* What are the major goals of the project?
The goal of the project is to increase the number, preparation and technical expertise of irrigation technicians and designers who are prepared to improve agriculture water management, increase irrigation delivery system efficiency, and enhance on-farm water conservation.

Project personnel are implementing three objectives to reach the goal:

1. Develop and deliver standardized curriculum that advances the efficient design and use of irrigation systems and can be replicated at other institutions
2. Create a pipeline of skilled, certified technicians that meet current conservation, efficiency and water management regulations
3. Increase recruitment and success rates for underrepresented students in agricultural science technical programs.

* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

Major Activities: The Modesto Junior College Technical Skills for Agriculture Irrigation Technicians project made significant progress toward the accomplishment of the identified objectives. Major activities include:

- Planning, designing and installing an agriculture irrigation lab
- Professional development for program faculty and students
- NSF ATE Conference
- Regular participation in CALTEC Soil tests
- Faculty/student attendance at the Irrigation Association’s International Irrigation show and Educational Conference
- Faculty/student presentations to the East Stanislaus Recourse Conservation District
- Irrigation Association Faculty Academy

Recruitment and retention of twenty-six new students into program courses

Biannual Irrigation Technology Advisory Committee Meetings

Specific Objectives:

1) Develop and deliver standardized curriculum that advances the efficient design and use of irrigation systems and can be replicated at other institutions

The California Community College Chancellor’s Office approved the curriculum for four courses, four certificates, and an Associate of Science Degree in Irrigation Technology. The four certificates and the AS Degree were also approved by the Accrediting Commission of Community and Junior Colleges (ACCJC). Twenty-six students completed courses in the program. Students completed five degrees and fourteen certificates.

The PI shared the program design and curriculum with other institutions through large presentations (California Agriculture Teachers Association Short Course), and individual meetings (Fresno State University, College of the Sequoias, Bakersfield College, West Hills College, Victor Valley College, and Walla Walla Community College). In addition, program presentations were made to college counselors and multiple industry experts (Gallo Winery Educators Network, Stanislaus County Almond Board, Spray Safe Seminar, Irrigation Association Show and Educational Conference, Pacific Southwest Irrigation, East San Joaquin Water, East Stanislaus Recourse Conservation District, California State FFA Conference, Irrigation Association Facility Academy workshop, and the California Irrigation Association annual Meeting). Program students participated in many of the presentations, including a poster session at the NSF ATE Conference and a featured showcase at the California Irrigation Association Annual Meeting.

2) Create a pipeline of skilled, certified technicians that meet current conservation, efficiency and water management regulations

The Irrigation Technology program prepares students to meet current and emerging regulations and guidelines related to water conservation, efficiency and management. The PI and co-PI worked closely with area irrigation experts through the MJC Irrigation Technology Advisory Committee to develop a pipeline of technicians with the knowledge and skills needed by a variety of irrigation-related companies and public utilities. Toward that end, the PI established multiple student internship opportunities with Modesto Irrigation District (MID), Oakdale Irrigation District (OID), Turlock Irrigation District (TID), the California Almond Board, and other agriculture companies.

Twenty-three students who started the program in fall 2016 (88%) are currently serving internships. Six students who
completed certificates now have full-time jobs. Fourteen students are working part-time as they complete their education. Industry experts in the service area have requested additional trained technicians as soon as they have completed their education.

The PI worked with faculty from California State University, Fresno (CSUF), to develop a pipeline for students to transfer from the MJC Agriculture Irrigation Technology program to the new CSUF Agriculture Systems Management program, with a specialization in water management. Three MJC students completed the Agriculture Irrigation Technology program and are now enrolled in the CSUF program.

In addition to the industry pipeline for skilled students, agriculture and irrigation leaders in Stanislaus County have contributed labor, materials, and expertise to the establishment of a working agriculture irrigation lab for students. The combined efforts of industry and education have created a multi-faceted lab to meet applied science, educational, and research and development needs of an industry with emerging demand for technical tools and expertise.

