

**New Mexico  
Experimental Program to Stimulate Competitive Research  
Program Year 3 External Evaluation Report**

**September 1, 2010 to August 30, 2011**

**Prepared for:  
NM EPSCoR State Office**



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## Introduction

NM EPSCoR RII3 is funded by the National Science Foundation (NSF) and is designed to fulfill the foundation's mandate to promote scientific progress nationwide. The EPSCoR program is directed at those jurisdictions that have historically received lesser amounts of NSF Research and Development (R&D) funding. Twenty-five states, the Commonwealth of Puerto Rico and the U. S. Virgin Islands currently participate. Through this program, NSF establishes partnerships with government, higher education and industry that are designed to effect lasting improvements in a state's or region's research infrastructure, R&D capacity and hence, its national R&D competitiveness.

This report will attempt to assess the status of the project by linking the data reported with the project's Strategic Plan, which was developed in January, 2009. The metrics will focus around the following categories:

- People: Participant demographics of faculty, postdocs, undergrads, K-12, collaborators, institutions, and diversity of all the above;
- Material Infrastructure: Equipment purchased & installed, models developed and cyberinfrastructure acquired (number, type, use, results);
- Knowledge generation: presentations, publications, proposals and awards, products and patents
- Discovery Learning: data collected, observations and research (number, type, kind, availability)
- Knowledge generation: presentations, publications, proposals and awards, products and patents
- Outreach/Public Dissemination: Scientific literacy and outreach efforts, curriculum development, public outreach, public presentations, policy and policy makers impacted

## Background

NM EPSCoR RII3 was funded in September, 2008 for a period of five years and for \$3million per year. The overarching goal for NM EPSCoR RII3 is to enhance research competitiveness through the acquisition of critical research infrastructure and cyberinfrastructure, and through strategic investment in human infrastructure. Secondly, the goal is to address a critical state problem of worldwide significance of the effects of climate change on water supply and sources in arid regions. Five specific research infrastructure improvement programs are designed to significantly benefit and enhance competitiveness of the NM academic research and education enterprise. These are:

- Major research infrastructure that fills critical infrastructure gaps in monitoring and analyzing climate and hydrological conditions in northern NM;
- Innovative in situ hydrological sensing infrastructure;
- Climate change infrastructure seed grant program;
- Multi-scale and multi-disciplinary model development; and
- Innovation working groups

A focus on improving the cyberinfrastructure (CI) to support these efforts is also included in NM EPSCoRs plans to stimulate innovative uses of CI including:

- Development of efficient data acquisition, processing, and storage models;
- High performance computing;
- Interoperable data discovery and delivery through interfaces based upon open standards;
- Deployment of collaboration tools that facilitate both synchronous and asynchronous knowledge exchange; and
- Development of a project portal that provides a single point of access for project products, services, and information.

Finally, NM EPSCoR RII3 proposes to enhance the human infrastructure in NMs academic and scientific research enterprise with three plans focused on education and outreach. These are:

### Education Plan

- Summer Institute focusing on middle school teacher professional development in northern NM;
- Undergraduate Research Opportunities for students at NMs regional non-PhD granting institutions;
- Research Training Group Program that provides interdisciplinary training and develops modeling skills for MS/PhD students;
- Junior Faculty Leadership Training; and
- Informing faculty throughout NM about funding opportunities via NSF Days and other NSF outreach activities.

### Outreach and Communication Plan

- Climate Change Exhibit (incorporating Science on a Sphere) to reach 230,000 annual visitors;
- Climate Change Seminar Series to bring nationally recognized experts to the large municipalities throughout the state;
- Science Cafes to communicate climate change science to citizens in rural northern NM;

- Town Hall meeting to provide a forum for scientists, business leaders, and concerned citizens to build consensus and develop practical, actionable solutions; and
- Climate Change Web Portal to provide easy access to news, project information, documents and publications, data and services.

## Diversity Plan

- Place-based science education will reach out to community members and provide teachers with locally relevant science for their classrooms.
- Students with diverse backgrounds will be incorporated into all research opportunities through targeted recruitment.
- Faculty and staff will receive training on diversity inclusion in teaching and learning with a diverse student body.
- Diversity will be a theme of the program, addressed with workshops and through outside experts, and reflective study programs.
- Partner with other diversity programs in NM and nationally.

According to the strategic plan developed in October, 2008 and submitted to NSF in January, 2009:

*The overarching **vision** for the NM EPSCoR Program is to enable:*

***“An environment in which New Mexico scientists and educators are fully competitive in climate change research and education.”***

*NM EPSCoR RII3 is designed to enhance research competitiveness through investment in three strategic areas: (1) critical Research Infrastructure, (2) Cyberinfrastructure, and (3) Human Infrastructure. These investments will help establish NM as a laboratory for climate change research, and as a model for science-based public policy. The multi-disciplinary, multi-scale effort is envisioned to transform climate change science and policymaking in NM by providing the tools required for quantitative, science-driven discussion of difficult water policy options facing the State in the 21st Century. These goals are articulated in the NM EPSCoR **mission**:*

***“Provide the critical gap infrastructure, computational support, and education and outreach opportunities to foster excellence in climate change research and education.”***

The remainder of this report will focus on the outputs and outcomes resulting from the NM EPSCoR activities during the first three years of the initiative.

