July 29, 2016

Ms. Pamela Creedon, Executive Officer
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive, Suite 200
Rancho Cordova, CA 95670-6114

Re: Work Plan for Crop Nitrogen Knowledge Gap Study Plan and Guidance Documents

On March 29, 2016 the Central Valley Regional Water Board sent to the Central Valley ILRP Coalitions (except the California Rice Commission) a request for additional information about upcoming timelines associated with the collection and reporting of nitrogen applied and removed by coalition members. Specifically, the requirements are for the Coalitions to provide timelines to meet:

1. "By July 2016, the coalitions will submit a work plan with a timeline to develop nitrogen removed calculators for additional crops and to further refine the existing nitrogen removed calculators."
2. "Submit the summarized, crop-specific A/R ratio information to the Central Valley Water Board for the 17 listed crops during the initial reporting year. In subsequent years, newly added crop A/R ratio information shall be included in the summary."
3. "Disseminate the summarized A/R information to all coalition members, and provide each coalition member with their specific A/R ratio in the context of other similarly situated operations. Where it is feasible, this information must be provided in time for growers to be able to make modifications to their initial nitrogen management plan (if needed) during the same year as implementation (i.e. growing season)."

The Coalitions are submitting this work plan to update the Regional Board with respect to our progress on developing standardized N removal estimates and to satisfy the requirements in the March 29, 2016 letter.

Dates for submission of N removed calculators for additional crops and refinement of existing nitrogen removed calculators

The Coalitions have entered into an agreement with Dr. Daniel Geisseler, of the University of California Davis Cooperative Extension. Dr. Geisseler was responsible for developing the fertilization guidelines and the N removed calculators that are currently available through CDFA FREP. However, the N removed calculators were not developed to guide regulatory submissions and Dr. Geisseler is reviewing those calculators as part of his Scope of Work.

Specifically, Dr. Geisseler's Scope of Work (see attached) involves four tasks:

Task 1. Development of Y-to-R conversions for crops in the CDFA database
Information in the database is oriented to assist growers in making decisions about N applications to crops. In most cases, N consumption/removal by crops is included among this information. As part of

this task, specific algorithms (i.e. equations) for conversion of Y measurements to R estimates will be extracted from the available information.

Task 2. Identification of other significant crops
Additional crops will be identified based on data from National Agricultural Statistics database (Http://quickstats.nass.usda.gov/), other crop cover data (e.g., CropScape, DWR, county pesticide use reporting), or, if summary reports are available, from data submitted to the coalitions by growers. These crops will be prioritized and listed according to the approach and criteria described previously.

Task 3. Development of Y-to-R conversions for these additional crops
Data from the scientific literature, research reports, and existing databases (e.g., from NRCS and IPNI) will be used to develop Y-to-R conversion factors for as many of these crops as practicable.

Task 4. Assessment of the quality of data and description of work required to develop representative Y-to-R conversions
The quality of all Y-to-R conversion factors will be assessed based on the location of the studies, the number of site-years contributing to an estimate and the variability of the data. Efforts required to supplement the available factors with new information to develop reasonably reliable Y-to-R conversions for these and any remaining crops will be described.

The schedule for the work:
Tasks 1 and 2: September, 2016
Task 3: November, 2016
Task 4: January, 2017

Submit the summarized, crop-specific A/R ratio information to the Central Valley Water Board for the 17 listed crops during the initial reporting year. In subsequent years, newly added crop A/R ratio information shall be included in the summary

Summarized, crop-specific A/R ratio information will be submitted to the Regional Water Board by each Coalition with their NMP Summary Report Analysis; the timelines for submitting this information is based on the dates listed in each region's Order.

Disseminate the summarized A/R information to all coalition members, and provide each coalition member with their specific A/R ratio in the context of other similarly situated operations. Where it is feasible, this information must be provided in time for growers to be able to make modifications to their initial nitrogen management plan (if needed) during the same year as implementation (i.e. growing season)

Each Coalition will provide summarized A/R information to coalition members in context to other similarly situated operations as soon as practicable relative to when the Coalition receives the NMP Summary Report information from their members, is able to conduct proper QA/QC, and summarize complete information. At a minimum, the available summarized A/R information that will be provided to members 60 days prior to NMP Worksheet planning requirements for the next crop year. The exact timelines will vary by each general order.

As an example, the East San Joaquin Water Quality Coalition receives 2015 crop year NMP Summary Reports by March 2016. The Coalition conducts data entry, QA/QC of the data, and follow up prior to finalizing the summary information. Therefore, the Coalition will be able to create and provide member specific summarized A/R information (for crops without A/R information, A/Y information will be provided) between October and December 2016. East San Joaquin Water Quality Coalition growers are required to have their 2017 crop year NMP Worksheet(s) completed and on farm by March 2017. This gives members time to review and incorporate the information into their 2017 planning.

Regards,

Central Valley Water Quality Coalitions listed on the following page

Buena Vista Water Quality Coalition
Tim Ashlock

Cawelo Water District
Dave Hampton

East San Joaquin Water Quality Coalition
Parry Klassen

Kaweah Basin Water Quality Association
Donald Ikemiya

Kern River Water Quality Coalition
Nicole Bell

Kings River Water Quality Coalition
Casey Creamer

Sacramento Valley Water Quality Coalition
Bruce Houdesheldt

San Joaquin County and Delta Water Quality Coalition
Michael Wackman

Tule Basin Water Quality Coalition
David DeGroot

Westlands Water Quality Coalition
Charlotte Gallock

Westside San Joaquin River Water Quality Coalition
Joseph McGahan

Westside Water Quality Coalition
Greg Hammett

RESEARCH AGREEMENT 201603389

between

KINGS RIVER WATERSHED COALITION AUTHORITY
and

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA

This Research Agreement is made and entered into by and between **Kings River Watershed Coalition Authority**, a Joint Powers Authority with its place of business at 4886 East Jensen Avenue, Fresno, CA ("**Sponsor**") and **The Regents of the University of California**, a public educational institution, on behalf of its Davis campus ("**University**"), hereinafter the "Parties."

