Proposal to the McConnell Fund of the Shasta Regional Community Foundation for $50,000

Measuring Impact of Control of Yellow Starthistle in the Northern Sacramento Valley and Superior California on Watershed Runoff and Groundwater Levels

Shasta Valley Resource Conservation District

And

Natural Heritage Institute

March 1, 2016

INTRODUCTION

This proposal addresses two critical issues for Shasta, Tehama and all the other counties in the Northern Sacramento Valley, and the upper Sacramento River watershed.

The first issue is water supply. Even in normal years, water is in critical supply during the summer and early fall months in our region. Conditions are worse during droughts. Whatever can be done to increase groundwater storage and stream runoff during those periods would greatly contribute to the agricultural economy, and health of our streams, fisheries and watersheds.

The second issue is invasion of our rangeland by Yellow Starthistle. Yellow Starthistle dramatically reduces the quality of rangelands for livestock and wildlife. Yellow Starthistle has increased its coverage in Northern California from one million acres in 1981 to 10 million acres in 1997 to fifteen million acres today, and according to the Western Shasta Resource Conservation district it continues to steadily invade new acreage[1]

California faces growing demand for water. The strongest evidence for this is the overdraft of groundwater, especially in the Central Valley. The total amount of groundwater overdraft is uncertain, but normal year overdraft estimates range from 0 .5 to 2.5 million acre feet in the Central Valley.[2,3] The overdraft was undoubtedly considerably higher in 2013-2015.

Various measures have been and will be taken to respond to this need for additional water. The Legislature passed bills regulating the overdraft of groundwater, but they will not have any real effect for a decade or more. Cities are conserving, in part due to higher water rates and in part due to drought

[1] http://www.westernshastarcd.org/weeds.html

[2] Faunt, C.C., ed. (2009), *Groundwater Availability of the Central Valley Aquifer, California*: U.S. Geological Survey Professional Paper 1766, 225 pp.

[3] http://www.jpl.nasa.gov/news/news.php?release=2009-194

inspired conservation[4], but with a very high demand for water from permanent crops like almonds, overall water demand in California is likely to either remain stable or increase.

Building more surface and underground water storage capacity is favored by water agencies and political leaders because of the proven ability of storage to provide reliable water supplies. But a new study by the Nature Conservancy, CH2MHill, and UC Davis demonstrates the limited ability of new storage to provide new water supplies.[5] That study concludes that no more than 5-6 million acre feet of new surface and groundwater storage can be productively put to use. Even with full integration of this storage with existing water infrastructure, and with a Delta facility in place, this new storage would not produce much more than a million acre feet of new water. Further, the cost of this new infrastructure would be more than twenty billion dollars.

Even with expenditures of this magnitude, it is apparent that water storage alone will not meet all of California's water needs.

POTENTIAL WATER BENEFITS OF YELLOW STARTHISTLE MANAGEMENT

California must seek additional ways to make better use of the precipitation it receives. One way to do so is vegetation management. For example, a recent report by UC Merced, UC Berkeley and the Environmental Defense Fund calls for returning Sierra Nevada forests to the densities found before 1800, with a resulting increase in runoff due to lower water use resulting from thinning highly dense young trees.[6]

Another method of habitat manipulation to increase runoff could be through the removal of dense stands of weeds which use more water than other native and non-native vegetation, such as annual grasses. Yellow starthistle (YST)(*Centaurea solstitialis*) is such a weed.

A 2004 study[7] showed that YST uses substantially more water than the annual grasses it typically displaces. Soil moisture was 20% higher in annual grass test sites than in YST test sites.

Gerlach[8] estimated a loss of water of 0.4 AF/acre due to YST infestation, compared to areas with annual grasses. The extent of YST in California has not been calculated in the last few years, but most

---

4 http://www.swrcb.ca.gov/press_room/press_releases/2014/pr110414_rgcpd.pdf
5 INTEGRATING STORAGE IN CALIFORNIA'S CHANGING WATER SYSTEM. Nov 2014. Lund, Munevar, Taghavi, Hall and Saracino.
https://watershed.ucdavis.edu/files/biblio/Storage_White_Paper_20Nov2014.pdf
6 http://snri.ucmerced.edu/news/scientists-propose-thinning-sierra-forests-enhance-water-runoff
7 "Soil water dynamics differ among rangeland plant communities dominated by Yellow Star Thistle (*Centaurea solstitialis*), annual grasses, or perennial grasses" by Stephen F. Enloe, Joseph M. DiTomaso, Steve B. Orloff, and Daniel J. Drake Weed Science 52(6):929-935. 2004

8 "The impacts of serial land-use changes and biological invasions on soil water resources in California, USA" by John D. Gerlach Jr Department of Agronomy and Range Science, One Shields Avenue, University of California, Davis, CA 95616, USA (presently at State Water Resources Control Board). Journal of Arid Environments 57 (2004) 365–379

publications suggest YST affects at least 15 million of California's 100 million acres. Gerlach suggests that the average infested acre may have 1% coverage by YST, but others describe much higher densities. If only 1% of the infested fifteen million acres are covered by YST, elimination of the 150,000 acres of YST would save 60,000 acre feet of water.

This is probably substantially below the net water demand by YST, since it is possible to have up to nearly 100% of an infested acre covered by YST. Thus the potential water savings could range as high as several hundred thousand to one million acre feet per year. [See Appendix A for one set of calculations provided by the California Invasive Plant Council (pers. comm.)]

YST is found throughout California, especially in central California and northward, typically to about 5900 feet (1800 m), and sometimes at higher elevations. It is common in the Sacramento Valley, San Joaquin Valley, Sierra Nevada foothills, Cascade Range, Klamath Ranges, eastern North Coast Ranges, and the central-western region.[9] It thus largely overlaps the region of most water origination and use in California.[10]

YST is also common and invasive throughout much the western United States, and is also found in almost every other states except a few states in the South[11]

There are many other invasive plants known for their high water use, such as giant reed (*Arundo donax*), Tamarisk (*Tamarix* spp.), and others. But very few have the wide distribution of YST. YST is also easily controlled using Integrated Pest Management methods, making it susceptible to economically efficient control.

Harvesting water where it falls will be increasingly important in California, as climate change transforms snowfall to rainfall, making it harder to retain higher winter runoff in surface reservoirs, which must be operated for flood control purposes. Water captured in soil will be increasingly valuable under these conditions. This is because runoff is most valuable when it comes in the spring and summer. Higher groundwater levels are valuable at all times. YST is not likely to affect groundwater levels or runoff in the winter, when the plants are not substantially growing. The effects of YST removal on water levels will be strongest in the spring and summer, the main YST growth and transpiration periods.

Although the costs of treating YST vary greatly depending on the site, density of YST, access to the site and other factors, the cost of treatment can be as little as $5-6 per acre.[12] Assuming as much as 0.4 AF/acre of water can be generated as a result of controlling YST; the cost per acre foot of new water could be as low as $15 per acre foot. Of course, control would have to be annual for at least several years until no more seeds germinate, but it still appears that the cost of developing water using control

User 9/13/16 4:44 PM
Formatted: Font color: Auto
User 9/13/16 4:44 PM
Formatted: Font color: Auto
User 9/13/16 4:44 PM
Formatted: Font color: Auto
User 9/13/16 4:44 PM
Formatted: Font color: Auto
User 9/13/16 4:44 PM
Formatted: Font color: Auto
User 9/13/16 4:44 PM
Formatted: Font color: Auto
User 9/13/16 4:44 PM
Formatted: Font color: Auto
User 9/13/16 4:44 PM
Formatted: Font color: Auto
User 9/13/16 4:44 PM
Formatted: Font color: Auto
User 9/13/16 4:44 PM
Formatted: Font color: Auto
User 9/13/16 4:44 PM
Formatted: Font color: Auto

[9] http://www.ipm.ucdavis.edu/PMG/WEEDS/yellow_starthistle.html
[10] http://www.calflora.org/cgi-bin/species_query.cgi?where-calrecnum=1853
[11] http://plants.usda.gov/core/profile?symbol=ceso3
[12] Yellow Star Thistle Management Guide Ditomaso, Keyser, and Pitcairn. California Invasive Plant Council, Sept 2006.

of YST would be far cheaper than other sources of water, including water conservation, wastewater recycling, new storage, and desalting of brackish or sea water[13]

In addition to the economic benefits of greater water generation, reducing YST will greatly benefit cattle ranchers. Statewide benefits to ranchers could exceed $20 million per year[14]. There would also be substantial benefits to biodiversity, since native plants will do better when YST is removed. Increased streamflow due to greater groundwater recharge would benefit native fish species and help listed rivers meet temperature TMDLs.

