MEMORANDUM

TO: Programs, Projects, and Operations Subcommittee

FROM: Philip Paitz, Groundwater Management Engineer

SUBJECT: Contract with JEO Consulting Group for Groundwater Modeling

DATE: August 2, 2023

On Wednesday July 19, 2023, the Lower Platte River Basin Sub-Regional Groundwater Modeling Interlocal group comprised of the Papio-Missouri River NRD (Papio NRD), Lower Platte North NRD (LPN NRD), Lower Platte South NRD (LPS NRD), and the Nebraska Department of Natural Resources (NeDNR) interviewed and selected JEO Consulting group with which to negotiate a professional services contract for the design and construction of a numerical MODFLOW model (see attached Scope of Work). This MODFLOW model will cover the areal extent of Papio NRD, LPN NRD, and LPS NRD. The end product of this work will be a working groundwater model that utilizes previously collected information such as AEM, historic groundwater levels, and surface water flow that will aid in answering managerial questions that the collective NRDs and State have currently and may have in the future as development continues to occur.

A summary of the tasks for the planning contract are:

- Project Management and Coordination
- Building Hydrogeology Framework of the Groundwater Model
- Development of Refined Watershed Model from New and Updated Regional Watershed Model of the Lower Platte Missouri Tributaries Model
- Integrating Watershed Model Estimated Recharge and Pumping into Groundwater Model and Couple Groundwater Model with Adjacent Model and Parent LPMT Regional Model
- Model Calibration
- Model Documentation
- Model Use Training
- Quality Control (QA/QC) Review

A proposed detailed contract with a scope of work and cost estimate are attached. JEO would provide the professional services for the Sub-Regional Groundwater Model design and construction on a Task basis that will not exceed a total of $612,823.60. The Lower Platte River Basin Sub-Regional Groundwater Modeling Interlocal group has been awarded a WSF grant for $250,000. The interlocal is responsible for the remaining $362,823.60 balance. Each NRD is responsible for $63,024.03 of that balance and NeDNR is responsible for $173,751.51.

Management recommends that the Subcommittee recommend to the Board that the General Manager be authorized to execute a Professional Services Agreement with JEO Consulting for the Lower Platte River Basin Sub-Regional Groundwater Modeling project, in an amount not to exceed $612,823.60, subject to changes deemed necessary by the General Manager and approval as to form by District Legal Counsel

