

## Attachment III Scope of Work

### TASK 1 Inventory of Groundwater Models Technical Memorandum

RMC, in consultation with the Technical Collaborators, will develop an inventory of groundwater models in the NSVIRWM region. The inventory will include the following models: C2VSim, CVHM, SacFEM2013, BBGM, and Stony Creek Fan groundwater model. Based on our initial review and assessment of models in the area, there are no other water resources and hydrologic models that would be of relevance to this project in the project area. One consideration that can be brought to the Technical Collaborators is the two versions of C2VSim; the coarse grid version (C2VSim-CG) and the fine grid version (C2VSim-FG). At the discretion of the Technical Collaborators, RMC will inventory either or both versions, as needed.

The model inventory will include information on model characteristics, agencies responsible for development and use of the model, and a summary of how the models are used. The inventory will include narrative descriptions of each model application as well as comparison tables that allow for rapid evaluation of model features and capabilities. The following table shows an initial list of features relevant to the project that need to be addressed for each model. RMC will refine this feature list based on feedback from the Technical Collaborators during the execution of Task 1.

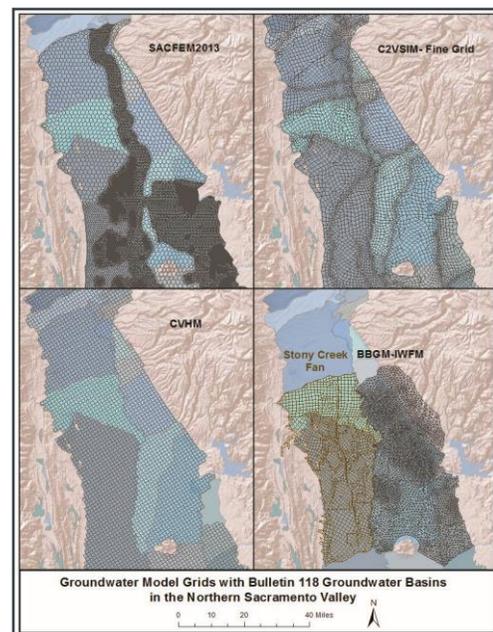
A map showing the spatial coverage and resolution of models in the NSVIRWM region will be included in the deliverable for this task. A preliminary version of this map is shown to the right; this map will be refined based on results of the Task 1 inventory process and feedback from the Technical Collaborators.

Task 1 will include one two-hour meeting with the Technical Collaborators. RMC's technical facilitator will attend this meeting prepared to lead a discussion based on initial findings by the RMC team related to the model inventory (e.g., maps of known model domains, initial documentation of key features) and ready to solicit feedback from the Technical Collaborators on additional models, important considerations for the inventory process, and any other feedback that will help to successfully meet the goals of this task and the overall project.

RMC's facilitator will also establish goals for the rest of the Technical Collaborator meeting process, so that members of the group know their responsibilities and the overall goal of the project. RMC's facilitator will document feedback received during the meeting and will work with RMC modeling team members to incorporate that feedback into a final Inventory of Groundwater Models Technical Memorandum.

#### Task 1 Deliverables

- Initial Draft Inventory of Groundwater Models Technical Memorandum (delivered electronically)



- Facilitation for Technical Collaborators Meeting #1 (assume two-hour meeting)
- Summary Notes for Technical Collaborators Meeting #1
- Final Inventory of Groundwater Models Technical Memorandum # 1 (electronic and hard copy)

