NATIONAL SCIENCE FOUNDATION ESTABLISHED PROGRAM TO STIMULATE COMPETITIVE RESEARCH (EPSCoR) RII TRACK-1:

Idaho Community-engaged Resilience for Energy-Water Systems *(I-CREWS)*

STRATEGIC PLAN

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NSF Award #OIA-2242769

August 1, 2023-July 31, 2028

V2 01/15/2025

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RII Track-1 Leadership Team (LT)

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- Kathy Araujo (Co-PI), Boise State University
- Karla Eitel (Co-PI), University of Idaho
- Kitty Griswold (Co-PI), Idaho State University
- Alistair Smith (Co-PI), University of Idaho
- Laura Laumatia (lead), Coeur d'Alene Tribe
- Sammy Matsaw (lead), Shoshone-Bannock Tribes
- Brian Johnson (co-lead), University of Idaho
- Jim Fredricksen (co-lead), Boise State University
- Bruce Savage (co-lead), Idaho State University
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Idaho EPSCoR RII Track-1 Project Idaho Community-engaged Resilience for Energy-Water Systems *I-CREWS*

NSF EPSCoR in Idaho

Idaho's $24 million NSF EPSCoR Research Infrastructure Improvement (RII) Track-1 project, I-CREWS, is a 5-year cooperative agreement between NSF and Idaho that aims to address the impact of climate, population, and technological change on energy-water (E-W) systems. Track-1 awards focus on improving the research competitiveness of jurisdictions by improving their academic research infrastructure in areas of science and engineering that are supported by NSF and are critical to a particular jurisdiction's science and technology initiative or plan. These areas must be identified by the jurisdiction's EPSCoR governing committee as having the best potential to improve the jurisdiction's future Research and Development (R&D) competitiveness. (Idaho SBOE State Board of Education 2022)

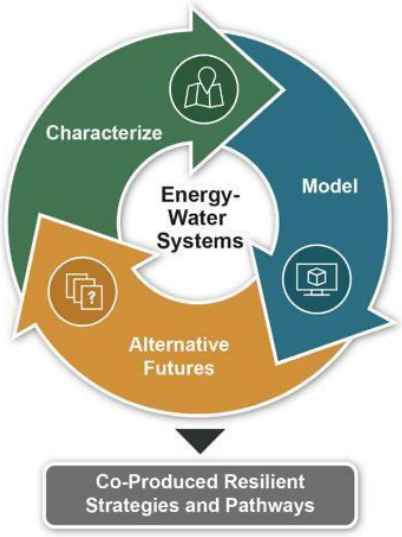

Figure 1: *Overview diagram showing connections among the characterization, modeling, and alternative futures objectives for energy-water resilience to support understanding of trade-offs in co-produced resilience strategies and pathways.*

Alignment with State and National Priorities

I-CREWS is well-aligned with Idaho's Higher Education Research Strategic Plan, directly supporting research and economic development in energy systems, natural resource use and conservation, and systems engineering. This alignment coupled with the promise of I-CREWS increasing collaboration among the State's universities and colleges served as a backdrop to the energy-water theme's selection by the Idaho EPSCoR Committee. I-CREWS responds directly to NSF grand challenges of climate and resilience research and innovation by advancing understanding of the interplay between availability and distribution of energy and water. Likewise, it addresses NSF's Sustainable and Clean Energy in NSF's 2022-2026 Strategic Plan.

Vision

Idaho envisions generating world-class research competitiveness and capacity in collaboration with resilient urban, rural, and tribal communities that can adapt to climate, population, and technological changes impacting E-W interactions.

Mission

The I-CREWS mission is to co-create research and solutions that transform the relationship between research, education, technologies and Idaho's urban, rural and tribal communities.

Aim

The aim of the project is to co-develop an understanding of the complex interactions of energy-water systems through characterizing, modeling, and envisioning alternative futures that are responsive to community needs and resilience.

INTRODUCTION

A.1 Overview of I-CREWS

The project will advance research, education, workforce development initiatives, and partnership capacity in Idaho in two strategic directions. First, I-CREWS leverages and builds linkages among existing areas of academic research strengths in the geosciences, biological sciences, social sciences, and resilience science, and second, I-CREWS expands Idaho's nascent research capacity in computational modeling, machine learning and artificial intelligence, to provide analytical outcomes to proactively address the impacts of climate, population, and technological change on energy-water (E-W) systems. Partnerships outside of academia involve a wide range of entities, from state and federal agencies, public and private utilities, Idaho National Laboratory, to Tribal nations.

Using a range of Idaho's communities, landscapes, and watersheds, the research areas of I-CREWS (Fig. 1) are aligned with collaborative efforts to:

- characterize E-W configurations for various resilience strategies,
- model E-W configurations and their resilience,
- develop alternative futures (scenarios) for E-W trajectories and resilience.

Education (ED), Workforce Development (WFD), and Broadening Participation initiatives are all aligned with these research areas and community-engagement (Fig. 1).

Research

I-CREWS will increase our empirical and theoretical understanding of how social systems, such as governance dynamics and local knowledge, can inform behaviors, trade-offs, and E-W futures in relation to climate, population, and technological change.

The motivating research hypothesis is that communities undergoing changes in their E-W systems can be characterized at different scales to determine patterns of multisystemic resilience to change. Thus, E-W system resilience will be more effectively and equitably evaluated, shaped, and implemented by incorporating co-produced local knowledge, and governance dynamics with advanced data analysis and modeling of stressors. Two cross-cutting research questions will guide the research and the capacity-building:

1. What role do trade-offs and changes in E-W systems, including storage, efficiency/conservation, local knowledge, and governance dynamics, play in determining resilience strategies or options to climate-driven, population, and technological change?

2. How does incorporating diverse ways of knowing, community engagement, and advanced modeling improve the parameterization of pathways associated with more equitable and resilient E-W futures?

The project's approaches will be applied in Idaho communities identified as E-W resilience testbeds for this work (Table 1).

Expected benefits will be:

- the creation of a statewide network that coalesces expertise in E-W resilience through a Resilience Futures Reciprocal Network (RFRN);
- building new capacities in Machine Learning (ML) and computational modeling outcomes;
- an open-source data ecosystem "E-W Data Hub" that serves Idaho and the nation, and;
- establishment of a Tribal Nation Research Network (TNRN) developed to recenter knowledge exchange between Tribes and Idaho universities, focusing on collaboration through the development of tribally-originated research.

Idaho Energy-Water Resilience Testbed					
Community	Watershed Reach	Hi-level Timeline	Deep level Timeline	Engagement	Preliminary SES Typology
1 - Fort Hall Reservation (Shoshone-Bannock)	Upper	Y1>	Y2>	CAG, EAP	Rural lifestyle, working landscape, resource dependent
2 - Coeur d'Alene Reservation	Proximal to Lower	Y1>	Y2>	CAG, EAP	Rural lifestyle, working landscape, resource dependent
3 – Boise / Treasure Valley	Middle	Y1>	Y1>	CAG, EAP	Formalized suburban
4 – McCall / Upper Payette	Middle	Y1>	TBD	(CAG), EAP	High amenity, high resource, rural lifestyle
5 - Teton Valley (Driggs/Victor)	Upper	Y1>	NA	EAP	High amenity, high resource, rural lifestyle
6 - Twin Falls / Magic Valley	Upper	Y1>	NA	EAP	Formalized suburban
CAG – Community Advisory Group; EAP – Expert Advisory Panel; Watershed- location on Snake River Basin					

Table 1: Idaho E-W resilience testbed comprising high-level analysis for six communities and deep level engagement in at least three communities.

Education and Workforce Development and Broadening Participation

The project emphasizes community engagement and the co-production of knowledge as a demonstration of transdisciplinary science. We will also conduct multiple initiatives to increase the participation of members of underrepresented groups in STEM. We will build on models of equitable STEM education while developing researchers' abilities to collaborate more effectively with communities and work with students to build the technical skills necessary to fill E-W systems workforce needs.

Expected benefits will be:

- support for WFD and student training through high-context, community-engaged courses and projects that are co-created with community members to address E-W systems issues;
- undergraduate research summer experiences that will provide meaningful research opportunities;
- innovative programs for faculty professional development that are expanded to faculty across all three research universities, creating a cohort of researchers supported and enabled to pursue transformative and community-engaged scholarship.

A.2 Primary Partners and Project Management

The I-CREWS team science-based management plan provides project management and oversight, and facilitates interweaving and collaboration across teams and institutions to meet project goals. The multi-institution project engages Idaho's research universities (Boise State University (BSU), Idaho State University (ISU), and University of Idaho (UI)), three of five primarily undergraduate colleges (College of

Southern Idaho (CSI), College of Western Idaho (CWI), and Lewis-Clark State College (LCSC)), two of five Tribal Nations (Coeur d'Alene Tribe (CDAT) and Shoshone-Bannock Tribes (SBT)), the Idaho National Lab (INL), and various local and regional organizations. UI is the award grantee and BSU, CDA, ISU, and SBT are subawardees. Leadership is provided by the Project Director, under the general oversight of the Idaho EPSCoR Committee. The Idaho EPSCoR Executive Committee (ExComm), which includes the State Committee Chair, Vice Chair, the respective Vice Presidents for Research at BSU, ISU, and UI meets regularly to monitor progress. The I-CREWS Leadership Team (LT) represents all award and sub-award institutions and entities and provides ongoing leadership to the project. A Cross-Cutting Team, comprising members of all project components including Research, WFD, and Broadening Participation, will: (1) facilitate effective team science/education strategies, (2) implement the I-CREWS research, education and WFD agenda, and (3) deliver and ensure project outcomes. Guidance and monitoring of progress will be provided by the Project Advisory Board (PAB) and external assessment will be provided by the External Evaluator.

A.3 Strategic Planning Process

The strategic planning process was initiated by RII Track-1 LT and involved co-leads of each major project Component. The plan was organized around four questions: (1) Who are we as a statewide team? (2) Where do we want I-CREWS to take us? (3) What do we do to get there? and (4) How will we know if we have achieved our goals?

A.4 Overview of the Strategic Plan

This plan describes a series of specific goals, objectives, activities, and tasks (including milestones) to enhance excellence in key priority areas to be integrated through science-based investments and community-engaged studies. Interweaving permeates all aspects of the Strategic Plan. The plan includes specific, measurable outcomes that are consistent with an external evaluation plan and achievable, in light of known risks and opportunities.

A.5 Summary of I-CREWS Goals

Goal 1: Characterize E-W systems (storage, efficiency, governance, and equity) and resilience indicators for the Idaho testbed.

- Objective 1.1: Characterize the historical and current state of the E-W systems (storage, efficiency, governance, and equity) for the Idaho testbeds.
- Objective 1.2: Identify and characterize potential cross-network and multi-scale indicators of resilience capacity of E-W systems under stress.
- Objective 1.3: Characterize data gaps, drivers, and interactions between socio-environmental technological system (SETS) attributes, historical perturbations in the E-W system, and resilience/vulnerability.
- Objective 1.4: Characterize typologies/archetypes of how E-W configurations respond to stressors and characterize multivariate decision factors driving tradeoff decisions.

Goal 2: Model Dynamic Existing and Alternative E-W Configurations.

- Objective 2.1: Build datasets to develop the ML modeling platform.
- Objective 2.2: Build ML models suitable for use in the testbed regions.

- Objective 2.3: Quantify dynamic risk.

Goal 3: Co-produce alternative futures scenarios with testbed communities, interweaving local knowledge and evaluating governance approaches that affect decision-making.

- Objective 3.1: Co-generate community perspectives, questions and priorities regarding current conditions, resilience, and vulnerabilities.
- Objective 3.2: Determine changes in climate, population, and the applications of technology over time, and how such stressors impact E-W systems.
- Objective 3.3: Develop future trajectories with interweaving of local knowledge and refine characterization/modeling of alternative futures on test bed site system resilience/vulnerability.

Goal 4: Develop individual, community, and institutional capacity for more resilient and equitable futures with respect to education and E-W systems.

- Objective 4.1: Engage Students across the WFD/ED Spectrum in the Community-Engaged Energy-Water Systems Scholarship.
- Objective 4.2: Enhance institutional transformation and professional development.

Goal 5: Improve Faculty Diversity and Equity.

- Objective 5.1: Expand Search Advocates.
- Objective 5.2: Serve Idaho's Latinx students.
- Objective 5.3: Serve Idaho’s Indigenous student population.
- Objective 5.4: Conduct rural K-12 educational needs assessment.

Goal 6a: Create and sustain industry and government partnerships at State and National levels that advance fundamental knowledge and capacity-building.

- Objective 6a.1: Coordinate the outreach and relationship-building with partners throughout the state.
- Objective 6a.2: Advance workforce readiness in E-W resilience in Idaho.
- Objective 6a.3: Interweave partner initiatives to create sustainable relationships and opportunities that benefit Idaho E-W resilience.

Goal 6b: Develop Tribal-centered research capacity.

- Objective 6b.1: Develop institutional environment for Tribal-originated research.
- Objective 6b.2: Develop Tribal-centered research capacity within the three universities and within Tribal nations in Idaho.

Goal 7: Strengthen research and education capacity through collaboration and recognition.

- Objective 7.1: Facilitate recurrent communication among I-CREWS participants and institutions.
- Objective 7.2: Promote public, rightsholder, stakeholder, and student awareness and interest in I-CREWS research.
- Objective 7.3: Increase I-CREWS scientific literacy through an E-W Literacy Framework and help prepare a diverse, well-trained STEM workforce.

Goal 8: Develop and sustain research capacity for E-W resilience and futures.

- Objective 8.1: Build human capacity for sustainable intellectual and transdisciplinary research capacity.
- Objective 8.2: Build institutional capacity for sustainable intellectual and transdisciplinary research capacity.

Goal 9a: Ensure continual progress and timely attainment of project goals and outcomes.

- Objective 9a.1: Provide effective and compliant oversight of day-to-day project implementation (operations).
- Objective 9a.2: Generate and obtain information and external input to enhance program effectiveness (accountability).
- Objective 9a.3: Instill practices and customs that enrich transdisciplinary interweaving across topic areas and institutions (interweaving).
- Objective 9a.4: Foster project alignment with state and national priorities (alignment).

Goal 9b: Develop and establish E-W data hub as an essential centralized data catalog, repository and data integration platform for all I-CREWS data.

- Objective 9b.1: Establish data needs assessment for characterization, modeling and alternative futures.
- Objective 9b.2: Develop cyberinfrastructure and databases to facilitate normalized workflows/ingestion and appropriate data sharing.

A.7 Overall Project Interweaving

The goals of the I-CREWS project cannot be achieved by a single institution working alone. Researchers, educators, and community members from participating academic institutions, partnering agencies, and communities will work together, leveraging the scientific expertise and local knowledge of each to ensure interweaving across the Characterize, Model, Alternative Futures, WFD/ED, Broadening Participation, Partnership, TNRN, and Sustainability project components. “Interweaving” rather than “integration’ is used to denote a more neutral term for explicit interconnections across project areas in deference to our Tribal partners. The Characterize component establishes the foundation for Alternative Futures and is the foundational element of the Alternative Futures methodology. The Modeling activities require the foundation established in Characterize, and in turn Modeling provides important ways to represent scenarios in the Alternative Futures activities. Alternative Futures provides the central methodological approach that interweaves across the three research components. We also foster project interweaving by implementing co-supervision of graduate students and postdoctoral fellows and co-delivery of Community and Vertically Integrated Projects (see WFD).

The I-CREWS research and education components and their associated goals are highly interwoven and interdependent - in the various component strategic plan tables that follow blue text is used to highlight interweaving efforts across two or more components and to explicitly call-out these cross-project hand-offs. Outputs produced by one component often serve as inputs elsewhere in the project, and this also occurs iteratively.

A collaboration plan supports knowledge sharing and generation in this large multi-institution, team-based science project. These protocols are intended to support both internal collaborations among participating

entities and to support external MOUs with agency and other partners. I-CREWS protocols provide guidelines for handling data sharing, publications, and intellectual property that involves two or more project personnel - many products and outcomes from I-CREWS will be multi-authored and frequently multi-institution in breadth. The intent of these protocols is to assist project personnel with collaborative sharing of data, publication of outcomes, and fair attribution for each person's role in generating knowledge from I-CREWS.

Guiding principles:

1) I-CREWS is foremost a statewide project, so data sharing, publication contributions, and intellectual property should be viewed as collaborative multi-institution endeavors when possible;

2) As a project centered on co-production of knowledge with two Tribal nation partners the FAIR and CARE data principles are considered important;

3) As an NSF-funded project data, products and outcomes are generally in the public domain. The Collaboration Plan addresses principles concerning this unique I-CREWS award, Expectations for Collaborative Team Science, Expectations for Professional Behavior, and Expectations for team members roles.

