2004 Water Use Efficiency Proposal

PROJECT INFORMATION FORM

Applying for: ☐ Urban ☑ Agricultural

1. (Section A) **Urban or Agricultural Water Use Efficiency Implementation Project**
   - ☐ (a) implementation of Urban Best Management Practice, #_____
   - ☐ (b) implementation of Agricultural Efficient Water Management Practice, #_____
   - ☐ (c) implementation of other projects to meet California Bay-Delta Program objectives, Targeted Benefit # or Quantifiable Objective #, if applicable _____
   - ☐ (d) Specify other: _____

2. (Section B) **Urban or Agricultural Research and Development; Feasibility Studies, Pilot, or Demonstration Projects; Training, Education or Public Information; Technical Assistance**
   - ☐ (e) research and development, feasibility studies, pilot, or demonstration projects
   - ☑ (f) training, education or public information programs with statewide application
   - ☐ (g) technical assistance
   - ☐ (h) other

3. Principal applicant (Organization or affiliation): West Hills Community College District

4. Project Title: Remote Sensing for Irrigation Scheduling and Water Efficiency

5. Person authorized to sign and submit proposal and contract:

Name, title	Dr. Frank Gornick, Chancellor
	West Hills Community College
Mailing address	9900 Cody Street
	Coalinga, CA 93210
Telephone	559-934-2100
Fax.	559-934-
E-mail	frankgornick@westhillscollege.com

6. Contact person (if different):	Name, title.	Joy Cowden Project Director
	Mailing address.	West Hills Community College 300 Cherry Lane Coalinga, CA 93210
	Telephone	559-934-2708
	Fax.	559-934-2856
	E-mail	joycowden@westhillscollege.com

7. Grant funds requested (dollar amount): *(from Table C-1, column VI)*	**$ 1,036,688**
8. Applicant funds pledged (dollar amount):	$ 885,132
9. Total project costs (dollar amount): *(from Table C-1, column IV, row n)*	$ 1,921,800
10. Percent of State share requested (%) *(from Table C-1)*	54%
11. Percent of local share as match (%) *(from Table C-1)*	46%
12. Is your project locally cost effective? *Locally cost effective means that the benefits to an entity (in dollar terms) of implementing a program exceed the costs of that program within the boundaries of that entity.* *(If yes, provide information that the project in addition to Bay-Delta benefit meets one of the following conditions: broad transferable benefits, overcome implementation barriers, or accelerate implementation.)*	☑ (a) yes ❑ (b) no

11. Is your project required by regulation, law or contract? ❑ (a) yes ☑ (b) no
    If no, your project is eligible.

    If yes, your project may be eligible only if there will be accelerated implementation to fulfill a future requirement and is not currently required.

    Provide a description of the regulation, law or contract and an explanation of why the project is not currently required.

12. Duration of project (month/year to month/year): 12/2005-11/2008

13. State Assembly District where the project is to be conducted: 30th

14. State Senate District where the project is to be conducted: 16th

15. Congressional district(s) where the project is to be conducted: 20th

16. County where the project is to be conducted: Fresno and Bay-Delta watershed counties of Central Valley

17. Location of project (longitude and latitude) N 36^0 10.718' S 120^0 21.313

18. How many service connections in your service area (urban)? N/A

19. How many acre-feet of water per year does your agency serve? N/A

20. Type of applicant (select one):

- ❑ (a) City
- ❑ (b) County
- ❑ (c) City and County
- ❑ (d) Joint Powers Authority
- ❑ (e) Public Water District
- ❑ (f) Tribe
- ❑ (g) Non Profit Organization
- ☑ (h) University, College
- ❑ (i) State Agency
- ❑ (j) Federal Agency
- ❑ (k) Other ❑
  - ❑ (i) Investor-Owned Utility
  - ❑ (ii) Incorporated Mutual Water Co.
  - ❑ (iii) Specify _____

21. Is applicant a disadvantaged community? If 'yes' include annual median household income.

(Provide supporting documentation.)

☑(a) yes, _____ **median household income is $26,800 – 63% below National Average**

❑ (b) no

SIGNATURE PAGE

By signing below, the official declares the following:

The truthfulness of all representations in the proposal;

The individual signing the form has the legal authority to submit the proposal on behalf of the applicant;

There is no pending litigation that may impact the financial condition of the applicant or its ability to complete the proposed project;

The individual signing the form read and understood the conflict of interest and confidentiality section and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant;

The applicant will comply with all terms and conditions identified in this PSP if selected for funding; and

The applicant has legal authority to enter into a contract with the State.

	Frank P. Gornick Chancellor	
_____	_____	_____
Signature	Name and title	Date

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INTRODUCTION

Project Description

Remote sensing has shown potential for use in agricultural management for more than 40 years, however, the availability of affordable, high quality spatial resolution, and near real-time photos has limited its application.[1] In the past, the cost of aerial imagery and the turnaround time (time from when the "field was flown" and photographs made to the time when the NDVI is available for the grower) has not been feasible for timely and cost effective irrigation scheduling.

Recently, remote sensing has gained popularity and is used extensively in the Central Valley for growth regulator applications on cotton, nutrient sampling and variable rate seeding maps, but has not yet been adopted as an irrigation water management tool. Due to the increased popularity of aerial imagery for other applications, new technology has allowed for NDVI's with good resolution to be available to the grower within 24 hours from the time the field was flown. The cost is now becoming cost effective.

NVDI and TIR images can be used to define areas with poor crop biomass useful as a guide to determine soil moisture and plant stress sampling locations. In addition, these images can aid in the placement of neutron probes, tensiometers, gypsum blocks and other soil moisture monitoring devices.

Aerial imagery can quantify areas of weak crop performance that may be due to water penetration problems, which ultimately leads to poor plant growth, excessive runoff of irrigation water, and possible runoff of nutrients. In a very real and demonstratable way, these site specific approaches to agricultural production are helping growers to stay profitable in a time of increasing input costs, decreasing crop prices and increasing awareness of environmental impacts. This technology is producing an environmental benefit which demonstrates more production is obtainable on less acreage and overall inputs are reduced per unit of production while minimizing soil drainage and surface runoff.

The focus of this grant will be to provide in-service education of agricultural advisors and farmers to use "off-the-shelf" remote sensing information to increase water use efficiency. This project will provide targeted training and demonstration, for the first two years, and extensive outreach and education in year three. The demonstration will involve distribution uniformity (DU) and scientific irrigation scheduling. The educational outreach will involve conducting "field days", seminars, and presentations and industry conventions and farm shows. Pre-training assessment of all participants and data on participating farms will be collected via personal interviews and compared to post-training experiences.

[1] Remote sensing of vegetation characteristics for farm management. R.D. Jackson. SPIE 475:81-96.

Remote sensing is the monitoring or measurement of a physical asset (crop), without coming in actual physical contact with that crop. Observing the colors of leaves or the overall appearance of plants can help in determining the health of the plant.
Remote sensing images taken from an aircraft provides a means to assess field conditions without physically viewing the land or crop. The focus for this project will be the training of crop production advisors and farmers to use cutting edge technology (Normalized Difference Vegetative Index-NDVI and Thermal Infrared-TIR) as a basis for irrigation scheduling. (see example NDVI photo - Appendix A.) **This type of training is currently not available in California or the western states.**

Normalized Difference Vegetative Indices (NDVI) generate from color infrared images. When a color infrared image is acquired, there are three primary bands of color: the near infrared (NIR), the red, and the green. As light radiation reaches earth, it can follow several paths. It may be absorbed into the plant, reflected from the plant, or reflected from the ground. The amount of light absorbed is primarily dependent on the chlorophyll content in the plant. With remote sensing, the light that is reflected can be captured, processed, and analyzed using appropriate software. Within every image acquired, there are a certain number of pixels for each of the color bands. NDVI is produced by the equation (Near Infrared – Red) / (Near Infrared + Red). NDVI images can be used to identify nutrient deficiencies, diseases, water surplus or deficiency, weed infestations, insect damage and plant population densities.[2]

Thermal Infrared (TIR) images are produced from a camera that records the thermal infrared portion of the electromagnetic spectrum. Thermal imagery can give a real time evaluation of the soil/moisture/plant relationship. In some cases, irrigation amounts or frequencies may be reduced and result in decreased water use by the crop. Measures of radiance in this area can be used to derive the surface temperature of the crop. Plants take up water from the soil and then release it from their leaves back to the air. As the water transpires from the plant, its leaves are cooled. If a crop cannot get enough water, its surface temperature will increase, so the plant's surface temperature is an indicator of the plant's health.[3]

This project will extend the availability of water to all Californians by training farmers and agricultural consultants in the use of cutting edge technologies to increase the efficiency of agricultural water use, thereby making a greater supply of water available for the Bay-Delta program.