1. **Scope of Work / Budget.** University researchers shall use their reasonable efforts to perform the research tasks in accordance with University's proposal entitled "Development of yield to N removed conversions for Central Valley Irrigated Lands Regulatory Program", hereafter referred to as "the Project." University's proposal is attached and incorporated herein as **Exhibit A**.

2. **Principal Investigator.** The performance of work and technical report preparation shall be under the direction of Daniel Geisseler, Principal Investigator, and shall be in accordance with applicable University policies.

3. **Period of Performance.** The work under this Research Agreement shall be performed during the 6 month period beginning with the date of July 01, 2016, unless otherwise changed in accordance with the **"Termination"** or **"Modifications and Amendments"** Articles of this Agreement.

4. **Reports.** Sponsor shall treat all reports submitted by the University under this agreement as confidential.

   A. **Final Technical Report** covering the entire Period of Performance shall be submitted by University to Sponsor no later than sixty (60) days after the expiration date of this Research Agreement. The Final Technical Report shall address in detail the technical aspects of the research activities in pursuit of the objectives as identified in **Exhibit A.**

5. **Consideration.**

   A. For the performance of work hereunder, Sponsor shall pay University expenses, direct and indirect, incurred in accordance with the budget included in Exhibit A. The total allowable costs hereunder shall not exceed Twenty Eight Thousand Two Hundred Sixty Two Dollars ($28,262), unless otherwise

changed in accordance with **"Modifications and Amendments"** Article of this Agreement.

B. Upon execution of the Research Agreement, and no later than five (5) workdays following the execution of the Research Agreement, Sponsor shall provide an advance payment of $28,262, to University to cover the estimated costs for the six (6) months of the Project.

C. Sponsor's checks shall be made payable to "The Regents of the University of California" and mailed to:

Cashier's Office
University of California
PO Box 989062
West Sacramento, California 95798-9062

6. **Rights in Data**. University shall have the right to copyright, disclose, disseminate and use, in whole or in part, any data and information received, collected, or developed under this Research Agreement, except as indicated in the following provision, **Confidentiality**. A copy of materials intended for disclosure by University shall be submitted to Sponsor not less than thirty (30) days prior to University's release for publication or other dissemination, for the purpose of Sponsor's review for patentable subject matter and proprietary information. In the event Sponsor determines patentable subject matter is included in such data or information, Sponsor shall immediately notify University and publication or disclosure will be withheld (a) for a period not to exceed sixty (60) days to permit preparation and filing of appropriate patent application(s), or (b) until a patent application thereon has been prepared and filed, or (c) until University and Sponsor mutually agree in writing that no patent application(s) shall be prepared or filed, whichever of (a), (b) or (c) is earlier in time. In the event Sponsor determines within the thirty (30) day review period that University's proposed publication or other dissemination of information includes Sponsor Confidential Information and notifies University of this, University agrees to delete such Confidential Information before release of the material intended for publication or other dissemination. Sponsor will be acknowledged in University's publications unless Sponsor desires otherwise and so advises University in writing. Sponsor and University each agree not to use the name of the other Party or its employees in any advertisement, press release or publicity with reference to this Research Agreement or any product or service resulting from this Research Agreement, without prior written approval of the other Party.

7. **Confidentiality.** During the course of this agreement, Sponsor may provide University researchers certain information, data or material in written or other tangible form which Sponsor regards as confidential or proprietary in nature. Such information, clearly marked "CONFIDENTIAL INFORMATION," which is disclosed by Sponsor to University employees during the Period of Performance of this Research Agreement and which is not in the public domain, known by the University, or independently developed by the University, shall be considered by University as confidential in nature. University agrees to use its reasonable efforts to prevent disclosure to third

parties of such confidential or proprietary information in the absence of any written consent by Sponsor of such disclosure. University shall, however, not be held liable for inadvertent disclosure of such confidential material provided University has exercised reasonable care and adequate security aimed at maintaining the confidentiality of the information. Upon expiration or early termination of this Research Agreement, University shall, at the sole discretion of Sponsor, destroy or otherwise dispose of the Sponsor's Confidential Information and/or Proprietary Material.

8. Patent Rights.

A. All rights to inventions or discoveries generated in the performance of the research conducted under this Research Agreement shall belong to University and shall be disposed of in accordance with University policy. To the extent the University has the legal right to do so and to the extent Sponsor pays all direct and indirect costs of the research project, including a proportionate share of the Principal Investigator's salary, University shall offer to Sponsor, in accordance with the provisions of the following paragraph, a time-limited first right to negotiate an exclusive, royalty-bearing license to make, use, and sell any patentable inventions conceived and first actually reduced to practice in the performance of the research under this Research Agreement.

B. University shall promptly and confidentially disclose to Sponsor any inventions generated in the performance of this Research Agreement. Sponsor shall hold such disclosure on a confidential basis and not disclose the information to any third party without consent of the University. Sponsor shall advise University in writing within sixty (60) days following University's disclosure to Sponsor whether or not it wishes to secure a commercial license. Sponsor shall assume all costs associated with filing and maintaining patent protection for such invention(s) in those countries requested by Sponsor, whether or not Letters Patent issue. Sponsor shall have ninety (90) days from the date of election to conclude a license agreement with University. Said license shall contain reasonable terms, shall require diligent performance by Sponsor for the timely commercial development and early marketing of such inventions, and shall include Sponsor's continuing obligation to pay patent costs. If such agreement is not concluded in said period, University has no further obligations to Sponsor. If Sponsor fails to elect to negotiate such license, right to the inventions disclosed hereunder shall be disposed of in accordance with University policies, with no further obligation to Sponsor.

