INTERAGENCY AGREEMENT NO. C0900112
BETWEEN THE
STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
AND
WASHINGTON STATE UNIVERSITY

THIS AGREEMENT is made and entered into by and between the DEPARTMENT OF ECOLOGY, hereinafter, referred to as the "DEPARTMENT" and the Washington State University hereinafter referred to as the "RECIPIENT", for the **Evapotranspiration and Consumptive Irrigation Requirements for Washington** and for updating of the Washington Irrigation Guide (WIG).

IT IS THE PURPOSE OF THIS AGREEMENT to provide funding to the RECIPIENT to update existing crop water use tables by employing recent weather data, and more current and accurate methods, equations and parameters.

THEREFORE, IT IS MUTUALLY AGREED THAT:

STATEMENT OF WORK

The RECIPIENT shall furnish the necessary personnel, equipment, material and/or services and otherwise do all things necessary for or incidental to the performance of the work set forth in Attachment "A" which is incorporated herein.

PERIOD OF PERFORMANCE

Subject to its other provisions, the period of performance of this Agreement shall commence on September 1, 2008, and be completed on February 28, 2010, unless terminated sooner as provided herein.

PAYMENT

Compensation for the work provided in accordance with this agreement has been established under the terms of RCW 39.34.130. The parties have estimated that the cost of accomplishing the work herein will not exceed $70,000.00. Payment for satisfactory performance of the work shall not exceed this amount unless the parties mutually agree to a higher amount prior to the commencement of any work which will cause the maximum payment to be exceeded. Compensation for services shall be based on the following rates and in accordance with the following terms, or as set forth in accordance with the budget in Attachment "B" which is incorporated herein.

BILLING PROCEDURE

The RECIPIENT shall submit invoices quarterly. Payment to the RECIPIENT for approved and completed work will be made by warrant or account transfer by the DEPARTMENT within 30

days of receipt of the invoice. Upon expiration of the contract, any claim for payment not already made shall be submitted within 30 days after the expiration date or the end of the fiscal year, whichever is earlier.

Reimbursements from the DEPARTMENT for invoice voucher submittals will be mailed to the RECIPIENT's designee at the following address:

Sponsored Program Services
Washington State University
P.O. Box 641025
Pullman, WA 99164-1025

The RECIPIENT shall submit all invoice voucher submittals and supportive documentation, to the Project Manager of the DEPARTMENT. Invoice voucher submittals shall include an original State of Washington Invoice Voucher Form A19-1A. Copies of all applicable forms shall be included with an original A19-1A, and shall be submitted to the DEPARTMENT. Blank A19-1A form is found in Administrative Requirements for Ecology Grants and Loans.

All invoice voucher submittals, progress reports, final completion report, and copies of professional services contracts shall be submitted to:

Alvin M. Josephy
Contracts Specialist
Water Resources Program
Washington State Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

RECORDS MAINTENANCE

The parties to this contract shall each maintain books, records, documents and other evidence which sufficiently and properly reflect all direct and indirect costs expended by either party in the performance of the services described herein. These records shall be subject to inspection, review or audit by personnel of both parties, other personnel duly authorized by either party, the Office of the State Auditor, and federal officials so authorized by law. All books, records, documents, and other material relevant to this Agreement will be retained for six years after expiration and the Office of the State Auditor, federal auditors, and any persons duly authorized by the parties shall have full access and the right to examine any of these materials during this period.

Records and other documents, in any medium, furnished by one party to this agreement to the other party, will remain the property of the furnishing party, unless otherwise agreed. The receiving party will not disclose or make available this material to any third parties without first giving notice to the furnishing party and giving it a reasonable opportunity to respond. Each party will utilize

reasonable security procedures and protections to assure that records and documents provided by the other party are not erroneously disclosed to third parties.

RIGHTS IN DATA

The DEPARTMENT reserves a royalty-free, nonexclusive, and irrevocable license to reproduce, publish or otherwise use, and authorize others to use, for Washington State Government purposes:

- The copyright in any work developed under the Agreement; and
- Any rights of copyright to which the RECIPIENT purchases ownership with funds from this Agreement

INDEPENDENT CAPACITY

The employees or agents of each party who are engaged in the performance of this Agreement shall continue to be employees or agents of that party and shall not be considered for any purpose to be employees or agents of the other party.

