111 Academy Way, Suite 150
Irvine, California 92617
Telephone: 949.752.5452

September 12, 2016

Central Valley Salinity Coalition
Attention: Daniel Cozad
dcozad@cvsalinity.org

Subject: Central Valley Salt and Nitrate Management Plan
Addendum to the Surveillance and Monitoring Program (SAMP)

Dear Mr. Cozad:

The Central Valley Salinity Alternatives for Long Term Sustainability (CV-SALTS) is in the process of developing a comprehensive regulatory and programmatic approach to the management of salt and nitrate in the Central Valley that is not only consistent with the State Recycled Water Policy (SRWP), but meets the broader goals of CV-SALTS to develop a workable, comprehensive plan to address salinity, including nitrates, throughout the region in a comprehensive, consistent, and sustainable manner. Among other things, the SRWP requires that development of the SNMP include the development of a Surveillance and Monitoring Program (SAMP); a basin/sub-basin wide monitoring plan that includes an appropriate network of monitoring locations.

CDM Smith entered into an Agreement for Professional Services with the San Joaquin Valley Drainage Authority (SJVDA) on March 18, 2015 to develop the Central Valley SAMP. The SAMP Agreement is under Agreement No. 11-123-555 between the SJVDA and the State Water Resources Control Board.

The scope of work for the SAMP was to develop the monitoring program using statistical tools at the Initial Analysis Zone (IAZ)-level of spatial resolution, in order to be consistent with other technical reports that, at the time, had been conducted at that scale. CDM Smith was also directed to use the CV-SALTS database[1] that was developed for use in other CV-SALTS studies. The CV-SALTS database categorized wells associated with a "shallow" aquifer zone; a "deep" aquifer zone; and unknown – where well construction information was not available. The definition of a shallow aquifer zone – developed as part of the Initial Conceptual Model – is the "…vertical distance [that] represents the distance that the water, at the water table, would travel downward or upward over a 20-year period."

[1] LWA and LSCE. 2014. Phase II Conceptual Model - Task 3: Groundwater Data Refinements and Updates. Memorandum from Dylan Boyle to Richard Meyerhoff. June 18, 2014.

Subsequent to the development of the SAMP Workplan, the CV-SALTS Executive Committee authorized new work to develop water quality characteristics for Central Valley groundwater basins/sub-basins, which provides a higher resolution of groundwater quality than provided by the use of IAZs. As part of this effort, CV-SALTS revised the CV-SALTS database with new definitions of aquifer zones: "Upper," "Lower," "Production," and unknown based on newly available well construction information. Dr. Thomas Harter's group at UC Davis has conducted further quality assurance/quality control (QA/QC) protocols on the data and have further refined the CV-SALTS database.

The Central Valley Water Board staff member participating on the SAMP Project Committee posed the following request in their comments on the draft SAMP report (dated April 29, 2016):

> *"Will it be much work to modify the SAMP to reflect the higher resolution groundwater data for basins and sub-basins instead of the IAZ scale? From using the Shallow and Deep Zones to Upper, Lower and Production Zones?"*

While it was recognized that the SAMP, as drafted, was consistent with the approved Workplan, the same request was made during the SAMP Project Committee conference call on May 3, 2016. The Project Committee decided that the draft SAMP report should be finalized addressing all of the other comments from the Project Committee and other stakeholders; however, CDM Smith was directed to prepare a scope of work and cost estimate to revise the SAMP analyses and develop new monitoring well networks at the groundwater basin / subbasin-scale and utilizing the refined CV-SALTS database. This would allow the most likely basis to be used to develop a draft implementing strategy that was coordinated with CV-SALTS nitrate and salinity permitting strategies. Further this effort would assist with the most accurate cost estimation which would be critical to being able to identify the economic impacts of this element of the CV-SALTS Basin Plan Amendment. In this scope of work, the SAMP report would not be modified, but the results of the new SAMP basin analyses would be published as an addendum with costs and incorporated into the Economics Report and Substitute Environmental Documents in preparation for the SNMP. The following sections of this memorandum provide a proposed scope of work, budget, and schedule to complete the SAMP addendum.

Scope of Work – SAMP Addendum

The following tasks are similar to work previously completed at the IAZ level and using the previous version of the CV-SALTS database. The same methodology will be repeated, but at the groundwater basin/sub-basin level and using the refined CV-SALTS database with implementation and costs provided.

Task 1. Power Analysis

Power analysis involves determining the sample size required to obtain a statistical result within a specified level of confidence, and thus one that effectively satisfies project-defined or representative objectives. It incorporates a cost/benefit analysis from the standpoint that results can be used to inform and assist with defining overall project goals. With regard to the SAMP

development, power analyses will be used in conjunction with bootstrap resampling to examine changes in uncertainty (levels of confidence) inherent in selecting various grid cell sizes and randomly selecting wells as monitoring points. The specific steps are as follows:

1. Assign grid number, fraction of the grid cell within a groundwater basin / subbasin, and basin number to updated database.
2. Select the grid cell size to evaluate, in sequence, beginning with the largest grid cell size (16 square mile grid) and ending with the smallest grid cell size (1 square mile grid).
3. Randomly select one well from each of the *n*-populated grid cells.
4. Calculate the mean value of the *n*-selected wells.
5. Repeat Steps 2-3 for *m* = 1000 random resamples with replacement (bootstrap samples).
6. Calculate the mean of the resamples and determine the lower and upper confidence limits (LCL and UCL) of the mean as the 2.5th and 97.5th percentiles, respectively.
7. Calculate the lower and upper margins of error as the mean minus the LCL and the UCL minus the mean, respectively; and the lower and upper percent margins of error as the margins of error divided by the mean times 100.
8. Repeat Steps 1-6 for the next grid cell size, until all 10 grid cell sizes have been evaluated.
9. Grid Size Selection using 15 percent upper margin of error (UME)

Task 2. Basin Statistics

The power analyses results will be evaluated in order to select appropriate grid cell sizes for each groundwater basin. Theoretically, as the grid cell size decreases, the number of populated grid cells increases and the variability (margin of error) decreases. Therefore, the number of wells to include in the monitoring network depends on selecting a set of grid cell sizes that results in a practical and consistent margin of error across all groundwater basins (to the extent possible given the data contained in the CV-SALTS database, the spatial distribution of wells with total dissolved solids (TDS) and nitrate data and the variability of the data). Average nitrate and TDS concentrations for each groundwater basins are independently calculated and compared to verify the validity of the power analyses results.