3) Increase recruitment and success rates for underrepresented students in agricultural science technical programs.

Program personnel made targeted outreach efforts to increase the number of underrepresented students who enroll in the program. This continues to be a challenge because a relatively low number of Hispanic students in the service area have shown interest in agriculture programs. This is, in part, due to their experience or the experience of their parents as farm laborers. Program presentations have included the description and demonstration of multiple technology skills students are learning. Program brochures and the website have been translated into Spanish. The PI presented program details to Latino audiences at multiple conferences, including a workshop and recruitment booth at the Hispanic Education Conference led by current Irrigation Technology students; a presentation and demonstration to the East San Joaquin Water Coalition meeting to nearly 1500 farmers and farm laborers; and a presentation at the Spray Safe Conference, hosted by the Stanislaus County Farm Bureau.

Significant Results:

The PI worked with MJC facilities personnel and local irrigation associations to build the MJC Irrigation Technology lab, including an entire irrigation system with a water reservoir, pump and electrical system. Students assisted with the work of planning and installing the irrigation system. The lab can replicate a full-scale irrigation system during the winter months when water typically does not flow. Students are now able to learn and apply the technical skills needed for the program.

Thirty-five students enrolled in the second year of the irrigation program, including five Hispanic students and one African American student (17%). Twenty-six students completed courses in the program. Students completed five degrees and fourteen certificates.

Key outcomes or Other achievements:

Year Two of the Irrigation Technology grant saw three key achievements:

Program and curriculum was approved by the California Community College’s State Chancellor’s office and the Accrediting Commission of Community and Junior Colleges (ACCJC), establishing the first irrigation technology associate degree in California along with four certificates.

Program design and curriculum were shared with thousands of students, teachers, and industry experts. The program PI is collaborating with community college and university faculty as well as agriculture irrigation industry experts throughout California, Oregon, and Washington.

Recognition of the need for skilled technicians and the quality of the program developed through this grant by irrigation industry experts, as well as the emerging partnerships with irrigation associations, companies, and independent farmers to increase knowledge and skills for incumbent workers and continue to develop the use of technology in this field.

* What opportunities for training and professional development has the project provided?

The PI and two students attended the ATE Principal Investigators Conference in Washington DC in October 2016. The PI also took groups of students to the International Irrigation Convention in Las Vegas, the San Joaquin Water Coalition meeting, a visit to irrigation facilities in Oregon and Washington, and the Irrigation Association Facility Academy in Lincoln, Nebraska. Students participated in soil research opportunities for new agricultural technology with CalTec Advanced Technologies to identify ways to improve irrigation in soils.
Ten students took the Irrigation Association’s Certified Agriculture Irrigation Specialist test, which was proctored at the college in April 2017. The College will proctor the Irrigation Association’s Certified Irrigation Design test in summer 2017. Summer internships are being developed for students in summer 2017, including one internship at the Natural Resource Conservation Service (NRCS) (one additional possibly being developed); five internships at Meras Engineering; one internship at the California Almond Board; two internships with Modesto Irrigation District, and numerous internships at local irrigation companies and with local farmers.

* How have the results been disseminated to communities of interest?

The PI has presented this program to thousands of students, teachers, and industry experts at multiple conferences and organizations. Students assisted with many of the presentations:

- MJC Agriculture Irrigation Advisory Committee (twice annually)
- California Agriculture Teachers Association (CATA) Trade Show (June 2016)
- Irrigation Association Faculty Academy Workshop, Fresno California (June 2016)
- Irrigation Association facility Academy Workshop, Lincoln, Nebraska (June 2016)
- NSF ATE PI Conference (October 2016)
- Farm Bureau Spray Safe Meeting, (November 2016)
- MJC Career Expo (February 2017)
- Hispanic Education conference (March 2017)
- Irrigation Field Trip with students to Oregon and Washington (April 2017)
- State FFA Conference (April 2017)
- California Irrigation Association Annual Meeting (February 2017)

* What do you plan to do during the next reporting period to accomplish the goals?

