Memorandum

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SUBJECT: **Scope of Work and Budget for Requested "Extreme" Modeling Scenario**

On October 15, 2015, the Larry Walker Associates (LWA) Team presented preliminary findings for the CV-SALTS Preliminary Draft Salt and Nitrate Management Plan (SNMP) and the Alta Irrigation District (AID) Management Zone archetype analysis and modeling results to AID stakeholders. The Team presented several sections of the draft AID report, with particular emphasis on the modeling of the Short and Long-Term Strategies for Salt and Nitrate Management. During the meeting, the Team summarized the modeling scenarios which had been previously developed with stakeholder input, the modeling tools developed and applied to analyze the scenarios, and the preliminary scenario results. The stakeholders asked the Team many questions related to the model area, model development, scenario details, and the results.

The stakeholders made two key requests, including:

- A conference call for the Team to provide additional details on the Soil Water Assessment Tool (SWAT) modeling assumptions and scenarios; and
- A cost estimate for the Team to execute an additional salt and nitrate management scenario, referred to as the "Extreme No-Ag Scenario".

The SWAT conference call was held November 13, with John Dickey presenting additional information on the model development, nitrogen loading, and results for the baseline analysis and the scenarios. As requested, this letter provides a scope and budget for the Extreme No-Ag Scenario.

The preliminary concept for the Extreme No-Ag Scenario and the tasks to perform the work are summarized below.

Concept

Preliminary results for Salt and Nitrate Management Scenario 3 (see attachment) were presented on October 15. These results included preliminary nitrate and TDS concentrations in groundwater within the AID boundary in the Upper, Lower, and Production Zones for four snapshots in time, including 1, 25, 50 and 98 years. Although Scenario 3 includes a reduction in nitrogen loading, changed irrigation practices (80% drip) and new recharge projects, preliminary results indicated changes in nitrate and TDS concentrations in groundwater were generally minor, even when the 98 year snapshot was compared to the baseline condition. The ensuing stakeholder discussion of these preliminary results led to the question of whether and/or to what extent would the nitrate and TDS concentrations currently observed for the baseline change if in the extreme case the future scenario is "No Ag". The purpose of this modeling exercise is not to suggest that such a scenario would occur, rather the purpose is to test the extent nitrate and TDS concentrations might improve with the agricultural-related mass loading removed altogether as a "bookend" scenario. The results would also provide insights to the potentially long time frames over which the current (baseline nitrate and TDS) condition would persist in the hydrogeologic environment.

The parameters that tentatively form the basis for the Extreme No-Ag Scenario include:

- No agriculture land use within the AID boundary
- No applied water (i.e., all applied water for agricultural land uses would be removed)
- Native vegetation would replace irrigated ag commodities
- No surface water diversions and no groundwater pumping for areas that were previously shown as agricultural land use
- Urban land use would remain the same (current land use)
- Groundwater pumping would be for municipal supply only
- No dairy
- Only current artificial recharge projects (i.e., recharge projects included in the baseline but no new recharge projects)
- No new "climate scenarios" – the hydrology is based on the steady-state model period WY 1991-2000

Task 1: Confirm Design Basis for Extreme No-Ag Scenario

Prior to conducting the Extreme No-Ag Scenario, the scenario design will be discussed with the AID stakeholders, and/or AID stakeholder representatives, to confirm the design parameters. A conference call would be organized for this purpose. The results of the conference call would be summarized and distributed to the full stakeholder group.