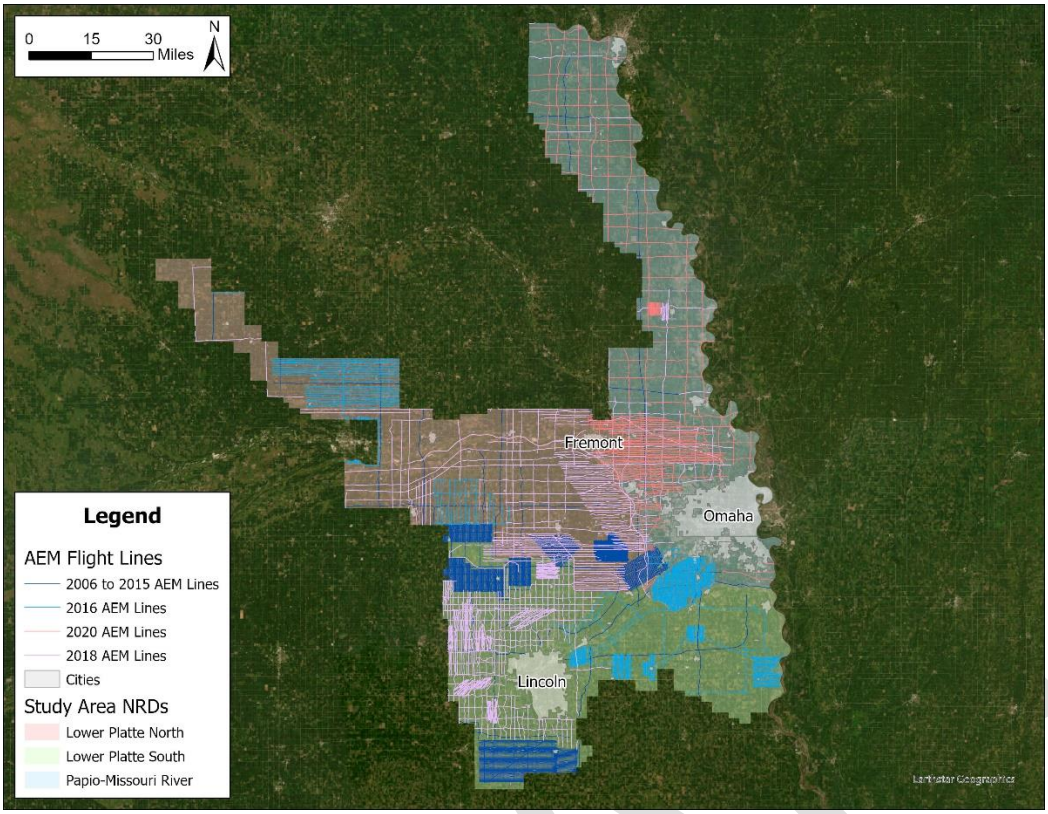
Exhibit A: Scope of Work

Lower Platte River Basin Sub-Regional Groundwater Modeling
JEO Project Number: 221004.00
Date Revised: August 02, 2023

PROJECT OVERVIEW

Through collaboration of three Natural Resources Districts (NRDs) — Papio-Missouri River Natural Resources District (P-MRNRD), Lower Platte North Natural Resources District (LPNNRD), and the Lower Platte South Natural Resources District (LPSNRD) — and the Nebraska Department of Natural Resources (NeDNR) the Lower Platte River Groundwater Modeling Collective (Collective) was created to develop a sub-regional groundwater flow model is being developed for the area encompassing the NRDs. This new model is intended to have multiple purposes that benefit both the cooperating NRDs and the State of Nebraska, including groundwater development and drawdown, streamflow depletion impacts from pumping, climate change impacts, examination of well head protection areas, and general understanding of aquifer conditions and hydrogeological properties and responses.

The goals of the modeling effort are to understand and leverage the information derived from past studies while modernizing to the latest modeling capabilities afforded by MODFLOW 6 in the development of a new unstructured grid version model with the parent-child approach, including performing model calibration. Development of this groundwater model (Project) will incorporate AEM hydrogeologic data, which has been retrieved and processed into the framework by the NRDs of the Collective. The combined framework model—3D AEM interpretation numeric model combined with a 3D solids geologic model—will be used to create a MODFLOW grid that defines the initial conductivity zones and model layering. The data will be transferred into different layers and gridded cells of the groundwater model for a higher accuracy representation of spatial patterns of hydrogeologic units and hydrofacies than afforded by the existing LPMT model. This includes the existing AEM-derived framework model and leverages the existing conductivity zone ranges associated with AEM-resistivity values previously developed by the NRDs of the Collective. More specifically, the State of Nebraska Lower Platte Missouri Tributaries (LPMT) regional model and LPMT Watershed model will be leveraged, along with incorporation of the 3D hydrogeologic framework models developed by the Collective NRD's and by the Lower Elkhorn NRD (Lower Elkhorn District model) for the development and calibration of the sub-regional model.



JEO Consulting Group, Inc. (JEO) will provide professional services to assist in model development. The JEO Team also includes Long Spring Consulting (Long Spring), HDR Engineering (HDR), and Aqua Geo Frameworks (AGF). The tasks to complete this project have been organized and broken down as follows.

