation, in the Ashton to Minidoka Reach

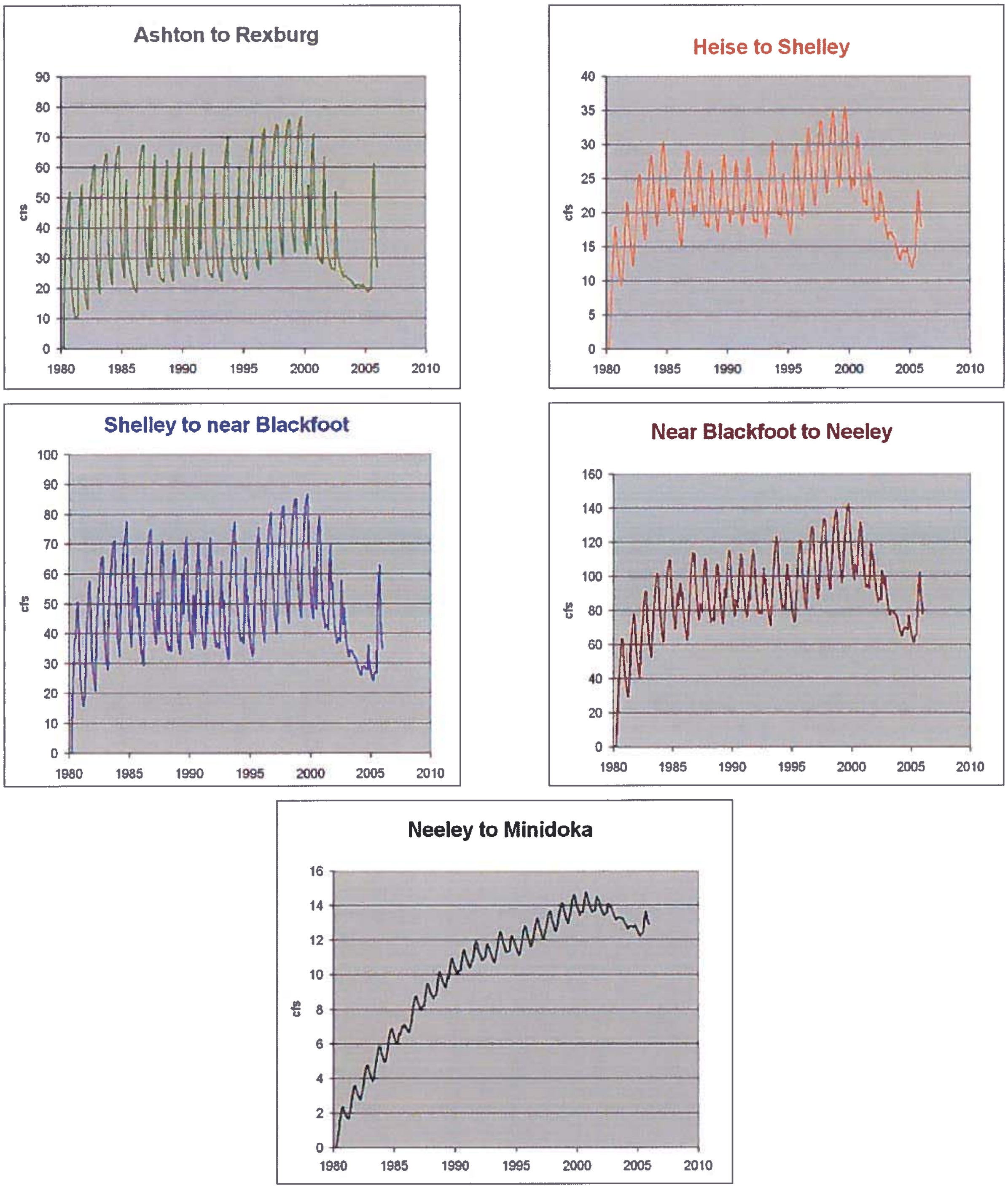


Figure 6 — Snake River: Devils Washbowl to Bancroft Reach

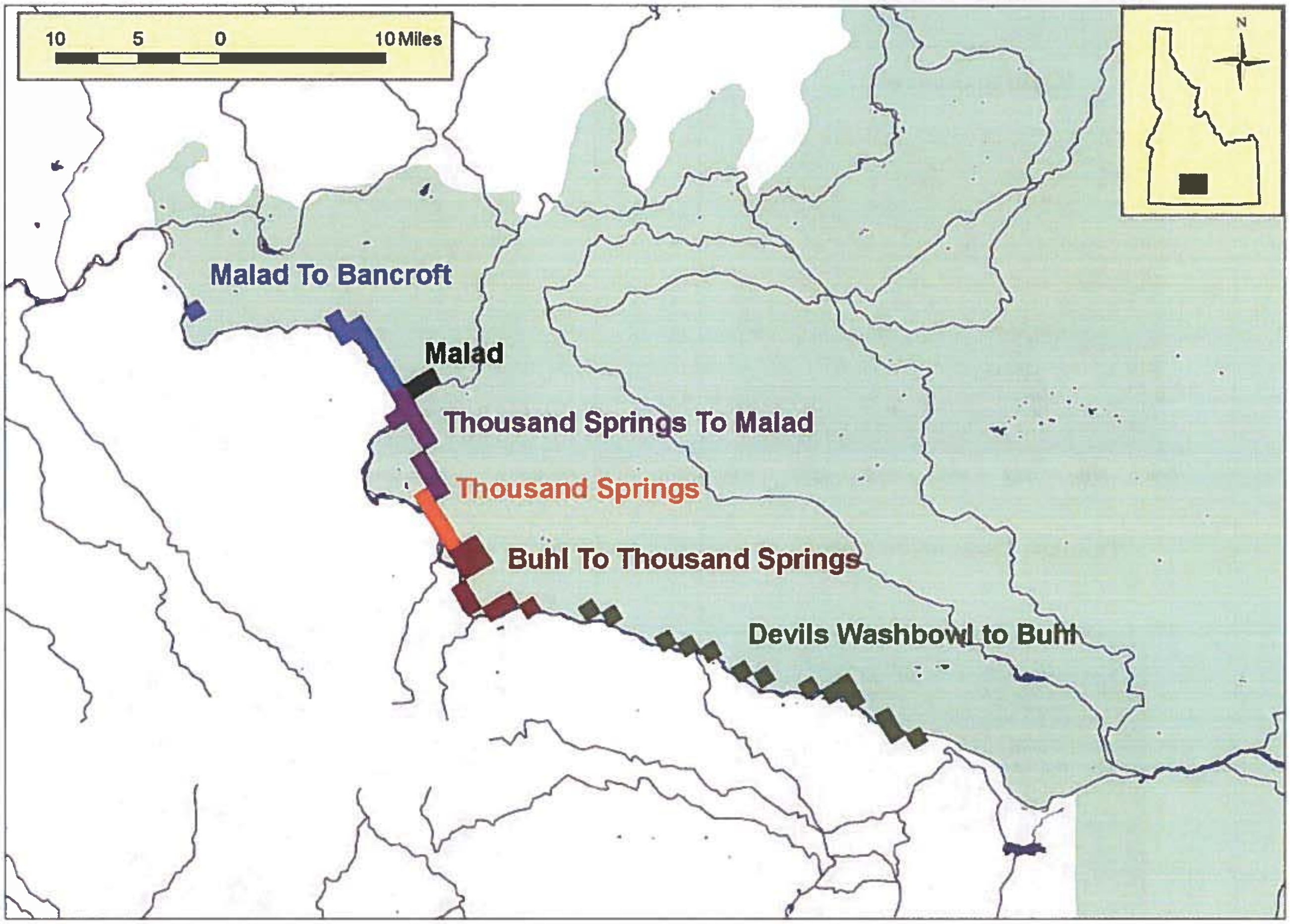


Figure 7 — Hydrographs of Simulated River Reach Gains Resulting from Phase I Implementation in the Devils Washbowl to Bancroft Reach