User 9/13/16 4:44 PM
Formatted: Font color: Auto
User 9/13/16 4:44 PM
Formatted: Font color: Auto

Proposal to study direct water supply benefits of control of yellow starthistle

While the science described above indicates that soil moisture and accompanying levels of groundwater and runoff could be substantially increased by control of YST, the water community seems unaware of these benefits. Even if the studies were brought to their attention, they are unlikely to implement widespread YST control without seeing field evidence that such control would produce tangible runoff and/or groundwater benefits.

The Shasta Valley Resource Conservation District and the Natural Heritage Institute propose a study of the water benefits of YST control. The principal researchers would be Dr. Joseph DiTomaso of the Department of Plant Sciences, UC Davis, and Dr. Michael Deas of Watercourse Engineering in Davis, CA.

In order to facilitate the transfer of the results of the study to the water and ranching communities, an advisory committee would be established at the start of the study. It could include the following organizations (listed below), as well as additional organizations.

Association of California Water Agencies
Northern California Water Association
California Cattlemen's Association
Glenn Colusa Irrigation District
The Nature Conservancy
California Rangeland Trust
American Rivers
Ducks Unlimited
California Invasive Plant Council
California Association of Resource Conservation Districts
California Farm Bureau
University of California Extension
County Weed Management Areas

If there appears to be a replicable water supply benefit from YST removal based on the proposed study, Dr. DiTomaso and Dr. Deas will prepare a plan of recommended YST removal in California which results in increased runoff and/or improved groundwater levels. The plan will prioritize proposed YST removal

[13] Legislative Analyst's Office, "California's Water: An LAO Primer" (Oct. 22, 2008), http://www.lao.ca.gov/2008/rsrc/water_primer/water_primer_102208.pdf page 67
[14] Costs and Losses Imposed on California Ranchers by Yellow Star Thistle Alison J. Eagle, Mark E. Eiswerth, Wayne S. Johnson, Steve E. Schoenig, and G. Cornelis van Kootens Rangeland Ecol Manage 60 :369-377 1 July 2007

areas by the cost effectiveness of YST removal with respect to water supply improvement. They will join NHI in meeting with water managers in the highest priority areas to encourage them to implement a YST removal program.

References

Gerlach, John D., Jr. 2004. The impacts of serial land-use changes and biological invasions on soil water resources in California, USA. Journal of Arid Environments, 57: 365–379

Yellow Starthistle continues its spread in California. Pitcairn, Michael J., Steve Schoenig, Rosie Yacoub and John Gendron. California Agriculture, 60(2): 83-90. 2006

Appendix A (provided by California Invasive Plant Council)

One Million Acre-Feet/Year Wasted by Yellow starthistle in the Central Valley

Gerlach (2004) found that Yellow starthistle (*Centaurea solstitialis*), a widespread invasive plant in California, consumes between 1,050-1,200 cubic meters/hectare/year of excess water relative to exotic annual grasses, the most common ground cover in California rangelands.

Pitcairn et al. (2006) estimated 2.6 million net acres of Yellow starthistle in the Central Valley (Sacramento and San Joaquin River drainages) in 2002.

Converting to acre-feet:
(1125 m^3/ha/yr) (0.0008 ac-ft/m^3) (0.4 ha/ac) = 0.36 acre-feet water/acre YST per year

Total for the Central Valley:
(2.6 x 10,000,000 acres YST) (0.36 acre-feet/acre YST/year) = 0.94 x 10^6 acre-feet/year

Thus approximately one million acre-feet of water are consumed by Yellow starthistle each year in the Central Valley above and beyond what would be consumed by annual grasses.

Work Plan and Budget

Objective

The objective of the study is to quantify surface water and groundwater response to different vegetation treatments – with and without yellow starthistle (YST) – in small sub-watersheds.

Goals

The goals of the study are to study smaller sub-watersheds that are representative of the larger landscape to:

- Quantify differences between control and treatment sites sufficiently to clearly quantify potential benefits.
- Allow translating experimental results to full-scale conditions.
- Estimate the potential saving of full-scale application on groundwater, runoff, soil moisture, and their interaction

Study Area

The proposed study area is the region along the west side of the Sacramento Valley in Yolo, Colusa, Glenn, or Tehama Counties, an area of extensive yellow starthistle infestation. These counties provide an opportunity to study the impacts of YST water use on surface water and groundwater.

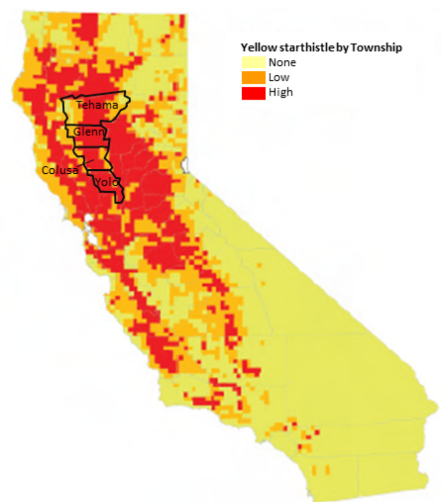


Figure 1. Yellow starthistle distribution throughout California (from DiTomaso et al 2006) and proposed study area.

Approach

The approach outlined herein seeks to explicitly quantify surface water and groundwater differences among a “control” and a “treatment” condition. Five tasks are envisioned for this project:

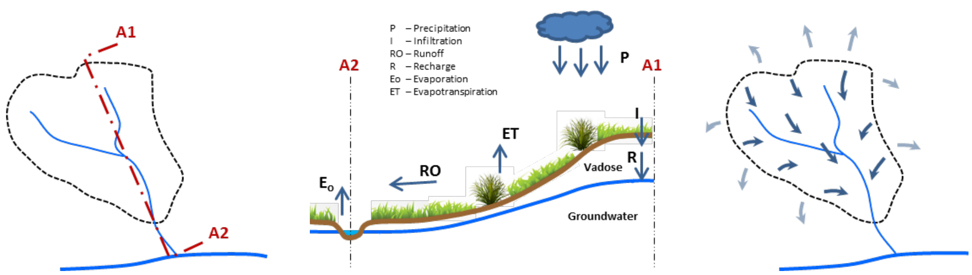
1. Scoping/Site Selection
2. Instrumentation Installation
3. Monitoring
4. Reporting
5. Meetings/Communication.

The proposed work implements these five tasks to identify sub-watersheds in the proposed target area, install appropriate instrumentation, and develop a water budget (Figure 2(a), (b)) within the experimental area to determine differences between the control and treatment conditions. The outcome will be a project report detailing the approach/methods, monitoring, analysis, and findings and recommendations.

Lisa Thompson 11/2/16 5:15 PM
Deleted: Figure 2

Meteorological information, surface runoff, and changes in groundwater conditions will be monitored. Vegetation distribution and water use (evapotranspiration, ET), and changes in soil moisture will be monitored or calculated by Watercourse Engineering. All precipitation is assumed to be captured by sub-watersheds, and vegetation ET is assumed only to draw water from within the watershed boundary. Groundwater flow paths in a sub-watershed are assumed to remain within the sub-watersheds, i.e., no exchange with adjacent basins Figure 2 (c).

Lisa Thompson 11/2/16 5:15 PM
Deleted: Figure 2



(a) (b) (c)

Figure 2. Representative sub-watershed (a) watershed boundary and creek (showing a longitudinal section A1-A2), (b) theoretical water budget along section A1-A2, and (c) assumed groundwater flow paths within a subbasin.

Representative paired sub-watersheds will be delineated by watershed boundaries. Two study sites will be identified, for a total of four sub-watersheds. A sample of paired study sites adjacent to a larger creek system is shown in Figure 3. The paired watersheds will not share a common boundary to ensure groundwater and ET effects are sub-watershed specific. Site selection of sub-watersheds adjacent to a larger creek or seasonal drainage is critical to this study. To effectively assess the impacts of water used by YST and the concomitant impact on groundwater levels requires that groundwater not be excessively deep. By selecting small watershed areas, with modest relief, adjacent to seasonal streams provides an opportunity to examine YST water use during the critical water uptake and seed germination during

Lisa Thompson 11/2/16 5:15 PM
Deleted: Figure 3

winter and spring months (Figure 4). The seasonal creek will maintain water tables at an elevation that can be relatively easily monitored (Figure 5), allowing for quantification of changes between the control and treatment sub-watersheds. Without the seasonal creek present, water tables may be at much greater depths, which would lead to markedly higher costs to install monitoring wells or piezometers. Further, these larger creeks are often important recharge areas, and identifying effects of YST control in such areas would provide insight on potential increases in seasonal creek flow and groundwater recharge.