Disadvantaged Communities

This project will be based in Fresno County and engage the farmers of the Central Valley. Fresno County has experienced unemployment rates of 12.6%. Local EDD data reports that many of our communities have unemployment rates exceeding 30% on an annual basis and 50% when reported seasonally.

[2] North Dakota State University, 2004 (ext.noda.edu/extpubs/ageng/gis/ae1262w.htm)
[3] U.S. Water Conservation Laboratory, 2005 – (uswcl.ars.ag.gov/EPD/Remsen/rsagintr.htm)

This project intends to impact a favorable reduction in this employment data through improved economic and environmentally sustainable farming practices.

The distressed areas in our community will be served as follows:

(a) Public information will be provided in Spanish and English in each of the communities.
(b) Instruction will be conducted in appropriate communities and at times conducive to worker attendance.
(c) Instruction will be conducted in a bi-lingual format encouraging participation of the greatest number of individuals.
(d) Instructional resources – computers, moisture sensors, water filtration and controllers - will be transported in an "instructional resource trailer" to the instructional site as needed.
(e) Class members will have frequent interactions with farmers, irrigation system employers, and public officials to gain an appreciation for the challenges of water conservation and explore job placement opportunities.

West Hills Community College serves a largely agricultural area of 3,464 square miles on the western side of Fresno and Kings Counties with a population of 149,000 persons. 2000 census data for Fresno County reports the total population as 799,400, an increase over 1990 Census data of 131,900 new residents or almost 20 percent growth. The cities of Kerman, Coalinga, San Joaquin, and Parlier recorded the highest percent of growth over the ten-year period; all four increased in population by over 40 percent. Fresno County is projecting a 42% growth by 2020.

Since 1997, the annual average unemployment rate for Fresno County has been much higher than the rate for the state, due in part to the influence of the seasonal agriculture industry. In the rural communities affected by the land retirement; unemployment rates can be as high as 34%. In the year 2001, the unemployment rate for Fresno County was 13.7 percent. [4]

Adoption of new irrigation technology and management practices requires implementation of new skill sets, not widely used in current production schemes. Communication with satellites, use of micro relay stations, solar powered wireless soil moisture probes, understanding of remote sensing and irrigation scheduling and using solid-state instrumentation applications are new to agriculture. Farmers and farm workers are asking for training in these subjects.

Successful use of these processes depends upon individuals who understand the system and its components, and can make on-farm decisions. Through the use of GPS referenced aerial photographs and new irrigation technologies, growers are reporting a 25% reduction in land preparation costs, a 7% increase in crop yields, and water use reductions approaching 30%.

[4] EDD Labor Market Information Division, 2001 Benchmark

SCOPE OF WORK, Section One: Relevance and Importance

Need for the Project

Lack of rain and snowfall in recent years has resulted in many persons learning to adjust to an inadequate water supply. A decision to restore water flow in the San Joaquin River will impact farms and towns as far south as the Tehachapi Mountains, and even influence the amount of water available for maintenance of Bay-Delta water quality.[5] The technology which forms the basis for this project enables farmers to make more effective use of available water. Farmers in the San Joaquin Valley have learned to produce their crops with less than 65% of the contracted amounts agreed upon when the State Water Project was formulated.[6] Any improvement in agricultural water use efficiency provides an increased amount of water availability for all other users.

There is a finite amount of water for Californians to use. Experts say the same amount of water that exists today is exactly the amount that was present during prehistoric times. Every resident of California expects to have access to an adequate supply of clean fresh water. "California's population growth of 500,000+ each year translates into 5 million+ each decade, bringing the state population from 36 million to 45 million by 2025."[7] We must plan now if we are to meet the expectations for freshwater in the future.

"Nature provides about 200 million acre-feet of precipitation to California in an average year. Of this total, 65 percent is lost through evaporation and transpiration by trees and other plants. The remaining 35 percent stays in the State's system as runoff. More than 30 percent of this runoff is depleted as outflow to the Pacific Ocean or other salt sinks. The rest is used by agricultural, urban, and environmental purposes."[8]

The genesis of this project lies in the advice of our local advisory committee members and continuing industry contacts. The strategies identified in the work plan have been derived from successful education and industry practices.

One of the "big picture" results of this project will be an improvement in the efficiency of water used for irrigation on California farms which account for 75% or more of total water consumed annually in the state. It is estimated that the technology of this project will be useful on 300,000 acres and have state-wide farming implications.

Depending on the crop grown, farmers project the use of 4 feet of water per year per acre for the typical crop. Assuming that it is possible to achieve a 25% reduction in water use would equate to saving 1 foot of water per acre per year. Current water values on the area approach $150 per acre-foot; therefore, **this technology can result in a savings of $45 million** (300,000 acre feet x $150/acre foot) when this technology is implemented.

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[5] Stockton Record, Friant Dam Broke Law, August 28, 2004
[6] Agricultural Water Caucus, April 2000
[7] Dan Walters, Fresno Bee, August 22, 2004
[8] California Department of Water Resources, 2004

The end product is the availability of 300,000 acre feet of water available for non-farm use. It is anticipated that much of this water volume savings will be available for environmental improvements within the Bay-Delta watershed.

Goals and Objectives

The goal of this project is to demonstrate water savings and water use efficiency through dynamic “just-in-time” and “just-the-right-amount” irrigation scheduling. Aerial imagery allows an individual to efficiently manage “more ground” in a shorter amount of time. One can examine large acreages while focusing their efforts on the areas that are demonstrating possible irrigation problems and inefficiency as indicated by impaired vigor. In addition, remote sensing imagery will be used to demonstrate their pressurized system/non pressurized system performance. Poor growth areas will be examined and inefficiencies will be corrected.

The largest barrier to the implementation of precision agriculture is the amount of time and increased awareness it requires for farmers to adopt the practices and the uncertainty of the results. Consultants cannot afford the time it requires to implement remote sensing into their current practices when they do not know the exact benefits the grower will receive. Once it has been demonstrated that this new technology can result in a profit, growers are willing to invest the time and capital into implementing it.

This project will train growers and consultants in the use of NDVI and TIR imagery for increased production efficiency and will enhance the adoption of the new practice. As with other aspects of precision agriculture, once remote sensing for irrigation scheduling is tried, it can be expected to spread like wildfire.

SCOPE OF WORK, Section Two: Technical and Scientific Merit, Feasibility

Methods and Procedures

For the first two years of the project, the main goal of this project is to train agricultural consultants and farmers of the Bay-Delta watershed in the use of remote sensing for identifying irrigation scheduling options. The initial group of participants will include seven irrigation schedulers, consulting with growers from Bakersfield to Stockton. Representative farms will be chosen which grow cotton, trees, vines, and row crops being irrigated on drip, micro spray and flood and furrow surface application of water.

Project leadership will survey each participant to collect information on traditional irrigation system, irrigation scheduling, and quantity of water used for irrigation. Data will also be collected describing traditional in-stream water quality and quantity. A similar survey will be conducted at the close of the project. This base data will serve as the comparison to asses the positive impact of the technology related to this project.

After selecting target fields, sampling locations will be identified for gypsum block installation. Location selection will be based on historical water use data and the recommendations from the consultants. These locations are those which the consultant would traditionally check to determine the timing for irrigation of the field.

These will be the control locations. The soil moisture readings from the gypsum blocks will be collected one day prior to the remote sensing flight over the field. These readings will be used to predict an irrigation schedule.

Remote Sensing: The fields "will be flown" and color infrared and thermal images will be captured by a commercial provider of aerial photography which has the instrumentation, including the airplane camera technology. The images will be processed and NDVI and TIR maps will be created within 24 hours from when the field was flown. The NDVI and TIR images will be used to define areas with poor crop biomass/vigor. These areas, or management zones, will be used for determining locations in the field for directed soil moisture probing using gypsum blocks. Plant growth vitality will be measured using pressure chamber readings. A project employee will take pressure chamber readings at these locations. The consultant and project leadership will create an irrigation schedule based on these readings. The grower will implement these recommendations on the targeted fields. The growers' fields not in the program will be irrigated using traditional methods.

Distribution Uniformity: Demonstration of the use of remote sensing to evaluate irrigation system distribution uniformity or the efficiency of water availability to each area of the crop. Remote sensing enhances the ability to determine whether or not a field has a uniform distribution (high DU) using NDVI images. Fields that have poor growth indications (Appendix B) will be chosen for a distribution uniformity evaluation. Imagery will be used to locate areas in the field with high and low vigor or plant biomass. Evaluation methods developed by California Polytechnic State University will be used to conduct the evaluations, locations for flow and pressure measurements will be those determined from the imagery. Recommendations for irrigation improvement will be given to the grower. After maintenance has been performed, another evaluation will be performed to calculate the water savings realized.