## People (Human Infrastructure, Collaboration and Diversity)

Diversity and expanding the involvement of women and underrepresented minorities in the sciences is one of the objectives of NSF, EPSCoR and NM EPSCoR. This section will explore the degree of involvement of different racial groups of participants by level of participation, component, participant role and participating institutions over the first three years of the initiative. The role of collaborators and the nature of their collaborations with the project will also be examined.

In this report, there are two types of participants. There are direct project participants, those that have participated in a significant way in accomplishing the goals of EPSCoR; either in one of the three research areas (climate and hydrology, water quality, or socioeconomics and acequia), human infrastructure or cyberinfrastructure. Direct participants also include K-12 teachers who have received Professional Development sponsored by EPSCoR, Innovative Working Group members, Junior Faculty Leadership Program participants and students participating in the Undergraduate Research Opportunities Program (UROP). Direct participants are all individuals who have been individually identified. Indirect project participants are the students of the K-12 teachers who have received professional development, members of the public or education institutions who have participated in outreach events; such as NSF Day, public seminars or who have attended the NMMNHS Climate Change exhibit sponsored by NM EPSCoR.

In this evaluation report, the FastLane definition of collaborators is used. These are scientists, engineers, educators and others who have had significant contacts with EPSCoR researchers to further the NM EPSCoR goals.

### Participants by Year

In Year 3 there were 203 direct participants in one or more project activities during the program year. While this is a significant increase from Year 1 which had 113 direct participants, the number of individuals who have been involved in NM EPSCoR activities during the first three years is over 300. Figure 1 shows how many of the directly involved participants were Under-represented ethnic minorities (Hispanic, African American, or Native American), or female by program year and over the three program years as an unduplicated count.

**Figure 1**  
**Number/Percent of Underrepresented Minority and Female Participants**  
**by Program Year and Cumulative**

Category	Year 1	Year 2	Year 3	Unduplicated Count
Underrepresented Minority (URM) -Ethnic	14 (12%)	25 (17%)	58 (29%)	64 (21%)
URM-Female	6 (5%)	14 (10%)	27 (13%)	30 (10%)
URM-Male	8 (7%)	11 (8%)	31 (15%)	34 (11%)
Female	46 (41%)	66 (46%)	87 (43%)	132 (43%)
Total Participants	113	145	203	306

The number of participants in NM EPSCoR has increased over the three program years from 113 in Year 1 to 203 in Year3. According to these data, the number and percent of underrepresented minorities participants in NM EPSCoR has increased over the course of the project from 12 (12%) in Year 1 to 58 (29%) in Year 3. The unduplicated count or number of individual participants across the three years was 64 or 21% of the total number of participants. The ethnic minority participants were equally divided

between male and female. Overall female participation has remained constant across the three program years at 41-43%.

It is important to examine the ethnic and gender diversity of participants by their role as well to ensure that diversity goals are being addressed across the spectrum. Figure 2 shows the #/% of under-represented ethnic minorities and females by participant role, program year and an unduplicated count.

**Figure 2**  
**Participants by Role and URM and Female**  
**by Program Year and Cumulative**

Role	Program Year			Unduplicated Count (%)
	Year 1	Year 2	Year 3	
Faculty	47 (44%)	32 (22%)	22 (11%)	52 (17%)
URM-Ethnic	2 (4%)	3 (9%)	4 (18%)	4 (8%)
Female	10 (21%)	6 (19%)	6 (27%)	12 (23%)
Post docs	0 (0%)	2 (1%)	2 (1%)	3 (1%)
URM-Ethnic	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Female	0 (0%)	1 (50%)	1 (50%)	1 (33%)
Graduate Students	8 (8%)	17 (12%)	24 (12%)	32 (11%)
URM-Ethnic	2 (25%)	5 (29%)	6 (25%)	7 (22%)
Female	4 (50%)	10 (59%)	14 (58%)	18 (56%)
Undergraduates	20 (19)	39 (27%)	45 (22%)	80 (27%)
URM-Ethnic	2 (10%)	8 (21%)	15 (33%)	18 (23%)
Female	9 (45%)	18 (46%)	15 (33%)	32 (40%)
K-12 Teachers	14 (13%)	27 (19%)	34 (17%)	46 (15%)
URM-Ethnic	5 (36%)	5 (19)	11 (32%)	12 (26%)
Female	10 (71%)	19 (70%)	22 (65%)	31 (67%)
Staff	9 (8%)	18 (12%)	43 (21%)	48 (16%)
URM-Ethnic	1 (11%)	1 (6%)	13 (30%)	13 (27%)
Female	5 (56%)	7 (39%)	15 (35%)	18 (38%)
Other	8 (8%)	10 (7%)	33 (16%)	38 (13%)
URM-Ethnic	2 (25%)	3 (30%)	9 (27%)	10 (26%)
Female	4 (50%)	5 (50%)	14 (42%)	16 (42%)
Total	106	145	203	299
URM-Ethnic	14 (13%)	25 (17%)	58 (29%)	64 (21%)
Female	42 (40%)	66 (46%)	87 (43%)	128 (43%)

The number and percent of under-represented minority (URM) and female participants has varied over the program years, as well as within role. Some of this variability is a result of changes in reporting. The number of participating faculty has decreased over the three program years, while the number and percent

of URM faculty has doubled from 2 to 4 and in Year 3 represents 18% of all participating faculty. The percent of female faculty involved during Year 3 was 27% of all faculty.

The number of graduate students involved in NM EPSCoR has tripled from 8 in Year 1 to 24 in Year 3. The percent of URM graduate students has remained fairly consistent (Year 1: 25%; Year 2: 29%; Year 3: 25%) as the numbers have grown. The percentage of female graduate students has risen slightly from 50% in Year 1 to 58% in Year 3.