Impact Area	Activity	Outputs	Outcomes	Component
Impact Area 1 – Advance convergent capacity in existing areas of research strengths in E-W resilience	Research 1 – Establish convergent strength in resilience of E-W systems	Research 1 – Multisystemic E-W resilience framework and testbed with co-produced indicators	Robust characterization and modeling of E-W resilience from framework	Characterize
	Research 2 – Characterize E-W governance in resilience testbed	Research 2 – Integrated E-W models that incorporate policy & governance	Tradeoffs for scenarios and governance mechanisms to promote local resilience	Characterize
	Research 3 – Apply protocol and methodology for incorporating local knowledge	Research 3 – Co-developed protocols and methodology that incorporate local knowledges	More resilient pathways for alternative future E-W configurations that reflect local knowledge and values	Alternative Futures
	Capacity 1 – Demonstrate and deploy futures forecasting expertise	Capacity 1 – Alternative E-W future configurations, pathways, and trade-offs in testbeds	Statewide capacity for forecasting alternative futures Resilience Futures Reciprocal Network (RFRN)	Alternative Futures
Impact Area 2 – Increase capacity in emerging areas of computational modeling allied with improved state data storage / cyber-infrastructure to accelerate research	Research 4 – Establish computational modeling and ML capability	Research 4 – Validated E-W models	Validated ML framework for assessing resilience	Modeling
	Capacity 2 – Deploy significant central shared data storage capabilities	Capacity 2 – Expertise and support aligned with petabyte-scale high-performance shared storage	Open-source data ecosystem (E-W Data Hub) and increased collaborative research	Management
	Capacity 3 – Develop exascale academic compute capabilities	Capacity 3 – New level of next-generation state high-performance computing	New level of research capabilities enabled by next-generation exascale high-performance computing	Modeling
Impact Area 3 – Expand research competitiveness to Idaho's Tribes	Capacity 4 – Co-develop strategic plan for Idaho Tribal Nations Research Network (TNRN)	Capacity 4 – Expand relationships with Tribal nations and communities with implementation plan for TNRN	Increased competitiveness and cultural competency for collaborative university-tribal research through established TNRN	Partnerships/ TNRN
Impact Area 4 – More equitable education, training, and solutions for complex environmental issues	Capacity 5 – Develop and demonstrate community-engaged research via existing and new partnerships	Capacity 5 – Community Integrated Programs and other collaborations between universities, Tribal Nations, etc.	Establish Communities of Practice and joint training among universities, colleges, and tribal nations	WFD/ED/BP
	Capacity 6 – Improve workforce development and student engagement	Capacity 6 – Increase students in undergrad research; Trained scientists/ engineers/modelers	Computationally literate students; increased career aptitude/knowledge of available opportunities	WFD/ED/BP
	Capacity 7 – Establish capacity and milestones for a future research center	Capacity 7 – Set and meet milestones for building capacity toward a research center	Establish capabilities, governance, & timeline for RFRN	Sustainability

Table 2: Idaho RII Track-1 I-CREWS overarching logic model

PROJECT IMPLEMENTATION:
I-CREWS Strategic Priorities and Action Plans

B.1. I-CREWS Timeline of Major Milestones

The following table summarizes Major milestones that will be achieved throughout the five-year award. Additional milestones are provided in the project implementation tables corresponding to each project component's **Goal(s) and Objectives.**

Major Milestones, by Objective	**Yr1**	**Yr2**	**Yr3**	**Yr4**	**Yr5**
Goal 1: Characterize E-W systems					
Obj 1.1: Characterize the historic and current state of the E-W systems (storage, efficiency, governance, and equity) for the Idaho testbeds					
Data associated with identified gaps were **collated**		X			
Testbed data gaps **resolved**			X		
Analysis of SETS across Idaho were **completed** and potential additional testbed locations **identified**		X			
Initial survey instruments **created,** and IRB approvals **obtained**	X				
Interview analysis papers **published**					X
Interviews were **conducted** to identify prior decision pathways and tradeoffs		X			
Initial visualization products that describe scenarios **completed**				X	
Paper describing historic range of variability in the E-W system **published**				X	
Obj 1.2: Identify and characterize potential cross-network and multi-scale indicators of resilience capacity of E-W systems under stress					
Metrics for forecasting and assessing potential indicators of E-W systems exhibiting stress **analyzed**			X		

Synthesis paper describing different indicators of resilience and interweaving frameworks **published**			X		
Meetings **held** to co-develop indicators of resilience to E-W systems under stress		X			
Final weighting schema associated with the quantitative datasets were **selected**					X
VR/XR collaboration spaces **established**		X			
Finalized representations of risk, resilience, and vulnerability **presented** to partners and communities				X	
Papers describing the decision factors, barriers and opportunities, and archetypes (if any) **published**					X
Initial resilience products **shared** with partners and effectiveness of weighting schema **evaluated**				X	
Obj 1.3: Characterize data gaps, drivers, and interactions between SETS attributes, historical perturbations in the E-W system, and resilience/vulnerability					
Data sources associated with past disturbances at statewide and testbed locations level **identified**	X				
Multivariate control charts **evaluated** to identify when extreme historic stressors have occurred		X			
Workshops **conducted** to refine scenarios and demonstrate implications					X
Obj 1.4: Characterize typologies/archetypes of how E-W configurations respond to stressors and characterize multivariate decision factors driving tradeoff decisions					
Assessment that may indicate the presence of E-W archetypes **conducted**				X	
Scenario outputs **shared** with testbed communities					X
Goal 2: Model Dynamic Existing and Alternative E-W Configurations					
Obj 2.1: Build datasets to develop the ML modeling platform					
1st data and ML training session for all I-CREWS teams and partners **hosted**	X				
Critical data gaps **identified**		X			
Data generation for SETS 1, 2 and 3 **completed,** respectively			X	X	X

Contributed to interview and survey questions		X			
Obj 2.2: Build ML models suitable for use in the Idaho testbed					
ML models **trained** and **tested** with new observational and synthetic data for various SETS			X		
Scenarios **predicted** by ML and **validated**					X
Obj 2.3: Quantify dynamic risk					
SETS variables and stressors based on Characterization team results **established**		X			
Dynamic behavior of stressors **defined**				X	
E-W Resilience Indicators **applied** and risk **assessed**			X		X
Goal 3: Co-produce alternative futures scenarios					
Obj 3.1: Co-generate community perspectives, questions and priorities regarding current conditions, resilience, and vulnerabilities					
Team workshop **held** in Spring 2024 to develop community engagement plan	X				
Internal workshop **held** to finalize community engagement plan and establish best language		X			
Convened workshops with community partners to co-identify priorities, resilience, and vulnerability		X			
Obj 3.2: Determine changes in climate, population, and the applications of technology over time, and how such stressors impact E-W systems					
Held data assessment and characterization workshop/discussions		X			
Assessment plan **finalized** regarding future scenario platforms		X			
Co-developed and **documented** decision trade offs			X		
Obj 3.3: Develop future trajectories with interweaving of local knowledge and refine characterization/modeling of alternative futures on Idaho testbed site system resilience/vulnerability					

Constructed first round of future scenarios			X		
Baseline scenarios **developed**		X			
Identified key attributes of governance affecting local government decisions			X		
Determined trade-offs from breaking traditional governance boundaries					X
Co-developed scenario-specific solutions to guide decision support and determine effects				X	
Goal 4: Develop individual, community, and institutional capacity					
Obj 4.1: Engage Students across the WFD/ED Spectrum in the Community-Engaged Energy-Water Systems Scholarship					
E-W literacy document **refined and ready** for dissemination			X		
E-W literacy meeting **held** at annual meeting	X				
31 new VIP/CIP courses were **designed**; results **reported** to communities and institutions					X
Institutional processes for VIP/CIP creation **identified**	X				
Included 75% of I-CREWS partner sites in SARE experiences			X		
Met participation target of PUI institutions and underserved students into SARE positions			X		
3 students have **completed** the EESC Certificate program				X	
Community of practice has been **formed** and 2 meetings **held**		X			
Obj 4.2: Enhance institutional transformation and professional development					
ASSERT program is **launched** at each of UI and ISU		X			
Postdoc ASSERT program is **piloted** at BSU					X
Statewide ASSERT retreat was **held**		X	X	X	X

An inventory of all faculty mentoring programs at the three universities **created**	X				
Goal 5: Improve Faculty Diversity and Equity					
Obj 5.1: Expand Search Advocates					
Implement SA program at each campus			X		
Obj 5.2: Serve Idaho's Latinx students					
Latinx students **recruited** into undergraduate research experiences, VIPs and CIPs		X		X	
Obj 5.3: Serve Idaho's Indigenous student population					
Indigenous students **recruited** into undergraduate research experiences, VIPs and CIPs		X		X	
Identified and collaborated with 3 new Indigenous-serving projects				X	
(Re)Cultivating and (Re)Newing reciprocal research Workshops **implemented**		X	X	X	
Obj 5.4: Conduct rural K-12 educational needs assessment					
Results of needs assessment **disseminated** to Research, Education and WFD teams			X		
Goal 6a: Create and sustain industry and government partnerships at State and National levels					
Obj 6a.1: Coordinate the outreach and relationship-building with partners throughout the state					
Partnership classification and directory **produced**	X				
Flexible partnership plan for engagement **developed**		X			
Assessment **completed** covering all partners and component teams, as appropriate			X		
Obj 6a.2: Advance workforce readiness in E-W resilience in Idaho					
Workshop **completed** with actionable recommendations disseminated		X			
Assessment **completed** with actionable recommendations, as appropriate					X

Obj 6a.3: Interweave partner initiatives to create sustainable relationships and opportunities that benefit Idaho E-W resilience					
Invitations **extended**, partners **joined**, where possible		X		X	
Synergies **identified** and knowledge-sharing **completed** as appropriate		X			
Actionable summary **produced**					X
Goal 6b: Develop Tribally-centered research capacity					
Obj 6b.1: Develop institutional environment for Tribally-originated research					
TNRN Strategic Plan component **completed**		X			
Hosted listening sessions in additional Tribal communities, as needed	X	X			
Convened Tribal leaders and conducted check-in via Tribal research symposia or comparable				X	
Developed one tribally-led research proposal through TNRN			X		
Obj 6b.2: Develop Tribally-centered research capacity within the three universities and within Tribal nations in Idaho					
Completed inventory of emerging Tribal research priorities and share opportunities with recruits		X			
Completed strategic plan to fill curricular gaps				X	
Two new faculty **added** to Tribal Nations Research Network			X		
Goal 7: Strengthen research and education capacity through collaboration and recognition					
Obj 7.1: Facilitate recurrent communication among I-CREWS participants and institutions					
Hosted bi-weekly Leadership Team (LT) meetings, 3 All-Hands meetings, and Annual Meeting		X		X	
Provided first shared language-related workshop during Annual Meeting		X			
Obj 7.2: Promote public, rightsholder, stakeholder, and student awareness and interest in I-CREWS research					

Delivered one I-CREWS topic with Tribes & McClure Center for Public Policy			X		X
Three newsletters and 2 videos **distributed** – and - 2 collaborative scientific publications **promoted**		X	X		
Obj 7.3: Increase I-CREWS scientific literacy through an E-W Literacy Framework and help prepare a diverse, well-trained STEM workforce					
Created and disseminated one I-CREWS targeted message outreach to CoP-related areas		X		X	
1 E-W project research and education materials **translated** into Spanish			X		
Implemented Communications Training for I-CREWS participants		X		X	
Goal 8: Develop and sustain research capacity					
Obj 8.1: Build human capacity for sustainable intellectual and transdisciplinary research capacity					
Three, then five new faculty **hired**		X	X		
Submitted 5 NSF CAREER proposals					X
Obj 8.2: *Build institutional capacity for sustainable intellectual and transdisciplinary research capacity*					
Submitted Seed proposal and Granted proposal for emerging TNRN needs			X		
Held workshop to review strategic positioning of E-W Data Hub			X		
E-W Resilience framework **published**					X
Resilience Futures Reciprocal Network scoping workshop **held**			X		
Determined interest and support for WFD/BP programs at each institution			X		
Goal 9a: Ensure continual progress and timely attainment					
Obj 9a.1: Provide effective and compliant oversight of day-to-day project implementation (operations).					
Online reporting system **implemented**	X				

Budget spending **monitored**	X	X	X	X	X
Obj 9a.2: Generate and obtain information and external input to enhance program effectiveness (accountability).					
Strategic Plan, External Evaluation Plan **implemented**		X			
Reverse Site Visit and subsequent Site Visit **accomplished**		X		X	
Initiate annual Project Advisory Board meetings	X				
Proposal success **reviewed**				X	
Obj 9a.3: Instill practices and customs that enrich transdisciplinary interweaving across topic areas and institutions (interweaving).					
One leadership retreat, 6 meetings of cross-component leads, and 1 in-person Annual Meeting **hosted**		X		X	
Potential problems, barriers, and opportunities **identified**		X		X	
Annual data management and data sharing (and permissions) workshop **delivered**	X	X	X	X	X
Obj 9a.4: Foster project alignment with state and national priorities (alignment)					
Two EPSCoR Committee meetings **hosted** annually			X		
Guidelines for large and small seed awards **formalized**	X				
Seed Award accomplishments /outcomes **reported**					X
Goal 9b: Develop and establish E-W data hub					
Obj 9b.1: Establish data needs assessment for characterization, modeling and alternative futures					
Needs assessment for data **initiated**	X				
Existing data **inventoried**		X			
Data sharing and sovereignty agreements **established.**		X			

Appropriately **shared and published** data through the public interface of the E-W Data Hub			X		
Obj 9b.2: Develop cyberinfrastructure and databases to facilitate normalized workflows/ingestion and appropriate data sharing					
Database(s) **accessible and interoperable** via API				X	
Data products appropriately **cataloged and indexed** within integrated metadata catalog					X
Metadata and data standards established		X			

B.2. Strategic Priorities and Action Plans

Overview of I-CREWS Goals, Objectives, Activities, Tasks, and Milestones.: The following sections include tables that summarize project goals, objectives, and major activities, with key annual tasks (normal font) and milestones (bold font) identified for each year of the project. **Bold** text within tables indicates annual milestones (using past tense, e.g., "completed, archived, analyzed"). Non-bold text in tables indicates activities to be undertaken (using active tense, e.g., "analyze, assess, collect"). **Blue text indicates interweaving across I-CREWS component teams.**

Objectives (gray)
Major Activities (blue)
Tasks (regular font); **Milestones (bold)**

RESEARCH - Characterize, Model, Alternative Futures

Research Component 1: Characterize Resilience in E-W Configurations

Leads: Alistair Smith (UI), Keith Weber (ISU), Matt Williamson (BSU),
Team members: Kathy Araujo (BSU), Bob Borrelli (UI), Dylan Hedden-Nicely (UI), Kitty Griswold (ISU), Brian Johnson (UI), Bruce Savage (ISU), Keith Weber (ISU), *Environmental Governance Hire (BSU),* Alyssa Kreikemeier *(UI Hire), Tribal Water Resources Hire (UI)*

Summary: This component focuses on characterizing resilience of E-W system configurations. The Characterize goal is to represent past and current configurations of E-W system complexities and indicators of multisystemic resilience. This goal is supported by four objectives.
The Characterize component interweaves closely with the Modeling and Alternative Futures components. The Characterize goals are framed within the context of iterative co-production with Tribal and community partners. Throughout Characterize are interweaving activities that include workshops and meetings to facilitate a convergence of affordant perspectives, not to adopt a single perspective, but rather to promote a respectful space where everyone seeks to understands different affordance viewpoints to then enable transformation and discussions to further advance the project goals in an interwoven team.

Research Component 1: Characterize

Goal 1: Characterize E-W systems (storage, efficiency, governance, and equity) and resilience indicators for the Idaho testbed

- Objective 1.1: Characterize the historic and current state of the E-W systems (storage, efficiency, governance, and equity) for the Idaho testbeds.
- Objective 1.2: Identify and characterize potential cross-network and multi-scale indicators of resilience capacity of E-W systems under stress.
- Objective 1.3: Characterize data gaps, drivers, and interactions between SETS attributes, historical perturbations in the E-W system, and resilience/vulnerability.
- Objective 1.4: Characterize typologies/archetypes of how E-W configurations respond to stressors and characterize multivariate decision factors driving tradeoff decisions.