C. Nothing contained in this Research Agreement shall be deemed to grant either directly or by implication, estoppel, or otherwise any rights under any patents, patent applications or other proprietary interests, whether dominant or subordinate, of any other invention, discovery or improvement of either party, other than the specific patent rights covering inventions arising under this Research Agreement.

D. Notwithstanding any other provision of this Research Agreement, the right of publication on the part of University personnel shall not be affected by any license to any patentable or non-patentable inventions or discoveries.

9. **Supplies and Equipment.** In the event that University purchases supplies or equipment hereunder, title to such supplies and equipment shall vest in University.

10. **Applicable Law.** The validity and interpretation of this Agreement and legal relations of the parties to it shall be governed by the laws of the State of California, applicable to the agreements entered into, and to be fully performed in, the State of California, without regard to its conflicts of the laws provisions.

11. **Independent Contractor.** Nothing in this Research Agreement shall be construed to create a relationship of an employer/employee between the parties hereto, and University and Principal Investigator shall be deemed to be at all times independent contractors.

12. **Excusable Delays.** In the event of a delay caused by inclement weather, fire, flood, strike or other labor dispute, acts of God, acts of Governmental officials or agencies, or any other cause beyond the control of University, University shall be excused from performance hereunder for the period or periods of time attributable to such delay, which may extend beyond the time lost due to one or more of the causes mentioned above. In the event of any such delay, this Research Agreement may be revised by changing the maximum amount, performance period, and other provisions, as appropriate, by mutual agreement of the Parties, in accordance with Article 16 herein.

13. **Indemnification.**

A. University agrees to defend, indemnify and hold Sponsor, its officers, employees and agents harmless from and against any and all liability, loss, expense, attorneys' fees, or claims for injury or damages directly resulting from the performance of this Research Agreement but only in proportion to and to the extent such liability, loss, expense, attorneys' fees, or claims for injury or damages are caused by or result from the negligent or intentional acts or omissions of University.

B. Sponsor agrees to defend, indemnify and hold University, its officers, employees and agents harmless from and against any and all liability, loss, expense, attorneys' fees, or claims for injury or damages directly resulting from the performance of this Research Agreement but only in proportion to and to the extent such liability, loss, expense, attorneys' fees, or claims for injury or damages are caused by or result from the negligent or intentional acts or omissions of Sponsor.

14. **Communications.**

A. All communications regarding the technical aspects of the research and programmatic aspects of this Research Agreement shall be between Sponsor's Coordinator and University's Principal Investigator.

B. Communications and correspondence regarding the fiscal and administrative aspects of this Research Agreement shall be between the Parties' designated officials:

Sponsor:

Casey Creamer, Coordinator
Kings River Watershed Coalition Authority
4886 E. Jensen Avenue
Fresno, CA 93725
Telephone: (559) 237-5567; Fax: (559) 237-5560
Email: ccreamer@krcd.org

University:

Ahmad Hakim-Elahi, Ph.D., J.D.
Executive Director, Research Administration
Office of Research - Sponsored Programs
1850 Research Park Drive, suite 300
University of California, Davis
Davis, California 95618
Telephone: 530-754-7687; Fax: 530-754-8229
Email: awards@ucdavis.edu

15. Termination. This Research Agreement may be terminated by either Party at anytime upon the giving of thirty (30) days prior written notice to the other Party. Upon the giving of notice of termination by either Party, University shall exert its reasonable efforts to limit or to terminate any outstanding financial commitments. Sponsor shall reimburse University for all allowable costs incurred by it for the research project, including without limitation all uncancellable obligations. University shall prepare, within ninety (90) days after the termination date, a report of all expenditures incurred and of all funds received hereunder and shall reimburse Sponsor for funds which may have been advanced in excess of total costs incurred.

16. Modifications and Amendments. No modification or amendment of this Research Agreement shall be valid unless made by an instrument in writing signed by University and Sponsor. No such modification or amendment shall be construed to alter or amend any other provision of this Research Agreement unless expressly so stated in such written instrument. No waiver of any provision of this Research Agreement and no consent to departure therefrom, by either Party, shall be effective unless in writing and signed by both Parties hereto.

17. Entire Agreement. The terms and conditions contained herein and in the following attachment constitute the entire Research Agreement between Sponsor and **The Regents of the University of California**:

Exhibit A As defined in Article 1, "Scope of Work / Budget"

This Agreement including the above listed attachments supersedes any and all proposals, prior or contemporaneous agreements oral or written, and other communications between the parties relating to the subject matter of this Agreement.

IN WITNESS WHEREOF, the Parties have executed this Research Agreement on the dates noted below.