The number of participating undergraduates has more than doubled from 20 in Year 1 to 45 in Year 3. The percent of URM undergraduates has risen consistently over the life of the project from 10% in Year 1 to 21% in Year 2 and now stands at 33% in Year 3. The percentage of female undergraduates was almost half (45-46%) in the first two years, but dropped to one-third (33%) during Year 3.

The K-12 teachers participating have also increased over the project, increasing from 14 in Year 1 to 43 in Year 3. The percentage of these who are from under-represented minority groups has also increased from 11% in Year 1 to 27% in Year 3. The percent of female teachers participating has decreased (Year 1: 56%; Year 2: 39%; Year 3: 35%).

The number and percentage of participating staff increased in Year 3 with the addition of those working on the Degrees of Change exhibit at the NM Museum of Natural History. It is not expected that these individuals will be involved again in Year 4, so looking at trends is difficult.

The reporting of unduplicated counts of participants by role across the program years provides a measure of how many individuals have been involved. The eighty undergraduate students represent the largest group being 27% of the total number of participants; with the 52 individual faculty participants representing 17% of the participants. Another way of looking at these data is to examine the relationship between unduplicated count and the sum of the participants from individual years. Over three-fourths (77%) of the undergraduate and post-docs (75%) have been involved in more than one program year; while about two-thirds (65%) of the graduate students have participated in more than one year. Only half (51%) of the faculty have participated in more than one program year. However, this may be the result of individual faculty with unique expertise being involved in an IWG that occurred in one program year and does indicate substantial changes in those involved in the core research activities.

Figure 3 presents the #/% of participants by the type of institution for each program year and overall.

**Figure 3**  
**Number/Percent of Participants by Type of Institution**  
**by Program Year and Cumulative**

Type of Institution	Year 1	Year 2	Year 3	Unduplicated Count
Academic-PhD Degree Granting	64 (57%)	89 (61%)	98 (48%)	150 (49%)
Academic-Non-PhD Granting	20 (18%)	20 (14%)	34 (17%)	64 (21%)
National Lab	2 (2%)	1 (1%)	3 (2%)	4 (1%)
State Agency	3 (3%)	3 (2%)	21 (10%)	22 (7%)
Federal Agency	0 (0%)	0 (0%)	1 (1%)	1 (<1%)
For Profit	4 (4%)	1 (1%)	2 (1%)	4 (1%)
Non-Profit	3 (3%)	3 (2%)	4 (2%)	5 (2%)
K-12	14 (12%)	27 (19%)	34 (17%)	46 (15%)
Other	3 (3%)	1 (1%)	6 (3%)	10 (3%)
All Institutions	113	145	203	306

NM EPSCoR has involved participants from a variety of institutions across the program years. About half (49%) of the individuals that have participated were associated with an Academic-PhD Degree granting institution. The percent from PhD institutions has decreased from 57% in Year 1 to 48% in Year 3, as participants from other types of institutions have become involved. One-fifth (21%) of the total of individual participants were associated with an Academic Non-PhD institution, with as about half of these being undergrads who participated in the UROP program to offer summer research experiences to undergraduates from non-PhD granting institutions.

### Collaborators by Year

Recognizing that for NM EPSCoR to be successful in improving its research competitiveness, it must maximize the collaborations between researchers within and outside New Mexico. Figure 4 presents the number of collaborators across NM EPSCoR components by the collaborator's institution type.

**Figure 4**  
**Number of Collaborators by Type of Institution by Year**

Category	Year 1	Year 2	Year 3	Unduplicated Count
Academic-Research Institution	33 (59%)	54 (54%)	65 (68%)	109 (59%)
Academic-Primarily Undergraduate	1 (2%)	9 (9%)	0 (0%)	9 (5%)
Community Organization	1 (2%)	3 (3%)	13 (14%)	13 (7%)
Federal/State Agency	16 (29%)	22 (22%)	8 (8%)	30 (16%)
Industry/Business	2 (4%)	2 (2%)	3 (3%)	5 (3%)
National Laboratory	2 (4%)	0 (0%)	2 (2%)	4 (2%)
Non Profit	1 (2%)	0 (0%)	0 (0%)	1 (<1%)
Other	0 (0%)	11 (11%)	4 (4%)	15 (8%)
Total Collaborators	56	101	95	186

Overall, geographical distribution of the collaborators was split almost 50/50 with 97 (52%) within NM, 85 (46%) in another state and 4 (2%) international. US but not



## Material Infrastructure (Equipment, Measuring Stations, Models and Cyberinfrastructure)

As the name implies, the Research Infrastructure Improvement (RII) funding is meant to provide EPSCoR jurisdictions with the resources to enhance their research capabilities by purchasing equipment and funding infrastructure necessary for world class research. Figure 5 presents a table of infrastructure acquired by program year.