Lisa Thompson 11/2/16 5:15 PM
Deleted: Figure 4
Lisa Thompson 11/2/16 5:15 PM
Deleted: Figure 5

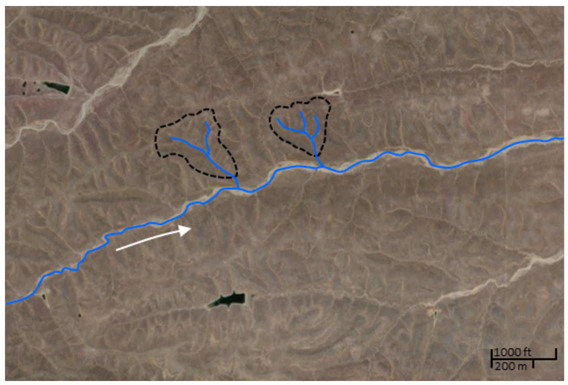
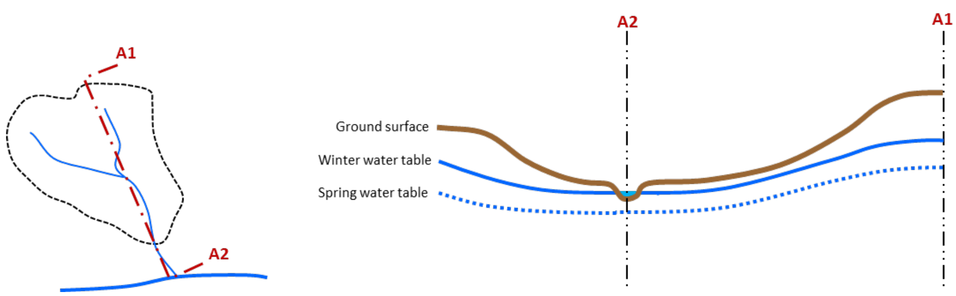


Figure 3. Sample study area with paired sub-watersheds detailed.



(a) (b)

Figure 4. Representative sub-watershed (a) watershed boundary and creek (showing a longitudinal section A1-A2), (b) theoretical winter and spring water table.

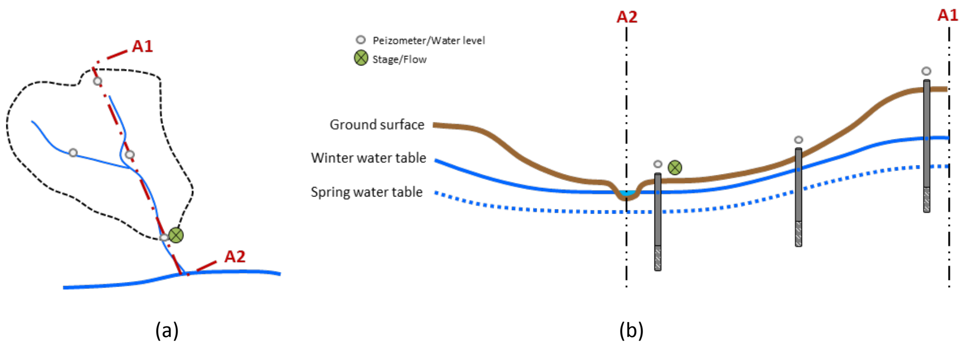
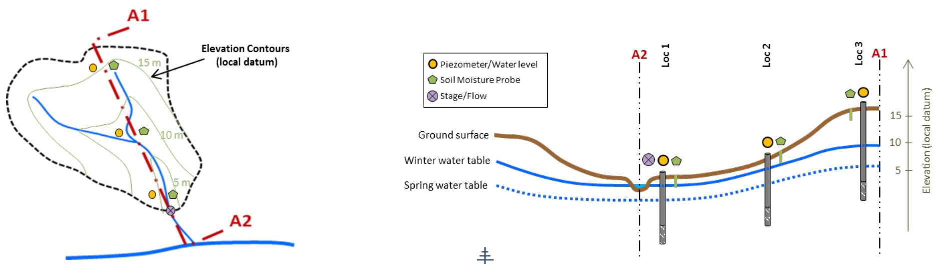


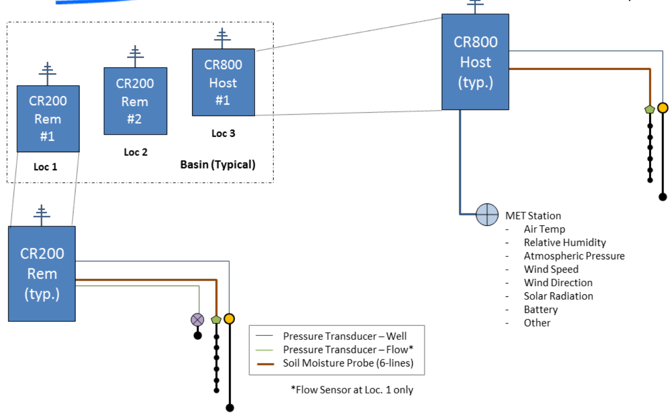
Figure 5. Representative sub-watershed with example instrumentation distribution (a) watershed boundary and creek (showing a longitudinal section A1-A2), (b) theoretical winter and spring water table.

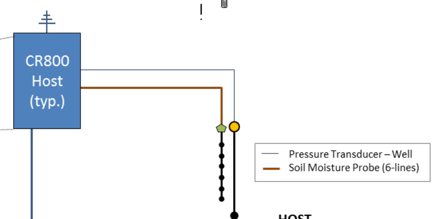
The experimental period would span three years to capture conditions over a water year– October 1 through September 30. Monitoring would occur year round for meteorological conditions, groundwater levels, vegetation and soil moisture, water quality including presence and concentration of any herbicides use, and late fall through spring for surface water flows.

Based on this information, changes in water table can be used to calculate inflows (precipitation) and outflows (infiltration, surface runoff, ET). Coupled with changes in soil moisture, groundwater levels and vegetation performance, water use differences between control and managed sites can be ascertained. Finally, by selecting representative sites, project results should be scale-able to larger areas, providing the means to approximate large scale YST control and associated water supply impacts.

Below is a schematic of a representative basin and a brief equipment summary.







HOST

- CR800 Host at highest elevation (line of site)
- Host has a lot more memory than CR200
- Host has more channels
- Host has modem

DATA

- Like BSC – can check on line and see what is going on
- Getting data for research:
    - Get from site as excel spreadsheet
- Periodically review data and download to make sure all is working right.

Remote Sensing Network Summary					
		Number of Basins =	4		
		Number of Stations per Basin =	2		
		Number of Hosts per Basin =	1		
		Total Number of Stations =	12		*12 remote stations (4 Basins * 3 Stations ea)
Item	**Qty**	**Description**	**Unit Cost**	**Total**	**Supplier**
1	8	CR200X - MCU - Remote	$4,320.85	$34,566.80	www.campbellsci.com
2	4	CR800 - MCU - Host	$6,761.95	$27,047.80	www.campbellsci.com
3	16	Channel Strut - 12"x13/16"x1 5/8"	$5.45	$87.18	Local supplier
4	16	Strut Mount Clamp	$1.98	$31.64	Local supplier
5	12	2-inch rigid conduit x 10 ft.	$56.65	$679.80	Local supplier
6	12	Sacrete	$10.30	$123.60	Local supplier
7	12	Coupling and Extension	$12.36	$148.32	Local supplier
SUBTOTAL MONITORING STATIONS INCLUDING ASSEMBLY & INSTALLATION				$62,685.14	
7	4	Vasaila MET station	$3,708.91	$14,835.63	www.vaisala.com
15	4	Pressure Transducer - 0 to 5 psi	$231.81	$927.23	www.campbellsci.com
16	12	Pressure Transducer - 0 to 15 psi	$231.81	$2,781.68	www.campbellsci.com
17	72	5TM - VWC and Soil Temp Sensor	$218.39	$15,723.81	www.decagon.com
		SUBTOTAL SENSORS		$34,268.34	
			TOTAL	$96,953.48	

Scoping/Site Selection

Relatively small subwatersheds will be identified in the project area that have similar attributes, including but not limited to size, topography, aspect, soils, geology, and other pertinent factors. The identified project area has vast areas where similar sites can be identified with sub-basins ranging from a few acres to much larger. Further, sites are to be well up-gradient of the Tehama-Colusa-Corning Canal or other similar conveyance facilities to avoid potential influences of groundwater associated with the canal and down-gradient agricultural areas. Completing the experiment in the extensive rangelands west of the agricultural areas would target current YST infestations, and focus on areas of groundwater recharge where management actions could have a marked effect (Figure 6).