Key Feature	BBGM	C2VSim	CVHM	SCF Model	SacFEM2013
Code Platform	IWFM	IWFM	MODFLOW-FMP	IGSM	MicroFEM coupled with IDC
Public Domain Code	Yes	Yes	Yes	Yes	MicroFEM is proprietary
Model Ownership	Butte County	DWR	USGS	DWR	Reclamation
RMC Project Experience	No	Original developers of CVGSM; currently under contract with DWR to upgrade FG version	Yes	Yes	Yes- Prior version
Documentation	Butte County Web site	DWR Web site	USGS Web site	Upon request to DWR	Available on the Web
Integrated Model	Yes	Yes	Yes	Yes	Partial
Geographic Area	Groundwater Subbasins in vicinity of Butte County	California's Central Valley	California's Central Valley	Corning Subbasin and northern Colusa Subbasin	Sacramento Valley Groundwater Basin
Period of Record	1970 - 1999	1921 - 2009	1961 - 2003	1970 - 2000	1970 - 2010
No. of Layers	Nine	Three	Ten	Four	Seven
Geologic Formations represented in the model	Holocene basin deposits, Alluvium, Sutter/Laguna Fmt., Tehama Fmt., Tuscan C/B/A Fmts., older marine (Neroly, Upper Princeton Gorge, Ione)	Generalized upper unconfined aquifer, confined production zone, deep confined zone	None specifically except for Corcoran Clay in the San Joaquin Valley; remainder based on sediment texture model	Alluvial and basin deposits, Tehama, Upper Tuscan, and Lower Tuscan formations	Layers not explicitly tied to hydrogeologic units except for portions of the Tuscan formation
Ag Demand Estimation Method	IDC (Integrated)	IDC (Integrated)	Farm Process (Integrated)	IGSM Ag Demand Package (Integrated)	IDC (external)
Stream-Aquifer Interaction Method	IWFM Stream package (Integrated)	IWFM Stream package (Integrated)	MODFLOW Streamflow routing package (Integrated)	IGSM Stream package (Integrated)	Limited; fixed head boundary condition for river stages

**Note:** Descriptions in this table may not reflect ongoing, unpublished updates to these models. Descriptions to be refined based on input from the Technical Collaborators

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### TASK 2 Interbasin Groundwater Flow Evaluation Report

Task 2 extends the inventory of models developed in Task 1, documenting specific analysis and results from the inventoried models. Subtasks described below culminate in the *Interbasin Groundwater Flow Evaluation Report*, which will address questions such as:

- Which (if any) of the existing tools are most suitable and reliable for determination of interbasin flows for the purposes of SGMA compliance? If no existing tools are suitable in their current state, what specific modifications to existing tools would be required for proper and reliable determination of interbasin flows, or what are recommendations for entirely new tools?
- In addition to interbasin flows, how can the existing or recommended model(s) be used to evaluate the undesirable results identified in the SGMA?

#### SUBTASK 2.1 Evaluation of Regional Models for their Applicability to Calculating Interbasin Flows in the Northern Sacramento Valley

Regional models (C2VSim-CG and C2VSim-FG, CVHM, and SacFEM2013) in the context of the NSVIRWM region are those whose domains generally include the majority the Sacramento Valley

RFP Questions	Additional Related Questions
How do the models compare in their conceptual model for the region and groundwater flows between subbasins?	<ul style="list-style-type: none"> <li>• A brief description of the conceptual model for each model will be documented, such as platforms for each model in representing the physical system in Northern Sacramento Valley, conceptual hydrogeology, hydrologic condition, physical features included in each model, major physical features that are not included.</li> </ul>
How does each model quantify the interconnectedness of adjoining subbasins?	<ul style="list-style-type: none"> <li>• Are existing water budget tools (e.g., Z-Budget and/or ZoneBudget) sufficient to generate the information required for SGMA? If not, what improvements are required?</li> </ul>
What updates to the models would increase confidence in their interbasin flow estimates?	<ul style="list-style-type: none"> <li>• How could boundary condition implementation be improved or enhanced?</li> <li>• Would increased resolution of land and water use processes (e.g., surface water deliveries) significantly improve a model's usefulness for interbasin flow analysis</li> </ul>
Could the models be used to evaluate impacts of 'undesirable results'?	<ul style="list-style-type: none"> <li>• What are the simulation capabilities of the code (e.g., to explicitly account for water quality or subsidence)?</li> <li>• How can models without the ability to explicitly simulate a process (e.g., subsidence) still be used to help evaluate the potential for those processes?</li> </ul>
Does it matter if a model is in the public domain or proprietary?	<ul style="list-style-type: none"> <li>• What are the GSP regulations software requirements (draft regulations do not allow proprietary models)?</li> <li>• How will members of the public be enabled to evaluate models developed with proprietary software?</li> </ul>

When considering all modeling efforts, what data gaps exist?

- What common datasets should be developed or hosted for the benefit of all model users/applications in a study area?