AGREEMENT ALTERATIONS AND AMENDMENTS

This agreement may be amended by mutual agreement of the parties. Such amendments shall not be binding unless they are in writing and signed by personnel authorized to bind each of the parties.

TERMINATION

Either party may terminate this Agreement upon 30 days prior written notification to the other party. If this Agreement is so terminated, the parties shall be liable only for performance rendered or costs incurred in accordance with the terms of this Agreement prior to the effective date of termination.

TERMINATION FOR CAUSE

If for any cause, either party does not fulfill in a timely and proper manner its obligations under this Agreement, or if either party violates any of these terms and conditions, the aggrieved party will give the other party written notice of such failure or violation. The responsible party will be given the opportunity to correct the violation or failure within 15 working days. If the failure or violation is not corrected, this Agreement may be terminated immediately by written notice of the aggrieved party to the other.

DISPUTES

In the event that a dispute arises under this Agreement, it shall be determined by a Dispute Board in the following manner: Each party to this agreement shall appoint one member to the Dispute Board. The members so appointed shall jointly appoint an additional member to the Dispute Board. The Dispute Board shall review the facts, contract terms and applicable statutes and rules and make

a determination of the dispute. The determination of the Dispute Board shall be final and binding on the parties hereto. As an alternative to this process, either of the parties may request intervention by the Governor, as provided by RCW 43.17.330, in which event the Governor's process will control.

GOVERNANCE

This contract is entered into pursuant to and under the authority granted by the laws of the state of Washington and any applicable federal laws. The provisions of this agreement shall be construed to conform to those laws.
In the event of an inconsistency in the terms of this Agreement, or between its terms and any applicable statute or rule, the inconsistency shall be resolved by giving precedence in the following order:

a. applicable state and federal statutes and rules;
b. statement of work; and
c. any other provisions of the agreement, including materials incorporated by reference.

ASSIGNMENT

The work to be provided under this Agreement, and any claim arising thereunder, is not assignable or delegable by either party in whole or in part, without the express prior written consent of the other party, which consent shall not be unreasonably withheld.

WAIVER

A failure by either party to exercise its rights under this agreement shall not preclude that party from subsequent exercise of such rights and shall not constitute a waiver of any other rights under this Agreement unless stated to be such in a writing signed by an authorized representative of the party and attached to the original Agreement.

SEVERABILITY

If any provision of this Agreement or any provision of any document incorporated by reference shall be held invalid, such invalidity shall not affect the other provisions of this Agreement which can be given effect without the invalid provision, if such remainder conforms to the requirements of applicable law and the fundamental purpose of this agreement, and to this end the provisions of this Agreement are declared to be severable.

CONTRACT MANAGEMENT

The contract manager for each of the parties shall be responsible for and shall be the contact person for all communications and billings regarding the performance of this Agreement.

DEPARTMENT Project Manager: Alvin M. Josephy
Telephone Number: (360) 407-6456
Fax Number: (360) 407-7162
E-Mail Address: ajos461@ecy.wa.gov

RECIPIENT Program Manager:	R. Troy Peters
Title	Extension Irrigation Specialist
Address	24106 N. Bunn Road Prosser, WA 99350-8694
Telephone Number:	(509) 786-9247
Fax Number:	(509) 786-9370
E-Mail Address:	troy_peters@wsu.edu
RECIPIENT Administrative Contact:	Dan Nordquist
Telephone Number:	(509) 335-9661
Fax Number:	(509) 335-1676
E-Mail Address:	ogrd@ws+u.edu
RECIPIENT Billing Contact:	Sponsored Program Services
Telephone Number:	(509) 335-2058
Fax Number:	(509) 335-2071
E-Mail Address:	spfo@wsu.edu

ALL WRITINGS CONTAINED HEREIN

This Agreement contains all the terms and conditions agreed upon by the parties. No other understandings, oral or otherwise, regarding the subject matter of this Agreement shall be deemed to exist or to bind any of the parties hereto.