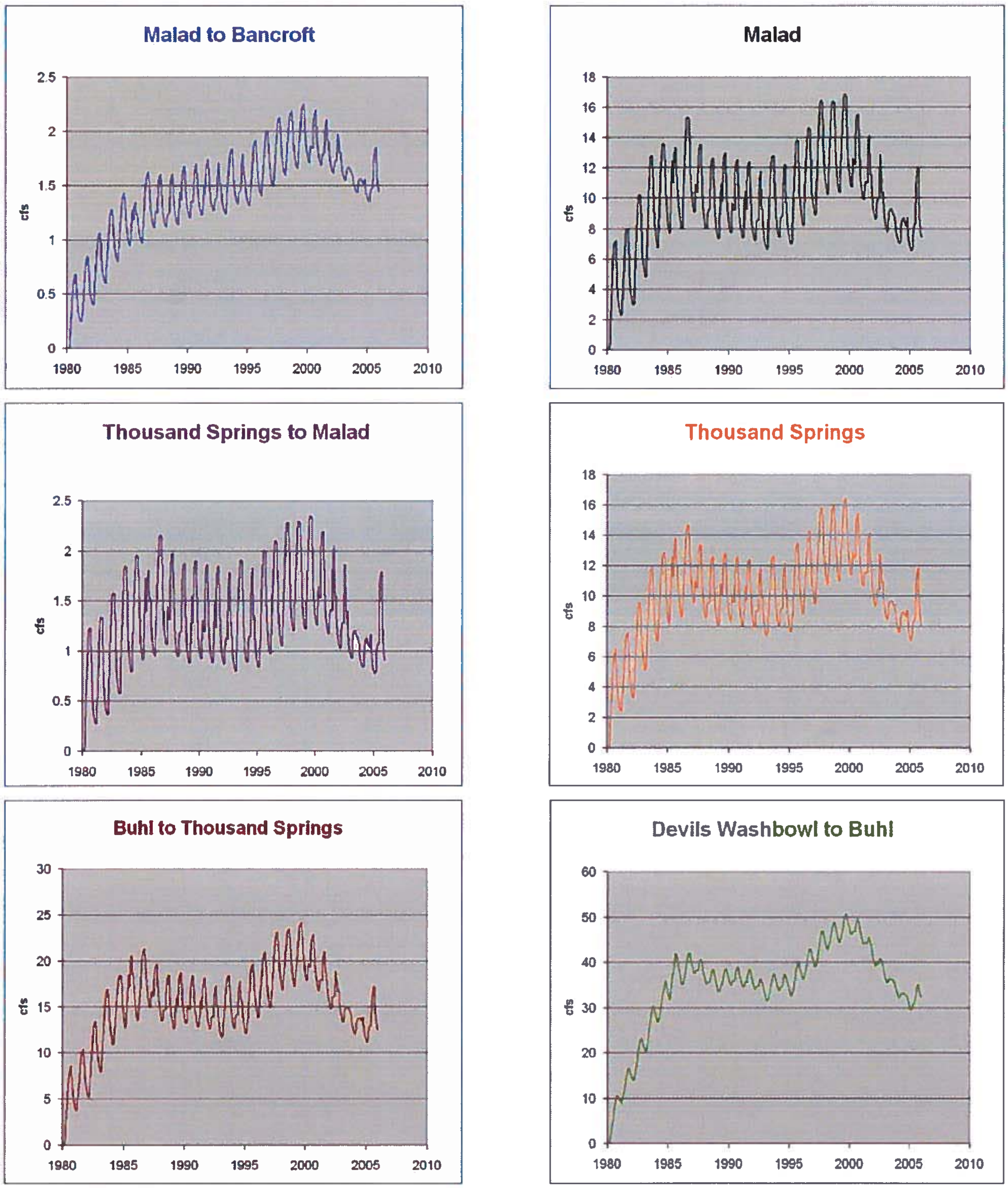


Figure 8 — Locations of Hydrographs Shown in Figure 9

