Proposal to:

Central Valley Water Quality Control Board
ATTN: SEP/RWQIP Proposal
11020 Sun Center Drive #200
Rancho Cordova, CA 95670-6114
Fax: 916-464-4775

Submitting Organization:

The Regents of the University of California
Office of Research, Sponsored Programs
1850 Research Park Drive, Suite 300
University of California
Davis, California 95618

Title of Proposed Research:

Land cover effects on runoff and non-point source nitrogen export in residential areas of metropolitan Sacramento

Total Amount Requested:	**Proposed Duration:**	**Desired Starting Date:**
$128,562	9/1/2011	6/30/2013
Principal Investigator:	**Department:**	**Phone Number:**
James McConaghie (PI/Grad Student) Mary Cadenasso (Co-PI/Major Professor)	Plant Sciences	530-754-6151

Checks Made Payable to:

The Regents of the University of California

Send Checks to:

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

Send Award Notice to:

Office of Research
Sponsored Programs
1850 Research Park Drive
University of California
Davis, California 95618
(530) 754-7700 / FAX (530) 754-8229
vcresearch@ucdavis.edu

Approvals:

Principal Investigator 7-26-11 Date

Department Chair July 26/11 Date

Dean, College/School (if required) Date

Other Endorsement (optional) Date

Official Signing for Organization Date

SEP/RWQIP Proposal

Project Title: Land cover effects on runoff and non-point source nitrogen export in residential areas of metropolitan Sacramento
Geographic area of interest: Metropolitan Sacramento Area
Name of responsible entity: The Regents of the University of California
Estimated cost for project completion: $128,562
Contact information: Mary Cadenasso, mlcadenasso@ucdavis.edu; James McConaghie, jbmcconaghie@ucdavis.edu
Address: Office of Research, Sponsored Programs, 1850 Research Park Dr, Suite 300, Davis, CA 95618-6153
Phone: 530-754-7700 **email**: vcresearch@ucdavis.edu
Water Body, beneficial use and/or pollutant addressed by this project:
Nitrogen pollution in urban and suburban tributaries including Arcade Creek and Dry Creek, affecting the Natomas Canal, American River, Sacramento River, and Sacramento-San Joaquin Delta.

Project Overview

Urban development has fundamentally altered Sacramento's streams. Increases in impervious surface cover and stream channelization for flood control increases both the amount of runoff and intensity of storm flows in local streams. At the same time, these changes also increase the flux of nitrogen, an aquatic pollutant. Nitrogen levels in urban streams are elevated because of enhanced runoff, loss of nitrogen sinks in riparian zones, and by providing more sources of nitrogen such as fertilized lawns. Since most stream flows occur during the winter rainy season, sampling storm flows are key to identifying solutions to these issues.

We propose a storm water monitoring program to study how different urban land cover types contribute to increases of nitrogen pollution and water quantity in Sacramento streams. By urban land cover, we mean the relative distributions of buildings, pavement, bare soil, and woody and herbaceous vegetation. We will sample storm water flows and nitrogen levels in urban streams that drain small residential watersheds. We will select 5 watersheds that differ in the relative proportions of land cover types. This monitoring is necessary to identify hotspots for non-point sources of nitrogen as well as the location of water and nitrogen retention.

Our proposed research is unique for two reasons. First, there is no previous work in metro-Sacramento on how different urban land cover types contribute to nitrogen pollution. This contribution is important to understand in order to reduce impacts from urban growth; especially since urban growth in California is projected to be concentrated in Sacramento and the Central Valley. Second, the fine spatial scale, small watershed approach of our study matches the scale of neighborhoods and local management units. This would make the results immediately applicable to city or county-level water resources managers and other stakeholders. The research proposed in this SEP/RWQIP would directly benefit surface waters impacted by nitrogen pollution and urban runoff from non-point sources, and its results would benefit water quality and storm water management efforts, especially with respect to stream restoration or sustainable urban development.

We hereby affirm that:

The proposed project is not independently required of any discharger or proposed as mitigation to offset the impacts of a discharger's project(s).

The proposed SEP/RWQIP shall not directly benefit the State Water Board or Central Valley Water Board functions or staff.

Proposed Project

This project will take the form of original research conducted by a PhD candidate at the University of California, Davis. It is comprised of two parts. First, a storm water quality and quantity monitoring project to collect water samples, second, GIS and statistical analysis and statistical modeling of the data. The specific tasks include:

1. GIS analysis

We have identified 10 residential watersheds in the Metropolitan Sacramento area, using visual methods, which represent a variety of land cover types and intensities of urban development (Fig. 1). We will quantify land cover in each of these watersheds using a new classification for urban landscapes that we developed. This classification is called HERCULES (High Ecological Resolution Classification for Urban Landscape Ecological Studies, Cadenasso et al. 2007). HERCULES quantifies the amount of building cover, pavement, herbaceous vegetation (grasses and herbs), woody vegetation (trees and shrubs), and bare soil in each watershed. Watershed boundaries will be mapped using high-resolution LIDAR elevation data and the GIS ARC-Hydro tool kit (ESRI, Redlands, CA). These watershed boundaries are also adjusted to take into account the drainage infrastructure which may deliver water across topographic features. Based on the determination of land cover types and amounts, 5 of these watersheds that expose the greatest range of land cover types will be selected for monitoring storm water quantity and nitrogen export.