	Project Activities					
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Responsible Parties**
Objective 1.1: Characterize the historic and current state of the E-W systems (storage, efficiency, governance, and equity) for the Idaho testbeds.						
Collate quantitative and qualitative data within testbeds and across Idaho to characterize E-W systems at different scales and analyze trends to assess magnitude and interaction of stressors on testbed locations.						
1.1.A	Datasets that describe historical and current storage and efficiency in	Data associated with identified gaps were **collated** and further statewide	Data associated with identified gaps were **collated**.	Data associated with identified gaps were **collated**.	Testbed data characterization were **completed**. Secondary data	Alistair Smith

	E-W systems were **identified**. Data was **shared** with E-W Data Hub.	and testbed data gaps were **identified**. In coordination with E-W Data Hub project metadata standards and metadata tools were **selected**. Coordinate with Modeling Team to resolve statewide data gaps.	Syntheses papers were **published** that describe statewide E-W datasets and needs. Coordinated with Modeling Team to **resolve** gaps in testbed data. Online workforce development (WFD) training modules describing access and use of primary data were **completed.**	Primary data papers were **published** associated with the baseline E-W datasets. Additional data gaps for new testbeds sites were **identified**. Online WFD training modules describing access and use of secondary data were **completed.**	papers were **published** associated with data produced by I-CREWS. Online WFD data access and use training modules were **completed** by 100 people (I-CREWS team and within regular courses).	
Identify potential additional testbed locations and coordinate with the TNRN and E-W Data Hub to refine data access, use, publication/authorship attribution, and sharing, protocols.						
1.1.B		Analysis of the variability and gradients of SETS across Idaho were **completed** and potential additional testbed locations **identified**.	At least 1 workshop were **offered** to educate I-CREWS participants to FAIR and CARE principles and data sovereignty.	At least 1 workshop were **offered** to educate new I-CREWS participants to FAIR and CARE principles and data sovereignty.		Matt Williamson

Conduct interviews with knowledge-rights holders to characterize testbed E-W systems.						
1.1.C	Interview approach **identified.** Initial survey instruments were **created** and IRB approvals **obtained**. Participant IRB and RCR training were **completed.**	Coordinate with Alternative Futures Team to develop questions related to outcomes that partners see as metrics of success.	Continued to analyze interview data. Preliminary products associated with how to visualize resilience and changes to E-W system from the Alternative Futures Team were **disseminated** to partners and online training modules educating people on their use **completed**.	Continued to analyze interview data. Coordinate with Alternative Futures Team to further refine products. New products associated with how to visualize resilience and changes to E-W systems from the Alternative Futures Team were **disseminated** to partners and online WFD training modules **revised**.	**Interview analysis papers published.** Papers describing the efficacy of different visualization methods to describe resilience and changes to E-W, including VR, XR, were **published.** Online WFD visualization modules were **completed** by 100 people (I-CREWS team and within regular courses).	Matt Williamson
Identify key decision factors and drivers as well as socially feasible decision pathways and tradeoffs for scenario development for use in the developed models and alternative future scenarios.						
1.1.D		Interviews were **conducted** in partnership with	Decision pathway and tradeoff data	Decision factors and tradeoffs papers associated	Decision pathway and tradeoff data analyzed and	Alistair Smith

		the TNRN to identify prior decision pathways and tradeoffs associated with historic and current E-W conditions at each testbed location.	analyzed and barriers, facilitators, and other feasible pathways associated with future E-W conditions at initial testbed location were **identified**.	with initial testbed locations were **published**. Initial visualization products (maps, VR, XR, etc.,) developed by the Modeling Team and Alternative Futures Team that describe scenarios were **completed**.	barriers, facilitators, and other feasible pathways associated with future E-W conditions at new testbed location were **identified** and secondary papers **published**. Final visualization products developed by the Modeling Team and Alternative Futures Team that describe scenarios were **completed**.	
Identify boundary conditions for models and alternative future scenarios.						
1.1.E		Historic range of variability in the E-W system (biophysical, governance, demographic, etc.) analysis were **completed**.		Paper describing historic range of variability in the E-W system were **published.**		Keith Weber

Objective 1.2: Identify and characterize potential cross-network and multi-scale indicators of resilience capacity of E-W systems under stress.						
Identify potential multi-scale and cross-gradient social (e.g., transportation routes) and natural networks (e.g., rivers).						
1.2.A		Historic and current biophysical and socio-environmental data associated with social and natural networks were **identified**.	E-W metrics for forecasting over time (e.g., crop rotations, power demand) and for assessing potential cross-network indicators of E-W systems exhibiting stress were **analyzed.**		Framework and synthesis papers on potential cross-scale indicators were **published**.	Kitty Griswold
Collate existing frameworks and indicators of resilience capacity under stress from the literature and synthesize strategies associated with data interoperability of qualitative and quantitative data.						
1.2.B	Coordinate with Alternative Futures Team and Modeling Team to assess qualitative and alternative indicators of resilience (e.g., visualizations,	Synthesis paper of existing frameworks, including weighting schema, indicators of resilience capacity under stress, and strategies associated with	Synthesis paper describing different indicators of resilience and interweaving frameworks were **published.**		3 testbed application papers showing application of resilience metrics were **published**.	Alistair Smith

	art, etc.).	data interoperability of qualitative and quantitative data were **conducted**.				
Co-develop emergent and novel indicators of resilience capacity under stress with the wider I-CREWS research team and partners.						
1.2.C		In coordination with the TNRN and Partnership Team informal meetings with testbed communities and key knowledge rights holders were **held** to understand success and co-develop emergent and novel indicators of resilience to E-W systems under stress.	In coordination with the Modeling Team and Alternative Futures Team co-developed indicators of resilience capacity under stress and place-based sovereignty and equity metrics were **evaluated**.		Papers describing novel indicators of resilience capacity under stress and novel indicators of place-based sovereignty and equity resilience metrics were **published.**	Alistair Smith
Evaluate the sensitivity and uncertainty of quantitative resilience indicators to inform potential weighting schema and Identify the most salient indicators to testbed community members and assess tools for exploring our understanding of those indicators.						

1.2.D		In coordination with the TNRN and Partnership Team meetings with testbed communities and key knowledge rights holders to understand the relative importance they assign to different indicators, tradeoff decisions, and pathways in terms of resilience to E-W systems under stress were **conducted**.	The sensitivity of quantitative data and models outputs related to the indicators of resilience capacity under stress were **evaluated**.	In coordination with the TNRN and Partnership Team meetings with testbed communities and key knowledge rights holders to understand the relative importance they assign to different indicators, tradeoff decisions, and pathways in terms of resilience to E-W systems under stress were **conducted**.	Final weighting schema associated with the quantitative datasets were **selected.**	Matt Williamson
Identify the most salient indicators to testbed community members and assess tools for exploring our understanding and conveying those indicators.						
1.2.E	Software and tools to create visualization products (VPs: infographics, vulnerability and hot-spot maps, low-fidelity 3D environments, maps, VR/XR assets, etc.) were	In coordination with the TNRN and Partnership Team informal meetings with testbed communities **held** to understand their affordant perspectives and the relative	In coordination with the Modeling Team and Alternative Futures Team region and testbed data into low fidelity 3D VR/XR environments	In coordination with the Modeling Team and Alternative Futures Team products to visualize potential indicators of resilience capacity under stress were **developed**.	Papers demonstrating the application and effectiveness of different VPs were **published.** Papers discussing different affordance perspectives of resilience were	Alistair Smith

	identified.	importance they assign to different indicators, tradeoff decisions, and pathways in terms of resilience to E-W systems under stress. VR/XR collaboration spaces were **established**.	were **created**. In coordination with the TNRN and Partnership Team, informal meetings with testbed communities **held** to understand the effectiveness of different VPs to visualize potential indicators and weights of resilience capacity under stress.	Focus group and key informant interviews to assess effectiveness of the VPs were **completed**. Finalized representations of risk, resilience, and vulnerability **presented** to project partners and testbed communities.	**published.**	
Evaluate the consistency or uniqueness of indicators across the state and within the testbed location.						
1.2.F			Potential Decision Factors and archetype factors at testbed scales were **identified**.	Potential cross-scale decision factors and archetype factors were **identified.**	Papers describing the decision factors, aligned and unaligned barriers and opportunities, and archetypes (if any) were **published.**	Matt Williamson
Co-develop with key knowledge and rights holders importance scores to inform potential weighting schema.						

1.2.G		In coordination with the Alternate Futures Team and the TNRN meetings with key knowledge rights holders to assess their perspectives of the relative importance of both quantitative and qualitative indicators of resilience capacity under stress were **conducted**.	In coordination with the Modeling Team the sensitivity of both the qualitative and quantitative data to inform a potential weighting schema were **completed**.	Weighting schema associated with the quantitative datasets were **identified** and **shared** with the Alternate Futures Team. Initial resilience products were **shared** with partners and effectiveness of weighting schema were **evaluated**.	Weighting schema were **finalized**. Application papers describing effectiveness and of weighting schema were **published.**	Laura Laumatia
Objective 1.3: Characterize data gaps, drivers, and interactions between SETS attributes, historical perturbations in the E-W system, and resilience / vulnerability.						
Understand what factors and drivers led to prior decision tradeoffs and pathways to inform "feasible" future scenarios.						
1.3.A	In coordination with the Modeling Team data sources associated with past disturbances at statewide and testbed locations level were **identified**.	In coordination with the Partnership Team, the TNRN, and Alternate Futures Team meetings with testbed key informants were **held** to understand prior decision pathways, timings	Facilitators, barriers, and unaligned decision factors from both meetings and literature were **identified**. Governance, sociopolitical	Historic decision factors that impacted the ultimate decisions that were made were **identified** and their relative impact on the success (including perceived) were	Literature review(s) of decision factors on studies similar to the I-CREWS project were **published**. Papers describing the differences between current	Matt Williamson

		and magnitude of interventions, and drivers (biophysical, governance, community, etc.,) impacting decision tradeoffs. For distinct governance periods, thematic literature review(s) of decision factors on studies similar to the I-CREWS project were **completed**.	factors, biophysical, and perceived risk/benefit factors impacted availability of decision tradeoffs and pathways were **evaluated**.	**evaluated.** Feasible "set" of decision pathways (and scenarios) were **shared** with Alternate Futures Team.	and historical decision factors were **published.**	
Characterize the Historic Range of Variability of the Resilience Metrics.						
1.3.B		In coordination with the Modeling Team, multivariate control charts were **evaluated** to identify time periods when extreme (outside HRV) historic stressors have occurred.	In coordination with the Modeling Team, statistical models were **evaluated** to assess potential interactions and feedback between E-W system processes associated with	In coordination with the Modeling Team, multivariate control charts were **evaluated** to assess when extreme (outside HRV) predicted stressors may occur. In coordination with the Alternate Futures Team, workshops with	In coordination with the Alternate Futures Team, workshops with key knowledge rights holders in the testbed communities were **conducted** to refine scenarios and demonstrate implications associated with complex decision	Keith Weber

			extreme events to identify drivers of potential system thresholds and breakpoints.	key knowledge rights holders in the testbed communities were **conducted** to co-develop scenarios and demonstrate implications associated with complex decision tradeoffs and pathways.	tradeoffs and pathways.	
Objective 1.4: Characterize typologies / archetypes of how E-W configurations respond to stressors and characterize multivariate decision factors driving tradeoff decisions.						
Interweave disparate quantitative and qualitative data sources into spatially explicit typologies / archetypes.						
1.4.A			In coordination with the Modeling Team and Alternative Futures Team potential diagnostic indicators of typologies / archetypes factors were **identified.**	In coordination with the Modeling and Alternative Futures Team an assessment of whether the different testbed locations exhibit similar (or distinct) patterns and properties that may indicate the presence of E-W archetypes of how communities consider different	Publications focused on whether a scalable typology / archetype exists were **published.**	Matt Williamson

				tradeoff decisions and respond to stressors was **conducted.**		
Interweave results of patterns of the drivers, impacts, and decision tradeoffs within Alternate Future.						
1.4.B Scenarios				Assessment of how potential timing, magnitude, and patterns of decision factors impact E-W resilience to stressors was **completed**.	In coordination with TNRN and Partnerships Team scenario outputs were **shared** with testbed communities.	**Alistair Smith**

Research Component 2: Model Dynamic Existing and Alternative E-W Configurations

Leads: Lan Li (BSU), Tim Link (UI), Leslie Kerby (ISU), Bruce Savage (ISU)
Team members: Bob Borrelli (UI), Kathy Araujo (BSU), Erin Brooks (UI), Brian Johnson (UI), Roger Lew (UI), Mojtaba Sadegh (BSU), Terry Soule (UI), *Environmental/Civil Engineer Hire (ISU),* Michael Perlmutter *(BSU Hire),* Angel Monsalve *(UI Hire), Systems Engineer Hire (BSU), Tribal Water Resources Hire (UI)*

Summary: This component focuses on the conceptual, quantitative, and qualitative modeling of existing and alternative E-W system configurations. The Modeling component supports the parameterization of configurations of future trajectories of E-W system changes. The team will implement data-driven, process-oriented models for E-W storage, efficiency, and conservation that reflect impacts from climate, population, and technological stressors. This approach uses a combination of ML and physics-based models. By leveraging ML, the team will model dynamic stressors and system variables to support the Characterization Team and the Alternative Futures Team. Measurement data from physical measurements and simulation data from physics-based computational models, combined with ML, will be integrated to model and develop scenarios of multiple E-W system trajectories. We will integrate and iterate qualitative data from interviews, surveys, feedback from other I-CREWS teams and community partners by coding key information into quantifiable data used in the ML models. The modeling component has three objectives:

1. Build datasets to develop the ML modeling platform.
2. Build ML models suitable for use in the testbed regions.
3. Quantify dynamic risk.

This component aims to increase capacity in computational modeling and machine learning, advancing our understanding of (i) scales of data needed to effectively model the risks and losses of multiple interacting stressors on E-W systems, and (ii) stressor conditions, tradeoffs and feedback decisions leading to state-shifts.

Research Component/Area: Modeling

Goal 2: Model Dynamic Existing and Alternative E-W Configurations.

- Objective 2.1: Build datasets to develop the ML modeling platform.
- Objective 2.2: Build ML models suitable for use in the Idaho testbed.
- Objective 2.3: Quantify dynamic risk.

	Project Activities					
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Responsible Parties**
Objective 2.1: Build datasets to develop the ML modeling platform.						
Offer data and ML training sessions to all I-CREWS teams and partners.						
2.1.A	**1st data and ML training session for all I-CREWS teams and partners conducted.**	**Year 1 training online archived for on demand use.**	**2nd data and ML update workshop for all I-CREWS teams and partners conducted.**	**Year 3 training online achieved for on demand use.**	**3rd data and ML update workshop for all I-CREWS and partners conducted.**	Lan Li
Collect and compile existing relevant datasets from publicly accessible databases and published literature.						
2.1.B	Collaborate with Characterize Team (lead) to identify key variables and compile existing data from available energy/water systems and databases in first testbeds.	Evaluate data quality and organize data. **Critical data gaps identified.**	Expand datasets for "drivers of change" and local knowledge. Emphasis on energy/water interdependencies. **Additional testbeds**	Compile / generate datasets for additional testbeds.	Evaluate expanded datasets for additional testbeds. **Data published / archived.**	Bruce Savage

	Share literature data with other I-CREWS teams. **Data sharing plan and agreement drafted** with other I-CREWS teams and shared with community partners.		**identified**. **Data published / archived.**			
Develop synthetic hydrometeorological, energy production, export, and usage, and water resource datasets.						
2.1.C	Assess candidate software of energy and water models.	**Selection of models for SETS completed.** Implement models for SETS 1.	**Data generation for SETS 1 completed.** Implement models for SETS 2.	**Data generation for SETS 2 completed.** Implement models for SETS 3. Incorporate stressors and mitigation measures into simulations.	**Data generation for SETS 3 completed.** **Projected data for alternative futures completed.** **Synthetic data visualizations completed.**	Tim Link
Compile data from interviews, surveys, feedback from other I-CREWS teams, and community partners.						
2.1.D	Include interweaving of knowledge to support qualitative data.	**Contributed to interview and survey questions.**	Pilot approach to interweaving of knowledge from qualitative data	Compile collective qualitative data from interviews, surveys, and other I-CREWS	**Collective qualitative data updated and interweaved.**	Leslie Kerby

		Collect synthetic social data to guide model development.		teams' feedback.		
Objective 2.2: Build ML models suitable for use in the Idaho testbeds.						
Train, validate and test ML models.						

2.2.A	**Literature review for existing data and prior modeling efforts (e.g., GEM3) for applicability completed.**	**Existing models tested and expanded if the models are suitable for use.** **New ML models built if needed.** Use qualitative data as guidance for model selection, development, and optimization. Explore capabilities of ChatGPT or other LLMs on qualitative data.	**ML models trained and tested with new observational and synthetic data for various SETS.**	**ML models expanded to integrate other features, such as: climate-driven, population, or technological stressors; hydropower, cooling of power plants, water storage, irrigation, land use, local microgrids, or hydrogen production; local governance or knowledge.** Prototype interweaving of qualitative data into ML models.	**Scenarios predicted by ML and validated with other I-CREWS teams and community partners.**	Leslie Kerby
Objective 2.3: Quantify dynamic risk.						
Determine risk to be assessed and relevant variables contributing to risk.						

2.3.A	Conduct literature review on similar risk problems. Coordinate with **Characterize** and **Alternative Futures teams.**	**SETS variables and stressors based on Characterization team results established.**	**'Status quo' futures (to compare) defined with Alternative Futures team.**	**Risk to be assessed determined.**	**Risk definition reiterated.**	Bob Borrelli
Derive or apply relevant models to characterize risk.						
2.3.B	Conduct literature review for any relevant dynamic risk modeling techniques and metrics that could be applied and/or modified.	Explore how SETS variables change with changes to stressors.	Explore how to integrate ML results.	Integrate ML results into SETS variables and stressors. **Dynamic behavior of stressors defined.**	**Knowledge Holder Inputs coupled and aligned with Alternative Futures team.**	Bob Borrelli
Assess risk.						
2.3.C	Explore incorporating 'risk' within the context of resilience or related construct with all teams.		**E-W Resilience Indicators applied.**	Conduct sensitivity analysis of risk/resilience to changes in SETS variables and stressors if needed.	**Risk assessed.**	Bob Borrelli

Research Component 3: Alternative Futures

Leads: Brittany Brand (BSU), Morey Burnham (ISU), Erich Seamon (UI)
Team: Bob Borrelli (UI), Dylan Hedden-Nicely (UI), Kitty Griswold (ISU), Laura Laumatia (CDAT), Lan Li (BSU), Sammy Matsaw (SBT), Terry Soule (UI), Jared Talley (BSU), Georgia Hart-Fredeluces (*ISU Hire*), *Environmental/Civil Engineer Hire (ISU)*

Summary: The alternative futures team will work to understand community interests and needs for complex analysis and scenarios representing alternative futures for E-W systems. These insights will inform iterative analysis/modeling that identifies decision tradeoffs that produce socially acceptable and feasible resilience pathways. Local knowledge, regional decision making, and vulnerabilities will be lenses to evaluate future pathways. Through interweaving with the other teams, we will develop immersive and interactive products that help us convey scenario outputs to a broad set of audiences. We will also develop a community engagement plan and will work across the component groups to coordinate engagement opportunities and workshops to minimize the effort of the community.