**Figure 5**  
**Infrastructure Acquired by Component and Program Year**

<b>Component</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Total</b>
Acequia Interdisciplinary Research	\$0	\$117,608	\$141,912	<b>\$259,520 (17%)</b>
Climate and Hydrology Research	\$97,397	\$469,237	\$170,200	<b>\$736,834 (49%)</b>
Cyberinfrastructure	\$0	\$24,000	\$10,000	<b>\$34,000 (2%)</b>
Public Outreach	\$2,000	\$63,000	\$10,000	<b>\$75,000 (5%)</b>
Water Quality Research	\$171,271	\$218,486	\$10,000	<b>\$399,757 (27%)</b>
<b>Overall</b>	<b>\$270,668</b>	<b>\$892,331</b>	<b>\$342,112</b>	<b>\$1,505,111</b>

About half (49%) of the \$1.5 million of equipment purchased has been used in the Climate and Hydrology research. The bulk of the expenditures occurred in Year 2 with equipment for Weather Stations/ Installation, USDA/NRCS SNOTEL Sites; Enhanced SNOTEL Sites, a SensorTran Gemini Dual Laser Distributed Temperature Sensing System, IMET Upper Air Sounding System and Ott Pluvios,

The Water Quality Research area had the second highest (27%) infrastructure expenditures. Most of the funding was used during Year 2 to equip the water quality lab at NM Highlands University and including EPSCoR funds as well as funding obtained from a NSF MRI grant.

The Acequia Interdisciplinary research group had the third highest expenditures with \$259,520 or 17% of the infrastructure funds. The funding was used for equipment and supplies for installing weather stations, flow measurement stations, moisture probe and logger, water level logger, and purchasing telemetry data for water sheds involving acequia.

The Public Outreach and Communication component purchased the "Science of a Sphere" from Magic Planet, a LED projector and a couple of laptops for a total for \$75,000 or 5% of the infrastructure funds to support the installation of the Degrees of Change exhibit.

## Discovery Learning (Observing, Data Collecting, Research, Funding Sought)

Data collected, observations or field work, research conducted and proposals submitted and awarded provide an indicator of the discovery learning outputs obtained through the work of the NM EPSCoR researchers. Figure 6 lists the amount of funding requested by component and year.

**Figure 6**  
**Amount of Funding Requested via Proposals by Component and Year**

<b>Component</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Total Requested</b>
Aquatic Chemistry Lab at NMHU	\$82,000	\$300,000	\$446,428	<b>\$828,428</b>
Climate and Hydrology Research	\$879,743	\$6,335,464	\$518,162	<b>\$7,733,369</b>
Cyberinfrastructure	\$0	\$8,018,634	\$0	<b>\$8,018,634</b>
Diversity	\$0	\$0	\$2,684,415	<b>\$2,684,415</b>
K-12 Teacher Professional Development	\$0	\$0	\$9,987,209	<b>\$9,987,209</b>
Socioeconomics and System Dynamics Models	\$408,000	\$3,693,434	\$0	<b>\$4,101,434</b>
State Office Management	\$2,000,000	\$1,176,470	\$150,000	<b>\$3,326,470</b>
Undergraduate Research Opportunity Program	\$12,280	\$11,730	\$0	<b>\$24,010</b>
Water Quality Research	\$4,206,184	\$0	\$1,192,562	<b>\$5,398,746</b>
<b>Overall</b>	<b>\$7,588,207</b>	<b>\$19,535,732</b>	<b>\$14,978,776</b>	<b>\$42,102,715</b>

Proposals totally over \$42.0 million have been submitted by NM EPSCoR faculty or staff during the first three years of the program. A proposal of almost \$10 million was submitted in Year 3 by a K-12 collaborator of NM EPSCoR to expand the work begun with school districts involved. The Climate and Hydrology Research and Cyberinfrastructure faculty have both submitted proposals requesting almost \$8 million of funding to expand the work begun with EPSCoR. The amount of funding requested by NM EPSCoR faculty and staff more than doubled from Year 1 to Year 2 and then dropped slightly in Year 3. The drop in Year 3 proposal submission may be partly the result of the success of earlier proposals, which are presented in the next table.

Figure 7 lists the status of funding requests by component and year.

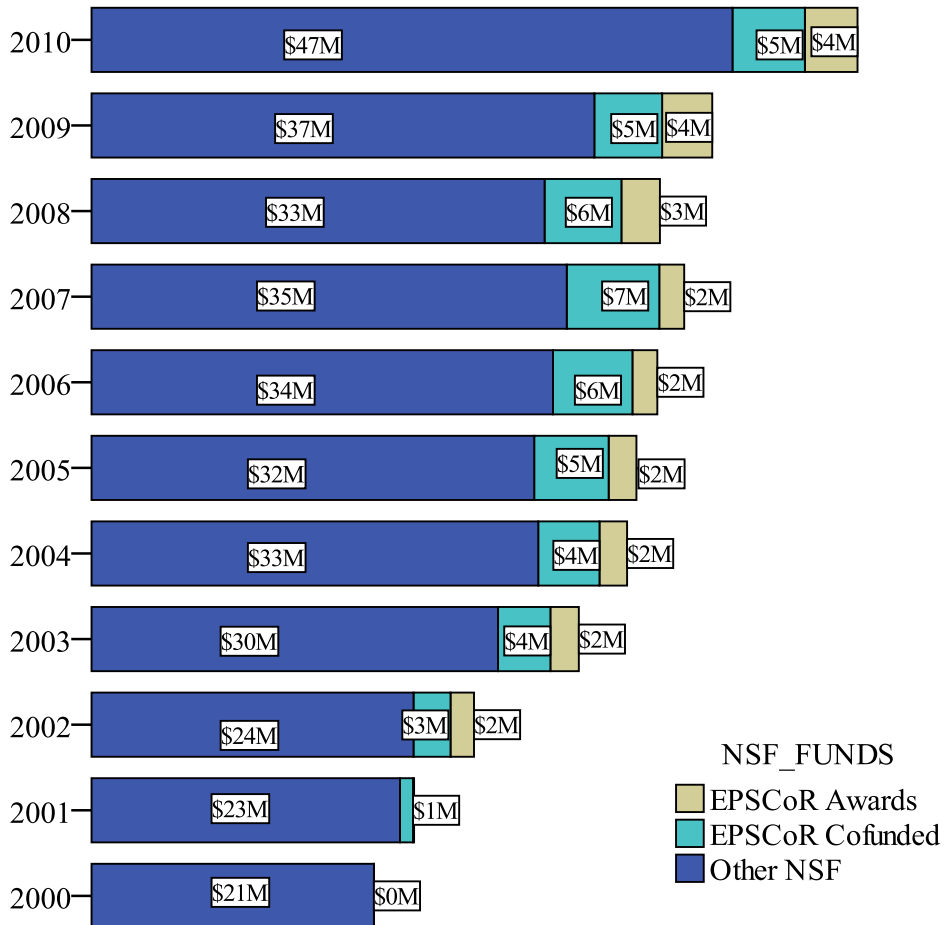
**Figure 7**  
**Status of Funding Requests by Component**