SCOPE OF WORK

- Task 100: Project Management and Coordination
- Task 200: Building Hydrogeology Framework of the Groundwater Model
- Task 300: Development of Refined Watershed Model from New and Updated Regional Watershed Model of Lower Platte Missouri Tributaries Model
- Task 400: Integrating Watershed Model Estimated Recharge and Pumping into Groundwater Model and Couple Groundwater Model with Adjacent Model and Parent LPMT Regional Model
- Task 500: Model Calibration
- Task 600: Model Documentation
- Task 700: Model Use Training
- Task 800: Quality Control (QA/QC) Review

TASK SERIES 100: PROJECT MANAGEMENT AND COORDINATION

Provide project management services such as maintaining progress on project tasks, updating the schedule, maintaining budget, invoicing, developing progress report, internal team management and other contract administration services. This task will also include a project coordination meeting with the larger management group within the Collective along with Stakeholder meetings. Additionally, this task will also include technical coordination meetings focused on technical communication and review. It is anticipated that phone calls, progress reports, and email communications will be sufficient to facilitate most project management efforts. JEO will facilitate and coordinate routine progress and technical review meetings between the project team and representatives from NRD, NeDNR, and/or others as needed.

TASK 110 –PROJECT MANAGEMENT

- The Project Team will perform routine project management tasks.
- The team will prepare and update an ongoing project schedule.
- The team will perform contract administration services.
- The team will coordinate and integrate various technical disciplines to facilitate efficient completion of project deliverables.
- The team will regularly disseminate necessary information to Project Team members.
- The team will submit progress reports monthly.

TASK 120 – PROJECT COORDINATION MEETINGS

- The Project Team will facilitate up to six (6) progress meetings with Collective staff and other stakeholders as needed.
- The Project Team will facilitate up to four (4) in-person Stakeholder meetings, including final project NRD Board or Committee Meetings.

TASK 130 – TECHNICAL COORDINATION MEETINGS

- The Project Team will facilitate up to eight (8) conference calls with a technical group to discuss the model design and construction process.

KEY UNDERSTANDING/ASSUMPTIONS:

- Assuming half of the project coordination meetings will be in person and half will be virtual
- Review invoices, status reports, and necessary documentation and upon approval make payment to JEO
- Furnish relevant data to project team
- Ensure reviewing agencies perform reviews in agreed upon times

KEY DELIVERABLES:

- Monthly invoices and progress reports
- Meetings notes

TASK 200: BUILDING HYDROGEOLOGY FRAMEWORK OF THE GROUNDWATER MODEL

- Our team will draw from past experience using Leapfrog Works and will ensure the data processed from the Leapfrog framework will be appropriately represented in the groundwater model.
- AEM-processed data will be transferred into different layers and gridded cells of the groundwater model with a higher accuracy representation of aquifer spatial patterns.

- Fully utilize the capability of unstructured grid cells during model framework development (i.e., clusters of model cells of adjacent layers will be combined).
- In areas where the cells of adjacent layers have similar aquifer properties, these cells would be combined and represented as a single grid cell. This will decrease the number of model grid cells, which will help to reduce the model simulation time—making the model lighter will result in less data storage.
- In areas of the stream network, the model cells will be refined for a more accurate simulation of flow interaction between streams and the underlying aquifer.

KEY UNDERSTANDING/ASSUMPTIONS:

- Leapfrog Works project files of the combined 3D hydrogeologic framework model will be provided by the Collective. The initial model layers and hydrogeologic property zones defined by the NRDs will be reviewed and may (or may not) be used as the final numerical model (MODFLOW) grid for use in the new sub-regional groundwater flow model.
- Development of geologic layers and data will be reviewed externally and modified once before considered final for export.

KEY DELIVERABLES:

- Finalized layering and grid cell set-up to be used in MODFLOW model with associated aquifer properties derived from the AEM-processed data.