Research Component/Area: Alternative Futures

Goal 3: Co-produce alternative futures scenarios with testbed communities, interweaving local knowledge and evaluating governance approaches that affect decision-making.

- Objective 3.1: Co-generate community perspectives, questions and priorities regarding current conditions, resilience, and vulnerabilities.
- Objective 3.2: Determine changes in climate, population, and the applications of technology over time, and how such stressors impact E-W systems.
- Objective 3.3: Develop future trajectories with interweaving of local knowledge and refine characterization/modeling of alternative futures on Idaho testbed site system resilience/vulnerability.

	Project Activities					
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Responsible Parties**
Objective 3.1: Co-generate community perspectives, questions and priorities regarding current conditions, resilience, and						

vulnerabilities.						
Establish best practices and formal guidance for community engagement and co-production of knowledge.						
3.1.A	Guidance on best practices for community engagement established, documented and distributed. **Held team learning sessions on best practices for community engagement**. **Held team workshop in Spring 2024 to develop community engagement plan.** Identify key points of community contacts (people) through our existing networks.	Provide guidance (written and/or workshop) for co-production expectations and protocols. **Contribute to hiring plan and training of new hires.**	Continue community engagement best practices training / guidance Identify key points of community contacts (people) through our existing networks.	Continue community engagement best practices training / guidance	Continue community engagement best practices training / guidance Identify key points of community contacts (people) through our existing networks.	Brittany Brand

Open discussions with test bed communities to identify their questions, concerns, needs, gaps in knowledge.						
3.1.B	Initiate discussion with community points of contact. Develop relationships with test bed communities and invite them to be engaged in this project.	**Working sessions held to finalize community engagement plan and establish best language.**	Determine need for kick off workshops with NEW testbed community(s). **Established common language and guiding concepts at the community level.**			Morey Burnham
Facilitate cross-cutting group workshop, inviting community partners and component teams - what are we co-producing?						
3.1.C		**Workshop designed and shared with team.** Work with cross-cutting team to develop a process/decision tree for appropriate uses of community	Incorporate community feedback, scientific literature, and baseline data from the Characterize team.			Brittany Brand

		knowledge. **Convened workshops with community partners to co-identify E-W priorities, resilience, and vulnerability.**				
Objective 3.2: Determine changes in climate, population, and the applications of technology over time, and how such stressors impact E-W systems.						
Collect quantitative and qualitative data from testbed partners to develop scenarios.						
3.2.A		**Held data assessment and characterization workshop/discussions.** Identify and validate datasets in conjunction with Modeling and Characterize teams.				Erich Seamon
Develop spatio-temporal outputs that are represented as alternative future scenarios.						

3.2.B	**Initial data inputs developed and documented.**	**Iterative development of spatio-temporal outputs (maps).** Two joint meetings with Modeling and Characterize teams held. **Assessment plan for future scenario platforms started.**	**Assessment plan finalized regarding future scenario platforms.**	**Established communication** and feedback with stakeholders regarding future scenario trajectories.		Erich Seamon
Determine decision-trade-offs which increase/maximize resilience.						
3.2.C		Identify and document spatial and temporal extents, boundaries, unit standardization and scaling normalization for testbeds, and proposed scenarios.	**Co-developed and documented decision trade-offs.**			Erich Seamon
Objective 3.3: Develop future trajectories with interweaving of local knowledge and refine characterization/modeling of alternative						

futures on Idaho testbed site system resilience/vulnerability.						
Evaluate the effectiveness of baseline/plausible scenarios by alignment with stakeholder/researcher indicators.						
3.3.A		Identify and select visualization tools for scenarios in collaboration with Characterize and Modeling teams.	**Constructed first round of future scenarios (**depicted as spatio-temporal representations. [FALL 2025] Validate and align knowledge holder inputs with computational model outputs.	**Constructed second round of future scenarios.**	**Constructed final E-W scenario results.** Engage with communities to develop alternative spatio-temporal representations.	Erich Seamon
Identify the impact of local knowledge by comparing the results obtained from the models compiled with and without data and scenarios that integrate local knowledge.						

3.3.B		**Developed baseline scenarios.**			Compare and refine future scenario trajectories and alternative futures within the E-W systems. **Measured impacts using vulnerability indicators.**	Erich Seamon
Iterate futures with changing governance conditions using decision-making models.						
3.3.C			**Identified key attributes of governance affecting local government decisions for incorporation into scenarios.**	Identify governance components to be incorporated into alternative future models and representations.	**Determined trade-offs from breaking traditional governance boundaries through increased cooperation in test-bed site resilience.** Compare alternative governance scenarios to the Modeling Team's results to determine how	Kathy Araujo

					they affect changes in test-bed site resilience.	
Project changes to vulnerability output and evaluate options to reduce vulnerability through scenario-specific solutions.						
3.3.D				Work with testbed communities to identify populations vulnerable to high-risk scenarios. **Co-developed a suite of scenario-specific solutions to guide knowledge-holder decision support mechanisms and determine effects on vulnerability.**		Morey Burnham
Use ML to evaluate changes to coupled E-W systems for specific hydroclimatic and land-use/land-cover alternative future scenarios.						
3.3.E					Assess and model how changing SETS affect testbed community resilience and decisions using a	Erich Seamon

					stressor matrix.	

Education and Workforce Development (ED/WFD)

Leads: Karla Eitel (UI), Jim Fredricksen (BSU), and Sarah Penney-Jackson (ID EPSCoR)
Collaborators: Vince Bowen (ISU), Bill Ebener (CSI), Dylan Hedden-Nicely (UI), Katherine Himes (UI), Laura Laumatia (CDAT), Sammy Matsaw (SBT), Laticia Herkshan (ISU), Nancy Johnston (LCSC), Sonia Martinez (ISU), Doug Habib (UI), Reshmi Murkhajee (BSU), Elizabeth Redd (ISU), Miranda Striluk (CWI/BSU), Jared Talley (BSU), Colden Baxter (ISU), Keegan Schmidt (LCSC)

Guiding Research Question: How and in what ways can education and workforce development support energy-water systems resilience? What knowledge, skills, and dispositions are necessary for equitable E-W systems resilience? How should emerging understandings of E-W systems influence education and workforce development approaches? How might education and workforce development approaches inform how we define E-W system resilience?

Summary: The overall goal of the I-CREWS Education (ED) and Workforce Development (WFD) plan is to develop individual, community, and institutional capacity for more resilient and equitable futures with respect to education and E-W systems. I-CREWS builds capacity and implements programs at levels spanning K-12, through graduate education, to faculty. Proposed activities will build the necessary skills for leadership and democratic participation in equitable E-W systems through internships, coursework, and teacher professional development. Further, institutional capacity to support community-engaged teaching and learning will be developed through graduate student, faculty, and administrator development programs. Each of this plan's five objectives is aligned with the community-engaged research and capacity-building priorities of I-CREWS and integrated with plans to broaden participation (see Section 4.6). Broadening participation (BP), diversity, and inclusivity are central to building more equitable approaches and knowledge systems (Figure 6). Our overall goal will be achieved through the completion of these five ED and WFD objectives: (1) creating both Community-Integrated and Vertically-Integrated projects/courses; (2) integrating a Certificate in Environmental Education and Science Communication (EE&SC) for graduate students; (3) expanding PUI and university undergraduate research opportunities; (4) infusing high context, community-engaged E-W content in General Education (GenEd) courses at PUIs; and (5) expanding an innovative faculty professional development model for transformative scholarship.

Project Component: Education and Workforce Development

Goal 4: Develop individual, community, and institutional capacity for more resilient and equitable futures with respect to education and E-W systems.

- Objective 4.1: Engage Students across the WFD/ED Spectrum in the Community-Engaged Energy-Water Systems Scholarship.
- Objective 4.2: Enhance institutional transformation and professional development.

Project Activities

	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible Parties
Objective 4.1: Engage Students across the WFD/ED Spectrum in Community-Engaged Energy-Water Systems Scholarship.						
Create a framework that names and describes E-W systems literacy and related cross-disciplinary competencies.						
4.1.A	Identify contributors to E-W literacy framework. Hold cross-team institution meetings to compile a list of key understandings and competencies	Convene group with representation from across the project [optimally at the annual meeting]. Revise list of critical understandings and competencies (biophysical,	Convene group at annual meeting. Refine list based on iterative feedback process. **E-W literacy document refined and**	Convene group at annual meeting. Disseminate E-W literacy principles to ICREWS team to identify where literacies are being built across project (e.g. research team, mentoring, VIPs and CIPs, SARE).	Convene group at annual meeting. **E-W literacy document disseminated and implemented. Results ready to report.**	Karla Eitel

	necessary for an energy-water literate citizenry. **E-W literacy meeting held at annual meeting.**	cultural, social, data).	**ready for dissemination.**			
Create Community-Integrated Projects and expand Vertically Integrated Projects across academic institutions to engage in E-W systems literacy.						
4.1.B	Identify institutional processes necessary to support CIPs and VIPs at each institution. Identify research, educational and workforce needs (determined by communities and ICREWS team) to address. Define characteristics of CIPs. Articulate the characteristics of VIPs.	Build infrastructure as needed to support CIPs and VIPs at each institution (course numbers, listing community members as co-instructors, etc.). *and as possible…* Design 4 new VIP or CIP courses across research institutions (up to 3 total). Design 1 new CIP with Coeur d'Alene Tribe. Design 1 new CIP with Shoshone-	Create 7 new VIP or CIP courses across research institutions. 1 new VIP or CIP at LCSC/CWI/CSI. Implement 1 new CIP with Coeur d'Alene Tribe. Implement 1 new CIP with Shoshone-Bannock Tribes. Sustain courses that were	Create 7 new VIP or CIP courses across research institutions. 1 new VIP or CIP at LCSC/CWI/CSI. Sustain courses that were created. Implement 1 new CIP with Coeur d'Alene Tribe. Implement 1 new CIP with Shoshone-Bannock Tribes. Interweave course learning / findings with research, as appropriate and possible under	Create 4 new VIP or CIP courses across research institutions. 1 new VIP or CIP at LCSC/CWI/CSI. Sustain courses that were created. Report on outcomes of courses in ways that are meaningful to communities. **31 new VIP/CIP courses have been designed; results have been reported to**	Karla Eitel (CIPs) Jim Fredricksen (VIPs)

	Establish an application process to access VIP/CIP funding. Share learning opportunity on CIP/VIP for faculty and community members. **Institutional processes for VIP/CIP creation are identified.**	Bannock Tribes. **Institutional processes for VIP/CIP creation are implemented (e.g. course numbers, etc.).** **6 new VIP/CIP courses are designed.**	created. Interweave course learning / findings with research, as appropriate and possible under ethical research protocols. Report on outcomes of courses in ways that are meaningful to communities. **16 new VIP/CIP courses have been designed.**	ethical research protocols. Report on outcomes of courses in ways that are meaningful to communities. **26 new VIP/CIP courses have been designed; results reported to communities and to institutions.**	**communities and institutions.**	
Engage undergraduates in Energy-Water Systems research through the I-CREWS Summer Authentic Research Experience program.						

4.1.C	Engage all partners in development of SARE framework (objectives/criteria/partnership opportunities, etc.). Identify areas of interweaving with other components (VIP/CIP). Create and build SARE materials & website.	Promote and recruit for I-CREWS SARE program. Select 31 students to participate.	Promote and recruit for I-CREWS SARE program. Select 31 students to participate. **Include 75% of I-CREWS partner sites in SARE experiences.**	Promote and recruit for I-CREWS SARE program. Select 31 students to participate.	Promote and recruit for I-CREWS SARE program. Select 31 students to participate. **Include 100% of I-CREWS partner sites in SARE experiences.**	Sarah Penney-Jackson
Develop and implement I-CREWS SARE diversity and recruitment plan to increase participation from PUI and underserved populations.						
4.1.D	Engage partners in development of E-W-STEM diversity & recruitment plan. Integrate targeted PUI & URM	Implement plans to recruit to both institutions and partner sites.	Refine plan. Continue recruitment strategy **Met participation target of**	Refine plan. Continue recruitment strategy.	Refine plan. Continue recruitment strategy. **Met participation target of students from PUI**	Sarah Penney-Jackson

	strategies into recruitment plan. With Partnerships team engage CAES/ INL to create a 2-way pathway for I-CREWS student employment & recruitment for INL.		**students from PUI institutions and students from underserved populations into SARE positions.**		**institutions and students from underserved populations into SARE positions.**		
Mentor graduate students in Community-engaged Environmental Education and Science Communication.							
4.1.E	Identify possible students from across all three research institutions and Tribal nation partners during recruitment process. **1 student identified.**	Engage 1 student in the EE&SC at the UI McCall Field Campus. Student supports CIP development. **1 student has completed the EE&SC Certificate program.**	Engage 1 student in the EE&SC at the UI McCall Field Campus. Student supports CIP implementation. **2 students have completed the EE&SC Certificate program.**		Engage 1 student in the EE&SC at the UI McCall Field Campus. Student supports CIP implementation. **3 students have completed the EE&SC Certificate program.**	Engage 1 student in the EE&SC at the UI McCall Field Campus. Student supports CIP implementation. **4 students have completed the EE&SC Certificate program.**	Karla Eitel

Establish, describe, connect, and apply a community of practice for E-W literacy for LCSC, CSI, and CWI.						
4.1.F	PUI faculty participate in E-W literacy definitions (terms, concepts, practices, connections, etc.) activity at annual EPSCoR meeting. Create concept maps showing E-W literacy connections with terms and opportunities for skills exploration (practices).	Coordinate 2 Community of Practice meetings (different times and locations) throughout the year...e.g., P20, iSTEM, in-service. Using the co-created definition of E-W literacy, PUI leads Identify Student Learning Outcomes (SLOs) and specific courses that align with E-W literacy. Create crosswalk table to use existing SDE HE Gen Ed "Ways of Knowing" outcomes and E-W literacy. Pen a dialogue of revision of SDE	Coordinate 2 Community of Practice meetings. Create institutional conditions (e.g., administrative processes) for faculty to engage in Community-Integrated Program and/or Vertically Integrated Projects to provide high context opportunities to apply E-W literacy principles.	Coordinate 2 Community of Practice meetings. Explore institutional and industry recognition (e.g. a Certificate program or micro-badges) for students who complete E-W literacy aligned courses. **6 Community of practice meetings have been held.** **Industry recognition has been identified.**	Coordinate 4 Community of Practice meetings. Create and implement institutional recognition for students and faculty to engage in these activities at 1 of 3 PUIs. Examples: certificate recognition for students; institutional recognition of faculty activity as scholarship. **10 Community of practice meetings have been held.** **Industry recognition has been implemented.**	Bill Ebener

		gen ed outcomes. **Community of practice has been formed and 2 meetings held.**				
Objective 4.2: Enhance institutional transformation and professional development.						
Expand the ASSERT program from BSU to ISU and UI to create a network of parallel programs. Early career faculty have access to opportunities to receive mentoring.						
4.2.A	Install leads at UI and ISU. Convene meetings to share ASSERT resources from BSU to ISU and UI ASSERT leads and other campus leaders.	**ASSERT program is launched at each of UI and ISU.** Postdoc ASSERT initial design is developed at BSU.	**ASSERT cohorts are run at each of the universities.** Postdoc ASSERT program is further designed at BSU.	ASSERT cohorts are run at each of the universities. Postdoc ASSERT program design is finalized and circulated around campus at BSU.	ASSERT cohorts are run at each of the universities. **Postdoc ASSERT program is piloted at BSU.**	Jim Fredricksen
Create a structure for networking the three ASSERT program cohorts together.						
4.2.B	Plan the joint retreat schedule across the state.	**Statewide ASSERT retreat was held at BSU.**	**Statewide ASSERT retreat was held at UI.**	**Statewide ASSERT retreat was held at ISU.**	**Statewide ASSERT retreat was held at BSU.**	Jim Fredricksen

New I-CREWS faculty participate in mentoring pathways						
4.2.C	**An inventory of all faculty mentoring programs at the three universities has been created.**	Early career sessions are held at the annual meeting. Mentoring resources are shared via the IDN and other communication channels.	**Early career sessions held at the annual meeting.**	Mentoring resources are shared via the IDN and other communication channels.	Early career sessions are held at the annual meeting. **Mentoring resources shared via the IDN and other communication channels.**	Jim Fredricksen

Broadening Participation (BP)

Leads: Karla Eitel (UI), Jim Fredricksen (BSU), and Sarah Penney-Jackson (ID EPSCoR)

Collaborators: Bill Ebener (CSI), Dylan Hedden-Nicely (UI), Laticia Herkshan (ISU/SBT), Laura Laumatia (CDAT), Sammy Matsaw (SBT), Elizabeth Redd (ISU), Shanny Spang Gion (UI)

Summary:

Broadening participation (BP), diversity, and inclusivity extend directly from the ED/WFD component and are central to building more equitable approaches and knowledge systems. Our overall goal will be achieved through equity approaches to academic recruitment and hiring, to tailored support programs that serve Latinx students and Indigenous students, and a stronger understanding of rural education needs.