Order of Precedence:
In the event of an inconsistency in this agreement, the inconsistency shall be resolved by giving precedence in the following order:

1. Applicable statues and regulations;
2. Terms and conditions contained in the basic agreement;
3. Scope of work;
4. Budget

IN WITNESS WHEREOF, the parties have executed this Agreement.

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

10/7/08

KEN SLATTERY DATE
DEPUTY DIRECTOR
WATER RESOURCES PROGRAM

WASHINGTON STATE UNIVERSITY

9/19/08

DAN NORDQUIST DATE
DIRECTOR
OFFICE OF GRANT AND RESEARCH DEVELOPMENT

APPROVED AS TO FORM ONLY
ASSISTANT ATTORNEY GENERAL

APPROVED AS TO FORM ONLY:
Attorney General

RECIPIENT Federal ID Number: 91-6001108

Attachment A: Scope of Work

Evapotranspiration and Consumptive Irrigation Requirements for Washington

R. Troy Peters; Extension Irrigation Engineer/Assistant Professor, WSU, Prosser, WA
Leigh Nelson; WA State Irrigation Engineer, USDA-NRCS, Ephrata, WA
Richard Allen; Irrigation Engineer/Professor, University of Idaho, Kimberly, ID

Background

The competition and demand for Washington's already limited water resources will increase steadily over time due to the following emerging issues:

- The water demand to produce food to feed a *growing population*,
- Summer water shortages predicted as a result of *climate change*,
- The water demand to produce *biofuel crops*, and
- The desire to maintain our *environment* and aquatic wildlife habitat.

Good data is required to manage these water resources. The Washington evapotranspiration (ET) and consumptive irrigation water requirements tables (crop-water-use tables) are used extensively throughout the state for irrigation system design and planning, irrigation scheduling and management, water rights discussions, water rights transfers, and hydrologic studies. The crop-water-use estimates currently being used were created in the early 1980's and 1990's. With the changes in climate, crops, and irrigation systems, the foundation information which was then best available data, has become old and out-dated. These tables are not available in electronic format and are therefore difficult for the public to access and use for improved irrigation planning and management.

Objectives and Significance

It is proposed that the crop water use tables be updated using current weather data, and more current and accurate methods, equations and parameters. Additional locations and crops will be added to expand the existing tables. This data will be compiled into a database and published on the internet. It will also be made available through the NRCS Washington Irrigation Guide (WIG). A report on the results and the methods and procedures used will be produced so that the data compilation and analysis will be transparent and reproducible. The improved data quality, quantity and transparency will help make planning, design and water rights users of the WIG make better decisions.

This new database will be subsequently used for creating simple irrigation scheduling and planning tools, and tools that demonstrate the economic benefits to producers for improved irrigation management. These improvements in irrigation management will result in better yields with less water and lower pumping energy use. This is a formula for improved farmer profitability, but is also important for improved environmental water quality.

Design and Procedure

The creation of these crop-water-use tables needs to be done by a reputable entity in order to ensure accuracy and unbiased results. The two investigators of this project are unique in the state of Washington in their experience, training and their ability to oversee this work. Their positions also make them disinterested third parties which also uniquely qualifies them for this work in the state of Washington. Their goal is to develop accurate, unbiased numbers that can be used for good water planning and management, and fair and equitable water allocations that will both increase grower profitability, the state's economic vitality, and environmental water quality.

ET Estimation
A committee of leading researchers in evapotranspiration within the American Society of Civil Engineers recently updated and standardized the method for calculating evapotranspiration. This updated equation (the ASCE standardized Penman Monteith equation) will be used to calculate ET on a daily time step instead of a monthly time step to give improved within-month accuracy. Reference ET rates over the whole year, including winter months, will be calculated. All of the assumptions about which evaporative losses are included in the calculations will be explicitly stated. Accuracy of ET calculations will be estimated and documented. Guidance for modifying these calculations for non-standard conditions and/or deficit irrigation will also be provided. Since these will be estimates based on historical averages, measurements of the variability in this data will also be reported, namely standard deviation and different return intervals (2, 5, 10, 20, and 100 years).