_____ ("Sponsor")	The Regents of The University of California, Davis ("University")
By: _____ Casey Creamer for	By: _____
Mark C. McKean	Ahmad Hakim-Elahi, Ph.D., J.D.
President, Board of Directors	Executive Director, Research Administration
Date: May 24, 2016	Date: 6/13/16

1. Project overview

Project Title:

Development of yield to N removed conversions for Central Valley Irrigated Lands Regulatory Program

Project Leader:

Daniel Geisseler, CE Nutrient Management Specialist, University of California, Department of Land, Air and Water Resources, One Shields Ave., Davis, CA, 95616. (530) 754 9637, djgeisseler@ucdavis.edu

Supporter:

John Dickey, PlanTierra LLC, 611 Del Oro Pl., Davis, CA 95616 530-554-9500, jdickey@plantierra.com

Project Duration:

6 months (July1st to December 31st, 2016)

Sponsor:

Southern San Joaquin Valley MPEP Committee
c/o Casey Creamer, Coordinator
4886 E. Jensen Avenue
Fresno, CA 93725

Phone: (559) 237-5567 ext. 105

Email: ccreamer@krcd.org

Funding Request Amount:

Funding request $28,262

Agreement Manager:

Randi L. Jenkins, Associate Director, The Regents of the University of California, Sponsored Programs. 1850 Research Park Drive, Suite 300, Davis, CA 95618-6153. (530) 754 7700, awards@ucdavis.edu

2. Background

As part of developing the Irrigated Lands Regulatory Program (ILRP), Central Valley coalitions (exclusive of irrigated agriculture covered under the Dairy or California Rice Commission [CRC] General Orders; here referred to as the "Coalitions") have developed an approach to providing the Central Valley Regional Water Quality Control Board (Water Board) with information on nitrogen (N) balances in agricultural fields. The proposed approach involves reporting of yield (Y) data by growers to the Coalitions, and transformation of these data to N removal (R) for the Water Board's use. Ultimately, the ratio of applied N (A) to R (A/R), having been recommended by the Expert Panel convened by the State Water Resources Control Board (State Board), is a key metric for the Water Board.

Initially it was implied that growers would report R, but this is impractical for several reasons:

- Growers measure and know Y.
- The Water Board prefers reliable data be reported.
- There are many (<10,000) growers, and more (<100,000) fields. It is unlikely that calculations independently made by the many members of this group, for each of their many fields, would render a more reliable estimate of R than conversions performed based on reports of Y by these same growers.
- Although inherent variability in the N content of Y is substantial, a consistent conversion methodology will yield best results. If growers report Y to Coalitions, such a conversion methodology can be applied, and the results reported to the Water Board. The Water Board has discussed and agreed to this reasoning and approach.

In this context, it was decided that reasonable Y-to-R conversion procedures be developed for the major crops. Crop types and fields covered under the Dairy (represented here as non-alfalfa hay and silage acreage) and CRC (represented as rice acreage, which is minor beyond the CRC Coalition boundary) general orders are excluded at this time, but may later be included at the options of these grower groups.

With the assistance of Dr. Daniel Geisseler/University of California Cooperative Extension (UCCE), the California Department of Food and Agriculture (CDFA) developed and made available online a significant database that includes basic information on N consumed and removed (https://apps1.cdfa.ca.gov/FertilizerResearch/docs/N_Uptake.html). The purpose of this compilation of information is to assist growers in selecting appropriate rates of N to apply to a number of major crops. The purpose of the proposed project is to describe the effort required of Dr. Geisseler and various collaborators to employ these and other data to develop a report containing (or describing methods for developing) Y-to-R conversion methods for crops that cumulatively cover first 95%, and then (in a later phase) 99% of the acreage within the General WDRs' boundaries. Based on data from the 2012 USDA Census, approximately 32 and 54 crops (respectively) occupy 95 and 99% of the irrigated acreage considered under this current scope of work (see Appendix 1).

For crops not included in the CDFA database, initial information shall be developed based on data published in scientific papers, research reports, the NRCS database, or the IPNI database.

The report will include an assessment of the data based on variability, geographic location of the field sites and site-years contributing to the average value. For crops for which existing information to underpin a reliable Y-to-R conversion is inadequate, the report may simply describe additional work that would be needed to develop usable Y-to-R conversions. For reference, notes on an initial discussion of this work are appended to this proposal (Appendix 2).

3. Objectives

The objective of this project is to develop Y-to-R conversion for crops that cumulatively cover first 95%, and then (in a later phase) 99% of the acreage within the General WDRs' boundaries.

4. Tasks and Schedule

4.1. Tasks.

Tasks under this scope of work include the following:

1. Development of Y-to-R conversions for crops in the CDFA database
2. Identification of crops not included in the CDFA database that are grown on a major Central Valley acreage. Taken together, the report will include values for crops that occupy first 95, and then 99% of the acreage in the Central Valley (exclusive of rice and non-alfalfa hay and silage, see Appendix 1).
3. Development of Y-to-R conversions for these additional crops.
4. Assessment of the quality of data as well as description of additional work that would be needed to develop usable Y-to-R conversions for crops included in (1) and (2), above.

As phases of the work proceed, crops may be grouped by priority, and the work delivered in stages, to allow for more rapid progress in getting usable information to Coalitions. Other than the extent (acreage) of the crop (mentioned above), crops and sub-crop classes (e.g., different cultivars or cropping systems that are for some reason thought to have differing Y-to-R conversions) shall be prioritized according to factors such as the following:

a) Crops for which usable data are most readily available,
b) Crops that typically use high nitrogen rates per acre (≥200 lbs/ac), and/or
c) Crops typically grown at locations where time of travel to underlying groundwater is especially brief.

The tasks are described in the following paragraphs.

Task 1. *Development of Y-to-R conversions for crops in the CDFA database*

Information in the database is oriented to assisting growers in making decisions about N applications to crops. In most cases, N consumption/removal by crops is included among this information. As part of this task, specific algorithms (i.e., equations) for conversion of Y measurements to R estimates will be extracted from the available information.

It is assumed that conversion of these algorithms to applications (i.e., computer code or database applications to convert large Y datasets to R) will be developed separately on the basis of information furnished in the initial report.

Task 2. *Identification of other significant crops*
Additional crops will be identified based on data from National Agricultural Statistics database (http://quickstats.nass.usda.gov/), other crop cover data (e.g., CropScape, DWR, county pesticide use reporting), or, if summary reports are available, from data submitted to the coalitions by growers. These crops will be prioritized and listed according to the approach and criteria described previously.