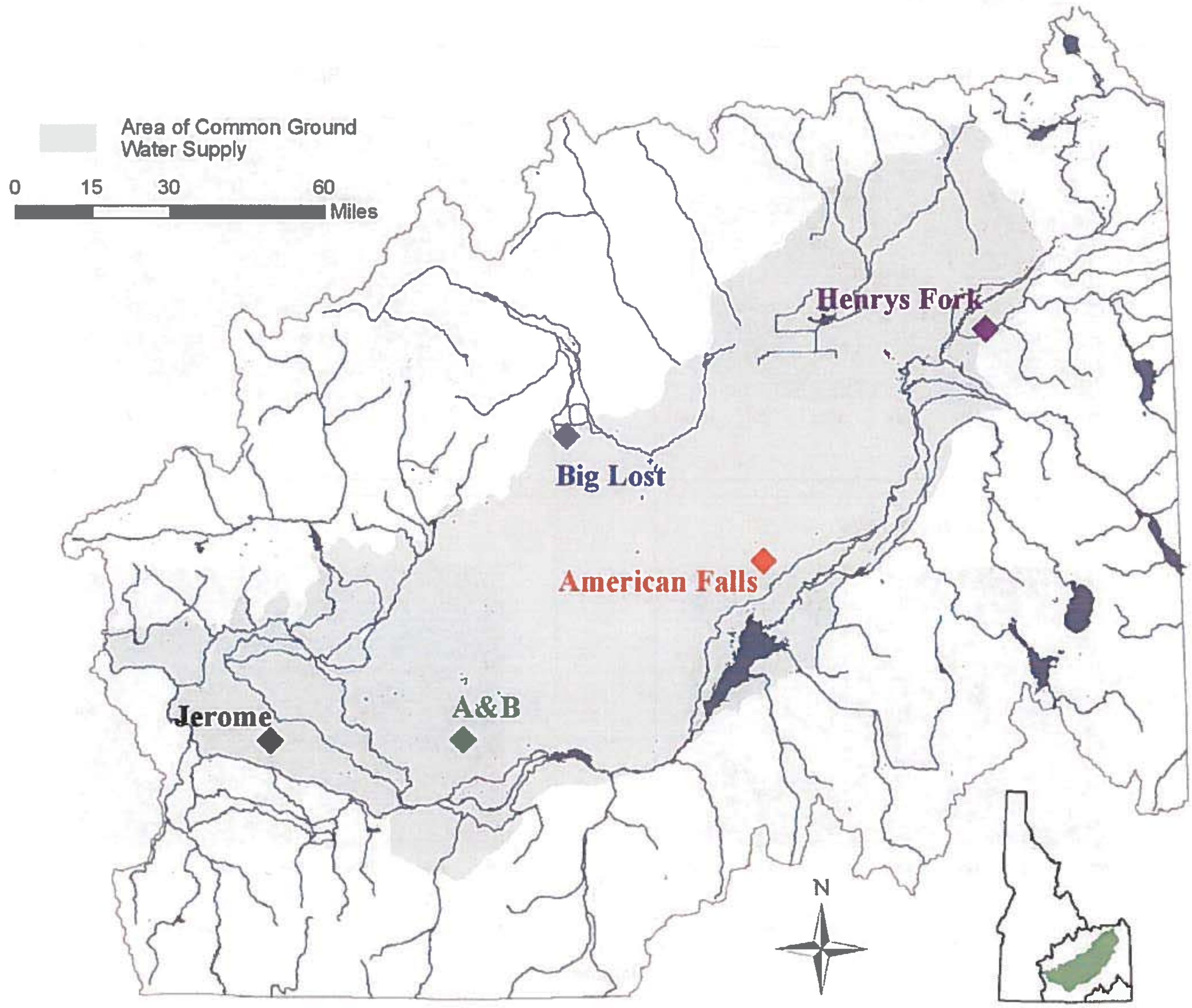
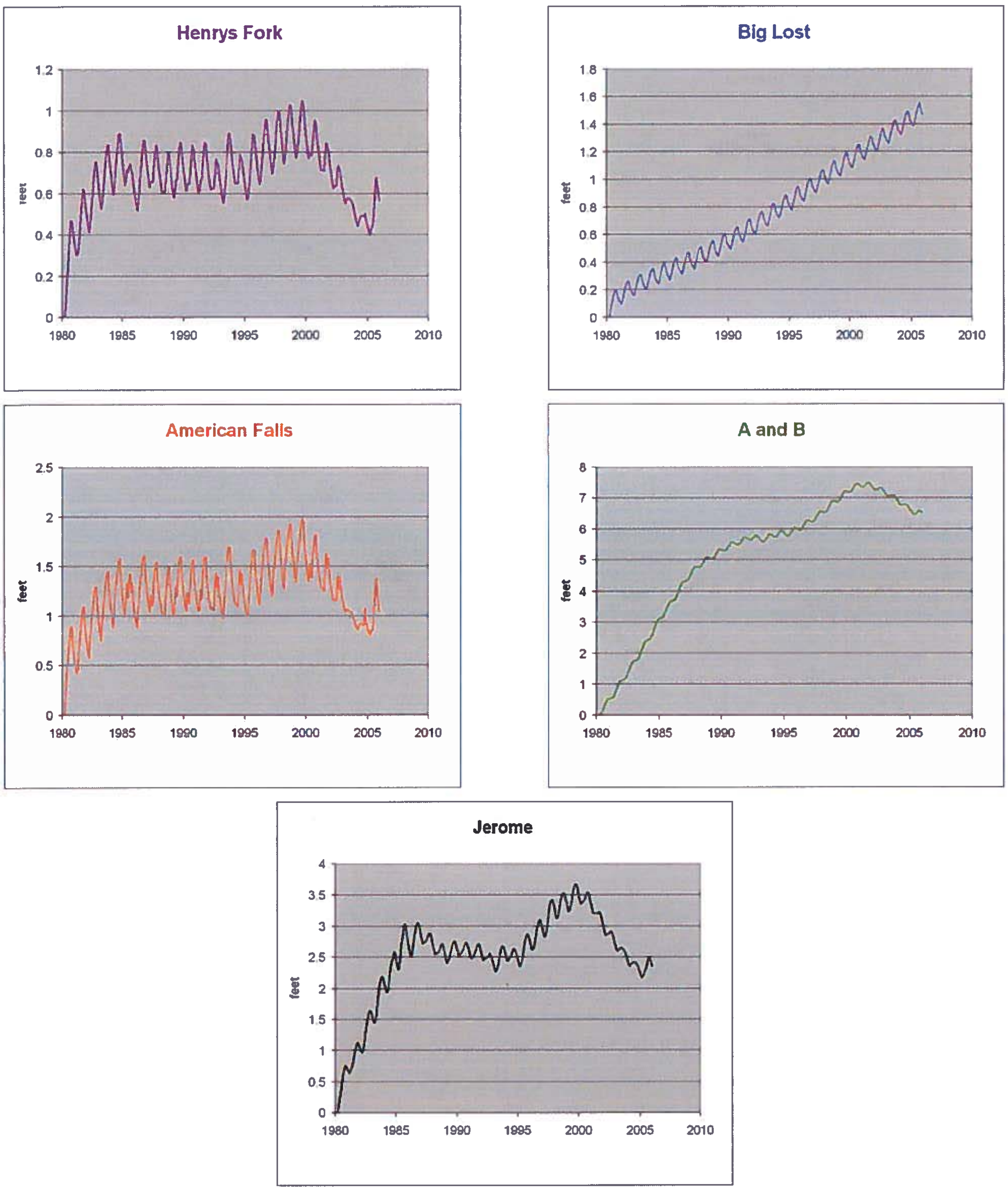