Weather Data
There are multiple sources of historical weather information for calculating crop water use: 1) national weather service (NWS) stations, 2) Agrimet, and 3) Washington AgWeatherNet. Additional areas of local crop water use expertise also exist, such as the Wenatchee Tree Fruit Research Laboratory, the USDA-ARS Moxee Farm, WSU Puyallup Research and Extension Center, and information through watershed planning units. Currently the Washington Irrigation Guide (WIG) contains 76 selected NWS stations. All of these will be included in the new report, the Agrimet stations will be included and select AgWeatherNet stations will also be included. Information from areas of local crop water use expertise will also be considered. The general goal is to include all data possible to accurately represent the diverse climates from the important urban and agricultural regions of the state. Which additional stations will be chosen for inclusion depend on the station siting, which weather parameters are measured at that site, the data quality from that station, and the historical period of record. It is anticipated that the new report will contain over 100 total stations and an effort will be made to bridge geographic data gaps where possible (e.g. Asotin County, Tucannon, North Central Washington, etc.).

Crops
All of the crops that are currently in the WIG will be included in the new report. Crops that have recently become economically important and traditional crops that are emerging in new geographic areas will be added. This includes winegrapes, canola, blueberries, cranberries, cherry w/o cover, cherry w/cover, bluegrass seed, alfalfa seed, and cottonwood. Water use of native sagebrush, cheatgrass, pine trees and ET rates from wetlands, evaporation ponds, and open and deep water will also be included for use by hydrologists and other water management professionals. All assumptions about spacing or density will be stated.

Procedure

The steps required to update the Washington water use tables are as follows:

1. Identify and collect historical weather data sources from wide and diverse areas of the state. Weather stations should be located in green and growing fields. Those located in town, or whose readings are influenced by dry fields, buildings, or concrete should not be used if possible. In order to use the ASCE standardized reference ET equation the following data are required for each station: station location, elevation, latitude. The daily data required from each station are: day of year, minimum and maximum daily temperature, precipitation, dew point temperature, wind speed, and the total received shortwave solar radiation. National Weather Service stations, which usually have the longest histories typically only consist of temperature and precipitation data. Methods similar to Allen and Robison (2007) will be used to calculate solar radiation, wind speed, and dewpoint temperature for these stations.

2. Develop protocols for data cleaning and review with Ecology's technical committee[1].

3. Graph, review, and clean the weather data to fill in missing spots and check for anomalies (such as unrealistic numbers). Make a best effort to fill in holes or make good estimates of missing data.

4. Collect appropriate crop coefficients for economically important crops in Washington from published research data.

5. For every weather data location calculate evapotranspiration using the ASCE standardized reference ET equation on a daily time step for every year of record.

6. Sanitize data by graphing and looking for outliers and other anomalies. Chase these down and correct any errors. QA/QC data cleaning efforts.

7. Total the daily values into monthly and yearly values for each year. Statistics on these values will be performed to show year-to-year variability, the means, and 20% and 80% exceedence values. Chart these and compare these with nearby stations.

8. Apply the crop coefficients to get estimated average water use for the economically significant crops in each area. Compare these values with the existing (old) data set. Be able to include information on these comparisons between the old and new data in the final report.

9. Create tables of these values, and put them together in a relational database that can be accessed on the web, published in the Washington Irrigation Guide and used in later applications. Publish this data on the web.

10. Write up procedures and results in a draft report. The draft report shall be formatted consistent with the newly reprinted 2005 Washington State Irrigation Guide and serve as an addendum thereto.

---

[1] Ecology assembled a technical committee of professionals who use the Washington Irrigation Guide, including Ecology staff, Conservation Commission, river conservancies, Washington Dept. of Ag., NRCS, and the Farm Bureau.

11. Circulate draft report for internal Ecology and technical committee review. Incorporate comments and circulate for external public comment. Incorporate comments and finalize report.