1. Calculate time-weighted well average for TDS and nitrate. Then calculate basin average TDS and nitrate in Upper, Lower, and Production Zones for each groundwater basin.
2. Determine the percentage of wells with TDS and nitrate concentrations that exceed the MCL and half the MCL in the Upper, Lower, and Production Zones of each groundwater basin.

3. The spatial distribution of wells varies widely from basin to basin and zone to zone. GIS tools will be used to identify data gap areas in the Upper, Lower and Production zones and select a grid cell(s) where an additional monitoring point is warranted.

Task 3. Select Monitoring Well Network

ESRI's ArcGIS ModelBuilder is a "visual programming language for building geoprocessing workflows." The workflow described below will be programmed into ModelBuilder and then ModelBuilder will be run to semi-randomly select wells for the revised SAMP monitoring network in the Upper, Lower, and Production Zones for each groundwater basin.

1. Assign land use to all grid sizes. (This subtask was already completed as a component of the original SAMP analyses and will not need to be repeated in the addendum analyses.)
2. Only use wells with nitrate and/or TDS data between 2003 and 2014.
3. Wells with an active status were preferentially selected over wells with inactive status.
4. Randomly select wells.
    a. Community water system (CWS) well preference for urban land use areas, CWS wells selected randomly.
    b. No other preferences for other land uses – random selection from any active well.
5. For unpopulated grid cells, assign an inactive well.
6. Assign water quality value (TDS and nitrate) to grid cell.
7. Compute area weighted concentrations (for cells that are not entirely contained within a groundwater basin).
8. Estimate area weighted concentrations for SAMP wells.
9. Selection verifications.

Task 4. Develop SAMP Addendum Report

A brief addendum will be developed, which will provide the context for the additional analyses, explain the procedures, and present the results of the additional analyses. The addendum will include all of the appropriate tables and maps, consistent with the existing SAMP Report. The addendum report will propose a likely scope and estimate costs for the implementation of the SAMP after the Basin Plan amendments adopted to implement the SNMP become effective. The addendum will also propose a methodology and process for coordinating the requirements and distributing the costs of the SAMP among participants in the implementation of the nitrate and salinity permitting strategies. This part of the addendum is critical to the most accurate

completion of the Economics study and Substitute Environmental Document. The budget includes time for coordination with the Project Committee.

Budget

The estimated cost to conduct Tasks 1 through 4 is summarized in Table 1 (attached), including a detailed breakdown of the estimated hours and costs for each task. The cost to redo the SAMP analyses, as described above, is $53,100.

Schedule

The work on the additional scope will begin upon approval of the proposed scope and budget. The technical work and draft Addendum Report should be completed in approximately two months from notice to proceed. A final Addendum Report will be provided within two weeks following completion of CV-SALTS review of draft materials.

The re-analysis of the SAMP on a groundwater basin / subbasin basis and using the updated CV-SALTS database is important to the implementation of the SNMP; however, this work can either be executed as part of the current economics study and published as the SAMP Addendum or as one of the preliminary tasks in the implementation of the SAMP. Please call or email if you have any questions.

Sincerely,

Joseph P LeClaire

Joseph P. LeClaire, PhD
Associate
CDM Smith Inc.

cc: Richard Meyerhoff, PhD | CDM Smith
Roger Reynolds, PE | Summers Engineering

Table 1
Cost Estimate and Work Breakdown Structure: SAMP Addendum

Task		Description	Labor							ODCs	Total Task Costs
			Associate	Grade 2 Scientist	Grade 3 Scientist	Word Processor	Outside Professional	Total Labor Hours	Total Labor Dollars		
1	Power Analysis		3	24			28	55	$6,495		$6,495
	1a	Data Preparation	1	8			8	17	$2,045		$2,045
	1b	Power Analyses	1				16	17	$1,685		$1,685
	1c	Grid Size Selection	1	16			4	21	$2,765		$2,765
2	Basin Statistics		3	76	8			87	$12,155		$12,155
	2a	Mean TDS & Nitrate in Upper/Lower/Production Zones	1	48				49	$6,725		$6,725
	2b	Percentage of Exceedances	1	20				21	$2,945		$2,945
	2c	Identify Data Gaps	1	8	8			17	$2,485		$2,485
3	Select Monitoring Well Network		2	20	40			62	$8,990		$8,990
	3a	Update ModelBuilder			20			20	$2,900		$2,900
	3b	Review Results	1	20				21	$2,945		$2,945
	3c	Deliverables	1		20			21	$3,145		$3,145
4	Develop SAMP Addendum Report		72	52		8		76	$25,460		$25,460
	4a	Cost Estimate and Permitting Strategy for SAMP Implementati	40	16					$11,960		$11,960
	4b	Draft Addendum Report	16	20		4		40	$7,020		$7,020
	4c	Final Addendum Report	16	16		4		36	$6,480		$6,480
		TOTAL COSTS	***80***	***172***	***48***	***8***	***28***	***280***	***$53,100***	***$ -***	***$ 53,100***