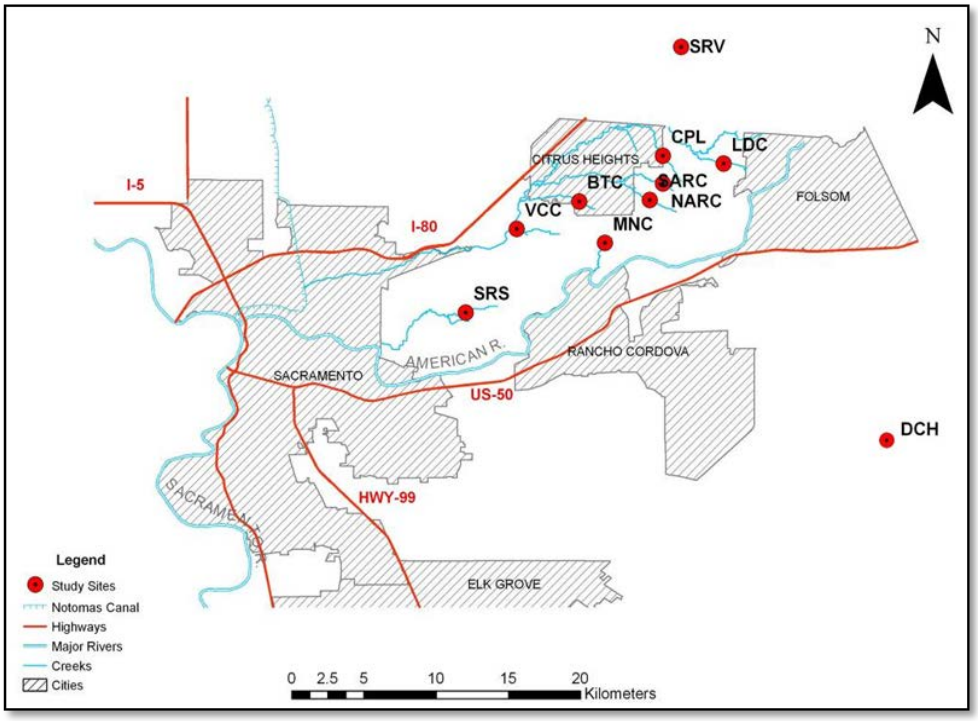


Figure 1.
The study area in metro-Sacramento includes urbanized portions of Sacramento County, and the cities of Citrus Heights, Roseville, and Rocklin. Potential storm water sampling locations, including 9 urban and 1 reference site, are shown. These sites are distributed through several urbanized tributaries of the American River including: Strong Ranch Slough (SRS), Verde Cruz Creek (VCC), Minnesota Creek (MNC), Brook Tree Creek (BTC), Arcade Creek (NARC and SARC), Cripple Creek (CPL), Linda Creek (LDC), and Secret Ravine Creek (SRV). A reference stream from a nearby undeveloped area at the Deer Creek Hills reserve (DCH) is included for baseline and comparison. Preliminary sampling of CPL, LDC, NARC, and SRS was conducted in winter of 2010 as proof of concept. The selected watersheds represent a range of land cover distribution from high density urban development to areas of low density development and high vegetation cover.

2. Monitoring

Storm water monitoring samples have previously been collected in 4 watersheds during the winter of 2010-2011. This preliminary work has established the procedures for the proposed study, but requires further funding for laboratory analyses of the samples. We propose to use the results from this preliminary study to implement a storm water monitoring program for winter 2011-2012. Auto-samplers will be deployed to 5 watersheds to sample storm flows throughout the winter. Data logging stations will be established at each of these sampling points which will record water level, stream flow, and water temperature. It is important to compare this data from 2 separate seasons to draw conclusions and account for variability in rainfall from year to year.

3. Data analysis

Water samples will be analyzed for nitrogen concentration -- total nitrogen (TN), NH_4-N, and NO_3-N -- using a spectrophotometer. Tracking each of these forms of nitrogen will help to elucidate possible sources of nitrogen and identify appropriate remediation actions. Water discharge and nitrogen concentration data will be used to calculate nitrogen flux, which is the amount leaving the watershed per unit time (kg/time), and nitrogen yield, which is the amount leaving each watershed per unit land area (kg/ha/time).

4. Statistical Analysis

Nitrogen and stream discharge response to differences in the amount and type of land covers will be analyzed using partial correlation methods and a mixed linear model. This statistical analysis will describe relationships between different proportions of the types of land cover and nitrogen or stream discharge levels in streams. These results will help us to understand how runoff is generated and what part of the landscape is affecting nitrogen levels in the streams. These results can also inform future changes in urban design or management which may reduce runoff and nitrogen pollution.