Equipment and Facilities

West Hills College Coalinga presently conducts instruction in each of the subjects related to Precision Agriculture including crop science, GPS mapping, GIS modeling, variable rate applications, and yield monitoring and the integration of this data for optimum production efficiency. These subjects are provided through a "Learning Community approach" in which the instructors of mathematics, English, agriculture, science and social science plan and coordinate their lessons to optimize student learning outcomes.

The Farm of the Future operates a 230 acre diversified farm including classrooms and laboratories on which more than $600,000 has been invested in irrigation technology and management equipment. We also have a Precision Agriculture inventory (Appendix C) exceeding $300,000 of computers, software, and field data loggers, which will have supporting use in this new program.

During the past four years, West Hills Community College District has invested over $2.1 million in resources for the Farm of the Future. Furthermore, the District is committed to utilizing the estimated $2.5 million proceeds derived from the sale of the old campus farm to further develop the new farm. Local donations and federal and state grants have generated an additional $4.7 million for a total investment approaching $9.3 million. The Board of Trustees has consistently adopted resolutions expressing strong programmatic and budget support for the Farm of the Future.

The California Community Colleges recognize 47 college agriculture programs, each with a curriculum responsive to local needs and expectations. West Hills College Coalinga agriculture curriculum is provided under the organization of the Farm of the Future. Created in July, 2000, instruction is focused on those technologies and practices that will contribute to sustainable farming with responsiveness to economic, environmental, and human interactions. We believe that farming is first a human activity that serves the region, state and world for improved living standards.

West Hills College Coalinga has been responsive to state and local initiatives such as the implementation of GPS, GIS and satellite imagery technologies for the improvement of farming efficiencies. Our graduates serve as employees, managers, and consultants to farming interests statewide. In cooperation with the Diesel Engine Program at Reedley College, we annually conducted educational seminars at the World Ag Expo each February.

In cooperation with the Rio Pasajero Conservation District, our students have mapped local streambeds and grown native trees for streambed stabilization. In cooperation with Helena Chemical Company of Louisiana and SST Toolbox of Okalahoma, we have conducted field agent computer and GIS workshops. For the past three years, we have cooperated with the Kings County Agricultural Extension Service in conducting an annual Precision Agriculture field day for local growers which included participation of 220 farmers this year.

We have developed strategic public and private sector partnerships with 49 companies and corporations in formal and informal agreements to enhance and extend our resources. In the past four years, we have received in excess of $646,000 of in-kind donations.

Environmental Documentation

This project will not result in the alteration of any “physical change in the environment” and is therefore NOT a project as defined by California Environmental Quality Act.

Project Work Plan

As follows:

WORK PLAN			
Task	**Deliverables**	**Timeline**	**Costs**
1.0 Project Administration including organization of advisory committee, employment of consultants and report development and filing.	1.0 Effective and cost efficient project management 1.1 Advisory committee meeting	1.0 December, 2005 – June 30, 2008 1.1 December, 2005	1.0 $490,392
1.1 Purchase supplies and equip	1.1 Gypsum blocks, data loggers, PDA's and supplies	1.1 December, 2005 thru June, 2008	1.1 $44,000
2.0 Recruitment and training of crop advisors, employment of project technician and clerical, enlistment of cooperating farms, placement of gypsum blocks, and collection of soils moisture data.	2.1 Retention of 7 crop advisors 2.2 Employ technical and educational consultants 2.3 Employment of technician and clerical support 2.4 Enlist at least 125 farms 2.5 Placement of 1300 blocks 2.6 Collection of field data from gypsum blocks	2.1 January, 2006 2.2 February, 2006 2.3 February, 2006 2.4 March, 2006 thru July, 2006 2.5 April, 2006 thru August, 2006 2.6 May, 2006 thru December, 2007	2.0 (Included in 1.0)
3,0 Employ consultant to collect aerial images	3.0 Field over-flights to collect aerial images – 75 farms with 3 flights each per year 3.1 Field over-flights to collect aerial images	3.0 May, 2006 thru December, 2007 3.1 July, 2006 thru December, 2007	3.0 $ 161,280 3.1 $ 126,720

WORK PLAN

Task	Deliverables	Timeline	Costs
4.0 Curriculum and instructional material development	4.0 Develop materials for 6 two-day workshops	4.0 May, 2006 thru October, 2006	4.0 $ 16,000
	4.1 Engage 65 days of technical consultant advisory	4.1 April, 2006 thru May, 2008	4.1 $ 20,000
5.0 Spanish translation	5.0 Translate instructional materials and workshop presentations	5.0 October, 2006 thru May, 2008	5.0 $ 10,800
6.0 Project monitoring	6.0 Employ project monitor and evaluator	6.0 February, 2006 thru May, 2008	6.0 $ 36,000
7.0 Conduct workshops	7.0 Conduct at least 6 two-day workshops for industry, farmers, and public	7.0 January, 2007 thru May, 2008	7.0 $ 30,000
8.0 Conduct conference and seminar presentations	8.0 Make presentations to at least four conferences	8.0 November, 2007 thru May, 2008	8.0 $ 8,000
9.0 Project promotion	9.0 Develop and manage web site and print materials as developed	9.0 February, 2006 thru May, 2008	9.0 $ 10,800
10.0 Project travel	10.0 Conduct project activities	10.0 December, 2005 thru May, 2008	10.0 $ 23,976

SCOPE OF WORK, Section Three: Monitoring and Assessment

Planning, operation, and evaluation of each component of this project will occur in collaboration and cooperation with an existing 27 member Farm of the Future Advisory Committee supplemented by a group of five industry representatives with direct experience in remote sensing and irrigation scheduling. Building upon the contacts of the committee members and current irrigation specialists, prospective participating farms will be surveyed by project leadership to assess traditional irrigation practices, water use, drainage treatment and adoption of related technologies.

Normative data will be analyzed by the most common unit of measure, which is anticipated to be: acre-feet or gallons of irrigation water, crop observation and monitoring practice will include: direct visual observations, and crop yields at time of harvest. Summative data will be analyzed and synthesized to provide baseline information of traditional practices

This project is built upon the positive assumption that growers can and will elect to implement new farming practices provided there is instruction, demonstration and expert testimony at the farm level. Building on the principles of precision agriculture, remote sensing, and irrigation monitoring and scheduling technologies, it is expected that new farming practices will be appealing and cost effective to growers within the Bay-Delta program.

Pre and Post observations and measurements will be accurate to the degree that growers are willing to share relevant data and experience as confirmed by the on farm production records.

The project will retain the services of a third party project evaluator to guide the development of the survey and data collection instruments, examine the data and resulting analysis, and lead discussion with the advisory committee as recommendations are formulated and “approved practices” are identified and disseminated. The project evaluator will also be responsible for leading the progressive assessment of the projected work plan, material development, field demonstrations and report filing.

This project and the Farm of the Future are built upon an assumption that farming is a human endeavor conducted in the total environment of the human experience: weather, crop choices, marketing alternatives, and social and environmental circumstances. The advisory committee will guide the project leadership team in responding positively to the reality of the total human experience including social, cultural, and new technological innovations.

Project information will be computer compatible or adaptable to existing software for ease of analysis and dissemination. Web compatible reporting will be practiced to enhance the greater distribution and sharing of project activities and results with

appropriate individuals, participating firms, agencies and DWR. Cost of the monitoring and assessment efforts have been specifically identified and included in the budget.

Water savings will be determined on a field-by-field basis, by calculating the difference in water used from historical data as well as by control fields. Savings realized from distribution uniformity evaluations will be determined by comparing the uniformity before improvements with the uniformity after improvements.

QUALIFICATIONS OF THE APPLICANTS AND COOPERATORS

West Hills Community College
West Hills College Coalinga is the only community college in California providing a one year certificate program in Precision Agriculture including crop and soil science, GPS mapping, GIS modeling, variable rate applications, and yield monitoring and the integration of this data for optimum production efficiency.

Using the equipment, computers, professional and technical assistance developed through earlier grants and donated resources; we have conducted Precision Agriculture farmer short courses with community colleges in Yuba City, Modesto, Merced, Reedley, and Salinas. The cooperation and joint benefit of these short courses is testimony to the mutual respect that our program has throughout the state, and the acceptance of the premise of “sharing is good” among our colleagues.

Project Leadership Team (Resumes - Appendix D)
Dr. Larry Rathbun, Project Co-Director, brings to the project more than 30 years of experience as a teacher and administrator at the secondary, community college and university levels including agricultural project work in eight countries. He has successfully managed more than 34 projects totaling $6.5 million including a $100,000 grant funded by DWR in 2001 for on-farm irrigation improvements. He currently serves as Associate Dean for Student Learning and Director, Farm of the Future at West Hills College Coalinga.