Figure 9 – Hydrographs of Simulated Groundwater Level Changes at Selected Locations Resulting from Phase I Implementation



3.2.1 Phase I Actions

A. Ground Water to Surface Water Conversions

GOAL:	IMPLEMENT 100 KAF ANNUAL AVERAGE BY YEAR 5
Actions:	• Opportunistically pursue conversions equally above and below American Falls. • Conversion opportunities include Hazelton Butte (estimated 9,000 acres); A&B service area through Milner Gooding canal and Minidoka Irrigation District; Aberdeen Springfield (lower end of system); South side of Minidoka (WD 140); Southwest Irrigation District, and others.
Issues:	• Examine capacity above American Falls for conversions (new wells in the last 40 years) on land previously using surface water. • Opportunistically acquire Snake River water below Milner Dam, or from other tributary basins, to be exchanged for flow augmentation water with consideration of potential third party impacts including but not limited to impacts on water quality, aquatic resources, and hydropower. • Opportunistically acquire upstream surface water rights on flow-limited streams and transfer them downstream to achieve both conversions and stream flow restoration. • Execute conversions during the spring and fall shoulder seasons as well as during irrigation season as capacity allows. • Coordinate with the United States Department of the Interior, Bureau of Reclamation (BOR) operations and other interested parties to plan for conversions and optimize outcomes for fish and wildlife, surface water quality, and recreation. • Identify sites and conduct engineering during winter 2009, focusing on high-lift pump areas. • Implement initial conversions by 2010 crop year. • Assume that a portion of costs may be born by irrigators who benefit from conversion (e.g., reduced power costs and value of water "on the land"). This is potentially the least expensive option available, although incentives will likely be needed to implement conversions. • Evaluate impact on surface water availability and the reservoir system operations.

B. Managed Aquifer Recharge

GOAL:	IMPLEMENT 100 KAF ANNUAL AVERAGE BY YEAR 5
Actions:	• 20 kaf of recharge above Blackfoot on the Egin Bench including both fall and spring recharge efforts. Evaluate results of fall 2008 recharge pilot project using storage water. Consider further recharge efforts in consultation with the Committee of Nine and with consideration of Henry's Fork winter flows. • 30 kaf of recharge above American Falls on Jensen Grove, Aberdeen Springfield Canal, and New Sweden systems, and with consideration of South Fork Snake River springtime flows. • 30 kaf of recharge that impacts the Thousand Springs Reach on the North Side Canal Company, Milner Gooding Canal. Explore opportunities for small scale targeted recharge in the Thousand Springs reach. • Explore recharge options on the north side of Lake Walcott. • 20 kaf estimated to maximize use of the Board's recharge water permit, Wood River Legacy transactions, and/or flood control releases on the Wood River system. • Develop and implement a detailed monitoring plan to assess the efficacy of recharge efforts.
Issues:	• Attempt to maximize recharge efforts on an annual basis unless recharge significantly impacts available supply for conversions or adversely effects ground water quality. • Prioritize the continued study of a recharge site at Lake Walcott. A recharge site in this area is expected to have positive effects on spring discharge above American Falls and at Thousand Springs. Use measurement and monitoring tools to demonstrate reach gain benefits. • Coordinate with BOR operations and other interested parties to plan for recharge efforts and optimize outcomes for fish and wildlife, surface and ground water quality, hydropower and recreation. • Develop long-term contracts with canal companies to deliver recharge water when the Board's permit is in priority. • Opportunistically acquire upstream surface water rights on flow-limited tributary streams and transfer them downstream to achieve both ground water recharge and stream flow restoration.

C. Demand Reduction

1. Crop Mix Modification in the Aberdeen/Bingham Groundwater District

GOAL:	5 KAF PER YEAR AFTER YEAR FIVE
Actions:	• Implement a pilot project, administered through Aberdeen-American Falls and Bingham Groundwater Districts that targets a reduction of groundwater use through alternate cropping patterns (e.g., exchanging hay for grain). • The program targets a reduction in ground water use of an average of 5 kaf annually by Year 5. Year 1includes a 1 kaf target and the target increases 1 kaf per year until Year 5. • Aberdeen/Bingham Groundwater District will determine most effective methods to accomplish targets.

2. Surface Water Conservation

GOAL:	MOST EFFICIENT USE OF AVAILABLE SURFACE WATER SUPPLY, 50 KAF
Actions:	• Evaluate opportunities for surface water conservation measures. • Construct check structures and automated gates, equalizing reservoirs and pump backs and investigate reducing transmission loss at specific areas where transmission loss does not benefit a ground water user or spring water user without impacting incidental recharge, thereby reducing return flows and saving water to be used for additional conversions. • Explore federal grants to leverage state monies and reduce cost to canal companies.
Issues:	• All conservation efforts will be site specific and examined on a case-by-case basis to ensure desired results. • Hydrologic effects of conservation actions could include an increase in natural flow and storage, and may provide water supply for conversions. • Pursue incentives for conservation activities and quantify hydrologic benefits, including water quality benefits from reduced return flows.

3. Buyouts, Buy-downs and/or Subordination Agreements

GOAL:	NO PHASE I TARGET - OPPORTUNITY-BASED
Actions:	• Opportunistically pursue buyouts, buy-downs, and/or subordination agreements across the ESPA, including in the Thousand Springs reach. • Set aside financial resources to enable transactions. • Pursue opportunities for environmental enhancements as a component of such agreements.

4. Rotating Fallowing, Dry-Year Lease Agreements and CREP Enhancements

GOAL:	NO PHASE I TARGET BUT ASSUMING CONTINUATION OF THE 40 KAF THAT HAS ALREADY BEEN ACHIEVED THROUGH CREP
Actions:	• Implement dry-year lease options proportionally above and below American Falls. • Develop a predictable and defined system to implement rotating fallowing program. • Employ Dry-year Lease Options that use storage water to provide water supply and incentives for conversions. • Pursue opportunities to leverage federal resources by providing additional incentives to increase CREP participation. Pursue other opportunities to increase CREP enrollment. • Utilize the State Water Fund, or other sources as available, to provide seed money for demand reduction projects. • Pursue opportunities for environmental enhancements as a component of such agreements.
Issues:	• Develop specific demand reduction program to implement and generate funds by the end of 2009. • Explore programs that may reduce ground water demands during dry years and programs that would have an impact on river flows during the growing season.