Task 3. *Development of Y-to-R conversions for these additional crops*

Data from the scientific literature, research reports and existing databases (e.g., from NRCS and IPNI) will be used to develop Y-to-R conversion factors for as many of these crops as practicable.

Task 4. *Assessment of the quality of data and description of work required to develop representative Y-to-R conversions*
The quality of all Y-to-R conversion factors will be assessed based on the location of the studies, the number of site-years contributing to an estimate and the variability of the data. Efforts required to supplement the available factors with new information to develop reasonably reliable Y-to-R conversions for these and any remaining crops will be described.

4.2 Schedule
Draft report segments will be developed in stages, as follows:

Tasks 1 and 2: Within 2 months of authorization

Task 3: Within 4 months of authorization

Task 4: Within 6 months of authorization

5. Budget

Position	Funds requested
Salary Junior Specialist (0.33 FTE; 4 months full time)	$ 12,698
Benefits Junior Specialist (38.3%)	$ 4,863
Travel	$ 440
Indirect costs (57%)	$ 10,261
Total funding requested	**$ 28,262**

6. Budget Justification

Salaries and benefits

Four months of salary for a junior specialist plus benefits (38.3%) are requested. The junior specialist will devote two third of his time from July to December to this project. The rest of his salary will be covered through other sources. Under the supervision of Daniel Geisseler, the junior specialist will compile and analyze the data and help writing the report. The salary is based on an annual full time salary of $ 36,984.

Benefits

It is anticipated that the Junior Specialist composite benefit rate will remain at 38.3% for the duration of the project.

Travel

Funding for four trips to the San Joaquin Valley is requested to present and discuss the report with representatives of the coalitions. A distance from Davis of 400 miles roundtrip is estimated. A sedan from UC Davis fleet service ($50 per day, $0.146 per mile) will be used.

Indirect Costs

Indirect costs at a rate of 57% are included.

Appendix 1. Central Valley crop acreage, showing cumulative totals and counts, with and without rice and non-alfalfa hay and silage (Source: http://quickstats.nass.usda.gov/).

Total acreage	**6,261,336**	**100%**
Excluding rice & non-alfalfa Hay/silage	**4,973,836**	**79%**

		All crops		*Excluded acreage*		*Excluding Rice and non-Alfalfa Hay & Silage*	
Data Item	*Area (acres)*	*Cumulative acreage*	*# of crops*	*Rice*	*Hay/silage, ex. Alfalfa*	*Cumulative acreage*	*# of crops*
ALMONDS - ACRES BEARING & NON-BEARING	887,792	14.2%	1			17.8%	1
GRAPES - ACRES BEARING & NON-BEARING	643,053	24.4%	2			30.8%	2
RICE - ACRES HARVESTED	549,692	33.2%	3	549,692		30.8%	2
HAY, ALFALFA - ACRES HARVESTED	498,767	41.2%	4			40.8%	3
CORN, SILAGE - ACRES HARVESTED	477,111	48.8%	5		477,111	40.8%	3
WHEAT - ACRES HARVESTED	357,587	54.5%	6			48.0%	4
WALNUTS, ENGLISH - ACRES BEARING & NON-BEARING	295,895	59.3%	7			53.9%	5
TOMATOES, IN THE OPEN, PROCESSING - ACRES HARVESTED	234,506	63.0%	8			58.7%	6
HAY, SMALL GRAIN - ACRES HARVESTED	226,858	66.6%	9			63.2%	7
COTTON, PIMA - ACRES HARVESTED	225,672	70.2%	10			67.8%	8
PISTACHIOS - ACRES BEARING & NON-BEARING	221,629	73.8%	11			72.2%	9
CORN, GRAIN - ACRES HARVESTED	175,854	76.6%	12			75.7%	10
ORANGES - ACRES BEARING & NON-BEARING	174,198	79.4%	13			79.3%	11
HAYLAGE, (EXCL ALFALFA) - ACRES HARVESTED	169,010	82.1%	14		169,010	79.3%	11
COTTON, UPLAND - ACRES HARVESTED	125,093	84.1%	15			81.8%	12
HAYLAGE, ALFALFA - ACRES HARVESTED	72,795	85.2%	16			83.2%	13
PRUNES - ACRES BEARING & NON-BEARING	52,624	86.1%	17			84.3%	14
HAY, TAME, (EXCL ALFALFA & SMALL GRAIN) - ACRES HARVESTED	52,435	86.9%	18		52,435	84.3%	14
PEACHES - ACRES BEARING & NON-BEARING	50,505	87.7%	19			85.3%	15
SUNFLOWER - ACRES HARVESTED	46,914	88.4%	20			86.2%	16
OLIVES - ACRES BEARING & NON-BEARING	43,849	89.1%	21			87.1%	17
SORGHUM, SILAGE - ACRES HARVESTED	39,252	89.8%	22		39,252	87.1%	17
BEANS, DRY EDIBLE, (EXCL LIMA) - ACRES HARVESTED	35,715	90.3%	23			87.8%	18
CHERRIES, SWEET - ACRES BEARING & NON-BEARING	34,571	90.9%	24			88.5%	19
CARROTS - ACRES HARVESTED	34,280	91.4%	25			89.2%	20