Project Component: Broadening Participation (BP)						
Goal 5: Improve Faculty Diversity and Equity. ● Objective 5.1: Expand Search Advocates. ● Objective 5.2: Serve Idaho's Latinx students. ● Objective 5.3: Serve Idaho's Indigenous student population. ● Objective 5.4: Conduct rural K-12 educational needs assessment.						
Project Activities						
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Responsible Parties**
Objective 5.1: Expand Search Advocates.						
Implement the Search Advocates program, currently at BSU, to UI and ISU. (Also see Objective 4.2).						

5.1.A	Install faculty leads of the SA programs at ISU and UI. Three leads meet to share resources and plans.	Engage faculty in training and implement SA program at each campus. Three leads meet to share resources and plans.	Implement SA program at each campus. Three leads meet to share resources and plans.	Implement SA program at each campus. Three leads meet to share resources and plans.	Implement SA program at each campus. Three leads meet to share resources and plans.	Reshmi Murkhajee
Objective 5.2: Serve Idaho's Latinx students.						
Serve the needs of Idaho's Latinx students through high context courses, research experiences and institutional relationships with Hispanic Serving undergraduate institutions.						
5.2.A	Solidify relationships with HSIs. Coordinate and explore opportunities with Idaho STEM Ecosystem.	**Latinx students recruited into undergraduate research experiences, VIPs and CIPs.**	Recruit Latinx into undergraduate research experiences, VIPs and CIPs. Implement CIP at HSI.	**Latinx students recruited into undergraduate research experiences, VIPs and CIPs.** Implement CIP at HSI.	Recruit Latinx into undergraduate research experiences, VIPs and CIPs. Implement CIP at HSI.	Sonia Martinez
Objective 5.3: Serve Idaho's Indigenous student population.						
Serve the needs of Indigenous communities and Indigenous students through educational and research experiences working with Tribal nations.						

5.3.A	Continue to invest in relationships with Tribal nations.	**Indigenous students recruited into undergraduate research experiences, VIPs and CIPs.**	Recruit Indigenous students into undergraduate research experiences, VIPs and CIPs. Implement CIPs in collaboration with Tribal nations.	**Indigenous students recruited into undergraduate research experiences, VIPs and CIPs.** Implement CIPs in collaboration with Tribal nations.	Recruit Indigenous students into undergraduate research experiences, VIPs and CIPs. Implement CIPs in collaboration with Tribal nations.	Sarah Penney-Jackson
Collaborate with existing Indigenous-serving projects.						
5.3.B	Convene 1 cross-collaboration meeting with PIs of CIRCLES, Cultivating Relationships and Weetespeme Stewardship Project.	Convene 1 cross-collaboration meeting with PIs of CIRCLES, Cultivating Relationships and Weetespeme Stewardship Project. **Identify and collaborate with 1 new Indigenous-serving projects.**	Convene 1 cross-collaboration meeting with PIs of CIRCLES, Cultivating Relationships and Weetespeme Stewardship Project.	Convene 1 cross-collaboration meeting with PIs of CIRCLES, Cultivating Relationships and Weetespeme Stewardship Project. **Identify and collaborate with 3 new Indigenous-serving projects.**	Convene 1 cross-collaboration meeting with PIs of CIRCLES, Cultivating Relationships and Weetespeme Stewardship Project.	Karla Eitel

Expand (Re)Cultivating and (Re)Newing reciprocal research workshops for faculty, post docs, and administrators.						
5.3.C	Outreach to TNRN for potential collaboration and coordination.	**1st Workshop implemented (spring 2025).**	**2nd Workshop implemented (spring 2026).**	**Culminating Workshop implemented (spring 2027).** Analyze data & results.	**Workshop results Shared** Prepare manuscript.	Liz Redd
Objective 5.4: Conduct rural K-12 educational needs assessment.						
Serve Rural K-12 ED Needs by conducting a formal needs assessment of education and workforce in rural, Latinx and Indigenous communities with respect to energy-water resilience.						
5.4.A	Establish / foster relationships with rural partners.	**Surveys conducted.** Workshops implemented across rural communities to understand E-W workforce and education needs.	**Disseminate results of needs assessment to Research, Education and WFD teams.**	Demonstrate how Research, Education and WFD are addressing identified needs.		Jared Talley

Partnerships and Collaborations

Leads: Kathy Araujo (BSU), Brian Johnson (UI), Kitty Griswold (ISU)

Team Members: Travis McLing (INL), Justin Welch (INL)

Collaborators: INL (Resilience Optimization Center - IROC, Energy and Environment Science & Technology Directorate, etc.), Idaho Power, Idaho AVISTA, Idaho Consumer-Owned Utilities Association (ICUA), Idaho STEM Action Center, Idaho Department of Water Resources, ISU's Center for Ecological Research and Education (CERE), UI's Center for Secure and Dependable Systems (CSDS), etc. Note: All Idaho tribes are welcome to engage as partners via this component. Additional collaborators may be added, as appropriate. This plan accounts for the above partners and anticipates that other partners will be engaged, as determined, throughout the project.

Summary: The Partnership component has an overarching goal to create and sustain partnerships that advance the fundamental knowledge and capacity-building aims of I-CREWS. Note: the term 'partner' for this section refers to state, regional, or federal-level collaborators from industry or government.

This involves advancing workforce readiness in E-W systems resilience in Idaho interweaving partner initiatives to create sustainable relationships and opportunities that benefit Idaho's E-W resilience. Partnerships and collaborations are fundamental to all project areas, facilitating the interweaving of science with informed governance and system management. INL and Tribal nations, together with other private and public sector groups, will support capacity-building, leverage computational cyberinfrastructure, and support knowledge-sharing, research, and professional networks among students and employers. Engagement of partners across constituencies (scientists, land managers, policymakers, administrators, sovereigns, and users) will help to advance the interweaving or integration of more comprehensive science with management and policy strategies for resilient stewardship and governance that accounts for locally-valued choices as well as capacity-building to achieve proposed impacts.

Project Component: Partnerships and Collaborations

Goal: Create and sustain industry and government partnerships at State and National levels that advance fundamental knowledge and capacity-building.

- Objective 6a.1: Coordinate the outreach and relationship-building with partners throughout the state.
- Objective 6a.2: Advance workforce readiness in E-W resilience in Idaho.
- Objective 6a.3: Interweave partner initiatives to create sustainable relationships and opportunities that benefit Idaho E-W resilience.

	Project Activities					
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Responsible Parties**
Objective 6a.1: Coordinate the outreach and relationship-building with partners throughout the state.						
Coordinate outreach, relationships and capacity-building with partners, leveraging the diversity of the I-CREWS network.						
6a.1.A	Survey point(s) of contact within the I-CREWs team and with partners. **Partnership classification and directory produced.** Work with TNRN to identify best practices for tribal engagement, and needs/priorities for co-developing or implementing coherent I-CREWS strategy.	Survey partner capabilities and resources tied to E-W systems and workforce capability. Identify needs and opportunities for core I-CREWS team, and testbed communities. **Flexible roadmap produced.** Coordinate cross-cutting outreach with Characterize, Modeling, Alternative Futures teams/TNRN/ Education/ Workforce/ Diversity teams on	Complete review and update, as appropriate. **Assessment completed covering all partners and component teams, as appropriate.**	Complete review and update, as appropriate. **Assessment completed covering all partners.** Complete review and update, as appropriate. **Assessment completed with actionable updates, as appropriate, communicated across I-CREWS and partners.**	Assess, formulate lessons learned/ recommendations; gauge interest in areas for future engagement. **Assessment completed with actionable recommendations, as appropriate.** Assess, formulate lessons learned/ recommendations; gauge interest in areas for future engagement. **Assessment**	Kathy Araujo

		equipment/training/ advising/data needs, plus stake-/ knowledge- /rights-holders, all as appropriate. **Flexible partnership plan for engagement developed.**			**completed with actionable recommendations, as appropriate.** Assess, formulate lessons learned/ recommendations; gauge interest in areas for future engagement. **Assessment completed with actionable recommendations, as appropriate.**	
Objective 6a.2: **Advance workforce readiness in E-W resilience in Idaho.**						
Collect input and disseminate on external partner workforce needs, advising potential, and experiential learning potential with respect to the energy-water systems resilience.						
6a.2.A		Host a workshop to determine key areas for potential synergistic value (workforce needs, advising potential, and experiential learning potential). **Workshop completed with**			Assess, formulate lessons learned/ recommendations; gauge interest in areas for future engagement. **Assessment completed with actionable recommendations,**	Kitty Griswold

		actionable recommendations, as appropriate, disseminated across I-CREWs and external partners.			**as appropriate.**	
Objective 6a.3: Interweave partner initiatives to create sustainable relationships and opportunities that benefit Idaho E-W resilience.						
Develop a two-way process/mechanism for engaging, advising, and communicating with I-CREWS external partners.						
6a.3.A	Create two-way communication channels and problem-solving process in discussion with Cross-cutting, Characterize, Modeling, Alternative Futures and Education/ Workforce Development/ Diversity, TNRN, and Expert Advisory Panel (EAP). **Flexible mechanism adopted that accounts for channels of interface.**	Repeat, as in prior year. **Invitations extended, partners joined, where possible.**	Review and update, as appropriate. **Assessment completed with implemented updates, as appropriate.** Repeat, as in prior years. **Invitations extended, partners joined, where possible.**	Repeat, as in prior years. **Invitations extended, partners joined, where possible.**	Assess, formulate lessons learned/ recommendations; gauge interest in areas for future engagement. **Assessment completed with actionable recommendations, as appropriate.** Repeat, as in prior years. **Invitations extended, partners joined, where possible.**	Kathy Araujo

	Invite external, collaborating organizations to participate in Idaho EPSCoR annual meeting. **Invitations extended, partners joined, where possible.**					
Establish and leverage ties with other large federally-funded projects that overlap with I-CREWS.						
6a.3.B		Survey relevant projects. **Actionable summary produced.** Conduct outreach with others in large federally-funded projects that overlap with I-CREWS. **Synergies identified and knowledge-sharing completed as appropriate.**		Review and update. **Actionable summary produced** . Review, update, and conduct outreach. **Synergies identified and knowledge-sharing completed as appropriate.**	Review and update. **Actionable summary produced.** Review, update, and conduct outreach. **Synergies identified and knowledge-sharing completed as appropriate.**	Brian Johnson

Component/Area: Engage and Strengthen Partner Initiatives – Tribal Nation Research Network

Leads: Dylan Hedden-Nicely (UI), Laura Laumatia (CDAT), Sammy Matsaw (SBT), Kitty Griswold (ISU)

Collaborators: Colden Baxter (ISU), Sophia Borgias (BSU), Karla Eitel (UI), Laticia Herkshan (ISU/SBT), Andy Kliskey (ID EPSCoR), Sarah Penney-Jackson (ID EPSCoR), Liz Redd (ISU)

Summary: The purpose of the Tribal Nation Research Network ("TNRN") is to recenter knowledge exchange between Tribal Nations and Idaho universities, and support Tribes in their nation-building efforts. Nation building refers to "a community's natural right to determine the tools, knowledge, and ways of living that best further the culture and community growth" (Stevens, Lorenzo, & Ahumada, 2021). Critical to that effort is dismantling the barriers to inclusion not just for Tribal students, but for inclusion of Tribal ways of knowing into higher education and research. The TNRN will focus on collaboration between Tribes and the universities through the development of tribally-originated research, education through the Community Integrated Program (CIP) education projects and other educational initiatives that are supported by a long-term strategic plan for sustaining research capacity across partners.

Project Component: Partnerships and Collaborations: Tribal Nation Research Network

Goal 6b: Develop tribally-centered research capacity.

- Objective 6b.1: Develop institutional environment for Tribally-originated research.
- Objective 6b.2: Develop Tribally-centered research capacity within the three universities and within Tribal nations in Idaho.

	Project Activities					
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Responsible Parties**
Objective 6b.1: Develop institutional environment for Tribally-originated research.						

Develop TNRN Strategic Plan.						
6b.1.A	Finalize overall I-CREWS Strategic Planning and TNRN component.	**TNRN Strategic Plan component completed.**		Initiate TNRN strategic plan process for years 6-10. Plan tribal research symposium(s) to share TNRN research and provide workshops to develop new/supplemental TNRN research priorities.	Identify funding sources to fund years 6-10. **Strategic plan for years 6-10 finalized, including sustainability plan.** Draft five-year report for distribution.	Dylan Hedden-Nicely
Establish research protocols within and between the Tribes and the three universities.						
6b.1.B	Research MOUs that address research protocols at other institutions. **Hosted listening sessions in at least two Tribal communities to garner input and address**	Establish TNRN governance procedures. **Hosted listening sessions in additional Tribal communities, as needed.** Track development of	Work with universities and other entities to develop or improve data agreements. Identify best practices for research dissemination within Tribal	**Convened Tribal leaders and conducted check-in via Tribal research symposia or comparable opportunity**	Update tribal MOUs (as needed) for next round of research. **Results disseminated within TNRN communities.**	Dylan Hedden-Nicely

	concerns. Identify existing research protocols at each tribe, as well as current university tribal research requirements. Develop and host a workshop on FAIR and CARE data principles for faculty and tribal representatives.	and participate in or collaborate on MOA/MOUs between Tribal Nations and research institutions.	communities. **Best-practices framework established for research protocols and data agreements.**			
Develop and Implement Tribally-Originated Research.						
6b.1.C	Identify research that is already initiated or completed and share results with tribal communities/leadership, as well as tools, research from previous EPSCoRs that may be of interest.	Begin to formulate tribal research questions and pilot projects. Identify tribal and university researchers for research projects.	**Developed one tribally-led research proposal through TNRN.**	Engage in tribal research. Begin to disseminate research results.	Disseminate research results. **Hosted statewide Tribal Symposium to share TNRN research with tribal leadership and others.** Begin to formulate a second round of tribally-originated	Dylan Hedden-Nicely

					research questions. Identify funding sources.	
Objective 6b.2: Develop Tribally-centered research capacity within the three universities and within Tribal nations in Idaho.						
Build Native student-researcher capacity.						
6b.2.A	As part of TNRN strategic plan, host meeting with university student services/Native student centers and Tribal Depts of Education to begin to develop a process for identifying potential student recruits. Include representatives from area PUIs/Tribal colleges, Idaho Indian ED committee members.	Identify with WFD Team the tribal undergraduates for recruitment for TNRN research projects and develop criteria for selection and funding. **Completed inventory of emerging Tribal research priorities and share opportunities with student recruits.**	Work with WFD to develop student pathways from high school to graduate/law school (including opportunities at 2-year colleges). Start identification of curricular gaps for TNRN students.	**Completed strategic plan to fill curricular gaps.** Develop proposal to integrate NA studies across institutions, e.g., cross-listed courses, and explore opportunities for joint-appointed faculty. **Curricular gaps for TNRN students identified, with steps identified to address course development.**		Dylan Hedden-Nicely

Build Faculty researcher capacity through recruitment, hiring, and retention of Tribal faculty and/or faculty with TNRN commitments.						
6b.2.B	Consider expanding the TNRN strategic plan to include a plan to hire joint-appointed faculty/tribal researchers. Work with teams to ensure that TNRN activities are integrated into broader I-CREWs research goals, WFD goals, and postdoc duties. Inventory potential faculty mentors for new hires.	Explore opportunities to support institutionalizing tribal scholar positions. Identify barriers to recognition of community partnerships in existing T&P process and make recommendations on alternative recognition pathways.	Work with existing university programs to develop a faculty mentorship program to support new hires (e.g., ASSERT program). **Two new faculty added to Tribal Nations Research Network.** Continue engaging new faculty in support of TNRN research. Develop a tribal nation building training curriculum.	Use Tribal research symposium or comparable gathering to solicit feedback from Tribal leaders on shared appointments. TNRN leaders meet individually with new hires to assess challenges and strengths and concerns regarding joint appointments.		Dylan Hedden-Nicely

Communication and Dissemination

Leads: Sarah Penney-Jackson (ID EPSCoR)

Collaborators: McClure Center (Katherine Himes), Project Scientia (Carolina Viera), Leigh Cooper (UI), Zenaida De La Cruz (BSU), and (TBD ISU)

Summary: I-CREWS implements numerous approaches for communication and dissemination of project progress and results to increase general scientific literacy on I-CREWS topics; develop a diverse, well-trained workforce; promote sharing of data and findings; and enhance recognition of Idaho's E-W activities and accomplishments. Our communications plan is coordinated by Idaho EPSCoR staff in collaboration with all partner institutions.

The intent of the I-CREWS Communication and Dissemination Plan is to: (1) foster successful collaboration, including sharing of data and findings, across disciplinary, institutional, and other boundaries, and (2) help Idaho prepare a diverse, well-trained STEM workforce and scientifically informed citizenry.