Responsibilities

WSU will oversee and direct the tasks in this scope of work unless otherwise noted. NRCS will assist in Tasks 2 and 6 and provide technical assistance to WSU upon request on other tasks. WSU will rely on advice and input from Richard Allen on development of the consumptive use model. Ecology staff will work on Tasks 3, 9 and 11 based on direction and QA/QC from WSU. Ecology and WSU will rely on advice from the technical committee.

Timeline

It is estimated that the steps 1-8 can be completed within one year from the date of funding. Publishing the tables to the web and creating the final report will take an additional 6 months. The total time to complete this project is 1½ years.

Bibliography

USDA-ARS Washington Irrigation Guide. 1997. Available online at http://www.wa.nrcs.usda.gov/technical/ENG/irrigation_guide/index.html. Last verified on 2/12/2007

Allen, R.G., and C.W. Robison. 2007. Evapotranspiration and Consumptive Irrigation Water Requirements for Idaho. Available online at: Last verified on 10/2/2007

Allen, R.G., I.A. Walter, R.L. Elliot, T.A. Howell, D.Itenfisu, M.E. Jensen, and R.L. Snyder. 2005. *The ASCE Standardized Reference evapotranspiration equation*. Published by the American Society of Civil Engineers.

Allen, R.G. 1996. "Assessing integrity of weather data for use in reference evapotranspiration estimation." *J. Irrigation and Drain. Engr.*, ASCE. 122(2):97-106

Allen, R.G., C.E. Brockway, and J.L. Wright. 1983. "Weather station siting and consumptive use estimates." *J. Water Resour. Plng. And Mgmt. Div.*, ASCE 109(2):134-146

ASAE, 2004. *Measurement and report Practices for Automatic Agricultural Weather Stations*. Engineering Practice 505. St. Joseph, MI, 21p.

Doorenbos, J. and W.O. Pruitt. 1975, 1977. "*Guidelines for predicting crop water requirements*," Irrig. And Drain, Paper 24, (1rst and 2nd ed). Food and Agriculture Organization of the United nations, Rome, 179 and 156 pp.

Meek, D.W., and J.L. Hatfield. 1994. "Data quality checking for single station meteorological databases." *Agric. And Forest Meteorol.* 69:85-109

Snyder, R.L. 2000. "PMDay.xls and PMhr.xls spreadsheet software for estimating daily and hourly reference evapotranspiration using the Penman-Monteith equation." Dept. Land, Air and Water Resources, Univ, Calif., Davis, CA. http://biomet.ucdavis.edu/evapotranspiration/PMdayXLS/PMday.htm http://biomet.ucdavis.edu/evapotranspiration/PMhrXLS/PMhr.htm

Snyder, R.L., W.O. Pruitt, and A. Dong. 1985. "An automated weather station network for estimation of evapotranspiration." *In:* A. Perrier and C. Riou (ed.). *Crop Water Requirements.* Int. Commission Irrigation and Drainage. P. 133-142. Versailles, France.

ATTACHMENT B: BUDGET

BUDGET BY TASK

TASK	FY 2009	FY 2010	TOTAL
Evapotranspiration and Consumptive Irrigation Requirements Report	**$53,410.00**	**$16,590.00**	**$70,000.00**
TOTAL BUDGET	**$53,357.00**	**$16,643.00**	**$70,000.00**

BUDGET BY ELEMENT

ELEMENT	FY 2009	FY 2010	TOTAL
Salaries	**$27,575.00**	**$7,171.00**	**$34,746.00**
Personal Service Contracts			
Goods and Services	**$1,896.00**	**$600.00**	**$2,496.00**
Travel	**$3,500.00**	**$3,000.00**	**$6,500.00**
Computer Services			
Equipment			
Benefits	**$9,376.00**	**$2,438.00**	**$11,814.00**
Stipends/ Subsidies			
F&A	**$11,010.00**	**$3,434.00**	**$14,444.00**
TOTAL BUDGET	**$53,357.00**	**$16,643.00**	**$70,000.00**