Task 2: Loading Analysis with SWAT

A supplementary SWAT analysis, in which irrigated agriculture would be replaced with upland native shrub vegetation (without irrigation or fertilization) would be developed. Average annual water, salt, and nitrate surface loading to groundwater in the study area would be estimated for each cell in the model grid. Additional features (e.g., recharge projects), if and as

identified by stakeholders, would be added to these loads. The work efforts associated with this task include the following:

- Create and parameterize a native vegetation class (or classes) that is applicable to existing irrigated lands;
- Re-code irrigated lands to this (these) classes;
- Re-run model and post-processing for salinity loads;
- Post-process loads to add recharge and POTW loads;
- Review results in comparison with other scenarios and refine runs as needed;
- Potentially re-run to address needed refinements;
- Summarize and interpret data (tables, graphics, maps, written interpretation);
- Transmit to groundwater modelers for their use;
- Consult with groundwater modelers to coordinate analysis and presentations;
- Develop presentation materials;
- Present additional, extreme scenario;
- Revise draft report to incorporate and reflect additional scenario;
- Revise report based on input from reviewers; and
- Revise report again based on further input from reviewers.

Task 3: Groundwater Modeling

PlanTierra and Formation will provide the mass loading and deep percolation rates to LSCE for purposes of groundwater flow and transport modeling to simulate the Extreme No-Ag Scenario. The groundwater modeling task includes:

- Prepare the model recharge package using deep percolation values provided by PlanTierra/Formation (based on No-Ag Scenario)
- Prepare pumping package using reduced pumping based on No-Ag pumping (pumping will still exist for drinking water, urban landscaping, other residential drinking/landscaping purposes)
- Rerun baseline condition groundwater flow model with new flow regime
- Check calibration; adjust parameters as necessary (this may require extra effort due to the extreme nature of scenario)
- Perform water budget post processing for flow and mass flux components
- Perform transport modelling into the future with nitrate and TDS concentrations for 100 years
- Post process flow and transport results

Task 4: Incorporate Scenario Results in AID Report

Prepare description of the Extreme No-Ag Scenario for inclusion in the AID report, including the scenario design, methodology and results. The additional information will include nitrate and TDS maps for Upper/Lower/Production Zones; time series plots, bar charts, text and tables.

Budget

The estimated budget for the above tasks is summarized below. The total budget is estimated to be $52,030.

Task	LWA	LSCE	PlanTierra/Formation
Task 1: Confirm Design Basis for Extreme No-Ag Scenario	$1,215	$1,440	$860
Task 2: SWAT Tool Analysis	--	--	$16,380
Task 3: Groundwater Modeling	--	$22,065	--
Task 4: Incorporate Scenario Results in AID Report	$1,410	$6,480	$2,180
Sub-Total	**$2,625**	**$29,985**	**$19,420**
			Total $52,030

Schedule

The work would begin upon authorization to proceed by CV-SALTS. It is estimated the work described above, including incorporation of the new scenario results in the AID report, within two months following authorization.