Project Component: Communication and Dissemination
Goal 7: Strengthen research and education capacity through collaboration and recognition. ● Objective 7.1: Facilitate recurrent communication among I-CREWS participants and institutions. ● Objective 7.2: Promote public, rightsholder, stakeholder, and student awareness and interest in I-CREWS research. ● Objective 7.3: Increase I-CREWS scientific literacy through an E-W Literacy Framework and help prepare a diverse, well-trained STEM workforce.
Project Activities

	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible Parties
Objective 7.1: Facilitate recurrent communication among I-CREWS participants and institutions.						
Foster regularly occurring cross-project interaction.						
7.1.A	Host bi-weekly Leadership Team (LT) meetings, 3 All-Hands, and 1 Annual Meeting.	Host bi-weekly Leadership Team (LT) meetings, 3 All-Hands, and 1 **Annual Meeting.**	Host bi-weekly Leadership Team (LT) meetings, 3 All-Hands, and 1 Annual Meeting.	Host bi-weekly Leadership Team (LT) meetings, 3 All-Hands, and 1 **Annual Meeting.**	Host bi-weekly Leadership Team (LT) meetings, 3 All-Hands, and 1 Annual Meeting.	Rick Schumaker
Develop skills, shared platforms, and language to facilitate research and education collaboration.						
7.1.B	Identify platform to share I-CREWS language across disciplines. Engage participants to utilize platform.	Implement shared platform and refine as needed. **Provide one shared language-related workshop during Annual Meeting.**		**Provide one shared language-related workshop during Annual Meeting.**		Rick Schumaker
Objective 7.2: Promote public, rightsholder, stakeholder, and student awareness and interest in I-CREWS research and education.						
Disseminate scientific results.						

7.2.A		Identify targeted conferences. Identify I-CREWS topic in coordination with partners.	**Deliver one I-CREWS topic in coordination with partners.**	Identify I-CREWS topic in coordination with partners.	**Deliver one I-CREWS topic in coordination with partners.**	Sarah Penney-Jackson
Produce and distribute project results and communications material.						
7.2.B	Publish 2 media releases. Distribute 3 newsletters. Participate in 1 stakeholder sponsored event.	Publish 3 media releases. **Three newsletters and 2 videos distributed.** Convert abstracts for the public.	Publish 5 media releases. Distribute 3 newsletters. Participate in 3 stakeholder sponsored events. **Promoted 2 collaborative scientific publications**	**Six media releases published** Distribute 3 newsletters and 5 videos. Publication abstracts rewritten for public audience.	Publish 6 media releases. Distribute 3 newsletters and 7 videos. Participate in 6 stakeholder sponsored events. **Promoted 2 collaborative scientific publications**	Sarah Penney-Jackson
Objective 7.3: Increase I-CREWS scientific literacy through an E-W Literacy Framework and help prepare a diverse, well-trained STEM workforce						
Utilize the E-W Literacy Framework for use in trainings and use by project participants.						

7.3.A	Identify strategies to incorporate E-W Literacy Framework in communication training. Coordinate efforts to identify targeted communication strategies to rural/non-scientific communities.	Utilize E-W Literacy Framework to help guide and infuse 1 communication training into project components. **Create and disseminate one I-CREWS targeted message outreach to CoP-related areas.**	Create and disseminate I-CREWS targeted message outreach to CoP-related areas.	Utilize E-W Literacy Framework to help guide and infuse 1 communication training into project components. **Create and disseminate two I-CREWS targeted message outreach to CoP-related areas.**	Share and distribute E-W Literacy Framework via outreach and targeted messaging (web/other).	Sarah Penney-Jackson
Engage in Science Communication efforts to prepare diverse, well-trained STEM workforce.						
7.3.B	Meet with Project Scientia to discuss mechanisms for diverse recruitment into I-CREWS research.	**Implement 1 Communications Training for I-CREWS participants.** Translate (via Project Scientia) 1 E-W project research and education materials into Spanish.	**1 E-W project research and education materials translated into Spanish.**	**Implement 1 Communications Training for I-CREWS participants.** Translate (via Project Scientia) 1 E-W project research and education materials into Spanish.	Translate (via Project Scientia) 1 E-W project research and education materials into Spanish.	Sarah Penney-Jackson

Sustainability

Leads: Andy Kliskey (ID EPSCoR), Rick Schumaker (ID EPSCoR)

Team Members: Kathy Araujo (BSU), Dylan Hedden-Nicely (UI), Kitty Griswold (ISU), Karla Eitel (UI), Laura Laumatia (CDAT), Jim Fredricksen (BSU), Sammy Matsaw (SBT), Luke Sheneman (UI), Alistair Smith (UI)

Summary: Sustainability of I-CREWS activities is of paramount importance to ensure that investments from NSF, the State of Idaho, and partners will continue after the award period. I-CREWS will: (1) support and sustain human capacity for sustainable intellectual and transdisciplinary research capacity, and (2) support and sustain efforts to advance knowledge on energy-water resilience.

Project Component: Sustainability

Goal 8: Develop and sustain research capacity for E-W resilience and futures.

- Objective 8.1: Build human capacity for sustainable intellectual and transdisciplinary research capacity.
- Objective 8.2: Build institutional capacity for sustainable intellectual and transdisciplinary research capacity.

Project Activities

	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible Parties
Objective 8.1: Build human capacity for sustainable intellectual and transdisciplinary research capacity.						
Recruit and hire personnel.						

8.1.A	Initiate faculty and postdoc recruitment. Initiate ASSERT Initiate Search Advocates.	**Three new faculty hired.** Fill graduate student cohort, Hire postdocs.	**Five new faculty hired.**	Fill graduate student openings. Fill postdoc openings.	Report impact of 8 institutionalized faculty hires.	Rick Schumaker
Develop and demonstrate research competitiveness.						
8.1.B	Initiate cross-project training.	Proposal working group formed. NSF proposals submitted.	NSF proposals submitted.	**NSF CAREER proposals submitted.** NSF proposals submitted.	**NSF CAREER proposals submitted.** NSF proposals submitted.	Andy Kliskey
Establish national recognition of I-CREWS scholarly work.						
8.1.C		Conference presentations delivered. Peer-reviewed manuscripts published.	Conference presentations delivered. Peer-reviewed manuscripts published.	Conference presentations delivered. Peer-reviewed manuscripts published.	Conference presentations delivered. Peer-reviewed manuscripts published.	Alistair Smith
Establish reciprocal recognition of I-CREWS co-produced work.						

8.1.D			Community or Tribal member co-authored manuscripts, or Community or Tribe Invited presentations or other engagements.	Community or Tribal member co-authored manuscripts, or Community or Tribe Invited presentations or other engagements.	Community or Tribal member co-authored manuscripts, or Community or Tribe Invited presentations or other engagements.	Andy Kliskey
Objective 8.2: Build institutional capacity for sustainable intellectual and transdisciplinary research capacity.						
Establish a Tribal Nations Research Network (TNRN) (Also see Goal 6b).						
8.2.A	Establish initial network; Revisit and affirm goals.	**Held retreat to design network approach and protocols.** **Submitted GRANTED proposal for Tribal research administration capacity**	**Submitted Seed proposal for emerging TNRN needs.**	Develop agreements and MOU to support TNRN.	Evaluate TNRN impact. **Draft next 5-year vision for evolving TNRN.** Identify and submit/secure funding for next 5-years.	Dylan Hedden-Nicely
Establish an Energy-Water Data Hub (E-W Data Hub) (Also see Objective 9.b.2).						

8.2.B	Needs assessment undertaken.	Ongoing implementation of Hub.	**Hold workshop to review strategic positioning of E-W Data Hub**	Draft strategic plan for institutionalizing E-W Data Hub.	Finalize agreements, funding plan, and MoA.	Luke Sheneman
Establish an Energy-Water Resilience Framework (Also see Goal 1).						
8.2.C	Draft framework.	Start pilot testing framework including vetting with partners.	Continue pilot testing framework.	Evaluate and revise framework.	**Publish framework.**	Alistair Smith
Establish a Resilience Futures Reciprocal Network.						
8.2.D		Undertake needs assessment; incorporate previous Track-1 experience.	**Held scoping workshop.** Design statewide structure. Identify initial agreements with centers, institutes etc.	Draft agreements and MOU for centers, institutes, and organizations vetted and revised. Identify external center funding.	Finalize Futures Network and 5-year strategic plan.	Andy Kliskey
Sustain and institutionalize WFD/ED/Diversity programs.						

8.2.E		Identify potential programs to sustain (e.g., VIP, CIP, CoP, etc.).	**Determined interest and support for each program at each institution (college, university, Tribe).**	Determine each institution's needs to enable sustainment, any partnerships or collaborations needed in the future, any MOUs needed.	Determine institutional structure; draft MOUs.	Karla Eitel

Management, Evaluation and Assessment Plan

Leads: Andy Kliskey (EPSCoR) & Rick Schumaker (EPSCoR)

Collaborators: Leadership Team, Luke Sheneman (UI), Sanaz Salati (UI), Kim Bernard (Evaluator)

Summary: Idaho's I-CREWS EPSCoR management plan provides overall management and oversight and facilitates interweaving and collaboration across both teams and institutions to meet project goals. An established and successful team science-based management strategy will be utilized. General oversight is provided by the *Idaho EPSCoR Committee*, including the *Executive Committee* (ExComm), which includes the State Committee Chair, Vice Chair, the respective Vice Presidents for Research at UI, ISU and BSU. The project is managed through shared leadership represented by the Leadership Team (LT) and Component Leads (CL).

Project Element: Management & Evaluation/Assessment

Goal 9a: Ensure continual progress and timely attainment of project goals and outcomes.

- Objective 9a.1: Provide effective and compliant oversight of day-to-day project implementation (operations).
- Objective 9a.2: Generate and obtain information and external input to enhance program effectiveness (accountability).
- Objective 9a.3: Instill practices and customs that enrich transdisciplinary interweaving across topic areas and institutions (interweaving).
- Objective 9a.4: Foster project alignment with state and national priorities (alignment).

Goal 9b: Develop & establish E-W data hub as an essential centralized data catalog, repository and interweaving platform for all I-CREWS data.

- Objective 9b.1 - Establish data needs assessment for characterization, modeling and alternative futures.
- Objective 9b.2 - Develop cyberinfrastructure and databases to facilitate normalized workflows/ingestion and appropriate data sharing.

Project Activities

	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible Parties

Objective 9a.1: Provide effective and compliant oversight of day-to-day project implementation.						
Manage administrative information and data sharing.						
9a.1.A	**Online reporting system implemented.** Host 10 leadership meetings. Develop shared software platform. Establish Working Groups. Monitor budget.	Review partnership agreements. Use EDOCS and internal reporting systems. **10 leadership meetings hosted.** Oversee working groups. Monitor budget.	Use EDOCS and internal reporting system. Host 10 leadership meetings. Oversee working groups. **Budget spending monitored.**	Review partnership agreements. **EDOCS and Internal reporting system used.** Host 10 leadership meetings. Oversee working groups. Monitor budget.	Use EDOCS internal reporting system. Host 10 leadership meetings. Oversee working groups. Monitor budget.	Andy Kliskey, Rick Schumaker
Objective 9.2: Generate and obtain information and external input to enhance program effectiveness.						
Plan, monitor, and report progress.						
9a.2.A	Assess internal progress reports, 1 PAB report, and 1 evaluation plan. Submit annual report to NSF.	Assess internal progress reports, 1 PAB report, and 1 evaluation report. Submit annual report to NSF.	Assess internal progress reports, 1 PAB report, and 1 evaluation report. Submit annual report to NSF.	Assess internal progress reports, 1 PAB report, and 1 evaluation report. Submit annual report to NSF.	Assess internal progress reports, 1 PAB report, and 1 evaluation report. Submit annual report to NSF.	Andy Kliskey, Rick Schumaker

	Develop Strategic Plan. Develop Evaluation Plan.	**Strategic Plan, External Evaluation Plan implemented.** Monitor milestones.	Update Strategic Plan and External Evaluation Plan. Monitor milestones.	**Strategic Plan and External Evaluation Plan updated.** Monitor milestones.	Implement Strategic Plan, External Evaluation Plan. Monitor milestones.	
Formally evaluate and assess program activities.						
9a.2.B	Conduct SWOT analysis. Host 1 PAB meetings. Respond to PAB report. Establish EAC.	Host 2 PAB meetings. Respond to PAB and external evaluation reports. **RSV accomplished.** Review proposal success.	Assess seed funding outcomes. Host 2 PAB meetings. Implement response to PAB, RSV, and external evaluation reports.	**NSF Site Visit hosted.** **Seed Funding outcomes assessed.** Host 2 PAB meetings Respond to PAB and external evaluation reports. **Proposal success reviewed.**	Host 2 PAB meetings. Implement response to PAB, external evaluation, and Site Visit reports.	Andy Kliskey, Rick Schumaker
Objective 9a.3: Instill practices and customs that enrich transdisciplinary interweaving across topic areas and institutions.						
Bring people from different organizations and disciplines together in productive meetings/events.						

9a.3.A	Host 1 leadership retreat, 6 meetings of cross-component leads, and 1 in-person Annual Meeting.	**One leadership retreat, 6 meetings of cross-component leads, and 1 in-person Annual Meeting hosted.**	Host 1 leadership retreat, 6 meetings of cross-component leads, and 1 virtual Annual Meeting.	**One leadership retreat, 6 meetings of cross-component leads, and 1 in-person Annual Meeting hosted.**	Host 1 leadership retreat, 6 meetings of cross-component leads, and 1 virtual Annual Meeting.	Rick Schumaker
Communication and Dissemination (see Goal 7).						
9a.3.B						
Arrange regular meetings between research and other I-CREWS teams.						
9a.3.C	Conduct monthly cross-functional team meetings across project area teams.	**Monthly cross-functional team meetings across project area teams conducted.**	Conduct monthly cross-functional team meetings across project area teams.	**Monthly cross-functional team meetings across project area teams conducted**	Conduct monthly cross-functional team meetings across project area teams.	Brittany Brand
	Coordinate and participate in monthly cross-functional team meetings to identify potential problems, barriers, and opportunities (see Risk	**Potential problems, barriers, and opportunities identified.**	Monthly interweaving team meetings to identify potential problems, barriers, and opportunities.	**Potential problems, barriers, and opportunities identified.**	Coordinate and participate in monthly cross-functional team meetings to identify potential problems, barriers, and opportunities.	

	Management).					
Coordinate Data Management and Sharing Workshops.						
9a.3.D	In coordination with the E-W Data Hub, develop data management and data sharing (and permissions) workshop for project participants.	**In coordination with the E-W Data Hub, an annual data management and data sharing (and permissions) workshop delivered.**	In coordination with the E-W Data Hub, coordinate an annual data management and data sharing (and permissions) workshop	**In coordination with the E-W Data Hub, an annual data management and data sharing (and permissions) workshop delivered.**	In coordination with the E-W Data Hub, coordinate an annual data management and data sharing (and permissions) workshop.	Sanaz Salati
Coordinate Engagement and Partnership Meetings.						
9a.3.E	**As detailed in Goals (1.2.B, 1.2.C., 2.1.A., 2.1.C., 2.2.B., 2.2.D., and 3.1.A),** coordinate as needed engagement and partnership meetings associated with characterization of E-W testbeds.	**As detailed in Goals (1.2.B, 1.2.C., 2.1.A., 2.1.C., 2.2.B., 2.2.D., and 3.1.A), coordinate as needed engagement and partnership meetings associated with characterization of E-W testbeds.**	**As detailed in Goals (1.2.B, 1.2.C., 2.1.A., 2.1.C., 2.2.B., 2.2.D., and 3.1.A), coordinate as needed engagement and partnership meetings associated with characterizatio n of E-W**	**As detailed in Goals (1.2.B, 1.2.C., 2.1.A., 2.1.C., 2.2.B., 2.2.D., and 3.1.A), coordinate as needed engagement and partnership meetings associated with characterization of E-W testbeds.**	**As detailed in Goals (1.2.B, 1.2.C., 2.1.A., 2.1.C., 2.2.B., 2.2.D., and 3.1.A), coordinate as needed engagement and partnership meetings associated with characterization of E-W testbeds.**	Alistair Smith

			testbeds.			
Objective 9a.4: Foster project alignment with state and national priorities.						
Support State EPSCoR Committee governance.						
9a.4.A	Host 2 EPSCoR Committee meetings.	Host 2 EPSCoR Committee meetings. Participate in national events.	**Two EPSCoR Committee meetings hosted.**	Host 2 EPSCoR Committee meetings. Participate in national events.	Host 2 EPSCoR Committee meetings.	Andy Kliskey, Rick Schumaker
Administer RII Seed Funding Program.						
9a.4.B	**Guidelines for large and small seed awards co-developed and formalized.** Select and allocate 1 Small; 1 Large.	Select and allocate 2 Small; 2 Large. Monitor award progress.	Revise guidelines. **Award 3 Small; 2 Large.** Monitor award progress.	Select and allocate 3 Small. Monitor award progress.	Complete Large and Small awards. **Seed Award accomplishments /outcomes reported.**	Rick Schumaker

Goal 9b: Develop & establish E-W data hub as an essential centralized data catalog, repository and data integration platform for all I-CREWS data.

- Objective 9b.1 - Establish data needs assessment for characterization, modeling and alternative futures.
- Objective 9b.2 - Develop cyberinfrastructure and databases to facilitate normalized workflows/ingestion and appropriate data sharing.