D. Pilot Weather Modification Program

GOAL:	SURFACE WATER SUPPLY ENHANCEMENT, UNDETERMINED QUANTITY
Actions:	• Implement a cooperative 5-year pilot weather modification project designed to increase winter snowpack in the Upper Snake River Basin and potentially the Wood River system.
Issues:	• Develop plan in 2009 and implement during winter 2010. • Design and implement a detailed monitoring and evaluation program. • Idaho Power Company has agreed to work with the State and interested counties to implement the experimental project. • Coordinate with the State of Wyoming regarding potential program partnership. • Develop procedures to suspend weather modification activities during heavy precipitation periods when additional rain or snow may increase the risk of flooding, or have adverse consequences for fish and wildlife resources and the public safety.

E. Incidental Recharge

GOAL:	NO REDUCTION IN INCIDENTAL RECHARGE OVER THE ESPA DURING THE 10 YEAR PHASE I PLAN
Action:	• Recognize the role of incidental recharge. • Work with canal managers and funding agencies that are implementing water conservation measures to offset the effects of conservation to the aquifer.

F. Plan Implementation and Growth

GOAL:	IDENTIFY AND ADDRESS IMPEDIMENTS TO MUNICIPAL, INDUSTRIAL, AND COMMERCIAL GROWTH.
Actions:	• Review administrative rules and processes that may be an impediment to growth and implementing Plan management actions; take administrative steps to assure that water is available to sustain future economic growth.

3.2.2 Additional Plan Components

In addition to the overall hydrologic goal and Phase I implementation steps, the Plan includes the following actions to enhance coordination, decision making, and aquifer management.

A. **Plan Implementation Committee** – The Board will establish an Implementation Committee to assist in the implementation of the Plan. The Implementation Committee will assist the Board in the prioritization, development, implementation, and monitoring and evaluation of management actions. The Implementation Committee will consider and recommend actions and objectives to stabilize and improve spring flows and aquifer levels and effect changes in river flows. The Implementation Committee will include, but not be limited to, interest groups currently represented on the Advisory Committee. The Implementation Committee will also establish a coordination process that provides for the sharing of information on river and aquifer management actions and provides opportunity for public involvement. The Implementation Committee will serve at the pleasure of the Board and provide a forum for public participation. Board's staff and/or contractors will facilitate the work of the Implementation Committee and provide the technical information needed for its deliberations. The Board will continue to make all final decisions concerning Plan project priorities, implementation, and funding.

B. **Environmental Considerations** – The Plan integrates environmental and other considerations into the decision-making and implementation process. With the advice of the Implementation Committee, the Board, through implementation of the Plan, will seek to optimize outcomes for fish and wildlife, recreation, hydropower, municipalities, irrigation, aquaculture, and other uses. Where feasible, the Board will pursue opportunities for cooperative program and funding arrangements that may expand resources available for optimizing environmental resources.

C. **Clearinghouse** – During implementation of Phase I, options for implementing a flexible mechanism that connects willing participants in the implementation of ESPA water management projects will be considered as well as strategic approaches to implement recharge, conversion, and demand reduction strategies using a clearinghouse structure.

D. **Outreach and Education** – During Phase I, the Implementation Committee will help develop and recommend funding mechanisms for a broad water education and outreach effort, building on existing water user outreach efforts and programs, with an initial emphasis on local governments, domestic well owners, and consumptive water users.

E. **Management Flexibility & Innovation** – The Board will pursue and implement the most cost effective water management tools that achieve the overall goals and objectives for improving the ESPA. In addition, innovative approaches that can improve water supplies available for conversion, recharge, and/or enhancement of surface supplies will be identified for consideration.

F. **Downstream Transfer Policy** – Opportunities for providing water for recharge and conversion projects through downstream transfers of surface water rights to the ESPA in a manner that enhances flows in flow-limited tributaries will be identified. Such transfers should be consistent with state law, policy and programs and utilize the water supply bank wherever appropriate.

3.3 Phase I Implementation Plan

A Phase I Implementation Plan will be developed within the first year of Plan approval. The Implementation Plan will outline the sequence of implementation steps and identify research and funding requirements and sources, required legislation and monitoring and evaluation protocols. The Implementation Plan will also describe an operating protocol to ensure continued public involvement and participation. The Board's staff and/or contractors will work with the Implementation Committee and the Board to finalize and approve the Implementation Plan.

The proposed plan outlined in the following table represents a multi-pronged approach for funding the Phase I actions over a 10-year period (see **Appendix B**). The Implementation Plan will further define the outlined necessary funding strategies and mechanisms. Funding participation targets are identified for each water user category.

Table 3 — Phase I Funding Participation Targets

WATER USER CATEGORY	PHASE I FUNDING PARTICIPATION TARGETS
Irrigated Agriculture (groundwater and surface water)	$3 million annually (based on participation of $2 million annually for ground water users and $1 million annually for surface water users)
Idaho Power Company/Co-Ops	$1 million - $1.5 million annually (for projects that qualify for TEMP)[3]
Municipalities	$700,000 annually (includes commitment to address rules and statutes that may inhibit municipal growth)
Spring Users	$ 200,000 annually (based on cfs)
Industrial/Commercial Users (not in municipalities or groundwater districts)	$150,000 annually (based on estimated 15 kaf annually)
State of Idaho	$3 million annually
Federal	Pursue EQIP/Water America Initiative/CREP and other funding opportunities
Recreation/Conservation	Pursue grants and other funding opportunities

[3]In connection with the relicensing of the Hells Canyon hydroelectric project, Idaho Power Company has proposed to implement a Temperature Enhancement Management Program (TEMP) as part of the Clean Water Act Section 401 water quality certification process. Through the TEMP, Idaho Power Company intends to develop, fund and implement watershed management and enhancement projects that will assist in ameliorating Snake River water temperature conditions. Idaho Power Company will work with the Implementation Committee and Board to identify Plan actions that qualify for inclusion in the TEMP. The § 401 application is currently pending before the Idaho Department of Environmental Quality and has not yet been approved.

It is estimated that $70 million - $100 million dollars will be needed to implement the Phase I, 200-300 kaf annual change in the ESPA water budget.[4] The ESPA water users[5] have conceptually agreed to contribute 60% of the required funds, with the State of Idaho contributing the balance. In addition, other potential sources of funding, including federal and private sources, will be identified and secured to advance implementation of the Plan.

All fees and assessments collected for Plan implementation and accrued interest will be deposited into a dedicated sub-account within the Board's Revolving Development Fund. The Board, with consideration of the recommendations of the Implementation Committee, legislature, and Governor's office, will make all final decisions concerning project priorities and implementation and allocation of funds from the dedicated sub-account.