TASK 300: DEVELOPMENT OF REFINED WATERSHED MODEL FROM NEW AND UPDATED REGIONAL WATERSHED MODEL OF LOWER PLATTE MISSOURI TRIBUTARIES MODEL

The team will review the NeDNR's updated new Lower Platte Missouri Tribs. (LPMT) watershed model data. Refined groundwater recharge and pumping data in historical time series will be generated ready to be used as data inputs to the groundwater model.

TASK 310: INCORPORATE AEM PROCESSED DATA INTO GRIDS AND LAYERS OF MODFLOW 6 GROUNDWATER MODEL

- Appropriately define layers of the groundwater models based on the analysis of Leapfrog data
- Transfer geologic resistivity data and aquifer materials into the MODFLOW 6 groundwater model
- Carve out the model boundaries to the NRD boundaries
- Refine model grid cell resolution in stream main stem and tributaries area

TASK 320: DEVELOPMENT OF REFINED WATERSHED MODEL FROM NEW AND UPDATED REGIONAL WATERSHED MODEL OF LOWER PLATTE MISSOURI TRIBUTARIES MODEL

- The team will review the NeDNR's updated new Lower Platte Missouri Tribs. (LPMT) watershed model data.
- Watershed model of LPMT will be customized to the area of Papio Missouri NRD, Lower Platte North NRD, and Lower Platte South NRD.
- Output of the refined watershed model will be analyzed and different surface water budget components covering the three NRDs will be summarized and analyzed.

- Refined groundwater recharge and pumping data of historical time series aligned to the grids of groundwater model will be generated ready to be used as data inputs to the groundwater model.

TASK 330: DEVELOPMENT OF MODFLOW PACKAGES TO SIMULATE THE BOUNDARY CONDITIONS

- Develop the shallow groundwater evapotranspiration (ET) EVT package to represent wetland and riparian ET.
- Develop the stream network and the SFR package using flowlines, LiDAR data, and satellite imagery.
- Develop the river RIV package to represent the Missouri river.
- Develop the LAKE package to represent the important reservoirs and lakes in the area.

KEY UNDERSTANDING/ASSUMPTIONS:

- The scope includes developing two separate groundwater models for now, but the final decision of starting off model development work with either two models or one model will be made based on the discussion.

KEY DELIVERABLES:

- Finalized MODFLOW layers and grid cells, with aquifer properties transferred from the Leapfrog
- MODFLOW package data and files.
- Memo documenting and summarizing surface water budget, groundwater recharge, and pumping data. Hydrology data that will be used as inputs for the MODFLOW model.

TASK 400: INTEGRATING WATERSHED MODEL ESTIMATED RECHARGE AND PUMPING INTO GROUNDWATER MODEL AND COUPLE GROUNDWATER MODEL WITH ADJACENT CHILD MODELS AND PARENT LPMT REGIONAL MODEL

- The team will import the processed data (aquifer properties) from the hydrogeologic framework into the model.
- Add recharge in the top layer grid cells of the groundwater model.
- Add groundwater pumping data into the model and assign a pumping layer by using the screening depth of wells retrieved from NeDNR's well registration database.
- Couple the boundaries of the groundwater model (NRDs' boundaries based) with adjacent child groundwater models and the parent LPMT regional model for the exchange of flow and groundwater elevation during model simulations.
- The model will be simulated and the water budget of the groundwater system of the three NRDs will be summarized and analyzed.

KEY DELIVERABLES:

- The datasets of watershed and groundwater model of child model that simulates operationally without any convergence issue (before model calibration version) developed in this task
- Memo summarizing the initial groundwater budget components of the child model for analysis and discussion in the technical team