	Project Activities					
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Responsible Parties**
Objective 9b.1: Establish data needs assessment for characterization, modeling and alternative futures.						
Perform needs assessment and catalog data for characterization, modeling and alternative futures.						
9b.1.A	Initiate research data needs assessment. Catalog existing and novel E-W data resources at both the statewide and testbed scale.	Identify data gaps for each research component. Catalog novel E-W data resources. **Existing data inventoried.** **Needs assessment for data completed.**	Identify data gaps for each research component. Catalog novel E-W data resources.	Identify data gaps for each research component. Catalog novel E-W data resources.	**Novel data inventoried.**	Sanaz Salati

Complete data sharing/sovereignty agreements with all research partners prior to the collection and/or use of any research data.						
9b.1.B	**I-CREWS data sharing plan initiated.**	Appropriately share and publish data through the public interface of the E-W Data Hub. **Data sharing and sovereignty agreements established**	Update data sovereignty and sharing agreements as project goals and objectives are modified. **Appropriately shared and published data through the public interface of the E-W Data Hub.**	Update data sovereignty and sharing agreements as project goals and objectives are modified. Appropriately share and publish data through the public interface of the E-W Data Hub.	Update data sovereignty and sharing agreements as project goals and objectives are modified. Appropriately share and publish data through the public interface of the E-W Data Hub. **Data shared per data sharing plan, and data sharing and sovereignty agreements.**	Sanaz Salati
Objective 9b.2: Develop cyberinfrastructure and databases to facilitate normalized workflows/ingestion and appropriate data sharing.						
Develop CI and database(s) to provide internal and external web accessibility, data driven web applications, dashboards and interactive visualization tools.						

9b.2.A	CI and compute capabilities needs assessment. CI prototyping and storage configured to support Hub platform.	Implementation of Hub database(s). Design/implementation of web accessible data dashboards, mapping interfaces, and interactive data visualization tools.	Modification of Hub database(s) and CI web accessible tools. Appropriately share and publish data through public interface of the E-W Data Hub **Internal access to Hub data and database(s) via C3 Falcon Supercomputer**	Modification of Hub database(s) and CI web accessible tools. Appropriately share and publish data through the public interface of the E-W Data Hub. **Database(s) accessible and interoperable via API.**	**Fully operational data hub.** **Data products accessible to researchers, stakeholders, and the general public in accordance with data sharing plan. The Data Hub platform itself released as Open Source.**	Sanaz Salati, CI support staff, research component leads
Ingest data from existing legacy datasets and ongoing I-CREWS data collection.						
9b.2.B	Standardized data ingestion & normalization workflows discussed.	Ingest legacy data (3A.1.A) to Hub database(s). Internal and Public-facing implementation of integrated HUB metadata catalog. **Metadata and data standards established.**	Ingest legacy and novel data (3A.1.A) to Hub database(s).	Ingest legacy and novel data (3A.1.A) to Hub database(s).	Ingest legacy and novel data (3A.1.A) to Hub database(s). **Data products appropriately cataloged and indexed within integrated metadata catalog.**	Sanaz Salati, research component leads

MEASURES and METRICS

This Strategic Plan identifies many milestones and targets to be achieved during the project. An External Evaluation Plan is to be developed that is consistent with this Strategic Plan per NSF guidance during the first year of the award. The following table describes the nature of the metrics to be quantified, monitored, and reported on throughout the award. Specific numerical targets will be established for each of the measures by the project team working in concert with the External Evaluator during development of the Evaluation Plan. Numerical targets will be published in the Evaluation Plan and incorporated into future revisions of this Strategic Plan.

Component Area
Research
participants in tribe-specific training workshops
interviews conducted with knowledge rights holders
presentations of testbed data/visualizations to communities
participants engaged in Spatial.io partner meetings
datahub accounts created

Component Area
Broadening Participation
# of meetings of Search Advocates
% of VIP, CIP, SARE classes with participation of students from underrepresented groups equal to or exceeding institution enrollment rates
% CIPs/VIPs occurring on Tribal lands
# surveys collected on rural K-12 educational needs
Partnerships

publications acknowledging I-CREWS/NSF funding
conference presentations on I-CREWS scholarly work
participants in ML training workshops
new datasets added since GEM3
models integrating qualitative data from community partners
participants in community engagement workshops
new partners working in collaboration with team
maps/representations of alternative future scenarios
% of community testbed members engaged in developing scenario specific solutions

# of new State & Federal agency, industry and national lab partners added to the directory each year
% of State & Federal agency, industry and national lab partner summaries reflected in roadmap or partnership plan
% of all State & Federal agency, industry and national lab partners in attendance at the Annual Meeting
Tribal Nation Research Network
MOUs executed with TNRN
% seed grants applications from TNRN
# products co-produced with Tribal Members
# conference presentations co-produced with Tribal Members
# publications co-produced with Tribal Members

Education and Workforce Development
new VIP or CIP courses created
students participating in the SARE program
students engaged in VIP, CIP, SARE
Community Practice Meetings held
% Community Practice Meetings held at or above attendance goal
# conference presentations with post docs as co-authors
# publications with post docs as co-authors
# conference presentations with undergraduates as co-authors
# publications with undergraduates as co-authors
Management
% of all academic partners in attendance at the Annual Meeting
# students in attendance at the Annual Meeting

media releases highlighting TNRN contributions
social media posts highlighting TNRN contributions
Communication and Dissemination
leadership team meetings held
% leadership team meetings held meeting quorum
# media releases
# newsletters distributed
# social media posts referencing I-CREWS
Sustainability
new faculty hires
proposals submitted
Amount of new funding acquired to sustain initiative
# of I-CREWS post docs placed in career positions

RISK MANAGEMENT PLAN

Introduction

The I-CREWS risk management plan is based on a risk analysis process that occurred over a 3-month period in 2023 in accordance with NSF guidelines. It is based on a SWOT analysis (see Appendix B) that included multiple synchronous and asynchronous input from the project Leadership Team, Component Leads, and project participants. The plan represented in the tables below identifies issues and circumstances that could impact the scope, timing, or budget of specific activities. The likelihood and potential impact of each identified risk are identified and estimated on the scale of low, medium, or high.

Succession Plan

Idaho EPSCoR has established a system of shared leadership that accounts for the possibilities that key team members may be unable to fulfill their roles in the project, which could be due to a number of professional or personal reasons. It is based in part on a model of co-leadership and institutional representation within the Leadership Team as well as in project Component leadership. For example, each I-CREWS component is co-led by at least three individuals, each representing a different institution. If an individual is not able to continue in any leadership position, the work of the team will continue while the represented institution designates either an interim or long-term replacement for the individual. This model of co-leadership ensures that one or more individuals at each level of responsibility are knowledgeable and empowered to advance the work of the team. At the level of the Idaho EPSCoR Office and associated positions, the staff overseeing and supporting I-CREWS includes individuals with many years of Track-1 experience cross-training, and if any one of these key positions becomes vacant, existing staff will temporarily assume expanded responsibilities until such positions can be filled or the associated institution will reallocate existing staff time to accomplish necessary tasks (e.g., financial transaction oversight and processing). At the level of PD, the Idaho EPSCoR Committee will designate an interim PD to provide uninterrupted leadership during a search for new PD.

Risk Assessment category and ratings:	**High**
Likelihood (L)	**Medium**
Impact (I)	**Low**

#	Risk	Likelihood	Impact	Major Actions or Mitigation Activity for high and medium likelihood or impact	Lead
Risk Category: All Components / Cross-cutting					
1	Overarching coordination and interweaving across component groups is lacking	Hi	Hi	Utilize interweaving framework and cross-functional team. Request component groups to map objectives; Identify explicit hand-offs, gaps, and overlaps	Cross-functional team
2	Uneven collaboration across institutions and project areas (e.g., hierarchical thinking about expertise, significance of contributions, etc.)	Hi	Hi	Regular cross-functional interweaving team meetings; foster transdisciplinary systems thinking	Cross-functional team
3	Key participants across all components are over-committed	Hi	Hi	Participants to set realistic commitments; use postdoc positions and grad students effectively; work with institution to make sure time is protected to do work; communicate with dept heads / deans	Leadership Team
4	Unrealistic expectations and effort for community engagement and co-production	Hi	Hi	Clear plan developed and reviewed for community engagement, including data, relationships, etc.	Alternative Futures Team with Partnerships Team

5	Mismatch in timing among project areas and community responsiveness	Hi	Hi	Leverage I-CREWS activities with existing cultural activities that are ongoing (see #4)	Alternative Futures co-leads with Partnerships co-leads
6	TNRN team is pigeon-holed as primarily serving liaison role rather than having a role in research development	Hi	Hi	Ensure TNRN is empowered to undertake research development	Leadership Team, TNRN Team, Cross-functional Team
7	Risk of TNRN lacking bandwidth to address many aspects/needs	Hi	Hi	Research questions must address how tribal communities benefit; Teams offer workshops on their projects, methods, as well as participate in TNRN-developed workshops	TNRN Team, Leadership Team, Cross-functional Team
8	Risk of misunderstanding that leadership in TNRN is Tribally-centered	Hi	Hi	Continue to emphasize Tribal leadership for TNRN	Leadership Team, TNRN Team
9	Community engagement will be variable, risk stakeholder burnout	Hi	Med	Set realistic expectations for community engagement; support long-term relationship building	Alternative Futures Team, Partnerships Team
10	Recurrence of Covid or other event that prevents working in communities directly	Med	Hi	Brief hiatus to assess but move quickly to virtual engagement	Leadership Team

11	Lack of clarity regarding specific objectives, specific systems and time periods to be simulated, specific metrics to define resilience, etc.	Med	Hi	Team-wide engagement in strategic planning progress review; regular interweaving and coordination meetings with project partners	Cross-functional Team
12	Lack of common understanding across team on different disciplinary details	Med	Hi	Build cross-team training and knowledge (e.g., Resilience, Tribal sovereignty, Comp modeling, Futures methodologies) through workshops and seminars	Cross-functional Team
13	Tribal governance processes can cause concerns / communications problems and can impact data collection	Med	Hi	Maintain open communication with multiple partners within each Tribe; follow established plans for early engagement of Tribes through their respective research protocols	Andy Kliskey/Rick Schumaker/Laura Laumatia /Sammy Matsaw
14	Internal groups act in competition and not in coordination with regard to intellectual products produced by project	Med	Hi	Define and share authorship criteria at the start of project - ensure implementation of Collaboration Plan, expand detail on authorship	Leadership Team
15	Loss of access / permissions to tribal partners' data	Med	Hi	Tribal data sovereignty protocols implemented and monitored: training workshops; FAIR and CARE principals; data use and sovereignty agreements; publication/authorship attribution agreements; regularly revisit agreements with Tribal partners and revisit trainings	Sanaz Salati/TNRN, Leadership Team

16	Loss of new hires to other institutions outside of the state	Med	Med	Mentoring plans, early-career support, team building, ensure ASSERT program is implemented	Institution Co-leads, WFD Team
17	Delays in recruiting students due to interdisciplinary nature of the research; e.g., course requirements or degree may not 'fit' the research	Med	Med	Interdisciplinary programs can be utilized at the universities; provide co-advising across disciplines	WFD Team
18	Tendency to reframe goals and deviate from aims of the project by new participants onboarding	Low	Med	Regular coordination / interweaving meetings to assist in onboarding of new participants, in-person onboarding, creation of research brief to share with new participants	Leadership Team
19	Meeting locations and formats are uninspiring and unconducive to the type of focused work that generates substantive progress	Low	Med	Support teams to self-organize intensive, focused planning and work sessions	Leadership Team, Cross-functional Team
Risk Category: Research					
20	Varying perspectives and values associated with terminology across disciplines and partners, appropriateness of research approaches, and description of "valued" research products	Hi	Hi	Organize Sharing Circle meetings for people to share values and perspectives, e.g., What does resilience mean to them? What are their metrics of success?	Alternative Futures and Partnerships

21	Nascent knowledge of capabilities and limitations of AI/ML tools by broader project team	Hi	Hi	Project-wide annual training on basics of computational modeling, AI, ML	Modeling Team
22	Multifaceted research strengths across the institutions are not utilized	Hi	Med	Regular interweaving and coordination meetings	Cross-functional Team
23	Computational system inputs are unknown or difficult to measure	Med	Med	Model with estimated confidence intervals	Modeling co-leads
24	Insufficient local knowledge to train ML algorithms	Med	Med	Identify existing data from government reports / online resources and ML algorithms that will be used; Communicate with other teams	Modeling co-leads
25	Existing computational models cannot produce intended results, e.g., validation	Med	Med	Identify new models; Optimize parameters with measurement data; Develop model validation criteria and test plan	Modeling co-leads
26	Unrealistic expectations regarding the volume and types of data available for characterization	Med	Med	Robust prioritization plan for data requests and delivery timelines	Characterize co-leads, Statewide Data Manager
27	Complex, diverse projects (testbeds) on a large landscape may become disconnected and difficult to compare	Med	Med	Each testbed location needs to have a lead that communicates regularly with other leads to assure similar approaches, products and resolutions to issues; Leads highlight cross-testbed comparisons to	Characterize co-leads

				guide synthesis activities	
28	Rapidly evolving landscape of energy/water concerns (new issues emerging; past issues being addressed)	Med	Med	Testbed leads focus on larger or better-established parts of the system; Make use of seed grant and other mechanisms for emerging topics	Cross-functional Team
29	Poor data quality	Med	Med	Clear and open meetings with Tribal partners via the TNRN and other knowledge rights holds to identify any restrictions of allowable data use; adherence to Tribal protocols; Acceptance that some data/access will not be available - and that data/access can be taken away at any time (Tribal sovereignty); ensure FAIR and CARE principles implemented thru Data management plan and E-W Data Hub	Statewide Data Manager, Cross-functional Team
30	Paucity of data needed for AI/ML training	Med	Med	Use detailed physically-based simulated data where feasible; Use large language models to develop training data for qualitative data with input from characterize and futures teams	Modeling co-leads
31	Loss of critical research data (failures, etc.)	Low	Med	Multiple backup mechanisms of data; ensure implementation of E-W Data Hub; Clearly defined data management plan	Statewide Data Manager

Risk Category: WFD / ED					
33	WFD and Diversity programs are treated as check-box activities and sustainable programs are not designed, developed, and integrated into the university structures	Med-Hi	Med-Hi	Need clear, invested, and supported leads who are tasked explicitly with program design and development rather than just activity implementation, for CIP, VIP, SA, and ASSERT	WFD co-leads
32	Narrow definition of STEM may hinder exploration of topics relevant to grant goals and communities	Low	Low		WFD co-leads

Collaborating and Advisory Organizations and Individuals

Participating Organizations

- University of Idaho, Moscow, Idaho
- Boise State University, Boise, Idaho
- Idaho State University, Pocatello, Idaho
- Coeur d'Alene Tribe, Plummer, Idaho
- Shoshone-Bannock Tribes, Fort Hall, Idaho
- College of Southern Idaho, Twin Falls, Idaho
- Lewis-Clark State College, Lewiston, Idaho
- College of Western Idaho, Nampa, Idaho
- Idaho STEM Action Center, Boise, Idaho
- Idaho Power, Boise, Idaho
- Idaho Consumer Owned Utilities Association, Boise, Idaho
- Idaho Department of Water Resources, Boise, Idaho
- Idaho National Laboratory, Idaho Falls, Idaho
- Avista Utilities, Spokane, Washington
- Nez Perce Tribe, Lapwai, Idaho
- Shoshone-Paiute Tribe, Owyhee, Idaho

Participating Individuals

Boise State University

- Kathy Araujo, Director of the Energy Policy Institute
- Brittany Brand, Associate Professor, Department of Geoscience
- Sophia Borgias, Assistant Professor, Interdisciplinary Programs
- Zenaida De La Cruz, Science Communications Assistant
- Jim Fredricksen, Director, Institute for Inclusive & Transformative Scholarship
- Lan Li, Associate Professor, Micron School of Materials Science and Engineering
- Reshmi Murkhajee, Associate Professor, Humanities and Cultural Studies

- Michael Perlmutter, Assistant Professor, Department of Mathematics
- Mojtaba Sadegh, Assistant Professor, Civil Engineering
- Jared Talley, Faculty, Environmental Studies
- Carolina Viera, Associate Professor, Spanish
- Matthew Williamson, Assistant Professor, Human-Environment Systems

Idaho State University

- Colden Baxter, Professor, Biological Sciences
- Vince Bowen, Exec Dir/Chair, Energy Systems Technology & Education Center
- Morey Burnham, Program Director/Assistant Professor of Sociology
- Kitty Griswold, Research Administrator
- Georgia Hart-Fredeluces, Assistant Professor, Department of Anthropology and Languages
- Laticia Herkshan, Tribal Scholar/Undergrad Advisor & Mentor in Geosciences
- Leslie Kerby, Associate Professor and Graduate Program Director, Computer Science
- Sonia Martinez, Director, UG Research & Outreach, Research Integrity & Compliance
- Elizabeth Redd, Assistant Professor, Director of American Indian Studies
- Bruce Savage, Professor and Dept. Chair, Civil and Environmental Engineering
- Keith Weber, Director, GIS Training & Research Center