Ms. Joy Cowden, Project-Coordinator, has a baccalaureate degree in Agricultural Systems Management from Cal Poly and is an Irrigation Association Certified Irrigation Golf Course Auditor. She’s currently serving as the GPS Coordinator at West Hills College Coalinga. She has experience as an Agricultural Systems Analyst and GIS Specialist and is scheduled to complete her master’s degree in June 2005.

Mr. Clint Cowden, Project Consultant, has a baccalaureate degree in Agricultural Engineering from Cal Poly and is scheduled to receive his master’s degree in April, 2005. He is an Irrigation Association Certified Landscape Irrigation Auditor with more than four years of irrigation industry experience. He is currently employed as Agriculture Science & Technology Instructor at West Hills College Coalinga.

The project will employ a full-time Project Co-Director with the education and industry experience appropriate to lead this important project. Candidate evaluation and selection will be preformed with cooperation of the industry advisory committee.

Cooperators

The development of the project materials, building of industry acceptance, and demonstration of the effectiveness of using remote sensing technology to more effectively schedule irrigation applications will be enhanced by the following industry cooperators:

Brock Taylor

Brock Taylor is an agronomic management consultant branched in the Fresno area. He consults in the areas of water management, soil and crop fertility, Precision Ag management and contract research. Brock is a certified professional agronomist and a certified professional soil scientist

J M Lord Incorporated

J M Lord, Inc. is a Fresno based company with over twenty year's experience as agricultural engineers and plant scientist consultants working with growers on nutrition management and irrigation scheduling necessary for optimum crop production and efficient utilization of resources. The areas in which they consult are: fertility management, soil chemistry surveys, crop monitoring programs, production trouble-shooting, weather-based water monitoring, irrigation system evaluations, micro irrigation system design and irrigation and drainage engineering.

Kurt Quade

Kurt Quade has been an irrigation and fertility management consultant on the west side for over 20 years. He consults for growers on irrigation management for cotton, almonds, tomatoes, row crops and vines. He has been a community college instructor in the areas of crop science and precision agriculture. Kurt is a leader in bringing precision agriculture to California.

In-Time

In-Time is a precision agriculture management company that provides crop input management services through the use of remote sensing, enabling the spatially variable application of agricultural chemicals to a farmer's field during the growing season. In-Time originally started in the Mississippi Delta and serviced clients in Mississippi, Louisiana, Arkansas and Alabama, but has recently expanded their operations to include California and Texas. In-Time is a key supporter and proponent in the development of this project.

Irrigation Association

The Irrigation Association promotes and supports the irrigation industry by: providing a voice for the industry on public policy issues related to standards, conservation and water-use on local, national and international levels, acting as a source of technical and public policy information within the industry, raising

awareness of the benefits of professional irrigation services, offering professional training and certification and uniting irrigation professionals,

Agri-Valley Irrigation Company

Agri-Valley Irrigation Company has provided irrigation design, construction, and consultant services in the Central Valley for more than 25 years including serving as principal irrigation design consultant to the Farm of the Future.

Rainbird Irrigation

Rainbird Irrigation has donated drip system materials and a micro-irrigation computer controlled orchard irrigation management system.

Westlands Water District

Westlands Water District engineers serve as advisors to the Farm of the Future and are committed to serving as technical advisors to this project. It is anticipated that some of the farmers and consultants associated with this project will be associated with Westlands Water District.

Advisory Committee

The Farm of the Future Advisory Committee, organized in July, 2000, continues to meet at least semi-annually with formal and informal committee meetings more frequently as needed. The following list identifies the current 27 advisory committee members.

Ross Allen, Owner, RMA Farms, Coalinga
Dan Bartell, Dean, School of Agriculture, CSU-Fresno
Joe Bezerra, Director, Agricultural Research Initiative, CSU-Fresno
Mark Borba, President, Borba Farms, Riverdale
Elaine Cash, Superintendent, Riverdale Joint Unified Schools
Steve Cantu, Owner, Cantu Farming, Tranquility
Allan Clark, Owner, Clark Brothers Farming, Dos Palos
Steve Clark, PCA Agronomist, Western Farm Service, Huron
Don DeVine, Harris Feeding Company, Coalinga
Brad Gleason, Farm Manager, Coalinga
Mark Grewal, Vice President, J. G. Boswell Company, Lemoore
John Harris, Owner, Harris Farms, Coalinga
Phil Larson, Retired, Wilbur-Ellis Company, Kerman
Jim McDermott, Superintendent, Coalinga-Huron Unified Schools
Dave McGlothlin, Harris Ranch, Coalinga
Bill Mouren, Owner, Mouren Farming, Coalinga
Bill Pucheu, Community Director, Pucheu Brothers Ranch, Tranquility
Kurt Quade, Agronomist, Lemoore
Ted Sheely, Sheely Farms, Lemoore and Westlands Water District
Doug Stanley, General Manager, Empire Farms, Coalinga
Jack Stone, Owner, Stone Land Company, Lemoore
Tim Stone, Sales Manager, Britz Fertilizer, Five Points
Bob Viets, Owner, Viets Farming, Coalinga and Pleasant Valley Irrigation Distinct
Tony Villalobos, Peeling Plant Manager, Sequoia Packing, Coalinga
Bob Waid, Plant Manager, Tomatec, Firebaugh

Jack Woolf, Owner, Woolf Farming, Huron and Westland Water District
A. J. Yates, Deputy Director, Dept. of Food and Agriculture-retired, Kerman

Previous Water Use Efficiency Projects

West Hills Community College successfully conducted the DWR grant #4600001621 July 1, 2001 through June 30, 2003. TheOn-Farm Integrated Irrigation and Drainage Management project has been visited by more than 200 members of the industry and the public and has significantly contributed to the ability of the college to demonstrate effective irrigation water management practices. Dr. Larry Rathbun served as Director.

OUTREACH, COMMUNITY INVOLVEMENT AND ACCEPTANCE

Project Outreach

After the demonstration aspect of the project is complete, the focus will be to disseminate the information. All of the information will be gathered and prepared in binders. Six field days will be held throughout the Central Valley: Bakersfield, Reedley, Coalinga, Merced, Modesto and Fresno. These meetings will be open to the public with targeted invitations to all interested members of the agricultural community. Consultants and growers will share their project experiences and give testimony to the success and shortcomings of the project. Project leadership will conduct workshops on the basics of remote sensing and how the principles can be adopted.

The information gathered from this project will be presented at four technical conferences located within the United States, such as: the Central Coast Cotton Conference, Beltwide Cotton Conference, Irrigation Association and United States Committee on Irrigation and Drainage.

Project Involvement

This project design includes representatives from business, industry, government, and agriculture interests serving on the advisory committee and participating in project activities including training and field demonstrations. Project events will be publicized using radio and newspaper media complimented by an active web site displaying calendars and project information and materials. A review of the advisory committee business and industry linkages displays a diverse association of individuals interested in the success of this project.

After the initial seven consultants are trained, project outreach activities are expected to reach 150 other workshop attendees plus an additional 300 attendees at county, state and national conferences. West Hills College has successful experience in conducting workshops for growers as part of area farm shows and the World Ag Expo.

We work in cooperation with the United States Committee on Irrigation and Drainage, the Center for Irrigation Technology at California State University, Fresno, and the Irrigation Training and the Research Center at California Polytechnic State University, San Luis Obispo for counsel and articulation/coordination of efforts. Westlands Water District is a partner in our program through direct financial aid and in-kind donations.

This project intends to work closely with other community college agriculture programs by sharing equipment, curriculum, materials, and staff as appropriate.

Project Acceptance

West Hills College has been motivated and encouraged by our constituents to make this application due to our successful investment in technology and people through our Farm of the Future programs.

Farmers, growers, crop advisors, and students have experienced our precision agriculture program using hand-held GPS and data managers, satellite imagery interpretation, field data collection and mapping, and instruction and demonstrations of water measurement and distribution efficiencies. This project will provide an opportunity to build upon previous success and reach additional persons, especially farmers who control irrigation water usage.

Traditional farming practices have evolved over a long period of time and have extensive “comfort zones” for farmer behavior. This project will challenge participants to “look” at farming from a new point of view utilizing cutting edge and conservation appropriate technologies to achieve economic, social and cultural sustainability and benefit the purposes of the Bay-Delta program.

INNOVATION

Remote sensing is the wave of the future; the use of vegetative indices is growing throughout the state for applications such as predicting yield to variable rate fertilizer applications.

Remote sensing imagery can be a powerful grower/manager educational tool. A picture says a thousand words. People may not be able to fully comprehend a chart showing moisture depletions, or a graph showing available water, but when looking at an image, "colors" that correlate to the spatial variability of the crop are easy to understand.