Lisa Thompson 11/2/16 5:15 PM
Deleted: Figure 6

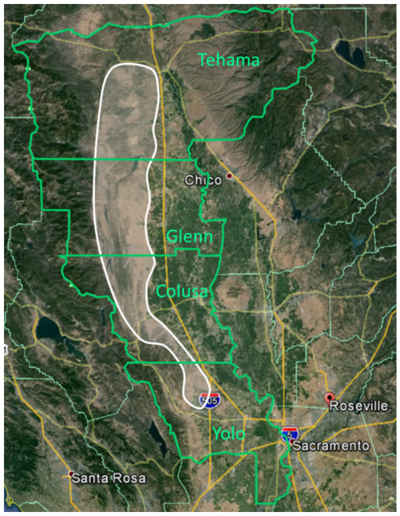


Figure 6. Proposed target region of experimental sites (white border).

Lisa Thompson 11/2/16 5:15 PM
Deleted: 7

Installation

Surveying the selected watersheds, providing appropriate fencing, and installing the necessary field instrumentation will be carried out early in the project period.

A survey of each watershed will be completed and a topographic map developed in GIS. This map will be used by the project team to identify all instrumentation, vegetation distributions and densities, and other project elements. Topographic surveys will be completed with a TOPCON HiperLite+ Real Time Kinematic survey or similar unit.

Fencing will be required to exclude grazing from each sub-watershed. A barbwire fence with a wildlife friendly bottom strand is proposed. Assuming the four sub-watersheds are 1000x1000 feet, this would equate to 24,000 feet of fencing.

Yellow starthistle removal and specific instrumentation installation are addressed below.

While Milestone herbicide is used as the exclusive agent to eliminate Yellow Starthistle in the experimental plots, there are many other methods which can be used to reduce or eliminate the plant in actual field applications[15] If the test shows that Yellow Starthistle removal results in substantial water savings, Integrated Pest Management methods will be used to eliminate the weed throughout the Sacramento Valley. Water managers will be willing to fund this program, if the water savings are sufficiently large. Outreach to these managers in included in this funding request.

[15] Yellow Starthistle Management Guide, DiTomaso, Kyser and Pitcairn, 2006. Published by California Invasive Plant Council.

Milestone is substantially below all of the EPA levels of concern (LOC) for non-target organisms. Milestone produces no significant soil or water metabolites other than $CO2$ and $NH3$ and has a low bioaccumulation potential. In EPA's assessment under the Reduced Risk Pesticide Initiative, Milestone was found to have reduced acute and chronic toxicity to mammals, birds, algae and aquatic vascular plants compared to market standards.

Eradication methodologies referred to in footnote 15 are effective in a broad range of habitats, from the flatter lands of the Sacramento Valley to the foothills of the Coast Range and the Sierra Nevada.

Substantial numbers of workers will be required for initial widespread elimination of Yellow Starthistle, and continuing employment will be provided for a small number of workers to keep the plant under continuing control.

Antecedent conditions

Once they are fenced and instrumentation is installed, all 4 plots (experimental and control) will be monitored for one year to determine if they are comparable with respect to groundwater levels and surface water runoff.

Yellow starthistle removal from three treatment watersheds

Untreated plots will not receive an herbicide application, but yellow starthistle control plots will be treated with Milestone® (aminopyralid) using a helicopter. Milestone® has been shown to provide 99-100% control of yellow starthistle with no negative impact on annual or perennial grasses. One treatment per year will be adequate. To guarantee that no yellow starthistle remains in the treated plots in each year of the study, treatments will be made in January or February every year. During the spring (late April to May) and summer (July), vegetative cover of all species in the plots will be determined using 10 line transects per treated and untreated plot. Line transects will be conducted with a 50 ft measuring tape, where each species contacting a vertical meter stick will be recorded at one foot intervals. This technique allows us to determine the dominant species within the various study sites. From this data, we can identify any major community shifts from year to year within the treated and untreated areas.

Monitoring

Monitoring includes meteorological observations, groundwater levels, and surface water outflows from the sub-watershed. All information will be managed with data collection and management system.

Data Collection and Management

Data collection and management will be completed with remote sensors, data loggers, and a solar powered network. These data will be available real-time and output from the system will be automatically available in a variety of formats including spreadsheet and raw data files. Quality assurance criteria will be implemented in the system to track anomalous events, equipment malfunction, or other issues. The system will reduce the number of field visits, allow maintenance to occur in a timely fashion, and dramatically reduce data management for the extensive monitoring network proposed.

Frequency of all data collection will be sub-daily. Our initial estimate is hourly data will be collected for all stage (surface and GW), meteorological information, and soil moisture. While this data frequency is probably not necessary for all parameters, aggregating up to daily, weekly, monthly, or seasonal averages is a more robust technique than collecting data at less frequent intervals and attempting to disaggregate to a finer time step.

Surface Flow

Parshall Flumes will be used at the outlet of each sub-watershed. Each flume will include a stilling well and pressure transducer. The flumes will be installed on a concrete apron with erosion protection on the downstream end. Sizing of the flume will be based on a peak flow for a Q_{50} design event for the area. Alternatively, depending on the size of the sub-watersheds, flow meters may be employed. All materials will be removed at the termination of the project.

Meteorology

Meteorological data will include at a minimum solar radiation, air temperature, relative humidity, atmospheric pressure, wind speed and direction, and precipitation. Other sensors can be added as deemed necessary. These data will be used to calculate evaporation.

Groundwater

To gain an assessment of groundwater depths, three piezometers[16] will be installed per sub-watershed to a depth of 15 to 30 feet depending on the selected site and depth to seasonal groundwater. Groundwater levels may fall below this level in the late summer and fall. However, the effects of YST on groundwater are postulated to be most prominent during the winter through spring (and possibly early summer). Deeper wells would be costly. Wells will be 2-inch and screened from approximately 5 feet to the bottom of the well. This will most likely require an 8-inch auger hole, and these will be akin to a regular well with seal and cap. Each well will be instrumented with a water level logger. At the termination of the project the well head will be excavated and the pipe cut off and capped below the ground surface and backfilled with native material.

Soil Moisture

To quantify soil moisture, water content sensors will be placed adjacent to piezometers in each sub-watershed. Sensors will measure volumetric water content and be placed at six discrete depths from the soil surface to approximately 2 meters – the approximate rooting depth of YST. As with all other sensors in the monitoring network, all soil moisture sensors will be connected to the remote sensing network.

Analysis

Field data collected under this study plan will be analyzed and a water budget developed for each sub-watershed. Water budgets will be developed on a monthly and annual (or seasonal) time period to ascertain the differences between the control and treatment plots. A variety of statistical approaches may be used to test for significance among control and treatment sites. The analysis will include a water budget for surface and subsurface components. Specifically, using measured meteorology and

[16] Piezometers are pipes that include perforations throughout a portion of the well. Water levels inside the pipe reflect water pressure above the bottom of the pipe.

hydrology, surface infiltration will be calculated. Subsequently, recharge past the root zone will be calculated based on soil moisture probes, plant transpiration based on literature values, and the aforementioned surface infiltration. Treatment sites are expected to have a larger recharge to groundwater and/or greater soil moisture than untreated sites due to lower water use, i.e., $R_T > R_{YST}$ (see Figure 7).