[4]Not including operations and maintenance costs.
[5]Including consumptive and non-consumptive industries and municipalities.

4.0 ADAPTIVE MANAGEMENT

This section sets forth an adaptive management strategy for implementation of the Plan. The goal of adaptive management is to support improved decision-making and performance of water management actions over time.

Key principles fundamental to this approach include:

1. Anticipating possible future uncertainties and contingencies during planning.
2. Employing science-based approaches to build knowledge over time.
3. Designing projects that can be adapted to uncertain or changing future conditions.

Adaptive management involves taking actions, testing assumptions, and then monitoring and adapting/adjusting the management approach as necessary. It is a way of taking action - even in the face of uncertainty - in a complex system with many variables and constant change. Developing perfect knowledge concerning any system, including the ESPA, is impossible, and therefore an adaptive management approach is critical to the successful attainment of the qualitative and quantitative goals set forth in the Plan. Successful adaptive management requires patience and long-term commitment, as acquiring enough data to make decisions about program changes takes time.

The adaptive management strategy will allow the Board to:

- Develop protocols for revising management actions and/or quantitative targets as necessary.
- Compare costs and impacts of different actions to manage and improve the water budget in the ESPA.
- Adjust funding allocation between projects to get the most "bang for the buck."
- Concentrate funding on management actions that show results.
- Make adjustments and revisions to the Plan as new information becomes available or in response to changing water supply and demand needs.
- Proceed with flexibility depending on results and analysis of monitoring and measurement data.

4.1 Coordination & Implementation

Management of the ESPA affects numerous stakeholders and the State of Idaho. Effective implementation of the Plan will require the participation and cooperation of stakeholders and governmental entities with jurisdictional authorities and responsibilities. The Implementation Committee will be charged with providing guidance and recommendations concerning the implementation of management strategies and review of goals and objectives. The Implementation Committee will provide a forum for discussing Phase I implementation, establishing benchmarks for evaluating the effectiveness of actions, coordinating with water users and managers, evaluating and addressing environmental issues and identifying and pursuing funding opportunities.

The Implementation Committee will include interest groups currently represented on the ESPA Advisory Committee. In addition, the Board will appoint at least one of its members to serve as a liaison between the Committee and the Board. The Implementation Committee will serve at the pleasure of the Board and provide a forum for public participation. Board's staff will facilitate the work of the Implementation Committee and provide the technical information needed for its deliberations. The Board will make all final decisions concerning Plan project priorities, implementation, and funding.

4.2 Monitoring & Evaluation

A monitoring plan has been funded and developed for the ESPA, but additional monitoring and evaluation will likely be required beyond the existing program. The ground water model (and other modeling tools) are subject to technical review by the Eastern Snake Hydrologic Modeling Committee on a periodic basis. As various water budget adjustment programs are implemented, additional monitoring or modifications to the modeling program will likely be needed, e.g., specific projects may require site specific measurement and analysis, which are not currently provided. Additional modeling scenario analysis will likely be required to assist the Board and the Implementation Committee in the implementation process. Additionally, increased measurement of water use across the ESPA and an increased understanding of the hydrogeologic complexity of the aquifer are necessary to inform and raise public awareness about this valuable resource during the planning and management process.

With data gathered through the monitoring process, the Implementation Committee and Board's staff will be able to assess the impacts of each management activity. In some cases, it may take a number of years to obtain sufficient data to achieve a comprehensive understanding of the effects of particular actions. Regardless, the success of the Plan depends upon the development and maintenance of state-of-the-art monitoring and evaluation tools that provide the information necessary to make sound planning decisions for the future.

4.3 Legislative Reporting and Plan Revision

The Board will provide periodic reports to the legislature documenting the progress made on the implementation of the Plan. The Board will evaluate the Plan after 10 years of implementation for Phase I, and make planning recommendations to the legislature and Governor's office.

5. APPENDICES

PLAN TECHNICAL DOCUMENTS

Technical documents were used to design Phase I actions and these and other technical information will guide the Implementation Committee. These and all Plan-related materials can be found at www.espaplan.idaho.gov in the Technical Document folder.

APPENDIX A — Advisory Committee Membership List

	REPRESENTATIVE	ALTERNATE
MUNICIPALITIES/COUNTIES	**Mayor Lance Clow,** City of Twin Falls	**Mayor Correll,** City of Jerome
	Mayor Fuhriman, City of Idaho Falls	**Mayor Roger Chase,** City of Pocatello
BUSINESS	**Alex S. LaBeau,** IACI President	
LAND DEVELOPERS	**Rebecca Casper,** Ball Ventures LLC	**Bob Muffley,** Board of Realtors/ Mid-Snake Commission
SURFACE WATER USERS	**Jeff Raybould,** Fremont-Madison Irrigation District	**Lloyd Hicks,** Rigby
	Randy Bingham, Burley Irrigation District	**Steve Howser,** Aberdeen-Springfield Canal Company
	Vince Alberdi, Twin Falls Canal Company	**Albert Lockwood,** Northside Canal Company
GROUND WATER USERS	**Don Parker,** Water District 110-100	**Scott Clawson,** Water District 110-100
	Tim Deeg, Water District 120	**Craig Evans,** Water District 120
	Dean Stevenson, Water District 130-140	**Lynn Carlquist,** Water District 130
SPRING WATER USERS	**Randy MacMillan,** Clear Springs Foods, Inc.	**Linda Lemmon,** Thousand Springs Water Users Association
HYDROPOWER	**James Tucker,** Idaho Power Company	**Dee Reynolds,** Fall River Electric
DOMESTIC WELL OWNERS	**George Katseanes,** Blackfoot	

	REPRESENTATIVE	ALTERNATE
ENVIRONMENTAL AND CONSERVATION INTERESTS	**Kim Goodman**, Trout Unlimited	**Will Whelan**, The Nature Conservancy
MIXED-USE INTEREST	**Dan Schaeffer**, A&B Irrigation District	**Stan Standal**, Spring Water User
COUNTY ASSESSOR	**Max Vaughn**, Minidoka County	**Steven Seer**, Bonneville County

AGENCY PARTICIPANTS	
IDAHO DEPARTMENT OF WATER RESOURCES	**Hal Anderson**, Administrator – Planning and Technical Services Division
IDAHO DEPARTMENT OF ENVIRONMENTAL QUALITY	**Barry Burnell**, Water Quality Administrator
IDAHO WATER AND ENERGY RESOURCES RESEARCH INSTITUTE	**Roy Mink**, Former Director
IDAHO FISH AND GAME	**Dave Parish**
BUREAU OF RECLAMATION	**Richard Rigby**, Special Assistant to Regional Director
US FISH AND WILDLIFE SERVICE	**Damien Miller**
GOVERNOR'S OFFICE	**John Chatburn**

APPENDIX B — Phase I Funding Recommendations

The following table outlines a recommended funding approach for Phase I implementation, including participation targets. These participation categories have been discussed and conceptually agreed to, but necessary mechanisms have yet to be finalized. As noted above, the estimated funding required for Phase I implementation is $70 million - $100 million ($7 - $10 million per year for 10 years).