This project will develop the capacity to demonstrate this new technology and train consultants and farmers in the cost-effective use of this innovation. Although each segment of this proposal may be found at university level courses in California, project leadership in consultation with the advisory committee is aware of **no other opportunities for agricultural growers to learn the adoption of this technology.** Our previous success in disseminating GPS and precision agriculture technology to growers throughout the state will be invaluable in developing acceptance of this technology.

Our belief is that agriculture is first a human activity to meet the multiple purposes of existence including production of food and fiber, it is also our opportunity to interact with the natural environment and leave it as good or better than when we first came to this land.

COST AND BENEFITS

The grower assessment referenced earlier is expected to provide baseline data for analysis and impact related to water utilization, as well as stream flow quantity and quality using data from existing DWR and Natural Resource Agency data collection stations.

Following consultation with the project cooperators and industry advisory committee, it is anticipated that the direct beneficiaries of this project will be 1,350 agricultural consultants and farmers in Central California. Using the educational materials, experiences, and imagery collected in the project, it is estimated that an additional 1,000 individuals will receive benefits from the project in the first five years.

The project is estimated to cost a total of $1.9 million serving 1,350 persons with an initial cost per beneficiary of $1,423.

An additional benefit is estimated to be the eventual annual **freedom of 300,000 acre feet** of water for uses other than production agriculture.

The technology to be demonstrated is anticipated to find positive acceptance throughout California similar to the adoption of precision agriculture practices in which West Hills Community College has been a leader and a primary educator of growers.

Applicant : West Hills Community College District

Table C-1: Project Costs (Budget) in Dollars)

	Category	Project Costs	Contingency % (ex. 5 or 10)	Project Cost + Contingency	Applicant Share	State Share Grant	Life of investment (years)	Capital Recovery Factor	Annualized Costs
	Administration[1]								
	Salaries, wages	$352,800	0	$352,800	$64,800	$288,000	0	0.0000	$0
	Fringe Benefits	$137,572	0	$137,572	$25,272	$112,300	0	0.0000	$0
	Supplies	$37,000	0	$37,000	$0	$37,000	0	0.0000	$0
	Equipment	$7,000	0	$7,000	$0	$7,000	0	0.0000	$0
	Consulting services	$406,800	0	$406,800	$0	$406,800	0	0.0000	$0
	Travel	$23,976	0	$23,976	$0	$23,976	0	0.0000	$0
	Other	$446,330		$446,330	$397,530	$48,800	0	0.0000	$0
(a)	Total Administration Costs	$1,411,478		$1,411,478	$487,602	$923,876			$0
(b)	Planning/Design/Engineering	$0	0	$0	$0	$0	0	0.0000	$0
(c)	Equipment Purchases/Rentals/Rebates/Vouchers	$0	0	$0	$0	$0	10	0.0000	$0
(d)	Materials/Installation/Implementation	$0	0	$0	$0	$0	0	0.0000	$0
(e)	Implementation Verification	$0	0	$0	$0	$0	0	0.0000	$0
(f)	Project Legal/License Fees	$0	0	$0	$0	$0	0	0.0000	$0
(g)	Structures	$0	0	$0	$0	$0	0	0.0000	$0
(h)	Land Purchase/Easement	$0	0	$0	$0	$0	0	0.0000	$0
(i)	Environmental Compliance/Mitigation/Enhancement	$0	0	$0	$0	$0	0	0.0000	$0
(j)	Construction	$0	0	$0	$0	$0	0	0.0000	$0
(k)	Other (Precision Ag Equip)	$397,530	0	$397,530	$397,530	$0	0	0.0000	$0
(l)	Monitoring and Assessment	$36,000	0	$36,000	$0	$36,000	0	0.0000	$0
(m)	Report Preparation/Indirect Costs	$76,792	0	$76,792	$0	$76,792	0	0.0000	$0
(n)	**TOTAL**	$1,921,800		$1,921,800	$885,132	$1,036,668			$0
(o)	Cost Share -Percentage				46	54			

Table C-1 - Project Cost DETAIL		Total Project		Year One		Year Two		Year Three	
		Applicant	State	Applicant	State	Applicant	State	Applicant	State
Administration									
Salaries, Wages									
Project Director	12 mo x $5,000/mo		180000		60000		60000		60000
Project Co-Directors	12 mo x $7,000/mo x .2 time	64800		21600		21600		21600	
Project Technician	12 mo x $2,000/mo		72000		24000		24000		24000
Program Clerical	12 mo x $2,000/mo x .5 time		36000		12000		12000		12000
Fringe Benefits	Salaries x 39%	25272	112320		37440		37440		37440
Tools and Supplies									
Gypsum Blocks	2100 x $10		21000		21000				
Data Loggers	3 x $200		600		600				
Field PDAs	2 x 500		1000		1000				
Project Supplies	12 mo x $400/mo		14400		4800		4800		4800
Equipment									
Pressure Chambers	2 @ $1500		3000		3000				
GPS Field Backpack	2 @ $2,000		4000		4000				
Consulting									
NDVI & TIR Remote Sensing	20000 ac x $3/ac x 3 flights/year		360000		180000		180000		
Curriculum and Technical Support	2 @ 12 mo X $500/mo		36000		12000		12000		12000
Spanish Translation	12 mo x $ 300/mo/yr		10800		3600		3600		3600
Travel	1800 miles/mo x 12mo x $0.37/mile		23976		7992		7992		7992
Other									
6-2-day workshops x 25 persons = 150	6 workshops x $5,000/workshop		30000						30000
4 one day Conferences x 300 persons = 1200	4 Conferences x $2,000/conference		8000						8000

Precision Ag Equp	Appendix A1	397530		397530					
Publications & Web	12 mo x $300		10800		3600		3600		3600
Project Evaluator	12 mo x $1,000/mo		36000		12000		12000		12000
Sub-total		487,602	959,896	419,130	387,032	21,600	357,432	21,600	215,432
Indirect Cost	TDC x 8%		76,792		30,963		28,595		17,235
Total Administration		487,602	1,036,688	419,130	417,995	21,600	386,027	21,600	232,667

BUDGET DETAIL EXPLANTION

Administration		
Salaries, Wages		
Project Director	12 mo x $5,000/mo	Project administration
Project Co-Directors	12 mo x $7,000 mo x .2 time base	In-kind contribution to project leadership
Project Technician	12 mo x $2,000/mo	Project technical and equipment setup support
Program Clerical	12 mo x $2,000/mo	Project clerical and record keeping
Fringe Benefits	Salaries x 39%	
Tools and Supplies		
Gypsum Blocks	2100 x $10	Soil moisture sensors with elect data loggers
Data Logger Read	3 x $200	Handheld computers to record gypsum block data
Field PDAs	2 x 500	Handheld computers to manage field data
Project Supplies	12 mo x $400/mo	Paper, postage, phone, office materials
Equipment		
Pressure Chambers	2 @ $1500	Plant moisture diagnostics
GPS Field Backpack	2 @ $2,000	Field mapping of gypsum blocks using gps data to correlate with aerial images and irrigation data
Consulting		
NDVI & TIR Remote Sensing	20000 ac x $3/ac x 3 flights/year	20000 acres bay-delta influenced cropping to be flown 3 times per year to cost $3 per acre
Curriculum and Technical Support	2 @ 12 mo X $500/mo	Two experienced educators and irrigation specialist to provide advice as needed.
Spanish Translation	12 mo x $ 300/mo/yr	Translation of materials and workshops as needed
Project Evaluator	12 mo x $1,000/mo	One person for 36 project months
Travel	1800 miles/mo x 12mo x $0.37/mile	Estimated miles to collect data, conduct team and advisory meetings, and direct project requirement
Other		
6-2-day workshops with 50 participants each = 300 participants	6 workshops x $5,000/workshop	Workshops to disseminate results, promote use of the technology, and reinforce new management concepts.
4-2-day Conferences with 200 attendees = 800 attendees	4 Conferences x $2,000/conference	Farm, ag industry, and general interest seminars to disseminate project principles and results.
Precision Ag Equip	Appendix A1	Basic gps and irrigation measurement equipment needed for success of this project currently available from the college.
Publications & Web	12 mo x $300	Estimate cost to create and maintain project web site, develop and print project reports and recommendations.
Indirect Cost	TDC x 8%	Total Direct Costs x 8%

Table C-5: Project Annual Physical Benefits (Quantitative and Qualitative Description of Benefits)