Lisa Thompson 11/2/16 5:15 PM
Deleted: Figure 7

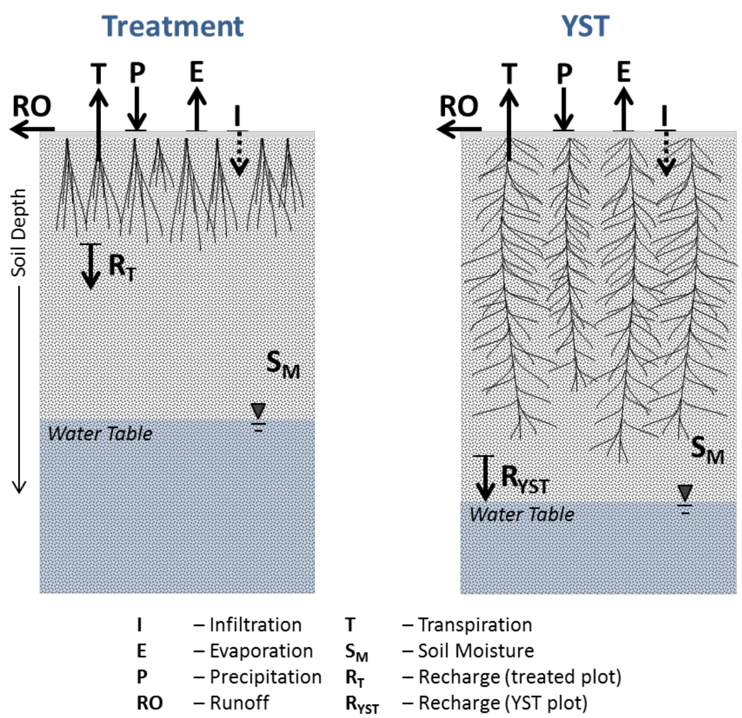


Figure 7. Hypothetical water budget components for a treatment plot soil profile (at and below land surface) with current or native vegetation (left) and an untreated plot soil profile with YST (right).

Lisa Thompson 11/2/16 5:15 PM
Deleted: 8

Watercourse Engineering or a subcontractor will monitor the plots and develop a water budget. Dr. DiTomaso will interpret and evaluate the results.

Reporting

The principal deliverable for the project is a report detailing the approach/methods, monitoring, analysis, and findings and recommendations. All data will be made available electronically.

Meetings/Communication

For a project of this scope and duration, meetings among collaborators, agencies, internal project team, and others will be paramount. A kick-off meeting will occur at project inception and subsequently there will be semi-annual group meetings (remote, conference call) to keep all parties up to date on activities, challenges, resolutions and overall progress. The internal project team will be communicating at a much higher frequency. During these meetings and at other outreach and extension talks, Dr. DiTomaso will discuss with ranchers the grazing techniques that can discourage re-infestation of yellow starthistle. For example, grazing can be combined with other forms of good management to control or even eradicate yellow starthistle after initial control. An outline of best practices will be developed for use by ranchers if the study proves the potential of water enhancement by yellow starthistle control

Budget

Watercourse Engineering Budget

Tasks include field reconnaissance for site selection, installation of field monitoring equipment, maintenance of monitoring program, data analysis and development of water budget elements (e.g., surface runoff, infiltration, soil moisture, groundwater recharge) and water use, reporting, and communications throughout the project with project team members and involved parties.

Personnel	
1. Scoping/Site Selection	$8,000
2. Installation	$18,000
3. Monitoring	$30,000
4. Analysis (water budget)	$60,000
5. Reporting	$20,000
6. Meetings and Communications	$15,000
Personnel Sub-total	$ 151,000
Field Equipment/Expense	
Groundwater Piezometer Installation and Monitoring	$36,000
Meteorological Stations	$8,000
Surface Flows - Parshall Flumes or meter	$17,000
Data collection Network	$94,000
Fencing (including maintenance)	$20,000
Field Supplies/Expenses	$14,000
Removal (at end of project)	$6,000
Equipment Sub-total	$ 195,000
Total	**$ 346,000**

University of California, Davis (Dr. DiTomaso)

Tasks include preparing the study sites through vegetation control, vegetation monitoring, and interpretation and evaluation of water budget results.

1. Herbicide aerial application: 69 acres, 10 gal/acre	$2000/yr for 3 years: $6000
2. Vegetation monitoring (2 people, several days each spring and summer, 3 years)	$12,000
3. Interpretation and evaluation of results of water budget	$16,000

Field Expense

Herbicide cost ($8/acre*70 acres*3 years)		$2000
	Total	**$36,000**
Water quality analysis	**Total**	**$14,000**

NHI Budget
NHI tasks include project oversight, administration and results dissemination.

Monitor and administer project		$5,000
	Total	**$5,000**
Project Total		**$401,000**

Status of budget of this proposal.

The State and Federal Water Contractors Association has agreed to provide $150,000 over 3 years to implement this proposal. A private donor has agreed to match that contribution. This leaves $101,000 to complete the funding.

This proposal requests $50,000. If the request is granted, applicants are confident that the remaining $51,000 can be found quickly and the program can move forward this year.

Schedule

The project is proposed to commence in July 2016 and be completed December 2021.

Meetings with the advisory committee will occur every January and July

Interim Reporting of results will occur every June, and results will be reported to the advisory committee in July.

2016 July: Scoping and site selection
August: Installation of equipment, fencing of sites.
September 2016- August, 2017. Monitoring surface water and groundwater antecedent conditions of 6 watersheds (experimental and control) prior to YST elimination

2017 August through October: elimination of YST in experimental plots
September, 2017 through September, 2020. Monitoring of surface and groundwater conditions of 6 watersheds.

2020 October through December. Compile study results and publish results. If results indicate that a program of widespread YST removal would result in substantially increased groundwater and surface water production, develop a methodology for a removal program which would have minimal adverse environmental impacts.

2021 Present proposed methodology to water users in Sacramento Valley and to Delta water exporters, and suggest a program to eliminate YST from the Sacramento Valley watershed. At least one presentation will be made in Siskiyou County, in coordination with UC Extension

Citations

DiTomaso, J.M. G.B. Kyser, and M.J. Pitcairn. 2006. Yellow starthistle management guide. Cal-IPC Publication 2006-03. California Invasive Plant Council: Berkeley, CA 78 pp. Available: www.cal-ipc.org.

Joseph M. DiTomaso, Ph.D.

CURRICULUM VITAE

University of California
Department of Plant Sciences, Mail Stop 4
One Shields Ave, Davis, CA 95616

Office: (530) 754-8715
Fax: (530) 752-4604
E-mail: jmditomaso@ucdavis.edu

My research and extension program focuses on understanding of the biology and ecology on invasive plants in non-crop areas and using this information to develop more effective, environmentally safe and cost effect method for their management.

EDUCATION

Ph.D. (1986), Botany/Weed Science, University of California, Davis
M.A. (1981), Biological Sciences, Humboldt State University, Arcata, CA
B.S. (1978), Wildlife and Fisheries Biology, University of California, Davis

PROFESSIONAL AWARDS AND HONORS (past 5 years)

Lifetime Achievement Award for Vision and Dedicated Service awarded by the California Invasive Plant Council (Cal-IPC), 2011
Selected as Fellow of the Weed Science Society of America, 2011
Outstanding Extension Award by the Weed Science Society of America, 2008
Gold Award by the Association for Communication Excellence for the two volume book "Weeds of California and Other Western States", 2007
Outstanding Weed Scientist, Public Sector, Western Society of Weed Science, 2004
Award of Excellence, California Weed Science Society, 1999
Distinguished Service Award, DANR, Outstanding Research-Specialist, 1998
American Society for Horticultural Science, Extension Division Educational Materials Award for Commercial Ornamentals, Floriculture and Turf, *Weeds of the Northeast*, 1998

SERVICE TO PROFESSIONAL SOCIETIES (past 5 years)

President, Western Society of Weed Science, 2010-2011
President, Weed Science Society of America, 2014-2015
Editor, Invasive Plant Science and Management, Weed Science Soc. of America Journal (2007-present)
Member, Board of Directors, California Horticultural Invasive Prevention, 2008-present
Member, National Invasive Species Advisory Committee, 2008-present
Member, California Invasive Species Advisory Committee, 2009-present

PEER-REVIEWED JOURNAL PAPERS AND BOOKS (since 2013)- 160 total

1. DiTomaso, J.M. and G.B. Kyser. 2015. Effects of aminopyralid on annual California grassland plant communities. Invasive Plant Science and Management 8(1):(in press)