WATER USER CATEGORY	PHASE I FUNDING PARTICIPATION TARGETS
Irrigated Agriculture (groundwater and surface water)	$3 million annually (based on participation of $2 million annually for ground water users and $1 million annually for surface water users and conceptually agreed to)
Idaho Power Company/Co-Ops	$1 million - $1.5 million annually (for projects that qualify for TEMP)[3]
Municipalities	$700,000 annually (includes commitment to address rules and statutes that may inhibit municipal growth)
Spring Users	$200,000 annually (based on cfs)
Industrial/Commercial Users (not in municipalities or groundwater districts)	$150,000 annually (based on estimated 15 kaf annually)
State of Idaho	$3 million annually
Federal	Pursue EQIP/Water America Initiative/CREP and other funding opportunities
Recreation/Conservation	Pursue grants and other funding opportunities

The proposed funding approach seeks to raise the needed funds through a flexible strategy that is broad-based, provides for equitable benefits and efficient revenue collection, and minimizes interest expenses. Potential funding strategies are set forth below for further discussion and consideration.

[3]In connection with the relicensing of the Hells Canyon hydroelectric project, Idaho Power Company has proposed to implement a Temperature Enhancement Management Program (TEMP) as part of the Clean Water Act Section 401 water quality certification process. Through the TEMP, Idaho Power Company intends to develop, fund and implement watershed management and enhancement projects that will assist in ameliorating Snake River water temperature conditions. Idaho Power Company will work with the Implementation Committee and Board to identify Plan actions that qualify for inclusion in the TEMP. The § 401 application is currently pending before the Idaho Department of Environmental Quality and has not yet been approved.

A. **ESPA Water Users Component:**
   1. **Pay-As-You-Go.**
      Pay-As-You-Go is a financial policy that funds capital outlays from current revenues rather than through incurring debt. Modified Pay-As-You-Go is an approach that funds some improvements from current revenues and others by incurring debt.

   2. **Idaho Water Resource Board Contract.**
      Using the existing Board's authority to issue revenue bonds, in which principal and interest are payable entirely from the revenue received (ultimately by the people and businesses that benefit by the facility). This approach would be potentially taxable.

   3. **Water Management Improvement District (WMID).**
      This approach allows for the assessment of a fee to defray part or all of the costs of a specific improvement or service. Legislative action would be required to grant the Board's authority to establish a WMIDs.

B. **State Component:**
   1. **State Water Management Project.**
      General Fund Appropriations from kilowatt per hour (kwh) power franchise fee, a state sales or property tax, special product or service tax, etc.) would be used to pay for the state portion of the management plan.

   2. **State Water Fund.**
      Develop a state-wide water fund, funded through a state water management project, to authorize and fund such projects. The Board would request annual appropriations to fund proposed projects.

Based on an analysis of the alternatives developed, a combination of funding strategies may represent the most viable approach to effectuate implementation of the Plan. This approach, using a pay-as-you-go strategy, the Board's existing loan and grant program, and the establishment of WMIDs will undergo further review by the Board for consideration by the legislature. Together, these strategies could finance the water user component of Plan implementation costs. The inclusion of a pay-as-you-go strategy would eliminate interest rate exposure. Board's authority to establish WMIDs would:

1. Simplify administration and collection of water-user contributions.
2. Reduce interest rate expense.
3. Augment the ability to raise funds from specific geographic areas within the ESPA.
4. Increase the likelihood of public acceptance of Plan fees.

The Board will also take under consideration the feasibility of establishing a state water project fund. Power franchise fees, sales tax, product tax, or other sources could be collected and deposited in the state water project fund and matched with contributions by water users and other partners. Where water users and implementation partners secure their 60% funding for a project or group of projects, the Board would request that the legislature authorize matching funds for the proposed projects. A collection approach that should be further evaluated involves using water districts as vehicles for collecting contributions from water user groups, including irrigated agriculture, municipalities, spring-users, and industrial/commercial users.

APPENDIX D –

IWRB Supporting Documents

BEFORE THE IDAHO WATER RESOURCE BOARD

IN THE MATTER OF AQUIFER STABILIZATION AND CLOUD SEEDING IN THE UPPER SNAKE, WOOD, AND BOISE RIVER BASINS	RESOLUTION TO APPROVE FUNDS FOR THE COOPERATIVE CLOUD SEEDING PROGRAM

WHEREAS, House Bill 547, passed and approved by the 2014 legislature, allocates $5,000,000 annually from the Cigarette Tax to the Idaho Water Resource Board (IWRB) for statewide aquifer stabilization, with the funds to be deposited into the Secondary Aquifer Planning, Management, and Implementation Fund; and

WHEREAS, cloud seeding was identified as a strategy in the Eastern Snake Plain Aquifer Comprehensive Management Plan (ESPA CAMP) for which stabilization and recovery of the ESPA is a principal goal, and was identified as a strategy in the draft Treasure Valley Comprehensive Management Plan; and

WHEREAS, a well-managed cloud seeding program can increase winter snowpack as much as 10% or more, and thereby increase surface water runoff, resulting in more surface water for all uses, including aquifer management projects, and less supplemental ground water pumping; and

WHEREAS, an existing water user and county-led cloud seeding program has been in place in the Upper Snake River Basin for decades and a similar water user led program has existed in the Boise River Basin that has resulted in increased runoff; and

WHEREAS, the Idaho Power Company (IPC) established a remote-operated "Pilot Program" and brought its operational experience gained from its Payette River Basin program to the ESPA, as a result of the ESPA CAMP. The two cloud seeding programs in the Upper Snake River Basin are currently operating in parallel and cooperate on operational matters; and

WHEREAS, water users in the Boise River and the Wood River Basins agreed to share in the operation and maintenance costs of a collaborative cloud seeding program with IPC, which includes the use of remote ground-based generators and aircraft; and

WHEREAS, discussions between IPC, the IWRB and water users resulted in the creation of a Cooperative Cloud Seeding Program (Program) to expand IPC's cloud seeding operations in the Upper Snake River Basin and establish IPC run programs in the Boise River Basin, and Wood River Basin with support from the IWRB and water users; and

