MEMO

PLANTIERRA

From: *John Dickey/PlanTierra*

To: *File*

Date: ***October 17, 2011***

Subject: ***Conceptual Modeling of Salt and Nutrient Loads***

At the Technical Advisory Committee meeting on September 29, 2011, I suggested an alternative to a non-spatial (or grossly-spatial) spreadsheet model of salt and nutrient balance as an Initial Study to define salt and nitrate sources and loads in a given Study area. The purpose of this memo is to summarize that suggestion in writing so that it may be fully considered by the Knowledge Gained committee.

The initial method for developing salt and nutrient loads for CV Salts should meet several criteria, including the following:

1. Employ readily available, existing data so that new or challenging data procurement and/or collection effort does not become an impediment.
2. Employ tools that are widely available so that they can be used by diverse, yet technically proficient groups.
3. Be sufficiently detailed and explicit to provide an accurate first cut at the size, intensity, nature, and location of sources, and therefore be readily checked by inspection and critical analysis with alternative tools.
4. Employ software that lends itself to structured, documented, repeatable analyses.
5. Provide a jump-start for more detailed analyses that might follow by providing data in formats that are needed by more sophisticated, mechanistic analytical tools. This is not only efficient; it breeds consistency and comparability among analyses. Inputs might be refined and enriched to provide mechanistic model inputs, but most of the load characterization needed as input to these models would be complete.
6. To the extent possible, methods should be informed by experience in other watersheds, including those developing salt and nutrient management plans in California.

The GIS-based approach I described, like the spreadsheet model, requires an inventory of sources, but employs land-use data, documented information regarding land management (irrigation, nutrient and salt loads), and waste loads (land application or discharge of salt and nutrient loads). The main difference is that instead of a list of loads associated with a geographic subarea, one begins with a much more detailed map from a QC'd data source, classified into a broadly recognized set of land uses. For example, the California Department of Water Resources maps land use every few years in field-by-field detail, with each individual field placed into one of a couple of hundred land use classes. Counties often do the same sort of mapping. Land use classes can be readily consolidated into groups that, from the standpoint of salt and nutrient management, are similar. The detail is not a detriment, since mapping exists in database format, and can be summarized into broader units by means of database or GIS queries.

Where a single data source proves inadequate, others may be employed. Two examples are wastewater discharges and animal waste loads. Both are documented by the Regional Boards in the form of permit documents, and have comparable spatial attributes that facilitate their incorporation into a GIS-based approach. These data contain far more detailed information regarding these important sources than DWR and county-level land use data, and thus are an ideal complement.

Parameters (hydraulic, salt, and nutrient loads, rates of uptake and other losses) can be developed for each land use class, and applied by means of queries. Water, salt, and nutrient balances can equally be performed by calculations in these queries. Since the data are both spatial and in database format, the means by which results are obtained are documented in the tables, queries, and GIS layers.

The finished product can be developed in a number of ways, but generally has the following components:

- Land use and other waste load geospatial data (a map)
- Classification of land use and waste loads (a legend for the map)
- Loading parameters (hydraulic, salt, and nutrient input-output quantities for the classes in the legend)
- Queries that produce water, salt, and nutrient balance results for areas of interest (calculations)
- Reports that summarize input data and query results (tables and figures, summary or otherwise, according to needs)

The GIS-based approach meets all of the listed criteria, and is superior in most respects to spreadsheet models of salt and nutrient loading. The major drawback of the GIS-based approach is that, like spreadsheet models, it lacks a priori peer review and does not incorporate sophisticated or spatial modeling transport and transformation processes that are available in mechanistic models.

Thus, at a minimum, GIS-based approaches should be considered an equal alternative to those depending on calculations mostly done in spreadsheets or workbooks containing spreadsheets. I recommend that GIS-based approaches be considered in preference to the use of any spreadsheet model due to their superiority, as follows (numbered according to the criteria listed above):

1. DWR land use, water quality permit, irrigation, fertilization, irrigation water quality, estimated fate and transport, and other salt load (e.g., gypsum application) data are generally available.
2. GIS software and capable practitioners are widely available, employed by all major agencies and counties in Region 5.
3. Field-by-field, permit-by-permit information (for major permits and dairies) is quite detailed, but readily summarized in a GIS database.
4. GIS is a database format, employing documented tables of data and explicit queries and reports that any capable practitioner can review and duplicate.
5. GIS source inventories exactly like those described above are available for Region 5, having been developed as mechanistic model inputs for the Drinking Water Policy Working Group effort.
6. GIS-based conceptual models have been developed for areas of the Central Valley and the North Bay for this exact purpose.

Even if spreadsheet models are used, mechanistic models will eventually require that geospatial inputs be developed. Where the information and capability exists, why not begin by organizing load data linked to readily available geographic information, since this provides a more robust conceptual model? When/if mechanistic tools are used, the conceptual analysis can be employed directly as model input, so that the conceptual and detailed analyses will be more consistent with conceptual work, less costly, and more rapid.

In the event that a spreadsheet model is employed, the limitations imposed by the lack of geographic context should be stated clearly, and the resulting uncertainty recognized explicitly. If the spreadsheet model is used to develop a sub-basin salt and water budget, the inputs should be documented in such a way that they can be related to spatial elements in later analytical steps. Given the drawbacks of the spreadsheet approach, its application (if any) should be limited to high-level, sub-basin summaries. But again, these would be more robust in the first place if produced as roll-up summaries of the GIS-based analysis described previously, or of mechanistic modeling that employs GIS-based inputs.