<b>Component</b>	<b>Total Requested</b>	<b>Pending</b>	<b>Declined</b>	<b>Awarded</b>
Aquatic Chemistry Lab at NMHU	\$828,428	\$446,428	\$0	<b>\$382,000</b>
Climate and Hydrology Research	\$7,733,369	\$4,132,194	\$2,031,178	<b>\$1,569,997</b>
Cyberinfrastructure	\$8,018,634	\$1,747,865	\$6,270,769	<b>\$0</b>
Diversity	\$2,684,415	\$2,684,415	\$0	<b>\$0</b>
K-12 Teacher Professional Development	\$9,987,209	\$100,000	\$9,887,209	<b>\$0</b>
Socioeconomics and System Dynamics Models	\$4,101,434	\$942,677	\$1,747,865	<b>\$1,410,892</b>
State Office Management	\$3,326,470	\$0	\$0	<b>\$3,326,470</b>
Undergraduate Research Opportunity Program	\$24,010	\$12,280	\$0	<b>\$11,730</b>
Water Quality Research	\$5,398,746	\$1,792,562	\$3,307,184	<b>\$299,000</b>
<b>Overall</b>	<b>\$42,102,715</b>	<b>\$11,858,421</b>	<b>\$23,244,205</b>	<b>\$7,000,089</b>

While proposals requesting over \$42.0 million have been submitted by NM ESPCoR, a determination has only been made on proposals requesting two-thirds (\$30 million) of that amount. Seven million has been awarded in the first three years, while \$23 million has been declined by funding agencies.

While tracking the funding levels of NM EPSCoR associated researchers, it is also important to examine the award dollars received by New Mexico from NSF over the last ten years. Figure 8 presents the amount of NSF awards to New Mexico broken out by EPSCoR awards, EPSCoR co-funded awards and other NSF awards. The award dollars are distributed over the projected length of the project to smooth out the effect of a large award causing a spike in an individual year. This technique also provides a better representation of when the dollars are expended and makes it easier to track trends in funding levels.

**Figure 8**  
**NSF Funding Awarded to New Mexico**  
**NSF Funded Awards in New Mexico by Calendar Year: 2000 to 2010**  
**Awarded Funding Equally Distributed Across Project Years**



New Mexico did not become an EPSCoR jurisdiction until 2000, when a small planning grant was awarded to the state. The first RII was awarded in 2002 for \$11 million for a three year award. Since 2002, New Mexico has met success with each RII submitted and has been awarded over \$45 million in RII awards. In addition, proposals from New Mexicans have been funded using NSF EPSCoR co-funding in the amount of \$23 million since 2001. While these EPSCoR related funds are significant and an essential part of the Federal research dollars coming into the state, it is even more significant that non-EPSCoR related funding has increased from \$21 million in 2000 to over \$47 million in 2010, an increase of over 120%.

## Knowledge Generation (Professional Presentations, Publications, Patents)

Professional presentations, posters and invited talks are critical to increasing the visibility and reputations of NM climate change researchers, in addition to disseminating their valuable research findings to their colleagues. Figure 9 presents the number of presentations made by EPSCoR researchers by component and year.

**Figure 9**  
**Professional Presentations, Posters and Invited Talks by Component and Year**

Component	Year 1	Year 2	Year 3	Total
Acequia Interdisciplinary Research	2	1	12	<b>15 (12%)</b>
Climate and Hydrology Research	5	22	30	<b>57 (46%)</b>
Cyberinfrastructure	3	10	4	<b>17 (14%)</b>
Project Management	8	1	3	<b>12 (10%)</b>
Socioeconomics and Systems Dynamics Models	1	4	4	<b>9 (7%)</b>
Water quality Research	0	6	9	<b>15 (12%)</b>
<b>Overall</b>	<b>19</b>	<b>44</b>	<b>62</b>	<b>125</b>

Over 125 professional presentations, posters and invited talks were reported by NM EPSCoR researchers. Almost half (46%) were reported by Climate and Hydrology Researchers, and 90% of these were reported in the last two program years. As expected the number of professional presentations, posters and invited talks has increased over time, from 19 in Year 1 to 62 in Year 3, for a three fold increase.

## Publications

Dissemination of the knowledge and research findings by EPSCoR researchers is an important outcome of the project. Figure 10 lists the presentations by researchers for each component.