WHEREAS, while a comprehensive and versatile cloud seeding program includes aircraft and ground based generators, the use of aircraft is particularly effective for increasing snowpack because it can be used to target specific storms; the IWRB and IPC currently share the costs associated with three aircraft which perform cloud seeding in the Boise, Wood River, and Upper Snake River basins; and

WHEREAS, to further enhance the Cooperative Cloud Seeding Program's operational capabilities in the Upper Snake River Basin, and to take advantage of appropriate storms that may pass through the region, the IWRB and IPC have discussed adding a fourth aircraft to provide two aircraft dedicated to this basin specifically; and

WHEREAS, the IWRB's annual budget for the Cooperative Cloud Seeding Program's operations and maintenance for Fiscal Year 2020 authorized expenditures of up to $1.17 million, which included one third of expenses related to the operation of a fourth aircraft to be dedicated to the Upper Snake River Basin; and

WHEREAS, IPC has requested, should both parties agree to contract a fourth aircraft, the IWRB contribute fifty percent of the costs until an analysis of benefits to various water users resulting from cloud seeding snow augmentation activities has been completed, and a more appropriate division of funding between IPC, IWRB, and other water users can be determined. A commitment of fifty percent of the costs would increase the total authorized expenditures for operations and maintenance from $1.170 to $1.232 million; and

WHEREAS, in 2011 IPC began working with the National Center for Atmospheric Research (NCAR), Boise State University (BSU), and University of Arizona (UOA) to develop a model known as the Weather Research and Forecasting Cloud Seeding Module (WRF-CSM) to enhance cloud seeding by providing improved forecasting and guidance for cloud seeding operations, simulations for project planning, and to estimate cloud seeding benefits by tracking snow accumulation with and without cloud seeding; and

WHEREAS, on August 30, 2017, the IWRB authorized expenditures for reimbursement to IPC for up to fifty percent of actual costs towards the development of the WRF-CSM; estimated at the time to be $2.94 million. This funding was authorized for expenditures through calendar year 2020, in an amount not to exceed $1.47 million, subject to availability of annual appropriations; and

WHEREAS, due to the computing capacity requirements of the WRF and WRF-CSM, a high performance computing (HPC) system is required for its operation, and each HPC holds a life span of approximately five to eight years. Throughout the developmental process, the WRF-CSM has been housed under contract on an HPC owned by UOA, which is nearing the end of its lifecycle and will not be replaced. The acquisition of a new HPC will be required to operate the WRF-CSM model; and

WHEREAS, IPC, after consideration of multiple contract options, has chosen to collaborate with BSU and the Idaho National Laboratory (INL) to purchase a new HPC. The purchase costs will be divided based on the proportionate operational capacity dedicated to each user, or the total number of "cores" each party will receive; and

WHEREAS, BSU will procure the new HPC through a formal state bidding process and it will be physically housed at the Collaborative Computing Center (C3) on the INL Education Campus in Idaho Falls, ID; and

WHEREAS, the equipment expenses related to the purchase of the HPC are $1.4 million and IPC has requested a fifty percent cost share commitment by the IWRB, or an estimated $700,000.

WHEREAS, the IWRB, through its Fiscal Year 2020 Budget Resolution, allocated $500,000 towards the total equipment costs of a new HPC, but required additional approval by IWRB resolution to authorize expenditures for the budgeted purpose; and

WHEREAS, IPC, throughout the continued development of the WRF-CSM and verification of field data collected during the National Science Foundation (NSF) funded SNOWIE 2017 project, has identified significant issues related to the data inputs with the WRF model upon which the WRF-CSM is based. Further research and analysis based on the SNOWIE 2017 data are required to resolve these issues; and

WHEREAS, the original Principal Investigators (PI) of the 2017 SNOWIE project are in the process of applying to NSF for additional funding to continue analyzing the data. In order to apply new findings to the WRF, or the WRF-CSM, NCAR will need to continue their involvement in the project, and must be funded from resources other than NSF. As such, IPC would request that the IWRB make a commitment to a fifty percent cost share in NCAR's portion of the project costs; and

WHEREAS, the IWRB directed staff to evaluate the benefits of additional runoff generated through cloud seeding by quantifying the distribution of the increased in water supply (benefits analysis). IDWR staff, in consultation with IPC, proposes to evaluate these benefits using hydrographs with and without cloud seeding to represent potential additional runoff resulting from cloud seeding in the Boise, Wood, and Upper Snake River basins, followed by a routing analysis to identify beneficiaries of the estimated additional runoff.

WHEREAS, IDWR staff propose to contract with BSU to develop the basin hydrographs for use in the routing analysis at an estimated cost of $25,000; and

WHEREAS, the IWRB, through its Fiscal Year 2020 Budget Resolution, committed funding for program development activities in an amount up to $200,000, subject to further authorization by IWRB resolution; and

NOW, THEREFORE BE IT RESOLVED that the IWRB authorizes expenditures not to exceed $25,000 from the Secondary Aquifer Planning, Management, and Implementation Fund, for expenses related to the development of hydrographs to be used in a benefits analysis.

BE IT FURTHER RESOLVED that the IWRB authorizes expenditures not to exceed $1.232 million from the Secondary Aquifer Planning, Management, and Implementation Fund in Fiscal Year 2020 for operations and maintenance expenditures for the Cooperative Cloud Seeding Program, which includes fifty percent of the expenses for a fourth aircraft.

BE IT FURTHER RESOLVED that the IWRB authorizes expenditures not to exceed $500,000 from the Secondary Aquifer Planning, Management, and Implementation Fund for equipment expenses related to the acquisition of a new HPC in Fiscal Year 2020, and authorizes expenditures not to exceed a total of $700,000 through Fiscal Year 2021, and subject to the availability of annual appropriations.

BE IT FURTHER RESOLVED that the IWRB authorizes expenditures not to exceed a total of $600,000 in Fiscal Years 2021-2023, from the Secondary Aquifer Planning, Management, and Implementation Fund for expenses related to the SNOWIE extension project, subject to the availability of annual appropriations.

BE IT FURTHER RESOLVED that the IWRB authorizes its chairman or designee, Brian Patton, Executive Officer to the IWRB, to execute the necessary agreements or contracts for the authorized expenditures and IWRB program participations outlined in the above resolutions.

DATED this 26th day Of July, 2019.

Roger Chase

ROGER W. CHASE, Chairman
Idaho Water Resource Board

ATTEST: ______________________

VINCE ALBERDI, Secretary