Cost:

The estimated total cost of the project is $128,562. The primary cost is $75,047 for two years of tuition and stipend for a PhD student who will implement the sampling and analysis. Monies for scientific equipment, consumables, and lab fees for collection and analysis of the samples and data have been included. The standard negotiated overhead rate (53.5% for FY2011-12; 54% for FY2012-13) for the University of California, Davis has been applied. We will be acting as a third party in submitting this SEP and responsible for project oversight and completion if selected by a discharger. Pursuant to Section H, Item 1 on the Policy on Supplemental Environmental Projects, no additional 10% estimate has been included in our budget to cover oversight costs.

Implementation:

Primary implementation of the project will be provided by James McConaghie, a PhD student in Urban and Landscape Ecology at the University of California, Davis. He currently holds a B.A. in Environmental Studies from Oberlin College, and an M.E.Sc. from the Yale University School of Forestry and Environmental Studies. He has previous experienced in water quality and ecological research. James has already begun development and implementation of research which would support this project as a part of his dissertation, including 3 years of water quality monitoring on the proposed watersheds and sampling of storm water for the winter of 2010-2011.

Upon approval of funds, James would prepare a storm water monitoring plan of water quality in selected watersheds for the winter of 2011-2012, and analysis of stored water samples for nitrogen compounds (collected winter 2010-2011). Analysis and statistical modeling of data would be undertaken in Spring of 2012. Final reports and write-up of the project would be concurrent with completion of his dissertation no later than Spring of 2013.

James is supervised by Dr. Mary Cadenasso, an Associate Professor in the Department of Plant Sciences. Mary is an urban ecosystem ecologist with over 10 years experience conducting urban watershed studies in Baltimore, MD, and Sacramento CA. Her lab on the UC Davis campus includes GIS facilities and analytical chemistry space and equipment which are all available to support the proposed research.

Deliverables:

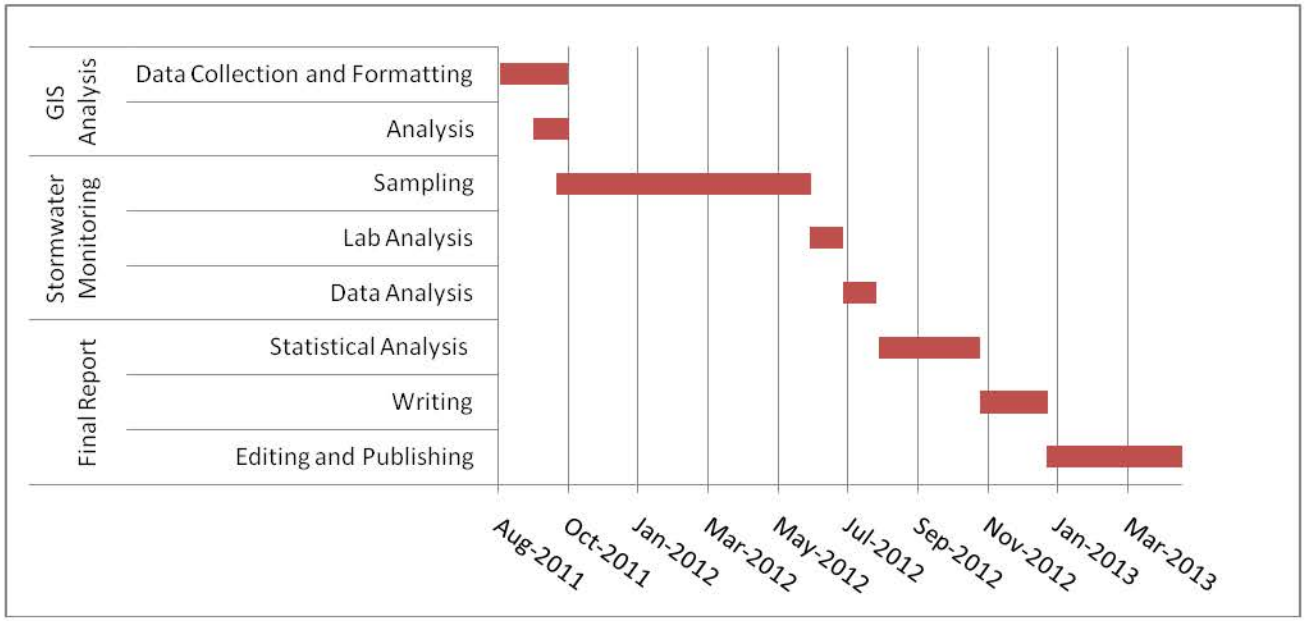
Within 30 days of issuance of the funding, provide a detailed copy of the monthly monitoring and storm water monitoring plan. Provide summary of data collected to support development of the project.

Each calendar quarter beginning upon approval of funding, and ending June 30, 2013, provide a report on the status of the project.

January 30, 2012. Provide a preliminary report including a data summary and analysis for the 2010-2011 storm water monitoring program.

June 30, 2012. Provide a preliminary report including data summary and analysis for the 2011-2012 storm water monitoring program.

January 2013. Provide a preliminary report on the results of analyzed data and statistical modeling.

July 31, 2013. Provide a final report on all findings in scientific format and the raw and summarized data from all storm water monitoring projects.

Project Gantt