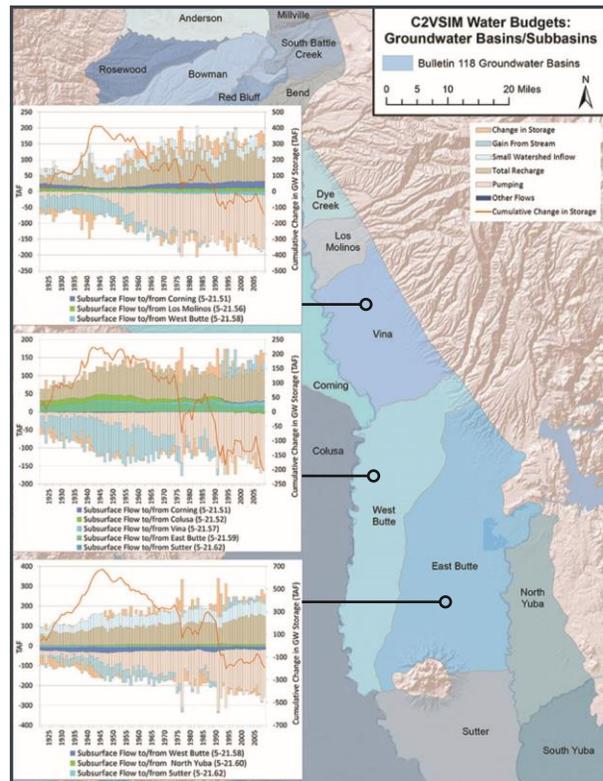
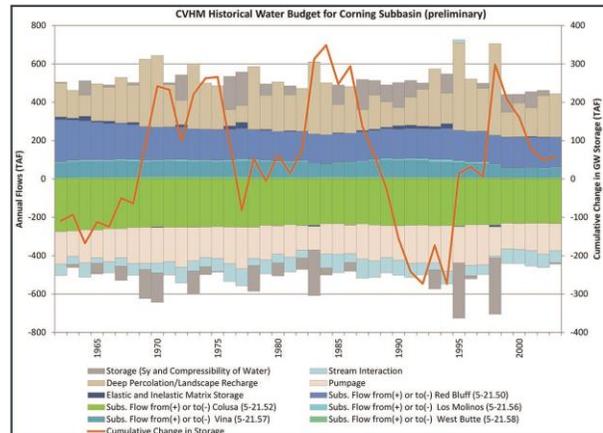
Groundwater Basin, if not the entire Central Valley (including the San Joaquin Valley Groundwater Basin). Developers for each regional model being considered will be represented in the Technical Collaborators group. RMC’s role at the Technical Collaborators meeting will be to foster meaningful discussion for the purpose of answering the following questions:

RMC will perform a water budget analysis using model outputs from each regional model. If the regional model has a baseline and/or future conditions scenario, then budgets for those scenarios will also be prepared. The budget analysis will include evaluation of annual (historical and projected, if available) and the historical average monthly groundwater flows between adjacent subbasins. The budget analysis will also include development of land and water use budgets for the subbasins, which drive groundwater fluxes.

Development of subbasin-specific water budgets from existing regional models will allow for comparison of flows between regions/subbasins and between different regional and local models. The format and data sets shown on these groundwater budget presentations will be modified based on feedback from the Technical Collaborators and included in the final project report.

Finally, this Subtask will include a non-modeling analysis for interbasin flows based on observed data. RMC will select a boundary line between two subbasins to evaluate using groundwater level data available from local agencies and/or DWR. This evaluation will help to constrain the magnitudes and directions of flow using basic hydrogeologic principles, and can serve as a template for the types of analysis that others throughout California can use to evaluate flows in the absence of a model.

Upon completion of major parts of this Subtask (i.e., after development of water budgets for each subbasin in the study area), RMC will facilitate one two-hour meeting with the Technical Collaborators to focus on evaluation of the regional models and their applicability to interbasin flow quantification. Discussion results, comments, and recommendations from this meeting will be



Upon completion of major parts of this Subtask (i.e., after development of water budgets for each subbasin in the study area), RMC will facilitate one two-hour meeting with the Technical Collaborators to focus on evaluation of the regional models and their applicability to interbasin flow quantification. Discussion results, comments, and recommendations from this meeting will be

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documented in meeting summary notes and will be incorporated in completing the work for this Task.