TASK 500: MODEL CALIBRATION

- Perform a sensitivity analysis of groundwater model parameters, such as hydraulic conductivity, specific yield, recharge, streambed conductance, etc.
- Process stream flow data at different gage locations within the model area to derive baseflow data to be used for model calibration
- Process groundwater level depth data from different observation well locations to derive groundwater elevation data to be used for model calibration
- Model baseflow and groundwater elevation observation package will be developed with weights assigned to them
- Model will be calibrated to groundwater levels and stream baseflow.
- Major calibration parameters will be hydraulic conductivity, the specific yield and storage of aquifer zones, and stream bed conductance at different reaches.
- Use of PEST-HP v.17 (Doherty, 2005) program for model parameter calibration.
- Use of programming scripts for a random selection (in space and time) of different calibration (training – 80%) and verification (testing - 20%) observation datasets (for each iteration of PEST run). Training and testing do not replace calibration and validation but adds a robust understanding of performance accuracy.
- Lessons learned from the past modeling experience will help us to calibrate this model efficiently.

KEY UNDERSTANDING/ASSUMPTIONS:

- During the model calibration phase, a model calibration strategy will be first developed; which will then be discussed in the modeling team and changes will be made. Upon agreement of this strategy, the calibration process will undergo.
- After the initial calibration run, the results of model calibration will be summarized and discussed in technical team. Then, next strategy for improving the modeling calibration will be developed and discussed before the next iteration of model calibration work. These steps will undergo a few iterations in the modeling calibration process, until the technical team is satisfied with the model's performance to match the observation data of stream baseflow and groundwater level trends.
- The scope includes effort to calibrate two separate groundwater models

KEY DELIVERABLES:

- Calibrated groundwater model with finalized parameter values will be developed in this task.
- Customized watershed model data which is needed to run different water management scenarios.

TASK 600: MODEL TESTING AND DOCUMENTATION

- Couple of scenarios of water management will be developed by the modeling team, which would be tested and evaluated by applying the calibrated groundwater model. This is to verify if the developed model is capable of running scenarios and generating results that make sense, and are reasonable.
- All processes of model development will be documented.
- NRDs and NeDNR will review the model report before calling it a final model report.
- NRDs' staff will have information supporting the water budget of the area.

- The model is ready to be used for evaluating water management scenarios such as land use change, additional pumping, and climate scenarios.
- The model is ready to be used for delineating hydrologically connected areas.
- HDR to provide QC of model documentation

KEY DELIVERABLES:

- Final report of the groundwater model development process and final groundwater model datasets.
- Model datasets that were manipulated for testing and evaluating water management scenarios.

TASK 700: MODEL USE TRAINING

- Training to technical staffs of NeDNR and NRDs on the structure and organization of parent and child model.
- Training on parent-child coupling of this model to other models.
- Training on how to run the developed calibrated groundwater model.

KEY DELIVERABLES:

- Training provided to Collective staff.
- Videos of online training.
- Follow-up on technical questions.

TASK 800: QUALITY CONTROL (QA/QC) REVIEW

- Quality control for incorporation of AEM into MODFLOW layers to ensure accurate representation of geology and hydrostratigraphy.
- Quality control of developed watershed model for 3-NRD area.
- Quality control of calibration process and resultant parameter values.
- Quality control of finalized model runs and results.
- Quality control of model documentation and GIS datasets

KEY DELIVERABLES:

- Comments and QA/QC forms

PROJECT COSTS AND SCHEDULE

The table given below shows the breakdown of the total fee by individual task described above in the Scope of Work section. The project schedule is also shown in the table below and is based on completion of this project within 16 months.

TASK	TASK TITLE	COST*	Timeline**
100	Project Management and Coordination	$99,150	Throughout Project Duration
200	Building Hydrogeology Framework of the Groundwater Model	$40,668	Aug 23 – Nov 23
300	Development of Refined Watershed Model from New and Updated Regional Watershed Model of Lower Platte Missouri Tributaries Model	$153,920	Aug 23 – Nov 23
400	Integrating Watershed Model Estimated Recharge and Pumping into Groundwater Model and Couple Groundwater Model with Adjacent Model and Parent LPMT Regional Model	$33,870	Nov 23 – Mar 24
500	Model Calibration	$158,905	Mar 24 – Aug 24
600	Model Testing and Documentation	$62,110	Jul 24 – Oct 24
700	Model Use Training	$16,340	Oct 24 – Dec 24
800	Quality Control (QA/QC) Review	$47,860	Throughout Project Duration
Total		**$612,823**	

*Proposed fee assumes development of ONE groundwater model.

