

EXHIBIT 87

ET Mapping of Agricultural Valleys in the Walker River Basin, 2009-2011

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The National Fish and Wildlife Foundation (NFWF) is implementing a program to acquire water rights from willing sellers in Smith and Mason Valleys to increase flow to Walker Lake. The purpose of this NFWF project is to sustain the freshwater habitat of Walker Lake, while working equitably with current water right holders and other stakeholders.

Nevada water law provides for the consideration of consumptive use for a proposed change in place of diversion, manner of use or place of use (NRS 533.3703). In anticipation of the water right changes resulting from the NFWF project, NFWF has funded the Nevada State Engineer's Office to implement space borne remote sensing techniques to quantify evapotranspiration (ET) and consumptive use from agricultural lands in the Walker Basin over the period 2010-2013.

To date, the Nevada State Engineer's office has processed Landsat satellite data for the 2010 and 2011 seasons using METRIC (Mapping Evapotranspiration at High Resolution with Internalized Calibration) to develop ET maps of Smith Valley and Mason Valley. METRIC calculates ET as the residual of the surface energy balance, calibrated using ground-based reference ET from weather stations. The method was developed by researchers at the University of Idaho. Scripts developed at the Desert Research Institute have greatly improved processing capabilities.

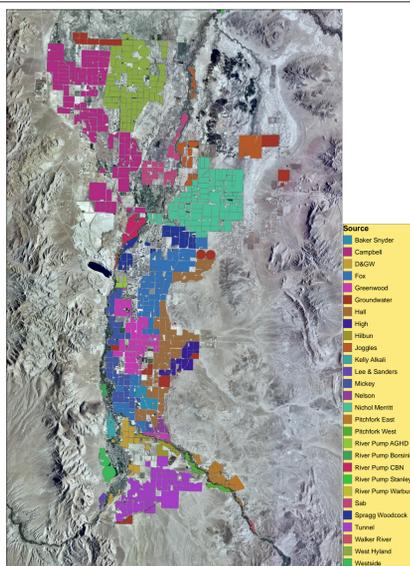
Findings of the METRIC analysis help provide a technical basis for administration of water right transfers based on consumptive use, and for long-term monitoring to provide clear comparisons of water use and water consumption reductions. Specific results of the METRIC analysis are compiled to:

- Build a field-scale ET database for agricultural lands in Smith and Mason Valleys, with monthly and seasonal ET maps for the project period.
- Develop individual crop ET characteristics for both Smith and Mason Valley by relating crop inventories to ET maps.
- Develop an annual ET record for areas served by individual ditches and other points of diversion from the Walker River.