**Figure 10**  
**Journal Articles and Book Chapters by Year and Cumulative**

Component	Year 1	Year 2	Year 3	Total
Acequia Interdisciplinary Research	1	0	4	<b>5 (28%)</b>
Climate and Hydrology Research	0	3	8	<b>11 (61%)</b>
Cyberinfrastructure	0	0	0	<b>0 (0%)</b>
Public Outreach	0	0	0	<b>0 (0%)</b>
Water Quality Research	0	0	2	<b>2 (11%)</b>
<b>Overall</b>	<b>1</b>	<b>3</b>	<b>14</b>	<b>18</b>

A total of 18 journal articles, chapters in books and conference proceedings were reported published by NM EPSCoR researchers during the first three years. The Climate and Hydrology group reported 11 articles or abstracts published, while the Acequia Interdisciplinary groups reported 5. As expected the number of publications has increased dramatically in the last program year as instrumentation has produced enough data to be analyzed. The time lag between data collection, analysis and publication in the EPSCoR research areas are longer than say in Nanotechnology.

## Patents

There have been no reports of any patent applications submitted or awarded during the first three years of the initiative.

## Outreach/Public Dissemination

### (Scientific Literacy, Public Presentations, Policymakers, Education)

Increasing the scientific literacy and understanding of scientific research at all levels of society is important for increasing the diversity of the scientific workforce. This includes the general public, undergraduates, graduate students, junior faculty, K-12 teachers and others. Each group needs different strategies and approaches which is evident from the education and public outreach activities conducted by the various components. Figure 11 presents the estimated number of people reached by NM EPSCoR presentations, posters and invited talks for various audiences since the beginning of the project.

**Figure 11**  
**Number of People Reached by Invited Talks, Presentations, Posters, etc.**  
**by Type of Audience**

Type of Audience	Males	Females	URM	Total
General public	1,534	1,266	1,537	2,800
K-12	1,466	1,571	1,580	3,037
Researchers/Other Professionals	3,696	2,573	1,836	6,269
Undergraduates	57	66	62	123
Total	6,753	5,476	5,015	12,229

Overall, an estimated 12,000 people have attended presentations, panel and poster sessions conducted by NM EPSCoR researchers and educators. Presentations directed towards professionals and other researchers made up over half (50%) of this total. Outreach represented the other half, with an approximate equal split between K-12 and the general public. Estimates of the gender of audience members attending these presentations tended to slightly favor males, while an estimate 5,000 (40%) audience participants were members of under-represented ethnic minority groups.

These numbers do not include the general public who experienced the Climate Change Exhibit at the NM Museum of Natural History, which was installed in May of 2011. It is estimated that approximately 50,000 members of the general public would have experienced the exhibit during the summer.

## Findings and Recommendations

### Component 1: Climate and Hydrology

**Findings:** The Climate and Hydrology research group appears to be proceeding according to the strategic plan. There is increased collaboration across the research institutions in the state as well as with colleagues from the Western Tri-State Collaboration with Idaho and Nevada, supported with Track 2 funding. The climate and hydrology observing instrumentation that has been deployed is being incorporated into one of the existing national networks; either through the National Resources Conservation Service (NRCS) or Remote Automatic Weather Stations (RAWS). In this way, data are being shared with other researchers and New Mexico data is maintained in a national network.

In addition to deploying instrumentation in the field and collecting data, there is a huge effort in trying to use the data collected with these instruments and other data sources to model climate variability, snow run off, watershed and water residence times in hydrological systems. The watershed modeling portion of this component has expanded to include researchers from the water quality component to account for the transport and reaction of dissolved organic matter. While the various modeling efforts have largely been confined to individual universities, researchers at NMSU and NMT were planning a seminar to share their researchers with their colleagues.

**Recommendations:** While the planned seminar is a good first step, an effort should be made to integrate the modeling efforts across the state. As the project nears its goal of providing policy makers and water managers with models to use in managing decreasing water resources a common platform and interface would make the adoption and use of these model more likely.

### Component 2: Water Quality

**Findings:** The Water Quality research group has conducted a number of studies, some in conjunction with the Climate and Hydrology and Acequia research groups. The deployment of the onsite water quality trailer has been delayed, although progress has occurred with the installation of electricity and a foundation for the trailer at the selected site. Somewhat related to the delay in deploying the trailer has been a delay in making water quality data available to other researchers and the public. These researchers have been working with the data portal developers and hopefully, this will be remedied in Year 4. Researchers have done well at dissemination at conferences, although the number of peer reviewed papers is relatively low.

**Recommendations:** A special effort should be made to publish findings from this research, perhaps in collaboration with researchers in one of the other research areas. The trailer must be installed by spring to capture the spring run-off and document the impact of the Las Conchas fire.

### Component 3: Socioeconomics and Acequia Research

**Findings:** These researchers have deployed instrumentation in many of the water basins with acequias. they have involved these communities in their work and shared the data collected. Researchers have also conducted outreach and training activities with the acequia associations on how to use the data collected. However, much of the data collected cannot be share with other researchers and the public because of ongoing legal issues surrounding the use of water by these communities. This group has expanded some modeling of the impact of socioeconomics in water use and plan to expand this effort. There was a noted increase in professional presentations and publications by this research group in Year 3.

**Recommendations:** A continued focus on professional presentations and publications should be maintained. A way to share the data with other researchers, without compromising the acequia legal rights, should be addressed. This group should be commended for their community engagement efforts and their willingness to train the acequia organizations in the use of the data.