QUALITATIVE DESCRIPTION - REQUIRED OF ALL APPLICANTS[1]				QUANTITATIVE BENEFITS – (where data are available) [2]
Description of physical benefits (in-stream flow and timing, water quantity and water quality) for:	**Time Pattern and Location of Benefit**	**Project Life: Duration of Benefits**	**State Why Project Bay-Delta benefit is Direct[3], Indirect[4] or Both**	**Quantified Benefits (in-stream flow and timing, water quantity and water quality)**
Bay-Delta: Improved water use efficiency Reduced drainage and runoff Improved crop profitability Bay-Delta water shed quality improvement	Year 1 & 2 Demonstration of water efficiency, drainage and runoff, and water quality technology Year 3 Community involvement and acceptance.	Year 1- 3 Project life and dissemination Year 4-10 Continuation of community involvement and acceptance	Project benefits to include water management efficiencies, drainage and runoff reduction, and crop profitability are expected to continue as direct benefit to Bay-Delta watershed for multiple years as a cost and environmentally effective practice	Not applicable as direct measures Project impact to be determined by on-farm pre and post evaluations.
Local: Training and education of crop advisors and farmers	Years 1-3 Direct involvement in project training and demonstrations	This project seeks to change the production practices and procedures of crop farming in the Bay-Delta watershed. When successful, growers will make greater efficiencies in water use and contribute to stream and river water quality improvements.	**Not Applicable**	

APPENDIX A

file:///C|/Documents%20and%20Settings/Eric%20&%20Megan/Desktop/InTime_Wine_Grapes_Example/classified.html

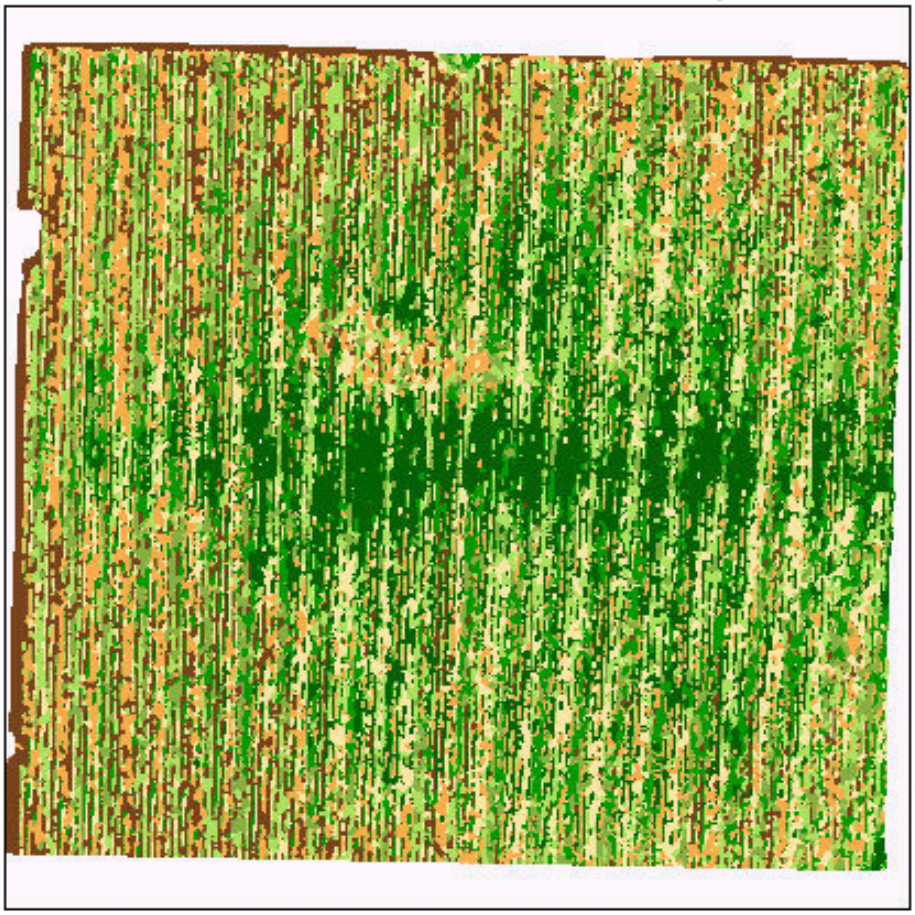
InTime Scout Report

Farm Name Here

Requested by: **E. Osterling**
Date of report: **November 1, 2004**
Scope of Statistics: **Field**

Date of Acquisition: **August 24, 2004**
Type of Classification: **Normal NDVI**

1M Resolution Wine Grapes



Legend
- 1 lowest biomass
- 2
- 3
- 4
- 5
- 6
- 7 highest biomass

In-Time
PRECISION PAYS!
Phone Us Toll Free
1-866-843-0235

Total Acreage : **38.30 Acre**

- **Often Times the best wine grapes are found in areas of a vineyard that have been stressed by influences such as soil type/quality and moisture content to name a few. Because of this, a grower might choose to selectively harvest from one area of a vineyard to produce a higher quality bottle than would have been obtainable had the vineyard been harvested as a whole. The InTime biomass index can be an invaluable tool in locating such areas in a vineyard.**

file:///C|/Documents%20and%20Settings/Eric%20&%20Megan/Desktop/InTime_Wine_Grapes_Example/classified.html1/5/2005 8:50:13 AM

APPENDIX B

file:///C|/Documents%20and%20Settings/Eric%20&%20Megan/Desktop/InTime_Almond_Example/classified.html

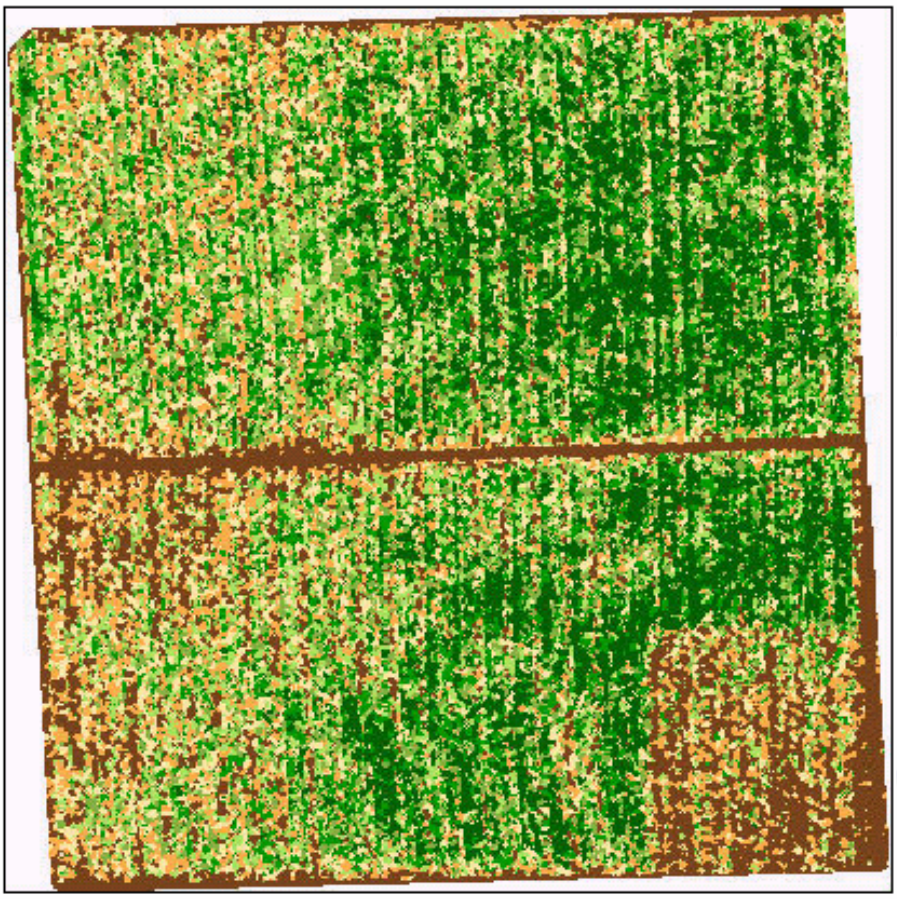
InTime Scout Report

Farm Name

Requested by: **E. Osterling**
Date of report: **November 1, 2004**
Scope of Statistics: **Field**

Date of Acquisition: **August 3, 2004**
Type of Classification: **Normal NDVI**

1M Resolution Almonds



Legend
- 1 lowest biomass
- 2
- 3
- 4
- 5
- 6
- 7 highest biomass

In-Time
PRECISION PAYS!
Phone Us Toll Free
1-866-843-0235

Total Acreage : **149.50 Acre**

- **This is an example of an Almond Orchard. The SE corner of the orchard is a replant area resulting from a chemical drift accident two years earlier. Notice how the East half of the field has a higher biomass rating. After scouting this orchard the grower determined that this was due to an insufficient number of drip system emmitters on the West half of the field.**