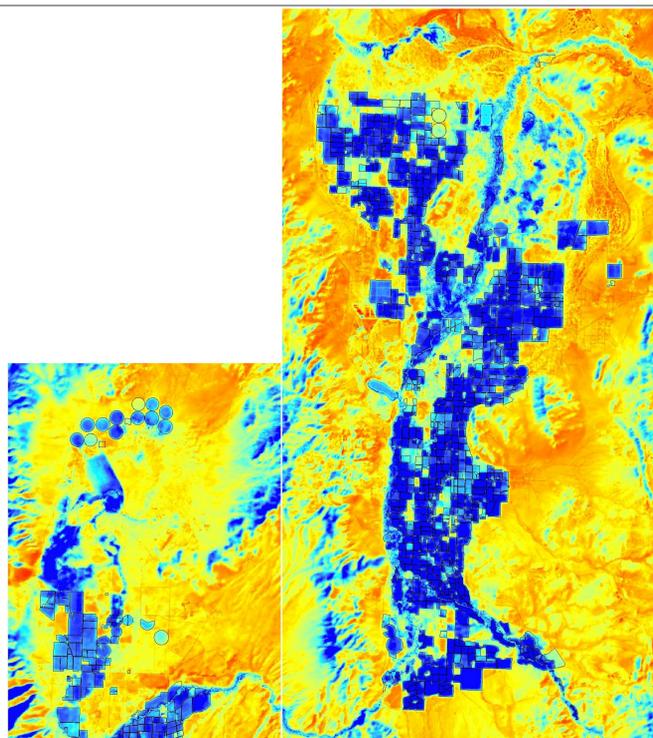
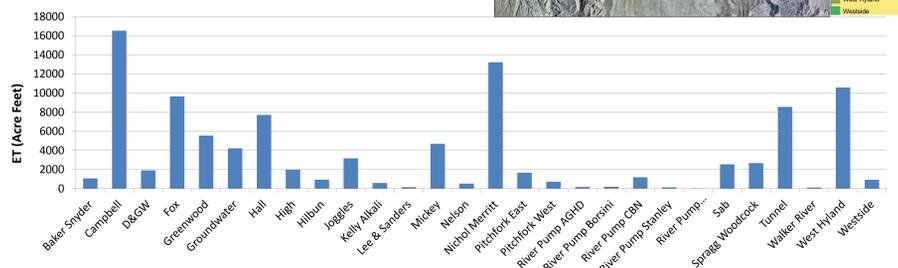
Data presented on this poster summarize project findings to date. Data presented for 2009 were processed independently by DRI, and are included here for comparison with 2010-2011 results. Findings will be published by the Nevada State Engineer's office in tandem with annual pumpage inventories for Smith and Mason Valleys.

Consumptive Use by Ditch Area

Consumptive use by fields irrigated by each Walker River diversion was quantified using field-scale ET maps and ditch service area maps created by the Desert Research Institute. These results can be compared with diversion records to estimate recharge and runoff return flow.



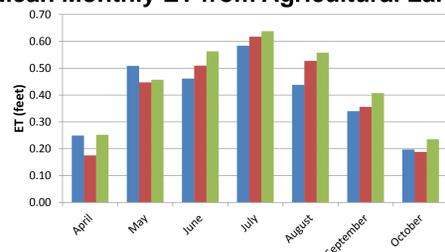
Agricultural ET by Ditch Service Area, Mason Valley, April-October, 2011



2011 Seasonal Evapotranspiration (mm)
Value
High : 1561.58
Low : 0

Maps of seasonal ET provide field-scale data on consumptive use. This image shows the ET map for the period April-October, 2011. Similar maps were created for 2010 and 2009. Smith Valley and Mason Valley ET was calculated separately using site-specific weather data.

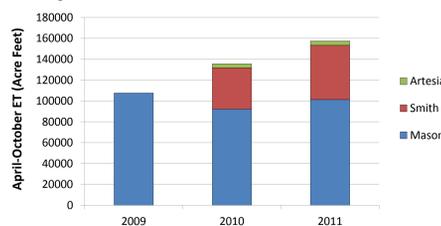
Mean Monthly ET from Agricultural Lands in Smith and Mason Valleys, 2009-2011



Monthly variation in ET among the three years is indicative of both atmospheric demand and water availability. Increased ET late in the 2011 season is notable for unusually high water availability. Total seasonal ET in acre feet averaged 2.78 in 2009, 2.82 in 2010, and 3.11 in 2011.