#### **Component 4: Critical Gap Infrastructure for NMHU**

**Findings:** The NMHU water quality lab has been equipped with the infrastructure necessary to conduct experiments locally. This has resulted in the ability of undergraduates, graduate students and faculty to conduct their own analyses on samples they collect. Students are gaining valuable experience and training on the use of state of the art equipment not previously available on campus. The use of the equipment was also incorporated into undergraduate courses.

**Recommendations:** The group should continue to maintain the equipment and involving students in using the lab facility in their research. A plan for ongoing maintenance and replacement should be considered, perhaps be the inclusion of equipment usage fees in proposals.

#### **Component 5: Innovation Working Groups**

**Findings:** A total of six IEGs have been supported by NM EPSCoR during the first three years. This does not include those that were funded by the Tri-state. These working groups have covered a wide range of topics and involved over 70 people. IWGs have resulted in proposals, awards, white papers and working committees that have been formed to continue the work. They have also provided post-docs and graduate students the opportunity to gain valuable experience in submitting proposals, organizing working groups and becoming leaders in their field.

**Recommendations:** The IWG funding process should continue to evolve and include more post-docs and young faculty. An effort to solicit proposals from FLP participants might be warranted to expand their experiences to a hands-on activity that incorporates many of the leadership strategies learned during their workshop. This could also include the use of IWGs at primarily undergraduate institutions, such as Northern, Western or Eastern.

#### **Component 6: Critical Infrastructure Gap Seed Awards**

**Findings:** The seed awards were first awarded in Year 3 to faculty at two non-PhD granting institutions: NMHU and Dine College. The NMHU proposal built upon the water quality lab and the award has been successful at engaging non-PhD students in hands-on data collection and water quality analysis using the equipment purchased through the RII-Track 1. In addition, other NMHU faculty have become involved, thus extending participation at this four year institution. The Dine proposal sought funding for environmental sensors to be installed in the watershed at Whiskey Creek on the Navajo Nation and increase the research and field experiences of Dine students in hydrology and water quality monitoring. The instrumentation was installed by faculty at NM Tech and is part of the NRCS SNOTEL network. Unfortunately, the Dine faculty member was let go by the college and a replacement has not been hired, thus limiting the educational use of the equipment by students at this four year institution.

**Recommendations:** Continue to fund these worthwhile awards that increase the access to research tools by faculty and students at four year institutions. Students and faculty at these institutions are increasing becoming critical to the research pipeline and need to be provided the necessary infrastructure to succeed. Difficulties will arise as there is often few faculty available at these institutions with the capabilities to implement a seed grant. Perhaps identifying a co-pi at the four institution should be required for an award.

#### **Component 7: Cyberinfrastructure Improvements**

**Findings:** The CI group had developed a data portal for storing and providing access to data collected by researchers. They have contacted all researchers to create a universe of data being generated and begun work with selected researchers to develop data import protocols. The data aggregation process has been difficult as faculty have become accustomed to managing their research data themselves. The CI group has been patient with developing protocols that do not impose extra burden on researchers. An IWG focused on using data in K12 classrooms found that the EPSCoR data portal was difficult to use and needed more tools for access.



**Recommendations:** The CI group needs to give a higher priority to enhancement suggested by the IWG working group on using data in the classroom. Similarly the NM EPSCoR management team needs to link continued research funding to participation in the data portal by the faculty. An updated data management plan should be developed detailing how and when data collected with RII funds will be archived and made available to other researchers and the public within a reasonable amount of time. The CI group should lead this effort with the support of the management team.

### **Component 8: Enhance Diversity**

**Findings:** In Year 2 developed a Diversity Strategic plan with Idaho and Nevada. This plan was updated during Year 3. A Best Practices Guide for Increasing the Diversity of Faculty at NM Research Institutions was developed with the help of an IWG on diversity. The plan was adopted by the council of University Presidents. The number and percent of NM EPSCoR participants identified as under-represented ethnic (URM-Ethnic) minorities has increased from Year 1 to Year 3 by 17% points (Year 1: 12(12%); Year 3: 58 (29%), while one-fifth (21%) of total project participants across the three years are under-represented minority. Almost half (43%) of project participants have been women.

Increases in diversity by participant role have also been positive. The percentage of URM-Ethnic faculty has risen from 4% in Year 1 to 18% in Year 3, although the numbers are still low. Similarly the percentage of URM-Ethnic undergraduates has increased from 10% in Year 1 to 33% in Year 3, while the absolute numbers have also increased. The percentage of URM-Ethnic graduate students has remained constant across the three years at 25%, while the absolute numbers have increased.

**Recommendations:** NM EPSCoR should continue to focus on increasing the diversity of participants, especially at the faculty level. Researchers from diverse backgrounds help to encourage young students to pursue careers in STEM. The Tri-state consortium should revisit their strategic plan and identify activities that can be accomplished during the last two years of funding.

### **Component 9: Professional Teacher Development Programs**

**Findings:** NM EPSCoR has supported multiple teacher professional opportunities during the first three program years. Each summer the Northern Network conducts teacher training in the Valles Caldera for 10-15 math and science teachers involved EPSCoR researchers. On pre-post surveys of the teacher, they consistent report increases in research knowledge and skills as a result of the training.

**Recommendations:** Continue to support these teacher development programs, but explore ways to include a workforce development component in the training.