** Anticipates receiving notice to proceed by August 15,2023.

** Anticipates receiving hydrogeology framework data by September 30, 2023.

SERVICES NOT INCLUDED

- Web-based Graphic User Interface
- Additional meetings mot mentioned in the above scope
- Additional groundwater models not mentioned in the above scope

Lower Platte River Groundwater Modeling Collective

Fee Estimate

Lower Platte River Basin GW

August 02, 2023

Task and Fee Structure

	Task	Hours / Task	JEO Hours			JEO	Long Spring	HDR	AGF	
			Lalit Jha	Chris Shultz	Liz Motter	Fee	Fee	Fee	Fee	
			PM	PE/GIS	EI/GIS					Fee
Task 100: Project Management and Coordination										
110	Project Management	160	80	80		$35,600.00		$9,515.60		$45,115.60
120	Project Coordination	12		12		$2,040.00	$7,425.00	$16,500.00		$25,965.00
130	Technical Coordination	16		16		$2,720.00	$14,850.00	$10,500.00		$28,070.00
	Subtotal	**188**	**80**	**108**		**$40,360.00**	**$22,275.00**	**$36,515.60**		**$99,150.60**
Task 200: Building Hydrogeology Framework of the Groundwater Model										
200	Building Framework	20	4	16		$3,820.00	$3,795.00	$33,053.00		$40,668.00
	Subtotal	**20**	**4**	**16**		**$3,820.00**	**$3,795.00**	**$33,053.00**		**$40,668.00**
Task 300: Development of Refined Watershed Model from New and Updated Regional Watershed Model of Lower Platte Missouri Tributaries Model										
300	Model Package Construction	108	8	60	40	$17,400.00	$136,520.00			$153,920.00
	Subtotal	**108**	**8**	**60**	**40**	**$17,400.00**	**$136,520.00**			**$153,920.00**
Task 400: Integrating Watershed Model Estimated Recharge and Pumping into Groundwater Model and Couple Groundwater Model with Adjacent Model and Parent LPMT Regional Model										
400	Integrating Watershed Model	36	4	16	16	$5,820.00	$28,050.00			$33,870.00
	Subtotal	**36**	**4**	**16**	**16**	**$5,820.00**	**$28,050.00**			**$33,870.00**
Task 500: Model Calibration										
500	Model Calibration	32	8	24		$6,280.00	$152,625.00			$158,905.00
	Subtotal	**32**	**8**	**24**		**$6,280.00**	**$152,625.00**			**$158,905.00**
Task 600: Model Documentation										
600	Model Documentation	92	4	48	40	$14,260.00	$32,850.00	$15,000.00		$62,110.00
	Subtotal	**92**	**4**	**48**	**40**	**$14,260.00**	**$32,850.00**	**$15,000.00**		**$62,110.00**
Task 700: Model Use Training										
700	Model Use Training	16	4	12		$3,140.00	$13,200.00			$16,340.00
	Subtotal	**16**	**4**	**12**		**$3,140.00**	**$13,200.00**			**$16,340.00**
Task 800: Quality Control (QA/QC) Review										
800	QA/QC	28	4	24		$5,180.00	$7,000.00	$22,000.00	$13,680.00	$47,860.00
	Subtotal	**28**	**4**	**24**		**$5,180.00**	**$7,000.00**	**$22,000.00**	**$13,680.00**	**$47,860.00**
	Total Hours	**520**	**116**	**308**	**96**					**$612,823.60**

	JEO				Long Spring	HDR	AGF	
Total	$31,900	$52,360	$12,000	$96,260.00	$396,315.00	$106,568.60	$13,680.00	**$612,823.60**