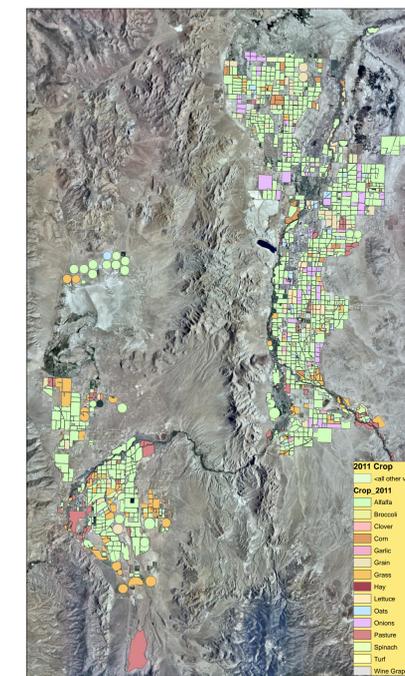
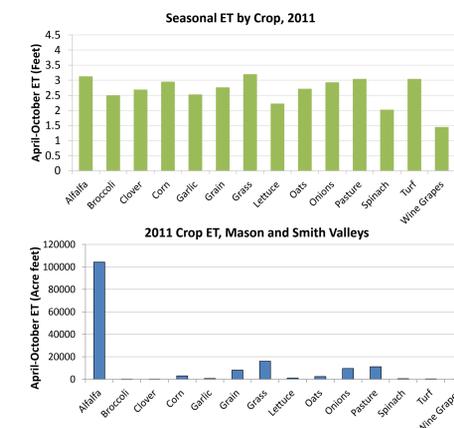
Total ET from Agricultural Fields, April-October, 2009-2011

Total agricultural ET in the Walker Basin varied by 10%-30% among years both within individual valleys and for the entire basin. Annual variations are primarily due to water availability, and to a lesser extent by atmospheric demand.



Consumptive Use by Crop Type

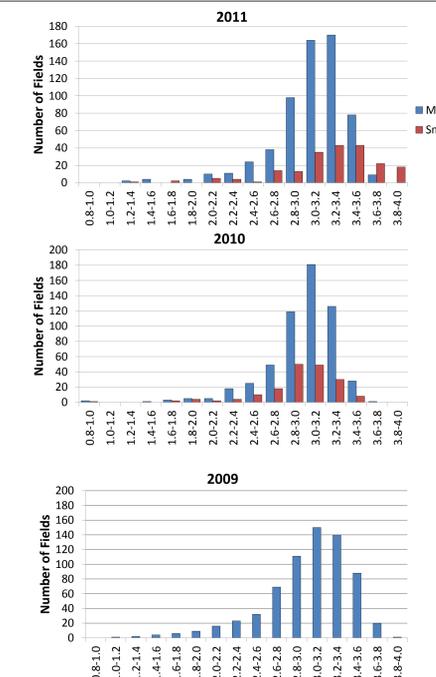
Actual crop consumptive use was determined by comparing ET maps with crop inventories completed by NDWR staff. Consumptive use computed by METRIC for the period April-October, 2011 is consistent with expected values based on crop physiology and agricultural practices.



Variability of Consumptive Use from Individual Alfalfa Fields

Water right duties for agricultural use in the Walker Basin are based on total volume of water required at the point of diversion. Of that total, actual ET for well-irrigated full cover alfalfa is considered by the Nevada State Engineer to be 3.5 ft/yr in Mason Valley and 3.6 ft/yr in Smith Valley. These values are based on a dual crop coefficient and daily soil water balance approach, with reference ET estimated from 30 years of weather data following the ASCE-EWRI Standardized Penman-Monteith equation. (Huntington and Allen, 2010).

In practice, actual ET varies by agricultural management, water availability and atmospheric demand, and tends to be less than the theoretical ET for well-irrigated, full-cover crops. These charts display the variability among individual fields for different years.



Acknowledgements

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References

Allen, Richard G., Masahiro Tasumi, Anthony Morse, Ricardo Trezza, James L. Wright, Wim Bastiaansen, William Kramber, Ignacio Lorite, and Clarence W. Robison, 2007. Satellite-Based Energy Balance for Mapping Evapotranspiration with Internalized Calibration (METRIC)-Applications. Journal of Irrigation and Drainage Engineering Vol. 133, No. 4, August 1, 2007.

Huntington, Justin L., and Richard G. Allen, 2010. Evapotranspiration and Net Irrigation Water Requirements for Nevada, Nevada Division of Water Resources, Department of Conservation and Natural Resources, January 2010.