2. DiTomaso, J.M. 2014. The importance of herbicide resistance in weeds of natural Areas. California Agriculture 68:149.
3. Spencer, D.F., S. F. Enloe, M. J. Pitcairn, and J. M. DiTomaso. 2014. Impacts of mowing and bud destruction on *Centaurea solstitialis* growth, flowering, root dynamics, and soil moisture. Weed Research 54:140-150.
4. Barr, T.C. and J. M. DiTomaso. 2014. Integrating hot water under benthic barrier for curlyleaf pondweed turion control. Journal of Aquatic Plant Management (in press)
5. Barr, T.C. and J. M. DiTomaso. 2014. Curlyleaf pondweed turion control with acetic acid and benthic barriers. Journal of Aquatic Plant Management 52: 31–38
6. Brusati, E.D., D. W. Johnson, and J. M. DiTomaso. 2014. Predicting invasive plants in California. California Agriculture 68(3):89-95.
7. Brownsey, R.N., G.B. Kyser, and J.M. DiTomaso. 2014. Growth and phenology of *Dittrichia graveolens*, a rapidly spreading invasive plant in California. Biological Invasions 16:43-52.
8. Kyser, G.B. and J.M. DiTomaso. 2013. Effect of timing on chemical control of Dalmatian toadflax (*Linaria dalmatica*) in California. Invasive Plant Science and Management 6:362-370.
9. Kyser, G.B., R.G. Wilson, J. Zhang, and J.M. DiTomaso. 2013. Herbicide-assisted restoration of Great Basin sagebrush steppe infested with medusahead and downy brome. Rangeland Ecology and Management 66:588-596.
10. Kyser, G.B., A. Hazebrook, and J.M. DiTomaso. 2013. Integration of prescribed burning, aminopyralid, and reseeding for restoration of yellow starthistle-infested rangeland. Invasive Plant Science and Management 6:480-491.
11. Brownsey, R.N., G.B. Kyser, and J.M. DiTomaso. 2013. Seed and germination biology of *Dittrichia graveolens* (stinkwort). Invasive Plant Science and Management 6:371-380.
12. Brownsey, R.N., G.B. Kyser, and J.M. DiTomaso. 2013. Stinkwort (*Dittrichia graveolens*) is rapidly expanding its range in California. California Agriculture 67(2):110-115.
13. DiTomaso, J.M. and B. Smith. 2013. Linking ecological principles to tools and strategies in an EBIPM program. Rangelands 34:30-34.
14. DiTomaso, J.M., J. N. Barney, J. J. Mann, G. B. Kyser. 2013. Switchgrass has a low potential risk of invasiveness in California from biofuel cultivation. California Agriculture 67:96-103.
15. Mann, J.J., G.B. Kyser, J.N. Barney, and J.M. DiTomaso. 2013. Assessment of above and belowground vegetative fragments as propagules in the bioenergy crops *Arundo donax* and *Miscanthus* × *giganteus*. BioEnergy Research 6:688-698.
16. Mann, J.J., J.N. Barney, G.B. Kyser, and J.M. DiTomaso. 2013. *Miscanthus* × *giganteus* and *Arundo donax* shoot and rhizome tolerance of extreme moisture stress. Global Climate Biology Bioenergy 5:693-700.
17. Mann, J.J., J.N. Barney, G.B. Kyser, and J.M. DiTomaso. 2013. Root system dynamics of *Miscanthus* × *giganteus* and *Panicum virgatum* in response to rainfed and irrigated conditions in California. BioEnergy Research 6:678-687.
18. Robison, R., N. Barve, C. Owens, G. Skurka Darin and J. M. DiTomaso. 2013. Mapping and modeling prioritization of red sesbania (*Sesbania punicea*) populations for eradication. Environmental Management 52:19-28.
19. DiTomaso, J.M. and 14 other authors. 2013. Weed Control in Natural Areas in the Western United States. UC Weed Research and Information Center, Davis, CA 544 pp.

Michael L. Deas

Watercourse Engineering, Inc.
424 Second Street, Suite B
Davis, CA 95616
(530) 750-3072
mike.deas@watercourseinc.com

EDUCATION

Doctor of Philosophy, 2000, University of California, Davis, Civil and Environmental Engineering
- Major: Environmental Fluid Mechanics
- Minor: Water Resources Planning and Management
- Dissertation: Application of Numerical Water Quality Models in Ecological Assessment

Master of Science, 1989, University of California, Davis, Civil and Environmental Engineering
- Major: Water Resources
- Thesis: Unconfined-confined groundwater modeling of perched aquifers

Bachelor of Science, 1986, University of California, Davis, Civil and Environmental Engineering

CURRENT POSITION

Principal, Watercourse Engineering, Inc.

BACKGROUND

Dr. Deas has extensive professional experience in the field of water quality monitoring, modeling, and analysis. His Ph.D. work focused on environmental fluid mechanics. He has taught water quantity and quality modeling courses at the University of California, Davis, and is a coauthor of a review of Central Valley water temperature modeling for the Bay Delta Modeling Forum As a consultant and researcher, he has continued to apply his education to a wide range of problems including surface flow, temperature, and water quality assessments; formulating conceptual models and identifying the interactions between aquatic system elements; developing and applying analytical tools as well as complex numerical models to evaluate flow and the fate and transport of physical and chemical constituents in aquatic systems; and providing technical presentations, both orally and in writing, for diverse audiences. He has participated in several peer review panels reviewing technical analyses associated with fisheries reintroduction, biological opinions, and Total Maximum Daily Load analyses. He has worked throughout Central and Northern California on reservoirs, rivers, and estuaries.

Recent projects that Dr. Deas has worked on include:

- Development and application of a spatially and temporally detailed study of the Klamath River basin. These numerical models represent flow and full water quality conditions for multiple years on sub-daily time steps (e.g., hourly) at small spatial scales (e.g., 100 to 400 meters). The various modeling elements cover over 250 miles of the Klamath River, and over 110 miles of the Trinity river, including several reservoirs.
- Development of logic for numerical/analytical modeling of organic matter, phytoplankton and benthic algae forms, pH and alkalinity representation, and topographic and riparian shading logic for temperature simulations. Such logic has been used in multiple model applications and studies.
- Development and application of an operations model (FORTRAN) representing the City of Santa Rosa's recycled water system, including reuse elements, treatment, storage, and disposal.
- Participated in and provided technical support for a multi-stakeholder Facilitated Process in the Mono Basin.

PROFESSIONAL EXPERIENCE

Principal, Watercourse Engineering, Inc., 2001-present.
Provided professional engineering services for water quantity and quality issues associated with river and reservoir systems. Typical tasks include system definition, monitoring (including development and implementation of Quality Assurance Project Plans), numerical model construction and/or application, and analysis of system response to alternative management conditions. Projects include:

- Basin-scale flow and water quality modeling for river and reservoir reaches in the Klamath River basin (PacifiCorp)
- Water quality modeling and monitoring of Keno Reservoir, Klamath River, OR (U.S. Bureau of Reclamation)
- Water temperature model of the upper Tuolumne River: O'Shaughnessy Dam to Early Intake. (City and County of San Francisco)
- Physical characterization of spatial and temporal variability of flow and temperature within thermal refugia for over-summering anadromous fishes on the Klamath River (U.S. Bureau of Reclamation in cooperation with the Yurok Tribe)
- Recreation of historic flow and water temperature conditions on the Upper Sacramento River: 1970 to 2001 (United States Geological Survey)
- Shasta River flow and temperature modeling to support Total Maximum Daily Loads (North Coast regional Water Quality Control Board)
- Water quality model application to assess eutrophication potential within the Crystal Springs Reservoir complex, reservoir water quality management plans (City of San Francisco for Merritt Smith Consulting)

Senior Engineer, Earth Science Associates, 1992-93.
Designed, constructed, tested, and applied a monthly operations model of the Los Angeles Department of Water and Power Mono Basin − Owens Valley Aqueduct System (Los Angeles Aqueduct Simulation Model). Implemented a long-term computer model maintenance program. Performed water supply analyses for various clients.

Consulting Engineer, Los Angeles Department of Water and Power - 1991, 1993.
Co-managed Mono Basin − Owens Valley computer modeling project. Formulated and implemented system operation model for Los Angeles' eastern Sierra Nevada water gathering facilities. Participated in a UCLA-Mono Basin public policy program mediation effort, and served on technical advisory committees for the State Water Resources Control Board (State Board) water rights re-issuance hearings for Los Angeles. Testified before the State Board concerning predictive computer models for the Mono Basin and Owens River Basin.