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APPENDIX C

FARM OF THE FUTURE

Irrigation Program Inventory

Manufacturer	Model	Cost
Weather Station	A733MD Standard	$12,000
Receiver	A730-SD	
AdCon	"C" Probe	$2,500
AdCon	"C" Probe	$2,500
AdCon	"C" Probe	$2,500
AdCon	"C" Probe	$2,500
Flowmeter	McCrometer 8"	$10,000
AdCon		$3,000
Tape Irrigation Sys	Netafim	$10,000
Sprinkler Pipe 3"		$5,500
Sprinkler Pipe Fittings		$1,500
Gated Pipe 8"	60 pcs x 30'	$6,500
RainBird Controllers		$10,000
Compac	Laptop computers	$26,000
iPAQ	Pocket PC	$800
iPAQ	Pocket PC	$800
iPAQ	Pocket PC	$800
iPAC	Pocket PC	$800
iPAC	Pocket PC	$800
iPAC	Pocket PC	$800
iPAC	Pocket PC	$800
iPAC	Pocket PC	$800
iPAC	Pocket PC	$800
iPAC	Pocket PC	$800
iPAC	Pocket PC	$800
iPAQ	Pocket PC	$800
iPAQ	Pocket PC	$800
iPAQ	Pocket PC	$800
iPAC	Pocket PC	$800
iPAC	Pocket PC	$800
iPAC	Pocket PC	$800
iPAC	Pocket PC	$800
iPAC	Pocket PC	$800
iPAC	Pocket PC	$800
iPAC	Pocket PC	$800
iPAC	Pocket PC	$800
Gateway Lap Top	VI.2/F3UX	$2,200
Ashtech	Ag Navigator	$10,000
AG 132	GPS RCVR	$4,000
& gps ant.		
AG 132	GPS RCVR	$4,000
& gps ant.		
Trimble Back Pack		$1,000
Trimble Back Pack		$1,000
Ashteck	Ag Navigator	$10,000

Starlink	MRB - 2A	$450
Beacon Receiver W/Ant		
Starlink	MRB - 2A	$450
Beacon Receiver W/Ant		
Globe	1000	$900
Globe	1000	$900
eTrex	GPS Receiver	$110
eTrex	GPS Receiver	$110
eTrex	GPS Receiver	$110
eTrex	GPS Receiver	$110
eTrex	GPS Receiver	$110
eTrex	GPS Receiver	$110
eTrex	GPS Receiver	$110
eTrex	GPS Receiver	$110
eTrex	GPS Receiver	$110
eTrex	GPS Receiver	$110
eTrex	GPS Receiver	$110
eTrex	GPS Receiver	$110
eTrex	GPS Receiver	$110
Compaq	Lap top w/ RW CD	$2,600
Compaq	Lap top w/ RW CD	$2,600
Compaq	Lap top w/ RW CD	$2,600
Compaq	Lap top w/ RW CD	$2,600
Compaq	Lap top w/ RW CD	$2,600
Compaq	Lap top w/ RW CD	$2,600
Compaq	Lap top w/ RW CD	$2,600
Compaq	Lap top w/ RW CD	$2,600
Compaq	Lap top w/ RW CD	$2,600
Compaq	Lap top w/ RW CD	$2,600
Gateway	VX720/E-3400	$1,800
Gateway	VX720/E-3400	$1,800
Gateway	VX720/E-3400	$1,800
Gateway	VX720/E-3400	$1,800
Gateway	VX720/E-3400	$1,800
Gateway	VX720/E-3400	$1,800
Gateway	VX720/E-3400	$1,800
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Gateway	VX720/E-3400	$1,800
Gateway	VX720/E-3400	$1,800
Gateway	VX720/E-3400	$1,800
Gateway	VX720/E-3400	$1,800
Hewitt Packer	ScanJet 6300C	$550
Hewitt Packer	DeskJet 812C	$450
JVC VCR	HR-A324	$600
Hewitt Packer	LaserJect 2100TN	$850
Sanyo	Pro Xtra X	$6,000
Panasonic TV		$750
Panasonic VCR	PV 9450	$400
EIKI	Overhead Projector	$350
CF Card Expansion Pack		$250
CF Card Expansion Pack		$250
(Used for expanding iPAQ's Capabilities		
Veris Machine with computer		$15,000
John Deere Gator With sprayer		$9,000
John Deere Gator		$9,000
John Deere Gator		$9,000
John Deere 6520		$45,000
Kawasaki Mule		$6,000
Golf Cart / Club Car Transporter		$8,000
Overhead projector		$700
Trimble Base Station		$26,500
Beeline Base Station		$22,000
SOFT WARE		
Surfer 7		$1,500
SSToolBox		$10,000
MapInfo		$500
SGIS		$200
JDMAP		
Active Sync		$200
"C" Probe		
Field Rover II		$450
Advantage 3.4		
Ag Navigator		$10,000
TOTAL		$397,530

APPENDIX D

LARRY P. RATHBUN, Ph.D.

201 Hill View Lane
Coalinga, CA 93210
E-mail: larryrathbun@westhhillscollege.com

PROFESSIONAL EXPERIENCE

	West Hills Community College District, Coalinga, California
2001 - Present.	Associate Dean Student Learning
	Rathbun Associates, San Luis Obispo California
1992 - 2001	Principal, Leader of professional group providing consultant services in educational planning and development.
	California Polytechnic State University, San Luis Obispo, California
1990 - 1992	Associate Dean-Administration, School of Agriculture. Provide administrative support to Dean; serve as the acting dean in his absence. Monitor all budgets within the school including interaction with department heads for budget planning. Capital Campaign; contact industry, alumni and parents and conduct donor visitations.
1988 - 1990	Chief of Party and Project Director, Costa Rica Project. Conduct extensive project assessment activities including programmatic and fiscal actual records with project paper and budget. . Reside in Costa Rica for two years beginning, August, 1988.
1986 - 1988	Project Director, Costa Rica Project (one-half time). Lead the advisory team in support of the development of a new college of agriculture for the wet humid tropics. Develop support university funding proposals and negotiate contracts (48 months and $2.5 million).
1982 - 1986	Associate Dean – Administration, School of Agriculture (one-half time)
1976 - 1982	Department Head and Professor, Agricultural Education Department. Supervise and provide program leadership to the department. Teach graduate classes in agricultural education with emphasis in curriculum planning, program evaluation, and educational program planning. Supervise seventy-five student teachers, thirty-two intern teachers
1973 - 1976	Assistant Professor, Agricultural Education Department. Teach graduate class in curriculum planning and undergraduate class in orientation to agricultural education
1970 - 1972	Assistant Professor, Agricultural Education Department. Teaching and supervision duties as above with one-half time responsibilities devoted to providing backstopping support for international programs in Thailand and Guatemala.
	Los Banos Unified School District. Los Banos, California
1967 - 1970	Director of Vocational Agriculture and Teacher of Agricultural Science. Teach high school classes in all phases of agriculture including ornamental horticulture and greenhouse operations. Supervision of student agricultural experience programs Advisor to FFA chapter.
	Rio Vista High School. Rio Vista, California
1965 -	Director of Vocational Agriculture and Teacher of Agricultural Science and Mechanics.

1970 Responsibilities include planning, teaching and administering high school and adult classes in agriculture, metal shop, welding and labor management. Advisor to FFA Chapter, Supervision of student agriculture experience programs.

INTERNATIONAL DEVELOPMENT

1998 Consultant, Agricultural College for the Humid Tropic Region, Costa Rica.

1987 - 1990 Chief of Party and Project Director, Costa Rica Project.

1989 Travel to Brazil for ten day assessment of library management systems.

1988 Travel to Panama and Chile for ten days to interview candidates for Director of the College.

1987 Travel to Puerto Rico for five days to examine university and experiment station relationships.

1987 Travel to Honduras for seven days to examine small farm production and marketing.

1985-1987 Consultant, Coalicion Costarricense de Inciativas de Desarrollo (CINDE) for the formation of the new Agricultural College of the Humid Tropic Region

1978-1982 Project Director, Mexico Agricultural Education Project. Improve the quality of teaching in the agricultural technology centers and post-secondary institutes of Mexico

1981 Project Director, Pakistan Agricultural Education Fellowship Program.

1974 Member, two-person team to conduct feasibility study of poultry production in Yemen.

1970-1972 Campus Backstopping, Thailand Agricultural Education Project.

1970-1971 Campus Backstopping, Guatemala Mobil Agricultural School Project.

SPECIAL PROJECTS

Author and project director of the following special projects funded by various agencies with total value in excess of $ 6.5 million for funding 34 projects.

EDUCATION

1972-1973 Ohio State University, Columbus, Ohio
Doctor of Philosophy in Agricultural Education and Vocational Education.
June, 1974.