University of Idaho

- Bob Borrelli, Associate Professor, Nuclear Engineering
- Erin Brooks, Professor, Agriculture Engineer, Dept. of Soil & Water Systems
- Leigh Cooper, Strategic Content Manager and Science Writer
- Karla Eitel, Dir, McCall Field Campus/Professor of Environmental Education
- Doug Habib, Assistant Director for Programming, Center for Excellence in Teaching & Learning
- Dylan Hedden-Nicely, Associate Professor of Law/Director, Native American Law Program
- Katherine Himes, Dir, McClure Center for Public Policy Research
- Brian Johnson, Distinguished Professor, Endowed Chair in Power Engineering
- Aly Kreikemeier, Assistant Professor, Department of History
- Roger Lew, Associate Professor, Virtual Technology & Design

- Angel Monsalve, Assistant Professor, Department of Civil & Environmental Engineering
- Erich Seamon, Assistant Professor, Virtual Technology & Design
- Luke Sheneman, Director of Research Computing and Data Services
- Alistair Smith, Professor and Chair, Department of Earth & Spatial Sciences
- Terry Soule, Professor and Chair, Department of Computer Sciences

Idaho Tribes

- Laura Laumatia, Environmental Program Manager, Coeur d'Alene Tribe
- Sammy Matsaw Jr., Research Scientist in Fish and Wildlife, Shoshone-Bannock Tribes

Idaho 2-4 year Colleges

- Bill Ebener, PUI Liaison, Adjunct Faculty, Agriculture, College of Southern Idaho
- Nancy Johnston, Associate Professor, Chemistry, Lewis-Clark State College
- Keegan Schmidt, Professor of Earth Science, Lewis Clark State College
- Miranda Striluk, PUI Liaison, Assistant Professor, Biology, College of Western Idaho

APPENDIX A

Glossary of Terms

AI	Artificial Intelligence
API	Application Program Interface
ASSERT	Aligning Stakeholders and Structures to Enable Research Transformation
BP	Broadening Participation
BSU	Boise State University
CARE	Collective Benefit, Authority to Control, Responsibility, Ethics
CAREER	Faculty Early Career Development
CDAT	Coeur d'Alene Tribe
CAG	Community Advisory Group
CI	Cyberinfrastructure
CIP	Community Integrated Program
Co-PI	Co-Principal Investigator
CoP	Community of Practice
CERE	Center for Ecological Research and Education
ChatGPT	Chat Generative Pre-trained Transformer
CIRCLES	Cultivating Indigenous Research Communities for Leadership in Education and STEM
CSDS	UI's Center for Secure and Dependable Systems
CSI	College of Southern Idaho
CWI	College of Western Idaho
DM	Data Management
EAC	Expert Advisory Committee
EAP	Expert Advisory Panel
ED	Education
EDOCS	EPSCoR Data Outcomes Collection System
EO	Education and Outreach
EE&SC	Environmental Education and Science Communication
E-W	Energy-Water
EWS	Energy-Water Systems

EPI	Energy Policy Institute
EPSCoR	Established Program to Stimulate Competitive Research
ExComm	Executive Committee
FAIR	Findable, Accessible, Interoperable, and Reusable
GenEd	General Education
HE	Higher Education
HRV	Historical Range of Variability
HSI	Hispanic Serving Institutions
I-CREWS	Idaho Community-engaged Resilience for Energy-Water Systems
ICUA	Idaho Consumer-Owned Utilities Association
IDN	Idaho Diversity Network
INL	Idaho National Lab
IRB	Institutional Review Board
IROC	INL Resilience Optimization Center
iSTEM	Idaho Science, Technology, Engineering, and Mathematics
ISU	Idaho State University
LCSC	Lewis-Clark State College
LT	Leadership Team
LLM	Large Language Model
MOU	Memorandum of Understanding
MoA	Memorandum of Agreement
ML	Machine Learning
NA	Native American
NSF	National Science Foundation
PAB	Project Advisory Board
PD	Project Director
PI	Principal Investigator
PUI	Primarily Undergraduate Institution
R&D	Research and Development
RCR	Responsible Conduct of Research
RII	Research Infrastructure Improvement
RFRN	Resilience Futures Reciprocal Network

RSV	Reverse Site Visit
SA	Search Advocates
SBT	Shoshone-Bannock Tribes
SDE	State Department of Education
SES	Social Ecological Science
SETS	Socio-Environmental Technological System
SARE	Summer Authentic Research Experience
SBOE	State Board of Education
SLO	Student Learning Outcomes
STC	Science and Technology Center
STEM	Science, Technology, Engineering, and Mathematics
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TNRN	Tribal Nation Research Network
UI	University of Idaho
URM	Underrepresented Minority
VIP	Vertically Integrated Project
VP	Visualization Product
VR	Virtual Reality
WFD	Workforce Development
XR	Extended Reality

APPENDIX B

Results of original SWOT Analysis

I-CREWS SWOT INPUT				
SWOT INPUT TABLE:				
BOLD = Required Not Bold = Not Required				
Internal Strengths	**Significance *(Hi / Med / Lo)***	**Leveraging Strategy**	Lead:	Addressed in Strategic Plan:
Leverages local capabilities (governance, decision science and risk management; resilience and environmental planning; energy and electricity policy, management and engineering; infrastructure; machine learning, etc.).	Hi	Prioritize targeted and explicit integration	Kathy Araujo	Characterize, Modeling, and Alt Futures sections
Partners are critical subject matter experts/actors in industry, Tribes, and educational institutions.	Hi	Develop and update, as needed, contributor roadmap.		Partnerships & Collaborations section and TNRN goal
Integrates knowledge co-production, diagnostics, modeling, and applications, and theory.	Hi		Brian Wampler	PTC 8.2
Strong research expertise across group on climate-induced disturbances (drought, fire, etc.)	Hi		Alistair Smith	
Alignment with State economic plan and infrastructure priorities.	Hi			
Have a diverse group of experts in energy, water, modeling, WFD	Hi	Develop a good strategic plan and plan on details		
Desire to improve collaborations between institutions and Tribal nations	Hi	Support good intentions with learning opportunities to improve practice. Clear goals for WFD and strong engagement in trainings are needed	Dylan Hedden-Nicely, Laura Laumatia, Sammy Matsaw	
Expertise in community-engaged teaching, learning, and research collaboration	Hi		Vince Bowen	
Expertise in developing and leading (CIRTL-based) Learning-through-Diversity engaged teaching and research programs	Hi			
Expertise in scholarship of engagement and community engaged scholarship	Med-Hi			
Expertise in developing sustainable ASSERT-relevant programs	Med	Need co-leads at all institutions who have that expertise		WFD/ED objective 4.2a and 4.2b
Involves PUIs throughout the state	Med		Nancy Johnston willing to help coordinate PUI faculty; Stephanie Sevigny	

Internal Weaknesses	**Risk Assessment:** *Likelihood / Impact*	**Mitigation Strategy** *(for all Hi & Med risks)*	Lead:	Addressed in Strategic Plan:
Overarching framework to coordinate goals and activities across component groups needs to be developed (physical framework in addition to the cross-cutting team)	Hi/Hi	Map phases and activities. Request component groups to map objectives. Identify gaps and points of coordination	Brittany Brand	Explore approaches and software to facilitate complex project management. Once component teams finish objectives, goals and activities, give them time and space to map the goals to the overarching framework. We will (1) identify the relative timeline of the different tasks and meeting broad objectives, (2) identify places where teams will coordinate due to overlapping efforts, (3) Recognize and build in flexibility for the time consuming nature of relationship building and co-development/co-production processes, (4) Build in space and time for iterative processes in and between phases and component groups, (5) mitigate redundancy
Varying perspectives and values associated with terminology across disciplines, appropriateness of research approaches, and description of "valued" research products (e.g., what Tribal partners values vs what academic value).	Hi/Hi	Organize Sharing Circle meetings for people to share values and perspectives (e.g., what does resilience mean to them? what are their metrics of success?)	Colden Baxter	
Uneven collaboration across institutions (universities, 4-yr colleges, PUIs, and Tribal nations) and between components (three research areas plus Ed/WFD) (e.g. hierarchical thinking about expertise, significance of contributions, etc.)	Hi/Hi	Regular integration meetings that include all components and participants from across institutions. Development of cross-cutting team.	Brittany Brand - and also aligned with line 35	
Nascent knowledge of capabilities and limitations of AI/ML tools by broader project team	Hi/Hi	-Develop a training plan by Feb 2024 (discuss with LT what depth they would like) -First trainings completed by Aug 2024: focusing on what AI can do and what is required to successfully build ML models, to understand how AI/ML tools can be effectively and creatively applied to meet project objectives. -Continue trainings and feedback throughout project annually	Leslie Kerby, Lan Li, Bruce Savage, Tim Link, Bob Borrelli	Same as row 20

Key participants on all components are often over-committed	Hi/Hi	Participants to set realistic commitments; use postdoc positions and grad students effectively; work with institutions to make sure time is protected to do work.		
Community engagement is key to success, need key people to lead	Hi/Hi	Clear plan needed for engagement, this weakness is likely internal and external and cross cuts the issue of co-production. There are issues with data, relationships and other elements. The weakness identified on line 29 is rather narrowly described. There may need to be multiple migitration strategies for this problem see the write up from Sarah and Colden as mitigation regarding relationship building. We need key people who are responsible and key actions to address. This should be done carefully and stepwise so we do not burn out or make critical errors (see also Sarah and Colden's write-up)	Brittany Brand (Alt Futures working on this), Kitty Griswold - I think this is a multi-person effort.	
Multifaceted research strengths across the institutions	Hi/Med	Regular interweaving and coordination meetings		
Counting on faculty who already have full time jobs to add new efforts or lead components	Hi/Med	Budget put towards actual buy out of teaching / admin responsibilities - requires conversations with department chairs	This is related to line 22 and needs a leader.	
Lack of clarity regarding specific objectives, specific systems and time periods to be simulated, specific metrics to define resilience, etc.	Med/Hi	Team-wide engagement in strategic planning development; regular interweaving and coordination meetings with project partners	Brittany Brand is open to this, aligned with line 35	
Uneven engagement on multifaceted subject matter.	Med/Hi	Build cross-team training and knowledge (e.g., Resilience, Tribal sovereignty, Comp modeling, Futures methodologies)	Proposed cross-cutting team	Management section
Tribal governance processes can cause concerns/communications problems and can impact data collection	Med/Hi	Maintain open communication with multiple partners within each tribe; establish plans for early engagement of tribes through their respective research protocols	Andy Kliskey/Rick Schumaker/Laura Laumatia/Sammy Matsaw	
Computational system input are unknown or difficult to measure (e.g., ground water storage capacity, aquifer capacity, even SWE)	Med/Med	Model with estimated confidence intervals	Bruce Savage, Tim Link, Brian Johnson	
Insufficient local knowledge to train ML algorithms	Med/Med	Identify existing data from government reports / online resources and ML algorithms that will be used; Communicate with the Characterization group and other community partners as to the overall breadth of knowledge needed	Lan Li, Leslie Kerby, Bruce Savage, Tim Link, Brian Johnson, Bob Borrelli	

Existing computational models cannot produce intended results; e.g., validation	Med/Med	Thorough study of existing models (also mentioned in the panel review); Identify new models; Optimize parameters with measurement data; Develop model validation criteria and test plan.	Tim Link, Bruce Savage, Brian Johnson, Lan Li, Leslie Kerby, Bob Borrelli	
Unrealistic expectations regarding the volume and types of data available for characterization	Med/Med	Robust prioritization plan for data requests and delivery timelines		
Complex, diverse projects (testbeds) on a large landscape may become disconnected and difficult to compare	Med/Med	Each testbed needs to have a lead that communicates regularly with other leads to assure similar approaches, products and resolutions to issues. Leads highlight cross-testbed comparisons to guide synthesis activities	Ben Crosby, Kitty Griswold. See 23 for starters, but there is an additional approach needed to create the engagement team on location.	
Meeting locations and formats are uninspiring and unconducive to the type of focused work that generates substantive progress	Low/Med	Develop a mechanism similar to what's been done for Innovation Working Groups to enable sub-teams to self-organize intensive, focused planning and work sessions		
Narrow definition of STEM may hinder exploration of topics relevant to grant goals and communities	Low/Low		Vince Bowen	
Recurrence of Covid or other event that prevents working in communities directly	Med/Hi			
Mismatch in timing among project elements	Hi/Hi	Can we find ways to leverage ICREWS activities with existing cultural activities that are ongoing	Connect this risk to community engagement plan above.	
Risk of TNRN team being pigeon-holed as liaisons, v. having a role in research development	Hi/Hi	Development of research policies and procedures, recognizing that delayed onboarding of research in tribal communities does not reflect tribal researcher capacity; engagement of TNRN in other leadership teams; ensuring that tribal communities understand tradeoffs of any gaps in data to effectiveness of future scenarios development; provide $$ to tribal researchers working with TNRN leads to engage in other components of project		
Risk of TNRN lacking bandwidth to address many aspects/needs	Hi/Hi	Research questions should be able to respond to question: how does tribal community benefit? Teams offer workshops on their projects, methods, as well as participate in TNRN-developed workshops (TNRN)		
Risk of misunderstanding where leadership in TNRN is held	Hi/Hi	Continue to emphasize Tribal leadership for TNRN		

External Opportunities	Significance *(Hi / Med / Lo)*	Leveraging Strategy	Lead:	Addressed in Strategic Plan:
Contribute to frontier areas, such as AI and local knowledge, with subject matter that is of high relevance to the State.	Hi			
Inclusion and integration of additional partners within the TNRN	Hi			
Building a generative culture of innovating research, teaching, and learning across institutions and aligned with ASSERT model and other WFD/Education strategies	Hi			
Scope of work centers on a complex area of State need, which may not otherwise be addressed.	Med			Management section
Potential to advance organizational and individuals' sophistication in subject matter research and workforce development.	Med			
Partnering with agencies and programs to establish and maintaining dynamic, sustainable, and mutually beneficial relationships	Med			
Creating opportunities to share course revenue with Tribal partners so that CIPs can be sustained.				
External Threats	**Risk Assessment:** *Likelihood / Impact*	**Mitigation Strategy** *(for all Hi & Med risks)*	Lead:	Addressed in Strategic Plan:
Loss of new hires to other institutions outside of the state	Med/Hi	Mentoring plans, early-career support, team building, ensure ASSERT program is implemented	Donna Llewellyn (for ASSERT)	In WFD/ED and Sustainability sections
Community engagement will be variable, risk stakeholder burnout	Hi/Med	See "Low Buy-in" section above		
Related to buy-in among university members - WFD and DIV programs are treated as check-box activities and sustainable programs are not designed, developed, and integrated into the university structures. This is in regards to CIP, VIP, EA, and ASSERT.	Med-Hi / Med-Hi	Need clear and invested and supported leads who are tasked explicitly with program design and development rather than just activity implementation.	Kitty is working on ISU leads, TBD	

Internal subgroups acting in competition and not in coordination with regards to intellectual products produced by project	Med/Hi	Define and share authorship criteria at the start of project - ensure implementation of Collaboration Plan, expand detail on authorship		
Loss of access / permissions to tribal partners' data	Med/Hi	1. In year 1 organize tribe-specific training workshops (for all participants) focused on FAIR and CARE principals and data sovereignty - see about bringing in leaders in this area (Small-Rodriguez, Carroll, etc.). 2. In year 1, work with each tribal partner to develop separate data access, storage, and data use agreements. 3. In year 1, work with each tribal partner to develop publication /authorship attribution agreements. 4. In year 2, the tribal partners refine data access, use, and sharing, protocols. 5. Reuse CDA MILES training around sovereignty. 6. In years 2-5, regularly revisit agreements with tribal partners and revisit trainings with new project participants as they become onboard.	Laura laumatia, Sammy Matsaw, Alistair Smith, Data Manager, Andy Kliskey	
Rapidly evolving landscape of energy/water concerns (new issues emerging, past issues being addressed)	Med/Med	Testbed leads try to stick to larger or better established parts of the system. Make use of seed grant and other mechanisms for emerging topics	Ben Crosby, Bruce Savage open to help, Brian Johnson	
Difficulty in recruiting students due to interdisciplinary nature of the research; e.g., course requirements or degree may not 'fit' the research	Med/Med	Interdisciplinary programs can be developed at the universities; co-advising Specifically, recruiting Native/Tribal students is already difficult (note, this is university/degree dependent)	Vince Bowen	
Poor data quality	Med/Med	Clear and open meetings with Tribal partners via the TNRN and other knowledge rights holds to identify any restrictions of allowable data use; adherence to Tribal protocols Acceptance that some data/access will not be available - and that data/access can be taken away at anytime (Tribal sovereignty); ensure FAIR and CARE principles implemented thru Data management plan and E-W Data Hub	All I-CREWS teams	
Paucity of data needed for AI/ML training	Med/Med	Use detailed physically-based simulated data where feasible. Use large language models to develop training data for qualitative data with input from characterize and futures teams.	Bruce Savage, Tim Link, Leslie Kerby, Brian Johnson, Lan Li, Bob Borrelli	
Reframing goals and aims of the project by new participants onboarding on to the project away from funded project overarching goals and objectives	Lo/Med	Regular coordination / interweaving meetings to assist in onboarding of new participants, creation of research brief to share with new participants Leadership team can mitigate this with strong coordination and management	Leadership Team	
Loss of critical research data (failures, etc.)	Lo/Med	Multiple backup mechanisms of data; ensure implementation of E-W Data Hub Clearly defined data management plan	Data Manger	