BARLEY - ACRES HARVESTED	32,384	92.0%	26			89.9%	21
POMEGRANATES - ACRES BEARING & NON-BEARING	31,594	92.5%	27			90.5%	22
TANGERINES - ACRES BEARING & NON-BEARING	30,224	92.9%	28			91.1%	23
TOMATOES, IN THE OPEN, FRESH MARKET - ACRES HARVESTED	28,671	93.4%	29			91.7%	24
POTATOES - ACRES HARVESTED	25,799	93.8%	30			92.2%	25
MELONS, CANTALOUP - ACRES HARVESTED	25,592	94.2%	31			92.7%	26
ONIONS, DRY - ACRES HARVESTED	21,927	94.6%	32			93.2%	27
SAFFLOWER - ACRES HARVESTED	21,723	94.9%	33			93.6%	28
OATS - ACRES HARVESTED	21,051	95.3%	34			94.0%	29
NECTARINES - ACRES BEARING & NON-BEARING	19,165	95.6%	35			94.4%	30
PLUMS - ACRES BEARING & NON-BEARING	18,777	95.9%	36			94.8%	31
SWEET POTATOES - ACRES HARVESTED	17,506	96.1%	37			95.1%	32
GARLIC - ACRES HARVESTED	17,496	96.4%	38			95.5%	33
SWEET CORN - ACRES HARVESTED	14,820	96.7%	39			95.8%	34
LEMONS - ACRES BEARING & NON-BEARING	13,382	96.9%	40			96.1%	35
BEANS, DRY EDIBLE, LIMA - ACRES HARVESTED	12,912	97.1%	41			96.3%	36
SORGHUM, GRAIN - ACRES HARVESTED	12,514	97.3%	42			96.6%	37
VEGETABLE SEEDS, IN THE OPEN - ACRES IN PRODUCTION	12,186	97.5%	43			96.8%	38
TRITICALE - ACRES HARVESTED	11,431	97.7%	44			97.1%	39
MELONS, WATERMELON - ACRES HARVESTED	9,301	97.8%	45			97.2%	40
NURSERY TOTALS, IN THE OPEN - ACRES IN PRODUCTION	9,112	98.0%	46			97.4%	41
APRICOTS - ACRES BEARING & NON-BEARING	8,524	98.1%	47			97.6%	42
APPLES - ACRES BEARING & NON-BEARING	7,701	98.2%	48			97.8%	43
ASPARAGUS - ACRES HARVESTED	7,215	98.3%	49			97.9%	44
HAY, WILD - ACRES HARVESTED	7,171	98.4%	50			98.0%	45
CUCUMBERS - ACRES HARVESTED	6,908	98.6%	51			98.2%	46
PEARS - ACRES BEARING & NON-BEARING	6,861	98.7%	52			98.3%	47
PEPPERS, BELL - ACRES HARVESTED	6,365	98.8%	53			98.4%	48
LETTUCE, HEAD - ACRES HARVESTED	5,920	98.9%	54			98.6%	49
FIGS - ACRES BEARING & NON-BEARING	5,547	98.9%	55			98.7%	50
MELONS, HONEYDEW - ACRES HARVESTED	5,458	99.0%	56			98.8%	51
BROCCOLI - ACRES HARVESTED	5,121	99.1%	57			98.9%	52
LEGUMES, ALFALFA, SEED - ACRES HARVESTED	4,071	99.2%	58			98.97%	53
PUMPKINS - ACRES HARVESTED	4,039	99.2%	59			99.1%	54
SQUASH - ACRES HARVESTED	4,014	99.3%	60			99.1%	55

BEANS, SNAP - ACRES HARVESTED	3,564	99.4%	61			99.2%	56
PERSIMMONS - ACRES BEARING & NON-BEARING	3,500	99.4%	62			99.3%	57
KIWIFRUIT - ACRES BEARING & NON-BEARING	3,482	99.5%	63			99.3%	58
PLUM-APRICOT HYBRIDS, INCL PLUMCOTS & PLUOTS - ACRES BEARING & NON-BEARING	3,066	99.5%	64			99.4%	59
CUT CHRISTMAS TREES - ACRES IN PRODUCTION	2,951	99.6%	65			99.5%	60
GRAPEFRUIT - ACRES BEARING & NON-BEARING	2,426	99.6%	66			99.5%	61
ONIONS, GREEN - ACRES HARVESTED	1,869	99.6%	67			99.6%	62
LETTUCE, ROMAINE - ACRES HARVESTED	1,808	99.7%	68			99.6%	63
FLORICULTURE TOTALS, IN THE OPEN - ACRES IN PRODUCTION	1,688	99.7%	69			99.6%	64
BLUEBERRIES, TAME - ACRES GROWN	1,631	99.7%	70			99.7%	65
TANGELOS - ACRES BEARING & NON-BEARING	1,626	99.8%	71			99.7%	66
BEANS, GREEN, LIMA - ACRES HARVESTED	1,624	99.8%	72			99.7%	67
PECANS - ACRES BEARING & NON-BEARING	1,580	99.8%	73			99.8%	68
LETTUCE, LEAF - ACRES HARVESTED	1,086	99.8%	74			99.8%	69
SOD - ACRES HARVESTED	1,082	99.8%	75			99.8%	70
FLOWER SEEDS, IN THE OPEN - ACRES IN PRODUCTION	1,004	99.9%	76			99.8%	71
SPINACH - ACRES HARVESTED	975	99.9%	77			99.8%	72
EGGPLANT - ACRES HARVESTED	954	99.9%	78			99.9%	73
PEPPERS, CHILE - ACRES HARVESTED	687	99.9%	79			99.9%	74
CABBAGE, HEAD - ACRES HARVESTED	645	99.9%	80			99.9%	75
AVOCADOS - ACRES BEARING & NON-BEARING	631	99.9%	81			99.9%	76
CABBAGE, CHINESE - ACRES HARVESTED	602	99.9%	82			99.9%	77
DAIKON - ACRES HARVESTED	594	99.9%	83			99.9%	78
BEETS - ACRES HARVESTED	521	99.9%	84			99.9%	79
BRUSSELS SPROUTS - ACRES HARVESTED	481	100.0%	85			99.9%	80
STRAWBERRIES - ACRES GROWN	416	100.0%	86			99.9%	81
PARSLEY - ACRES HARVESTED	329	100.0%	87			100.0%	82
WILD RICE - ACRES HARVESTED	263	100.0%	88			100.0%	83
RADISHES - ACRES HARVESTED	243	100.0%	89			100.0%	84
RYE - ACRES HARVESTED	227	100.0%	90			100.0%	85
BEDDING PLANT TOTALS, IN THE OPEN - ACRES IN PRODUCTION	211	100.0%	91			100.0%	86
CHESTNUTS - ACRES BEARING & NON-BEARING	177	100.0%	92			100.0%	87
CUT FLOWERS & CUT CULTIVATED GREENS, IN THE OPEN - ACRES IN PRODUCTION	165	100.0%	93			100.0%	88
BLACKBERRIES, INCL DEWBERRIES & MARIONBERRIES - ACRES	123	100.0%	94			100.0%	89