### **Component 10: Undergraduate Research Opportunity Program**

**Findings:** UROP has involved 8-10 undergraduate students from non-PhD institutions in the state in each of the three program years. These students have benefited from conducting research as well as mentoring by EPSCoR faculty. Students learn how to posit scientific question, collect and analyze data, organize results into presentations and posters and learn about the scientific enterprise. The program has recruited participants from across the state and involved many minority students.

**Recommendations:** Develop a plan for continuing UROP when the RII funding ends. Perhaps approach private or university foundations for the funding. Private individuals may welcome a chance to provide money to support a successful program that allows students from their community to have an opportunity to conduct research as undergraduates.

### **Component 11: Graduate Research Training**

**Findings:** Training opportunities were provided to graduate students in collaboration with the Tri-State consortium and Los Alamos National Labs. Topics included climate and interdisciplinary modeling, cyberinfrastructure and bridging disciplines and scale in simulating spatial-temporal patterns of anthropogenic climate change.

**Recommendations:** The project may want to consider providing graduate students workshop opportunities in other areas; such as leadership development, mentoring, balancing career and personal lives, etc; similar to the Faculty Leadership Program. Graduate students who can learn these skills now will be better equipped to be successful faculty members and researchers in the future. It may be useful to ask graduate students through a survey what topics they would be interested in learning about.

### **Component 12: NSF Day**

**Findings:** NSF Day was held in Year 3 and attended by over 150 professionals from across the state and representing a variety of institutions. Those institutions that had more than five percent of the total participants were: University of New Mexico: 43(28%); New Mexico State: 31 (20%); Los Alamo National Lab: 10 (7%) and New Mexico Institute of Mining and Technology: 7 (5%). Over half (54%) of the attendees were from research universities with another 14% from either a branch of one of the research universities or a center affiliated with a research university. Almost one in ten (9%) were from a national lab or national lab foundation, while six percent either worked for a K-12 institution or an institution closely affiliated with the K-12 system, such as non-profit professional development provider.

A survey was emailed to NSF Day attendees. The number of attendees who responded was 91, for a response rate of 60%. Over half (52%) of the survey respondents have not submitted an NSF proposal in the last two years. Only 15% have submitted 3 or more proposals during that time period. The number of respondents receiving NSF awards in the past two years was even less, with 11% reporting receiving 1-2 awards and 1% receiving 3-4 awards.

Almost four out of five (79%) of the survey respondents 'Strongly Agree' (4 or 5) that 'The information presented will be helpful for your future success when submitting a proposal to NSF?'. In response to the question on whether they see themselves submitting a proposal to NSF in the next 12 months, 70% 'Strongly Agree' (4 or 5) that they will. This compares to only 48% reporting that they had submitted a proposal in the last two years.

**Recommendations:** A one year followup survey should be sent to respondents to determine whether participants had increased their NSF proposal submission or success rate, and other impacts that could be attributed to NSF Day.

### **Component 13: Faculty Leadership Program**

**Findings:** The Faculty Leadership Program has been held every January of each year during the project. It has involved from 15-20 early career faculty every year from a wide variety of higher education institutions, both within New Mexico and our Tri-State consortium states of Idaho and Nevada.

On post event surveys participants consistently rate the quality of the content, presentations and materials used in the week long training workshop. The workshop has changed over the years in response to feedback from the participants. For example, mentoring was added as a topic for the latest workshop in response to feedback from the prior year participants. The workshop is always well designed and well run.

**Recommendations:** A followup survey/interview with prior workshop participants to assess longer term impacts from their participation should be conducted. Questions about their leadership skills/positions; career path; communicating with the media and others; plus other questions to determine the longer term success of the workshop.

### **Component 14: Public Outreach and Communication**

**Findings:** The Degrees of Change exhibit, partially sponsored by NM ESPCoR, was opened to the public at the NM Natural History and Science Museum in May of 2011. The museum has an annual visitor ship

of over 250,000 and it is hoped that the exhibit will be engaging to all. The exhibit consists of interactive components on Carbon Footprint, Greenhouse Effect and Energy and Climate, as well as a Magic Plant, a video of three New Mexican's personal observations of climate changes that they have observed; posters on three NM EPSCoR researchers and a display board of precipitation and temperature over the last 2,000 years.

NM EPSCoR has also sponsored over 50 education and public outreach events conducted by the NMMNHS and the Northern Network. The Network has conducted field trips involving over 200 K-12 students in outdoor science activities, while the museum has conducted community events involving over 5,000 participants in events ranging in size from 6 to 1,000 participants. Each of the museum public outreach events are designed to reach different audiences; such as a hands-on bilingual event to celebrate Hispanic Heritage Month involve more families and children, while seminars and science cafes tend to involve older adults with few children attending.

**Recommendations:** This component has expanded its activities and potential impact each year. The next challenge will be to assess the efficacy of the climate change during Year 4 to determine if any changes should be made to the exhibit based on visitor feedback.

### **Overall Project Recommendations**

Overall, NM EPSCoR is on schedule and following the strategic plan developed in Year 1 of the project. There have been minor changes in activities as the research and outreach developed but no significant changes that would warrant a change in project scope or impact. There is considerable integration between and among the research areas and education, which speaks well for creating that critical mass of researchers needed to study the impact of changes in snow pack on climate change.

As the project moves towards its final two years, it is important to revisit the strategic and evaluation plans to ensure that the project will complete all its deliverables and be able to document what it has accomplished. A strategic planning session immediately prior to the annual reporting process may result in the best outcome for both the annual report as well as the strategic plan.