Assistant Engineer, Aqueduct Division, Los Angeles Department of Water and Power, 1989-90.
Revamped and expanded the Mono Basin computer model from a spreadsheet to a FORTRAN program capable of assessing a wide range of scenarios. Conducted various studies examining the impact of alternative operations and hydrologic conditions on Mono Lake surface elevations and water supply to Los Angeles. Reviewed water rights issues and made recommendations to legal staff.

REFEREED JOURNALS

Willis, A.D, A.L. Nichols, C.A. Jeffres, A.C. Fowler, C.A. Babcock, M.L. Deas. 2015. Seasonal aquatic macrophyte growth mediates stream temperature patterns in a northern California spring-fed river. *River Research and Applications*. In submission

Willis, A.D. A. M. Campbell, A.C. Fowler, C.A. Babcock, J.K. Howard, M.L. Deas, A.L. Nichols. 2015. Instream flows: new tools to quantify water quality conditions for returning adult Chinook salmon. *J Environ Eng-ASCE*. In submission.

Oliver, A.A., R.A. Dahlgren, M.L. Deas. 2014. “The upside-down river: Reservoirs, algal blooms, and tributaries affect temporal and spatial patterns in nitrogen and phosphorus in the Klamath River, USA.” *Journal of Hydrology.* 519, 164–176

Nichols, A.L., A.D. Willis, C.A. Jeffres and M.L. Deas. 2013. “Water Temperature Patterns Below Large Groundwater Springs: Management Implications for Coho Salmon in the Shasta River, California.” *River Research and Applications*. Wiley Online Library. DOI: 10.1002/rra.2655.

Null, S.E., J.H. Viers, M.L. Deas, S.K. Tanaka, J.F. Mount. 2013. Stream temperature sensitivity to climate warming in California’s Sierra Nevada: impacts to coldwater habitat. *Climate Change*. 116(1), pp 149-170.

Null, S.E., M.L. Deas, J.R. Lund. 2010. Flow and water temperature simulation for habitat restoration in the Shasta River, California. *River Research and Applications*, 26: 663-681. DOI: 10.1002/rra.1288.

McCullough, D.A., J.M. Bartholow, H.I. Jager, R.L. Beschta, E.F. Cheslak, M.L. Deas, J.L. Ebersole, J.S. Foott, S.L. Johnson, K.R. Marine, M.G. Mesa, J.H. Petersen, Y. Souchon, K.F. Tiffan, and W.A. Wurtsbaugh. 2009 “Research in Thermal Biology: Burning Questions for Coldwater Stream Fishes.” *Reviews in Fisheries Science*. 17(1):90-115.

Sutton, R.J., M.L. Deas, S.K. Tanaka, T. Soto, R.A. Corum. 2007. “Salmonid observations at a Klamath River thermal refuge under various hydrological and meteorological conditions.” *River Research and Applications*. 23: 775-785.

Registrations, Professional Societies, Affiliations

Registered Professional Civil Engineer, State of California (1990), #45624
Sigma Xi – Member
American Society of Civil Engineers, Member (ASCE)
American Water Resources Association (AWRA)
American Geophysical Union (AGU)
North American Lake Management Society (NALMS)
California Water and Environmental Modeling Forum – Steering Committee (CWEMF)
Yolo Basin Foundation – Board Member

Gerald H. Meral, Ph.D.

Gerald H. Meral received a bachelor's degree in Zoology from the University of Michigan in 1965 and a Ph.D. in Zoology (fish behavior and ecology) from the University of California, Berkeley, in 1973.

From 1971 to 1975 he served as staff scientist for the Environmental Defense Fund, where he worked as program manager of the Western States Water Program.

From 1975 to 1983, Meral was deputy director of the California Department of Water Resources. In this role he supervised the Energy and Water Development and Planning Programs, the Office of Water Conservation, and the Delta Planning Program.

Meral served on the Bay Delta Public Advisory Committee to the Bay Delta Authority, where he co-chaired the Water Supply and Conveyance Committee with Ron Jacobsma of the Friant Water Users. He was appointed by Interior Secretary Norton and Governor Davis.

From 1983 to 2003, he was Executive Director of the Planning and Conservation League (PCL is a statewide coalition of organizations and individuals who lobby for improved state environmental laws and regulations) and the PCL Foundation. He directed all development, long range planning and professional staff activities. Meral has overseen research and development that led to over $16 billion in new public funding for California environmental protection, including several billion dollars in water bonds. Water development and conservation was a major focus of his work at PCL.

From 2011 to 2014 he served as the Deputy Secretary of the California Natural Resources Agency of California, in charge of the Bay Delta Conservation Plan

He currently is the California Water Program Director of the Natural Heritage Institute.

He founded or co-founded Friends of the River, American Rivers, Tuolumne River Preservation Trust, Protect the American River Canyons, and Restore Hetch Hetchy.

Meral serves on the Board of Directors of the Environmental Action Committee of West Marin. He formerly served on the boards of the Berkeley Ecology Center, Tuolumne River Preservation Trust, Restore Hetch Hetchy, American Land Conservancy, Sustainable Conservation, the Sierra Fund, the Planning and Conservation League Foundation and the National Wildlife Federation. He serves on the advisory committees of the Four Pumps spending committee (responsible for spending money resulting from mitigating the effects of installing new State Water Project pumps in the South Delta), Sustainable Conservation and the Smith River Alliance.

A –Brief Description of Organizational History and Scope

NHI is a non-profit natural resources conservation organization incorporated under the laws of the State of California and tax exempt under Section 501(c)(3) of the Internal Revenue Code. Founded in 1989 by a multi-disciplinary group of experienced environmental professionals, NHI is specialized in rehabilitating heavily engineered river systems to restore their natural functions and protect the natural functions that support water-dependent ecosystems and the services they provide to sustain and enrich human life. Adapting river systems to the effects of climate change is a core element of most projects. NHI's vision is to recreate a world where rivers function like rivers again in harmony with human needs.

Since its inception 23 years ago, NHI has worked both domestically and at the global scale. Equipped with interdisciplinary expertise, NHI designs and then demonstrates restoration tools and techniques in local settings, usually at a river basin-wide scale, often in a transboundary context. We have done this work comprehensively in hydropower systems throughout the US, in irrigation and flood management systems in the Central Valley of California, in the bi-national river system that defines the U.S.-Mexican border, in the Okavango River system in southern Africa, and throughout continental Africa for the World Bank, to name a few examples (*see table below*).

B –Institutional Structure and Expertise

NHI is governed by a Board of Directors, which comprises seven exemplary people that are prominent experts in their fields, actively working on conservation and water resource management projects. They are affiliated with leading academic institutions and non-profit organizations, and many also provide regular guidance to government agencies. In addition, NHI also has an impressive team of affiliates who act as adjunct staff, and along with many of NHI's Directors, they are routinely deployed in NHI project teams and also play a role in developing new project activity. With this flexible and ever-expanding talent pool, NHI is never capacity limited in our undertakings. All affiliates and directors also have a professional home in major universities or consulting firms or other NGOS, but are engaged in NHI projects in their individual capacities, whenever possible, to avoid overhead expenses associated with institutional sub-contracts. Similarly, it has been NHI's working model since its inception to execute projects with diverse partnerships – NGOs and for-profit organizations, academic and research institutions and government agencies – to engage the highest quality expertise and achieve the project objectives in a pragmatic manner.

Current NHI Board Members (See http://www.n-h-i.org/about-nhi/board-staff.html for information about these board members.)

Gerald Galloway

David Harrison

Henry Vaux, Jr.

Daniel Peter Loucks

Peter Moyle

Desiree Tulos

C – Pertinent Work Experience, Approaches and Representative Accomplishments

As mentioned above, NHI works both domestically and at the global scale. NHI designs and then demonstrates restoration tools and techniques in local settings, usually at a river basin-wide scale, often in a transboundary context. These are "learning laboratories" strategically selected to illuminate successful models and replicable precedents. In typical projects, NHI will use the template it has developed over many years for illuminating feasible and practical water management innovations that can break through decades-long impasses among riparian nations. We employ a cascade of analytical screens that start with the creation of a water resources database and an associated advanced hydrologic simulation of the important physical processes in the entire basin. We then use this tool to evaluate the feasibility of a suite of stakeholder-generated scenarios for improving the management in stressed systems, particularly those opportunities that bridge across management units and jurisdictional boundaries. By feasibility, we mean both physical viability and the ability to provide mutual benefits to stakeholders throughout the system. These scenarios are developed in consultation with the full range of water managers and water users in all jurisdictions. The "winning scenarios" are then be subjected to an economic feasibility analysis, and, finally, a legal and political feasibility analysis.