GROWN							
GREENS, KALE - ACRES HARVESTED	98	100.0%	95			100.0%	90
PEAS, GREEN, (EXCL SOUTHERN) - ACRES HARVESTED	83	100.0%	96			100.0%	91
PEAS, CHINESE (SUGAR & SNOW) - ACRES HARVESTED	78	100.0%	97			100.0%	92
TRANSPLANTS, COMMERCIAL, VEGETABLE & STRAWBERRY, IN THE OPEN - ACRES IN PRODUCTION	65	100.0%	98			100.0%	93
GREENS, MUSTARD - ACRES HARVESTED	60	100.0%	99			100.0%	94
BULBS & CORMS & RHIZOMES & TUBERS, DRY, IN THE OPEN - ACRES IN PRODUCTION	54	100.0%	100			100.0%	95
HERBS, FRESH CUT - ACRES HARVESTED	54	100.0%	101			100.0%	96
OKRA - ACRES HARVESTED	53	100.0%	102			100.0%	97
GRASSES, BERMUDA GRASS, SEED - ACRES HARVESTED	49	100.0%	103			100.0%	98
GRASSES, SUDANGRASS, SEED - ACRES HARVESTED	45	100.0%	104			100.0%	99
TURNIPS - ACRES HARVESTED	43	100.0%	105			100.0%	100
PEAS, GREEN, SOUTHERN (COWPEAS) - ACRES HARVESTED	40	100.0%	106			100.0%	101
ARTICHOKES - ACRES HARVESTED	35	100.0%	107			100.0%	102
CAULIFLOWER - ACRES HARVESTED	32	100.0%	108			100.0%	103
PROPAGATIVE MATERIAL, IN THE OPEN - ACRES IN PRODUCTION	32	100.0%	109			100.0%	104
GREENS, TURNIP - ACRES HARVESTED	22	100.0%	110			100.0%	105
RASPBERRIES - ACRES GROWN	22	100.0%	111			100.0%	106
PEANUTS - ACRES HARVESTED	20	100.0%	112			100.0%	107
BOYSENBERRIES - ACRES GROWN	19	100.0%	113			100.0%	108
SHORT TERM WOODY CROPS - ACRES HARVESTED	15	100.0%	114			100.0%	109
GREENS, COLLARD - ACRES HARVESTED	13	100.0%	115			100.0%	110
FLOWERING PLANTS, POTTED, INDOOR USE, IN THE OPEN - ACRES IN PRODUCTION	10	100.0%	116			100.0%	111
AQUATIC PLANTS, IN THE OPEN - ACRES IN PRODUCTION	9	100.0%	117			100.0%	112
MINT, TEA LEAVES - ACRES HARVESTED	5	100.0%	118			100.0%	113
HORSERADISH - ACRES HARVESTED	3	100.0%	119			100.0%	114
CHERRIES, TART - ACRES BEARING & NON-BEARING	2	100.0%	120			100.0%	115
GUAVAS - ACRES BEARING & NON-BEARING	2	100.0%	121			100.0%	116
RHUBARB - ACRES HARVESTED	2	100.0%	122			100.0%	117
FOLIAGE PLANTS, INDOOR USE, IN THE OPEN - ACRES IN PRODUCTION .	1	100.0%	123			100.0%	118

Appendix 2

MEMO

PLANTIERRA

From: *John Dickey/PlanTierra*

To: *File*

Date: 1/19/2016

Subject: ***Summary of discussion of yield to N removed conversion tools with Daniel Geisseler/UCCE Nutrient Management Specialist***

After discussion among water quality coalitions to work collaboratively with UCCE on development and refinement of yield to N removed conversion tools that will be needed to complete N Summary Reports, I had inquired whether it would be useful to check in with Daniel about his interest in and availability for such a project. We spoke about it 1/19/2016 afternoon. This is a summary of what we discussed.

Daniel described several aspects of the existing tools and the potential work:

- CDFA tools are aimed at helping growers and grower advisors decide how much fertilizer to apply, but within them there are tables and relationships with Y-to-R information with which conversions can be made. These tools are relatively well researched and documented, and familiar to Daniel since he was the/a principal developer. The 20 or so crops represented would cover most of the Central Valley's acreage.
- Resources and time permitting, Daniel could direct a UC team in developing a short report on the suitability of these and some other (e.g., NRCS, IPNI) tools to provide the basic Y-to-R relationships that are needed. He notes that the level and quality of documentation of the other tools is unknown, and that they are national or global in scope, so that the outcome of some of these reviews may retain substantial uncertainty. He thinks that this review could contain prioritization of crops for further investigation.
- After some discussion, we agreed that the Y-to-R relationships could be translated into a batch-mode database tool that coalitions could use to translate Y to R for at least the 20 crops. This translation is more of a database/programming function (with guidance from qualified plant scientists), so that this programming capability would need to be identified.
- It is feasible to phase the work, beginning with an initial effort focused on existing tools and review, followed by phases including further (in some cases field) investigation and refinement. The first phase could be done relatively quickly, but funds for the scientific support staff to do it, and for Daniel's time to oversee it, would be needed. We noted that FREP proposals are just going in, so that we are probably around a year out to secure funding there. If so, this would seem to imply other funding sources for urgent, near-term work.
- Later phases could be planned for crops with significant acreage, for which existing knowledge could be improved a lot by such work. This work would take longer and cost more.
- Agreed that, for some crops, supplementary input data would be helpful in making an accurate conversion. Several examples:
  - Information about what plant parts are being removed. E.g., for a grain crop, is straw baled or incorporated?
  - Crop quality data that affects N concentrations and is readily available. E.g., canning tomato % solids.
  - Varietal differences that strongly influence N uptake. E.g., for some fruit & nut crops.

- As improvements to the system are made, archived (past years') Y and ancillary data could be re-converted with updated tools, rendering more accurate estimates of R. Therefore, if preliminary estimates of R are less comprehensive or certain than is ultimately desired, this could be addressed over time.

Thoughts and information I shared with Daniel included the following:

- Key determination that Y-to-R conversions will be handled by coalitions, so that they are the "users" of any batch conversion tool.
- Emphasis of CDFA tools in TAWG Report, existence of other tools that could be evaluated and perhaps used.
- Status of the TAWG, and the approximate schedule (this year) +`for having workable conversion tools in the hands of coalitions.
- R outputs would be summarized for Regional Board, shared in an informative (likely comparative) format with growers, and archived for coalition (e.g., MPEP) use.
- If we move forward with the work, then there would be an initial scoping step to clarify what is needed and when.
- Suggested prioritization criteria such as average total and locally important acreage, average N application rate, and effort required for a given improvement in accuracy (i.e., how would it be to make the needed refinements?).
- Recognize that conversion is just part of the process, since there is inherent sampling uncertainty in the yield data fed into the conversion. In some cases, improved conversions might provide little real improvement in estimation of R.
- Emphasized that, in seeking improvements, we need to avoid creating new and costly monitoring burdens on growers. Therefore, we should focus on collecting and using ancillary data only a) if growers already collect these data (e.g., baling or incorporation of straw, variety grown, and % solids of canning fruit, where this is easily known to the grower), and b) where the ancillary data are crucial to a significant and needed improvement in the Y-to-R conversion.

To the extent that this work is urgent, it would now be helpful if we could proceed with scoping and preliminary discussions about funding (so that we know who to write the scope for). I would be happy to facilitate development of a) a general statement of long-term approach (along the lines described here), and b) a more specific, phase 1 scope of work and budget.

Start Date:	7/01/16	Project Title:	Development of yield to N removed conversions for Central Valley Irrigated Lands Regulatory Program			Proposal Due Date/Archive:		4/15/16	
End Date:	12/31/16	PI(s):	Geisseler, Daniel	6 Months	0 Months	0 Months	0 Months	0 Months	6 Months

Personnel							*Reference Info*			Escalation:		FY	3%
										Period 1	Period 2	Period 3	Period 4	Period 5	Total
Name/Role:		Base Salary	% Annual Effort				Type	/12	Escal	7/1/16-12/31/16	-	-	-	-	7/1/16-12/31/16
1	Junior Specialist (Step 1) - TBN	36,984	67%				CAL			12,698	0	0	0	0	12,698
2										0	0	0	0	0	0
Total Salaries										12,698	0	0	0	0	12,698

										Escalations to fringe?		Yes
	Split:	*6/0*	*0/0*	*0/0*	*0/0*	*0/0*						
Benefits by Person	Code	%	%	%	%	%	Period 1	Period 2	Period 3	Period 4	Period 5	Total
1 Junior Specialist (Step 1) - TE	C	38.3					4,863	0	0	0	0	4,863
2	Choose						0	0	0	0	0	0
Total Benefits							4,863	0	0	0	0	4,863
Total Personnel							17,561	0	0	0	0	17,561

Equipment						Total
						0
						0
Total Equipment	0	0	0	0	0	0

Travel	International?						Total
	No	440					440
	No						0
Total Travel		440	0	0	0	0	440

Supplies						Total
						0
						0
Total Supplies	0	0	0	0	0	0

Subaward Costs	UC/Non-UC						Total
	Non-UC						0
	Non-UC						0
Total Subaward Costs		0	0	0	0	0	0
Total Subaward/Contractual Costs		0	0	0	0	0	0

Other Expenses										Period 1	Period 2	Period 3	Period 4	Period 5	Total
GSR Tuition/Fees										Total GSR Tuition/Fees:					
Provost's Discount?		Escal %	Type	Current $	Yr1	Yr2	Yr3	Yr4	Yr5	*0*	*0*	*0*	*0*	*0*	0
Resident	Yes	10%	AY	17,118						0	0	0	0	0	0
Non-Resident		10%		32,220						0	0	0	0	0	0
Other (e.g.,filing status)		10%		8,559						0	0	0	0	0	0
Other Direct Costs Subject to Indirect Costs															
															0
															0
Total Other Direct Costs										0	0	0	0	0	0

Total Direct Costs			18,001	0	0	0	0	18,001
Indirect Cost Base	Rate Type:	On-Campus Research	18,001	0	0	0	0	18,001
Indirect Costs			*10,261*	*0*	*0*	*0*	*0*	*10,261*
Total Costs (Direct + Indirect)			$28,262	$0	$0	$0	$0	$28,262