1964-1965 California Polytechnic State University, San Luis Obispo, California
Master of Arts in Education with a Concentration in Agriculture and Agricultural Education.
July, 1967.

1962-1964 California Polytechnic State University, San Luis Obispo, California.
Bachelor of Science in Poultry Industry
June, 1964.

1959-1962 Modesto Junior College, Modesto, California.

Clint C. Cowden
415 Stanford Ave (559) 816-9465
Coalinga, CA 93210 CowdenAdvAg@peoplepc.com

Education

California Polytechnic State University, San Luis Obispo, CA

- **Master of Agriculture;** *Precision Agriculture, To be Completed* April 2005
- **Bachelor of Science**; *Agricultural Systems Management,* August 2001
  - **Minor;** Agricultural Business
  - **Concentration;** Water/Irrigation

Certified Landscape Irrigation Auditor, The Irrigation Association

Certified in SSToolbox for GIS Applications, SST Development Group

Relevant Projects

American Society of Farm Managers and Rural Appraisers, Yosemite, CA 9/02

- Prepared and presented presentation at the fall meeting for the California Chapter of ASFMRA
- Discussed "Current trends in Precision Agriculture on the West Coast:"

Pacific Wine Partners, Santa Rosa, CA 11/01

- Prepared and presented presentation to Pacific Wine Partners top 200 wine grape growers
- Discussed "Irrigation Factors that Influence Wine Grape Quality:"
  Irrigation systems maintenance and distribution uniformity
  Irrigation scheduling, evapotranspiration based, sample calculations using crop coefficients

Cal Poly State University, San Luis Obispo, CA 1994-2000

- Irrigation Association: International Meeting Attendant (1998-2000)
- National Agri-Marketing Association: Ag Student Council Representative (1997-98)

Work Experience

West Hills Community College, Coalinga, CA 7/04-Present

Agriculture Science and Technology Instructor (55 hours/week)

- Created curriculum for Precision Agriculture certificate program
- Prepared curriculum and taught courses in Introduction to Precision Agriculture, Plant Science, Computer Applications, Soil Science, Irrigation and Advanced Precision Agriculture
- Manage 200 acre school farm with pistachios, almonds, hay and vegetables and supervise student internships

J.M. Lord, Inc., Indio, CA 7/03-7/04

Agricultural Systems Analyst (55 hours/week)

- Consulted on irrigation frequency and duration, salinity threshold and leaching requirements, fertility, and crop suitability and feasibility in the Coachella Valley
- Scheduled 5,000 acres of dates, citrus, grapes, bell peppers, cantaloupe, artichokes, broccoli, lettuce and etc.

- Maintained site-specific information such as field boundaries, soil EC, soil moisture and fertility in ArcView
- Created curriculum and taught weekly grower courses on topics from soil identification to computer based crop modeling for irrigation scheduling

Cowden Advanced Agriculture, Coalinga, CA 12/02-7/03

- Scheduled and generated irrigation recommendations for 2,400 acres of cotton
- Geo ectified and prepared satellite imagery for clients
- Created variable rate seeding, spreading and spraying recommendations
- Interpreted and analyzed multiple years of cotton yield data for over 2000 acres

West Hills Community College, Coalinga, CA 7/02-7/03

- Performed field studies to determine the needs of professional agriculture today
- Created curriculum and course material for precision agriculture short courses that addresses those needs
- Taught short courses to regional agriculturalists in Kingsburg, Coalinga, Salinas, Modesto and Yuba City

Bio Resource and Agricultural Eng. Dept., San Luis Obispo, CA 1/01-6/02

- Created on-line teaching modules intended to instruct junior college professors about precision ag equipment
- Generated lessons about GIS software to generate variable rate prescriptions
- Conducted on-site instruction to junior college professors on the use of variable rate applicator and how this technology would apply to local farming
- Created a computer model to estimate soil moisture tension for different soil types
- Generated “Effects of Irrigation Scheduling on Precision Irrigation” for the Precision Irrigation web site

Irrigation Water Management, San Luis Obispo, CA Fall 2001

- Lectured on irrigation systems (center pivots, linear move sprinklers, hand-move sprinklers, and micro)
- Generated and corrected all exams and homework; reviewed rough drafts and graded term papers
- Administered and taught large group study sessions; conducted regular office hours

Wyatt Irrigation, Napa, CA 3/00-9/00

- Designed drip, frost and micro-frost irrigation systems for vineyards
- Troubleshot existing irrigation systems to increase performance and uniformity
- Performed outside Ag. Sales
- Created communication links with new customers to insure the highest customer satisfaction
- Consulted farmers on irrigation techniques that minimize costs and improve crop quality and production

Ernest & Julio Gallo Sonoma, Healdsburg, CA 1999

Designed drip and frost protection systems for 46 acre private reserve vineyard

- Created irrigation systems maintenance program
- Supervised irrigation evaluations on all 2000 acres of Gallo Sonoma Vineyards
- Managed special projects and performed miscellaneous vineyard, winery and winemaking operations
- irrigation systems and executed required adjustments to maximize irrigation uniformity

Joy Cowden
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(559) 816-9465
Coalinga, CA 93210
CowdenAdvAg@peoplepc.com

Education

California Polytechnic State University – San Luis Obispo, CA

- **Master of Agriculture;** *Agriculture Engineering Technology, To be Completed June 2005*
- **Bachelor of Science;** *Agricultural Systems Management*, *August 2001*
  Concentration; *Water/Irrigation*
  Minor; Agribusiness
- **Certified Irrigation Golf Course Auditor,** *Irrigation Association*

Work Experience

West Hills Community College, Coalinga, CA
GPS Project Coordinator

- Assist in curriculum preparation for Precision Agriculture certificate program.
- Maintain GPS equipment and prepare instructional laboratories.
- Oversee campus farm activities and supervise student labor.
- Administer $200,000 workforce development irrigation grant.

J.M. Lord, Inc, Indio, CA

- Consulted on irrigation frequency and duration, salinity threshold and leaching requirements and fertility in the Coachella Valley.
- Scheduled 2,000 acres of bell pepper, cantaloupe, watermelon, tomato, artichoke, broccoli, and lettuce.
- Maintained site-specific information such as field boundaries, soil EC, soil moisture and fertility in ArcView for 50,000 acres.
- Created curriculum and taught weekly grower courses on topics such as irrigation uniformity and system maintenance.

RJG Consulting, Coalinga, CA
January 2003-Present
GIS Specialist

- Georectified and prepared satellite imagery for clients.
- Created variable rate seeding, spreading and spraying recommendations.
- Interpreted and analyzed multiple years of cotton yield data for over 2000 acres.
- Generated soil sampling schemes and instructed clients on the proper use of handheld GPS units and software.
- Maintained GIS database on over 50,000 acres.

West Hills Community College, Coalinga, CA
- Created course material for grower precision agriculture short courses.
- Assisted in grower short course instruction and maintained and prepared GPS equipment.
- Assisted with farm manager operations on cotton, alfalfa, pistachios and almonds.

Agriculture Safety Institute (AgSI), San Luis Obispo, CA
- Arranged and coordinated industry short courses.
- Maintained budget and records using Quicken and People Soft.
- Prepared short course proceedings and presentations.

Precision Agriculture Institute, San Luis Obispo, CA
- Created on-line teaching modules intended to instruct junior college professors about precision agriculture.
- Used SSToolbox (GIS software) to generate variable rate spray prescriptions.
- Mapped field boundaries using Trimble AgGPS 170.

Wyatt Irrigation Supply Inc., Santa Rosa, CA
- Assisted head irrigation designers both in Napa and Sonoma Counties.
- Gathered field dimensions and elevations required for proper design of irrigation systems.
- Consulted with growers and designed drip and micro frost irrigation for vineyards with AutoCAD 14.
- Evaluated and corrected irrigation systems to insure proper functioning of valves, filters and etc.

Irrigation Training and Research Center (ITRC), San Luis Obispo, CA
- Welded tripods for sprinkler irrigation evaluations.
- Performed irrigation on school research field.
- Converted film slides to digital images using Thumbs 4.0.

U.S. Bureau of Reclamation/ITRC, Northern California
Summer 1999
Field Consultant
- Performed distribution uniformity tests on undertree and side roll sprinklers and drip/micro irrigation systems.
- Evaluated irrigation systems in Chico, Dunnigan, Glenn-Colusa, Glide-Kanawha and M & T Irrigation Districts.
- Consulted farmers on current system performances.

Jack Tone Ranch, Stockton, CA
Summers 1997 & 98
Amateur Horse Trainer
- Exercised horses and advised owners.

APPENDIX E

Proof of Average Family Median Income