Program personnel have exceeded many of the goals originally designed for this project. The industry collaboration in establishing the irrigation lab enabled a comprehensive design that will support education, training, and research for agriculture throughout the Central Valley. The irrigation technology lab will be completed by mid-summer, 2017.

Program courses in the next year will include advanced courses for students completing the two-year program as well as introductory courses for students starting the program in the fall. Outreach efforts to high school programs will increase to recruit students into the pathway. Program personnel are planning a late-start course in October 2017, targeted for growers and other industry experts, following the fall harvest. Additional short-term trainings for farmers and farm workers will be offered to broaden technology skills across the local industry.

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<th>Supporting Files</th>
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<tr>
<td><strong>Filename</strong></td>
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<tr>
<td>(Download) MJC Agriculture Irrigation Technology Program Photos revised.pdf</td>
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<td><strong>Description</strong></td>
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<td>Photos of MJC Irrigation Technology Program</td>
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<tr>
<td><strong>Uploaded By</strong></td>
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<tr>
<td>Don Borges</td>
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<td><strong>Uploaded On</strong></td>
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Products

Books

Nothing to report.

Book Chapters

Nothing to report.
Inventions

Nothing to report.

Journals or Juried Conference Papers

Nothing to report.

Licenses

Nothing to report.

Other Conference Presentations / Papers

Nothing to report.

Other Products

Nothing to report.

Other Publications

Nothing to report.

Patents

Nothing to report.

Technologies or Techniques

Nothing to report.

Thesis/Dissertations

Nothing to report.

Websites

Nothing to report.
Participants/Organizations

What individuals have worked on the project?

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<tr>
<th>Name</th>
<th>Most Senior Project Role</th>
<th>Nearest Person Month Worked</th>
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<tr>
<td>Amador, Steve</td>
<td>PD/PI</td>
<td>9</td>
</tr>
<tr>
<td>Borges, Don</td>
<td>Co PD/PI</td>
<td>12</td>
</tr>
</tbody>
</table>

Full details of individuals who have worked on the project:

Steve Amador
Email: amadors@mjc.edu
Most Senior Project Role: PD/PI
Nearest Person Month Worked: 9

Contribution to the Project: Led the development of the Irrigation Technology degree and certificate coursework and the installation of the irrigation lab. Recruited students, shared program curriculum with colleges, collaborated with industry experts.

Funding Support: 25% of Mr. Amador's salary is funded by the ATE grant. 75% is funded by Modesto Junior College.

International Collaboration: No
International Travel: No

Don Borges
Email: borgesd@yosemite.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 12

Contribution to the Project: Oversight of budget, irrigation lab installation, and program delivery.

Funding Support: 100% funded by Modesto Junior College.

International Collaboration: No
International Travel: No

What other organizations have been involved as partners?

Nothing to report.

What other collaborators or contacts have been involved?

A highlight of this grant is the development of multiple partnerships to address the severe irrigation needs of the agriculture industry in the Central Valley. Many industry partners have consulted and contributed to the establishment of the curriculum and irrigation lab, including:
Impacts

What is the impact on the development of the principal discipline(s) of the project?

California passed the Sustainable Groundwater Management Act that will regulate agriculture irrigation. Program personnel have identified and embedded new technology in the Agriculture Irrigation Technology program that enables technicians to predict irrigation needs and manage water flow to crops and plants with an incredible degree of accuracy. These tools will help farmers and farm managers meet increasing federal and state regulations related to water conservation, particularly in light of the severe drought California is still experiencing. Experimental collaboration with irrigation companies is experimenting with enzymes to change the distribution of water flow to crops. Other collaborations include testing the use of electronic pressure transducers, (usually used on oil pipelines), to read and manage the flow and pressure of water in a pipeline, transmitting data to an iPad.