CV-SALTS
Fee Proposal Estimate for "Extreme" Modeling Scenario

Task	Larry Walker			PlanTierra		Luhdorff & Scalmanini					Formation		Estimated Fee Proposal
	Karen Ashby	Danielle Moss		John Dickey		Vicki Kretsinger	Barb Dalgish	Dylan Boyle			Chaun-Shin Chong/ George Paul	Sub-Total	
	Principal	*Project Staff*		*Principal Scientist*		*Principal Hydrologist*	*Project Hydrogeologist*	*Staff Hydrogeologist*	Other Direct Costs	Sub-Total	*Associate Scientist 1*		
	$255	$150	Sub-Total	$215	Sub-Total	$195	$165	$125			$115		
Task 1. Confirm Design Basis for Extreme No-Ag Scenario			**$ 1,215**		**$ 860**					**$ 1,440**		**$ -**	**$ 3,515**
Discuss with the AID stakeholders, and/or AID stakeholder representatives, to confirm the design parameters.	3	3	$ 1,215	4	$ 860	4	4			$ 1,440		$ -	$ 3,515
Task 2. Loading Analysis with SWAT			**$ -**		**$ 2,580**					**$ -**		**$ 13,800**	**$ 16,380**
Create and parameterize a native vegetation class (or classes) that is applicable to existing irrigated lands;			$ -	1	$ 215					$ -	10	$ 1,150	$ 1,365
Re-code irrigated lands to this (these) classes;			$ -		$ -					$ -	5	$ 575	$ 575
Re-run model and post-processing for salinity loads;			$ -		$ -					$ -	30	$ 3,450	$ 3,450
Post-process loads to add recharge and POTW loads;			$ -		$ -					$ -	20	$ 2,300	$ 2,300
Review results in comparison with other scenarios and refine runs as needed;			$ -	1	$ 215					$ -	30	$ 3,450	$ 3,665
Potentially re-run to address needed refinements;			$ -		$ -					$ -	20	$ 2,300	$ 2,300
Summarize and interpret data (tables, graphics, maps, written interpretation);			$ -		$ -					$ -	5	$ 575	$ 575
Transmit to groundwater modelers for their use;			$ -	1	$ 215					$ -		$ -	$ 215
Consult with groundwater modelers to coordinate analysis and presentations;			$ -	1	$ 215					$ -		$ -	$ 215
Develop presentation materials;			$ -	1	$ 215					$ -		$ -	$ 215
Present additional, extreme scenario;			$ -	1	$ 215					$ -		$ -	$ 215
Revise draft report to incorporate and reflect additional scenario;			$ -	2	$ 430					$ -		$ -	$ 430
Revise report based on input from reviewers; and			$ -	2	$ 430					$ -		$ -	$ 430
Revise report again based on further input from reviewers			$ -	2	$ 430					$ -		$ -	$ 430
Task 3. Groundwater Modeling			**$ -**		**$ -**					**$ 22,065**		**$ -**	**$ 22,065**
Prepare the model recharge package using deep percolation values provided by PlanTierra/Formation (based on No-Ag Scenario)			$ -		$ -		6			$ 990		$ -	$ 990

CV-SALTS
Fee Proposal Estimate for "Extreme" Modeling Scenario

Task	Larry Walker			PlanTierra		Luhdorff & Scalmanini					Formation		Estimated Fee Proposal
	Karen Ashby	Danielle Moss		John Dickey		Vicki Kretsinger	Barb Dalgish	Dylan Boyle			Chaun-Shin Chong/ George Paul	Sub-Total	
	Principal	*Project Staff*		*Principal Scientist*		*Principal Hydrologist*	*Project Hydrogeologist*	*Staff Hydrogeologist*	Other Direct Costs	Sub-Total	*Associate Scientist 1*		
	$255	$150	Sub-Total	$215	Sub-Total	$195	$165	$125			$115		
Prepare pumping package using reduced pumping based on No-Ag pumping (pumping will still exist for drinking water, urban landscaping, other residential drinking/landscaping purposes)			$ -		$ -		16			$ 2,640		$ -	$ 2,640
Rerun baseline condition groundwater flow model with new flow regime			$ -		$ -		3			$ 495		$ -	$ 495
Check calibration; adjust parameters as necessary (this may require extra effort due to the extreme nature of scenario)			$ -		$ -	1	40			$ 6,795		$ -	$ 6,795
Perform water budget post processing for flow and mass flux components			$ -		$ -		8			$ 1,320		$ -	$ 1,320
Perform transport modelling into the future with nitrate and TDS concentrations for 100 years			$ -		$ -	1	16			$ 2,835		$ -	$ 2,835
Post process flow and transport results			$ -		$ -	2	40			$ 6,990		$ -	$ 6,990
Task 4. Incorporate Scenario Results in AID Report as an Appendix			**$ 1,410**		**$ 1,720**					**$ 6,480**		**$ 460**	**$ 10,070**
Prepare description of the Extreme No-Ag Scenario for inclusion in the AID report.	2	6	$ 1,410	8	$ 1,720	8	16	18	$ 30	$ 6,480	4	$ 460	$ 10,070
	5	**9**	**$ 2,625**	**24**	**$ 5,160**	**16**	**149**	**18**	**$ 30**	**$ 29,985**	**124**	**$ 14,260**	**$ 52,030**