### Subtask 2.1 Deliverables

- Facilitation for Technical Collaborators Meeting #2 (assume two-hour meeting)
- Summary Notes for Technical Collaborators Meeting #2

### SUBTASK 2.2 Evaluation of Local Models for their Applicability to Calculating Interbasin Flows in the Northern Sacramento Valley

Local models (Stony Creek Fan groundwater model, BBGM) in the context of the NSVIRWM region are those whose domains generally include only a subset of the Sacramento Valley Groundwater Basin. The boundaries of these models generally do not extend to all natural hydraulic or hydrologic boundaries of the basin. Developers for the Stony Creek Fan groundwater model and BBGM will be represented in the Technical Collaborators group; to the extent possible, developers for other local models identified through Task 1 should be invited to the Technical Collaborators meeting, but that coordination will be the responsibility of Butte County staff. RMC's role will be to foster meaningful discussion for the purpose of answering the following questions:

RFP Questions	Additional Related Questions
Do the localized models adequately address interconnection to adjoining subbasins?	How will discrepancies between other local or regional models be addressed?
How do they compare to the regional options?	Is the typically increased resolution of grid and land and water use representations, as well as the associated accuracy of model outputs merit the cost for local agencies developing their own models?  Which processes or geographic areas simulated in local models are not included in the regional models? Should they be added to the regional models?
Are there advantages to their continued use?	Can the local agencies rely on available regional models developed and maintained by others?  Will the developing entities be responsive to local modeling needs?
What data sets do they contain that would be of value to a regional scale approach?	How can these datasets most effectively be incorporated and updated in an ongoing manner into regional models?
What data gaps or format modifications are needed to utilize their data on a regional scale?	Are some of the local data, such as detailed land use, irrigation methodology, local geologic information, and municipal wells, needed in much of the regional models so they can better represent the local areas?
How could a regional tool for interbasin flow improve the localized model?	Can the regional tools provide regional context, such as boundary flows and stresses on the groundwater system

that are outside of the local model boundaries, but affect the groundwater system within the local model area?

Upon completion of major parts of this Subtask (e.g., development of water budget information from local models), RMC will facilitate one two-hour meeting with the Technical Collaborators to focus on evaluation of the local models and their applicability to interbasin flow quantification, and their strengths and weaknesses and relationships with the regional models. Discussion results, comments, and recommendations from this meeting will be documented in meeting summary notes, and will be incorporated in completing the work for this Task.

#### **Subtask 2.2 Deliverables**

- Facilitation for Technical Collaborators Meeting #3 (assume two-hour meeting)
- Summary Notes for Technical Collaborators Meeting #3

#### **Subtask 2.3 Interbasin Groundwater Flow Evaluation Report**

RMC will synthesize information developed during the prior Technical Collaborators meetings and subtasks into a report entitled the *Interbasin Groundwater Flow Evaluation*. The report will address the following key points identified in the RFP:

- Recommend tools or approaches to be developed for the project study area (NSVIRWM region) to address interbasin issues and assessment of ‘undesirable results’;
- Describe the role that existing localized models may continue to have in relation to a regional scale tool; and
- Provide a summary of take home messages and lessons learned from the process. In doing so, other regions can utilize the outcome of this project to develop their own process. Some of the lessons learned will include how to choose an acceptable group of technical experts, reaching agreement on acceptable datasets, how to reach agreement on technical issues and how to account for technical disagreements.

RMC will facilitate an additional 2 two-hour meetings with the Technical Collaborators during development of the report as well as provide a presentation to the NSVIRWM Board. The purpose of these meetings will be to solicit feedback and obtain buy-in for the conclusions and recommendations presented in the report.

#### **Subtask 2.3 Deliverables**

- Facilitation for Technical Collaborators Meetings #3 and #4 (assume two hours for each meeting)
- Summary Notes for Technical Collaborators Meetings #3 and #4
- Draft *Interbasin Groundwater Flow Evaluation* Report (delivered electronically)
- Final *Interbasin Groundwater Flow Evaluation* Report (electronic and hard copy)
- Presentation to the NSVIRWM Board

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### **TASK 3 Project Management/Administration**

RMC’s project manager will provide project oversight and contract management. The project manager will be expedient in contract processing, invoicing, client communications, and will

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oversee preparation and review of all contract deliverables. Butte County has outlined general timelines associated with this project in the RFP. A detailed project schedule is shown below.

### **Task 3 Deliverables**

- Submission of invoices every other month

# EXHIBIT A SCHEDULE