NHI acts as both a representative of environmental interests and a counselor to the ultimate governmental or private sector custodians, managers and regulators of water resource assets. Somewhat uniquely, we operate both within and outside of the policy-making institutions. We typically bridge across institutional boundaries, often working in creative partnerships with other governmental and non-governmental organizations. Whereas these government agencies and the private resource custodians are often absorbed by urgent needs, NHI has the advantage of being able to take the longer view and illuminate the transformational solutions that loom beyond the conventional planning horizon.

For more information about NHI, visit our website at www.n-h-i.org.

THE NATURAL HERITAGE INSTITUTE
STATEMENT OF ACTIVITIES
FOR TWELVE MONTHs Ending DECEMBER 31, 2015

	Unrestricted	Temporarily Restricted	Total As of 12/31/15	Total As of 12/31/14
SUPPORT AND REVENUES				
Contributions and Grants	$ 209,564	$ 517,006	$ 726,570	$ 729,634
Interest and Dividends	$ 947		$ 947	$ 942
Other Income	$ 49,028		$ 49,028	$ 96,385
Net assets released from restrictions	$ 593,639	$ (593,639)	$ -	$ -
Total Support and Revenues	$ 853,178	$ (76,633)	$ 776,545	$ 826,961
EXPENSES				
Program services	$ 615,581	$ -	$ 615,581	$ 508,165
Management and general	$ 260,361	$ -	$ 260,361	$ 308,653
Fundraising	$ 344	$ -	$ 344	$ 2,226
Total Expenses	$ 876,286	$ -	$ 876,286	$ 819,044
INCREASE (DECREASE) IN NET ASSETS	$ (23,108)	$ (76,633)	$ (99,741)	$ 7,917
NET ASSETS				
Beginning Balance	$ 400,728	$ 214,622	$ 615,350	$ 607,433
Ending Balance	$ 377,620	$ 137,989	$ 515,609	$ 615,350

SHASTA VALLEY RESOURCE CONSERVATION DISTRICT

The Shasta Valley Resource Conservation District was formed in July of 1953 and reached its present boundaries in 1957. Under Division 9, Soil Conservation Districts were originally empowered to manage soil and water resources for conservation, but these powers were expanded in the early 1970s to include “related resources,” including fish and wildlife habitat.

The District is managed by five non-paid volunteer directors. Division 9 of the California Public Resources Code, Chapter 3, Article 7, Sections 9314 and 9316 recommends that the Board of Supervisors select appointments from an applicant’s list that are landowners within the district and have demonstrated interest in resource issues.

Today, the District’s Board consists of persons whose backgrounds vary from agriculture, academia, geology and environmental sciences. This diverse Board has given the District a capacity to better serve the diverse population within its boundaries as well as handle current resource issues.

The District is has an Associate Director program that will directly focus on stakeholder interests. Associate Directors are appointed to the RCD Board and must attend a required number of Board meetings each year. Associate Directors cannot vote on actions taken by the Board but their input will be critical for making sure all Board members fully understand the issues under discussion and how they might impact local stakeholders.

Until 2003 funding and project implementation was primarily managed by the Great Northern Corporation. In July 2003, this responsibility moved to the District and additional staff have been hired to accommodate the needs of carrying out conservation and restoration projects, in addition to financial management. Currently, the District manages 15 open funding contracts and employs 5 permanent staff members. In addition to permanent staff, the District also employs 2 temporary staff members and about 12 seasonal employees who work with the California Department of Fish and Game to run the Rotary Screw Trap operations in both the Shasta and Scott Rivers.

Please visit our website http://svrcd.org/wordpress for more information about our organization.

Current projects include a Tailwater Management program, development of designs to remediate 3 fish passage problem sites on the Shasta River, implementation of the Shasta River Coordinated Resource Management Plan, implementation of the Shasta River Stewardship program, and better management of the groundwater resources in the Shasta River Valley.

Our greatest challenge is in mobilizing the resources necessary to better manage the soil and water resources in our region.

Board of Directors

William H Hirt, Chairman

William H. Hirt has been a Board Director since March 2005 after having been involved with the organization for a little over a year. He has lived in Siskiyou County since August 1991, when he joined the faculty at College of the Siskiyous as the geology instructor. He learned about the RCD's work through conversations with another of its board members, and hopes to be able to draw upon his professional background to assist the district in addressing some of the geological and hydrological questions it deals with. He was re-elected Chairman of the Board in January 2015.

Chris Robertson became a board member for the Shasta Valley RCD in December 2011.He owns and works an agricultural property in the Shasta Valley. His family roots are from North Eastern California that now span six generations. As a youth Chris spent each summer working the family ranch in Modoc County. His grandfather taught resource conservation to his family as a way of life. He worked the farm and served as the president of the Soil Conservation District for decades. Chris says: “I have been watching resource issues unfold for decades in the Klamath Basin. I believe that conservation issues in Siskiyou County are being watched by a great many interested parties around the world, and understand the gravity of the work of the SVRCD. ” Prior to purchasing the farm in Montague, Chris worked in the information technology (IT) world in the San Fransicso Bay Area.

Ryan Walker has been a director since 2011. Ryan grew up on the JJJ Ranch along Bogus Creek where he assisted his parents in running a large sheep ranch. After attending Bogus Elementary School and Yreka High School, he went on to earn a bachelors degree from Stanford University and a law degree from Yale Law School. Along the way, he married his high school sweetheart Jennifer (Root) who grew up on her family’s ranch, which straddles the Shasta River just outside Grenada. After law school, Ryan practiced law in Los Angeles for 10 years. In 2005, Ryan and Jennifer returned to Siskiyou County with their two young sons where Ryan joined his father in operating the JJJ Ranch. Since he returned, Ryan and his father have greatly expanded the ranch and made the transition from raising sheep to raising commercial beef cattle. He currently serves as an active board member on the Bogus Elementary School District and the Upper Mid-Klamath Watershed Council. Ryan has a direct interest in the resource issues within the conservation district and a strong desire to see the present resource concerns in the district resolved in a way that will allow ranches like his own to be economically and environmentally sustainable into the next generation.

Rich Klug is our newest board member, appointed in January 2013. Rich works for Roseburg Forest Products as a wildlife biologist. He grew up in Maryland where he earned a BS in Wildlife Management from Frostburg State University before moving to California to work with Spotted Owls. While working for Simpson Timber in Arcata he earned a MS in Wildlife Management from Humboldt State and has worked in the woods ever since focusing mainly on rare and endangered species such as the Northern Spotted Owl and Pacific fisher. He serves on several other boards in Siskiyou County including the Siskiyou County Fish and Game Advisory Commission, the Rocky Mt. Elk Foundation and the Siskiyou Family YMCA. Rich is passionate about hunting, wildlife and will provide a valuable forest management perspective to our work.

Beth Sandahl was appointed to the board in January 2015. She is a fifth generation resident of Siskiyou County. Since 1864,Beth's family has been passionate about education, agriculture and conservation in our community. Beth graduated from Simpson College in 1989 with distinction and also holds a Masters of Science in Literacy and Reading. In addition to teaching first grade, she and her husband also own and operate one of the three remaining dairies in Siskiyou County.

Associate Directors: Stan Sears and Justin Sandahl. We are always looking for more associate directors who give the RCD input on many important issues, but do not vote.

Shasta River CRMP

NEWSLETTER

August 2014

Shasta Valley RCD

Board of Directors

Bill Hirt - Chair
Rich Klug
Ryan Walker
Mike Matherly
Chris Robertson

Associate Directors

Stan Sears
Kim Mattson
Kerry Mauro

RCD/CRMP Staff

Adriane Garayalde Executive Director
Kara Baylog South County Coordinator
Dave Webb CRMP Coordinator
Brenda Nystrom Finance Manager
Karen Mallory Business Manager
Tim Beck Construction Manager
Steve Hill Project Manager
Ayn Perry Project Manager
Ally Sherlock Monitoring
Tammy Sullivan Arboretum

DROUGHT 2014

Drought Resources

In recognition of the extreme drought, Siskiyou County has created an internet drought page.

Log into:

http://www.co.siskiyou.ca.us/content/drought-2014

For links of interest, local contacts for drought support, Federal assistance programs and results of the Agricultural Drought Survey.