New technology and equipment embedded in the program include:

- Weather station (live satellite images of aerial views and soil moisture tables) [http://westernwx.com/ModestoJC/](http://westernwx.com/ModestoJC/)
- Agriculture aerial drones (provide soil moisture data to computers)
- Sand tank (test and modify water distribution)
- Soil pH meters, soil salinity meters, and soil moisture meters
- Leaf pressure chamber (tests leaf moisture content to identify irrigation needs)
- Portable electronic flow meter (measures water flow in pipelines)
- Electronic pressure transducer (measures flow and pressure and transmits to iPad)
- Electronic Well Sounder (measures water table levels)
- Electronic Power Meter (measures pump power consumption)
- Electrical Test Equipment (mega ohm meter, thermal image camera to test pumping station components)

What is the impact on other disciplines?

The use of technologies in irrigation is evolving and may have an impact on landscape design, water conservation and other disciplines. Crop science and plant science students will benefit from understanding new irrigation technologies as irrigation regulations continue to evolve.

What is the impact on the development of human resources?

Students are learning to program and fly aerial drones that collect rich data and photographs of field irrigation needs. These skills may be able to transfer to multiple disciplines as the use of drones continues to grow. The highly technical program is changing the expectations of farmers and other industry experts for the necessary skills an employee in the field of irrigation should possess.

What is the impact on physical resources that form infrastructure?

An eleven-acre site is now the home of the MJC Irrigation Technology lab, near a Modesto Irrigation District (MID) canal and adjacent to MJC Agriculture Division fields. The installation work is nearly complete to establish a fully-operational agriculture irrigation lab, including a small reservoir to hold water (as the canal is empty during most of the program academic year), an electrical pumping system, pipelines, and other equipment necessary to learn how to plan and manage water distribution.
The installation of an agriculture irrigation lab adjacent to other division fields enables multi-disciplinary projects with irrigation students and others (plant science, crop science). The lab, built with resources from the grant and multiple irrigation organizations in the area, provides an ongoing site for students to study the evolving field of agriculture irrigation; provide professional development to program faculty from other colleges and high schools; and develop new approaches that impact agriculture science technical fields.

What is the impact on institutional resources that form infrastructure?

Nothing to report.

What is the impact on information resources that form infrastructure?

Nothing to report.

What is the impact on technology transfer?

Nothing to report.

What is the impact on society beyond science and technology?

The agriculture industry in the Central Valley and throughout California has been seriously impacted by the severe drought of the last several years. Farmers have been accustomed to flooding fields without too much attention to water run-off and many have not incorporated technology into their operations. New legislation has established complex regulations that will include severe fines for any water that leaves the agriculture property. Farmers will need highly trained technicians to implement water conservation and efficient irrigation practices.

Changes/Problems

Changes in approach and reason for change

The original proposal included a summer institute to prepare students for the irrigation technology program. The PI and co-PI changed the approach from an intense start-up program to ongoing activities throughout the year because the majority of students who enroll in fall courses were working during the summer months and many students come from around the state for this program, moving to Modesto just before the semester begins. The focus of the academic-year activities continues to be on leadership development and hands-on experience with industry partners. From skills and networking experiences in these activities, most program students are now working in irrigation internships or full-time jobs.

Actual or Anticipated problems or delays and actions or plans to resolve them

Curriculum for the program was developed and submitted through the college and state approval process in fall, 2015. While the program was approved at the college level, the state approval process was severely delayed, due to regular processing issues. The state approved the courses in spring 2016. Approval for the degree and certificates, however, was not received until spring 2017. This delay may impact the number of students who complete the degree within the grant period.

Changes that have a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects

Nothing to report.

Significant changes in use or care of vertebrate animals

Nothing to report.
Nothing to report.

Significant changes in use or care of biohazards

Nothing to report.

Special Requirements

Responses to any special reporting requirements specified in the award terms and conditions, as well as any award specific reporting requirements.

Nothing to report.